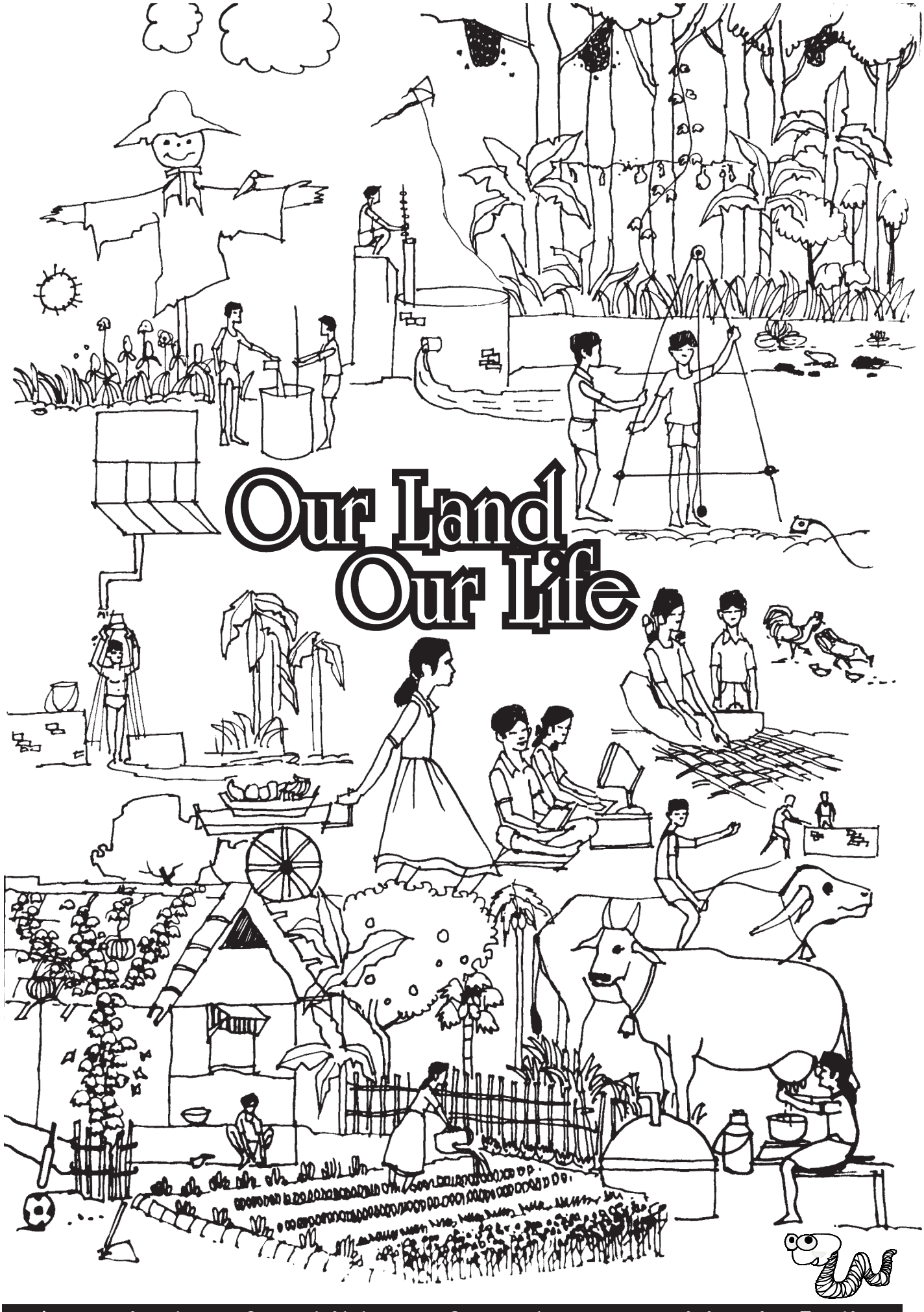
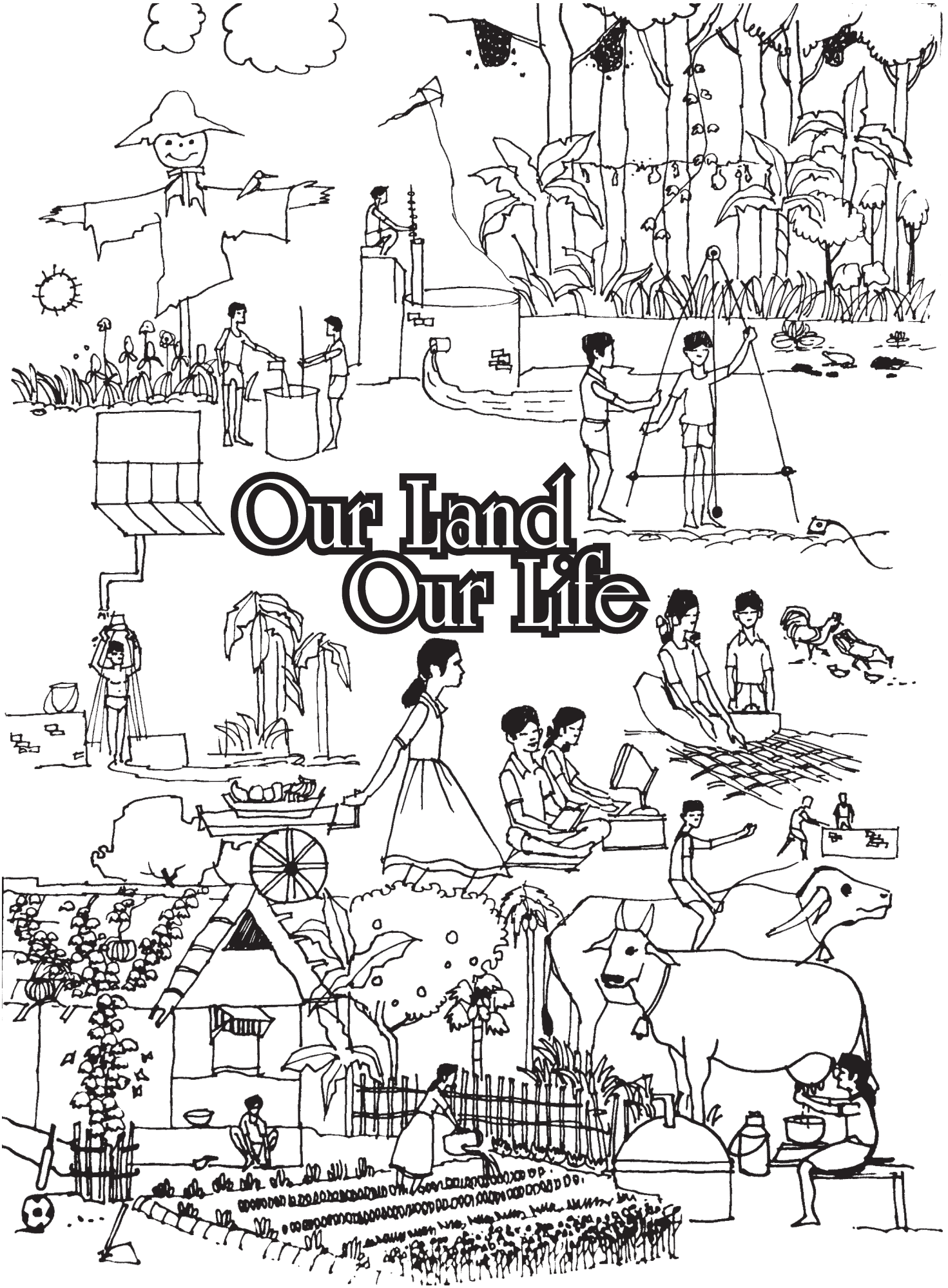



A curriculum for children of rural communities in India




A curriculum for children of rural communities in India

# *Our Land Our Life*

A curriculum
for children of rural communities
in India

*Researched and prepared by*

***Nyla Coelho***

October 2012

***Our Land Our Life***
(A curriculum for children of rural communities in India)
*Researched and prepared by*
Nyla Coelho

*Published by*
**Organic Farming Association of India**
G-8, St Britto's Apartments
Fiera Alta, Mapusa 403 507, Goa
Website: www.ofai.org
Email: myofai@gmail.com/ofaigoa@gmail.com
Ph: 0832-2255913

*Funded by*
**NEG-FIRE**
A-1, 3rd Floor, Sarvodaya Enclave
Behind Mother's International School
New Delhi 110 016
Website: www.negfire.org
Ph: 011-26531887

*A Project of*
**Cerana Foundation**
D- 101, Highrise Apartments
Lower Tankbund Road
Hyderabad 500 080, Andhra Pradesh
Email: t.vijayendra@gmail.com, sagdhara@gmail.com
Ph: 040- 27536128

*Distributed by*
**Peoples Books**
49/5, Sushil Niwas
Mahadwar Road, IVth Cross
Belgaum 590 002
Cell : +91 9341463231, 9343413193
Ph. : +91 831 2489474



Limited First Edition : February 2012
First Printed Edition : October 2012
Research Assistance : Gerard J. D'Silva
Cover : Illustration by Chaitanya Kubal
Page Setting : Vijay Amashi

Printed at : Impressions, Belgaum

## *Foreword to the First Printed Edition*

Between the time of its first release in February 2012 and now, this curriculum has generated a reasonable degree of interest among various sections of society. Educators and institutions, especially those, working with rural communities in India, religious groups exploring sustainable ways of life and livelihoods, pioneering visionaries attempting to establish stable self sustaining communities, home schooling parents, schools with green curricular orientations and others have expressed their enthusiasm to adapt its contents. It has inspired workshops for children and experimental field tests. Several individuals have expressed their interest to translate this work. Given its limited exposure, the feedback has been more than encouraging.

Many friends and well wishers who have seen some worth in the document have gone out of their way to recommend it to wider circles. The Ecoscience Research Foundation and Samanvaya, Chennai; Deccan Development Society and Cerana Foundation, Hyderabad; Nai Talim Samithi,Wardha; Safayi Vidyalaya and Manav Sadhana, Ahmedabad; the ISKCON monks at Hebri; the various on-line discussion groups; Isabel Carlisle, S A Jahns, Sunita Rao, Blaise Joseph and the many many unknown more have taken it to the larger community. Their support and trust is gratefully acknowledged. The feedback received from educators has been incorporated into this edition.

This edition in print would not have seen the light of day yet if it was not for the generous financial support of NEG – FIRE, New Delhi. The book is being distributed free of cost to several institutions, schools and educators working with children in rural areas across the country. Others who wish for a copy can contact Peoples Books, Belgaum or write to taleemnet@gmail.com. We will be happy to send the book to you against a small contribution which will go towards keeping the book in circulation for the benefit of others. This book is also available as a free download at http://multiworldindia.org/natural-farming-institute

*Nyla Coelho*
October 2, 2012

*Dedicated to*
*Our Children, Our Future*

## *A Note from the Principal Researcher*

An idea is like a date seed. It can lounge in dormancy till the time it finds suitable conditions to come alive. The germ of an idea for a rural curriculum lay dormant for many years, making every effort to surface now and then; asserting its life potential. In early 2011, the New Education Group - Foundation for Innovation and Research in Education (NEG-FIRE), New Delhi, saw the possibilities that such a school curriculum would open up for children of rural communities in India. They readily agreed to support the work financially.

It takes a community to nurture a child and a family to bring it up. Likewise the rural curriculum design has been nurtured by a country wide community of educators, organic farmers, thinkers, academics, children, rural community groups and practitioners in innumerable ways. Cerana Foundation, The Organic Farming Association of India, Natural Farming Institute and Taleemnet have shouldered parental responsibilities. And like all parents have done so, at most times, happily. Each gesture is hereby acknowledged with deep gratitude.

What came across very clearly in the process of this work was that, it was a 'dream child' of numerous eager and expectant "parents". So naturally, it carries within it several strands of complex 'DNA'. Many however, will question its birth, worth, relevance and place. Many others will see its potential, may want to pick and choose using an astute eye; while some others may wish to embrace it completely. Each of these sentiments is perfectly valid and in fact encouraged. Such is in the nature of all things new.

Throughout the entire research period there was always a sense of excitement. Fears and apprehensions were aplenty as the team was navigating in unchartered waters. But we woke up each morning with renewed enthusiasm to sail on. Captain and crew switched roles with ease. Early in the day, there was a casualty. Sameer Badodekar, our young secretarial assistant, left us to journey on to his final rest. We have egged on. Reconciling with the loss, however, is taking time.

Finally, in all sincerity and modesty, I would like to place on record that it has been an honest attempt to put together a framework as best as we could within our understanding of the issue. No doubt, there is much scope for improvement, and this can happen only with your feedback. Anyone who may wish to improve on it, independently, is most welcome to do so. We would be happy to hear from them.

The credit for the merits within this document goes to many. The demerits are entirely my responsibility. We look forward to hearing from you about both. Inconsistencies if any, if brought to our notice, will be corrected in subsequent publications.

*Nyla Coelho*
February, 2012

# *Acknowledgements*

The numerous individuals and institutions who have contributed towards seeing this work to its fruition, the various ways in which they have come forward generously with their time, resources and wisdom only reiterates the good still left in this world.

Thanks are due firstly to Dr Claude Alvares, the director of this project, for the briefings, critical comments and demands of exacting standards.

This work required that we visit many rural schools, institutions and farms across the country. Each one took special care to make our stay comfortable, made special efforts to give us their valuable time, show us the resource materials and share information generously. The hospitality, the sharing of expertise and experience of Anuradha and Dr Lalit Pande, Brian Jenkins, Anuradha and Krishna, Neema Vaishnav, David (at Laxmi Ashram), Kunti didi, Sushama Sharma, Meenakshi Umesh, David (at Mitrola Ashram) and Shanu, Manik Das Gupta, Sachin and Minal Desai, T. S. Ananthu, Niranjana Maru, Malati didi, Juli and Vivek Cariappa and Richard Rebello are hereby acknowledged with special thanks.

Some of the modules included within the curriculum required a perspective and technical knowledge that only experts, practitioners and professionals in the field could provide. The contributions of Dileep Kamat, Shree Padre, Dr Mathew Joseph, Prof Nana and Medha Marate, Shivaji Kaganikar, C.O.Patil, Deepak Pillai, Ramesh Raichur, Krishna Prasad and Kamakshi Shenoy are gratefully acknowledged.

Valuable insights which helped to plan the design of the curriculum came from many quarters. Dr Sultan Ismail, Pawan Gupta, Joss, Bernard Declerq and Deepika Kundaji, Jacob Nellithanam, G Gautama, Ranjeet Shanbag, Preeti Joshi, Karuna and Vasant Phutane, Kapilbhai Shah, Anjali Kaul took special care to understand our efforts and shared their insights generously.

Obtaining useful resources for such a framework may well be a project in itself. Apart from hunting the internet, physical copies of books and materials were sourced, sometimes even photocopied and sent to us. Dr Yogesh Kulkarni, Arvind Gupta, Meenakshi Varma, M.C.Malathi, Anshuman Das, Rohit Shetty, Carmalita Machado, Ravi Gulati and his student volunteers, Jenessey Dias and Suresh Kosaraju receive a standing salute for their help.

Dr L.S.Saraswathi, Vasant Palshikar, Jane Sahi, B. Ramdas and the late Dr Venkat are thanked for their generous sharing of perspective and their words of encouragement.

Several women's groups from rural Karnataka, children of schools run on Gandhian thought and children home schooled on farms have also shared their aspirations and expectations out of such a curriculum. These have helped greatly in giving direction to our work. Each has been a voice of wisdom. Our namaskar to all.

A special thanks to Marita Ishwaran, Biswajeet Mukarjee and Asha of NEG-FIRE.

Blaise Joseph, Ravi Gulati, Rama and Ramasubramanian, Priya Nagesh and Krishna went out of their way to liaison and arrange some crucial meetings and affordable accommodation for us. A big thank you to each one of you.

Cerana Foundation took on the entire responsibility for all the paper work involved, thus leaving the researchers mentally free to get on with the task at hand. T.Vijayendra and Sagar Dhara's efforts in this regard deserve appreciation.

If it was not for the patience, support, encouragement and the gentle but firm hand of Dr M.G. Jackson directing us during the last phase of the work and Dr G.P. Pande sharing his expertise, this document would not have seen the light of day as yet. Their assistance with drafting some parts of the document is gratefully acknowledged.

Gerard J. D'Silva, my colleague and research assistant for this project showed up at the door unfailingly each morning. Words seem inadequate to acknowledge the steady support, enforced rigour, discipline and the quality he brought into this work.

Each has contributed in ways that only they could have done.

*Nyla Coelho*

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## Contents: Voices from the Field

# Contents : Farm Related Modules



*Contd...*

# SUMMARY

This document describes in outline an innovative educational programme for children of rural communities in India, why it has been developed and how.

The past thirty years have seen great improvements in school education in terms of enrolment, curriculum and pedagogy, albeit adopting a top down approach. Serious short-comings, however, remain. The three most important of these are:

1. national and state-level curricula have an urban bias;
2. these curricula fail to address effectively the critical problems of today and specifically those of the rural communities;
3. in practice, the teacher-student interaction remains largely chalk and talk.

The present curriculum addresses all three problems in fundamental ways, utilising entirely new concepts and practices.

This curriculum has come about as the result of the merging of three contemporary streams of thinking and practice.

1. Alternative education
2. Alternative agriculture
3. Recovery and interpretation of traditional thinking and practice of agriculture

Specifically, the members of the Organic Farming Association of India articulated the need for creating a land based curriculum for school aged children. The first phase of this process has been the creation of a curriculum framework. This has now been completed and is presented in this document.

Two basic concepts have been utilised in building this curriculum.

1. The living systems concept in terms of which everything is seen as living and organised into self-limiting, self-organising and self-perpetuating systems.
2. The concept of learning by reflecting on experience to create understanding of why things are the way they are and behave as they do.

   This curriculum is a planned educational programme for children six to sixteen years old. However the age factor may be viewed in flexible terms. It is designed to give children a sound general education that will enable them to participate as responsible citizens at all levels and at the same time acquire the knowledge, concepts and skills required to pursue livelihoods on the land or in farm-related services.

   The content of the curriculum falls under two broad categories:

   1. Core academic subjects
   2. Farm related modules

The system as a whole (that is, curriculum) is holistic, activity centred, going from the known to the unknown, concrete to abstract, simple to complex. The topics offer more than ample opportunity for extra-curricular activities. Students have a choice of elective modules under the category of farm related modules.

The curriculum is so designed that learning with pen and paper is minimal and most of the learning would be through active engagement with living systems on the farm or in the neighbourhood.

The local community would play a central role in many ways in this learning programme. One may safely do away with the prevalent examination type of evaluation as progressing through the curriculum makes demands in terms of prerequisites of competence.

Having completed the work of constructing the curriculum framework, it remains to fill in all the details such as activity guides, preparing the teaching resources manuals, enlisting the collaborations in testing the programme and conducting orientation workshops for those interested. A booklet for children describing the learning programme could also be produced.

This document is only a beginning towards a holistic programme of education for children of rural communities in India. While the syllabus is presented as a collection of discrete topics and subjects, it may be used for building a holistic educational programme. This is highlighted through some of the case studies from the field that one will find spread throughout the document.

The curriculum document has drawn from the many prevalent educational programmes in the country that have tried to address this issue in various ways.

# A letter to our young friends

*Dear friend,*

This rather long letter is penned specially for you. There is no need to read it all at once if you do not wish to. Also, you may need the help of an adult to help you with all that it says and talks about here and in the rest of the book. It is about the many things that one sees, experiences, hears or may wish to know about. The book talks about how one can go about learning many of these things. I am hoping you will find the contents interesting, especially if you happen to live in a village or a very small town, close to a farm or within a farm in India. If you happen to live in a city but enjoy the outdoor activities of the countryside, then too you may find this book of some interest. In the adult world, where people decide or would like to have a say in what children learn or ought to learn, this may be called the Rural Curriculum Design.

*What is a Rural Curriculum Design?*

Let me explain what each of these words mean on their own and when put together.

*Rural* refers to a village or a small town with fewer people, fewer houses, many trees, clean air, farms, lakes, rivers, less noise and a steady pace of life. Most people living in such places work on the land or the work they do is related to the land. What I mean is most people do farming or activities that help farming directly or indirectly like carpentry, smithy, pottery, weaving of cloth or baskets, rearing and grazing animals, repair of farm implements, trading in farm produce etc.

*Curriculum* is a word commonly used to describe a programme of study. The way we live today, it is necessary to know how to read, write and do math. We also like to know the reason why things are as they are or how something works or how something is done. Generally, these things are learnt when one is young because young children are growing up, are curious and quick learners. It is natural for adults to teach or train children in what they think are important matters that children ought to know. It is like a preparation for making them independent and free to explore the world around; to depend on themselves for their needs. You will see this among cats, dogs, chickens, tigers, elephants, fish etc. Bees and bugs too teach their young. Also, there are many things we do naturally, learn naturally. Some things we learn with some effort.

*Design* is a map, a plan, a guideline or a blueprint on how to go about doing something. It is generally drawn up by people who know about these things or who have done it themselves and would like to share it with others. Many a time it helps to know how something is done, so you have some clue as to where and how to begin and then you can make it such that it suits your needs or interests best.

So if we put the meaning of these three words together, it adds up to a guideline for a programme of study for children growing up in a village or a small town, especially on a farm.

*Why a Rural Curriculum Design?*

You may now ask me, why a Rural Curriculum Design, when we already are being taught how to read, write and do math and many other things in a school? Well, the story for the reason goes back a long time.

The place we live in is part of a much bigger place that is called the earth. Its land parts have been divided up into many smaller places by people and are called nations. India, where we belong, is one such nation. It is like a big village that has many houses and within each house there may be rooms and within a room spaces for keeping and doing things. Like in a home where we do things in a certain way, sharing chores so that everybody within the family is happy and healthy, so also in a nation, we do things in a certain way. However because a nation is huge, and has many many people and many many chores, these have to be shared. The education of its young people is one such task.

For a very long time now, maybe since the time of our great great grandfathers, not many have paid careful attention to this task. Like hand me downs, that sometimes do not fit us well even

after much tucking in and opening out and sewing up, so too with learning or education, what we offer our children in schools does not seem to fit most, more so if you belong to a rural area. It falls short of preparing young people to become independent, responsible and free to explore the world around; to depend on themselves for their needs and most of all enjoy the process of learning.

Mind you, many people have known this and from time to time shared with others their thoughts and plans and some even today do so all the time. Two persons who thought about this and even set up places to show how it is to be done in India very many years ago are Rabindranath Tagore and M .K. Gandhi. However nobody followed it up seriously and so, it has not been taken care of and has hence become a little rusty, rather like an unused old bicycle, whose parts are difficult to fix.

If you look around and ask around, you will discover that India is a country whose people are mostly farmers or people doing things that are related to farming. Children too help with chores and learn how to do many of the things that adults in the family do. They learn many things this way. When these children go to a school, it takes away from them much time that they would have otherwise spent in learning how to do things that are part of the family's work. Also what is taught in school is not really connected with their everyday life. It ends up making them feel confused, unhappy with study, or worse still, they begin to find learning very burdensome. Such children lose interest or if they do study, they have little use for it in their everyday life as grownups.

Many farmers and people from rural areas feel that, what their children study at school is of little use. They would rather have their children learn things that will come in handy in their life. The Rural Curriculum Design is an attempt at a programme of study that would be useful in such cases. It will help children learn most of the essentials while allowing them to pick and choose various topics of their interest. Although, it does not cover everything, one can use the tools it offers to learn almost anything on one's own whenever one may wish to do so at a later date.

*What is in the Rural Curriculum Design?*

The Rural Curriculum Design is a programme and plan of study for children growing up in rural areas as against what is offered in schools, in these areas, mostly through a textbook. In schools, a textbook forms the main content of study. Some parts of it are interesting, others not so interesting and some, downright boring and useless! It is like being told that you can take only a particular dish (that you may or may not really care much for) at a buffet and have it in a particular way. Is that not a sad thought, when there are many many dishes that one may like to serve oneself from and have it in a way one likes? Well, what I am trying to say is, in schools, we are expected to learn particular things in a particular way. They are the same for all, and there are not many choices given. Also, some of these things may not be useful to us in any way. It is like asking a fish to learn how to climb a mountain, totally pointless!

The Rural Curriculum Design (let us call it RCD for short) has tried to carefully pick the things that one may benefit from learning if living in a rural area. Like a buffet, it offers many interesting dishes, but like at a buffet, where we like to be allowed to pick what we would like for a meal, and we do not serve ourselves everything, just because it is there, here too, the programme includes many topics that one may like to learn, to know about or do or find out for oneself. It allows for picking and choosing favourites. But it also tells you about certain things, that it would be best to know first, so you can try other more advanced things. Like if you wanted to learn to SCUBA dive, it would be first essential to know swimming! Also it is helpful to do things in small steps. It is the natural way of doing things. There are bound to be many goof ups before one gets it just right! That is where repeating things over and over again and practice becomes important. Just watch a child learning to walk, or a kitten learning to catch mice, you will see what I mean.

Well, so also with the RCD, it tells about all that children from rural areas will enjoy learning or will find useful to know.

*How is the RCD set up?*

The RCD is presented in three levels in a way that is suited for children from 6 to 16 years of age. There is nothing very strict about this age; it is only a matter of convenience. One can begin

earlier or later, or begin from where one knows. Like if you already know to count and add up small numbers, you can take up from there onwards in math work. Also for older children say, 12 or 13 onwards, one can pick a particular topic, and come back to others later. Like if you wish to know how much will spill out of a drum full of water if you sit in it, but do not know what the volume of a liquid means, or how to calculate volumes of cylindrical bodies, one may have to go back to those topics before being able to calculate using math how much water spilled out on stepping into a drum full of water.

To make it simple and straight forward, the topics are arranged subject wise from simple to not so simple. It may be interesting and easy to learn it in that order, but not necessary. People who work in education call such arrangements as going from the known to the unknown or from concrete to abstract or progressive degree of complexity.

To say all this in the language used by people in education, the curriculum is divided into three parts – Lower Level 1,2,3,4 and 5; Middle Level 1 and 2; Upper Level 1,2 and 3.

The subjects are offered in two parts:

1. Academic Subjects

    Language
    Mathematics
    Science
    Geography
    Understanding History
    Understanding Governance

2. Farm Related Modules*

    Farming Fundamentals
    Farm Related Technology
    Supplementary Farming Activities
    Accounts Trade Records and Permits

    (* modules, meaning topics that are by themselves complete units of study)

There is a full list of modules to look up and check what one would like to learn. At the end of each subject and module is a list of resources – books, websites, films, CDs, institutions… to help you with the task at hand.

In writing the RCD, many people who have done these things themselves and children who have grown up on farms in many different places in India have said how they have done it, or what things work. All their first hand experience has been put down here in a way that is easy to follow.

Since adults will no doubt have to help you with many of the things mentioned here, the details have been written in a form that they are used to. Don't let that bother you too much.

*Why the RCD is titled '**Our Land Our Life**'*

Several hundred years ago in India, there lived a man who loved to express himself in verse so much that he wrote plenty of it. He was a weaver and his name was Kabir. He had a way of putting things such that one caught the deeper meaning instantly.

While working on the RCD, we put our heads together to think of a name for the course of study which would tell at once its central idea. "Our Land Our Life" seemed to say it best. As a matter of fact it is not a new name. It is a subject that all school children of class six, seven and eight study in the hill state of Uttarakhand. This is because the mountains, the water and the lands are very important in the everyday life of people living there.

The same is true for all of us who live in rural areas in other parts of the country. Our life has a direct connection with the land, trees, farms, rivers, forests, mountains and people. Hence we really need to understand it well. What better way to do this than to begin by calling our course of study **'Our Land Our Life'**?

*How, when and where does one go about using the RCD?*

There are many ways in which this can be done. The basic academic topics are quite simple, graded, with many things for one to learn by doing and by making careful observations along the way. It is best that children work with an adult to help decide on many of the things it offers, helps to explain, do together with adults and with friends. Many things can be learnt from people who are already familiar with these things.

If one stays on a farm, there are many things one can do while still quite young. These could be things like growing plants, keeping pets, raising a brood of chickens, watching what birds, butterflies, bugs and worms do and how they live. Taking a walk by the river, learning to catch fish, watching tadpoles grow into frogs–by growing a pair of legs and losing the gills and tail and so on.

When slightly older, one can help grow a vegetable patch, make compost, fix tools and machines, build a live fence, fix a fuse or water pump, keep a record of the weather, the crop cycles, the yields, check which soil is most suited to grow a particular crop, milk the cows, grow mushrooms, keep bees, maintain farm data on the computer, keep farm accounts, do bank related work, apply for a license etc.

All this and more can be done with the help of adults who will help you to learn how. There will be many opportunities to work with things rather than work with only books.

The RCD has been set so that people who are running schools can use it in their schools. This way it becomes useful to many more children. The way it is written is in a form that adults or a teacher who is helping children learn will know right away how to go about things. Hence, it uses words like pupil, student, teacher, classroom etc. However, it is really meant for children, and I would like to urge you to remember this all the time. It is you who are the learner, and you are free to decide, what within the RCD you would like to learn and when. Adults, schools and teachers can only help, show you how, explain, assist, draw your attention to, but unless you see the value in learning, there is not much anyone else can do. It is like a game. You enjoy it best, when you are playing it yourself. Watching is fun only partly, playing it yourself is the real thing.

I am hoping you will find this way of learning interesting, you may like to do bits of it or all of it. The choice is entirely yours. So also, schools and teachers may take bits and parts of it, depending on what the children wish to learn or what they think children will benefit from. Anyway, it's a buffet of yummy treats through and through; you may prefer some over the others.

It's a pleasure to invite you to it. Dig in, enjoy!

Chapter 1

# INTRODUCTION

The past thirty years have seen great improvements in school education in terms of enrolment, curriculum and pedagogy. Serious short-comings, however, remain. The most important of these are the following three.

1. The curriculum has an urban bias.
2. It fails to address in an effective way the problems of global warming, environmental destruction, loss of community, educational needs of rural communities, violent conflicts over limited natural resources (land, water, forests, minerals, fossil fuels), financial instability, and persistent poverty.
3. In practice, the teacher-student interaction remains largely one of transferring pre-determined packages of information from teacher/textbook to student.

The urban bias of mainstream school education is the outcome of the large-scale, urban-centred model of industrial development adopted after independence. This bias has been further strengthened by the economic liberalisation policy adopted in the 1990s. The media and parents offer children a vision of their future as compliant employees in global business and a consumerist lifestyle in an urban setting. The school curriculum reinforces this vision by convincing children that what they learn in school is the passport to this future. For a majority of children, however, this vision turns out to be a mirage.

School curricula in India, as everywhere else, reflects and perpetuates the European so-called Enlightenment worldview which sees human beings as separate from and independent of their natural surroundings, having an unquestioned right to use natural resources in whatever way they think will lead to their greater material comfort. Further, it delegitimizes all pre-enlightenment ways of thinking and acting. The global problems we now face are clear indications that this worldview is inadequate – and, indeed, is self-defeating in the long run. Mainstream thinking has yet to face up to this fact and so it is not surprising that formal education has failed to address these problems, except to the extent of 'greening' the curriculum around the edges. What is not understood is that any serious effort to address these problems will require a shift in worldview – in those responsible for formal education and in society as a whole. In the absence of such a shift, 'greening' simply creates incoherence and confusion all around.[1]

The curriculum presented here addresses all three of these shortcomings of present-day school education. Briefly, it is designed to:

1. meet the needs of children who would like to pursue farming and farm related services as a livelihood option;
2. offer rural children an alternative vision of the future in which they can realistically hope to participate on a basis of equality;
3. embody and project an alternative worldview, in which human beings must strive to ensure the health of the natural and man-made systems in which they are embedded;
4. challenge students to evaluate critically the pre-enlightenment views and achievements of their own and other societies, and to make use of them where they seem appropriate to today's conditions, re-interpreting them as may be necessary.
5. prepare them, at the same time, to take an informed and active part in the larger life of the nation and the world;
6. bring into use new modes of learning to help accomplish the fore-going (items 1-5);
7. free-up the learning process from the excessive structuring that characterises present-day formal school education.

The process of building this new curriculum has taken advantage of the lessons learned from numerous educational and agricultural innovations over the past century in our own country and elsewhere. We are convinced that the general approach to education embodied in this curriculum can be adapted to any set of local circumstances anywhere in rural India. We are also convinced that this curriculum framework and pedagogy can guide the development of more effective curricula for urban schools.

This project is the direct outcome of a need for such a course articulated by the members of the Organic Farming Association of India (OFAI). They are concerned that their children will not have the type of education that will give them a vision of a life on the land and the knowledge, concepts and skills they will need to realise it. While their children do learn alternative agriculture by working with their families, there is a need to provide a framework that integrates farming related education with other more general subjects, rationalises them in terms of first principles, and not least, legitimates what they learn at home and their traditional knowledge systems in the eyes of society. These are the same concerns that have motivated many existing experimental school programmes. A beginning in this direction was made by Rabindranath Tagore and M. K. Gandhi.

There is also the conviction of these farm families, a conviction shared with large numbers of other people in the country that, as chemical agriculture has failed to ensure sustainable food production and viable rural communities, the rapid adoption of natural methods of farming throughout the country is imperative.

The OFAI, Natural Farming Institute and Taleemnet had tried to firm up this idea. In early 2007 a start was attempted with limited resources. Cerana Foundation joined these efforts. Work began in earnest in March 2011 with financial support from the New Education Group – Foundation for Innovation and Research in Education (NEG-FIRE), New Delhi.

Between March 2011 and February 2012 the coordinator of Taleemnet, the principal researcher for this project, visited rural schools, families practicing alternative farming, met with women's groups and community-based organisations (CBOs) who have created learning activities rooted in rural life, and groups promoting rural appropriate technology and alternative energy sources, as well as studied the available literature. In formulating the final curriculum framework design, the assistance of the Uttarakhand Seva Nidhi Paryavaran Shiksha Sansthan (USNPSS), Almora was sought.

During discussion with USNPSS members it was decided to name the curriculum *Our Land Our Life* as it aptly described this educational programme. A three-year course developed by USNPSS and going by the same name was made a part of the curriculum in all government schools in the state of Uttarakhand in 2002.

[1] The *Organic Farming Sourcebook*, written and edited by Claude Alvares, published by the Other India Press, Goa and the Third World Network, Penang, Malasysia documents the work of these alternative farmers in India as well as elsewhere.

Chapter 2

# BACKGROUND TO THE DEVELOPMENT OF THE RURAL CURRICULUM

The rural curriculum has come about as a result of the merging of two streams of thinking and practice: alternative education and alternative agriculture. These two streams have been particularly strong in India, as a result of our attempts to free ourselves from the worldview imposed by European colonialism in the 18th and 19th centuries and, in the second half of the 20th century, by globalisation. A prominent element in the attempt to de-colonise our thinking has been the effort to recover and legitimise traditional systems of learning, community governance, farming and non-farming rural livelihood pursuits.

*The alternative education movement*

The attempt to free our thinking from the educational paradigm imposed on us during the colonial era began in earnest during the colonial period itself, during the first half of the 20th century. The most conspicuous examples of this were Rabindranath Tagore's Shantineketan and M. K. Gandhi's Nai Taleem system. Tagore's model of a residential school was followed by a large number of individuals and organisations outside the mainstream formal education system. Gandhi's Nai Taleem schools were also residential as well as self-supporting financially. It is in the Nai Taleem curriculum formulated by Gandhi and endorsed and given final shape by a national conference at Wardha in 1937 that the possibility of developing a rural curriculum as an alternative to mainstream school curricula became evident. The key elements of this curriculum, from this point of view, are:

1. an emphasis on building and sustaining rural communities and the individual's role in this, while at the same time ensuring that children develop an understanding of and the ability to participate intelligently in national and world affairs;
2. livelihood education (agriculture and rural non-farm enterprises);
3. instruction in the child's mother tongue;
4. allowing the child some say in what he or she learns, and how he or she learns it.

Nai Taleem schools were recognised and supported by state governments for a decade or so after independence, but in the 1960s a decisive shift in government policy towards a 'modern', uniform national curriculum occurred. As frustration with this policy built up in the later decades of the century, interest in and support for Nai Taleem schools revived. A national-level autonomous body, the National Council of Rural Institutes was established in 1995. Today Nai Taleem schools are experimenting with a variety of further innovations with official support.

Another important innovation with direct relevance to the creation of a rural school curriculum has been the *Our Land, Our Life* school course on rural life and livelihoods developed by the USNPSS over the past 25 years. It embodies the same general principles as the Nai Taleem curriculum but has been enriched by the living systems perspective and several further pedagogical innovations. This course was developed with the support and collaboration of the Central and Uttarakhand State Governments and in 2002 it was made a regular subject (that is, an examinable subject) in the state school curriculum.

In the Southern states of India the alternative education movement took on a semi-formal structure, with the formation of the Network two decades ago. Though a small group, its members have pioneered many innovative educational practices addressing the needs of rural communities. Many members of the Network schools made significant contributions towards drawing up the National Curriculum Framework document.

*The alternative agriculture movement*

The development of the chemical agricultural paradigm followed closely on the heels of the development of the modern science of chemistry in Europe and North America during the 19th

century. In fact, during that century and well into the 20th century it was termed 'Agricultural Chemistry' in schools, universities and research establishments. This signified that crop and animal husbandry were merely matters of supplying appropriate types of chemicals in right amounts. Traditional practices of mixed cropping, crop rotation, biomass recycling and site-adapted varieties of crops and breeds of animals were jettisoned in favour of continuous mono-cropping and intensive animal rearing – and, of course, bags of purchased chemicals. This type of agricultural education was introduced in Indian schools and colleges before independence and continued until the mid-1960s. However, teachers had serious reservations about this move and hedged it about with many reservations prompted by traditional thinking. After the mid-60s these reservations were dropped and the new chemical paradigm was embraced enthusiastically.

The unexpected 'side effects' of the switch to chemical agriculture were first noticed in Europe and North America in the first half of the 19th century itself, initiating various alternative agricultural movements. The work of three pioneers in particular stands out: Albert Howard (natural farming) who actually worked in colonial India, Eve Balfour (the Soil Association) in England and Rudolph Steiner (biodynamic farming) in Germany. During the second half of the 20th century Masanobu Fukuoka in Japan pioneered natural or 'do-nothing' farming, Bill Mollison in Australia pioneered 'permaculture' while many others, mostly academics, advocated 'ecological agriculture' and 'sustainable agriculture'. Consumer consciousness of food contamination with chemicals grew rapidly.

In India with its tropical and sub-tropical climates soil deterioration and stagnating and falling crop yields began to appear within two decades of the introduction of chemical agriculture. Farmers all over the country were quick to respond to this situation, creating numerous alternative farming systems. There are now thousands of alternative farmers.[1] The OFAI was established in order to share their varied experiences. Not unexpectedly, the agricultural establishment has been slow to understand the present agricultural crisis in the country, not to mention think of possible responses to it.

### *Recovery of traditional farming knowledge*

The widespread disillusionment with chemical agriculture has also generated widespread interest in ancient agriculture. A prominent element among the alternative farming systems now appearing is a revival of ancient farming practices and the thinking underlying it. In 1995 a group of retired (mainstream) scientists who had become convinced that chemical agriculture has no future formed the Agri-History Foundation with headquarters at Secunderabad. Their first task has been to recover ancient documents that describe traditional practices, translate them into English and comment on them. The issues of their quarterly journal *Asian Agri-History,* together with the numerous translations and commentaries, constitute a vast repository of knowledge of ancient agriculture.[2] The essential sameness of traditional thinking and practice and the thinking and practice of present-day alternative farmers is striking. Considerable reference has been made to traditional agricultural practices in developing the present rural curriculum.

[1] The *Organic Farming Sourcebook*, written and edited by Claude Alvares, published by the Other India Press, Goa and the Third World Network, Penang, Malasysia documents the work of these alternative farmers in India as well as elsewhere.

[2] For information about these see www.agri-history.org.

Chapter 3

# THE LIVING SYSTEMS WORLDVIEW[1]

It is obvious to perceptive parents and teachers that young children look upon all the things in their surroundings as living, even those things that contemporary science and society insist are inanimate. Stephan Harding, in his book *Animate Earth*, writes that psychologists studying child development recognise that children pass through an animistic phase during which they relate to objects in their surroundings as if they are alive and have definite characters. However, these psychologists see this as a passing phase, appropriate only to children; they must be helped to outgrow this attitude and accept that the world is composed essentially of dead, insentient matter. However, at least one psychologist, James Hillman, maintains that this attitude is not merely a projection of human feelings onto inanimate matter, but that the things in the world project upon us their own 'ideas and demands', that indeed any phenomenon has the capacity to inform us through our interaction with it, as long as we are free of an overly objectifying attitude. As adults many people intuitively feel the truth of this, though in their public integrations they refrain from acknowledging it. Hillman points out that a gaping construction site, or a clear-cut mountainside may communicate the objective suffering of the earth, and that one's sharing in this suffering is not just a dream-like symbol of some inner process which relates only to one's private inner self.[2]

In terms of the European Enlightenment worldview, life is 'nothing but' an emergent property of certain complex aggregations of non-living material particles. The logical discontinuity in this bland assumption should be obvious, and indeed has been pointed out by many European philosophers: how can something that is non-living spontaneously become living? This is only one of the illogical arguments that are necessary in order to sustain the worldview of contemporary global culture.[3]

Today, an increasing number of people who participate in contemporary global culture, in all walks of life, and including many scientists, are coming to accept the view that all things are living – from atoms and sub-atomic particles to galaxies – and are ushering in a revolution in the worldview of this culture. They are being guided by their intuition and by the realisation that the worldview of contemporary global culture is dysfunctional and the root cause of the multiple crises we face

Similarly, young children do not see themselves as being separate from the things in their surroundings. At the same time they see everything as inter-connected. These intuitions are another casualty of the socialisation process children undergo in contemporary global culture. The present-day adult view of things, likewise bequeathed to us by the European Enlightenment, focuses on individual things rather than on the interconnections among them, on parts rather than on systems. This accounts for the untold violence wrought by human interventions in nature and society, for the unexpected 'side-effects' that plague modern technology and techniques, from agriculture to health care, education and finance. Recognising the root cause of these side effects has prompted pioneering efforts for change such as natural farming, holistic health care, and also in numerous alternative education experiments. All of these assume, at least implicitly the systems view of phenomena. Some scientists within diverse disciplines are also now beginning to work from a systems point of view.[4]

In the systems view, everything is connected to everything else holistically. This means that not only is everything connected to everything else, but that everything reflects the whole. More simply, the qualities of a thing derive from its place and function in the system of which it is a part; qualities of things are not intrinsic to the things themselves.

These two concepts – of the livingness and interconnectedness of everything – combine to give the living systems concept. The defining features of a living system are that it is self-limiting, self-organising and self-sustaining. Thus in thinking about a living system, whether it is the human body, the family, community, farm or the environment (and ecosystem) , our foremost concern is how to maintain their health, of adapting ourselves to the needs rather than attempting to control them, or worse, redesign them.

The living systems concept is the key feature of the alternative worldview that seems to be imperative today. An alternative worldview, what we may term the 'living systems worldview' is already coming into view.[5] It is this worldview that will inform the rural curriculum we are formulating. It is the organising theme of the curriculum. The curriculum itself is a living system. And, it is itself a part of the larger system of the society of which it is a part. It must necessarily reflect and serve that society. As the worldview of society changes, so will the curriculum. The necessary, seemingly inevitable, direction of change in global society today is towards embracing the living systems worldview. Introducing this worldview unambiguously in the school curriculum at this time will be a proactive move of crucial importance.

The pre-eminent example of the living systems view is the Gaia concept which views the planet earth as a living, self regulating system. It is both a scientific theory and a powerful symbolic statement of the essential oneness and interdependence of all things; it serves as an inspiration and practical guide for ethical, non-violent and sustainable living. An important derivative concept is that of the learner's local ecosystem. Important sub-concepts are the principles of diversity of things and activities, appropriateness of these things and activities to local ecosystem conditions, and circularity of the flows of things within the system. The community of people inhabiting a given ecosystem is an integral part of this system. These principles apply to all ecosystems, everywhere, urban as well as rural. In all healthy ecosystems the production of food, goods and services will be tightly integrated and managed in the first instance by the local community. Students going through the new curriculum will learn these concepts and how to apply them, and acquire the skills needed to manage specific enterprises in relation to the overriding need to ensure the continued health and long-term productivity of their local ecosystem. At the same time, the relationships among local ecosystems in larger regional, national and global contexts will be given increasing importance as the students move from lower to higher grades. On the practical side of matters, the guidelines for translating this into practice may be fleshed out in teacher resource manuals, student hand outs, concept webs, curriculum calendars, practical and activity guides etc.

1 A worldview is a logical, coherent system of basic concepts that is shared by all members of a given society. It provides the members a way of understanding the phenomena they experience, and thus organize their individual and collective lives in orderly, consistent ways.

2 Harding, S. (2006), *Animate Earth: Science, Intuition and Gaia,* White River Junction, Vermont, USA: Chelsea Green Publishing Company, p. 21.

3 For a discussion of these see Jackson, M. G. (2008). *Transformative Learning for a New Worldview: Learning to think Differently*, Houndmilla, Basingstoke, Hampshire, U. K.: Palgrave Macmillan, especially Chapters 4-6.

4 See, for example, Capra, F. (1996). *The Web of Life: A New Synthesis of Mind and Matter,* London: Flamingo.

5 For a formulation of this alternative worldview see Jackson, M. G. (2012). *A Return to the Perennial Questions: Outlines of a New Worldview,* Cochin : Oneword Press.

Chapter 4

# THE CURRICULUM FRAMEWORK

The rural curriculum is a planned ten year educational programme for school aged children. It is designed to provide a general education and at the same time acquire the concepts, knowledge and skills required to pursue livelihoods on the land as farmers or in farm-related services.

***A note on the meaning of the word 'curriculum'***

*The word curriculum is a thoroughly unsatisfactory word to designate the educational programme developed in this project. It is a Latin word which meant a course over which chariot races were conducted. It thus connotes a fixed pathway along which a race is to be run. This pathway is clearly and narrowly defined by walls on both sides to force the chariots to follow the course laid down. There is a fixed starting point and a finish line. The participants are competitors, vying with one another to cover the course ahead of the others and reach the finish line first. It is a rough sport and there are accidents in which the competitors are injured and sometime killed. There is an accident squad to clear the track after an accident so that the remaining participants are not impeded on the next lap. A handsome prize is awarded to the winner and much public acclaim is received. There could not be a better description of what present-day school education has become. We would prefer to use the terms 'educational programme' but it is cumbersome, and so, reluctantly, we have continued to use the word 'curriculum', insisting that it be considered a short synonym for the longer term.*

The curriculum is spread over a ten year period of regular study. Flexibility in its use is left to the discretion of the educators and the interest of the learner. The basic unit of the curriculum is a topic or theme which is presented under subjects. This curriculum has been written in English because of the language limitations of the authors, and also because, if the need arises at a later date, translations into other languages can be easily made from English. The resources listed for study are also only those available in the English language.

*The Syllabus*

The curriculum is divided into two broad areas consisting of academic subjects and farm related modules.

The academic subjects consist of language, mathematics, science, geography, understanding history and understanding governance. Understanding history is aimed at building a perspective of human societies while understanding governance with the practical aspects of the functioning of the government. The study of farm related topics are presented as independent modules under four sub sections: farming fundamentals, farm related technology, supplementary farming activity, and accounts, trade, records and permits.

This curriculum assumes that the child will be introduced to local and regional languages and the mother tongue by members of the family or a neighbourhood tutor or the school as the case may be. The curriculum has opted for the learning of English on the presumption that it is presently an essential transaction tool. Although designed for the learning of English, the pedagogy may be broadly applied to the learning of other languages.

At the lower level the emphasis is on language and mathematics. Science and geography adopt an integrated approach to 'learning about living', mostly through outdoor engagements.

At the middle and upper levels, science for the sake of convenience is split into biology, chemistry and physics. Geography has been approached from a science perspective as a sound understanding of natural phenomena would be of much use to a student of this particular educational programme. The farm related modules although designed for older students, topics in their simplified form, can be introduced throughout all levels.

At the end of each subject/section/module, as the case may be, resources have been listed. Every attempt has been made to provide links and references to resources available. Since most of the topics are interconnected, one may find that the same resources find a mention in several places. Ready reference being the motive, this is intentional.

## Structure of the curriculum

**Academic Subjects**

| Levels | Suggested age of Entry* | Corresponding level in the formal system | Subjects |
|---|---|---|---|
| Lower | | | |
| 1 | 6 years | 1 | Language, Arithmetic, General Science, Geography, Understanding History. |
| 2 | 7 years | 2 | |
| 3 | 8 years | 3 | |
| 4 | 9 years | 4 | |
| 5 | 10 years | 5 | |
| Middle | | | |
| 1 | 11 years | 6 | Language, Mathematics, Biology, Chemistry, Physics, Geography, Understanding History. |
| 2 | 12 years | 7 | |
| Upper | | | |
| 1 | 13 years | 8 | Language, Mathematics**, Biology, Chemistry**, Physics**, Geography, Understanding History**, Understanding Governance. |
| 2 | 14 years | 9 | |
| 3 | 15 years | 10 | |

* Depending on the maturation of the student

** Recommended but optional depending on the interest, skills and need of the Student.

**Farm Related Modules**

To be introduced at the upper level and carried forward depending on interest, skills and need of the student. However, topics within these modules, in their simplified form may be selectively tackled at the lower and middle levels.

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*Lower level*

The lower level is a five year period split for convenience into 1,2,3,4, and 5.

For these stages the academic emphasis will be on language and arithmetic. In levels 1 to 3 the time suggested for the academic subjects of language and arithmetic is 1hr to 1 hr 30 min, for levels 4 and 5, 1hr 30 min to 2 hrs 30 min each day. The other subject areas will be mostly hands on with a minimum of written work during the rest of the study time/school day.The general aim[1] of the 5 year period of lower level education is to equip the pupil with sufficient skills in language and arithmetic and get an overview of life around. In the area of language, the child should have developed proficiency in speaking, reading and writing. She/he should have the ability to describe objects, events, processes and thoughts clearly, develop a rich vocabulary of words, idioms and phrases; the ability to tell a story, create a story, weave a story around a word or phrase, truthfully write about any event as it happened. At the end of this 5 period the pupil should have developed adequate proficiency in the use of language as an effective communication tool. This proficiency should equip the pupil to tackle/study any subject that will interest her/him later. In the area of arithmetic, the pupil should be able to add, subtract, multiply and divide whole numbers, fractions and decimals, understand place value in the decimal system; compare whole numbers, fractions and decimals, be able to read numbers in the Indian system and the western system. Time and calculations involving time, units of measurement of length, capacity and weight, basic calculations involving these units may be introduced. Money calculations so as to

independently handle money related transactions in her/his personal life. At the end of this 5 year period the student should have a sound foundation in arithmetic, so as to enable him/her to handle with confidence higher stages in the learning and use of mathematics.

In the area of science (and life education), the pupil is offered ample opportunity to understand and interpret the natural and socio-cultural phenomena in the immediate neighbourhood and also beyond. The basic thrust is to train the pupil to observe and record facts and patterns from the world around as an introduction to learning science. The socio-cultural aspects of the study would be such that the pupil develops sensitivity to ones connectedness to the larger society; the benefits and responsibility that come with it.

At the end of the lower level the student should have developed the habit of observing and recording facts. She /he should have gained a basic understanding of the interconnectedness of the various factors that influence individuals, communities and the environment. Understand that what we do today as individuals and as a local or global community affects the world around us and has a direct consequence on the future.

*Middle level*

The middle level is a two year period, split for convenience into levels 1 and 2.

This stage is a transition period from learning directly through the senses, that is, by concrete experience to a more abstract form of learning. It sets the basis/foundation for an increased level of abstract thinking.

For the development of a wholesome personality and for making the best of these impressionable (the lower and middle level) years in a child's development, it is desirable that educators/ teachers /family:

Provide an environment conducive to develop dexterity and skills of creative expression by means of exposure to local arts, crafts, making of models, artifacts, improvised toys, tools and implements. Introduce pupils to cultural traditions of performing arts such as dance, speech and drama, singing, music, theatre and puppetry. Provide the opportunity for physical, mental and emotional development through games, swimming, yoga and traditional martial arts.

Encourage personality development for social skills and self development. And that they:
Learn personal care, health, hygiene, nutrition and the importance of community hygiene.
Develop responsible behavior towards self, others and the surroundings.This may be achieved through activities such as:

Going on outdoor walks, trails, excursions to learn science first hand
Learning to identify a variety of flora, fauna and objects, phenomena in the neighbourhood
Use of the senses in observing ones surroundings
Familiarising with the behavior of domesticated, feral and farm animals
Observing animal life in the vicinity or wilderness
Birding
Keeping and caring of pets
Using multiple ways of recording observed facts and phenomena in the form of scrapbooks, diaries, tables and graphs.
Looking for patterns in recorded observations
Making models, drawing pictures, creating improvised tools and toys from readily available material
Observing and understanding cyclic patterns in nature.
Mapping the village community and family history
Exposure to the local cultural, artisan and religious practices
Visits to festival gatherings, fairs and shandies
Activities for understanding the population and demography of the area
Activities that will help in understanding the livelihoods of people in the community
Investigating into the reasons for migration of people away from and into the village

Knowing about the agricultural and veterinary practices, local trades and occupations, traditional and modern industries and services in the village
Visiting places of historical, cultural and ecological significance in the area
Observing the natural and physical environment and the phenomena that unfold in nature
Learning about the local water sources, weather, seasons and soil, waste and its management in the village
Knowing about civic amenities, local administration, infrastructure, transport and communication, roads, bridges, dams in the local area
Carrying out independent tasks and safe experiments

*Upper level*

The upper level is a three year period split for convenience into 1, 2 and 3.

This may be considered as a period to consolidate the learning of all the previous years and be used for skill building in various areas of interest. The study at this stage is more analytical, intensive and abstract in nature. The student will now be able to build on the foundation subjects covered in the past seven years of study to explore select areas of aptitude and interests in greater detail or prefer to stream in classical ways of study. Much of the learning will be self directed.

At the beginning of this period students are usually in their early teens, a period of physiological and physical changes within the body. Their dexterous abilities would be well developed, and there is a strong urge towards independence, assertion, sense of achievement... These traits should be supported and helped to blossom through much outdoor activity, independent assignments, initiation into apprenticeships, sport, games, cooperative and team projects. Around the end of this period the interests and aptitudes of the students becomes clearer and he/she is in a position to move towards developing long term livelihood or career interests.

Some of the modules presented in the curriculum may be appropriate for older students who may now wish to be engaged full/part time with them. A one to two year period may be further spent in learning a few select modules based on ability and interest. This could be considered as a preparatory stage prior to university level education. Alternatively, a young adult may wish to discontinue formal education and plan for an internship period with a mentor, undertake travel as a learning experience, take up an action research fellowship project, a part-time employment cum training assignment etc. At the end of this period the pupil would have been exposed to the theoretical and practical aspects of a variety of subjects of his/her interests through modules.

*Activities*

Teacher and student engagement occurs in definite, planned activities by means of which it is expected that they will acquire specific information, concepts and skills. Students are guided by the teacher in carrying out these activities.

Activities are sequenced in terms of increasing complexity of the concepts/skills they are designed to impart. To facilitate this sequencing concept webs are recognised and made explicit. In other words, pre-requisites are specified for each activity. Pre-requisites are those other activities which must be completed before a given activity is undertaken.

Activities may be broadly classified into compulsory and optional. Compulsory activities are those in which every student must participate to ensure he or she achieves a satisfactory level of general education. Optional activities are those that children choose in accordance with their interests and needs in consultation with their faculty advisors.

*Working together*

While recognising that children would benefit from moving through the curriculum at their own pace, the curriculum has been presented in year-wise or in some cases level-wise portions.

Some of the other considerations are:

Most (recognised) schools handle too many students to permit them to give individual children the attention they would need if they were allowed to progress at their own pace.

Many activities are season-dependent like measuring crop yields or starting a tree nursery with seeds collected from the wild, and often there is a window of only a few days in the year when they can be conducted. Children may like to do such activities in groups, in which case, these activities can be slotted into time frames in an activity-year-calendar.

Small-group learning (three to five students) is more effective than individual learning or whole class learning for many activities. Plus children learn how to work together to achieve a common end. Further, it has been found advantageous by many educators to have several small groups working at the same time on the same activity, followed by group discussions in which what has been learned by each team is shared and discussed.

*Annual calendars*

In order to plan and co-ordinate the work of carrying out the required activities, and because many activities are season-dependent, anyone taking up this curriculum would benefit from preplanned year-wise calendars with some scope for flexibility.

*Children's ability*

In the drafting of this curriculum, it is assumed that the child, when introduced to the course of study of lower level, is already adept at speaking at least one language and has the motor skills of a normal child of his/her age. For the benefit of slow learners and differently enabled children, educators would be required to adapt the syllabus to individual needs.

Note : In presenting some subjects/modules the curriculum has adopted a didactic approach. This is more to serve as a guideline for the teacher, than for actual transaction.

[1] Aim : These are broad outcomes to be achieved in areas such as knowledge, application, skill, creativity, appreciation and so on.

**Dr M. G. Jackson**

I see two very broad types of modules, one type is primarily theoretical where you sit the children down in a classroom or under a tree or wherever and together with them devise activities which develop the concepts you want them to understand. Devising an activity to lead to 'learning' gives children an opportunity to think. This is the preferred way - the activity way. It requires a lot of original work to create this. If you are going to simply teach them in the normal fashion from selected published material, which you may have to do sometimes,

Dr M. G. Jackson and Dr G. P. Pande the creators of the ecology and agriculture based curriculum for the schools of Uttarakhand

it may not serve the purpose of this curriculum completely, but it is required. It will not be as effective as learning through an activity. So one type is primarily theoretical and another type, particularly when you come to the farm related modules, will be practical, aimed at acquiring skills.

Specifically, for some of the farming activities, the programme will have to devise ways for conducting certain activities or for introducing children to certain activities. In many ways the modules presented in this document at best serve the purpose of a broad guideline or check-list for the teacher. In a rural setting, children in the course of their daily life would be exposed to farm related activities. The modules may be used to systematise the child's knowledge, formalise what they already know; relate the same to certain scientific principles and provide theoretical explanations where required. Most of these activities obviously require the actual set up to be in place. e.g. Most children would have a cow in their own home or in the neighbourhood. The routine activities of feeding, cleaning, milking, grazing etc., they would naturally be familiar with. At most some of the theoretical aspects concerned with these activities may need to be told. Rather specialised issues like drawing conclusions regarding an illness based on symptoms, how to identify when a cow is in heat and needs to be bred, helping the cow with the delivery, initial care of the calf and the mother, how to deal with an emergency etc., may have to be learnt as and when the situation arises. Some of the theoretical aspects related to the above could be learnt either in advance or alongside dealing with these matters practically.

The teacher manual will need to highlight these aspects or explain the role of the facilitator who may have a rather round the clock job while dealing with certain aspects. The teacher would have to be an informed expert. Since most of us would be conditioned by conventional learning it would be difficult to shake off the old habits. It has to be accepted that this curriculum by its very nature is a leap beyond conventional learning. This is only to illustrate the challenge that the curriculum offers. It is an opportunity for making learning a practical creative experience. On the other hand, if one were to follow a conventional method then the entire module of cattle rearing or poultry or mushroom cultivation or bee-keeping would demand setting up of highly specialised and terribly expensive infrastructure and require systematically planned topic wise activities to deal with each module. The entire purpose is to break out of the mindset of a structured learning arrangement and use the outdoors as the classroom and make the best of the natural system unfolding around.

Community participation in the balwadi school programme in Uttarakhand. Young teachers seen cheering. School building in the background.

# LANGUAGE

It comes as a challenge to the imagination to comprehend the abundance of diversity in language and dialects that people of this subcontinent use in their everyday life. Although only a miniscule of them have formally accepted scripts, the richness that the diverse oral traditions bring into the lives of people are even today kept alive, to an extent, within homes and communities. Each language and dialect comes with its own patent brand of nuances and subtlety. The literature, poems, songs, stories, rhymes, limericks, idioms, phrases, folklore available in many written and non written vernacular languages, especially for children, is a heritage that is today under threat of being subsumed by a dominant few. The popular trend towards homogenization is sucking the rich language diversity into a bottomless vortex.

Given this, it is then left to families and communities to inculcate in children a love for languages, especially during their childhood, when 'picking up' a language comes with extreme ease. In any neighbourhood in India, one will hear atleast three if not more languages spoken. It is worthwhile for parents to make a conscious effort to encourage children to 'pickup' as many languages as possible during the course of neighbourhood interactions and play. The systematic study of a language for its own sake has much to add to the richness of one's life. Its practical utility too cannot be underestimated.

The aim of a systematic approach to learning to speak, read and write a particular language is to prepare the basis for good communication skills as also to be able to access information and knowledge available in that particular language. It also forms an effective tool for self study. The vast amount of knowledge available nowadays through print and electronic media can be harnessed only if one can comprehend the written word. Communicating with others is a basic human need. This can be fulfilled to a large extent by learning to read, speak and write precisely and cogently.

While initiating the study of a language, the curriculum has opted for English on the presumption that it is presently an essential transaction tool. It is assumed that the child will be introduced to its regional languages and the mother tongue by members in the family or a neighbourhood tutor or the school as the case maybe. Although designed for the learning of English, the pedagogy may be broadly applied to the learning of other languages too.

### *Lower level 1 to 5*

*The means of teaching language*

Young children 'catch' language. Analyzing and teaching 'correct' language is not the most efficient means to learn language. Children constantly observe and internalize all that happens around them. Good language, habits, ways of life are 'caught' just as naturally as bad language, habits and ways of life.

Given this fact about young learners, the most efficient way of teaching language would be to get students to 'catch' the language. This could be done most effectively through stories and incidents narrated by the teacher/adult. If the learner gets interested in the narration, he/she will unconsciously learn the language. This is how children 'catch' their mother tongue or any other language they are exposed to in early childhood. The earliest attempts of communication begin by imitation of sounds which later begin to be linked to a meaning. This "catching" is however only possible if there is sufficient exposure and opportunity of listening to proficient speakers in natural settings.

It is necessary to create an environment that is conducive for a child to 'catch' language. To do this, children should be often read stories from appropriately graded good books. Children 'pick up' rhythm naturally. Limericks, rhymes, songs all help a child to appreciate the nuances and beauty of the language. Learning can be facilitated by using an assorted set of about 20 or more carefully graded story and song books with coloured illustrations. These books may be left in a convenient place for a child to take and browse at will. Children are attracted towards pictures and try to make sense of them. In doing so they naturally begin 'reading' the accompanying text to know what is happening in the picture. For some children there may be a need for prompting, explicit instructions or support

from peers or others, in which case, it has to be a properly planned achivity. The teacher/adult should read out often from these books and then leave them in an area of easy access so that children can look at them on their own. By letting children look leisurely at picture books a natural love for books is developed. They discover that books can be sources of information and entertainment. If a teacher/ adult succeeds in getting a child to love books, a large part of learning a language can happen without much effort and drudgery. The language is then 'caught'. A great deal of education and self learning can happen if there is mastery over the language.

A graded list of books should be constantly made available to students at different stages. This will help raise their language proficiency to higher levels. *The key is in the selection of correctly graded books according to a child's interest and their convenient access*. It would help to bear in mind that there is also the matter of intrinsic interest that motivates children to want to explore a book. One must be realistic and prepared for many a disappointing moments.

Some suggested books for example could be

1. Picture story books through which the child 'catches' language.
2. Books of 'chain' stories which contain a lot of repetition.
3. Books of rhymes, limericks and songs.
4. Phonetically graded story books.
5. Phonetic books to learn spelling and good hand writing.
6. Word puzzles books.
7. Books based on grammar/vocabulary themes e.g. Picture book of action words (verbs), Picture book of naming words (nouns).
8. Textbooks containing comprehension passages through which spelling, grammar, syntax and punctuation may be learnt.

Alongside the language learning process, children could be introduced to recognising and writing the alphabet. Writing requires fine motor skills. Children do not show uniformity in the development of fine motor skills. Before introducing children to the alphabet, a period of time may be spent on learning to handle writing tools like crayons, colour pencils, sketch pens etc. in an informal way. Standard graded introduction methods may be carefully chosen to learn writing. *The use of graded phonetic copy writing books will help the child master good hand writing and spelling simultaneously.* Good and legible handwriting and neat written work is a matter of practice, diligence and habit. This may be emphasized from the very beginning.

Children should be encouraged to narrate stories or incidents to gain fluency in speaking. This may be practiced from the earliest stage of storytelling.

The child can then be encouraged to express himself/herself in writing, at first in one or two words and then is short sentences. This is the academic stage of learning in which the child learns grammar, syntax, spelling and punctuation. At the Lower level, correctness of writing should be taught only briefly through the use of simple lessons. Comprehension questions requiring one or at most two sentence answers may be set. At this stage the adult's/ teacher's job is to see that the child has his/her grammar, syntax, spelling and punctuation right. Generally grammar and syntax are 'picked up' by children intuitively during the course of speaking a language. However this depends on the quantum of exposure, and in the "picking up" process it is grammar that usually comes last.

Drama and mystery are valuable tools for learning a language

Children revel in the world of imagery, drama and make belief. They delight in humor, mystery and a sense of secret adventure. Love for this form of imaginative and creative expression should be used to advantage by 'playing along' and by introducing children to performing small plays based on the stories they like. Recitation of poetry, singing rhymes and songs, dressing up as their favourite character... play a vital role to language learning.

At the end of this level, it is expected that the student would have mastered the use of language in the spoken and written form. The student should have a good feel for spelling and punctuation and fluency in speech with correct pronunciation of words.

*Phonetics*

Most Indian languages with scripts are phonetic in nature. Such scripts offer definite pronunciations. Non phonetic languages like English have rules and conventions by which letters, syllables and words are pronounced. Hence learning to read and write a non phonetic language is difficult as compared to a phonetic language. The use of phonetically graded books can help greatly in this matter.

### *Middle level 1, 2*

If the student has a good 'feel' for the language, this is the stage for him/her to develop his/her own style of expression in speech and writing. This is facilitated by providing the students the opportunity to express themselves in writing through essays, poems, pieces of fiction. Oral expression may be developed through narrations, speeches, debates and elocutions.

The curricular content at this stage could comprise age and skill appropriate texts according to the student's interest.

Work in the following areas may be assigned.

Comprehension Exercises: (As an extension of work from Lower level 5).

The use of suitable stories or articles to develop reading comprehension and vocabulary. Comprehension may be tested using questions.

Detailed study of words and phrases.

Provide opportunities for listening skills and shared group work.

*Paragraph Writing*

The use of an indent at the beginning of a paragraph (when writing) or a double line space (when typing on computer).

The first sentence should give the reader some idea of what the paragraph is about. Know how to connect sentences so that the work reads smoothly. e.g. using 'but', 'since', 'although', 'after', 'afterwards', 'meanwhile', etc. to connect sentences.

a) The narrative paragraph: required to tell a story or write about an event. Telling things in the order in which they happened.
b) Descriptive paragraph: required to describe people, objects or scenes.

*Writing an essay*

a) The narrative essay
b) The descriptive essay

Using a mind map to jot down ideas and to plan the essay. Making the essay as interesting and lively as possible so that it holds the reader's attention to the very end. Just as the sentences within a paragraph must be connected smoothly, so also a paragraph should lead naturally to the next.

*Grammar*

Commas and colons

Apostrophes

Identifying nouns, adjectives, verbs, adverbs, past tense, present tense, future tense.

Spelling of similar sounding words in non phonetic languages such as English e.g. fair and fare, principle and principal, stationary and stationery etc.

Using a thesaurus, synonyms and antonyms

*Oral work*

Narrating stories
Reciting poems
Drama
Speeches
Elocutions
Debates

The reading list of books should include the following

1. Stories
2. Biographies and autobiographies
3. Adventures
4. Classics

***Upper level 1, 2, 3***

The aim of learning language at this stage is to further develop powers of comprehension and expression.

The study may be broadly divided into two areas: language and communication. By studying select pieces i.e. language, the pupil may be inspired to develop a love for language for its own sake.

The student here may be taught to develop appreciation of literature and poetry.

Communication is the use to which language will be put. This is the practical aspect of language.

*Language*

A carefully selected reading list consisting of various forms of writing may be used to achieve the objective of proficiency in language. The list may include

Autobiographies
Biographies
Short stories
Essays
Speeches
Pieces of historical, social and cultural interest
Comic incidents
Current topics
Travelogues
Reports
Fiction writings
Poetry
Drama

Under each category there may be a list of several pieces that a teacher may select for the student to study. Students may be tested for comprehension based on these pieces. Care must be taken to see that it does turn into the routinely practiced method of expecting memorised answers, but is an excercise in testing the level of comprehension in order to help students move to the next level.

Non detailed study of two books (fiction and non-fiction) over a period of a year may be offered for study. The teacher may select from a list of books by well known Indian writers and non-Indian writers based on the interest and level of the student. Students will be expected to write a summary of each book in 800 to 2000 words. A useful exercise would be to finally summarise the gist of the book or piece of writing in just one sentence.

As part of the course work, in a year, students may be expected to submit two original creative pieces of writing of their choice from the following categories:

An essay
A story
An autobiography
A report
A screenplay
A poem
A book review

*Grammar*

Grammar is necessary for clear and unambiguous communication. This means that the students should be proficient at punctuation, spelling, syntax and grammar. This is possible through extensive practice.

*Communication*

Oral communication

Oral communication skills may be cultivated by:

Practice exercises in

Reading aloud
Narrating a story
Narrating an incident
Reciting poems

Speech training
Elocutions
Debates
Discussions
Compering at cultural and social events
Moderating a discussion

*Written communication*

A piece of writing should flow smoothly and should be pleasant to read or hear. This is possible by reading extensively as a result of which good language can be 'caught'. Writing with precision comes only with practice. A piece of good writing may go through several drafts before precision is achieved.

Essay writing – the narrative essay, descriptive essay, argumentative essay

Journalistic writing – letters to the editor, articles for newspapers, press notes, report to a newspaper or magazine

Taking notes – in class, at lectures and speeches, field notes of outdoor experiences and visits, notes of conversations and discussions, taking down minutes of meetings

Letter writing – personal letters, letters of request, letters of complaint and suggestion, letters to government officials, letters to organisations, institutions, letters for ordering goods and services, electronic mail (email) – the decorum and protocol

Typing and shorthand are two extremely useful skills that hold any student in good stead and are highly recommended either within the curriculum or for independent study

*Computer use*

To type out articles, format text, organise text and prepare reports using computers.

Saving files, copying files within the hard disk and to external media such as pen drives, DVDs, external hard drives and cloud computing.

Using computer packages for desk top publishing (DTP).

Creating and using Power Point presentations.

## Resources

*Readers and workbooks for English*

1. *Spring Reader Series*: Books 0 to 5 by David Horsburgh. Published by Oxford University Press; first published 1973 with several reprints in subsequent years. Now out of print, but a copy can be requested from Taleemnet. Also available for reference at Vikasana School library, Bangalore.

2. *New Spring Workbooks*: Books 1 to 5 by David Horsburgh. Published by Oxford University Press; first published 1982. Now out of print, but a copy can be requested from Taleemnet. Also available for reference at Vikasana School library, Bangalore.

   Though the *Spring Reader and Workbook Series* seem very simple, they are based on sound pedagogy for the teaching of English to young children. The content deals with matters familiar to children in rural and suburban areas.

   David Horsburgh was a leading educationist who played a significant role in the development of school education in India. His focus and interest were inclined towards education within a rural milieu. He started Neelbaag, a school which formed the training ground for his teacher education programmes. He is considered a pioneer in setting up experimental rural schools in India. Nicholas, his son, who worked very closely with him, now works as an educational consultant.

3. *The New Oxford Modern English Series* Primers A & B and Course-books 1 to 8 by David Horsburgh and Nicholas Horsburgh. Published by Oxford University Press, 2010

4. *The New Oxford Modern English Series* Primer B Workbook and Workbooks 1 to 8 by David Horsburgh and Nicholas Horsburgh. Published by Oxford University Press, 2010

5. *The New Oxford Modern English Series Teachers' Kits* Primer to 8 by David Horsburgh and Nicholas Horsburgh. Published by Oxford University Press, 2010

6. *Everyday English Book1* by Jane Sahi, Published by Jyotsna Prakashan, 2009

7. *Everyday English Book 1* (*Teachers' manual*) by Jane Sahi, Published by Jyotsna Prakashan, 2009

8. *Teaching Language to Young Learners* by Lynne Cameron, Published by Cambridge Language Teaching Library is an excellent book on learning of second language.

9. Phoenetically graded story books such as those written by Mina Srinivasan, Published by Orient Longman.

10. There are several websites offering information on interesting techniques for phonics through phonemes rather than the alphabet. www.jollylearning.co.uk is one such site. In the Jolly Phonics method particular attention is paid to the simple but highly frequently used words such as 'the', 'of'. These are introduced separately and not "sounded out".

This book is for children who are already familiar with the basic phonetic patterns with some ability to recognise and write alphabets and a few simple words. It assumes that they have done a sufficient amount of oral work through games, stories and songs. The book is based on Jane Sahi's experience of teaching children for over thirty years in Sita School, a small alternative school in Silvipura, a village on the outskirts of Bangalore. The *Teachers' Manual* opens a world of possibilities in the use of the *Everyday English Book 1*. The accompanying CD contains songs, poems and stories based around the topics presented in *Everyday English Book 1*.

*Grammar books for Middle and Upper levels*

8. *Essential English Grammar* by Raymond Murphy published by Cambridge University Press
9. *Intermediate English Grammar* by Raymond Murphy published by Cambridge University Press
10. *Advanced English Grammar* by Martin Hewings published by Cambridge University Press

These three grammar books are a useful series in grammar and usage for a self learner. They contain a complete explanation of a point on the left hand page, with corresponding exercises on the right hand page.

*About reading lists*

A reading list would depend on far too many factors to be put down in a general list. The backgrounds of students, their interests and goals are highly varied. In such a situation the best method of introducing children to good, inspiring literature would be for the teacher / educator / parent to select books based on the guidelines specified in the language curriculum.

Two excellent books to introduce children to the English language and storytelling are:

*How to Tell Stories to Children and Some Stories to Tell* by Sara Cone Bryant

*The Art of the Story-Teller* by Marie L. Shedlock

These contain material to introduce children to the world of stories and the adult to the art of story-telling. The two books together contain an exhaustive reading list for children. Available as free downloadable pdf files from www.arvindguptatoys.com

*Detailed study of language at the upper level*

At the upper level the detailed study of language could be based on text selections that are of interest to the student as per guidelines in the language curriculum.

**Dr L. S. Saraswathi, Chennai**

"Just now the school curriculum is disconnected from children's actual life. Schools operate in isolation of their own environment. Children living in a place should be able to connect to their environment. In a large country like India, a decentralised curriculum is essential, especially so for rural children, because, within the country there are so many regional components that differ from one another. Forests, coasts, deserts, hill areas all have within them several unique sub regions so that a contextually relevant curriculum will have to be a localized micro exercise. Also, the component of teacher education is a matter for consi-deration.

"Language and mathematics become the most basic elements in the curriculum. The vocabulary of the language of an area is generally decided by the main engagement of its people and the local environment. For example, an agricultural village will have within its language a marked percentage of vocabulary related to farming activities. Language is useful in building and articulating ideas, a skill and virtue that should not be underestimated. Mathematics is found everywhere. Agricultural activities involve a lot of mathematics in every aspect of its operations. Our understanding of the world –composed of the basic five elements of heat/ light, air, earth, space and water is through the five senses. Every aspect of life is connected to these elements. It is important that the education process draws children's attention to linkages/ connections. That challenge of drawing children's attention to linkages and connections should be the main task for the teacher.

"Presently there is no dearth of knowledge, it is however available as fragmented bits and pieces. The effort to present it in a holistic manner in the form of comprehensive ideas should be the mandate of the education programme. Again it brings the onus back on teacher education which should provide for presenting study to students from a holistic approach that build linkages with the elements, with the self and with everyday life.

"All regions have their traditional knowledge systems which may or may not be present in documented form. One finds that riddles, which were the popular means to provoke thinking used rhyme, language and mathematics in very creative ways. There can be some effort made to reclaim these. They introduce children to many concepts and skills and generally bring out the distinctiveness of the predominant local vocabulary.

Dr L. S. Saraswathi

"Every Indian language for sure has much to offer in its traditional learning materials such as riddles, stories, poems that they can be easily used. Also these materials become significant because of their connection to everyday life of the region. For instance there is a collection of over 2000 riddles in Tamil covering every aspect of everyday life including common games that children play. There are riddles on flowers, fruits, insects, animals, birds, plants, forests, crops. Kanakadikarm by Satyabama Kameshwaran, published by Saraswathi Mahalaya Library of Tanjavoor contains mathematical problems which deal with very sophisticated mathematical techniques, concepts and calculations all relevant to rural life and agriculture. Such resources can be put to good use in transacting the rural curriculum."

Dr L.S. Saraswati has decades of experience working in the field of rural education. The thrust of her work has been to evolve a methodology for integrating peoples' practices with known and accepted forms of academic information.

# MATHEMATICS

The people of India in the past enjoyed the reputation of having sound mathematical skills. The many artisan crafts of India required a strong ability to perform calculations mentally. All school going children, especially in rural vernacular medium schools, till a few decades ago prided themselves over their ability to recite mathematical tables and carry out mental calculation with ease. People of the older generation, especially traders and money lenders were adept at tables of fractions. Jewelers could estimate weights of precious metals closed to the milligram. Even to this day, weavers of baskets, cloth, mats display superior mental mathematical skill as do builders of traditional structures, wells, persons who repair and maintain farm tools and equipment. Telling the time almost to the exact minute, making weather predictions based on seemingly disconnected parameters are skills one comes across even today amongst many rural communities. Farmers are able to make accurate estimates of the quantity of seed, saplings, water, compost requirements without putting pen to paper. Apart from a systematic study of the subject, it is important that children pick up traditional mathematical skills from their community through active engagement over extended periods.

Mathematical skills the world over have taken a down turn so much so that governments (globally) are making special efforts to reverse the situation. A sound base in mathematics makes the learning of other subjects and topics much smoother to negotiate. Also, children are fascinated by the challenge mathematics offers their intellect provided the topics are introduced correctly. A matter to note is that mathematics is a skill and like all skills takes time to develop. A good foundation in mathematics provides a head start to many other areas of study.

While beginning arithmetic, it is assumed that children understand terms like big, small, long, short, heavy, light, more, less, before, after and so on. These terms although often used in preschool arithmetic books, are really from the realm of language. All children would have surely come across these terms informally and therefore they have not been specially dealt with in this curriculum.

The emphasis in Lower levels 1 to 5 is on mastering arithmetic. This involves counting numbers, adding, subtracting, multiplying and dividing whole numbers, fractions and decimals. Mastering arithmetic is the most fundamental of all skills learnt in mathematics. To this end the child must be led through a graded series of exercises. Mathematics is largely a skill involving handling of numbers, data and geometric shapes. As with all skills, mathematics requires constant graded practice. In practicing, the child not only develops skill, but also sees relationships between numbers and the processes involved in mathematics. This cannot be overemphasised.

From Middle level 1 onwards, the curriculum deals with algebra and further skills in geometry and mensuration. Statistics and commercial mathematics are dealt with at the Upper levels. The Upper level 3 emphasises topics that would be useful to anyone taking up farming and enterprise.

The learning of mathematics here is to equip the student to handle every situation she/he encounters in which the use of basic arithmetic, algebra, geometry, mensuration, statistics and commercial arithmetic is required. It also provides the student with a basic foundation to pursue a higher level course.

*A note on mathematics textbooks*

Many children all over India find mathematics difficult. This is because the basis for teaching mathematics to children in India is a textbook which is more often than not based on unsound pedagogy. Often textbooks offer concepts in bits and pieces with inadequate prerequisites to build on. Many topics are introduced wrongly hence the student perpetually faces difficulty. The study of mathematics becomes easy if the books referred to are well graded, i.e. there is a logical progression in the degree of complexity while introducing mathematical operations, concepts and skills.

***Lower level 1***

Children generally become familiar with the basic mathematical concepts of quantity, shapes and the vocabulary of comparison as they grow from infancy to childhood. These skills gained intuitively can be further strengthened through creative exercises of counting, drawing, matching, colouring etc. Introducing children to numerical symbols, recognizing and writing the same may be done after enough time is spent on creatively presented exercises developed in situ, in books from standard publishers or from the internet. The didactic nature of the contents below may be taken as broad guidelines for a formal introduction to arithmetic.

Recognise and write numbers from 1 to 10 in figures

Count objects and write numbers from 1 to 10 in figures

Write numbers from 1 to 10 in words. (Writing in words to be undertaken only after necessary skills have been accomplished in the language class)

*Count objects and write numbers from 1 to 10 in words*

*Recognise and write numbers from 11 to 20 in figures*

*Extensive random quizzing on numbers to perfect their recognition*

*Write numbers from 11 to 20 in words*

*Count objects and write numbers from 11 to 20 in figures*

*Extensive random quizzing on numbers to perfect their recognition*

*Count objects and write numbers from 11 to 20 in words*

*Introduce numbers from 21 to 50 in figures*

*Extensive random quizzing on numbers to perfect their recognition*

*Revision of numbers in figures from 1 to 50*

*Extensive random quizzing on numbers to perfect their recognition*

*Extensive graded exercises for adding numbers upto a total of 20*

*Extensive graded exercises for subtracting from numbers up to 20*

*The idea of 0 (zero) introduced through subtracting a number from the same number*

*Number sequence exercises up to 20*

Comparing two numbers – greater and lesser

Arranging any 4 given numbers in ascending order

Arranging any 4 given numbers in descending order

*Count numbers 1 to 100*

*Counting numbers in 10s*

*Counting in ordinal numbers upto ten*

*Writing numbers in 10s in figures and in words*

*Counting numbers in 5s*

*Writing numbers 1 to 100 in figures and in words*

*Mixed adding up to 20 and subtracting from numbers up to 20*

*Word problems in addition and subtraction with numbers up to 20*

*Introduction to multiplication*

Introduced through extensive exercises in repetitive addition of groups of equal quantities of actual objects e.g. buttons, tamarind seeds, shells, pebbles etc. to establish that multiplication is a short cut to adding the same number many times

Introducing the "x" sign as symbolic representation of the above

Learning to write and say the 2s, 5s and 10s multiplication tables

Memorising the 2s, 5s and 10s tables

***Lower level 2***

*Revision*

- Numbers 1 to 100 in figures and words
- Number sequence exercises 1 to 20
- Addition and subtraction exercises with numbers upto 20
- Counting in 10s
- Counting in 5s
- The meaning of multiplication
- Multiplication tables 2, 5, 10

*Place value: Units and tens*

- Extensive exercises on place value

*Adding a single digit number to a 2 digit number*

- Without carrying over
- With carrying over

*Adding two digit numbers upto a total of 99*

- Without carrying over
- With carrying over

*Subtracting a single digit number from a 2 digit number*

- Without changing
- With changing

*Subtracting one 2 digit number from another 2 digit number*

- Without changing
- With changing

*Mixed exercises in addition and subtraction*

*Mixed word problems in addition and subtraction*

*Number sequence exercises for numbers from 1 to 100*

- Comparing two numbers to say which is greater or lesser. Using the > and < sign
- Arranging numbers in ascending order and descending order (upto 4 numbers only)
- Graded exercises in writing numbers in order from one given number to any other given number in ascending order
- Graded exercises in writing numbers in order from one given number to any other given number in descending order

*Extensive random quizzing on numbers to perfect their recognition*

*Introduction to numbers from 101 to 500*

- Counting numbers in 100s upto 500
- Counting numbers in 50s upto 500
- Exercise in writing a given number in words anywhere from 1 to 500
- Extensive random quizzing on numbers to perfect their recognition

*Multiplication by 3, 4, 6, 7, 8 and 9*

- Multiplication tables of 3, 4, 6, 7, 8 and 9
- Exercises based on these tables after having learnt each table
- Word problems based on these tables
- Revision of tables 2 to 10
- Random quizzing so that tables are perfected
- Mixed exercises based on tables 2 to 10
- Mixed word problems based on tables 2 to 10

*Counting in multiples of 2s upto 100*

*Introduction to odd and even numbers*

- Recognising odd and even numbers
- Counting odd numbers in sequence from 1 to 99
- Counting even numbers in sequence from 2 to 100

***Lower level 3***

*Revision*

Counting and writing numbers from 1 to 500
Counting numbers in multiples of 2, 5 and 10 upto 100
Counting numbers in multiples of 100s and 50s upto 500
Addition and subtraction of 2 digit numbers
Multiplication tables from 2 to 10
Multiplication exercises based on tables 2 to 10
Mixed word problems based on the multiplication tables 2 to 10
Arranging numbers in order – ascending, descending
Comparing 2 numbers, using the > and < sign

*Counting numbers from 501 to 1000*

Writing numbers in 100s from 100 to 1000
Exercise in writing a given number in words from 1 to 1000
Extensive random quizzing on numbers to perfect their recognition

*Place value: Units, tens and hundreds*

Extensive exercises

*Addition of 3 digit numbers upto a total of 1000*

Aligning numbers according to place value for addition

Addition

Without carrying over
With carrying over from units to 10s
With carrying over from 10s to 100s
With carrying over from units to 10s and 10s to 100s

*Subtracting from numbers upto 1000*

Aligning numbers according to place value for subtraction

Subtraction

Without changing
With changing from 10s to units
With changing from 100s to 10s
With changing from 100s to 10s and from 10s to units

*Mixed exercises in addition and subtraction*

*Mixed word problems in addition and subtraction*

*Using the multiplication tables to multiply*

a single digit number by another single digit number
a two digit number by a single digit number without carrying over
a two digit number by a single digit number with carrying over

*Introduction to division*

Meaning of division

Introduced through extensive exercises in separating real objects (buttons, beans etc.) into equal groups
Finding how many of each number are there in a given number
How many equal parts can be formed when a number is divided by another
(Into how many equal parts can a quantity be divided)

Exercises in division

Dividing a two digit number by a single digit number (no remainders)
Dividing a two digit number by a single digit number (with remainder)
(Graded simple exercises)

*Memorising multiplication tables 11 and 12 (may consider going on to memorizing further tables depending on the interest and ability of the student)*

*Time: The clock*

A day is divided into 24 hours
An hour is divided into 60 minutes
Introduction to the clock
The hour hand and the minute hand
Reading the time on the hour e.g. 5 o'clock, 8 o'clock
Reading the time on the half hour
Reading the time on the quarter hour
Reading the time in hours and minutes
The day and night cycle, what we do and when

*Time: The calendar*

A year has 365 days
A year is also divided into 12 months
The names of the 12 months in a year
The number of days in each month of the year
The leap year and February. 366 days in a leap year
The week – number of days in a week
Approximate number of weeks in a month
How to read the calendar
The month
Sundays and week days
Holidays and special days

*Exercises to improve speed in addition*

***Lower level 4***

*Revision*

Addition and subtraction of numbers up to 3 digits

Adding a single digit number or 2 digit number to a 3 digit number – aligning numbers correctly before adding
Aligning the numbers correctly before subtracting

Multiplication tables from 2 to 12
Multiplication of a double digit number by a single digit number
Division of a 2 digit number by a single digit number
Random quizzing for writing and recognizing numbers upto 1000 in words and figures

*Numbers*

4-digit numbers – introducing the thousands place

Writing 4-digit numbers in figures, using a comma to separate the hundreds from the thousands
Writing a 4-digit number in words
Comparing 4-digit numbers
Place value in a 4 digit number

5-digit numbers – introducing the ten thousands place and the lakhs place as a prelude to multiplying larger numbers whose products are in lakhs

Writing in figures and words, putting commas in the right places
Place value in 5-digit numbers

*Addition and subtraction of 4-digit numbers*

Addition of 4-digit numbers
Subtraction of 4-digit numbers
Mixed exercises in addition and subtraction
Checking addition and subtraction answers
Simple word problems

*Mixed operations of adding and subtracting numbers upto 3- digits*

*Multiplication*

Revision exercise in multiplying a 2-digit number by a single digit number
The use of the word 'product' to mean the answer when two numbers are multiplied
Multiplying by 10, 100, 1000, . . .
Multiplying by multiples of 10, 100, 1000, . . .: e.g. 30, 700, 6000, . . .
Multiplying by 2-digit numbers and 3-digit numbers
Multiplying by zero
Mixed exercises
Mixed word problems

*Division*

Revision of division of 2-digit numbers by a single digit number
Terms used in division: the divisor, dividend, quotient and remainder
Division of various types of 2 and 3 digit numbers by a single digit number
Division of 4-digit numbers by a single digit number
Division by 10, 100, 1000, . . .
Division by multiples of 10, e.g. 20, 50, etc.
Drawing the multiplication table grid from 10 to 19 to see patterns in products
Division by 11, 12, 13, 14, . . . 19
Division by any 2-digit number
Mixed exercises

Checking answers by multiplying the quotient by the divisor and adding the remainder to get the dividend
Word problems

*Mixed revision exercises in addition, subtraction, multiplication and division*

*Multiples and factors*

The multiples of a number
Common multiples of two or more numbers
The lowest common multiple (LCM) of two or more numbers
The factors of a number
Writing all the factors of a given number
The highest common factor (HCF)
Prime numbers
Prime factorization

*Fractions*

The meaning of a fraction
The numerator and denominator of a fraction
A fraction of a number
Equivalent fractions
Comparing fractions
Like fractions and unlike fractions
Comparing like fractions
The lowest common multiple (LCM) by the division method
Comparing unlike fractions
Simplifying fractions
Adding unlike fractions
Subtracting fractions
Mixed fractions and improper fractions
Converting from mixed fractions to improper fractions
Converting from improper fractions to mixed fractions
The meaning of the form such as 15 ÷ 4 : writing this form as a fraction
Adding mixed fractions
Subtracting mixed fractions
Word problems

*Decimals*

Introduction to decimals
Place values in a decimal
The decimal part and whole number (integral) parts in a decimal
The use of a zero before a pure decimal
Writing a whole number with a decimal point followed by a zero
The correct way of reading a decimal number. e.g. 0.541 is read as zero-point-five-four-one
Changing decimals to fractions
Changing fractions to decimals where the fractions have 10, 100, 1000 etc in the denominator
Comparing decimals
Adding and subtracting decimals: aligning the decimal points of the numbers one below other before adding or subtracting
Word problems
Multiplying decimals by 10, 100, 1000, . . .
Dividing decimals by 10, 100, 1000, . . .
Mixed exercises

*The metric system: length, weight and capacity*

Length

Reading the centimetre and millimetre scale on a ruler. (Since the inch and the foot are units of common usage, they may also be introduced simultaneously)
The centimetre (cm)
The millimetre (mm)
1 cm = 10 mm
Measuring small lengths using a ruler
Guessing lengths and distances
Converting from cm to mm
Converting from mm to cm
The metre rule (tape) to measure lengths in metres
The metre (m)
1 m = 100 cm
Converting from m to cm
Adding and subtracting lengths in m and cm
Simple problems in adding and subtracting units
The kilometre (km)
1 km = 1000 m
Converting from m to km
Converting from km to m
The speedometer, odometer and trip meter in vehicles, what they indicate

Weight[1]

The kilogram (kg) and gram (g)
1 kg = 1000 g
Guessing weights of common things
Measuring weight : the balance
Converting grams to kilograms
Converting from grams to kilograms
Simple addition and subtraction exercises
Simple word problems

Capacity

The litre (l), the millilitre (ml)
1 *l* = 1000 ml
Measuring capacity: the measuring cylinder
Guessing the capacity of various containers
Converting from litres to millilitres
Converting from millilitres to litres
Simple addition and subtraction exercises
Simple word problems

*Money*

Currency: 1 rupee = 100 paise
Indian currency and its symbol (₹)
Converting from rupees to paise (although the use of the paise is on the decline, it is introduced here as an academic exercise)
Converting from paise to rupees
Adding and subtracting money in rupees and paise
Multiplying money in rupees and paise by a whole number
Dividing money in rupees and paise by a whole number
Simple word problems
Reading bills and price lists
Calculating a restaurant bill

*Time: the clock and the calendar*

Revision exercise: 1 hr = 60 min
Reading time in hours (hr) and minutes(min)
Introduction to the second (s)
1 min = 60 s
1 hr = 3600 s
Morning and evening: a.m. and p.m.
The duration of time in hours from some given time to a time a few hours later
The duration of time in minutes from some given time to a time a few minutes later
The duration of time in hours and minutes from a given time to some time later

*Simple exercises*

Simple word problems
Counting the number of days between two days in different months
Simple exercises
How to calculate the leap year

*Exercises to improve speed in multiplication*

[1] Strictly speaking (in physics) the unit of weight is not the kilogram. The kilogram is the unit of mass. But in everyday use, we use the kilogram as the unit of "weight" and hence we give the weight of things in kilograms.

***Lower level 5***

*Revision*

- Adding, subtracting, multiplying and dividing whole numbers
- Finding the LCM and HCF of a set of whole numbers
- Adding and subtracting fractions
- Adding and subtracting decimals
- Multiplying and dividing decimals by 10, 100, 1000, . . .

*Rounding off numbers to the nearest 10, 100, 1000, , , ,*

*Writing numbers correct to a given number of decimal places (say 1, 2 or 3 decimal places)*

*Significant figures*

*Writing number correct to a given number of significant figures*

*Estimating answers in calculations*

*Multiplying by 3 and 4 digit numbers*

*Dividing by 2 and 3 digit numbers*

*Mixed exercises in multiplying and dividing*

*Extensive exercises in word problems involving multiplication and division upto the level learnt*

*Mixed word problems involving addition, subtraction, multiplication and division or a combination of these operations, using simple whole numbers upto 2 or 3 digits. The aim of this exercise is to build logical thinking for application in real life situations. (These are not problems based on BODMAS)*

*Mixed operations of +, − , × and ÷. (Basic form of BODMAS in which the operations using 'brackets' and 'of' are avoided)*

*The area of a surface*

- The notion of area of a surface
- Counting squares in grids (graph paper) to find the size (the area) of a given surface
- Areas of irregular shapes by counting the number of squares that fit in the shape
- Units of area
- Area and perimeter of rectangles and squares
- Formula to calculate the area and perimeter of rectangles and squares
- Given the area and one side of a rectangle, to calculate the other side
- Given the area and one side of a rectangle, to calculate the other side and the perimeter

*Revision of factors, multiples, prime numbers, HCF and LCM*

- Composite numbers
- Method to find prime numbers
- Expressing a number in prime factors
- HCF by the division method
- LCM by the division method

*Fractions: Revision*

- Equivalent fractions
- Comparing the sizes of fractions
- Simplifying fractions: Lowest terms
- Adding and subtracting like fractions
- Adding and subtracting unlike fractions
- Mixed fractions and improper fractions
- Changing an improper fraction to a mixed fraction
- Changing a mixed fraction to an improper fraction
- Adding and subtracting mixed fractions

*Fractions: Multiplication and division*

- Multiplying a whole number by a fraction
- Multiplying a fraction by another fraction

Multiplying mixed fractions
Writing a whole number as a fraction
Fractions of a number. e.g. a fraction of 25
Fractions of quantities. e.g. a fraction of 42 kg, a fraction of 10 metres
Dividing by fractions
Dividing by a mixed number
Mixed exercises
Mixed word problems

*Decimals: Revision*

The meaning of a decimal number
Place values in a decimal number
Changing decimals to fractions
Changing fractions with denominator 10, 100, 1000, . . . to decimals
Comparing decimals
Adding decimals
Subtracting decimals
Multiplying decimals by 10, 100, 1000, . . .
Dividing decimals by 10, 100, 1000, . . .

*Decimals: Multiplication and division*

Dividing a decimal by a single digit whole number
Dividing a decimal by a larger whole number
Changing fractions to decimals (exact values only)
Some commonly used decimals e.g. 0.5, 0.25, 0.75, 0.125, 0.2, 0.4 and their equivalent fractions
Multiplying decimals
Recurring decimals
Rounding off decimals: to 1 decimal place, to 2 decimal places and 3 decimal places
Writing a division answer correct to a given number of decimal places (upto 2 decimal places)
Dividing one decimal number by another

*Units of length, weight and capacity*

Revision of the basic metric units of length, weight and capacity
Various instruments used to measure length, weight and capacity
Converting from larger units of length to smaller units and vice versa
Converting from larger units of weight to smaller units and vice versa
Converting from larger units of capacity to smaller units and vice versa
Adding and subtracting units of length, weight and capacity
Multiplying units of length, weight and capacity by whole numbers
Mixed word problems

*Volume*

The meaning of volume
Measuring volume by counting cubes
Measuring volume in cubic centimetres
Finding the volume of a cuboid from its dimensions in centimetres
Measuring volume in other cubic units
Finding how many cubes of a particular size would fit into a cuboid of given dimensions
Word problems

*Time: on the clock*

Revision of time: a.m. and p.m.
The 24 hour clock
Converting time from a.m. and p.m. to 24 hour clock time
Converting hours to minutes
Converting minutes to hours

Adding time in hours and minutes
Subtracting time in hours and minutes
Converting minutes to seconds
Converting seconds to minutes
Hours, minutes and seconds
Word problems

*Time: on the calendar*

Adding years and months
Subtracting years and months
Word problems
Special names: a decade, a century, millennium, biweekly, bimonthly, fortnightly, monthly, biennial, quarterly etc
Special names for landmarks in time: birthdays, anniversaries, centenaries, the silver jubilee, golden jubilee, diamond jubilee etc

*Time: in nature*

Introducing the concept of rythms in nature
Seasonal cycles
Flowering, fruiting and seasonal outbursts of populations
Rythms in plants and animals related to time
Chronobiology - basic introduction

*Numbers*

Numbers with 8 or more digits
The Indian system involving lakhs and crores
The international place value system: millions and billions
Roman numerals up to 2000
Revision of terms used to describe numbers e.g. fractions, prime numbers, composite numbers etc

### *Middle level 1*

*Revision of basic arithmetic*

Addition, subtraction, multiplication and division of whole numbers, fractions and decimals
HCF and LCM
Rounding off numbers to the nearest 10, 100, 1000, , , ,
Writing numbers correct to a given number of decimal places (say 1, 2 or 3 decimal places)
Significant figures
Estimating answers in calculations

*Introduction to integers (positive and negative whole numbers and zero)*

Identifying integers
Comparing integers to see which is greater or lesser
Arranging integers in ascending or descending order
Adding and subtracting integers
Multiplying and dividing integers
HCF of numbers written as the product of prime factors
LCM of numbers written as the product of prime factors

*The order of basic arithmetic operations: +, −, ×, ÷, brackets and 'of', BODMAS*

*Tests for the divisibility of numbers*

Test whether a number is divisible by 2, 3, 4, 5, 6, 8, 9, 10, 11

*Factors and indices (revision from Lower level 5)*

Factors, multiples, prime numbers
Indices, (only positive integers)
Multiplying and dividing numbers with positive integral powers
Finding prime factors
Expressing a number in prime factors

*Units of length, weight (mass) – the metric system*

Mixed units
Changing from large units to smaller units
Changing from small units to larger units
Adding and subtracting units
Multiplying units

*Area (revision of Lower level 5)*

Area by counting squares (in irregular shapes)
Units of area
Area of a square, area of a rectangle (using a formula)
Area of compound figures made up of squares and rectangles

*Changing units of area*

From large units to smaller units
From small units to larger units

*Finding a side when the area of the regular figure (square or rectangle) and another side are known*

*Perimeter of squares and rectangles*

*For a regular figure (square or rectangle)*

finding a side when the perimeter and another side are known
finding the area when the perimeter and one side are known

*Introducing geometry with the idea of an angle as a fraction of a revolution*

The right angle
Two right angles
Acute angles
Obtuse angles
Reflex angles
Straight angles (two right angles)
Complete angles
– recognizing these types of angles

A degree as $\frac{1}{360}^{th}$ part of a revolution

Estimating the size of an angle
Naming angles – by three letters
- A single capital letter at the vertex of the angle
- A single small letter inside the angle

Measuring angles using a protractor
Drawing angles using a protractor

Vertically opposite angles
Identifying vertically opposite angles
Property that vertically opposite angles are equal

Angles on a straight line
Recognizing angles on a straight line
The property that the sum of the angles on a straight line add up to 180° (supplementary angles)

Angles at a point (add up to 360°)
Complementary angles

Introduction to construction in geometry
Using a pair of compasses
Drawing straight lines of given lengths

Triangles
The sum of the angles of a triangle (angle sum property)
Constructing triangles
Equilateral and isosceles triangles
Scalene triangles
Acute angled triangles (acute triangles)
Right angled triangles (right triangles)
Obtuse angled triangles (obtuse triangle)
Exterior angle property of a triangle (the exterior angle of a triangle is equal to the sum of the two interior opposite angles)
Triangle inequality property (the sum of any two sides of a triangle is greater than the third side)

Constructions
Constructing an angle of 60°
Bisecting an angle
Constructing angles of 30°, 120°, 90°, 45° and 135°
Dropping a line perpendicular to a given line from a point outside it
Constructing an angle of 90° at a given point on a line

*Introduction to algebra*

The idea of equations in puzzle form. e.g. I think of a number and add 6. I get 10. What is the number? Forming simple equations using such puzzles
Solving simple equations, treating them as made up of two sides of a balance. The balance remains undisturbed if whatever is done to one side of the equation is done to the other
Using this idea to solve simple equations
Applications of simple equations
Simplifying expressions: like expressions, unlike expressions
Solving equations containing like terms
Using brackets to hold two or more quantities together
Multiplying terms in brackets by an integer
Equations involving brackets

*Algebraic formulae*

Constructing simple algebraic formulae
Substituting values in a formula
Introduction to the exponential form or index form

*Algebraic expressions*

Simplifying algebraic expressions
Addition and subtraction of algebraic expressions
Finding the value of an algebraic expression

*Symmetry*

One axis of symmetry
Two axes of symmetry
Three or more axes of symmetry
Rotational symmetry

*Sets*

The set notation. (Not the rule method of defining a set)
Elements
Finite and infinite sets
Equal sets, empty sets
Universal sets, subsets
Venn diagrams
Union and intersection of two sets

### *Middle level 2*

*Revision of basic arithmetic*

- Addition, subtraction, multiplication and division of whole numbers, fractions and decimals
- HCF and LCM
- Adding, subtracting, multiplying and dividing integers (positive and negative whole numbers and zero)
- Rounding off numbers to the nearest 10, 100, 1000, , , ,
- Writing numbers correct to a given number of decimal places (say 1, 2 or 3 decimal places)
- Significant figures
- Estimating answers in calculations
- BODMAS
- Factors and exponents (indices)
- Revision of divisibility

*Properties of divisibility ( e.g. if a number is divisible by both 2 and 3, it must also be divisible by the product of 2 and 3, i.e. 6)*

*Exponents*

- Zero and negative exponents
- Laws for exponents of the form $a^m \times a^n$, $a^m \div a^n$, $(a^m)^n$, $(ab)^m$, $\left(\frac{a}{b}\right)^m$
- Scientific notation of writing numbers

*Decimal representation of rational numbers (positive and negative fractions and zero)*

- Converting rational numbers to decimals
- Terminating and non-terminating decimals
- Recurring decimals, non-recurring non-terminating decimals
- Recognising whether a rational number is a terminating decimal or not
- Writing a terminating decimal as a rational number

*Ratio and proportion*

- Ratios and simplifying ratios
- Writing ratios in their simplest form
- Comparing ratios to see which is greater
- Finding the missing quantity given two equal ratios
- Problems
- Direct proportion (Direct variation)
- Numbers which are in proportion (e.g. If 2 : 3 = 4 : 6, then 2, 3, 4 and 6 are in proportion)
- The unitary method
- Inverse proportion (Inverse variation)
- Recognising direct and inverse variation
- The golden ratio Ø *(*pronounced *phi)* in nature, architecture and aesthetics

*Introduction to percentages*

- The meaning of percentages
- Expressing percentages as fractions
- Expressing a fraction as a percentage
- Expressing one quantity as a percentage of another
- Finding the percentage of a quantity
- Profit and loss
  - Cost price (CP), selling price (SP)
  - Profit
  - Calculating profit/loss
  - Calculating percentage profit/loss
  - Calculating the selling price given the cost price and percentage profit or loss

*Revision of algebra*

- Solving simple equations
- Word problems in equations

Like terms and unlike terms
Using brackets to hold expressions together
Simple equations involving brackets
Framing and using formulae

*Algebra*

Adding and subtracting algebraic expressions
Multiplying algebraic expressions
Three identities:

$(a + b)^2 = a^2 + 2ab + b^2$
$(a - b)^2 = a^2 - 2ab + b^2$
$(a + b)(a - b) = a^2 - b^2$

Factorising algebraic expressions
Simple equations involving fractions
Substituting numerical values in a formula
Changing the subject of a formula

*Circles and angles in circles*

Summary of facts and terms in circles
- The centre
- The radius
- The diameter
- The chord
- The segment – major and minor segments
- The sector of a circle
- The angle subtended by an arc – at the centre, at the circumference

Relationships between the angles formed in a circle
- Angles standing on the same arc of a circle and in the same segment are equal
- The angle which the arc of a circle subtends at the centre is equal to twice the angle it subtends at any point on the remaining circumference
- The angle in a semicircle (is a right angle)

*Scale drawing*

Drawing a given shape to scale

*Area*

Area of a rectangle
Area of a parallelogram
Area of a triangle
The perimeter of rectangles, parallelograms and triangles
Inverse problems on area and perimeter
- Given one side and area of a rectangle, to find the other side
- Given one side (or height) and the area of a parallelogram, to find the height (or side)
- Given the base (or height) and area of a triangle, to find the height (or base)
- Given one side and perimeter of a rectangle, to find the other side and area
- Problems involving paths in and around rectangles

*Circumference and area of circles*

Introduction to $\pi$ (pronounced *pie*)
Calculating the circumference
Given the radius, to find the circumference
Calculating the area, given the radius or diameter
Given the area, to find the radius or diameter

*Time, distance and speed*

Speed
Finding the speed when the distance and time are given
Converting km/h to m/s
Converting m/s to km/h
Finding the time taken when the distance and speed are known

*Simple interest*

The terms principal, interest, time, rate of interest, amount
Simple interest
Formula to calculate simple interest
Problems
Inverse problems on simple interest

*Revision of basic facts from geometry*

The right angle, acute angle, obtuse angle, straight angle, reflex angle
Vertically opposite angles
Angle sum property of a triangle
Angles on a straight line are supplementary
Complementary angles
Angles at a point
Angle sum property of a triangle
Exterior angle property of a triangle
Constructions of straight lines and standard angles
Construction of triangles

*Parallel lines and transversals*

Corresponding angles
    Recognizing corresponding angles, relationship between corresponding angles
Alternate angles
    Recognising alternate angles, relationship between alternate angles
Supplementary angles
Interior opposite angles
    Recognizing interior opposite angles, the interior opposite angles are supplementary

*Quadrilaterals*

The angle sum property of a quadrilateral
Problems

*The cuboid – volume*

The meaning of volume
Cubic units
Finding the volume of a cuboid
Converting units of volume
Capacity – the litre
    Converting units of capacity
    1000 ml = 1000 cc = 1 litre
    1000 litres = 1 cubic metre
    1 ml = 1 cc
Mixed units
    Problems involving cuboids whose dimensions are in different units
Finding a missing dimension of a cuboid
    e.g. to find the length when the volume, breadth and height are known

*The cuboid – surface area of a cuboid*

Finding a missing dimension given other dimensions such as the remaining sides and area or volume

*Statistics*

What is statistics?
Average (the mean) – the need to calculate the mean
Finding the mean of a set of numbers (up to 8 numbers only)
Problems involving mean
Frequency tables – why frequency tables are useful
Constructing a frequency table from raw data
Using graph sheets to represent data
Bar charts, pie charts, pictographs – construction and interpretation

***Upper level 1***

*Revision of*

Addition, subtraction, multiplication and division of integers and rational numbers
Solving simple equations
Like terms, unlike terms, simplifying expressions
Constructing and using formulae
Adding, subtracting and multiplying algebraic expressions
Ratio and proportion

*Squares and square roots*

The squares of integers
Perfect squares
The square root of a number
The radical sign ($\sqrt{\ }$) to denote the positive square root
Using the factor method to find the square root of a perfect square
Using the factor method to check if an integer is a perfect square or not
The square root of perfect squares by the long division method
Squares of decimals and fractions
Areas of squares (as an exercise in calculating squares)
Square roots of fractions where the numerator and denominator both consist of perfect squares
Square roots of decimals which are perfect squares by the long division method
The square root of a number which is not a perfect square
The meaning of rational numbers, irrational numbers and real numbers
The square root of any fraction
Some useful properties of squares

*Cubes and cube roots*

The cube of a number
Perfect cubes
Finding the cube root of a number by the factor method
Checking whether or not a number is a perfect cube by the factor method

*Exponents and radicals*

Positive and negative exponents
The reciprocal of a number
The value of $a^0$
Revision of the laws of exponents of the form $a^m \times a^n$, $a^m \div a^n$, $(a^m)^n$, $(ab)^m$, $\left(\frac{a}{b}\right)^m$
Fractional exponents and the radical sign
Converting numbers written in radical form to numbers in exponential form
Converting numbers written in exponential form to radical form
Changing the subject of a formula where the formula involves radical signs or fractional indices

*Algebra*

Algebraic products and identities
Multiplying two algebraic expressions
Revision of the identities

$(a + b)^2 = a^2 + 2ab + b^2$
$(a - b)^2 = a^2 - 2ab + b^2$
$(a + b)(a - b) = a^2 - b^2$

The identity $(a + b + c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$

The identities

$(a + b)^3 = a^3 + b^3 + 3ab\,(a + b)$

$(a - b)^3 = a^3 - b^3 - 3ab\,(a - b)$

Algebraic factors
- Factorizing a binomial expression with one common factor
- Factorizing an expression by grouping (as a prelude to factorizing quadratic expressions)
- Factorising quadratic trinomials

Division of algebraic expressions
- Dividing a monomial by a monomial
- Dividing a polynomial by a monomial
- Simplifying rational expressions (algebraic fractions) by cancelling common factors
- Dividing one polynomial by another

Simple equations
- Solving simple equations involving fractions
- Problems

Percentages
- Revision of basic ideas from percentages
- Profit and loss
- Calculating percentage profit/loss given the cost price (CP) and selling price (SP)
- Finding the CP given the SP and percentage profit or loss
- Discount
- Finding the SP when the marked price and discount are known

Compound interest and depreciation
- Revision of simple interest
- Meaning of compound interest
- Calculating compound interest
  - Without the formula
  - With the formula
- Depreciation
  - Meaning of depreciation
  - Calculating depreciation
    - Without the formula
    - With the formula

Parallel lines and transversals
- Revision of corresponding angles, alternate angles and interior opposite angles
- Parallel lines and intercepts
  - Recognizing intercepts formed when a transversal cuts parallel lines
- Properties of intercepts when a transversal cuts three parallel lines
  - If three parallel lines make equal intercepts on one transversal, they also make equal intercepts on any other transversal cutting them
  - The line joining the midpoints of two sides of a triangle is parallel to the third side and equal to half of it
- Parallel lines and proportional intercepts
  - If three parallel lines are cut by two transversals, the ratio of the intercepts made on one transversal is the same as the ratio of the intercepts made on the other transversals (proportional intercepts)
- Dividing a line into a given number of equal parts

Quadrilaterals
- Quadrilaterals with special names:
  - The trapezium, the parallelogram, the rhombus, the rectangle, the square and their properties

Construction of quadrilaterals
- Facts needed to construct a unique quadrilateral

- Constructing a quadrilateral given
  - 4 sides and 1 diagonal
  - 3 sides and 2 diagonals
  - 4 sides and 1 angle
  - 3 sides and 2 included angles
  - 3 angles and 2 included sides
- Constructing special quadrilaterals such as
  - Parallelograms
  - Rectangles
  - Squares
  - Rhombuses
  - Trapezia

Circles

- Revision of the terms chord, segment, sector and arc
- The angle subtended by an arc
- Revision of angle properties in circles
  - Angles standing on the same arc and in the same segment of a circle are equal
  - The angle which the arc of a circle subtends at the centre is double the angle it subtends at any point on the remaining circumference
  - The angle in a semicircle is a right angle
- Cyclic quadrilaterals
  - The sum of the opposite angles of a cyclic quadrilateral are supplementary
  - Any exterior angle of a cyclic quadrilateral is equal to the opposite interior angle

Properties of the chords of a circle

- In a circle, the perpendicular from the centre to a chord bisects the chord
- In a circle, the line joining the centre to the midpoint of a chord is perpendicular to the chord
- Locating the centre of a circle by drawing any two chords. On bisecting these chords, the point of intersection of the bisectors gives the centre
- (This property is useful in farm settings to find the centre of circular cross-sections such as water channels, troughs etc)
- In a circle, equal chords are equidistant from the centre
- In a circle, chords which are equidistant from the centre are equal

The area and perimeter of

- Triangles
- Parallelograms
- Trapezia
- Quadrilaterals
- Circles
- Inverse problems on the above
- Finding the area of irregular rectilinear shapes by dividing the figure into convenient rectangles, parallelograms, trapezia and triangles
- Finding the areas and perimeters of compound figures formed by sectors of circles

Volumes of solids with uniform cross-section

- Meaning of a prism[1]
- volume of a prism = area of cross section × length

Statistics

- Meaning of statistics
- Raw data
- Frequency distribution tables
- Histograms, interpreting histograms
- Averages - mean

[1] We define a prism as a solid of uniform cross-section

***Upper level 2***

*Revision of*

- Simple equations
- Changing the subject of a formula involving formulas with fractional indices or the radical sign
- Finding square roots and cube roots

*Quadratic equations*

- Solving quadratic equations
- Problems involving quadratic equations

*Simultaneous equations*

- Solving simultaneous equations
- Problems involving simultaneous equations

*Pythagoras' theorem*

- Statement of the theorem
- Problems involving Pythagoras' theorem
- Pythagorean triplets
- Converse of Pythagoras' theorem

*Similar shapes, similar triangles*

- Meaning of similar figures
- Similar triangles, identifying similar triangles
- Properties of similar triangles
  - The corresponding sides are proportional
- Checking whether two triangles are similar
  - By checking the equality of the angles of the triangles
  - By checking if the corresponding sides are proportional
  - By checking if one pair of angles are equal and the sides containing them are in the same ratio
  - Using these properties of similar triangles to find missing sides
- Comparing the areas of similar figures
  - For similar figures, the ratio of the areas is equal to the ratio of the square of the corresponding lengths
  - Problems
- Volumes of similar figures
  - For similar solids, the ratio of their volumes is equal to the ratio of the cubes of the corresponding linear dimensions
  - Problems

*Introduction to trigonometry*

- Identifying the hypotenuse, the adjacent side and the opposite side in a rightangled triangle
- The tangent of an angle
- Reading natural tangent tables
- Finding the side of a triangle when one angle and one leg (adjacent side or opposite side) of the right triangle are known
- Finding an angle given its tangent
- Finding an angle given two sides of a right triangle
- The sine and cosine of an angle
- Reading natural sine and cosine tables
- Using the sine ratio to find a side or an angle of a triangle
- Using the cosine ratio to find a side or an angle of a triangle

*Bio-statistics*

Random sampling, standard deviation, standard errors

*Prisms and pyramids*

Volumes of prisms and pyramids
Mass of prisms and pyramids
Capacity of prism shapes
Surface area of prisms and pyramids
Problems

*Cylinders, cones and spheres*

Curved surface area of a cylinder
Volume of a cylinder
Volume of a cone
Problems
Surface area of a cone
Volume of a sphere
Surface area of a sphere
Problems involving similar shapes

*House hold bills*

Keeping domestic accounts

### *Upper level 3*

*Revision*

- Basic arithmetic processes
  - Adding, subtracting, multiplying and dividing whole numbers, integers, fractions and decimals, significant figures and decimal places
  - Factors, multiples, HCF, LCM
  - Percentages
  - Ratio and proportion
- Basic algebraic processes
  - Simplifying expressions
  - Factorising
  - Factorising quadratic expressions
  - Finding the value of an expression
  - Indices, laws of indices
  - Solving simple equations
  - Solving simultaneous linear equations
  - Solving quadratic equations

*Basics of permutations and combinations*

- The meaning of a permutation
- The meaning of a combination
- Recognising the difference between a permutation and a combination
- The rule: If one event occurs in *m* ways and another event occurs independently in *'n'* ways, then the two events can together occur in *mn* different ways
- Finding the permutation of *n* things taken *r* at a time
- The factorial of a number, the factorial notation
- Formula to calculate the permutation of *n* things taken *r* at a time
- Simple problems
- Finding the combination of *n* things by selecting *r* things at a time
- Formula to calculate the combination of *n* things selected *r* things at a time
- Simple problems

*Coordinate geometry*

- The *x* and *y* axes. The origin
- The positive *x*-axis, the positive *y*-axis
- The negative *x*-axis, the negative *y*-axis
- Plotting a linear graph
- Recognising linear graphs
- Straight lines which pass through the origin: recognizing such graphs from their equations
- Straight line graphs that do not pass through the origin: recognizing such graphs from their equations
- The slope of a linear graph: finding the slope of a linear graph from its equation
- Reading the angle of tilt of a linear graph from its equation (whether the line makes an acute angle or an obtuse angle with the positive *x*-axis)
- Examples of linear graphs in real life
- Exponential graphs
- Exponential growths in nature
- Solving pairs of simultaneous linear equations graphically

*Probability*

- Probability of a single event
  - The number of possible outcomes
  - The number of successful outcomes
  - Probability of a successful event:

$$\text{P (successful event)} = \frac{\textit{number of successful outcomes}}{\textit{total number of possible outcomes}}$$

P (certainty) = 1

P (impossibility) = 0

$0 \leqslant P(A) \leqslant 1$

Simple problems

Probability of two events

Probability that one event or another event happens

Probability that one event and another event happen

Simple problems

*Trigonometry*

Revision of basic ideas in trigonometry

The standard ratios of sine, cosine and tangent of an angle

Finding the angle given its sine, cosine and tangent

Using a suitable trigonometric ratio, to find a side when another side of the ratio and the angle are known

The angle of elevation and the angle of depression

Calculating heights and distances using trigonometric ratios

The sine law : $\frac{a}{sinA} = \frac{b}{sinB} = \frac{c}{sinC}$

Using the sine law to find the sides of a triangle given two angles and a side. (Brief reference to the triangulation method in land survey)

*Areas and volumes of compound shapes*

Areas and volumes of compound shapes involving cones, spheres, pyramids, cylinders etc

The area of the segment of a circle given its radius and the length of the chord or the distance of the chord from the centre of the circle (The use of trigonometry is also needed here)

Finding the volume of a liquid in a trough of uniform cross section filled to different levels. (The cross sectional area may be that of a circle, a segment of a circle, a trapezium, a rectangle, a triangle, etc)

Calculating the rate of flow of a liquid through a pipe given the radius of the pipe and the speed of flow

Calculating the rate of flow of a liquid through channels of uniform cross section of various standard shapes (e.g. circular, triangular, rectangular etc.)

*Scale drawings and measurement of land area*

Scale drawings of irregularly shaped fields

Recording measurements on a sketch drawn to scale in a surveyor's field book

Surveyor's mode of recording land measurements in a field book

Dividing the scale drawing into regular geometric shapes such as triangles and trapezia to calculate land area

Calculating the total area of the land

*Statistics*

Calculating the mean, median and mode of grouped data

Frequency polygons

Cumulative frequency curves

*Commerce*

Banking

Reading a bank passbook

Cheques – uses and precautions

Parties connected with a cheque

Drawer, drawee, payee

Types of cheques
- Bearer cheques
- Order cheques
- Crossed cheques
- Multicity cheques

Magnetic Ink Character Recognition (MICR) cheques and codes
Post dated cheques – precautions
Maintaining records of cheques issued
Life of a cheque (its validity period)
Terms used in electronic payment applications developed by Reserve Bank of India (RBI)
- Indian Financial System Code (IFSC)
- Real Time Gross Settlement (RTGS),
- National Electronic Funds Transfer (NEFT)
- Centralised Funds Management System (CFMS)

Automated Teller Machine (ATM) facilities
Debit cards and credit cards – uses and precautions
Demand drafts
Electronic money transfers
Saving schemes
- Savings bank accounts
- Recurring deposits of cumulative deposits
- Fixed deposits or term deposits
- Pygmy deposit schemes
- Single or individual accounts
- Joint accounts
- Nominations in bank accounts
- Postal saving schemes

Credit and debit slips/ forms and counterfoils
Current accounts
Overdrafts
Loans, collateral/ security, guarantor Rural banks e.g. National Bank for Agriculture and Rural Development (NABARD)

The share market
Shares and debentures
The need for shares and debentures
How shares and debentures are floated
Terms used when a company is floated
The promoters of a company
Bankers to the company
Demat account
Depository (of shares)
Share trading, brokerage
Investment and speculation
Par value or face value and market price

Purchase schemes
EMIs (equated monthly instalments)
Cash down payment
Hire purchase and instalment schemes

Income tax
Personal account number (PAN)
Taxable income

Standard deduction
Exemptions
Filing returns

Insurance

Life insurance
Health insurance
Disability insurance
Group insurance
Property insurance
Vehicle insurance
Crop and livestock insurance
Insurance against natural disasters
Agriculture related insurance companies e.g. Agriculture Insurance Company of India Limited

# RESOURCES

1. Creatively designed books to introduce children to numbers, shapes and numerical concepts are freely available in the market. Books from standard publishers may be carefully chosen.

2. *Step Up Series of School Mathematics* for introducing children to the basic operations of addition, subtraction, multiplication and division i.e. lower level 1 to 3. It consists of a series of 18 carefully graded booklets with exercises for children to quickly master basic arithmetic. Available from EMATS, B-1, Adarsh Bldg, M. G. Colony, Tilakwadi, BELGAUM 590 006, Karnataka. Phone: 0831-2436 205. Email: emats.belgaum@gmail.com or ematss@yahoo.com

3. *Spark Mathematics series Books 3 to 8* published by Macmillan Publishers India. May be purchased from www.flipkart.com. These series, though well graded contain topics such as the basic geometrical concepts of points, lines and planes introduced in the class 6 book. These notions though introduced (keeping in mind the requirements of the CBSE syllabus) at first seem reasonable but are pedagogically unsound as a student at that stage cannot grasp the definitions with ease. An intuitive notion is all that is needed at this stage. Though *Spark Mathematics* contains a limited number of practice exercises, a large number of supplementary exercises are available for a number of topics in *Cornerstone Mathematics*.

4. *Cornerstone Mathematics* (a set of 11 books) for Classes 6 to 10

   The series takes the learner through graded exercises to reach them to a good level of understanding of algebra, geometry, trigonometry and analytical geometry. It is assumed that the student has some proficiency in basic arithmetic. Percentages and ratio and proportion are introduced with clarity in this series. Available for reference from the Taleemnet library.

5. *A Hand Book for Designing Mathematics Laboratory in Schools* by Hukum Singh et al published by NCERT, New Delhi, 2005.

   Contains a large number of activities for investigation and to illustrate various mathematical relationships.

6. Excellent material for learning mathematics may be downloaded in pdf form for free at www.cimt.plymouth.ac.uk/projects/mep/default.htm. This link contains practice material from Reception (introductory level prior to the Lower level) to advanced Upper level (senior secondary). Also available on this website are teacher notes, lesson plans and various other related material. The material is translated from Hungarian and made available by a charitable foundation. This project was a response to the alarmingly low levels of mathematics skills in Britain. Although some of the illustrations at the lower levels are applicable to western ways of life, suitable adaptations may be made to suit the Indian context.

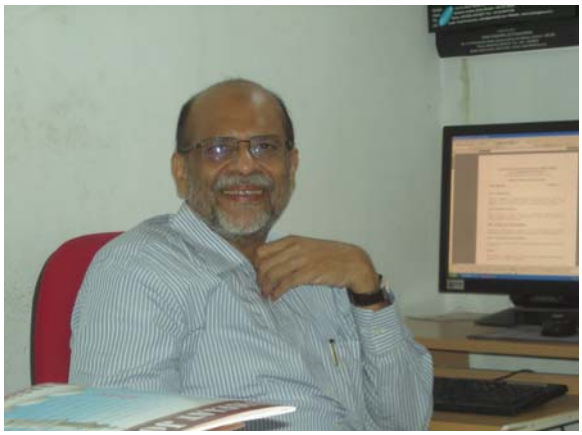
7. *The School Mathematics Project (SMP)* (http://www.smpmaths.org.uk ) have developed quality material for mathematics teaching. Their books in India are avail able with Cambridge University Press. Sample material may be viewed and downloaded from the SMP website.

**Dr Sultan Ahmed Ismail**

Children can learn many things related to farming through simple experiments using readily available resources. One of course, begins with soil. What is soil and how does one learn about soil? Very simple, take an empty large mouthed bottle, place some dried crushed soil in it, add some water, shake it well and let it rest for some time. The soil settles in layers; and there, you have your types of soils!

What about the chemical property of soil? That again is very simple. The pH of soil can be tested with indicator solutions made with turmeric, red cabbage leaves. Make a solution and test for pH.

What about inputs for the soil? Manures and compost can be made. In villages, it is a practice to dump all cow dung in a heap at one place and



Dr Sultan Ahmed Ismail

make compost using farm yard waste. Here is an opportunity to learn about anaerobic and aerobic methods of composting, the role of microbes and local earth worms. One needs to adopt the best suitable practice of bio-dung composting using cow dung, goat dung or poultry waste; one cannot wait for six months for the compost to be ready when the crop life cycle is of four months duration.

Tremendous heat is generated during the composting process; this heat can be used to heat water or prepare fermented biological pest repellant preparations. That again is very easy. Take the goat out for a stroll; observe very carefully the plants that it avoids eating. Collect a hand full of leaves from half a dozen such plants, crush and put them in a pot with water, leave it to ferment for two weeks in the compost pit. It would have gone through a biological process. You will have a sticky substance sticking to the pot, dilute it, mix it up, strain, add cow's urine and let it ferment for a day,

Composting at Mitrola Ashram, Almora, Uttarakhand

dilute and spray it on plants. You have a broad spectrum pest repellant ready there.

What about termites and earthworms? If the soil is moist and loamy it is good for earthworms. If the soil is dry and acidic it is good for termites. Depending on the soil conditions either of them will appear, both are good, both do the job efficiently. The only problem with termites is that they will attack the wood in the house. Termite compost is not as rich as earthworm compost because termites are active organisms; they use the nutrients from the soil for their own requirements. What passes through the earthworm is still rich in nutrients as earthworms are relatively sedentary. Children can learn the ecological classification of earthworms – surface level, middle level or deep soil worms; how are they useful at each level? What about termite mounds, they look so impressive that they would surely have some utility. Termite mound soil if mixed with cow urine can be used to treat seeds for germination or for storage. It gains pest repellant properties. Children can learn these simple techniques which they can readily apply on their

Vermiculture at Kattanbhanvi, Karnataka

farm/garden. Seed and the properties of seeds can be dealt with here. This can then be linked to the germination process in seeds. Germination takes place in the presence of ideal moisture conditions.

This can lead to the study of water. Soil and water management cannot be dealt with as independent topics. They go hand in hand. One can do simple experiments – three bottles, put soil in each. Leave one as it is, press the soil in the other and in the third compact the soil with a peg. Moisten each, sow the same variety of seeds in each bottle and watch it grow. How plants grow in aerated soil, slightly compacted soil and highly compact soil can be seen here. The soil, air (and water) relationship can be demonstrated vis-a-vis plant growth. Make observations of root and shoot growth. By the same logic, highly compacted soils can lead to stunted growth in plants resulting in low yields.

What happens if you sometimes have surplus unsold green vegetable crops? No worries. Take them, chop and mix them with jaggery and water and leave for two weeks. You get a beautiful fermented tonic solution for the soil microbes' to multiply. Strain and spray on the soil.

Spell bound moments at Isha Homeschool, Coimbatore

Having prepared the soil and planted, how do you recognise N, P, K deficiency in the soil? Again very simple, children can make standard indicator cards in different hues of green for deficiencies in the soil for their individual villages. Hold these cards against a leaf, and if it matches a particular hue, you can tell the deficiency in the soil and take appropriate measures to rectify the same. This green shade card concept has been developed by the International Rice Research Institute.

They can learn about alternate crops, companion crops, where to put the manure for a tree - not close to the trunk but away where the peripheral roots are most likely to be growing. Why always plant in straight rows, why not mix crops and plant criss-cross? What is the role of weeds, how can one control weeds, what is mulching and so on. This cycle can conclude with harvesting and post harvesting processes.

Naturally, food is grown for consumption to nourish the body. What is nutrition? The best metaphor for a balanced diet is our national flag. Take plenty of orange coloured fruits and vegetables in the diet to meet carotene needs. White- make use of rice, cereals and milk for energy and calcium. Include greens in the diet for meeting vitamin and mineral needs. The blue Ashoka Chakra in the centre with 24 spokes – drink plenty of water daily (24 hours).

Learning about nourishment at Isha Homeschool, Coimbatore

Gender sensitivity and the important role women play in the family and in farming has to be highlighted in the curriculum.

Health, personal and community hygiene, air management (as indiscriminate burning of garbage can lead to the release of toxic substances that can easily enter the food chain), academics should be given due emphasis, specially language, mathematics and the sciences as these are not only essential but are currently seen as career building subjects of study. Also, in my opinion, they are equally important as a part of a child's overall education.

I think we should move towards an integration and inter linkage of subjects. There needs to be a master curriculum as a reference base, from which an integrated approach can be developed. This will require very deep understanding of several aspects of not only subject matter but also pedagogy. Central to all this is an inspired teacher. There should be no compromise on the study of academic topics. This should be taken care of.

On www.simpletasksgreatconcepts.wordpress.com a hundred experiments have been uploaded to understand most of the concepts mentioned above.

# SCIENCE

Children are born with the instinct to understand their surroundings. Science is a systematic way of understanding the world around. In teaching science we make use of the child's natural instinct to understand phenomena in nature. As educators we need to provide children with an atmosphere which is conducive to learning science. In doing so, we also teach them systematic ways of investigating and exploring phenomena in nature i.e. a systematic way of seeing/ 'discovering' for themselves the accumulated wisdom of practitioners, scientists and researchers through the ages. It equips them to undertake their own investigations and to build on the phenomena they have discovered firsthand.

For the purpose of teaching, science may be classified into two broad categories of basic science (physical science and biological science) and applied science (its practical counterpart). Our concern with science in everyday life is with its applied aspect. However, to make the most of what science has to offer humanity it requires that we understand its basic underlying principles or 'elements'. It is for this purpose that the curriculum has been designed with the required emphasis on learning the principles behind a particular phenomenon while a major component is apportioned to understanding, experiencing, experimenting and applying these principles through hands-on or practical work. This is dealt with at the lower and middle levels as investigative activities, experiments and at the upper level through farm related modules apart from the usual laboratory work.

The teaching of science may be approached differently during the different levels of study:

At the Lower levels 1 to 5, science may be taught alongside the study of social science topics. This approach has been popularly described in recent times as environmental studies and in this curriculum has been dealt through science and geography. Here the student is guided towards investigating and seeing for oneself the natural, manmade and 'social' phenomena in ones immediate environment and community. The social, personal care and health (and value) education, at this level may be broadly termed as Learning about Living. At this stage, these topics are best dealt with through specific tasks or workbook engagements.

At the Middle levels 1 and 2, science may be introduced through basic science, covering subjects like physics, chemistry, biology and geography. Geography has been deliberately placed within basic science as its understanding from the science angle (rather than the social science angle) is felt necessary within a rural curricular framework.

At the Upper levels 1, 2 and 3, basic science will handle clearly defined subject categories of biology (including ecology) and geography (including hydrology and geology), physics and chemistry. These categories have been defined more for the purpose of focus rather than as strict compartments.

Learning of science requires special skills such as investigating, designing and making things, recording observations by means of tables, notes, drawings, drawing conclusions from observed facts and patterns. Tracing, drawing, measuring, cutting, joining things, fastening things need to be given ample practice at the primary level. Pitfalls like jumping to conclusions or drawing conclusions without sufficient evidence should be shown to be unscientific.

*A note on safe practices*

In the learning of science safety practices must be made a habit. The teacher should emphasise the need for safety to oneself, others and property during all practical work. For any task undertaken, safety practices when handling tools, gadgets, equipment (and their care), materials and living things, should be first dealt with as a matter of routine. This rigour (however dull) will hold the student of science in good stead through all scientific investigations and on farm activity. The old adage, 'prevention is better than cure' applies to the practice of science and farming as well. This can never be overstated.

# GENERAL SCIENCE

***Lower level 1 to 5***

*Skills*

In learning science at the Lower level, skills such as questioning, observing, predicting, investigating and experimenting, estimating and measuring, sorting and classifying, recognizing patterns, interpreting (i.e. drawing conclusions), recording and communicating, exploring, planning, designing and making, evaluating are to be *consciously developed through dealing with each topic mentioned in the syllabus*. This way of thinking and doing things is intrinsic to developing a scientific temper. At the end of the primary level it is expected that such a scientific approach to learning science will become second nature.

For the purpose of learning science, the curriculum at the Lower level has been grouped into 1, 2 then 3, 4 and finally 5. The emphasis is on activities, investigations and observations. Most work is outdoor in nature with sufficient time allotted to each topic. Keeping records is an important habit to be cultivated from this period on.

Below are some basic skills necessary for learning science, with explanations for each skill.

*Questioning*

What is it? Where does it live? How does it move? What do you hear, see or smell?
Where does it grow? What is it made of? Which of these materials would be waterproof?

Examples of using this type of questioning:

ask questions about animals, plants, objects and events in the immediate environment
What is it?
What animals and plants are here?
How heavy is it? How long is it? How thick is it? How far is it? How does it move, fast or slow?
Why do some leaves/petals/fruits/vegetables have holes in them?
What is the food of a cow, a pup, a cat, a bird, a rat, a butterfly, an owl etc.
Which material is the best for bouncing?

Ask questions that may lead to investigations

What will happen if we add water?
How will we move the box?
Will the ball bounce better on the grass or on the floor?

*Observing*

Characteristics, similarities, differences through using the senses
observe accurately both inside and outside a building such as a house or a classroom.
use all the senses, separately or in combination, to explore living things, objects and events in the immediate environment
observe differences and similarities in the environment e.g. in the pond and on a tree, on the farm and in an uncultivated space.
different plants and animals in contrasting habitats
observe gradual changes in living things and familiar objects and events over a period
growth of seed
weather (by noting the symbol of a cloud, sun, rain in the notebook alongside the date)
evaporation of puddles in the yard

*Predicting*

Guessing and suggesting what may happen in structured situations e.g. what would happen if a cloth (a flower, a sponge, a stick) is placed in water.
suggest outcomes of an investigation, based on observations

suggest outcomes in the course of an activity (e.g. I think the object will move faster on a smooth surface)
suggest outcomes over a longer period (e.g. I think that more seeds will germinate by next week in plot A than plot B)

*Investigating and experimenting*

Carry out simple investigations set by the teacher. Make observations. Collect data
carry out simple investigations where the problem, materials and method are suggested by the teacher
explore how to train a creeper's growth
explore how to make a paper bridge stronger
how to keep mould from growing on leather shoes in wet weather
begin to suggest approaches and methods of solving problems
begin to identify one or two variables with guidance from the teacher such as heat and water are necessary for growth

*Estimating and measuring*

Size, length, weight – smaller, bigger, shorter, longer, lighter, heavier
Use non standard units to measure
How many foot steps is the length of this room?
How many hand spans is the length of this table?
How many tamarind seeds will fit into this cup?
Which is heavier – a guava or an orange?
compare and identify differences in measurements-fast/slow, heavy/light
Which is faster – walking or cycling to the park?
appreciate the need for standard units

*Sorting and classifying into groups based on one or more than one feature e.g. living things, materials, plants, animals, things, animals with wings, etc.*

sort and group objects according to observable features e.g. colour, shape, size
appreciate that there are different criteria for sorting and suggest more than one way of sorting a number of items e.g. a group of animals could be sorted by number of legs, by the food they eat or where they live.

*Recognising patterns*

begin to look for and recognise patterns and relationships in observations
falling leaves and seasonal change, birds active at daybreak and sundown, mangoes in summer etc.

*Interpreting*

draw conclusions from simple investigations – seeds swell when soaked in water and germinate in a few days if left on a moist cotton swab

*Recording and communicating*

Trace pictures of animals, birds, flowers, trees, faces. Learning to trace is an important skill to learn
Using the right vocabulary, recording through simple annotated (one or two word) drawings
Describing orally – fish in a pond/aquarium, butterflies flitting from flower to flower, a mosquito bite, life cycle of a flower – it buds, blooms, wilts, drops to the ground, dries or rots

*Exploring*

explore, handle and manipulate a range of materials in structured and unstructured situations
observe, investigate and describe familiar objects. Investigate how objects work (always under teacher/adult supervision)
discuss what one likes or dislikes about a particular object,
discuss why people have a need for them

recognise that one may like only some features of an object and investigate the reasons for these preferences (in shape, colour, texture, structure, material)

*Planning*

suggest a possible material e.g. to make a boat, suggest a possible activity e.g. make a healthy salad. Suggest how to go about it.
discuss the possible ways of doing an activity through discussion, modelling material etc.
identify a need for new or revised design; imagine and suggest a possible object to be made
discuss, using appropriate vocabulary, what the student would like to design or make
clarify and communicate through pictures or simple modelling the materials required
prepare a list detailing item, quantity required and size
choose materials (preferably reclaimable domestic discards), from a given range, to comply with the design idea
communicate the plan of action using appropriate vocabulary in oral or written form.

*Making*

Make simple objects and develop craft-handling skills such as cutting, tearing, assembling, folding, sticking, moulding, tying knots, modelling, stacking etc.
marking out, cutting curved edges
cutting a variety of materials (e.g. paper, card, fabric, string)
use a variety of simple tools such as ruler (for tearing), child safe scissors, single-hole punch, stapler, marking chalk
use a range of materials such as reclaimable domestic waste, general-purpose adhesives, string, homemade glue made from flour/cooked rice, card sheet, cardboard of varied thickness, balloons, lollipop sticks, ice cream sticks, rubber tubing, matchsticks, thread spools, adhesive tape, pipe cleaners, fabric, clay, straws, fasteners (hair-clips, paper clips, bulldog clips, clothes pegs), cartons, newspaper, bottle caps, and natural materials from the neighbourhood e.g. seeds, sticks, leaves, stones, pieces of tile etc.
understand that these materials can be linked in simple ways to allow movement
make a wheel and axle using a pencil and thread spools; a paper fastener
joining two pieces of circular card allows a card wheel to rotate

*Evaluating*

evaluate design ideas as they develop in the making process
discuss own work and the work of peers
evaluate own work and suggest possible modifications to the designing and making task
evaluate suitability of materials chosen, aesthetics, the extent to which objects fulfil needs identified during planning

***Lower level 1 and 2***

*Syllabus*

In dealing with the science curriculum of Lower levels 1 and 2, the skills appropriate to the topic (as described above) should be specially emphasised.

*Living things*

*About self*

Parts of the body

Identify and name the external parts of the body and their associated functions and senses using the right vocabulary.
Recognise that although all individuals have similar body parts, each is unique in features, body structure, gait etc.
Draw a picture of yourself and name as many parts of the body as you can, using the right vocabulary.

Growth of the body

Infant, toddler, children, adults and old people. Name a few infants, toddlers, children, adults and old people.
Growth in height, weight, size – through discussions on growing out of clothes and shoes. How old are your brothers, sisters or friends? How taller or shorter than you are your brothers, sisters or friends?
Teeth – from being toothless as infants to milk teeth to permanent teeth. How many milk teeth do you have? How many permanent teeth do you have? How many are missing? Compare these numbers with that of your friends.
Progress in mobility – crawling, standing, walking, running.
Recognise that with physical growth there is also a change/growth in a range of physical and mental abilities and skills.
Make a list of activities that:

- A little baby can do and cannot do
- A small child can do and cannot do
- You can do and cannot do
- Your parents can do and cannot do
- Your grandparents can do and cannot do

Identify some of the requirements for growth e.g. food, rest, exercise

- What happens if you miss a meal?
- What happens if you go to sleep very late and get up very early?

Needs of the body

Air, water, food, rest, shelter, clothing, hygiene, exercise and play
What happens if one or some of these are not available?

The sense organs

become aware that the sense organs help in understanding the external environment. The protective role of the skin.
use all the senses to become aware of and explore environments.
Best explored through games e.g. close the eyes and identify sounds, smells, surface textures etc.

*Plants and animals*

Observe, discuss and identify a variety of plants and animals in different habitats (such as farms, gardens, parks, soil, roadside, trees, hedges, puddles, ponds, river banks, lake sides, well embankments, rocks, opens paces, compound walls, hills) in the immediate neighbourhood.

Identify

common trees and other plants
common birds, animals
common insects and small creatures in different habitats such as hedges, walls, parks, open fields, farms, ponds, rocks, under stones (with an adult), streams etc.

Develop some awareness of plants, trees, animals from wider environments through books, geographic/science films and documentaries or during visits to places of natural interest like sanctuaries, zoos, botanical gardens etc.

Sort and group living things into sets based on certain characteristics

birds, animals, insects, plants, trees, leaves, flowers, fruits, seeds
edible and non edible things
vegetables and grains
plants and animals that provide food
farm animals

Recognise, identify and describe (in one or two words) external parts of plants and animals

Flower, leaf, stem, root, fruit, seed (seed, although not external is included here as it is commonly encountered by children in their everyday life), bark, trunk, branches
Legs, tail, feathers, wings, beak, ears, whiskers, scales, fur

Recognise that trees are plants

Life processes in plants and animals

Appreciate that all plants and animals have essential needs for growth
Become aware that all our food comes from living things
Investigate how plants respond to light and water
Recognise that all living things grow and change
Understand that seasonal changes occur in living things
Examine the changes that occur in nature and in plants and animals during the different seasons
Flowering, fruiting, leaf fall, new leaves; sprouting of grass and bulbous plants with the first rains; grass changing colour and turning to hay; moss and ferns growing on walls with the first rains
Animal, insect and bird behavior and appearance during different seasons in different habitats. e.g. birds build nests, squirrels carry nuts, mosquitoes and flies appear in abundance in particular seasons

Farm and domestic animals

Identify different animals on the farm, their role on the farm and life processes dogs and pups, cows and calves, hens and chicks etc. In what way are they useful e.g. dogs guard, cats keep away mice, cows give milk and manure, bulls assist in farm work, poultry give eggs, meat and manure etc.

*Light*

Identify and name different colours
Sort things of similar colours into groups
Dark and light shades of the same colour
Observe colours in the surrounding

green grass and trees, blue sky, clouds, mud, water
colours of things at home, in the school, on the farm, road etc.

Explore the mixing of colours to form new colours
Recognise that light comes from different sources
Recognise that Sun is the primary source of light and heat
Recognise that light is needed in order to see
Become aware of the dangers of looking directly at the sun
Light and shade
Night and day
Investigate the relationship between light and materials

Sort materials according to whether or not they allow light to pass through
Explore materials that do not allow light to pass through
Observe how shadows are formed, their shapes
Design and make a pair of sunshades using transparent coloured film

*Sound*

Recognise and identify different sounds in the surroundings
Low and high sounds, soft and loud sounds, shrill and soothing sounds
Explore how different materials make different sounds
Identify different sounds in nature e.g. leaves, wind, thunder, streams and rivers
Sort sounds in nature and sounds made by materials based on characteristics like soft, loud, shrill, soothing, musical etc
Investigate the sounds made by various musical instruments
Learn to whistle and imitate the whistles of various common birds and animals in the surroundings
Make a whistle with a leaf, small strips of flat wood, paper etc

*Heat*

Hot and cold things in the surroundings
Hot and cold weather, foods, materials
Ways of keeping things hot or cold e.g. warm clothing, blankets, refrigerators, ovens.
Heat from sunlight, cool shade under a tree
Become aware of the different sources of heat
Learn that temperature is a measure for how hot or cold something is
Measure the temperature in different places such as indoors and outdoors, water in a cup, bath water in a bucket etc
Design a suitable cover to keep a hot cup warm

*Forces*

Explore pushing and pulling through toys, carts
Changing shapes by squashing or stretching them
Floating and sinking – group objects into those that float or sink in water by investigating
Changing shapes to make objects float e.g. bottle caps, trays, a paper boat
Pushing down different objects in water to see what happens e.g.an inverted mug or tumbler, a stick, a seed, a sponge, bottle caps, stones etc

*Electricity*

Static electricity

Charge different materials by rubbing and see what substances are attracted by these materials e.g. rub a plastic comb or ruler on the hand and see if it attracts materials such as small pieces of paper, sand, twigs, leaves
Rub a wooden pencil and see whether it attracts anything

Magnets

Explore how magnets attract different substances
Explore the effect of bringing one magnet close to another, first by taking one magnet close to the other and then turning one magnet around
Investigate if a magnet attracts another magnet or material through a medium such as a paper, water, glass, a sheet of aluminium, sheet of plastic, sheet of thin plywood, a cabbage (or a large) leaf etc
Design and make a fishing game using magnets
Design and make a holder to keep your teacher's pins and clips

Become aware of the uses of electricity in different places such as home, farm, school, community spaces, streets, during special occasions
Identify some household appliances that use electricity
Investigate to see if there is a relationship between heat, light and electricity
Become aware of the dangers of electricity
Learn about the safe practices to be followed when handling switches, while turning gadgets and appliances on and off. Learn that none of them is to be handled without prior permission from an adult and always under adult supervision

*Materials*

Become familiar with shape, texture, colour and weight of common materials in the surrounding e.g. water, wood, soil, hay, stones, textiles, paper, metals, plastic

Group materials based on properties like strength, colour, texture, flexibility, transparency, strength etc. Describe and compare them

Identify and investigate a range of common materials used in the immediate surroundings

- Food and its ingredients
- Materials used for making furniture
- Materials used for making clothes
- Materials used for making tools
- Materials used for making toys, combs, tooth brushes, mirrors, cutlery, floors, walls, taps, rainwear etc.

Distinguish materials into natural and manmade materials

Identify and investigate materials that absorb water and those that are waterproof

Investigate the absorbent properties of different materials and make a kitchen cloth

Investigate the different materials used in making different structures/ built spaces in the surroundings such as home, road, bridge, well embankments, cowshed, tractor or vehicle garage, temple, school, granary, homes of animals, birds etc

*Materials and change*

Investigate the characteristics of different materials when wet and dry

Materials that spoil or do not spoil in water

Effect of water on different materials

Properties of common materials when they are wet or dry

Effect of heating and cooling on a range of materials such as wax, ice cream, ice, water, chocolate, butter etc

Become aware of and investigate the suitability of different kinds of clothes for different seasons

Recognise that some kinds of fabric keep us warmer or drier than others

Make a list of clothes one may take on a holiday to a very warm or a very cold place

Explore ways in which liquids and solids may be kept warm or cold

Investigate what wrapper material will keep a cup of water hot or cold for a longer time e.g. paper, cloth, wool, foil, vacuum flask

Explore ways in which food can be kept fresh for a time e.g. keeping biscuits and crisps fresh and crisp in airtight containers, hanging pumpkins and onions from the ceiling, stocking vegetables and fruit in cool places

*Mixing and other changes*

Investigate how materials may be changed by mixing

- Mixing paints to make new colours
- Mixing sugar or salt to water
- Mixing different ingredients to make a simple dish such as bhel puri, fruit milk shake, a salad etc

*The environment and its care*

Identify, discuss and appreciate the features of the natural environment such as trees, plants, animals, birds, insects, the sky, stars, clouds, rain, sun, ponds, rivers, hills etc. in ones immediate surroundings

Identify, discuss and appreciate the features of man-made things e.g. artifacts, crafts, music, art, buildings, mechanical and electronic inventions etc. in ones immediate surroundings

Understand that humans share the environment with plants, animals, birds and nature in general

Observe and develop an awareness of living things in a range of habitats in the local and wider environments

Observe similarities and differences among plants and animals in different local habitats
Develop an awareness that air, water, soil, sunlight, living and non living things are essential to the environment
Begin to understand that plants, animals and humans are interdependent
Begin to appreciate that plants, animals and humans need clean environments
Realise that there is both an individual and a community responsibility in caring for the environment
Identify, discuss and implement simple tasks for caring and improving the environment

Things for individuals to do

caring for clothes, toys, tools and other possessions
caring for living and non-living things in the locality
keeping things in their proper places
keeping the home, garden, classroom and street clean and tidy
disposing litter in the proper bins or waste baskets or compost bins/pits
keeping lights, taps, fans, pumps turned off when not in use
using water and electricity sparingly and carefully
Take care that the places we go to and use are also left clean, tidy and safe for others

Things we can do together

keeping classroom, school and play spaces clean, tidy and safe
caring for living and non-living things in the locality
disposing litter in the proper bins or waste baskets or compost bins/pits

Become aware that many of our careless activities such as littering, polluting, vandalising cause harm to others and the environment

*Note to the teacher*

Although some words may be difficult to spell, the teacher may assist the students by writing the spellings of unfamiliar words on the black board. While studying language, if students have already gone through a thorough exercise in spelling and phonetics, writing down words will not be a difficult task. The emphasis here is to build a scientific vocabulary rather than to describe processes in writing. Descriptions should only be done orally. Many tasks can be dealt with based on the science books *Let's Discover Science* by David Horsburgh. We have found these to be very useful and pedagogically sound in introducing children to science. These books are downloadable free of charge from www.arvindguptatoys.com. A complementary set of books is *Learning about Living* by the same author. It deals with topics related to environmental science. This too is highly recommended.

***Lower levels 3, 4, 5***

In learning science, at this level, the student further develops the skill of exploration and experimentation. At this point the teacher must insist on safety procedures being observed strictly. In instances where tools and equipment are to be shared, students must learn to patiently wait their turn. This is not only a desirable trait to cultivate but a necessary practice from the point of safety. Through the topics dealt with at this level students will further explore their surroundings.

Continuing from Lower levels 1 and 2, below are the skills to be developed in the study of science.

*Skills and attributes to be developed*

*Questioning*

Ask questions about plants, animals, objects and events in the immediate surroundings.

How can we find out what causes holes in petals, leaves, vegetables and fruit?

How can we find out what ants, butterflies, flies like to eat?

Are there signs of animals eating plants or smaller animals in the area?

In what ways do plants and animals depend on each other?

Ask questions that will identify problems to be solved

How can we move this heavy box to the centre of the room?

What can we do with the excess lemons picked from the tree?

Ask questions that will help in drawing conclusions

Are all materials waterproof?

Do cows eat only grass?

Do all birds fly?

Did the type of medium (e.g. water, sand, soil etc.) make any difference to the way the seeds sprouted?

*Observing*

Observe and describe natural and human elements and processes in the immediate surroundings

Variety of flora and fauna to be found in a range of environments

Effects of heating and cooling on a variety of substances

The same variety of a plant growing in two distinct habitats such as a ficus (fig, peepal, banyan) on an old wall and in the open field

Observe and describe characteristics such as the shape, size, colour, pattern, texture

Observe and describe interrelationships of natural phenomena in the local environment

Learn the use of lenses, scales, timers and rulers to aid observations

Become familiar with terms related to physical properties like weight, length and capacity

*Predicting*

Offer suggestions (hypotheses) based on observations about the likely results of an investigation

Make suggestions based on observations over a period

Suggest what effects a cause will produce

*Investigating and experimenting*

Collect information and data from a variety of sources, including observations in the environment, classroom observations and experiments, photographs, books, maps and electronic media sources

Design, plan and carry out simple investigations

Identify one or two obvious variables relevant to the investigation

Realise that an experiment is unscientific if relevant variables are not controlled

e.g. each tray of seeds must be given an equal amount of water

temperature must be recorded at the same site and same time each day to enable reliable comparisons to be made

*Estimating and measuring*

Measure, compare and record mass, weight, capacity, time and temperature using appropriate standard units of measurement and simple equipment such as rulers, rain gauges, thermometers, weighing scales

*Analysing, sorting and classifying*

Sort and group data on people, events and natural phenomena using a range of appropriate criteria

animals observed in varying habitats
test objects that sink or float
test materials that will or will not conduct electricity

Sort and present data in sets and subsets

*Recognising patterns*

Look for and recognise relationships when making observations

Relationship between the quantity of water (or white) added to paint and the change in shade from dark to light.

Relationships between the length, thickness, tension and type of material used in making musical instruments and the sounds produced

Relationship between the ease with which a sheet of paper can be cut as a single sheet and when folded once, twice...

Select appropriate observations that fit a pattern

*Interpreting*

Collect information, interpret and offer explanations

Draw conclusions from suitable aspects of the evidence collected

*Recording and communicating*

Record and present findings and conclusions using a variety of methods

oral and written (in one or two sentences) accounts
charts and diagrams

*Exploring*

Explore a wide range of everyday objects to see how they work

hinges on a door, a bolt and nut, egg-beater, paper punch, screw-caps on bottles, jars and tubes, forceps, tongs, buckles, zippers...

Explore extensively and freely how a range of shapes, objects and other constructions can be made using a variety of materials such as paper, sand, mud, clay, stones, cork-wood, soapstone, card sheet, thread, string, beads, seeds, tiles, cones, leaves, sticks, bamboo, coconut shells, coconut coir ...

Explore how some objects can be improved, improvised, adapted

a piece of stone as a door stopper
a bottle with a hole for regulated drip water supply to a plant
a cut bottle, part of a tyre, coconut shell as planting pots

Recognise that people have preferences for certain characteristics in objects, tools and materials over others such as colour, texture, size, material, design. Explore the reasons for these preferences

*Planning*

In design and planning, working as a team or in collaboration creates interest, brings in more ideas, builds team spirit

Preparing a blueprint of a design or plan using sketches, mind-maps and models brings clarity into planning and provides direction for executing a plan

A plan must reveal measurements, materials and equipment required. It must take into consideration the resources available

Recognise that people adapt or change objects or surroundings according to their needs

Become aware that new designs create an interest or may meet a necessary or perceived need

*Designing and making*

Throughout the learning of science, children should be encouraged to design and make working models. The emphasis should be on improvisations and use of discarded reusable and recyclable materials. Children should learn that instructions related to safety practices must be strictly followed. Teachers and adult supervisors must discourage any laxity in this regard.

Make a range of simple objects to solve practical problems (hold a door open, hold a latch in place), to fulfill a need of preference (colour/texture/weight/shape/size) and to express creative ideas ( a mask, a costume, a paper weight, a pencil holder).

Develop craft handling skills and techniques

tying knots, marking and cutting, pasting, joining and fastening, making holes, weaving and plaiting, strengthening structures using struts, linking objects with glue and adhesives, simple card hinges, threading a needle, sewing a button etc

Making use of appropriate tools

Friction and polishing surfaces - sand paper, files, emery stone
Joining, tying and fastening - thread, needle, adhesives, stapler, bolts, nuts, spanners
Cutting and punching - blunt ended children's scissors, single-hole punch

Use a range of materials such as those listed below for making various things

Lollipop sticks, ice cream sticks, card sheet of various thickness, paper clips, binding clips, adhesives, homemade gum-paste, soft wood, paper plates, discarded plastic bottles, cartons, old greeting cards, newspaper etc

*Evaluating*

Recognise that modification to a plan may have to be made throughout the implementation of a task

Evaluate the effectiveness of the new product and suggest modifications to the design and making procedure

Suitability of materials chosen, aesthetic outcomes, extent to which the product fulfils needs identified initially

Examine the work of peers, appreciate quality outcomes, propose positive modifications, be sensitive to feelings while offering suggestions for improvement

***Lower level 3, 4***

*Syllabus*
*Living things*
*About self*

Identify and name some of the body's major external and internal organs
Draw a diagram and label the parts. (An activity that children enjoy immensely is to draw and possess an outline of themselves, their hands, palms, feet on card sheet with labeled parts. It makes a great poster that they are drawn to time and again and never tire of showing off.)

Develop an awareness of the importance of food for energy and growth
Note how many meals you have in a day. How do you feel when you are hungry?
How do you feel after having a nourishing drink or a snack?
Note how often you get a haircut, clip your nails
Keep a monthly diary of your height and weight

Need for a balanced and healthy diet and hygiene while handling food
Learn to make a nourishing and tasty green salad with seasonal vegetables and sprouts, and a fruit salad from seasonal fruit

Structure and function of the teeth
Count and write how many milk teeth and permanent teeth you have. How many are missing? List them in a table
Design and make a clay model of your dental set. Mark the milk and permanent teeth in different colours. Compare your set with those of your classmates

Investigate breathing
Appreciate the need for fresh air. Air contains oxygen along with other gases
Understand that air is drawn in through the nose and passes through the windpipe to the lungs. Breathing through the mouth is also possible, although it must be avoided for good health
Learn a few breathing exercises (pranayama)
Hold your breath for a while and see how you feel
Hold a finger in front of your nose and feel the breath as it comes out. Does it feel warmer?
Investigate the rate of breathing before and after a game or exercise
Investigate the relationship between the rate of breathing and heartbeat after a game or exercise
Investigate how you feel if you breathe smoke or breathe in a crowded place full of vehicles or people

Explore and investigate how people move
Understand that the body is supported by a structure that gives shape and stability: the function of bones and muscles
Appreciate that the human body can move only at the joints and within limits. Explore the movement of various body parts
Investigate the limitations of our control over some movements such as blinking of eye lids, jerking of the knee, tossing in sleep

*Variety and characteristics of living things*

Observe, identify and investigate the plants that live in local environments: at the
local stream, river, pond or seashore
local landscape – fields, gardens, open grounds, parks, the roadside, hedges, walls, old abandoned buildings

Develop an increasing awareness of plants and animals from wider environments

Observe and explore some ways in which plant and animal behavior is influenced by, or adapted to, environmental conditions
Shade loving plants, sun loving plants, plants that like wet, damp or dry conditions.
Animals that like the dark, the light, night time, day time

Animal colouration based on habitat and habits. Camouflage in some animals in the immediate environment

Sort and group living things into sets according to observable features

Animals that have fur, feathers, scales

Flowering and non flowering plants

Use simple keys to identify common species of plants and animals

Understand that plants use light energy from the sun

Investigate how plants need light energy through an experiment

Appreciate that animals depend on plants (directly or indirectly), and indirectly on the sun for energy. Discuss simple food chains

Become aware of some of the life processes in animals: feeding, breathing, growing, moving, resting, use of the senses, reproduction and death

Investigate factors that affect plant growth: soil, water, light, air, temperature, weather

Plan and design experiments (with the teacher) to test these factors

Seasonal cycles in plants and animals

Investigate the changes that occur in flowering plants and trees through the year

Keep a diary for grasses (pressed dry) that grow in your neighbourhood

Become familiar with the life cycles of common plants and animals in your neighbour hood

Investigate the appearance of frogs with the first rains. Where do they come from? Where were they during winter and summer?

Visit a pond and look for tadpoles. Observe the behavior of frogs around a pond.

Keep a bird diary and record the birds you see along with date, place and activity (were they feeding, hunting, building nests, flying across the sky, stayed in your locality for some time and then left)

Keep a butterfly and bug diary – record activity in the diary regularly with drawings, sketches and notes

*Light*

Investigate that light is a form of energy – use a magnifying glass to heat objects, see what happens. (Take note of safety measures while handling lenses.)

Recognise that sunlight is used in many everyday activities e.g. to dry clothes, food, grass, hay, papads, solar water heaters, solar lamps, cookers, calculators etc

Recognise that animals too use sunlight – to bask, groom, dry themselves

Observe a cat, a dog, hens, monkeys and other animals in the sun. Note when they go looking for shade

Recognise that light comes from natural and artificial sources. Make a list of natural sources and artificial sources

Recognise that the sun gives us heat and light without which people, plants and animals cannot survive

Be aware of the dangers of looking directly at the sun

Investigate that light can be broken up into different colours- using a prism

Where and when can you see a rainbow. Plan a simple activity to create a small rainbow

Observe what happens when water is released as a fine spray in a direction away from the sun

Investigate the relationship between light and materials

Sort materials into transparent, opaque and translucent

Collect things that are transparent, opaque and translucent

Investigate how these properties are used in windows, room partitions, roofing, shades and skylights, green houses

Investigate if these materials form shadows

Design and make a simple light shade using a paper plate

Investigate how mirrors and other shiny surfaces are good reflectors of light

- Investigate the reflections made by various flat shiny surfaces and curved shiny surfaces
- When you visit a children's park or funfair, look at yourself in all the magic mirrors
- Make drawings of how you appear in these mirrors
- Safety practices when handling lenses and mirrors

*Sound*

Recognise and identify a variety of sounds in the environment

Understand and explore how different sounds may be created by making a variety of materials vibrate

- A taut string
- A taut wire
- Two tumblers clashing
- A stick on a tumbler
- Design a guessing game using discarded film roll containers filled with pebbles, sand, rice, cotton, tamarind seed etc
- Use bottles filled with water to different levels to create the notes of a musical scale. Create a simple tune
- Can you make a similar musical scale using tumblers or glasses?
- Tie strings of various lengths (but same thickness) to produce different notes
- Tie strings of various thicknesses (but same length) to produce different notes
- Investigate how change in tension, thickness, length and type of material affect sound produced
- Investigate how a tuning fork generates waves on touching the water surface in a bowl
- Explore how sound travels through various media like air, water, wood, ground, metal etc
- Investigate how sound travels through materials by making a match box – string telephone

Understand that sound is a form of energy

Recognise that some sounds are unpleasant to the ear and can cause a person to feel ill at ease e.g. loud talking, a room full of people talking at the same time, unnecessary honking, loud music

Discuss etiquette related to sound and noise

*Heat*

Investigate how heat can be transferred from one material to another

- Pouring hot or chilled water into a cup makes the cup hot or cold to the touch
- List examples of heat transfer in your surroundings

Learn that temperature is a measurement of how hot or cold something is

- Observe a demonstration of measuring the temperature of various things around you. Record these readings
- Measure the temperature at the same time in the morning and afternoon everyday for a week and compare the readings, what conclusions can you draw?
- Measure the temperature in various places in your surrounding and explore the reasons for variations

Identify ways in which heat is used in everyday life. List the various sources of heat commonly used

Recognise that the sun is the earth's most important source of heat

Safety practices while using thermometers, handling hot and cold things. Follow strictly the instructions given by the teacher

*Electricity*

Static electricity

Create static electricity by rubbing a comb or plastic ruler on the hand
Explore various other materials for their electrostatic properties
Explore the effect of static electricity on various things in the surroundings
Attracting water to a comb
Sticking a balloon to the wall with nothing
Balloons on a string moving away from each other
Crackle of the static charges in a charged woollen blanket/coat
Learn about lightening conductors

Magnets

Investigate how some materials are attracted by magnets. List materials that are attracted and not attracted by magnets. Look for patterns created when materials are attracted by magnets
Investigate how magnets can push or pull magnetic materials
Investigate the pushing and pulling property when two magnets are brought close to each other
Learn about magnetic poles. Understand that magnets attract or repel each other at the poles
Learn to read a compass. Explore the relation between magnet and compass
Design a game of treasure hunt with clues based on the use of a compass

Learn about electrical energy

Observe a demonstration of how a bulb lights up with the use of electrical energy
Design and make a simple flash light with assistance from your teacher

Learn that electrical energy is a valuable resource. Discuss the habits we can inculcate for using electricity sparingly. Make creative reminder notes to be displayed near all electrical appliances in your classroom, home

Safety practices while dealing with electrical appliances. Follow strictly the instructions given by your teacher

*Forces*

Investigate how objects move from one place to another
Explore different ways in which objects move
by pushing and pulling
by twisting and stretching
by pouring
by rolling
by sliding
by machines e.g. rollers, wheels, pulleys, strings etc
Design and make a pulley system to help an old lady living on the fourth floor to get her newspaper every morning from the vendor without having to come down to fetch it

Explore how some moving objects may be slowed down or stopped

a bicycle by hand brakes
a falling fruit with a basket or an open inverted umbrella
Design and make a cascade to slowdown the flow of water in a garden pond

Investigate how a wheeled toy moves on different surfaces such as grass, concrete, mat, carpet, tiled surface, table-top etc. Discuss your findings

Learn about the effect of friction on movement
Investigate falling objects

a fruit, a piece of paper, a small pebble, a ball, a leaf

Explore how levers may be used to help lift or move different objects
Design a simple method by which a bicycle may be moved over a few steps without lifting or dragging it
Design and make a balance (you may use paper plates, thread and stick)
Design and make a toy see-saw (you may use empty match boxes, a strip of cardboard and a pencil stub)
Investigate the pushing force of water on a mug or tumbler
Compare floating and sinking of various objects in fresh water and salt water
Making different kinds of paper boats (origami)
Design and make a float for an oil lamp or a candle

*Materials*

Properties and characteristics of materials

Investigate and identify a range of common materials in the immediate surroundings
water, air, wood, metal, rock, paper, fabrics, foods, plastics…
List them. Collect, label and display them appropriately

Recognise that materials can be solid, liquid or gaseous
Sort the collected materials into solid, liquid and gaseous
Describe and compare materials noting the differences in colour, shape, weight (light or heavy in terms of density e.g. heavy pebble, light feather) and texture

Distinguish between natural (raw) and manufactured materials
Note the difference between the properties and characteristics of natural (raw) and manufactured materials

Group materials according to their properties
Flexible, transparent, magnetic
Strength, shape, ability to muffle sounds, solubility
Perishable and non-perishable

Investigate how different materials are used for various purposes in day to day life

Materials and change

Heating and cooling

Investigate the effect of heating and cooling on a range of liquids, solids and gases by observing the demonstration carried out by your teacher or an adult
Effect of heating and cooling on water
Effect of heat (boiling) a potato in water
Find out why a chapati or roti puffs up while being fried
Plan and prepare an ice-cream

Investigate the suitability of various fabrics and clothes for different seasons
Recognise that some fabrics (as also their colour and thickness) keep us warm while some keep us cool

Investigate (under supervision) through experiment to establish which materials are conductors or insulators of heat
Explore ways in which liquids and objects may be kept hot or cold
Design and make a cover for a hot water bottle
Find out why travelers, during summer, carry water bottles with wet cloth covers. Why are such bottles (often seen) tied to the outside of the window of a train or bus?

Mixing and other changes

Investigate how materials may be changed by mixing
mixing and dissolving materials such as salt, sugar in water
Plan and make fresh lime juice for the class

Investigate the characteristics of different materials when wet and dry

Make a bowl with papier mache using a coconut shell as mould. Colour it when dry

Examine the change that takes place in materials when physical forces are applied

When materials are beaten, rolled out (chapati/roti), whisked, mixed, pulled, stretched, bent, squashed

Explore simple ways in which materials may be separated

Using sieves of varying mesh size

Using magnet

Using ruler charged with static electricity

Allowing sediment to settle in a jar of liquid.

Separating water and salt through evaporation (teacher demonstration)

*Environmental awareness and care*

Environmental awareness

Identify positive aspects of natural and manmade environments.

Observe, discuss and record the positive aspects of natural, rural and urban environments

Diversity of plant and animal life

Diversity in ways of life in rural and urban environments

Range of materials, foods, buildings, open spaces

Places that people enjoy frequenting and the reasons for these preferences

List some negative aspects of natural, rural and urban environments

Identify the interrelationship of living and non-living elements in your locality within various habitats

Plants, animals, water, air and soil

Investigate renewable and non renewable resources. Recognise their significance to all life on earth

Explore how actions of people impact environments

Planting and felling trees

Constructing buildings, roads and bridges

Careless disposal of wastes

Positive civic actions such as segregation of waste at source; colour codes for bins in public and community spaces

Appreciate the need to conserve resources

Explore various ways in which resources can be conserved

Make a paper bag with old newspaper

Collect unused sheets from old notebooks; make a scrapbook or workbook (you can use an old calendar or a greeting card to make an attractive cover for the book)

Prepare a list of various situations in public places where resources can be conserved e.g. turning off lights and fans before leaving the hall after a programme, closing unattended public water taps by the roadside, at bus stands and railway stations etc. Discuss what action we can take on this list.

Plan and have an exchange bazaar of reusable and recyclable collection of toys, clothing, colour pencils and paints, seeds, saplings, story books, board games…

Science and Environment

Explore and appreciate the application of science and technology in familiar contexts

In one's personal life – food, clothing, footwear, house, mirrors, toys, reading and writing materials

At home, on the farm, in the school, at the bazaar and in wider environments.

Identify some ways in which science and technology contributes positively to the life of people

Food and farming
Health and wellbeing
Clothing
Building and construction
Tools and appliances
Transport
Communication

Recognise and discuss human activities that have a positive or an adverse impact on the environment – on air, water, soil and natural spaces in the surroundings

Design, plan and undertake a team activity for a positive impact in your local environment

Draw up a personal management plan for wastes. Begin to understand the term bio-degradable (compostable)

Caring for the environment

Appreciate how fortunate we are to have such a beautiful home (the Earth) and all the natural phenomena around that make this home so beautiful

Collect pictures of various aspects of the natural and man made environment and make a large collage (in teams or one for the entire class)

Realise that there is a personal and a community responsibility towards caring for the environment

***Lower level 5***

*Syllabus*

*Living things*

*About self*

Develop a simple understanding of the structure and function of some of the body's major internal and external organs

Develop a basic understanding of the structure, function and care of teeth

- What are caries?
- How are caries formed?
- Foods that cause caries
- Prevention of caries and the care of teeth
- Oral hygiene and the correct way of brushing teeth

Investigate breathing

- Air contains a mixture of gases, including oxygen
- Appreciate the need for oxygen from the air
- The structure and function of the nose, windpipe and lungs
- How the lungs exchange gases during breathing
- The importance of clean, unpolluted air for good health
- Recognise the dangers of smoking and air pollution
- Design and make a facial anti-dust mask
- Visit a hospital to learn about lung related illnesses

Investigating sight

- The external structure of the eye
- Eye care – importance of taking care of the eyes
- Protecting the eyes from dust and flying particles

Ways in which the body protects itself against disease and infection

- The role of the skin

*Plants and animals*

Choose an area in your neighbourhood. Make a detailed study of the landscape. Study the plant and animal life, the soil, the water resources, natural recycling processes within the landscape, factors affecting the landscape. Distinct physical and biological attributes and the interrelationship between them. Use various methods to record and present observations e.g. drawings, pictures, charts, tables, models, collection of seed samples, soil samples, rock samples.

Identify the interrelationship and interdependence between plants and animals within given habitats. Their dependence and competition with each other for resources. Simple food chains and food webs.

Become aware of the sun as the source of energy for plants through photosynthesis. The role of chlorophyll. The necessity of light for life on the planet as we know it.

The role of roots in the absorption of water and nutrients from the soil. Transpiration and the role of stomata in leaves.

Observe and explore some ways in which plant and animal behaviour is influenced by or adapted to environmental conditions. Factors such as physical conditions and food supply. Use of colour and camouflage by animals.

Group and compare living things into sets according to their similarities and differences.

Become familiar with the characteristics of major groups of living things. Mammals, insects, worms, arachnids, molluscs, fish, reptiles, birds. Flowering and non flowering plants, fungi and bacteria.

Construct and use simple keys to identify locally occurring species of plants and animals. Learn about the traditional keys that elders in your locality use for classifying plants and animals.

Become aware of some of the basic life processes in plants. Nutrition, movement in response to light, movement in response to water, use of oxygen and carbon dioxide. Flowering, fruit and seeds.

*Light*

Learn that light travels from a source

Investigate the splitting and mixing of light.

Use a prism to create a spectrum. The rainbow
Mix coloured light using filters. Make a Newton's wheel

Investigate the refraction of light.

Why does a coin in water appear to be closer than it actually is?
Why does a stick bend in water?

Investigate how mirrors and other shiny surfaces are good reflectors of light

The effect of a flat shiny surface
The effect of a curved shiny surface
Design and make a periscope
Design and make a kaleidoscope

Explore how objects may be magnified using a simple lens

Investigate the use of lenses. Know that it is extremely dangerous to look at the sun through lenses
Design and make a model telescope
Be aware of the dangers of looking directly at the sun
Appreciate the gift of sight

*Sound*

Recognise and identify a variety of sounds in the environment and appreciate the importance of noise control

Understand that prolonged exposure to loud noises can cause deafness and mental stress

Explore how sound travels through air, water, solids

Identify materials that muffle sound

Reducing sound from machinery by mounting machines on rubber bushings, growing trees around mills and factories so that sound is absorbed, placing machinery underground to avoid noise to the surroundings, lining machine enclosures with sound absorbing material

The difference between music and noise

Appreciate the gift of hearing. Learn about caring for the ears. Know that it is dangerous to put oil in the ears or to use sharp things to clean the ears

*Heat*

Experiment with a range of materials to establish that heat may be transferred in different ways

Know that heat energy can be transferred in solids by conduction, in water and air by convection, and from the sun and any source in space (e.g. bulbs, heaters, hot surfaces, rocks, hot ceilings, sand etc) through radiation

Recognise a variety of sources of heat: renewable sources, nonrenewable sources, friction in mechanical movement

Know that in many cases, heat is accompanied by light

Learn to measure and record temperatures using a thermometer. Know the normal body temperature is 37°C. Temperature during a fever

*Magnetism*

Investigate how magnets may be made

By repeated stroking of a piece of iron or steel with a magnet in one direction

By passing electricity through a coil around a piece of iron or steel

Permanent magnets and temporary magnets: materials used for permanent magnets, materials used for temporary magnets

Common magnet shapes: bar, ring, horseshoe, disc

Explore the use of magnets to lift and hold objects

How magnets are used in door knobs, box lids, refrigerator doors, pin holders, display boards etc

*Electricity*

Investigate current electricity by

Constructing simple circuits using wires, bulbs and batteries

Using more than one bulb in a circuit

Using more than one battery in a circuit

Experiment with simple switches. Design a two way switch circuit

Make a small electrical bell using an electromagnet

Learn to fix a fuse

Record the number of units of electricity consumed in the home each day/week/month by looking at the electricity meter

Learn how some common electrical appliances work

Safety practices with electricity

*Forces*

How objects and materials may be moved

By machines using rollers, wheels, axles, gear wheels, chains and belts

By moving water, pumping

Using trapped air pressure (pneumatics)

Using trapped liquid under pressure (hydraulics)

Design and make working models of

A windmill, a waterwheel

Design a simple mechanism to spin a Newton's wheel

Levers

Examine how a steel rod can be used to move a large stone

Why is it very painful if your fingers get caught in a door?

Examine how a pair of pliers work

Design and make a lifting device that uses levers and gears

Friction

Explore the effect of friction on movement and how it may be used to slow or stop moving objects. e.g. bicycle brakes

Air resistance and streamlining of objects for smooth movement

Examples of streamlined bodies in nature e.g. fish

Examples of streamlined machines e.g. boats, cars, aeroplanes

Explore how friction can generate heat: by rubbing hands together, striking stones, rubbing a tamarind seed on the floor, sharpening tools

Gravity

Become aware that objects have weight because of the pull of gravity

Design and make a spring balance

Gravity as a force

*Materials*

Identify natural and manufactured materials in daily use

Group materials according to their properties.
e.g. Flexibility, transparency, magnetism, conductivity, insulation, strength, shape, solubility, perishable or non-perishable etc

Group materials according to their composition
e.g. soil containing silt, sand, clay, gravel
paper, plastic, metal, wood, fabric

Relating the properties of a material to its use
e.g. Clay – for making bricks and pots, metal for utensils, tools, machines, wood for handles and furniture

Materials can be changed by mixing e.g dissolving salt or sugar in water to make a salt or sugar solution

Exploring materials and liquids that do not mix. E.g. sand and water, oil and water etc

The effect of light, air and water on materials
Fading of fabrics in sunlight
Rusting of iron

Investigate the properties of materials when wet or dry

Changes when forces are applied :
Beating a sheet of aluminium
Squashing paper
Pulling a rubber sheet

Examine how the shape affects the strength of structures
A flat sheet of metal and a sheet with corrugations
A plank that is placed flat or on its side
The corrugations in a cardboard box

Recognise that a gas such as air occupies space, has weight and exerts pressure

Investigate how the atmosphere exerts pressure

Explore the effect of air resistance – dropping a feather or dry leaf and a marble or stone
The feather or dry leaf experiences greater air resistance

Make a kite and fly it

Recognise that some materials decay naturally while others take a long time

Biodegradable and non biodegradable materials

Environmental problems caused by non biodegradable materials

Materials that can be recycled

Air is composed of different gases such as oxygen, nitrogen and carbon dioxide

Become aware of some of the practical applications of these gases in everyday life

Use of carbon dioxide in fire extinguishers

Investigate where oxygen comes from in nature

Become aware of carbon sinks in nature

The greenhouse effect

What are greenhouse gases?

*Heating and cooling*

Explore what happens when materials are heated or cooled

Water changes from ice (solid) to water (liquid) to steam (gas) depending on the temperature

Expansion of water on freezing

Temporary and permanent change of materials on heating
Temporary changes: water to ice or steam
Permanent change: burning wood, cooking rice, frying a chapati

Investigate which materials are good conductors or bad conductors of heat
Identify building materials used in extreme weather conditions
Find out how heating and cooling can be used to preserve food
Recognise that oxygen is required for burning

*Ecosystems*

Interrelationship of living and nonliving aspects of a given place (habitat)
Ecosystem of a tree, a farm, a stream, hedges and fences. Learn about larger ecosystems such as forests, mountains, oceans and deserts
Become aware of the significance of the earth's renewable and nonrenewable resources
Investigate the different ways in which people use the earth's resources
e.g. agriculture, fishing, river systems for transport and generation of power
Mining, fossil fuels, timber
Come to appreciate the need to conserve nonrenewable resources
Investigate adverse effects of human activity on the environment

*Science in daily life*

Examine some ways in which science and technology have contributed positively to the use of the earth's resources, such as farming, transport, communication, health care, recreation
Use of science in familiar situations
Housing, clothing, electricity, cooking, telephone, computers, food preservation, dairy science
Scientists and their contributions

*Caring for the environment*

What we can do
Use energy without wastage
Recycle, compost, grow a vegetable garden
Identify and discuss a local, national or global environmental issue
Come to appreciate individual, community and national responsibility for environmental care
Understand the term sustainability

## *Gardening and pet keeping activities for young children*

Children by nature like to explore their surroundings by playing in the mud, picking flowers, leaves, twigs, catching insects, digging for worms, playing with cats, dogs, chickens, calves etc. Many a time adults with preconditioned notions about care suppress this natural instinct by dissuading them from these activities.

Below is a list of suggested activities to introduce children to gardening and getting accustomed to close contact with animals and pets. Children may explore these based on age, interest and ability.

*Planting and nurturing*

Vegetables and greens such as lady fingers, brinjals, chillis, beans, peas, spinach, radish, turnips, pumpkin
Fruits such as bananas, guava, chickoo, lemons, pineapples, cherry
Berries such as tomatoes
Flowers such as marigold, periwinkle, hibiscus, and local flowers
Herbs and medicinal plants such as mint, lemon grass, brahmi (pennywort), tulsi (holy basil) etc
Tubers, bulbs such as potato, sweet potato, ginger, turmeric, onion, garlic and nuts such as peanuts etc
or greens such as spinach, methi (fenugreek), amaranth etc
Tending a vegetable patch
Germinating seedlings in a tray
Transplanting seedlings
Making compost

Vermiculture and vermicompost
Growing a timber tree, a fruit tree, bamboo
Seed collection, selection and preservation
Keeping a seed collection
Keeping a herbarium
Making a collection of rare dry fungi and mushrooms

*Garden diversity*

Growing varieties of plants to maintain diversity and balance
Maintaining purity of seed

*Reproduction and selection of traits*

Self and cross pollinated plants
Agents of pollination – the role of insects and birds
Selection of traits
Selective pollination by humans for trait selection, hybrids, pure lines
Dispersal of seeds and agents of dispersal
Grafting

*Garden implements*

Handling and care of garden implements. Safety practices

*Nutrient inputs and pest control*

Making different types of nutrient inputs such as panchagavya, fish and lemon solution, bio dynamic solutions, vermiwash, garlic and chili solutions

Biocontrollers

*Pet keeping*

Keeping an aquarium
Keeping a terrarium
Keeping ants and termites
Keeping a cat, dog, chickens, ducks, tortoise, hamsters, white mice etc

*Soil*

Tending the soil
Vermicage - the study of earthworms

*Water*

Learning about water requirements of various plants

*Weather*

Learning about conducive weather conditions and seasons for various gardening activities
Keeping weather records
Predicting weather

# RESOURCES

*Lower Level*

1) *Let's Discover Science* Books 1 to 5 by David Horsburgh. Available as a free download from www.arvindguptatoys.com. Copies for reference are available with Taleemnet and Vikasana School, Bangalore.

   This book is a careful and systematic introduction of science and the scientific method to children at the lower level. Sound pedagogy.

2) *Children's Britannica Nature Trail Series* published by Usborne Publishing Ltd, London in the late 1970s served as excellent books for introducing young children to nature study. Written more on the lines of a field guide, it enthuses children to take up nature study. Presently out of print. A sample copy of one of the books in the series – *Ponds and Streams* is available for reference at the *Taleemnet* library. It is strongly recommended that parents and teachers make an effort to source such books.

3) *UNESCO Sourcebook for Science in the Primary School* (Teacher resource that adopts a workshop approach to teacher education).Free download available from the link below:
   www.arvindguptatoys.com/arvindgupta/unescoprimary.pdf

*Lower Level and Middle Level resources*

4) *The green sprout journey* by Satoko Chatterjee published by Earthcare Books, Kolkata, 2009 is the story of a mother trying to stimulate environmental awareness in her two children within the space of their home and garden. The book is a store house of diligent recording of observations by her children. It outlines in detail various activities that can be used to initiate children into gardening and related activities which would serve them well in later years in farm related activities and responsible citizenship.

5) *Satpada: Our World of Insects* by Rebecca Thomas and Geetha Iyer, published by Rishi Valley Education Centre, Krishnamurti Foundation, 2009. Written by teachers of biology with several years of experience, this book introduces the children to the wonderful world of insects.

*A note on www.arvindguptatoys.com*

This website contains downloadable resource material in pdf, word and video format on a wide range of topics covered in school level education. There is much material that encourages children to learn through experiments by making their own toys, tools and equipment using everyday material, mostly scrap and waste. Arvindgupta's own books written for children bring in the play element into the understanding of many natural phenomena and laws of nature

Before beginning to look for learning resources for almost any topic in school education, it would be worthwhile to become familiar with what is available on this website. It is very likely that one may not have to search further for good material. This website is being constantly updated with more and more resource material. CDs are available from Arvind Gupta directly. He may be contacted by email at arvindguptatoys@gmail.com.

**Anand Niketan, Sevagram, Maharashtra**

Anand Niketan is a Nai Talim heritage school within the Sevagram Ashram premises at Sevagram (Wardha). Nai Talim institutions were started in India based on Gandhiji's

philosophy of education. Gardening, Charaka work, needle work, cooking, cleaning the premises are all integrated into the curriculum. Their unique curriculum has been developed by the school head, Shushama Sharma (in picture to the right) and her team of teachers based on years of experience.

The pedagogic emphasis is on balanced development of head, hand and heart. The basic (Nai Talim) curriculum is designed around

basic necessities of human beings in the local context.

Thus the work and craft included in the curriculum are-

1) Gardening and farming

2) Art of cloth making- spinning, stitching and embroidery

3) Food and nutrition

4) Understanding machines of everyday use- the bicycle and the sewing machine

Addition of a few more crafts like weaving, paper making and carpentry are also being thought of. Music, drawing and painting, clay work etc. are included in the Art curriculum.

**A day at Anand Niketan: pictures say it all !**

# GEOGRAPHY

In studying geography it is expected that the student will develop a sense of location, understand the distinctive natural, agricultural and human features of his/her locality (and beyond) and the inter dependence between these features. The student should develop an intuitive understanding of the weather and the environment with special emphasis on the cyclic pattern of physical and biological processes in nature. He /she should become adept at the use of basic instruments for making observations related to the weather and to interpret these observations with respect to farming. The student should be able to read maps and to create his/her own maps to convey matters related to a farm or any other geographical feature.

The study of geography has become especially important for people whose life and livelihoods revolve around the land because of the present conditions of climatic uncertainty. It is important that children from a young age have a sound grip on the understanding of weather patterns and natural physical phenomena related to the weather.

Each eco-region has its unique geographical and climatic features that determine agricultural practices. There is abundant area specific traditional knowledge available within communities. This knowledge is usually passed on as practices. Young students stand to gain from this knowledge if they actively participate in local practices and events. A systematic study of the subject will strengthen this knowledge while providing a scientific rationale to the many traditional practices relating to the weather and the land. While many good books are available, the internet too is a valuable resource to stay updated on topics of contemporary relevance specially related to the climate crisis and its implications for agriculture.

***Lower level 1 and 2***

*Human environment*

*Living in the local community*

My family and community

Explore and discuss the student's role and that of others in the family, school and local community

Begin to recognise the interdependence of individuals and groups in the local community

People we rely on for various things

People encountered in stories, pictures, on television programmes

Homes and shelter

Recognise that people live in a variety of homes

Describe your home, its location and surroundings

Record some of these features using simple drawings

Investigate materials used to construct homes

Discuss and record journeys to and from homes in simple terms

Develop an awareness and appreciation of different types of homes in the locality and in other areas

Houses, farmhouses, cottages

People at work

Investigate the work of people in a range of locations in the locality

Home, schools

Shops, farms, artisan crafts, offices, factories

Hospitals, bus stops, railway stations

Restaurants, local places of interest

Investigate the work of people involved in transport and communication

Discuss and record in simple words the buildings and places where people work in the locality

Discuss and record in simple words journeys to work places by members in your family

People at play

Appreciate the roles of people who help at play

Family and friends

Dance and drama teachers and sports coaches

People and places in other areas

Become familiar with some aspects of the lives of people and especially of children in other areas

Appreciate ways in which people in different areas depend on one another and on people living in other places far away

*Natural environments*

The local natural environment

Identify, explore and discuss aspects of some major natural features in the local environment

Names, location of features such as hills, mountains, rivers, lakes, beaches

Observe, discuss and investigate water in the locality

Observe and record relationship between rainfall, puddles, drains and streams

Investigate how water can move materials of different sizes and weights in simple experiments, in ponds and streams

Learn about water and its uses

Observe, collect and investigate a variety of natural materials in the local environment
collect and examine soil, mud, sand, pebbles, stones and rocks
compare and contrast samples and group them into broad sets (e.g. sand, stones, plant material)

Investigate qualities of materials (e.g. hard or soft, colour, texture, wet or dry)
Recognise that soils and rocks are habitats for living things such as worms, lichens, insects, small animals

Record and communicate experiences and observations using simple drawings, models and sketches

*Weather*

Observe and record varying weather conditions using appropriate vocabulary and simple equipment
Begin to associate cloud cover and other conditions with different types of weather
Begin to make and test simple weather predictions
Identify ways in which weather influences the lives of people, food, clothes, homes, games, farming and other work, travel
Observe and record the influences weather and seasonal changes have on people, animals and plants in the locality
Contrast weather in the locality with that in other areas you may have visited

*Planet Earth in space*

Eecognise the sun as a source of heat and light
Identify the sun, the moon, stars, day and night
Develop familiarity with the spherical nature of the Earth

***Lower level 3, 4***

*A sense of location*

Explore and become familiar with some of the distinctive human and natural features of the locality and other nearby places
- People and communities living and working in the area
- Major natural features
- Settlements: homes, other buildings, open spaces
- Economic activities, workplaces
- Transport and other links between these features

Develop some awareness of the distinctive human and natural features of a place you like

Develop an understanding of the relative location and size of major natural and man made features
- The major features of the locality you belong to

Recognise the relationship between the movement of the sun in the sky and directions

Become aware of terms of direction: East, West, North, South.
- Draw a map of a small part of your locality and mark the directions.

Using pictures, maps and the globe

Develop some familiarity with and engage in practical use of maps and photographs of different scales and maps for different purposes
- Plan of a room or building
- Reading maps that come with models and toy houses
- Reading maps and aerial photographs of familiar areas
- Reading road maps of the locality

Develop an understanding of and the use of some common map features
- A sense of aerial perspective
- Symbols (e.g. roads, railway lines, rivers and water)

Make simple maps of home, classroom, school and the immediate environment

Learn to find places on the globe and on a map

*Geographical investigation skills*

*Questioning*

Ask questions about natural and human features and processes in the environment and their interrelationships
- What makes this place different from other places?
- How does the farmer use this land?

*Observing*

Observe, discuss and describe natural and human features and processes in the environment and their interrelationships
- Shapes and sizes of natural features
- Colours and textures of buildings, farms and landscapes

*Predicting*

Offer suggestions (hypotheses) based on observations about the likely results of an investigation.

*Investigating*

carry out simple investigations and collect information from a variety of sources
- observations in the environment, photographs, books, maps etc

*Estimating and measuring*

Use appropriate simple instruments to collect data
- Improvised rain gauge, compass, wind vane

Use appropriate standard units of measurement

*Analysing*

Sort, group and/or classify data on, features, events and natural phenomena using a range of appropriate criteria

- Types of plants on a farm
- Types of shops or buildings in your town

Look for and recognise patterns and relationships in the environment

- Seasonal patterns in weather observations
- Best places for growing plants in a garden
- Water and land masses on maps

Interpret information and offer explanations e.g. why does water flow in a river even a few months after the rains have stopped?

Draw conclusions from suitable aspects of the evidence collected e.g. the difference between the same variety of a plant growing in the shade or in the sun

*Recording and communicating*

Record and present findings and conclusions using a variety of methods including oral and written form and through pictures and drawings

*Human environments*

*People and communities*

Learn about people and communities who live and work in the locality

- How people help each other and depend on one another
- Local organisations and their roles
- Links with people in other places outside your town

*Natural environmental features and people*

Become aware of the natural features in the locality

- Prominent natural features e.g. river, hill, sea, flora and fauna
- Interrelationships of natural features and the lives of people
- Names of places and the origin of these names

*Settlement: homes and other buildings*

Explore, investigate and come to appreciate the major features of the built environment in the locality

- The home, its location and surroundings; the variety of homes in the area (e.g. houses, huts, farmhouses, cottages)
- Homelessness
- Other buildings and human features, their location and uses (e.g. farmhouse, farmyards and fields, de-husking mills, shops, offices, other places)
- Materials used to construct homes and other buildings
- Colours, patterns and textures in buildings, path, road and street surfaces
- Services to homes and other buildings (e.g. water supply, sewerage, electricity, cable television, telephone service)

*People at work*

Explore and investigate through practical studies a few of the common economic activities of people in the locality

- Food and farming, fishing and forestry
  - Environment and work of primary producers, products, markets
- Industry
  - Work of factory, raw materials and products, markets, need for transport and communications

Services

Services available in the locality (e.g. shops, health care, water, sewerage, telephone, power supply)
Work of people involved in the supply of services

Tourism

Local attractions and facilities
Work of people involved
Caring for and enhancing local attractions and facilities

*Transport and communications*

Become aware of forms of transport and transport routes in the locality
Become familiar with the communication methods available
Investigate the work of people involved in transport and communications

*People*

Study some aspects of the environments and lives of people in your locality and

Location of these areas
People that live there
Language(s)
Myths and stories, art and culture
Clothes
Play and recreation
Features of the natural environment
Interrelationships of the lives of people and these features
Settlements: homes and other buildings
Foods and farming
Work and work-places

*Country*

Develop some knowledge of the relative location of the country and neighbouring countries
Develop an awareness of the interdependence of nations
Begin to develop a sense of belonging to the local community, nation
Responsible behavior towards others and common resources

*The local natural environment*

Investigate and become familiar with some natural features in the local environment aspects
Such as names, locations relative to other features, shape and appearance; flora and fauna
Streams, rivers, hills, valleys, mountains, lowlands, beach, bay, headland
Estimate distances and establish the cardinal directions during the exploration of these features

*Land, rivers, mountain and seas*

Become familiar with the names and locations of some major natural features in the country rivers, plateaus, mountain ranges, forests, seas
Observe and explore ways in which these features have affected the lives of plants, animals and humans
Influence of a hill or a stream or a river on transport, roads and bridges, towns and cities the stream, mountain, beach etc. as a habitat for plants and animals
Investigate the ways in which these features have been used by humans and the changes
Which have occurred as a result

Land for farming activity
Supply, treatment and distribution of water from rivers and lakes to homes in the area

Develop some familiarity with the relationship of these features with each other

Sources of rivers in mountains
Roads, railways and bridges over rivers
Towns built near bays or rivers

*Rocks and soils*

Observe, collect and examine different soil samples in the immediate and neighbouring environments

Sort and group constituent materials in samples as rocks, pebbles, sand, plant material

*Weather, climate and atmosphere*

*Weather observations*

Use simple equipment to observe and record weather phenomena

Simple cloud types, temperature, rainfall, wind direction

Examine satellite weather photographs on newspaper, television or the internet

Record and display simple weather observations in systematic ways using charts and common meteorological symbols

Use analysis of weather recordings to begin to associate simple descriptions of clouds, amount of cloud cover, wind direction and other conditions with particular types of weather: Make and test weather predictions

Compare temperatures indoors and outdoors, in shade and sunlight, on different sides of the same building, and explore reason for differences

Begin to explore the influence of types of soil, rivers, lakes on farming activity.

*Weather and climate*

Study climate variations during the year and their influence on plants, animals and humans

Begin to appriciate the importance of solar energy for the Earth

Develop some awareness of weather and climate patterns and their relationship with plant, animal and human life in a few environments in other parts of the country and the world

Collect and record weather lore from the locality

*Planet Earth in space*

Observe, describe and record the positions of the sun when rising and setting and the changing lengths of day and night during seasons

Investigate shadows and their directions in relation to the position of the sun

Understand the importance of sunlight for plants and animals

Begin to understand the influence of the sun on weather conditions

Become aware of the dangers of too much exposure to direct sunlight

### *Lower level 5*

*Natural environments and farming patterns*

Farming patterns depend on the physical features of the land, the soil, the weather and availability of water. These parameters vary from region to region.

Make trips to a local market, list the types of grain, vegetables and fruits. Then find out where each of them comes from, the kind of conditions necessary to grow them. Find out the time of the year when these foods are harvested. Based on these findings, look at the map and identify the locations from which these foods come. Name the type of climate and natural conditions in these areas.

*Features of the land in the neighbourhood*

Collect samples of various types of rock in the area. Identify and become familiar with some of the characteristics of these rocks. Classify them into igneous, metamorphic and sedimentary rocks. Identify rock types such as granite, lateritic stone, quartz, shale.

Find out how these rocks are used locally – e.g. in the construction of houses, roads, bunds and check dams

Collect samples of various soils in the area

Germinate green gram or any pulse seeds in each of these soil samples

Identify what grows better in each type of soil keeping the factors of water and sunlight constant

Design an experiment to find the characteristics and water retention capacity of the various soil samples

*Weather and climate*

The difference between weather and climate
How hot or cold?
Measuring temperature using a thermometer
How much rain? Measuring rainfall – using a rain gauge
Wind directions during different seasons
Design and make a weathercock
Investigate the relationship between the type of clouds and rain

*Water*

Explore the various water bodies in the neighbourhood. Are these perennial or seasonal?
Identify the source of water in these bodies.
During which period of the year and for how long is water scarce?
When is water more abundant and for how long?

*Maps and getting familiar with maps*

Identify your location on a map
Identify north, south, east and west on a map.
Locate well known places around our location
Locate the major cities in India
Locate the major cities of the world
Locate some countries that you have heard of
Look at a map showing physical features
What does a physical map show?
What do the colours on the map indicate?
Get used to the colours of a physical map and learn what the colours indicate. e.g. Blue shows water bodies, dark green shows the lowest plains, lighter shades of green indicate higher plains. Grey or brown indicate mountain ranges

Take a look again at the map showing your location
Learn to identify hills and plains, rivers, lakes, seas and oceans on a map
Identify mountains and mountain ranges in India
Understanding map scales
On the map measure the distance in cm to main towns or cities nearby
Find out in km, the actual distance of your location from these main towns or cities
Learn about scale. What does 1 cm on the map represent in actual distance
Understanding altitudes
Find out the altitude of your place on the map or at the railway station
Find out the altitude of a few places around your location on the map
Altitude as measured from sea level. Sea level is taken as zero

*Note*: Maps must be studied as far possible in horizontal positions by placing them on a table or on the floor.

# RESOURCES

1) *Learning about Living Books 1 to 5* by David Horsburgh. Published by Oxford University Press, the book is presently out of print. A book of environmental studies dealing with every aspect of the child in its environment and eventually in the environment of the whole world. It sets a sound foundation in social aspects that make for responsible living. Being an activity based book, it lays the foundation for learning geography. It also sets a good foundation for environmental and social science.

   A reference copy is available with Taleemnet and Vikasana School, Bangalore. Some of these books are available as a free download from www.arvindguptatoys.com

2) A good atlas is a very important resource when studying geography and must be used extensively. Topographic sheets are available from the Survey of India. www.surveyofindia.gov.in

3) The website www.earth.google.com may also be used in the study of geography.

4) National Geographic and Discovery TV channels regularly air programmes on geography. Their websites are rich sources of information. CDs and DVDs on various topics are also available.

## Niranjana Maru

Growing trees and green bio-mass are critical for dry land farming specially when rainfall is scanty and water runoff is high. Soils need to be built and water requires to be retained. The dry land areas of central Maharashtra with the land layout being medium slopes, fieldbased water shed approach with construction of contour bunds, graded contour bunds, drainage channels and gully plugs have proved highly efficient for soil and water management. The technique of marking contours, constructing bunds and gully plugs requires simple tools and skills which can easily be mastered by children. The cost for such work is to an extent dependent on the slope of the land. As a thumb rule a gradient of 0.2% is maintained by marking graded contours in medium slopes. An 'A-frame' is used for marking contours with high gradient of over 10%. A possible hitch to the watershed based approach is the fragmentation of fields. However, residual moisture because of this treatment to the land is able to sustain post monsoon crops such as pulses and cotton for as long as 35 days. The best benefit is that the top soil is not eroded.

Niranjana Maru expains dryland multicrop agricultural practices

Dusting branches of legume plants for pest collection. Technique developed at Chetana Vikas, Wardha, Maharashtra.

## Jacob Nellithanam

Crops are dynamic, diverse, evolving, and carry within them a potential to evolve. Farmers can look for solutions within their own existing systems within regions within their proximity as clusters of places have similar practices. Putting back indigenous seeds into their farming practices also means putting back knowledge. The word tradition has a problem, because of the feudalistic way of functioning and the caste system that prevailed. Reclaiming their skills, implements, ecosystems should be facilitated.

How one brings this into education is an issue that will need applying some thought. It is easy to reclaim many of these things. One can begin with seeds, let farmers become seed breeders. This can be easily imbibed by children. Women play a crucial role in keeping seeds and many farming activities. Children can learn easily as part of growing up. There is enough science in traditional knowledge. Education can facilitate its application.

Jacob of the Richharia Campaign

Do the actual selection with farmers. There is no dearth of diversity, in spite of so many years of the state promoting chemical farming. Dr Richharia, Vijay Jardhari have shown that it can be done. Hybrids should be discouraged. There are thousands of traditional varieties of paddy with traits of resilience to varied conditions, this should be highlighted. Same with millets, cotton and so on. Value to traditional knowledge is not given by the community, nation-state or NGOs. Stable varieties need to be selected. The community of agricultural scientists has always moved at a tangent from what is there within our systems and what can be facilitated, improved, promoted. Just because we have learnt some science, it does not mean we have to apply it.

Ultimately the aim is to base agriculture on ecologically sound practice. In today's condition of instability on a global scale on several fronts, it is crucial to work towards keeping knowledge alive, gene pools alive, diversity alive. This only farmers from egalitarian communities can do. It is essential to rebuild and nurture such communities and within them their children.

# BIOLOGY

***Middle level 1***

*The plant kingdom*

Classification of plants based on size and external characteristics
Trees, shrubs, herbs, creepers and climbers, ferns, mosses and fungi – salient features, characteristics and habits

Classification of plants as flowering and non flowering plants
Gymnosperms and angiosperms – salient features and characteristics

Parts of a typical plant
The stem, trunk, branches - their parts, structure and function
The leaf - shape, structure, parts and function
The roots – shape, structure, parts and function
Sprouting bean seeds to study germination, the root and the shoot system
The flower – parts, structure, function, role in pollination and fruit formation
The fruit – parts, structure, variety, size and function
The seed – the dicot and the monocot seed, parts, structure and function

Dispersal and seeds, the role of seed dispersal in propagation of plants, types, dispersal agents in nature

Traditional methods of seed keeping and seed exchange, their benefits and advantages

Pollination, the importance of pollination in obtaining quality seeds, types, pollinating agents in nature. Natural and artificial pollination
Local common plant propagation practices
Local common practices of pollination with human assistance
Local crops, edible plants, fruit and tubers, medicinal and aromatic plants – salient features, method of growing and their use
Local trees wild and planted by the forest department or the community – salient features, method of growing and their use
Local fodder plants – salient features, method of growing and their use

*The animal kingdom*

Classification of animals based on size and external characteristics and habits
Land or water dwellers, habits of movement, diet, wild, feral, domesticated etc.

Classification of animals as with and without a spinal chord
Chordates and non chordates

Salient features of some animal groups
Microscopic animals
The corals and anemone family
The annelids and the worm family
The insect and spider family
The crab, scorpion and star fish family
The frog and toad family
The fish family
The snake, lizard, turtle family
The birds
The mice and rabbits; dogs and wolves; cows and bison; zebras and horses; sheep and goats; deer and antelopes; pigs and boars; elephant and giraffe; monkey; chimps and man

*Food*

Why do we need food, why do all living things need food?
The ingredients in our food come from natural sources

Listing the ingredients in some everyday foods e.g. idli contains rice, black gram, salt and water, chutney contains coconut, chili, mint, ginger, salt, cumin and water, ice cream contains milk cream and sugar

Food is prepared using various ingredients of plant and animal origin

Food is prepared using various cooking techniques such as boiling, steaming, baking, frying, roasting etc

Cooking of food requires energy from wood, gas, electricity etc

What is the need to cook some foods before consuming them?

The source of our food materials

- Plant parts are ingredients of food
- Not all parts of a plant are edible
- Animal parts as food ingredients
- Not all parts of an animal are used as food
- Humans also use animal products such as milk and honey as food
- Humans also use certain minerals such as salt in their food

Processes that enhance the value of foods

- Fermentation of dough for breads, idli and dosa
- Sprouting of pulses
- Fermentation of milk to make curds, butter, ghee
- Fermentation of fruit to make wines and alcohol

Types of nutrition from foods –brief investigation

- Carbohydrates – energy providers
- Proteins –builders of muscle
- Fats –storing energy
- Minerals –builders of bones
- Vitamins –suppliers of vital substances of smooth bodily functions
- Simple tests to test for carbohydrates, proteins and fats in foods

The importance of roughage, water, minerals and vitamins in the daily diet

The importance of a variety of foods in the diet for proper growth and health of the body

Ill health caused by deficiencies in the daily diet

- Various vitamin deficiencies in the diet
- Various mineral deficiencies in the diet

Obesity, malnutrition, nutritional anaemia and food allergies

The importance of maintaining cleanliness and hygienic practices while cooking food and during meal times

The importance of a pleasant and cordial atmosphere during meal times

The balanced intake of nutrients – its importance to good health

Energy from foods

*The human body and its functions–a brief investigation*

The human body acts through coordination of all its systems as a single unit

- The sense organs – our windows to the external world
  - Structure and function of the various sense organs
- The brain and spinal chord – the control house of the body. Structure and function
- The circulatory system. Structure and function
- The respiratory system. Structure and function
- The skeletal and muscular system – gives shape to the body and helps in movement of the body. Structure and function
- The digestive system. Structure and function
- The excretory system. Structure and function
- The reproductive system. Structure and function

*The Building blocks of all living things*

Cells, tissues, organs, organ systems and organisms

*Characteristics of all living beings – a brief investigation*

Need food and rest
Grow
Respire
Respond to stimuli
Excrete
Reproduce one's own kind
Move
Instinct to survive
Try to adapt to new situations
Perish after a time

*Living organisms and their surroundings – a brief investigation*

Habitat and adaptation to a particular habitat

Aquatic

Saline and fresh water, in rivers, ponds, lakes and oceans

Terrestrial

On land, arboreal, under the soil, in burrows and nests

*Clothing and fibres*

Fibres from plants and animals – various types and how they are obtained

Clothing

For protection from the elements
Different clothing for different purposes and seasons
The value of a neat appearance in clothing

*Keeping a kitchen garden*

*Keeping the kitchen garden diary*

***Middle level 2***

Levels of organisation and their general characteristics
- Lower level
  - Molecular, cellular, tissue, organ, system, organism or individual
- Higher level
  - Aggregate colonies such as corals, hydra, yeast spores etc
  - Species, Family, community, populations
  - The biotic community; ecotypes, endemic and exotic species
  - Social life of insects (honey bees and termites)
  - The ecosystem, biome, the biosphere

*Nutrition and sustenance*
- Types: halophytic, holozoic, autotrophic, heterotrophic, semi or partial parasitic, saprophytic
- Photosynthesis- the primary source of all sustenance
  - The process of photosynthesis
  - The role of chlorophyll, water, minerals and sunlight

*Control and coordination in animals*
- Stimulus – response
- External and internal stimuli
- Reflex action and responses
- Organs involved in coordination in humans
- Mechanism of response coordination in humans
- Chemicals involved in coordination

*Growth in animals*
- The chemical and physical processes involved in growth

*Coordination of response in plants*
- Chemicals involved in coordination
  - Auxins, cytokinins, gibberllins and their action in plants
- Growth in plants
  - Annular growth rings and its significance, cambium and wood

*Movement and response coordination in plants*
- Tropisms: geotropism, phototropism, thigmotropism, hydrotropism, chemotropism

*Locomotion in animals*
- The role of cilia, antennae as sensors guiding movement and as navigation guides
- Locomotion in amoeba, leech, earthworm, snails, snakes
- Echolocation in bats, migration routes and periodic rituals in birds, animals and insects
- The role and function of muscle, tendon and bones in locomotion

*Reproduction*
- Asexual reproduction in lower plants and animals
  - Binary and multiple fission, budding, fragmentation, spore formation
- Vegetative reproduction in plants
  - Runners, tubers, rhizomes, corms, buds at leaf axils, leaves
- Artificial propagation
  - Grafting, cuttings, layering, tissue culture
- Sexual reproduction in plants
  - The flower – the bearer of the sexual units (gametes) of a plant
    - Familiarization with the parts of a flower and types of flowers
    - The gametes
    - Pollination, agents of pollination, types of pollination
    - Fertilization and formation of the zygote
    - Seed and fruit formation, germination of seeds
- Reproduction in animals
  - Asexual reproduction
    - Spore and bud formation, regeneration of some lost body parts
  - Sexual reproduction – brief investigation

In worms (earthworm), insects, fish, amphibians, reptiles, birds and mammals

*Food and Nutrition*

- What is nutrition and what are nutrients?
  - Energy giving, body building and protective foods
  - Energy in calories in different foods
  - Energy consumption by the body in relation to activity and body weight
- Maintenance of food quality
  - During storage – various types of processes of food storage
  - The importance of hygiene during cooking, storing and consuming food
  - Food poisoning and transmission of food and water borne diseases
  - Loss of nutrients during cooking
  - The proper way to cook various foods to retain maximum nutritional quality
  - Preservation of food
  - Food wastage and its prevention

*Health and disease*

- Principles of good health and factors affecting it
- Good health
  - The value of taking wholesome food, keeping regular meal times
  - The importance of selecting fresh and clean food stuff for cooking
  - The importance of cleanliness of person, food and surroundings
  - Vaccinations and inoculations as preventive measures against disease
  - The value of recreation, exercise and creative hobbies for overall wellbeing
- Factors affecting health
  - Diet and nutritional deficiency related
  - Air borne diseases
  - Water borne diseases
  - Food borne diseases
  - Stress
  - Addictive and narcotic substances
- Some common diseases – a brief investigation

*Farming*

- Introduction to organic farming
  - Local agricultural practices
- Soil as a living system
  - Soil micro fauna and flora, the living nature of soils
  - Composting, vermiculture
- The cow
  - The significance of cattle to farming activities
  - Farming related services from the cow
  - Keeping the cow-house
  - Care of the cow, feeding and fodder
  - Milk, cow dung and cow urine - its various benefits to the farm and the farming family
- Water
  - Water cycle in nature
  - Water as an essential component of all farming activities
- Weather
  - Local cropping patterns based on weather conditions
  - Local weather conditions - its role in farming
- Harvesting and post harvest practices on the farm
  - Keeping a kitchen garden
  - Keeping the kitchen garden diary

Note: For resources see page 140

***Upper level 1, 2, 3***

*Cells*

- General characteristics of all living things
  - They are made up of cells, feed, grow, respire, move, reproduce, excrete and are sensitive to stimulus
- Structure and parts of a typical animal and plant cell
- Similarities and differences between plant and animal cells
- Cell organelles, their structure, function and composition
- Cells and organisms
  - Specialised cells perform specialised functions
  - Organisation of cells based on function
  - Tissues, organs, organ systems, organisms

*How animals feed*

- Nutrition, what is autotrophic and heterotrophic nutrition
- Animal diet (with particular reference to humans)
  - Carbohydrates, its composition and types
    - Testing food for carbohydrates
      - Benedict's solution test for presence of simple sugars
      - Iodine solution test for starch
    - Animals get energy from carbohydrates, how?
  - Proteins, its composition and types
    - Testing food for proteins – the Biuret test
    - Proteins are needed for growth, repair and fighting disease, how?
    - Muscle, hair, finger nails, haemoglobin are all proteins
  - Fats, their composition and types
    - Testing food for fats
      - The emulsion test
      - The grease spot test
    - Animals store energy in fats, how?
    - Fats are needed for energy and for keeping warm (insulation)
  - Vitamins, minerals, water, roughage
    - Their composition, requirements by animals
    - Consequences to health in case of deficiency
  - Balanced diet
    - The need for a balanced diet, the need for variety in foods consumed, cooked and uncooked foods in the diet
    - Starvation, malnutrition and obesity
    - What comprises a balanced diet?
- Digestion
  - The need for digestion of food.
    - Not all foods need to be digested – simple sugars, water, vitamins, minerals are absorbed as they are
    - Mechanical and chemical digestion
  - Enzymes
    - Enzymes are biological catalysts
    - Properties of enzymes, types, function. Ideal conditions for optimal function of enzymes
  - Digestion in humans
    - Holozoic nutrition in mammals
    - Teeth
      - Structure of the tooth, types of teeth in humans, sets in a life time
      - Plaque, tooth decay, gum disease
      - Care of teeth, prevention of tooth decay and gum disease

- The alimentary canal – digestion processes in various parts of the alimentary canal
- Salivary glands, saliva and the partial breakdown of carbohydrates
- Pancreas, pancreatic juice and breakdown of carbohydrates and proteins
- Bile juice and the emulsification of fats; chyme, pepsin and hydrochloric acid in the stomach
- Absorption, the role of villi and colon
- Appendix and appendicitis. Tonsils and tonsillitis
- Egestion- undigested food, rectum, anus and faeces
- Assimilation of food–role of the liver

Digestion in other mammals – herbivores and carnivores

- Dental structure in herbivores and carnivores
  - Herbivores have loosely linked jaws
  - Bacteria help herbivores to digest cellulose
- Feeding and digestion in some farm animals such as bovines, sheep, pigs, poultry, fish, earthworms etc
- Feeding and digestion in some common farm animal parasites and human parasites
- Problems associated with the vermiform appendix

Heterotrophic nutrition

- Amoeba feeds by phagocytosis and digests food intracelluarly
- House flies cover their food with saliva
- Butterflies and mosquitoes use sucking mouth parts
- Locusts use jaws to crush their food
- Fungi feed saprophytically
  - Hyphae and mycelium, moulding in bread
- Some saprophytes are harmful – salmonella
  - Bacteria are affected by temperature

Good hygiene practices to prevent food spoilage/poisoning

- Some methods of food preservation – sun drying, freezing, freeze drying, smoking, salting, pickling, as jams and preserves, vacuum packing, pasteurization

*How green plants feed*

Autotrophism

Photosynthesis, role of sunlight and chlorophyll, production of glucose
Leaves the food factories in plants
Structure of a leaf, function of various cells and components observed in a transverse section of the leaf
Structure of chloroplast and stomata
How do leaves obtain carbon dioxide, water and sunlight
Adaptation in leaves to carryout photosynthesis

- Looking at the epidermis of a leaf under the microscope
- Making a nail varnish impression of both the leaf surfaces for observation under the microscope

Glucose is used by plants in different ways

- For release of energy
- Stored as starch
- To make other organic substances like carbohydrates, proteins, oils
- Transported to other parts of the plant as sucrose

Mineral salts (elements) taken by plants from the soil – nitrogen, sulphur, phosphorus, magnesium, iron, potassium. Their need, deficiency caused in their absence

Photosynthesis experiments

- All experiments need controls

Plants used in photosynthesis experiments must first be destarched
Testing a leaf for starch with iodine solution
Tests to find out if light, chlorophyll, carbon dioxide are necessary for photosynthesis
Test to show that oxygen is released during photosynthesis
Factors affecting the rate of photosynthesis- sunlight, carbon dioxide, temperature, stomata
Light and dark reactions

*Diffusion and Osmosis*

The property of random movement of ions, atoms and molecules
Examine the movement of potassium permanganate crystals in a glass of still water
Diffusion is important in living organisms for gas exchange, transfer of micro molecules of nutrients and excretory products from one location to another
Osmosis through membranes
Cell membrane is selectively permeable
Osmosis and animal cells
Find the effects of various solutions on animal cells
Osmosis and plant cells
Find the effects of various solutions on plant cells
Observe osmosis using chicken eggs, a potato trough

*Respiration*

Respiration releases energy from food
Sugars release energy when oxidized (combine with oxygen)
Peanuts release energy when they are oxidized
The respiration equation
Aerobic respiration
ATP (adenosine tri phosphate) stores energy within the cell, advantage of such a strategy
ATP is made within mitochondria
Heat is produced during respiration. Carbon dioxide and water are the bi-products of respiration
The respiration in yeast is anaerobic; the respiration equation
Use of yeast in brewing and bread making; fermentation
Gas exchange occurs at respiratory surfaces
In amoeba across cell membrane
Large organisms need transport systems and larger surface area for gas exchange- gills in tadpoles and fish, lungs in humans
Earthworms exchange gases through the skin
The need for thin moist surfaces for gas exchange
Respiration and the process of gas exchange in humans
Comparing the carbon dioxide content in inspired and expired air
Pranayama and breathing exercises for a healthy respiratory system
Correct way of breathing. Causes and corrective measures to curtail snoring during sleep
Exercise can cause oxygen debt
Activity to examine how the rate of breathing changes with exercise
Cigarette smoking damages the lungs and heart
Nicotine is addictive
Nicotine increases the chances of lung cancer
Carbon monoxide anaesthetizes bronchial and tracheal cilia
Carbon monoxide cuts down oxygen supply
Respiration in some farm animals such as bovines, sheep, pigs, poultry, fish
Respiration in snakes, frogs, earthworms and lower animal species
Respiration in some common farm animal parasites and human parasites

Gas exchange in gills of fish and tadpoles; investigating the structure of gills
Gas exchange in insects; investigating tracheoles and spiracles
Gas exchange in flowering plants
The respiration equation and energy
Investigating the effect of plants and animals on the carbon dioxide concentration in water
Balance between photosynthesis and respiration
Plants obtain oxygen by diffusion through leaf, root and stem

*Transport*

Large organisms need transport systems
Layout of a mammalian (human) transport system
The double circulatory system
Oxygenated and deoxygenated blood
The heart - structure and parts, coronary arteries, heartbeat, heart valves
The blood vessels, kinds, characteristics and functions; exchange of blood in the capillary network
Blood pressure, effect of exercise on the heartbeat
Blood, plasma, red and white blood cells, platelets
Functions of the blood- transport, defense, temperature regulation
Blood groups, donating blood
Lymph and tissue fluid, functions of tissue fluid (leaked plasma), lymph nodes.
Transport in a flowering plant
The two transport systems- phloem and xylem
The xylem – support system of plants, lignin
The phloem – sieve tubes and companion cells
The vascular bundles
The transport of water
The fibrous and tap root systems – their unique features and functions
The structure of the root; root hairs absorb water through osmosis
The role of xylem in the transportation of water
Investigating which part of the stem transports water and solutes
Transpiration from leaves
Investigating which surface of the leaf loses most water
Measuring the rate of transpiration of a potted plant
Conditions affecting rate of transpiration – temperature, humidity, wind speed, light intensity, water supply
Transport of mineral salts
Root hairs absorb mineral salts by active transport
Transport of manufactured foods
Phloem translocates organic foods
Aphids have mouth parts (a stylet) to reach into phloem vessels to suck plant sap
Examine the mouth parts of some common insects
Transport systems in some farm animals such as bovines, sheep, pigs, poultry, fish, earthworms etc
Transport systems in some common farm animal parasites and human parasites

*Growth*

Growth means a permanent increase in size
Growth usually involves cell division
Mitosis
Growth in a flowering plant
Only some parts of a plant can grow

A flowering plant grows from seed
Uptake of water begins seed germination
Investigate the conditions necessary for germination
Enzymes digest stored food during germination
Investigate how non flowering plants grow from spores; vegetative propagation

Plants grow in length by cell division and cell elongation
Investigating which part of the root is the growing region
Roots and stems can grow wider
Annual growth rings in wood
Carbon dating can tell the age of a tree
Counting the age of a tree by the marks on its bark e.g. coconut palm

Growth in animals
Mammals grow rapidly when young
Investigating the growth of snails, fish, frogs and birds
Snakes and insects periodically shed their skeletons
Insects grow in stages
Investigating the stages of metamorphosis in silkworm, butterfly, roaches etc
Metamorphosis reduces competition, find out why
Growth is controlled by hormones, find out how
Ways of measuring growth – height, weight of body
Weigh oneself before and after a bath, before and after exercise
Find out the meaning of dry weight?
Cancer is uncontrolled cell division
Tumors –benign and malignant
Causes of cancer
Factors that can reduce the risk of cancer
Investigating growth in some farm animals such as bovines, sheep, pigs, poultry, fish, earthworms etc
Investigating growth in some common farm animal parasites and human parasites

*Reproduction*

Types: asexual and sexual reproduction
Mitosis
Binary fission in amoeba
Vegetative propagation in some plant: bulbs, cuttings, grafting
Parthenogenesis e.g. aphids, water fleas, komodo lizards
Meiosis, formation of gametes; the zygote
Comparison of chromosome behaviour during mitosis and meiosis
Sexual reproduction in mammals: in man and some common farm animals
Implantation, growth of the embryo, role of placenta, gestation, partuation, post natal care and feeding
Sexual reproductive cycles in some common mammals
Identical and non identical twins
Sexual reproduction in fish, frogs, birds, insects
Examining the structure of a hen's egg
Sexual reproduction in flowering plants
Polygamous, monoecious and dioecious plants
Examining the parts of a typical flower
Floral symmetry
Arrangement of floral organs
Types of flowers based on arrangement of its parts
The pollen grain, the ovule
Types of pollination
Pollinators

Differences between wind-pollinated and insect-pollinated flowers
Hand pollinated flowers as in the case of vanilla
Fertilised ovules become seeds
A typical fruit is an ovary after fertilisation
Fruit protects and disperses the seeds
Dispersal mechanisms, modes of dispersal, facilitators of dispersal
Types of seed dispersal and special mechanisms for dispersal
Comparison of various types of sexual reproduction- advantages and disadvantages; adaptations
Comparison between asexual and sexual reproduction, advantages and disadvantages; adaptations
Understanding a floral formula

* The study of reproduction may also introduced in classical ways as in many standard text books

Living organisms and temperature

Chemical reactions within living organisms – metabolic reactions

Enzymes control or catalise metabolic reactions
Catalitic reactions are temperature sensitive

Animals and temperature

Poikilothermic and homeothermic animals
Rate of heating and cooling of the body depends on body size
Poikilotherms control body temperature through being active and sunning themselves
Homeotherms control body temperature through rate of burning of food and activity
Regulation of body temperature in mammals

Role of skin – epidermis and dermis
The role of hypothalamus in temperature control
Hibernation, aestivation, hypothermia
Animals store food for the winter months as fat in the body or by hoarding
Temperature related adaptations e.g. winter coats

Plants and temperature

All plants are poikilothermic

Plants loose water when hot
Low temperatures and metabolic dormancy
Annuls survive the winter as a seed
Perennials survive the winter in various ways
Adaptations to avoid damage due to frost-dying back, leaf fall, bud formation
Temperature related insulation measures e.g. scale leaves, bark wood with cork cells

*Excretion and osmoregulation*

Understanding the terms: metabolic wastes, excretory product, excretion, egestion

Excretion in plants

Excretory products of plants – carbon dioxide, resin etc
Role of stomata in excretion

Excretion in animal

Excretory products of animals – carbon dioxide, bile pigments, nitrogenous waste materials such as uric acid, urea (Plants do not excrete urea)
Deamination and urea formation in the liver

Human excretory system

Skin
Kidney
Working of the human excretory system – urine formation
Bladder stones, kidney failure and dialysis
Egestion of undigested waste products and cellulose

- Osmoregulation
  - Organisms need to correct the content of water in their body
  - How organisms gain water?
  - How organisms lose water
    - The function of the contractile vacuole in amoeba, paramecium
    - Osmoregulation in sea water fish and fresh water fish
    - The role of mammalian kidneys in osmoregulation
  - Osmoregulation in plants – role of stomata
  - Various adaptations in plants to cut water loss
  - Various adaptations in animals to cut water loss
  - Homeostasis

*Support and movement*

- Skeletal structures – exoskeleton and endoskeleton
  - Support and movement in mammals
    - Bone, its structure and composition
    - Cartilage
    - Major bones of the human body
    - Joints and lubricants
    - Muscle, its structure and composition
    - Role of muscle in movement
    - Tendons, its composition and function
    - Ciliated cells and blood cells
  - Support and movement in birds – adaptations for flight
  - Support and movement in fish – adaptation for swimming, pitching, yawing, rolling
  - Support and movement in insects – the exoskeleton, chitin and cuticle
    - Special muscle attachments for movement and flight in insects
  - Support and movement in earth worms – the hydrostatic skeleton
    - Role of chaetae, circular muscles, longitudinal muscles in movement
- Support in plants
  - Xylem and wood, the function of lignin
  - Turgidity of cells in herbaceous plants
  - Cell turgor in leaves

*Sensitivity and coordination*

- Understanding the terms sense organs, receptors, stimuli
- Sense of touch and taste
  - Skin contains receptive nerve ending sensitive to touch, heat, cold, pressure and pain
  - Concentration of receptors in an area determines the degree of sensitivity
  - Taste buds on tongue respond to chemical stimuli
  - Different parts of the tongue are sensitive to different chemicals (taste)
  - Care of the skin and tongue
- Sense of sight
  - The structure of the eye
  - Protective function of tears (lysozyme is anti-bacterial), eyelid, eyelashes, eyebrows
  - Function of retinal cells, blind spot, rods and cones
  - How does the eye see? Long and short sight and its correction
  - Night blindness
  - Care of the eye, cataract
- Sense of hearing
  - The structure of the ear
  - The ear an organ of hearing and balance

How does the ear hear?
Function of the ear as a balancing organ
Care of the ear, precautions against damage to ear drum

Coordination and response

The role of effectors in response to stimuli and in coordination
Role of hormones and nerves in communication

Sensitivity and coordination in some farm animals

The nervous system

Nervous system in animals
Structure and function of a neuron
Nerves are made up of nerve fibres
The central nervous system in humans
Reflex arcs, synapse
Structure of the brain and the function of its various parts
The spinal cord and its function

The endocrine system

Endocrine glands, their locations, secretion, function, effects due to under or over secretion

Goitre, diabetes their cause and cures

Coordination in plants

Tropisms are directional growth responses necessary for plant survival

Geotropism, phototropism, thigmotropism, hydrotropism
Experiments to prove the above
The role of auxin
In the absence of light plants become etiolated

*Ecology*

*Living organism in the environment*

Understanding the meaning of ecological terms such as habitat, population, niche, community
The study of an eco system
Learning to use the dichotomous key for identifying living organism within an eco system
Preparing a species list
Estimating population size within an ecosystem

The quadrat method to sample plant cover

Transect, random sampling and sample

Estimating animal population size using the mark, release, recapture technique

$$\text{Estimated population size} = \frac{\text{number of animals caught the first time}}{} \times \frac{\text{number of animals caught the second time}}{\text{number of marked animals caught the second time}}$$

Displaying the study through diagrammatic representation and tabular form

Food and energy in an ecosystem

Food chain, producers, consumers, the primary consumer, secondary consumer,
Food chains within an ecosystem are usually short
Food webs
Tropic (feeding) levels, pyramid of numbers, pyramid of biomass
Understanding energy flows is important in farming

Humans are able to feed at several different tropic levels

The nearer to the beginning of the food chain, the more is the energy available (our staple foods are cereals, pulses, tubers, vegetables and fruit)

The abundant energy available in cellulose is available to humans only as dairy product

- Production of protein rich pulses keeps the food chain short.
- Fermented foods make microbes a part of the food chain

Nutrient cycles

- The vital role of decomposers within an ecosystem chain
  - Decomposers enrich the soil with carbon and nitrogen-the building blocks for carbohydrates and proteins
  - The carbon cycle in nature
  - The nitrogen cycle in nature
    - Nitrogen fixation-the role of rhizobium in fixing nitrogen
    - Nitrifying and denitrifying bacteria
    - Well aerated soils are conducive to the action of nitrifying bacteria in soils
  - Denitrifying bacteria are active in waterlogged and boggy soils
    - Carnivorous plants grow in waterlogged and boggy soils getting their nitrogen supply from insect protein
    - Crop rotation and multiple crop practices promote soil health because of active rhizobium bacteria

Distribution of living organisms

- Biotic and abiotic environmental factors partly determine organism distribution
  - Abiotic factors
    - Macro and micro climatic factors
    - Chemical and physical factors
    - Light
    - Soil provides anchorage, micro nutrients, water and air
    - Soil formation from rocks
    - The significance of the size of soil particles
    - Some terms to understand: rock waste, top soil, clay and sand, capillarity, leaching, electrical charge of clay particles, crumbs, waterlogged soil
    - Components of soil
      - Soil types and their properties
      - Humus and its formation
    - Water and soil
      - Dissolved minerals in soil water
      - Osmosis in root hairs
      - Soil particle in loamy soil have better water holding capacity
      - Root adaptations of plants in waterlogged soils
    - Making a rough estimate of the proportions of particles of different sizes in a soil sample
    - To estimate the percentage of water in a soil sample
    - To estimate the percentage of humus in a soil sample
  - Soil nurtures many organisms- earthworms, insects, other worms, bacteria, fungi-that help in humus formation
    - The Tullgren funnel- a method for collecting small soil animals for identification and counting
    - Waterlogged soils are acidic- support low micro floral and faunal diversity
    - Management of acidic soils for agriculture
      - Draining excess water
      - Addition of humus (compost or manure) to initiate microbial activity and improve soil quality
      - Growing green manure grasses and legumes

- Clay soils
  - Heavy and hard to cultivate
  - High in mineral ions and water
  - Poor in drainage and aeration capacity
- Management of clay soils for agriculture by improving crumb structure
  - Addition of lime (calcium hydroxide) - flocculating the soil
  - Examine what happens to clay particles when lime is added to it
  - Addition of humus (compost or manure)
- Sandy soils
  - Well aerated but poor in nutrients and water holding capacity
  - Management of sandy soils for agriculture
    - Addition of humus (compost or manure)

The living environment

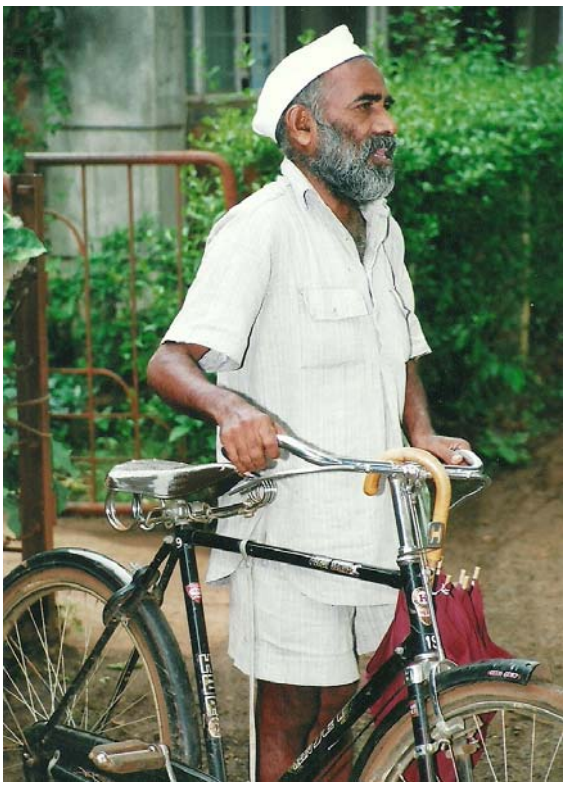
- Relationship between predators, parasites, pathogens, competitors
- Predators and adaptations for catching prey
- Prey and adaptations for protection from predators
- Parasites and host
- Adaptations in parasites
- Controlling parasites by breaking their life cycles
- Pathogens and disease
- Pathogens enter the body in different ways
- Natural body defenses against pathogens
  - Clotting of blood seals open wounds
  - Antigens and anti-body
  - Active and passive immunity
  - Important infectious diseases
    - Antibiotics, bacterial and viral diseases
    - Blood groups, blood transfusion, organ transplants, AIDS
  - Mutualism
  - Competition between organisms, niche habitat
  - Colonisation and succession, climax community, pioneer species
  - Population size, factors controlling population size and population growth, age pyramid
  - Human population over the ages, reasons for population explosion, consequences, stabilizing populations
    - Population outbursts in insects, weeds and animals
    - Pest problems
    - Biological control of pests
    - Ill effects of insecticide use
    - Benefits of biological pest control, some disadvantages
  - Habitat and adaptations
    - Adaptations in plants to various geo-climatic conditions: xerophytes, mesophytes, hydrophytes
    - Adaptations in animals
      - Terrestrial, aquatic and aerial (arboreal and volant)
  - Habitat alterations, conservation and biodiversity
    - Human activity results in the alteration of environments
    - Direct and indirect effect on ecosystems
    - Habitat conservation
    - Restoration of degraded habitats
    - Biodiversity and its conservation

- Human effect on environment
  - Deforestation
    - Clearing large stretches of forests for agriculture, industry, hydro-electric and development projects, mining etc.
    - Rain and wind cause erosion of bare soil
    - Measures to control soil erosion
      - Terracing and contour ploughing
      - Planting wind-breaks
      - Keeping plant cover on the ground
    - Effects of deforestation
      - Increased risk of flooding, reduced rainfall, extinction of species, drought, change in micro climate
      - Effects of overgrazing-soil erosion and desertification
    - Pollution
      - Common air-pollutants, acid rain, smog, exhaust fumes due to burning of fossil fuels, carbon footprint
      - Sewage
      - Industrial effluents
      - Fertiliser and pesticide leaching-residues in animal food chain
    - Treatment, recycling and safe disposal of rubbish
      - Composting of biodegradable waste
      - Conservation measures to improve the environment
    - Genetics
      - Cell nucleus, chromosomes, genes, DNA, RNA, enzymes
      - Human chromosomal set, homologous chromosomes
      - Genes, alleles, heterozygous and homozygous alleles
      - Genotype and phenotype
      - Dominant and recessive characteristics, dominance, incomplete dominance, co-dominance
      - Chromosomal anomalies as seen in Down's Syndrome
      - Karyotyping
      - Inheritance
        - The law of single gene single characteristic
        - Separation of alleles during meiosis
        - Genetic traits are determined during fertilization
        - Writing genetic crosses-F1 and F2 generation for single traits and double traits
        - Mendel's laws of inheritance
        - Back crosses help to determine genotype
        - Pure breeding-homozygous
        - Sex determination in humans
        - Sex linked genes and traits-haemophilia
        - Drosophila experiment in genetics
      - DNA and protein synthesis
        - The helical nature of DNA
        - DNA basis and amino acid sequence in DNA
        - Messenger RNA
        - Mutation, factors affecting mutation
        - Genetic engineering
          - Synthetic insulin
          - Genetically modified organisms (GMOs)
          - Opposition towards GMOs in organic farming
          - Bt cotton, Bt brinjal, ramifications if introducing such crops into agriculture

- Evolution
  - Evidence of evolution
    - Fossils
    - Homologous structures
    - Vestigial structures
    - Charles Darwin's theory of natural selection
    - Variation
      - Continuous and discontinuous variations
      - Causes of variation
        - Genetic, environmental
    - Cladograms
    - Evidence of natural selection
    - The origin of species
- Classification
  - The importance of classification
  - Binomial nomenclature
  - The plant kingdom – general characteristics
    - Subkingdom cryptogamae and its divisions; phanerogamae and its subdivisions
  - The animal kingdom – general characteristics
    - All phyla
    - Phylum annelida and arthropoda in relative detail
    - Subphylum vertebrata up to classes
  - The Angiosperms (flowering plants with enclosed seeds)
    - Life cycle of angiosperms
  - Morphology of plant parts and modifications for various purposes
    - Stem, root, leaf, flower, seed, fruit
  - Some groups of plants of importance to farming and related activities – common crop plants characteristic features of the order and family among Dicotyledons (seeds bearing two cotyledons) and monocotyledons (single cotyledon seeds)
- Laboratory apparatus and equipment useful in the study of biology
- Keeping a field diary

Note: For resources see page 141

## Shivaji Kaganikar



Shivaji with his preferred means of transport : the bicycle

Shivaji, as he is known, has spent over 40 years in education and community development. He has been guided by the thoughts of M.K. Gandhi, Vinobha Bhave, J.P. Narayan and Saneguruji. Hundreds of youth and children have been mentored by him. Shivaji's expertise is in the areas of:

Land management based on ecological principles
Watershed management
Contour marking using an A-Frame
Gully plugs, bunds and check dams
Rainwater harvesting
Agroforestry
Construction of biogas units
Vermiculture and vermicomposting
Tree grafting
Need based education

Mobilising the community and community elders is also Shivaji's forte. He has been the spirit behind reclaiming hundreds of acres of degraded lands in villages around his hometown.

The watershed at Kattanbhavi, Shivaji's major work

Composting

Bio-gas

A-frame for marking contours

# CHEMISTRY

***Middle level 1, 2***

*Classification of substances*

*The states of matter*

- Solid, liquid, gas and the properties of these three states
- Pure and impure substances
- What are crystals?
- The melting point and boiling point to identify pure or impure substances
- Distillation

*Separation of substances from a mixture*

- What is a mixture?
  - Heterogeneous and homogeneous mixtures
  - Solvents, solutes and solutions
  - Separating the solute from the solvent of a solution, some examples
- The difference between melting and dissolving
- Separation of solids in a mixture
  - Decantation
  - Filtration
  - Sublimation
- Separation of immiscible liquids
- Separation of miscible liquids – fractional distillation
- Chromatography of vegetable extracts

*Air in the atmosphere*

- The need for air
- The composition of air
- The component of air which supports burning: oxygen
- The inert component of air: nitrogen
- Experiments to demonstrate that oxygen supports burning
- Pollution of air

*What is decomposition of a substance?*

*What is synthesis of a substance?*

*Elements, compounds and mixtures*

- Physical changes and chemical changes
- Elements
- What are physical properties and chemical properties of a substance?
- The difference between mixtures and compounds
  - Some experiments to examine chemical changes and compounds
  - Some experiments to examine mixtures
  - Is air a mixture or a compound?
  - Is water a mixture or a compound?

*Oxygen*

- Preparation of oxygen in the laboratory
- Using a catalyst when preparing oxygen from potassium chlorate
  - What is a catalyst?
- Physical properties of oxygen
- Chemical properties of oxygen
- Oxidation and reduction in terms of reactions with oxygen
- Uses of oxygen

*Water*

- The water cycle
- Water in nature – sources of water
- Reaction of water with metals
  - With sodium
  - With calcium
  - With magnesium
- Synthesis of water from hydrogen and oxygen

*Hydrogen*

- Preparation of hydrogen in the laboratory
- Physical properties of hydrogen
- Chemical properties of hydrogen
- Uses of hydrogen

*The reactivity of metals: the reactivity series*

*Acidic and alkaline solutions and salts*

- Acidic solutions from acidic oxides
- identifying acidic solutions by the litmus test
- Common acids used in the laboratory
- Concentrated and dilute acids
- The correct method to dilute a concentrated acid
- Basic solutions from basic oxides
- Alkalis
- Common alkalis used in the laboratory
- Identifying basic solutions by the litmus test
- Indicators – litmus, methyl orange and phenolphthalein and their uses

*Characteristics of acidic and alkaline solutions*

- Their taste (caution!)
- Action of metals with acids
- Action of calcium carbonate with acids
- Action of basic metallic oxides or hydroxides with acids
- Strength of acidic and alkaline solutions: the pH scale
- The universal indicator to find the pH of a solution

*Water and compounds*

- Water of crystallization, copper sulphate crystals and water of crystallization
- Reversible reactions
- Saturated solution and solubility
  - What is a saturated solution?
  - Solubility
  - How solubility of solid substances increases with temperature
  - Solubility of gases in liquids, factors on which they depend
- Efflorescence and deliquescence
- Drying agents
- Rusting, factors on which rusting depends
- Prevention of rusting

*Atoms and molecules*

- Dalton's atomic theory
- What are atoms?
- What are molecules?
- Chemical symbols
- Symbols of oxygen, hydrogen, nitrogen, sulphur, carbon

Symbols of aluminium, argon, barium, bromine, calcium, chlorine, chromium, fluorine, helium, iodine, lithium, magnesium, manganese, neon, phosphorus, radium, silicon, uranium, zinc.
Symbols of copper, lead, iron, sodium, potassium, silver, mercury, gold, tin
Atomic mass and relative atomic mass
Molecular mass, relative molecular mass
Isotopes

*Chemical equations, formulae, valencies*

What is a chemical formula?
Empirical formulae of some compounds e.g. magnesium oxide, sodium carbonate
Molecular formulae
Radicals
Valency and formulae: how the formula of a compound is written
The number of atoms in the formula of compounds
Variable valency of some metals
Writing and balancing a few typical chemical equations
Information from a chemical equation
Limitations of a chemical equation

*Electricity and chemical changes: electrolysis*

What is electrolysis?
What are electrolytes?
Electrodes: the anode and cathode
Ions and their role in electrolysis
Cations and anions: their direction of movement
The charge on ions
Electrolysis of some solutions:
- Acidified water
- Copper chloride solution
- Copper sulphate solution

Applications of electrolysis

*Minerals and ores*

What are minerals and what are ores
Ores as the source of metals: haematite for iron, bauxite for aluminium
Sources of calcium carbonate
Action of heat on chalk or limestone
Uses of limestone
Preparation of carbon dioxide
Properties of carbon dioxide
Uses of carbon dioxide
Action of heat on some carbonates:
- Washing soda
- Copper carbonate
- Zinc carbonate

Action of water on calcium carbonate in rocks
Hard and soft water
Soap and its action on hard water
Methods of changing hard water into soft water
Disadvantages of hard water
Advantages of hard water

Note: For resources see page 140

***Upper level 1, 2, 3***

*The meaning of a pure chemical*

*Where do chemicals come from and some general methods of extraction from*

- rocks, soil
- the sea
- plants
- the air
- coal and crude oil

*Communicating chemical reactions: chemical equations*

- Symbols of various elements
- Radicals
- Valency
- Writing a chemical formula
- Counting the number of atoms in a molecule
- Variable valency
- Chemical equations
- Balancing chemical equations
- Information obtained from a chemical equation
- Information not obtained from a chemical equation
- Some typical chemical reactions

*States of matter*

- The three states of matter: physical properties of the states of matter
- What are fluids?
- What is a vapour?
- Melting point, boiling point
- Sublimation
- What is a volatile liquid
- Diffusion

*Elements, compounds and mixtures (revision)*

- Elements and compounds
- Mixtures and compounds – their differences
- The difference between melting and dissolving
- Separation of the components of a mixture
    - Separation of the solids in a mixture, e.g. common salt, powdered sulphur and sand
    - Separation by sublimation, e.g. separating ammonium chloride from other substances
    - Separation of immiscible liquids
    - Separation of miscible liquids by fractional distillation
    - Chromatography

*The air*

- The composition of air in the atmosphere
- The need for oxygen for combustion
- The oxygen cycle in nature
- Gases in the air and their uses
- Pollution of air
- Air: its significance in the biological world

*Water*

- Water as a compound of the elements of hydrogen and oxygen
- The proportion of water in various foods
- The water cycle in nature

Physical properties of water
Some special properties of water
Its lower density as ice
As a solvent for a wide range of substances
The variation of solubility with temperature: for solids and gases
The biological importance of dissolved air in water
Crystals and water of crystallization
Water: its significance in the biological world

*Oxygen and oxides*

Preparation of oxygen in the laboratory
Physical properties of oxygen
Chemical properties of oxygen
Reaction with magnesium, copper, phosphorus, carbon, iron, sulphur, calcium and sodium
Oxidation
Metal oxides, non metal oxides and their properties
Reduction as a process of removal of oxygen
Burning, breathing and rusting
Conditions for rusting
Air pollution
Oxygen: its significance in the biological world

*Metals*

Physical properties and uses of metals
Chemical properties of metals
Reaction of metals with air, water and acids
The reactivity series and using the reactivity series to study the reaction of metals with
Oxygen in air, cold water, steam, dilute hydrochloric acid
Using the reactivity series to predict the reaction of metals
The extraction of metals from their ores
Main methods of extraction: by reduction of the metal oxide with coke and by electrolysis
Method of extraction, depending on the position of the metal in the activity series
Why gold and silver occur in the free state
Extraction of metals by electrolysis
Extraction of sodium
Extraction of aluminium
Extraction of metals using carbon
Extraction of iron, zinc and lead
Extraction of copper

*The periodic table*

A survey of the names, symbols of atomic numbers of elements in the periodic table
The meanings of the terms periodic pattern, period, group and atomic number
Family names of metals in the periodic table
Alkali metals, identifying members, properties
Alkaline earth metals, identifying members, properties
Transition metals, identifying members, properties
Family names of non metals in the periodic table
Halogens, identifying the members, properties
Noble gases, identifying members, properties
General properties of carbon and silicon

*Atomic structure*

Protons, neutrons, electrons
How electrons are arranged in a series of shells

The electron structures of the first 36 elements
Formation of an ion of sodium
Formation of an ion of chlorine

*Structure and bonding of substances*

The regular shape of crystals
The structure of metals
Explaining the physical properties of metals from their structure
Covalent bonding
Covalent molecules, their properties
Sulphur and its allotropes
Carbon and its allotropes

*Acids, bases and salts*

*Acids*

Testing an acid using an indicator – blue litmus turns red
The pH scale – the pH of various acids and bases
Full range indicators, universal pH indicator
The reaction of acids on metals
The reaction of acids on carbonates
The reaction of acids and metal oxides
The physical appearance of various acids such as
    Citric and tartaric acids
    Sulphuric acid, nitric acid and ethanoic acid (acetic acid or vinegar)
    Hydrogen chloride
Preparation of gases in the laboratory: Preparation of Carbon dioxide, sulphur dioxide and hydrogen

*Bases*

Bases as chemical opposites of acids
Some examples of bases
Alkalis
Identifying bases
The pH of various bases
Bases turn red litmus blue
Bases mostly do not dissolve in water
Bases that dissolve in water are called alkaline solutions
A base neutralizes an acid to form a salt and water

*Salts*

How salts are formed when acids are neutralized by bases
Examples of salts from hydrogen chloride, HCl
Examples of salts from sulphuric acid, $H_2SO_4$
Examples of salts from sodium hydroxide, NaOH
Examples of salts from magnesium oxide, MgO
Salt crystals formed by crystallization from aqueous solutions
Water of crystallization
Patterns of solubility for bases and salts
Hard water and soap
    How hard water containing calcium hydrogen carbonate, $Ca(HCO_3)_2$ is formed
    Washing with hard water and soap
    Softening hard water
Overview of the method of analysing of salts

*Acid-base theories: an explanation for the action of acids and bases*

*Chemical calculations involving reactants and products*

Here chemical calculations are about using calculations to predict the amount of a product formed when a given quantity of a substance reacts with another

Counting the atoms and molecules of the reactants and products involved in a chemical reaction

Atomic mass and atomic mass unit

Relative atomic mass

Relative molecular mass

Using the relative molecular mass of the reactants to predict the relative molecular mass of the products (based on the chemical equation of that reaction) e.g. $C + O_2 \rightarrow CO_2$

Calculations

Avogadro's constant

The mole, the number of particles (atoms, ions, molecules) present in a mole

Calculating the mass of a substance present in any number of moles using the relationship

Mass (in grams) = number of moles × mass of 1 mole of the element

Calculations

Given the mass of an element, to find the number of moles of that element using the relationship

$$\text{Number of moles} = \frac{\text{mass of the element}}{\text{mass of 1 mole of the element}}$$

Calculations

Moles and compounds

Using the relationship

Mass of compound = number of moles of the compound × mass of 1 mole of the compound

Calculations

Given the mass of a compound, to find the number of moles of that compound using the relationship

$$\text{Number of moles of the compound} = \frac{\text{mass of the compound}}{\text{mass of 1 mole of the compound}}$$

Calculations

Moles and gases

The molar gas volume, i.e. one mole of any gas occupies a volume of approximately 24 $dm^3$ (24 *l*) at room temperature and pressure (rtp)

The relationship

$$\text{Number of moles of a gas} = \frac{\text{volume of the gas (in dm}^3\text{ at rtp)}}{24\,\text{dm}^3}$$

Or

Volume of gas = number of moles of gas (in $dm^3$ at rtp) × 24 $dm^3$

Calculations

Avogadro's law

Moles and solutions

Measures of concentration of a solution

Grams per cubic decimetre ($gdm^{-1}$)

Moles per cubic decimetre (mol $dm^{-3}$)

1 molar (1 mol $dm^{-3}$)

Calculating concentrations using the relationship

$$\text{Concentration (in mol dm}^{-3}) = \frac{\text{number of moles}}{\text{volume (in dm}^3)}$$

How to make solutions of known molarity

Calculations

Calculating the formulae of chemical compounds
Finding the empirical formula of a compound
The law of conservation of mass in chemical reactions

Calculations in the cases of

Solids
Liquids
Solutions

Percentage yield in a chemical reaction

$$\text{Percentage yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100$$

*Introduction to organic chemistry*

The special nature of carbon which reacts to form a great variety of compounds
The formulae and structures of some common carbon compounds
Isomers
The alkanes
Hydrocarbons
Homologous series
Chemical reactions of alkanes

They do not react with many of the common laboratory reagents
They do not dissolve in water
They do not react with acids or alkalis
They burn
They can be 'cracked'
They react with chlorine and bromine

*Natural gas, its composition and uses*

Crude oil

The composition of crude oil
Cracking
Polymerization
Reforming

*The alkenes–ethene*

Reaction with water to form ethanol
Reaction with benzene to form polystyrene, needed for the manufacture of plastic
Reaction with chlorine to form the intermediate in the manufacture of the plastic pvc
Polymerisation to form polythene

*Alcohols, acids and esters*

Ethanol
Fermenting to produce ethanol
Alcoholic drinks
Industrial methylated spirits
Alcohols
Reactions of alcohol

Reaction with sodium
Dehydration of alcohol
Oxidation of alcohol

Organic or carboxylic acids: Some common organic acids

Methanoic acid or formic acid
Ethanoic acid or acetic acid (vinegar)
Octadecanoic acid or stearic acid

- Citric acid
- Fumaric acid
- Tartaric acid
- Condition under which wine becomes vinegar

The esters

- Esters give fruits their flavour
- Some common esters
- Esterification: How esters are formed by combining an organic acid with an alcohol
- Hydrolysis of esters

Plastics

- Polythene
  - Low density polythene, its properties and uses
  - High density polythene, its properties and uses
- Ethene to polythene – polymerization
- Monomers and polymers
- Addition polymerization
- Nylon, Terylene and Bakelite – Condensation polymerization
- Polyesters
- Moulding plastics
  - Thermoplastics
  - Thermosets

Chemistry and food

- The various nutrients in food
- Carbohydrates, sugars – their formulae
  - Various sugars
- The carbon cycle in nature
- Digesting starch using enzymes
- Proteins
  - What are proteins?
  - Various proteins in the body
- The nitrogen cycle
  - Transfer of atmospheric nitrogen to the soil and to plants and animals
  - Transfer of nitrogen from plants and animals to the soil
  - Role of nitrosifying, nitrifying and denitrifying bacteria in the soil
- The role of the hydrogen cycle in nature, pH and energy (ATP – adenosine triphosphate)

*Essential nutrient elements in the soil*

Major elements – nitrogen, phosphorus, potassium, calcium
Nitrogen – for protein in stalks and leaves
Phosphorus- for growth of roots and ripening of crops
Trace elements – boron, copper, manganese

*Energy from fuels*

What is a fuel
Various fuels – coal, coke, charcoal, natural gas, wood, biogas
Good and bad fuels

- Characteristics of a good fuel
- The energy value of fuels
- Where does the energy in fuels come from?
- Carbon sinks; sequestration of carbon in nature
- Carbon footprint

Alternative forms of energy

*Energy changes in chemical reactions*

Exothermic reactions
Endothermic reactions

*Electrolysis*

Substances which contain ions, how they conduct electricity and decompose while in the liquid state
Electrolytes
Molten salts or aqueous solutions of salts as electrolytes
Aqueous solutions of acids and alkalis as electrolytes
Ions move towards the electrodes during electrolysis
Positive ions move towards the cathode and negative ions move towards the anode
Changes at the electrodes during electrolysis:
    Rules for the electrolysis of various salts with different electrodes
Electrolysis of dilute acids
Electroplating

*Oxidation and reduction*

Electron transfer during oxidation and reduction
Oxidation numbers
Meaning of oxidation:
    Can be the gain of oxygen
    Involves the loss of electrons
    Involves an increase in oxidation numbers
Meaning of reduction
    Can be the loss of oxygen
    Involves the gain of electrons
    Involves a decrease of oxidation numbers
The action of oxidizing agents
The action of reducing agents
Redox reactions, the reactivity series

*Electricity from chemical reactions: cells*

The Daniel cell: construction and working
The dry cell: construction and working
Rechargeable cells: the lead acid cell

Note: For resources see page 141

## Vigyan Ashram

Vigyan Ashram is a centre of the Indian Institute of Education (IIE), Pune. A scientist turned educationist, the late Dr S. S. Kalbag started Vigyan Ashram in 1983. It offers the following two programmes:

*Diploma in Basic Rural Technology (DBRT)* is a one year residential course recognized by the National Institute of Open Schooling. The minimum qualification for eligibility is eighth standard. It is a multi-skill program where all

Improvised cycle with a motor attached for generating electricity

learning is hands on, taking place in real life environments. It is specifically designed for pupils who are not interested in a formal school education. The programme prepares young adults to start their own enterprises.

Students are trained in:

Engineering (Fabrication & construction)

Energy & Environment (Electrical, Motor rewinding, survey techniques, solar / biogas etc.)

Agriculture and Animal Husbandry

Earthquake resistant dome constructions designed at the Ashram

Smt. Kalbag continues to stay at Vigyan Ashram, a source of inspiration to students and visitors

Home and Health - sewing, food processing and rural laboratory

General – Computer literacy, English, sports.

*Introduction to Basic Technology (IBT* is offered to the students of 8th, 9th and 10th standards along with other subjects. The programme is recognized by the education board of Maharashtra and is also offered through other schools in Maharashtra. One day per week is allocated for this course. Each school is required to have minimum facilities like engineering workshop, electrical section, agricultural land, poultry, and food and health labs. Instructors are entrepreneurs from within the community, while students learn as trainees; the services are paid for by the community. All assistance to introduce the programme in schools is offered by Vigyan Ashram.

Solar drier constructed and erected by students

# PHYSICS

***Middle level 1, 2***

*Measurement in science*

Measuring length, mass, time and temperature
Simple calculations based on these to find
    Area, volume, speed, velocity
Density of substances

*Density and floatation*

Measuring the mass and volume of a variety of solids and liquids and hence determining their densities
Investigate flotation for a variety of solids and liquids

*Force and moments*

Forces, effects of forces, unit of force
Investigate the relationship between the extension of a spring and the applied force
Friction, everyday applications of friction, the effect of lubrication
Centre of gravity and its importance in equilibrium
The force of gravity (weight) and its relationship to mass
    Weight varies with location
    mass in kilograms multiplied by 10 (approx) gives weight in newtons on the earth's surface
    find the centre of gravity of a thin lamina
    investigate the role of centre of gravity in design for stability and equilibrium
Levers and the everyday applications of levers

*Pressure*

The relationship between pressure, force and area, simple calculations using this relationship
Relationship between pressure and the depth of a liquid
Air has mass and occupies space
The atmosphere exerts pressure and the atmospheric pressure varies with height
Pressure and its relationship to weather
Measuring pressure

*Work, energy and power*

Define units of work, energy and power
Principle of conservation of energy
The sun as a primary source of energy – how it is important in food production and energy supply
Classify sources of energy as renewable or non-renewable
Advantages and disadvantages of various energy sources
Need for energy conservation

*Energy conversion*

Examples of energy conversion from everyday experience
Chemical energy to electrical energy to heat energy
Electrical energy to magnetic energy to kinetic energy
Light energy to electrical energy to kinetic energy

*Heat and heat transfer*

Heat as a form of energy that can be converted to other forms of energy
Expansion of solids, liquids and gases when heated and contraction when cooled
Expansion of water when freezing

Measure the temperature of various solids and liquids at, above and below room temperature
Determine the melting point of ice and boiling point of water
Investigate the effect of pressure on the boiling point of water
The difference between heat and temperature
Carry out experiments that involve changes from
- Solid to liquid and liquid to solid
- Liquid to gas and gas to liquid

Latent heat (explained with demonstration)
Plot a cooling curve and explain the shape of the curve in terms of latent heat
How all hot bodies radiate heat
Simple experiments to show the transfer of heat by conduction, convection and radiation
Investigate conduction and convection in water
Identify good and bad conductors of heat and compare the insulating ability of different materials

*Light*

Light as a form of energy that can be converted into other forms
Light travels in straight lines and how shadows are formed
Luminous objects as sources of light and non-luminous objects are visible because of the light reflected from them
White light is made up of different colours which can be separated by dispersion
Produce a spectrum of white light by using appropriate apparatus and list the colours of the spectrum

*Reflection and refraction of light*

Investigate the reflection of light by plane mirrors and illustrate this using ray diagrams
Refraction of light as it passes from
- Air to glass
- Air to water
- Glass to air
- Water to air

Refraction of light through a lens
Demonstrate and explain the operation of a magnifying glass

*Sound*

Show that sound is a form of energy and that sound is produced by vibrations
Sound transmission requires a medium
Echoes are reflected sound
The ear detects sound vibrations-exposure to very loud sounds can cause damage to hearing
The speed of sound is less than the speed of light - the time lag between seeing and hearing the same event. e.g. lightning and thunder

*Magnetism*

Simple experiments to show attraction and repulsion between magnets
Test a variety of materials for magnetism
Plotting the magnetic field of a bar magnet
Demonstrate that the earth has a magnetic field and locate north and south

*Static electricity*

Generating static electricity using materials commonly found
The force between various charged objects
The effect of earthing

*Current electricity, voltage*

Current as a flow of charge
Testing conduction in a variety of materials and classifying each material as a conductor or insulator

Measuring current, measuring potential difference (voltage) and resistance (for metallic conductors)
Relationship between voltage, current and resistance, simple calculations based on this relationship
Simple series and parallel circuits containing a switch and two bulbs
The heating effect, chemical effect and the magnetic effect of an electric current
Identifying everyday applications of these, including the action of a fuse

*Electricity in the home*

Distinguish between direct and alternating current
Know that the voltage of the mains supply is 230 volts, a.c.
The unit of electrical energy in domestic supply is the kilowatt-hour
Calculate the cost of using common electrical appliances based on their power rating
How to wire a plug correctly
The safety role of a fuse or a circuit breaker

*Electronics*

Diode – a device that allows current to flow in only one direction
Light emitting diodes (LEDs) – advantage of using LEDs to save electricity
Set up simple series circuits using switches, buzzers, LEDs and resistors
Measure the resistance of a light dependent resistor (LDR) under varying degrees of brightness of light
Identify everyday applications of the diode, LED and LDR

Note: For resources see page 141

***Upper level 1, 2, 3***

The study of physics at the upper level may be considered as a comprehensive single programme spread over 3 years. The content is arranged in order of growing complexity to be studied at one's own pace.

*Prerequisite for Upper level physics*

Since physics at this level involves calculations, it is necessary that the student is proficient in

Constructing and using algebraic formulae
Solving simple equations
Changing the subject of a formula
Direct and inverse variation
Basic trigonometry involving the sine, cosine and tangent of an angle:
Finding these three ratios given the sides of a right triangle
Given an angle and a side, to find all the sides of a triangle
And to some extent:
Solving quadratic equations
Solving simultaneous equations

Of course, every student should have a 'feel' for physical phenomena by experimentation and investigation, much before we begin this level. This would be assumed to have been done at the lower and middle level.

*Why use mathematics in the rural physics curriculum?*

It is not enough to merely understand a few principles in physics. Often it may be necessary to predict what may happen in a certain situation. To do this convincingly we need to use mathematics. The laws of the universe are mathematical in nature and to get a clear understanding of these laws it is necessary to have some proficiency in mathematics.

If this aspect of calculations in physics is neglected, it gives rise to hazy, erroneous notions. This is the reason why some amount of calculations will be necessary in the rural physics curriculum. While it is still possible to get by without calculations, as with many successful farmers, a knowledge of basic mathematics does help to raise the level of understanding of anyone who practices farming.

*Mass, inertia, density*

What is mass – effects of mass
What is inertia – effects of inertia
Units of mass
Mass and weight – differences; measuring mass, measuring weight
Density – definition, units
Densities of a few common materials

The formula for density : $\text{density} = \frac{\text{mass}}{\text{volume}}$

Simple problems based on the formula
Problems

*Motion*

Average speed
Formula to calculate average speed : $v = \frac{s}{t}$

Distance = average speed × time taken or $s = v \times t$

and $t = \frac{s}{v}$

Explanation and definition of the terms velocity, displacement, acceleration

Acceleration = $\frac{\text{change of velocity}}{\text{time taken for the change}}$

or $a = \frac{\triangle v}{\triangle t}$

Motion under constant acceleration $a = \frac{v-u}{t}$

or $v = u + at$

Deriving the formulas $s = ut + \frac{1}{2}at^2$

and $v^2 = u^2 + 2as$

Problems based on the formulas

$v = u + at$

$s = ut + \frac{1}{2}at^2$

$v^2 = u^2 + 2as$

*Heat and matter*

*Conduction, convection and radiation*

Conduction – flow of heat through solids
Good conductors, good insulators
Water as a poor conductor of heat
Air as a poor conductor of heat
Improving insulation by means of air gaps between layers of clothes, roofs, walls
The thermos flask, hot box
Convection
Convection in water, convection in air
Sea breezes, land breezes
Convection in hot water heating systems (boilers)
Radiant heat – absorption of radiant heat
Emission of radiant heat
Black surfaces as better absorbers and conductors of radiant heat than other coloured surfaces
Experiment to demonstrate that black is a better emitter than any other coloured surface
Cooling fins in the radiators of cars, computers, large transformers
The greenhouse effect – explanation
Examples of greenhouse effect
Uses of greenhouse effect
The solar water heater and its working
Solar cookers and solar dryers

*Expansion of solids and liquids*

Demonstration to show how metal expands when heated
Separating two metal bowls stuck together by placing the outer vessel in hot water and pouring chilled water in the inner one
Testing the force of expansion and contraction
The need for allowing gaps for expansion in bridges, railway tracks
Why a hot rivet is used to make a tight joint
The working of a bimetallic strip used in thermostats
Linear expansivity – linear expansivity of different materials
Calculating linear expansion given the length of the material, its expansivity and change of temperature

Demonstration of the expansion of liquids
The irregular expansion of water
Volume change of water as it changes from ice at –20°C to water at 50°C – graph of this change
Density change in water as it changes from ice at –20°C to water at 50°C – graph of this change
Temperature gradient of water when the surface of water in a lake or tank is covered with ice – its effect on aquatic life

*Measuring temperature – the thermometer*

The fixed points of a thermometer – melting point of ice: 0°C; steam point of water: 100°C
The centigrade scale
The Kelvin scale or absolute scale
Converting from the centigrade scale to the absolute scale and vice versa
The effect of impurities on the freezing point of ice: adding common salt to lower the freezing point of ice
The effect of an impurity on the boiling point
Liquid in glass thermometers:
- Mercury in glass thermometers
- Alcohol in glass thermometers
- Clinical thermometers
- The maximum and minimum thermometer to record daily temperatures
  - Features and advantages of the maximum and minimum thermometer
- Thermocouple thermometers
  - Their principle, features, advantages

*Light*

Rays and shadows
Rectilinear propagation of light
The solar eclipse and the lunar eclipse
Reflection by a plane mirror
The laws of reflection
Lateral inversion due to the reflection by a plane mirror
Converging (concave) mirrors and diverging (convex) mirrors
The pole of a mirror
Centre of curvature
Radius of curvature
Principal axis
Principal focus of a concave mirror, convex mirror, virtual focus
Focal length
Relation between the focal length ($f$) and the radius of curvature ($R$) of a spherical mirror:

$$f = \frac{R}{2}$$

Spherical concave mirrors and parabolic concave mirrors
The caustic curve in spherical mirrors
The focus in parabolic mirrors
The shape of reflectors in torches and headlamps
Real images and virtual images
Ray diagrams to explain where images are formed due to concave mirrors and convex mirrors
The two rays necessary to locate an image due to a concave mirror
The two rays necessary to locate an image due to a convex mirror
The image formed by a concave mirror when
- a) the object is between the pole and the focus (as in magnifying glasses)
- b) the object is at the focus (to produce parallel beams as in a spotlight)
- c) the object is between the focus and the centre of curvature
- d) the object is at the centre of curvature (used as a reflector behind a projection lamp)

e) the object is beyond the centre of curvature
f) the object is at infinity (used to form images of distant objects as in a reflecting telescope)

The relation between *f, u* and *v* : $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$

The image formed by a convex mirror
Parallax and no parallax
Errors due to parallax when reading instruments

Magnification as the ratio of the height of the image to the height of the object $m = \frac{I}{O}$

Magnification as the ratio of the image distance to the object distance : $m = \frac{v}{u}$

Simple problems based on $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$ and $m = \frac{v}{u}$

*Forces, turning forces, centre of gravity and stability*

*Forces*

What is a force?
Names for different forces: weight, tension, contact force, expansion force, upthrust force, resistance e.g. air resistance, friction, magnetic forces, electric forces
Effects of a force
Measuring forces
The strength of earth's gravitational field (*g*)
Scalars and vectors
Adding forces – parallelogram law of forces
Adding forces at right angles
Resolving forces into rectangular components
Problems
Turning forces
The moment of a force
Calculating the moment of a force
Investigating the law of moments
Using the law of moments in calculations
Parallel forces
Parallel forces in equilibrium
Couples – the moment of a couple
Centre of gravity
The centre of gravity of regular shaped objects
The centre of gravity of irregular shaped objects
Stability – stable equilibrium, unstable equilibrium and neutral equilibrium
Designing stable objects

*Acceleration caused by gravity, Newton's laws of motion*

Background : Module on 'motion'
Revision of the three equations of motion :

$$v = u + at$$

$$s = ut + \frac{1}{2}at^2$$

$$v^2 = u^2 + 2as$$

Motion of a body in free fall
Acceleration due to gravity
Simple problems involving acceleration due to gravity

*Newton's II law: statement, explanation, mathematical form of the law*

The unit of a force: the newton, its definition
The two meanings of '*g*': *g* as the strength of the earth's gravitational field (9.8 N/kg)
*g* as the acceleration caused by gravity (9.8 m/s$^2$)
Although the value of g is numerically the same, it has a different meaning and a different use indicated by its unit :
Earth's gravitational field strength, 9.8 N/kg is used for calculating weights and
The acceleration caused by earth's gravity 9.8 m/s$^2$ is used for calculating velocities and distances fallen
Momentum and impulse
Momentum and Newton's second law:

Impulse = change of momentum or

The resultant force acting on an object $\propto$ the rate of change of momentum

Some actions explained by Newton's second law:

a) hammering a nail
b) packaging eggs in a box
c) crumple-zones and seat belts in cars

Calculations based on Newton's second law
Newton's I law : statement and explanation
Identifying phenomena involving Newton's I law

*Newton's third law of motion*

The law of conservation of momentum
Calculations based on the law of conservation of momentum

*Kinetic energy ($E_k$) and potential energy ($E_p$) :*

$$E_k = \frac{1}{2} mv^2$$

and $E_p = mgh$

*Conservation of mechanical energy :*

kinetic energy (K.E.) + potential energy (P.E.) = constant
Gain of K.E. = loss of P.E.
Loss of P.E. = gain of K.E.
Energy changes in a swinging pendulum

*Motion in a circle*

Centripetal force, centrifugal force
Circular motion in a vertical circle
Circular motion in a horizontal circle

*Pressure*

Force and pressure
Pressure
Unit of pressure

$F = pA$

Calculating pressure due to a force on a given area
Calculating the pressure due to fluid pressure
Pressure in liquids and gases
Pressure and depth
Pressure and direction
Pressure and liquid density
Liquid levels
Calculating pressure in a liquid

*Some effects and uses of pressure*

Sucking
The syringe
Rubber suckers
The Magdeburg hemispheres
The force pump
The lift pump
The bicycle pump

*Measuring pressure*

The U-tube manometer
The mercury barometer
The aneroid barometer

*Variations of atmospheric pressure*

Height above sea level
Changes in the weather

*Archimedes' principle*

Sinking and floating
Law of floatation
Hydrometers, lactometers
Calculations

*Machines, energy and power*

Work, energy, power
What is work?
Formula to calculate work from force and distance
The joule
Machines and energy – the transfer of energy
Power of a machine :

$$\text{Power} = \frac{\text{work}}{\text{time}}$$

Unit of power – the watt
Calculating the power of a pump
Calculations
Machines : force multipliers and distance multipliers
Force multipliers – examples
The terms effort and load on a machine
Mechanical advantage (MA) of a machine
Velocity ratio (VR) or distance ratio - formula
Distance multipliers, examples of distance multipliers

$$\text{Efficiency of a machine : Efficiency} = \frac{\text{MA}}{\text{VR}} \times 100\%$$

Calculations
Efficiency and friction
Ways of reducing friction
The principles of some machines:
Levers – load, effort and pivot in a lever
The three types of levers
Pulleys – single fixed pulley, single moving pulley, block and tackle
Measuring the MA and efficiency of a block and tackle pulley system
Inclined planes
VR in inclined planes
Measuring the MA of an inclined plane
Bolts and screws – their working

The wheel and axle – the working
Gears
- Driving wheel
- Driven wheel
- The working of gears
- VR of a pair of gears

Hydraulic machines
- Why liquids and not gases in hydraulic machines
- Working
- Advantages
- MA of a hydraulic machine
- Uses – the hydraulic jack, hydraulic brakes

*Some properties of matter*

Molecules in motion in a gas or liquid
Brownian motion
Diffusion
Solid, liquid and gas – the three states of matter
How molecules produce pressure
Surface tension – the effects of surface tension
Adhesive and cohesive forces
Capillary rise
Models of a solid
- Crystalline solids
- Other kinds of solids – amorphous materials, metals and rocks – polycrystalline solids

Vibrational model of solids
Stretching a spring
Graph of stretching force on a spring against extension
Extension  stretching force
The elastic limit and Hooke's law
Mechanical properties of solids – strength, stiffness, elasticity, plasticity, ductility, brittleness – what they mean.

*Heat, heat capacity and specific heat*

(Background required for this topic : Energy, joules, power, wattage)

The heat capacity of an object
Factors on which heat capacity depends
Heat capacity and specific heat capacity
The unit of heat or heat energy – the joule.

Formula to calculate heat capacity: Heat capacity = $\frac{\text{heat energy}}{\text{temperature rise}}$ or $C = \frac{Q}{\triangle T}$

The unit of heat capacity: joule/kelvin or J/K

Specific heat capacity of a substance = $\frac{\text{heat energy}}{\text{mass x temperature rise}}$ or $c = \frac{Q}{m\triangle T}$

The unit of specific heat capacity J/kgK
Specific heat capacity of various materials – the significance of these values
Why water takes a long time to get heated while the same mass of steel takes much less time
Relation between heat capacity and specific heat capacity : $C = mc$
Calculating the heat energy to warm up different things
Calculations

*Calorific value*

What is calorific value
The calorific value of various fuels

*Change of state, latent heat*

Fusion, vapourisation, condensation, solidification, sublimation
Latent heat of fusion
Latent heat of vapourisation
Effect of evaporation – demonstration using alcohol or petrol
Why water in a mud pot is cool
The principle of refrigeration
Specific latent heat of fusion
Relationship between specific latent heat of fusion, mass and latent heat of fusion (heat energy):

$$\text{specific latent heat of fusion} = \frac{\text{heat energy}}{\text{mass}}$$

Specific latent heat of vapourisation
Calculating the heat energy to melt or evaporate things

*Heat and matter : The gas laws*

Expansion of gases when the temperature is raised and the pressure is kept constant :

Charles' law $V \propto T$

Compressing gas at constant temperature : Boyle's law $V \propto \frac{1}{P}$

Heating a gas at constant volume – the pressure law : $P \propto T$

The gas equation : $\frac{PV}{T} = \text{constant}$

Calculations
Vapours
- Evaporation
- Vapour pressure
- Saturated vapour pressure
- Vapours obey gas laws when not saturated
- Saturated vapours do not obey gas laws

Evaporation and boiling
The effect of an increase in pressure on the boiling point
The effect of a decrease in pressure on the boiling point
The working of a pressure cooker

*Refraction of light*

Refraction when light passes from one medium to another
The angle of incidence, angle of refraction and normal at the point of incidence
Path of a ray passing from a rarer medium to a denser medium
Path of a ray passing from a denser medium to a rarer medium
Laws of refraction, Snell's law
Refractive index
- Absolute refractive index
- Relative refractive index

The reversibility of light – refractive index depending on the direction of the ray
Refractive index and the speed of light
Real depth and apparent depth
Refractive index in terms of real depth and apparent depth
Total internal reflection and the critical ray
Prisms
Optical fibres
Calculations on refraction
Dispersion of light – colours

The colours of a spectrum of white light
Producing a pure spectrum
Recombining the spectrum
Mixing colours
The primary colours, secondary colours, complimentary colours
Addition of colours of light
Subtraction of colours of light
The colour of an object
Mixing paints
The colour of a filter. (colour filters)
Colour television
The rainbow

*Lenses and optical instruments*

Lenses – various types of lenses
Investigating the properties of lenses
Lens definitions
Principal axis
Optical centre
Principal focus of a converging lens
Principal focus of a diverging lens
The focal length
The two principal focuses of a lens
Measuring the focal length of a converging lens
Ray diagrams – the three special rays used to draw ray diagrams
Ray diagram for the image formed by a converging lens when
a) the object is between the principal focus and the optical centre. (*As in magnifying glasses, instrument eyepieces, spectacles for correcting long sightedness*)
b) the object is at the principal focus
c) the object is between the principal focus (F) and 2F. (*As in projectors, microscope objective lenses*)
d) the object is at 2F. (*As in cameras to make equal sized copies*)
e) the object is beyond 2F. (*As in cameras and the eye*)
f) the object is at infinity. (*As in the objective lens of a telescope*)
Ray diagram for the image formed by a diverging lens. (*As in the eyepiece of some instruments and in spectacles to correct short-sightedness*)
The lens formula $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$
Magnification $m = \frac{I}{O}$ and $m = \frac{v}{u}$
The power of a lens
Unit for the power of a lens : the dioptre
The structure and function of the eye
The retina
The eye lens and focusing
The iris and light control
Binocular vision
Persistence of vision
Normal vision range, accommodation of the eye
Myopia or short sightedness
Hypermetropia or long sightedness
Presbyopia – lack of accommodation of the eye
Astigmatism
Colour blindness
Detached retina

Optical instruments
- The pinhole camera
- The lens camera
- The projector or enlarger
- The magnifying glass
- The compound microscope
- The astronomical telescope
- Magnification
- Prism binoculars
- The reflecting or Newtonian telescope

*Sound and oscillations*

Longitudinal waves and transverse waves
How sound is produced
Sound is propagated through a medium
Sound as longitudinal waves
Wavelength
The speed of sound
Frequency of sound waves
The relation between the speed of sound, frequency and wavelength
Echo location in some animals such as bats

*Static electricity*

Charge – friction and charge
- Charging various materials by rubbing them with different materials
- Two kinds of charge : negative charge, positive charge
- Properties of charges
- Testing whether a material is charged or not

Where does charge come from?
- Conductors and insulators, earthing, testing materials for conduction
- Charging by contact, charging by sharing
- What happens when a charged conductor touches an uncharged conductor?
- The gold-leaf electroscope, its working, uses
- Testing the sign of the charge on an object
- Charging by induction
- Charging a gold-leaf electroscope by induction
- The electrophorus
- The charge distribution on the surface of a conductor
- Charge density
- Charge on a hollow conductor – investigating hollow conductors
- Faraday's ice-pail experiment
- Experiments with a Van de Graaff generator
- Blowing a candle flame with an 'electrical wind'
- The lightning conductor
- An electrostatic precipitator
- Detecting finger prints on a surface using a charged powder
- Electrical fields and forces
- The force between charged objects

*Electric currents*

Rationale for the section on electric currents
From the point of view of the RCD this section on electricity and magnetism is mainly for the student to get the necessary understanding of the working of electrical motors. Also, there are other topics that would be of use to anyone working on a farm.

Static charge and electric current
Conventional current and electron flow
Electric circuits – drawing circuit diagrams
Symbols for common devices in electrical circuits
Open circuits, closed circuits
Conductors and insulators
Series and parallel connections of conductors
Electric current and charge: relation between current I and charge Q :
The unit of current and the unit of charge
Measuring current in a series circuit
The current at a junction in a circuit : Kirchoff's first law
Potential difference, p.d. or voltage – its meaning
Earth potential
Using a voltmeter
    As a 'cell counter'
    In a series current
    In a parallel circuit
The relationship between voltage, work and energy in a circuit
Electrostatic force of a cell
Resistance
Measuring resistance
Ohm's law
Unit of resistance, the ohm
Practical resistors : various types of fixed resistors
Variable resistors or rheostats
    Using a rheostat to vary the current in a circuit
Using a voltage divider or potentiometer
Characteristic (curve) of a conductor
Ohm's law and the characteristic of a conductor
Characteristics of a few conductors :
    The ohmic conductor
    Filament lamp
    Thermistor
    Thermionic diode
    Ionic solution or electrolyte
    Gases
    Semiconductor diode or p-n junction (silicon)
Circuit calculations for
    Parallel circuits
    Series circuits
    Mixed parallel and series circuits
Using ammeters and voltmeters
Shunts
The multimeter: using a multimeter
Resistivity
Factors on which resistivity depends
Resistance and resistivity
Electrical energy and power
    The heating effect of an electric current – factors on which heating depends
    Power – definition
    Formulas to calculate power in a circuit
    Calculations

Capacitors
- The principle of a capacitor
- Capacitance and units of capacitance
- Various types of capacitors
- Charging and discharging a capacitor
- The effect of a capacitor on direct current
- Measuring the charge stored in a capacitor
- The capacitor formula: Q = CV
- Calculating the charge stored in a capacitor
- The effect of a dielectric on the capacitance
- Calculations

Cells and batteries
- Various types of cells
- Primary cells, secondary cells, solar cells
- Choosing a cell or battery for a particular application
- Principle of a cell – electrodes, e.m.f. (electromotive force) or voltage, capacity, internal resistance, short circuit current in a cell
- Calculations

Magnetism and electromagnetism
- Magnetic materials
- Properties of magnets
- Magnetic induction
- Permanent and temporary induced magnetism
- Special magnetic materials
- Magnetizing a steel bar by magnetic induction
- Theories of magnetism
- Demagnetising magnets
- Uses of permanent magnets

Magnetic fields and forces
- What is a magnetic field?
- The direction of a magnetic field
- Using a plotting compass to draw the map of a magnetic field
- Making a map of a magnetic field using iron filings

The magnetic effect of an electric current
- Oersted's experiment
- Magnetic field pattern due to a current in a straight wire
- Maxwell's screw rule
- The right-hand grip rule
- Magnetic field due to the current in a flat coil
- A solenoid
- The magnetic field pattern due to a solenoid
- The solenoid with an iron core
- Effect of the number of turns and current in a solenoid
- The earth as a magnet
- The angle of declination
- The dip circle, angle of dip

Electric currents in a magnetic field
- Effect of a current carrying wire in a magnetic field (catapult force)
- Fleming's left hand rule
- Measuring the catapult force with a current balance
- Factors on which the catapult force depends
- Catapult force $F = BIl$, where $B$ is the magnetic field strength, $I$ is the current and $l$ is the length of the wire

Hence calculating the magnetic field strength $B = \frac{F}{Il}$

Unit of magnetic field strength (tesla)

Calculations

Force between parallel wires carrying currents

Another definition of ampere.

Electromagnetic induction

Electromagnetic induction: electric current induced in wires by magnetic fields

The dynamo or generator effect

Electromagnetic induction using a coil and a magnet

The direction of the induced current: Lenz's law

Fleming's right-hand dynamo rule

Faraday's law of electromagnetic induction

The e.m.f. induced in a coil is directly proportional to the number of turns

Applications of magnetism and electricity

Lighting - devices their working, advantages and disadvantages :

The filament bulb

Fluorescent lamps

LEDs

Sodium, mercury and neon vapour lamps

Electromagnets used for lifting very heavy things

The electric bell

Relays

Reed switches

Moving coil loudspeakers

Making a simple d.c. motor

Electric motors which run on alternating current

Motors for different jobs

Motors with brushes and commutators

Motors without brushes and commutators

Converting sound to electricity in a microphone

An a.c. dynamo or alternator

Peak and r.m.s. (root mean square) values

Practical a.c. generators or alternators

Three phase alternating suppliers

A bicycle dynamo

Electromagnetic damping : eddy currents, emergency brakes

The principle of the induction motor

Electromagnetic induction without motion : induction coils and transformers

The induction coil and its working

Transformers: step up and step down transformers and their working

Power transfer in a transformer

Efficiency of a transformer

Power losses in a transformer and how transformers are designed to reduce power losses

The national power grid

The network of cables which link all the main power stations

Reducing power loss in transmission lines: why a.c. high voltage is used for transmission

Electricity in the home

Mains supply to houses in India – a.c. supply – advantages and disadvantages.

Colour codes of wires in the home

Power requirements of various household and farm appliances

Household wiring

Consumer units or fuse boxes
Miniature circuit breakers (mcb's)
Earth leakage circuit breakers (elcb's)
The main fuse
Earth wires
Double insulation
House wiring circuit diagram
Calculating the cost of electricity: Units of electricity – the kwh unit
Safety precautions with electricity in the home or on the farm

*Electricity in an automobile*

Generating and storing electricity in an automobile – the alternator and the dynamo
Simplified wiring diagram in an automobile
The car battery
Care of lead-acid batteries
The capacity of a lead-acid battery
The starter motor and its circuit
Fuses in an automobile
Fuel gauges, temperature gauges, the speedometer

*Atomic structure*

Various models of atoms
Alpha rays, beta rays and gamma rays – their properties
The constituents of the nucleus: protons, neutrons and their properties
Electrons and their properties
The atomic number. mass number
Isotopes and nuclides
Radioactivity
Three different types of radiation
Detection of these radiations
Properties
Radioactive decay of atoms
Half life
Decay series
Nuclear changes during radioactive decay
What makes a nucleus unstable
Radioactive dating
Carbon dating
What is ionizing radiation
How are people exposed to ionizing radiation
The effects of radiation on people
Precautions for people
Use of irradiation in agriculture – consequences
Radioactive tracers and their use in agriculture

*Alternative sources of energy*

Solar energy
The source of the sun's energy
Various means to harness solar energy
Wind energy
Hydroelectric energy
Microhydel power
Geothermal energy
Wave energy
Tidal energy
Biofuels

*Communication Devices*

The working of a telephone
Broad description of the working of the amateur (HAM) radio
Broad description of the working of television sets and television transmission
Broad description of the working of mobile phone systems
The internet and its broad working

*The electromagnetic spectrum*

The visible part of the electromagnetic spectrum
Above visible light : ultraviolet rays, X-rays and gamma rays
Below visible light : infrared light, radio waves, microwaves, UHF and VHF radio waves
The use of ultraviolet rays in tissue culture and other biological techniques related to farming

Note: For resources see page 141

# RESOURCES

*Middle Level and Upper level general resources*

A note on www.arvindguptatoys.com

This website contains downloadable resource material in pdf, word and video format on a wide range of topics covered in school level education. There is much material that encourages children to learn through experiments by making their own toys, tools and equipment using everyday material, mostly scrap and waste. Arvind Gupta's own books written for children bring in the play element into the understanding of many natural phenomena and laws of nature.
Before beginning to look for learning resources for almost any topic in school education, it would be worthwhile to become familiar with what is available on this website. It is very likely that one may not have to search further for good material. This website is being constantly updated with more and more resource material. CDs are available from Arvind Gupta directly. He may be contacted by email at arvindguptatoys@gmail.com.

1) *New UNESCO Source Book for Science Teaching* published by Universities Press (India) Limited. May be purchased through www.flipkart.com. The book is available as a free download from UNESCO's website. Contains a large number of experiments on physics, chemistry, biology and earth and space sciences. Excellent resource for experiments. Suitable for Middle and Upper levels.

   The previous edition titled *UNESCO Source Book for Science Teaching* was mainly developed for making simple equipment and for carrying out experiments using locally available materials. The book has since gone through several reprints and has been translated into thirty languages. Copy for reference is available with Taleemnet.

2) *The Green Sprout Journey* by Satoko Chatterjee published by Earthcare Books, Kolkata, 2009 is the story of a mother trying to stimulate environmental awareness in her two children within the space of their home and garden. The book is a store house of diligent recording of observations by her children. It outlines in detail various activities that can be used to initiate children into gardening and related activities which would serve them well in later years in farm related activities and responsible citizenship.

3) *Our Land Our Life – A Practical Course of Agriculture and Environmental Education* (Books for classes 6, 7, 8) published by Uttarakhand Seva Nidhi Paryavaran Shiksha Sansthan, Almora, fifth edition, 2009. These three books are strongly recommended at middle level and partly at Upper level as they offer a suitable build up to the detailed and advanced topics within the Farming Related Modules. In the three books one will find topics that introduce children to all modules on Farming Fundamentals; the following modules on Farm Related Technology: Watershed Based Approach to Land Management (Contours, A-frames), Understanding Energy, Appropriate Technology and Civil Constructions: Constructing Bunds, Pits, Compost Areas, Checkdams, Trenches, Tanks, Masonry Work, Sheds, Biogas Digesters; and some of the modules on Supplementary Farming Activities: Post Harvest Processing, Animal Husbandry: (Cattle Rearing), Ethno veterinary Practices, Essentials: (Food and Nutrition).

   The complete series for classes 6 to 10 is available on the website www.ueec.org.in as free downloads. Books for classes 6, 7, 8 are available for reference with Taleemnet. The books are presently used in all government schools in Uttarakhand as part of their course of study.

4) *Hamare Jaunpurke Paed Paudhe* (Hindi) Volume.1 Part I and II by the children of SIDH, Uttarakhand, published by Society for Integrated Development of Himalayas (SIDH), Mussoorie, 2001.

   A compilation of the biodiversity documentation, indigenous knowledge and village history undertaken by the children of SIDH School, Uttarakhand. May be used with suitable adaptations for other areas.

5) *Let us Protect our Environment by* Narayan Hegde published by BAIF Development Research Foundation, Pune, 1991. www.baif.org.in
   Introduces children broadly to various aspects of the environment.

6) *What on Earth is Energy?* By D.P. Sen Gupta published by NCERT, New Delhi, 1989. Contains energy related explanations, often in story from.

7) *The Raindrop* by Priti Jain et al published by Centre for Science and Environment (CSE), New Delhi,1993. The Raindrop is the story of the village Sukhomajri and its regeneration.

8) *Naina's Village* by Feisal Alkazi et al published by Centre for Science and Environment, New Delhi,1993. This book is about the close relationship between the forests and the life of the people in an Indian village.

   These two books (No. 7 & 8) are part of a series of 10 books published by CSE for children on environment. These books are based on real happenings related to environmental issues in rural India. The rest of the series and many more such books may be found on their website.

9) *Understanding Carbon Footprint* by Deepika G Prasad published by Hasiru Hejje, Mysore Amateur Naturalists (R), Mysore, 2009.

   An easy to understand book on climate change and carbon footprint.

10) *Technology and Children* by P.K Bhattacharyya published by NCERT, New Delhi, 2004. Contains several technological innovations by children for everyday use.

### *Middle and Upper level Biology*

1) *Biology GCSE edition* by Geoff Jones and Mary Jones
   This book introduces the learner in very simple language to basic biological concepts. Suitable for the Upper level. However, many of the plant and animals mentioned are native to the UK. The reason it is recommended here is because of its simple clear language and novel approach. This book is sold under different titles. May be purchased through www.flipkart.com

2) *Biodiversity: Nurture Nature for Our Future (Activity Guide)* published by NCSTC-NETWORK New Delhi, 2006

   This book contains several activities suitable for Middle and Upper level. Biodiversity being its theme, most of the activities can be suitably adapted for understanding ecological concepts in rural and farm habitats.

   A copy of the book would be available for reference in local science centres that coordinate the Children's Science Congress activities. Reference copy available with Taleemnet.

3) *Environmental Education: A Book of Activities (Climate Change, Natural Resources,)* published by Centre for Science and Environment (CSE) New Delhi 2011.

   The book introduces children to climate change in the context of its impact on natural resources. The human element in these issues is clearly brought out through activities.

4) *Glimpses of Plant Life Part I and II* published by NCERT, 2001

   These two low cost books are excellent reference books for introducing children to the world of plants and trees.

5) *Our Tree Neighbours* by Chakravarti S. Venkatesh, published by NCERT 1976.

   A good resource for children for identification of common trees.

6) *Simple Tasks Great Concepts* published by NCSTC (National Council for Science and Technology Communication) contains one hundred simple experiments for understanding concepts related mostly to biology. The book may be obtained from NCSTC. On the internet, the experiments are available for viewing and as downloads from http://simpletasksgreatconcepts.wordpress.com/

7) *Laboratory Manual: Biology for class XI, XII*, published by NCERT, New Delhi, 2010.

   These are good laboratory manuals for topics in botany and zoology. The books are well written and contain attractive coloured pictures and diagrams that cover most topics in basic biology. Highly recommended as guides for practical work.

8) *Science* textbook for class VI, published by NCERT, New Delhi, 2006.

9) *Science and Technology* test book for class VII (2003), VIII (2004) and IX (2002), published by NCERT, New Delhi.

10) *Science for Tenth Class (Part-3) : Biology* published by S Chand and Company Ltd. New Delhi, Revised edition 2007

11) *Pradeep's a Textbook of Biology for XII* by P. S. Dhami, H. N. Srivastava and G. Chopra may be referred to for an in depth study of various topics. Written in text book format, topics are presented in simple and straight forward language with abundant illustrations.

12) *Satpada: Our World of Insects* by Rebecca Thomas and Geetha Iyer, published by Rishi Valley Education Centre, Krishnamurti Foundation, 2009. Written by teachers of biology with several years of experience, this book introduces the children to the wonderful world of insects.

*Bombay Natural History Society, Botanical Survey of India, Zoological Survey of India, Centre for Environment Education, Centre for Science and Environment, National Book Trust, NCERT, Homi Bhabha Centre for Science Education and World Wide Fund for Nature have publications that children will enjoy reading.*

*Sanctuary Asia publishes the Sanctuary magazine and the Sanctuary Cub magazine on nature and wild life. Gobar Times comes as a supplement with the Down to Earth magazine, a CSE publication, addressing the young reader on contemporary environmental issues.*

## *Middle and Upper level Chemistry*

1) *Chemistry* by J. A. Hunt and A. Sykes published by Longman. Contains a practical and modern approach to chemistry. Suitable for Upper level.

2) *Middle School Science: Chemistry* by D.N. Verma and B.G.Pitre, published by Orient Longman. Suitable for Middle level.

3) *Modern Secondary Chemistry* by D.N. Verma and B.G.Pitre, published by Orient Longman. Suitable for Upper level

## *Middle level physics*

1) *Let's Discover Science* Books 1 to 5 by David Horsburgh

2) *Learning about Living Books* 1 to 5 by David Horsburgh

3) NCERT Science textbooks for classes 6, 7 and 8

## *Upper level Physics*

1) *The World of Physics* by John Avison
An excellent book for the Upper level if one is really interested in understanding physics.

2) *Physics for Today and Tomorrow* by Tom Duncan

3) *IGCSE Physics* by Tom Duncan and Heather Kennett
The books by Tom Duncan are very brief but simple and easy to use.
These books are sometimes available with Indian publishers at a much lower cost than the imported edition. The imported editions are more freely available through www.flipkart.com

**Puvidham**

In Puvidham, a rural school in Dharmapuri district in Tamil Nadu, the curriculum up to the middle level is theme based. All concepts are built around observation and experience of phenomena in relation to the five elements i.e. sun (heat/ light), water, earth, air, space. They are transacted in the form of modules.

Ms Meenakshi, the school's founder and head says, "Concepts take time to be understood, internalised and assimilated. In the early years the five senses are used to develop these. Observation and experiences are important at this time. What is observed and experienced through numerous activities, which are mostly outdoors, is then concretised in the form of song, poems and drama that the teachers together with the children co-create. Each year every class spends roughly about a month on each element (module). There is no distinct division into specific subjects, but all subjects are covered. e.g. In the Sun module very young children may relate to the Sun as the source of light; yellow in colour; round in shape; forms shadows of different sizes at different times of the day; clear or cloudy sky etc., while at the middle school level the Sun module may tackle energy, fossil fuels, discovery of fire, history of man and civilizations, myths, seasons, the solar system etc."

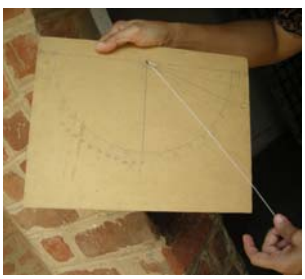
She contends that it is essential to teach language (specially reading and writing skills) and mathematics using established methods and pedagogy. However, many a time children naturally come across certain aspects of numbers - like fractions - while doing an activity on estimating and measuring lengths. The teacher at such times should be alert to this discovery and must not lose the opportunity to introduce the mathematical concept of fractions.

At Puvidham, children learn in Tamil and English. Tamil, the mother tongue, is encouraged while English is seen as an essential tool to deal with many aspects of contemporary and practical relevance. Children from Puvidham join the local Government school at class nine.

Farm related activities are not directly dealt as such at the lower level, although children tend a garden, learn to test the pH of food and soil, let the chickens out of the coop, play with the sheep, mulch and compost from the very early years. Older children are more adept. Taking care of the bio-gas unit, attending to the cow-house etc. is all part of a day at school. The school is powered by solar energy and uses dry compost toilets.

According to her there are two things that children do as part of the learning process in schools: one, mindlessly regurgitate what is heard or taught and two, absorb/internalise what is experienced. It is the second that an educational programme should strive for.

Learning about the elements through the senses, Meenakshi believes, not only sets the learner on a firm footing for farming and related activities but also nurtures the value of ecologically responsible behaviour. Children learn that everything needs care and that all things are inter related. To her this is of great value. For Meenakshi it is important that children be nurtured in an ambience of love, friendship and happiness so that they will live it in their adult lives.

Pictures (L to R) Meenakshi looks on at rehearsals, device for measuring heights, Mahua milking, learning to measure contours with an A-frame

# GEOGRAPHY

***Middle level 1, 2***

*Maps and map reading*

Identify east and west from the sun's rising and setting (exercise prior to map reading)
Identify north and south after the east and west have been determined (exercise prior to map reading)
Locate one's position – village or town on a map
Identify north, south, east and west on a map
Be able to make sketches of the local geography
Identify the nearest major towns and cities around one's town or village
Recognise map symbols
Identify the hills nearest to one's town or village on the map
Identify the nearest rivers nearest to one's town or village
Identify the Arabian Sea, Bay of Bengal and Indian Ocean on the map
Know that on a map, water bodies are shown in blue
Locate and name all the hill and mountain ranges of India
Locate and name the states and major cities of India
Identify and name the major continents of the world on a map
Identify and name the major oceans of the world on a map
Map scales
Extract information from maps
Measure straight and winding distances
Identify plains, plateaus and hills

*Astronomical geography*

The solar system – the sun and the planets, satellites
The shape and size of the earth
The motion of the earth – rotation and revolution
Direction of rotation, speed of rotation
Rotation and its consequences – day and night, variations in temperature
The plane of revolution of the earth and the axis of rotation – the inclination of the earth's axis
How the inclination of the earth's axis is constant during its revolution around the sun
Effects of the inclination of the earth's axis
The revolution of the earth round the sun – the elliptic orbit of the earth's revolution
Effect of the revolution of the earth – occurrence of seasons, variation in the duration of day and night at different times of the year
Solstices and equinoxes

*The globe - location of places on the earth*

The equator
Latitude – the distance of a place north or south of the equator measured as an angle whose apex is at the centre of the earth
The angle (latitude) between the equator and the poles – the largest value of latitude
Important parallels of latitude – the equator, the Tropic of Cancer, Tropic of Capricorn, Arctic Circle, Antarctic Circle
The use of latitude to predict the natural conditions of a place
Location of the torrid or tropical zone
Location of the temperate zones
Location of the frigid zones
Longitude – the Prime Meridian or Meridian of Greenwich
The longitude of a place
East and west longitudes

The maximum value of longitude
Locating the position of a place on the earth from the latitude and longitude

*The earth's surface*

Various rock groups – igneous, sedimentary and metamorphic rocks, examples of each type of rock
Plate tectonics – the crust of the earth made up of mobile plates. Seismic activity at plate boundaries, examples of such activity
The breakdown of rocks by various weathering processes
Erosion
Various soils – sand, clay and loam. Examples of places with such soils
Map of India showing various types of soils

*The weather and atmosphere*

Solar energy as the earth's main source of energy
This energy is distributed unequally, with large amounts of heat at the equators and less heat as we move away from the equator to the poles
The unequal heating leads to the movement of air and ocean waters
The monsoons in India – how they are produced every year from June to September
The receding monsoons and how they are produced from October to January
Some weather characteristics
- Temperature
- Humidity
- Atmospheric pressure
- Wind force
- Wind direction

Understanding the regularities and patterns in weather conditions enables forecasts to be made
Difference between weather and climate
Regularities of weather conditions over considerable periods of time over large areas of the earth's surface enable identification and classification of climate types

Climate types resulting from the influence of
- Latitude
- Distance from the seas and oceans
- Altitude
- Prevailing winds and air masses

Broad climatic divisions of the world
- Tropical climates (Hot)
  - Equatorial
  - Savannah
  - Tropical monsoon (Indian monsoon)
  - Hot desert
- Sub-tropical climates (Warm)
  - Warm temperate east coast climates
  - Mediterranean climates
  - Temperate grasslands
- Temperate climates (Cool)
  - West European type or cool temperate oceanic
  - Cool temperate east margin type
  - Cool temperate central type or Siberian type
- Polar climates (Cold)
  - Tundra type
  - Boreal type

The effect of burning of fuels exhausts from factories and other pollutants on the atmosphere – greenhouse effect

***Upper level 1, 2, 3***

*Astronomical geography*

The solar system and the sun as the centre of the solar system with 9 planets revolving around it
The asteroids, their location in the solar system
Comets and their paths around the sun
Names of a few famous comets
Meteors
The stars, a few prominent stars and constellations in the night sky
The Pole Star, finding north from the Pole Star
Finding the latitude from the Pole Star

*The sun, moon and the tides*

The sun, the source of the sun's energy
The moon, its distance from the earth, its revolution round the earth and around the sun
Its period of rotation and period of revolution round the earth, how it keeps the same face turned towards the earth
The lunar month
The phases of the moon
The moon rises about 52 minutes later everyday
Lunar eclipses
Solar eclipses – partial, total and annular
The tides, cause of the tides
Spring tides and neap tides
The effects of tides

*The earth*

The shape and size of the earth
Proof of the earth's shape
The size of the earth
The oceans, their locations and sizes
The continents, their locations and sizes
Motions of the earth – rotation and revolution
Effects of rotation
The earth's axis, its tilt of 66.5 degrees to the plane of the earth's revolution round the sun
Effects of the inclined axis
Time for one revolution round the sun
The leap year
Effect of the revolution of the earth
Solstices and equinoxes

*Locating places on the earth*

The latitude and longitude
The division of a degree into minutes and seconds
What is latitude?
The equator
One degree of latitude is equal to 111 km approx
The Tropic of Cancer, Tropic of Capricorn, Arctic Circle, Antarctic Circle
How to find the latitude of a place from the sun
Climatic zones – the tropical zone, temperate zones, frigid zones

*Longitude*

The Prime Meridian
What is longitude, its values east and west of the Prime Meridian
Longitude and time

Local and standard time, the need for standard time
Great circles and great circle routes
The International Dateline

*The structure of the earth*

The crust, mantle and core

*Types of rocks*

Igneous rocks
- Extrusive (volcanic)
- Intrusive (Plutonic)

Sedimentary rocks
- Mechanically formed
- Chemically formed
- Organically formed

Metamorphic rocks

*Plate tectonics*

The major plates on the earth's crust
Movement of the plates
Joints, folds, faults
Relief features of the earth due to the movement of plates
Earthquakes, causes of earthquakes, effects of earthquakes
Areas of the earth liable to earthquakes
Volcanoes
Causes of volcanoes
Various features and parts of a volcano
Various types of volcanoes, stages of volcanoes
Distribution of volcanoes on the earth
Volcanic activity and soil fertility, why many civilizations flourished near volcanoes

*Forces that sculpt the earth's surface*

The various forces at work on the earth's surface – the processes of denudation, transportation and deposition
- The work of running water
- The work of rivers
- The work of the sea, glaciers
- The work of wind

Ground water
- Pervious rocks, impervious rocks and aquifers
- The water table
- Springs, wells. Artesian wells, geysers

Major types of landforms – mountains, plateaus, plains
- The formation of mountains, types of mountains
- Distribution of major mountain ranges on the earth's surface
- Mountains and hydel projects
- Plateaus – various types of plateaus
- Distribution of plateaus on the earth
- The Deccan Plateau, its location in India, cause of its formation
- Features of the Deccan Plateau
- Various types of plains
  - Alluvial plains
  - Lacustrine (Lake) plains
  - Lava plains
  - Glacial plains
  - Plains of Denudation
  - Coastal Plains
  - The benefits of plains for human settlement

*The atmosphere*

- Composition of the atmosphere
- Layers of the atmosphere, the main features of each layer

*Weather and climate*

- The difference between weather and climate
- The main elements of climate – Temperature, pressure, winds and precipitation
- Recording air temperature
- Factors affecting air temperature over the earth's surface
- Range of temperature – factors affecting range of temperature
- World distribution of temperature
- The main factors controlling the climate of a region

*Pressure and movement of the atmosphere*

- Air exerts pressure
- How pressure is measured
- Factors on which air pressure depends
- Relation between pressure and air currents
- Pressure belts of the earth
    - Equatorial low pressure belt
    - The sub-tropical high pressure belt
    - The circum-polar low pressure belts
    - The high pressure belts at the poles
- The swing of the pressure belts
- Consequences of shifting pressure belts
- The movement of the atmosphere
    - Planetary winds
        - The Doldrums
        - The Trade Winds
        - The Prevailing Westerlies
        - The Polar Winds
    - Local and regional winds
        - Sea breezes, land breezes, their causes and effects
        - Other local winds like Khamsin, Mistral, Sirocco, Loo (of North India)
    - The monsoon winds, their causes, effects and importance
    - Cyclones and anticyclones
    - Jet streams at heights between 9,000 metres and 15,000 metres

*Water vapour in the atmosphere – precipitation*

- Clouds, types of clouds
- Humidity, effects of humidity
- How rainfall occurs, dew point, lapse rate
- Types of rainfall – relief rainfall, convectional rainfall, cyclonic rainfall
- The windward side of a mountain and leeward side of a mountain (rain shadow area)
- Regions in the windward and leeward side of hills in India
- Thunderstorms
- How rainfall is measured
- Factors determining rainfall
- Other forms of precipitation – snow, hail, dew, frost, fog, mist
- Interpreting climate data

*Weather study - meteorology*

- Meteorology and its importance
- Instruments used by a weather station
- Space satellites in the study of the weather
- Meteorological stations and their importance

*The hydrosphere*

- The oceans
- The shape of the ocean floor
- The major oceans
- Life in the ocean
- Sea water, salinity
- Ocean currents
  - Causes of ocean currents
  - Effects of ocean currents
  - Major surface currents of the ocean
  - The currents of the Indian ocean

*Broad study of major climate types and natural vegetation of the earth*

*Map study*

- A globe
- A map
- Importance of map study
- Map projections
- Kinds of maps
- Topographical maps
- Cadastral maps
- General or atlas maps
- Wall maps
- Political maps
- Physical maps
- Distributional maps
  - The dot method
  - The shading method
- Climate maps
- Temperature and rainfall maps
  - Line graphs
  - Bar graphs
- Scales
- Finding directions
- Orienting a map
- Finding directions by means of a magnetic compass
- Grid reference
- Measuring distances on maps
- Contour maps
- Symbols on contours maps
- Identifying various relief features from contour maps
- Drawing information from topographic sheets

# RESOURCES

1) *Learning about Living Books 1 to 5* by David Horsburgh. Published by Oxford University Press, the book is presently out of print. A book of environmental studies dealing with every aspect of the child in its environment and eventually in the environment of the whole world. It sets a sound foundation in social aspects that make for responsible living. Being an activity based book, it lays the foundation for learning geography. It also sets a good foundation for environmental and social science. Some parts of books 4 and 5 may be useful for middle level 1 and 2.

   A reference copy is available with Taleemnet and Vikasana School, Bangalore. Some of these books are available as a free download from www.arvindguptatoys.com

2) *Principles of General Geography* by Charles Farro, published by General Printers and Publishers, 263/F Rajaram Mohanroy Road, Girgaum, MUMBAI 400 004

   Good reference book for Middle and Upper level. Covers almost all key elements of geography. However, the sample study topics are outdated and irrelevant to Indian conditions and may be safely dropped.

3) A good atlas is a very important resource when studying geography and must be used extensively. Topographic sheets are available from the Survey of India. www.surveyofindia.gov.in

4) *Textbooks in Geography* for classes 6 to 10 published by NCERT, New Delhi. Each of these books are thematically organised and deal with different topics such as physical and astronomical geography, economic geography and contemporary issues of local and global significance. Contains a lot of up to date interesting information.

5) The website www.earth.google.com may also be used in the study of geography.

6) National Geographic and Discovery TV channels regularly air programmes on geography. Their websites are rich sources of information. CDs and DVDs on various topics are also available.

## Voices from the Field

### Nai Talim Institutions

Everyday life at the Ashram

### Laxmi Ashram, Kausani, Uttarakhand

Laxmi Ashram was created 70 years ago by Sarla behan who was strongly influenced by Gandhiji. Buniyadi Talim is the basis for education at this ashram for girls. At Laxmi Ashram girls live and learn from life which revolves around self-reliance and self-sufficiency. All activities emanate from the needs of the land and the needs of the inmates of the ashram. The girls are experts at all activities related to farming. Laxmi Ashram attracts many interns who come for short or long periods from within the country and outside to learn from its rich experience. It has played a significant role in many national level peoples moments including the famous Chipko Andolan.

Neema Vaishnav and David along with a team of senior ashramites lead this institution.

### Majhihira National Basic Educational Institution (MNBEI), Purulia, West Bengal

The MNBEI is one of the oldest Nai Talim institutions in the country and has stood steadfast inspite of the vagaries of political times. The curriculum offers a fine blend of academics and hands-on work to the children of the nearby villages.

Chittabhushan and Malati Dasgupta - founders of MNBEI

David explains the keeping of weather records at the Ashram

Neema Vaishnav (3rd from left) with the girls on their annual trip to the Himalayas

# UNDERSTANDING HISTORY

History is the study of past events and people who shaped those events. By understanding past events, how they occurred and their consequences one can better understand and deal with current situations. Understanding causes and effects of human actions in the past provides us with an understanding of our human nature. Events of the past may help us to understand how we have shaped our lives. Oral testimonies and traditions handed down from generation to generation and recorded facts form important tools for the understanding of history.

Unlike the study of natural and physical phenomenon which is detached from the person, history deals with evens that are a consequence of human action. Documentation of history can be greatly influenced by personal perceptions.

It is of educational value to understand history rather than study history. The study of history as is conventionally done involves memorisation of facts and figures. It is full of information (not knowledge). The understanding of history is rather an internalisation process. History is made over time by human societies. Its understanding helps in understanding society of which humans are a constituent part. It allows insights into how a society is structured, managed, governed and the forces that transform and decide its course.

The immediate family, neighbourhood, community/village, town/city offer a ready platform for understanding of history. It is important that children become familiar with this aspect of their lives. Apart from giving them a sense of rootedness and belonging in who they are, it introduces them to the basic units that make up the larger society. Oral knowledge traditions, indigenous life and livelihood practices, traditions, contemporary trends, local nuances of language become vital components.

Is there a real need to study past events, and why must children study them? If one is interested in understanding the present culture or how a society is living today, then one will need to examine the events in the past that have shaped the present. There is a natural process of change but many a time an external intervention may result in unforeseen consequences/changes. How societies take a particular course depends on numerous factors or it may be that one factor may influence many spheres in society. For example technology has brought about several changes in the way we live, dress, communicate, learn, travel, entertain ourselves etc. Also there is a natural process of change. History need not be only about people. It can also be about natural events, technology, architecture, design, forests, various traditions etc. If children can consciously observe change, they then will be witness to the creation of history in their own life time.

*Lower level 1, 2, 3, 4, 5*

The main objective at this stage should be for the child to develop a strong feeling of belonging, rootedness and security. Being at an impressionable and receptive age, children imbibe habits, mannerisms and attitudes from the immediate family and the neighbourhood. It is a good phase to introduce children, at this stage, through various activities to ones natural, social and cultural environments with the accompanying understanding of the connection between events of the past to their present reality. Family relationships, village dynamics and regional histories become vital components in developing an understanding of one's society and environment. Values by which to conduct oneself, care of self, private and public property are best inculcated early. The idea that society extends beyond ones immediate neighbourhood and that interactions between persons and towns outside one's own immediate sphere have an influencing role in one's life may be brought to light at this stage. It is important that children learn to observe "change" in every aspect of life around them. The skill of being conscious that changes in every sphere are constantly taking place around them may be inculcated during the later years at the lower level.

*Middle level 1, 2*

At this stage children may be exposed to various activities and dedicated projects that involve travel, visits, reading, watching motion pictures and documentaries, small research projects and documentation. Philately, a fascinating hobby, can be used to expose children to a range of topics that help in understanding history – local, regional, national and global. Associating with local heritage clubs and participating in community events are valuable experiences at this stage. Children may also

be simply introduced to the functioning and dynamics of social and political institutions and processes within the local, regional and national context.

*Upper level 1, 2, 3*

The "study" of history at this level can provide an opportunity to engage with the events of the past at a sophisticated level. How history has been abused by people in power, used for nation building since the 19th century, has justified wars for territory, played a role in communal disharmony, etc. Political history would offer investigative journeys into how society is shaped by political decisions; its direct relation to power, justice, equity, hunger, disease, death, war, peace... while the socio-cultural aspects of history would cover critical concepts of sociology, geography and anthropology. For those interested, this could be a phase to undertake critical investigations of historical events; how these events transformed society and civilizations. Many good books authored by historians may be used as texts for a deeper understanding of various aspects of history.

# RESOURCES

The dependence on a single text book for understanding history is not adequate. Local knowledge, oral traditions, museums, place of historical and cultural significance, travelogues, biographies of important personalities, motion pictures, documentaries, journals, magazines, the electronic media and books on historical events may be used to widen the enquiry and to examine various perspectives critically.

*Travel and a diary*

History being all about how societies conduct themselves over a period of time, travel is one of the best ways to understand how people in certain places live and function. Keeping a travel diary can be a useful practice to help observation and introspection.

*Philately*

Philately is not only a delightful hobby but also provides endless possibilities of extent and depth to the understanding of past and contemporary events across the world. It covers almost all aspects of human life, throwing light on politics, history, prominent personalities, national and international events, geography, flora and fauna, agriculture, science, monuments, soldiers, warriors, scientists, arms and ammunition, modes of transport, sports, advances in science and technology and much more. It cultivates the habit of being meticulous and paying attention to detail apart from the opportunity to cultivate friendships across age limits and national boundaries.

The postal services in India and in most parts of the world run a facility to encourage philately. They not only offer stamps but also a background to the stamp or the occasion for its release. India post has philately bureaus in most towns and district places that facilitate activities, meetings, club networking, exhibitions etc. www.indiapost.gov.in

1) *Philately* by S P Chatterjee published by NCERT, New Delhi, 1990 is a good beginner's guide to the hobby and art of philately.

2) *Romance of Postage Stamps* by S P Chatterjee published by National Book Trust, New Delhi. The book, written for children, traces the history of postage stamps, and gives practical suggestions to stamp collectors.

*Museums, art galleries and places of historical and archaeological interest*

The importance of visits to the above cannot be overstated in the quest for understanding history. The brochures published by the Department of Tourism, museums, art galleries etc are a repository of interesting information from a historical and cultural perspective. However there is always the possibility that they may be pretentious and pompous in many cases and hence are to be examined with a critical eye.

*The bazaar, fairs, celebrations, festivals*

The market place or the weekly shandy, fairs, festivals and celebrations reveal a lot about a place, its people and their life. This resource should be fully utilised to understand how societies function.

*Indian National Trust for Art Culture and Heritage (INTACH)*

INTACH in India has to its credit a mammoth pioneering effort in promoting as well as preserving India's rich and diverse art, culture and heritage. They have chapters in almost every town in India with active members who take a keen interest in passing on their knowledge to young children. *Young INTACH* is a magazine published specifically for the young readership. INTACH has published several books related to India's history, art, culture and heritage. www.intach.org
The following two books published by them may be especially useful for children:

3) *Indian Culture for Everyone*

   The book is designed to introduce India's rich cultural heritage to young people. It explores 10,000 years of history, and brings to the fore the richness and variety of cultures and communities that live in India. It is designed with young people in mind such that they begin to understand and appreciate this country of immense diversity.

4) *Hands on Heritage*

   Is a handbook with activities, worksheets, and several exciting and innovative ideas for learning about India's rich cultural and natural heritage.

   The book is divided into 3 sections: Natural Heritage, Built Heritage and Living Heritage. Each section has a set of activities, background information, ready-to-do worksheets and suggestions on heritage awareness that can be adapted to ones requirements.

   The book is available in English, Hindi, Urdu, Marathi, Tamil, Malayalam, Bengali and Gujarati.

5) *National Geographic* magazine is a valuable resource covering historical and contemporary topics related to geography, anthropology, environment, history, culture etc.

6) *Understanding History: a guidebook for teachers,* 2010, published by SIDH, Mussoorie, Uttarakhand is a guide book for teachers to help them reduce the dependence on textbooks for the understanding of history. It helps explain the concept of history and provides tips on possible ways to engage with students to explore issues in the local context. This book has been distributed to all schools in Chattisgarh by the state's dept of education.

7) *Learning about Living Books 1 to 5* by David Horsburgh. Published by Oxford University Press, the book is presently out of print. A book of environmental studies dealing with every aspect of the child in its environment and eventually in the environment of the whole world. It sets a sound foundation in social aspects that make for responsible living. Being an activity based book, it lays the foundation for social and environmental sciences and value education.

   A reference copy is available with Taleemnet and Vikasana School, Bangalore. Some of these books are available as a free download from www.arvindguptatoys.com

8) *Our Land Our Life – A Practical Course of Agriculture and Environmental Education* (Books for classes 6, 7, 8) published by Uttarakhand Seva Nidhi Paryavaran Shiksha Sansthan, Almora, fifth edition, 2009. These three books contain lessons that adopt a hands-on investigative approach to many topics related to understanding village life from a social science as also an ecological perspective. Teachers will find many useful ideas within its pages for suitable adaptation.

   The complete series for classes 6 to 10 is available on the website www.ueec.org.in as free downloads. Books for classes 6, 7, 8 are available for reference with Taleemnet. The books are presently used in all government schools in Uttarakhand as part of their course of study.

*A note on National Book Trust publications*

The National Book Trust has published scores of books on a wide range of topics for a young readership. These books cover almost all areas related to history, culture, nature, heritage, biographies, traditions, folklore etc that would be very useful to anyone interested, especially a keen learner. Most

books contain illustrations and are reasonably priced. The entire catalogue is available on their website. A careful study of the catalogue is highly recommended, so that books may be chosen according to a student's interest.

*About Other India Bookstore*

The Other India Bookstore based at Mapusa, Goa, was founded over two decades ago. It stocks books on most of the topics that one would encounter in the process of going through this curriculum. Most books related to organic farming, ecology and environment, education, appropriate technology, forests, water, soils, rainwater harvesting, indigenous construction techniques, law, panchayat raj institutions, history, health, nutrition and well-being, yoga, ethno-veterinary sciences, nature cure, medicinal and aromatic plants, and so on are available at this bookstore. The website carries a complete catalogue of books available. The store offers a mail order service and can be reached at

Other India Bookstore
Next to New Mapusa Clinic
MAPUSA 403 507
Goa®
Phone: 0832-2263306
Email: admin@otherindiabookstore.com
Web: www.otherindiabookstore.com

## Thulir

Thulir founders Krishna and Anu with volunteers Anita and Sanjeev (L to R)

Many of the farming modules specially related to appropriate technology, computers, repair and maintenance, construction, care of farm animals, drip irrigation, bee-keeping, farming practices etc. are part of the apprentice programme at Thulir, a rural learning centre in Sittilingi of Dharmapuri district in Tamil Nadu. Apart from offering a bridge programme for young adults in functional academic competence, they are introduced to the skills mentioned above. However, the most significant contribution of the programme, according to its founders, Anuradha and Krishna, is the increase of self esteem and confidence levels in the students as they go through the study period.

Although most of these activities may begin as a hands-on task, the theoretical aspects are integrated at the appropriate time. Much emphasis is placed on keeping records of work, material, procedures and care of tools and equipment. It is here that the student feels the need to improve upon reading, writing and arithmetic skills leading to being self motivated to 'make good the gaps'. Anuradha and Krishna feel that the students still retain much of the traditional knowledge and skills especially with regard to the forests, the useful plants, the birds and animals, local construction methods, making of packed mud floors, thatching, become intuitionally aware of weather patterns, dietary habits, farming systems. They may be diffident about these aspects and hence tend to underplay the value of their own knowledge. But, at the same time they are quite comfortable in their natural environs.

The "five stones" game being played with jungle seeds by children at Thulir

The activities with the younger children are more in terms of play, where the main aim is to motivate them towards self learning. The activities are designed such that a balance of the three components – the head (academic), the heart (aesthetics, art, music) and the hands (farm related activities and crafts) is attempted. Since the children in this area are naturally attuned to natural habitats, their instinctive knowledge of plants, animals, birds, weather, berries etc is further strengthened with activities such as birding and berry collection trips, watching nature documentaries, keeping diaries and seasonal nature calendars of birds, plants, foods etc. Apart from these, academic activities including extensive reading and storytelling sessions are conducted. Children use both Tamil and English.

Washing area constructed with provision for mulching, use of sprinkler pipes for taps

On the idea of a rural curriculum, they feel that both the urban and rural areas have their unique features, hence education for both should be contextually and culturally relevant. The emphasis on skill development should be an essential component of curriculum for all.

# UNDERSTANDING GOVERNANCE

Governance has evolved over centuries as a need of organised human societies. People have evolved and adopted various means and strategies of governance which operate today. Presently most societies organised as nations entrust the matter of governance to institutions that have been set up for the purpose. These are administered by persons (elected people's representatives in the case of democracies) entrusted with the authority / power to do so.

The key to good governance is the smooth and efficient functioning of government institutions. Various government departments with appointed staff carry out the day to day functions as per rules and regulations. However, for good governance, it is necessary that citizens abide by the law and ensure that bodies entrusted with the responsibilities of governance carry out their duties sincerely. Hence, the main pillar of a democracy *is an involved, educated and empowered people*.
This module deals with governance at the grass roots (Panchayati Raj Institutions), basic law, local administrative bodies, citizen's rights and responsibilities, provisions for a participatory democracy, the Indian Constitution and the structure of the government. It would be useful to understand these elements in the country's historical background, as at present, the need is for an equitable, transparent and efficient system of governance.

*Background to the prevailing system of governance in India*

Historically, kings and community heads laid down the laws of the land. They enjoyed authoritative positions concerning passing judgments and awarding punishments. Social customs and codes of ethics, in many cases, were as strong as laws. In India, the first person to codify these laws was Manu in his book *Manusmruti*. The secularist and democratic concepts evolved over time in different parts of the world and were adopted in India after Independence. Monarchy, feudalism and colonialism which prevailed before gave way to democracy with all citizens being equal and enjoying equal rights.

On Independence in 1947, the British transferred the responsibility of governing India to the leaders of the Indian people. As a free country that chose democracy, it needed a constitution (guidelines). A committee was entrusted with the task of drafting the constitution under the chairmanship of Dr B. R. Ambedkar.

Although a large document, the essence of the Constitution is stated in its Preamble. The Constitution is made up of three main parts: fundamental rights, duties of citizens and the directive principles. According to the Constitution of India, people are supreme.

Most Indian laws - the criminal and civil laws have largely remained unchanged even after Independence. Civil laws deal with property, inheritance and marriage. Criminal law has been borrowed heavily from Britain and continues to be used with very few changes to this day.

A point to note is that the Official Secrets Act of the 19$^{th}$ century colonial rulers remained even after Independence. This act made it convenient for people in power to discourage transparency. In a democracy, transparency and access to information are powerful tools to demand one's rights. The Right to Information Act was passed in 2005. It is only now that the people of India can demand information with regard to the working of the government.

New laws are enacted from time to time. The people's representatives in India are empowered to examine a bill and decide on enacting it as a law. Some laws such as those concerning defence and university level education are under the direct jurisdiction of the government at the centre. Some, such as water for drinking, irrigation and school education are under the control of the state governments. While matters concerning forests are under the authority of both.

In India, legislation is made by Parliament and State Legislatures. Laws made by Parliament are easily available in the public domain at various sites, including those maintained by the Law Ministry. However, laws enacted by the 30 state legislatures are not easily accessible. The Laws of India database, a project of PRS Legislative Research (www.prsindia.org), aims to make all these laws available to the public, free of charge.

According to the Indian Constitution the right to life is a fundamental right, but the right to work, food, education and health came under the directive principles and state responsibilities until recently. The Right of children to free and compulsory education act was passed in 2009 and the Right

to Work (100 days per family) was passed as the Mahatma Gandhi National Rural Employment Guarantee Act in 2005. Although the constitution provides enough scope to assert and fight for one's rights and access to community common resources, the policies of the government have always been in favour of the privileged few. The disparity created by such policies affects rural people the most. Hence, for a level playing field and equal opportunities it is important that the people living in rural areas understand the functioning of government institutions, especially local bodies, and are well aware of laws and regulations, rights and duties.

*Panchayat raj institutions and panchayat raj*

Zilla parishad: structure and organisation, departments and their duties, facilities available to citizens
Taluka panchayat: structure and organisation, departments and their duties, facilities available to citizens
Gram panchayat: structure and organisation, departments and their duties, facilities available to citizens
The gram sabha

*Panchayat raj*

The concept of gram swaraj
Gram sabhas and ward sabhas – the decision making body of a participatory democracy
Gram sabha meetings and resolutions – their implication in a participatory democracy
An active gram sabha, an indicator of the sovereignty of people in a true democracy
(True participatory democracy implies that the decision making and control of natural, financial and human resources lies with the people at the level of the gram sabha)
The difference between a law, an act and a scheme

*Panchayat level offices*

Gram panchayat departments and bodies

- Education
  - Anganwadi, primary school, the School Development Management Committee (SDMC)
- Health
  - Primary health centre
  - Auxiliary Nurse Maid (ANM)
  - The ASHA worker – local trained midwife
- Forests
  - Forest guard for every village with land under the jurisdiction of the forest department
  - An overseeing forester for every few villages
- Revenue
  - Village accountant – keeper of land records
- Horticulture
  - Horticulture extension officer overseeing requirements of many panchayats
  - Training and nurseries based on panchayat level needs
- Agriculture
  - Agriculture extension officer overseeing requirements of many panchayats
  - Trainings and implementation of government schemes
- Veterinary services
  - Extension officer overseeing the requirements of many panchayats

Panchayat level schemes
Pensions and facilities for general public and the marginalised
Housing site allocations; special schemes for rural cooperatives, self help groups and enterprise.

Pension schemes and facilities for the handicapped, widows and senior citizens

Understanding the panchayat budget

*The Indian Constitution*

How the Constitution was formed

The main parts of the Constitution

Preamble

Fundamental rights

Duties of citizens

Directive principles

Provision for amendments to the Constitution

What are bills, acts / laws and rules

What are gazettes and what are gazette notifications

*Democracy*

What is democracy

Understanding the rights and responsibilities of the citizens of a democratic nation

The Indian Parliament, the state assembly, their structure and functioning

Elections – who can contest elections, who can vote

*Basic law*

Brief introduction to the history of law in India

Types of law – criminal and civil law

The law making process in the country

The law making body in the country at the national level – the parliament; at the state level – the legislative assembly

The judiciary is entrusted with the task of interpreting the law and passing judgments on disputes

Courts at various levels

Gram Nyayalaya (Village Court)

Set up for every panchayat or for a group of panchayats. It can try simple civil and criminal matters.

A Nyayadhikari (Judicial magistrate of the first class) is the official qualified to hear cases; authorized to hold mobile courts and conduct proceedings in villages

Consumer courts

How to file a complaint in a consumer court (at the district level) for defective goods and services

Who is a Notary Public

What is an Affidavit

What is Power of Attorney

Traffic laws and regulations: the citizen's duty to abide by these laws.

*Right to information act (RTI)*

A tool for transparency and responsible governance

Situations in which the RTI may be used

Background, people's movements given impetus by the MKSS (Mazdoor Kisan Seva Sangh, Rajasthan)

Procedure for filing an RTI application to request for information

Letter to the concerned officer of the relevant department accompanied by a Rs 10 postal order, payable to the concerned officer

No fee in case of BPL card holders

Charge of Rs 2 per photocopy of information sought

Bulk information available on CD for Rs 50.

Regulations concerning RTI

Maximum of 30 days (recently raised to 75 days in Karnataka) within which the concerned department must respond

Concerned officer to attract a fine of Rs 250 per day from day 31 in case information is not provided within 30 days
In case of matters related to MGNREGA, maximum number of days within which requested information must be provided is 7 days
No fee if a single page of information related to MGNREGA is sought
Over one page to be charged at Rs 2 per page
In case of incorrect information / complaints, application to be sent to the immediate superior
Information Commissioner of the state level to redress all grievances / resolve complaints / provide information in case of unsatisfactory services from the above
Assistant Information Commissioner has to visit the Zilla Panchayat Office periodically to resolve matters at the district level

*Mahatma Gandhi National Rural Employment Guarantee Act 2005 (MGNREGA)*

Significance of the act for rural India – right to guaranteed employment
Financial implications at the panchayat level
Potential for community organisation and cooperative work
Potential for creating rural productive assets
Provision under MGNREGA for farm related work – especially farmers with small holdings of below 5 acres
Nature of the work that can be undertaken at the farm level under MGNREGA
Water and watersheds
Soil and land related
Cattle feeds and manures
Horticulture
Land management, levelling and bunds
Management of water bodies – desilting tanks, constructing checkdams, bunds etc

*Understanding the concept of wealth*

India as a rich country endowed with an abundance of natural resources, but a country with a large population of poor people
India as a nation with a dearth of planners and sincere executors of plans

*Analysing the demographic composition of India's marginalised: the majority being dalits, tribals, landless labourers, small farmers and women*
*Concept of decentralised[1] and "acentralised"[2] governance*
*Citizen: the key person in a participatory democracy*

What is a Public Interest Litigation
Social audit and public hearings
How to file a police complaint
What to do if arrested

[1] Decentralisation – the process of initially centralizing power and funds and then distributing it to the lower levels of governance. How much power to decentralise and the amount of funds to distribute are decided at the centre.

[2] Acentralisation – in a participatory democracy, the locals at the grass root level have complete control over human, natural and financial resources and decisions. Part of the funds is submitted to the centre for governance.

# RESOURCES

1) *Legal Education Series* published by Indian Social Institute (ISI), New Delhi

   ISI has published a series of small informative booklets that are available by mail order. They cover most topics related to specific issues vis-à-vis the citizen and law and are affordably priced. A catalogue with the entire list is available at www.isidelhi.org.in

2) *An Introduction to Parliament of India* is a brief booklet downloadable from www.rajyasabha.nic.in

3) The Ministry of Panchayati Raj on its website www.panchayat.gov.in provides exhaustive details relating to Panchayati Raj institutions, acts, schemes, finance, circulars etc.

4) Many books relating to law are generally sold by makeshift bookshops within the premises of the local taluka/district courts.

5) www.india.gov.in/sitemap.php

   This is the official portal of the Indian Government hosted by National Informatics Centre. It provides a single window access to the information and services being provided by the Indian Government for citizens. It is a comprehensive source of information about India. Links at various places have been provided to other Indian Government Portals/websites.

   This website contains resources related to the modules under Commerce, Administration and Law in particular and many of the farming modules in general. Every citizen will benefit from a thorough study of this website.

## Juli, Vivek, Kabir and Azad: the farming family of Krac-a-Dawna farm

About a quarter century ago a young couple, barely out of university, decided to settle in a village and do farming. They raised a loan to purchase a degraded piece of land. The only blessing that came with the land was four full grown trees, a cow, a dilapidated hut and a perennial stream. Not knowing a thing about farming, Vivek and Juli Cariappa set out. Today Krac-a-Dawna is an organic farm that is well known in the country and overseas. This farming family has to its credit a book written about them and a film based on their life and learning. Vivek Cariappa has been honoured with Krishi Pandit award by the Government of Karnataka while Juli has played a central role (in the initial years) in drafting the organic standards document for certification of farms for The Organic Farming Association of India.

Their children Kabir, 22 and Azad, 18, were born and brought up on the farm. The farm became their home and learning ground. All learning evolved through day to day activities on the farm. Presently, Kabir's interest is in mechanics and machines and hence the ongoing research work on bio-fuels. Azad is an animal person; a multifaceted personality with deep insights into how living systems function in unison to make the farm a complete whole. If anyone is in two minds about making a life on a farm, they would benefit from his considered opinion. One will find in him a voice of encouragement, pragmatism and objectivity.

Reminisces Vivek, as the evening meal is being prepared, "Both Kabir and Azad grew up on the farm and learnt from the farm. Initially it took a while for the village to accept us, but once accepted we became very involved in the community's activities. Kabir's education in the initial years was through actual exposure to peoples' issues as we were very involved with the Dalit movement at the time. His aptitude for machines, maintenance of farm machinery and now his interest in appropriate technology and experimentation with bio-fuels received the initial impetus in the farm workshed while I was repairing my motor cycle, pumps, motors etc. He would be assisting me and by the time he was six or seven he knew about tools, nuts, bolts, size of spanners etc etc.

Azad on the other hand has an artistic bent and is a natural with animals. Animals take to him intuitively. Unfortunately the farm has not been able to provide him with the opportunity to hone his artistic skills. That has been our regret. Otherwise, he is completely in charge of all the animals on the farm. Along with Juli, he is able to treat them using homeopathy. He is up very early in the morning to milk the cows and deliver it to the local collection centre. He would like to get a horse now, is what he says."

Together Juli and Vivek add, "The children learnt about farming activities very early as we spent a lot of time with them in the initial years, strolling around the farm, bathing in the river, all the time observing keenly. They found biology very easy as they freely mingled with the people of the village who would tell them the local names of plants and their special use or characteristics. Birds, insects, pests, wild and farm animals, they were very familiar with as they lived amongst them. Chemistry was learnt in the dyeing shed where we dye organic cotton cloth. Microbiology, entomology, soil science they know because of the compost and bio-dynamic preparations that are made on the farm as also the different kinds of cheese that is being prepared here for sale. Math and record keeping they have mastered, because we had to arrive at prices for our produce. The entire gamut of calculations factoring in numerous parameters was learnt at the time. Frankly, they were quite convoluted methods, but we arrived at the answers successfully.

Azad and Kabir growing up at Krac-a-dawna

"Sometimes a sum would go on for days. If one had to plant on an acre of land, measure the land, plant one foot apart, rows one foot apart, how many rows, how many seeds, how much seed in one kilo, how many bags of seed and so on.

Then the cost of planting and growing the crop until harvest time would have to be calculated. Post harvest processing and packaging and finally costing of the produce and selling price, profits.

"Good books were a resource that we invested in. The National Geographic magazine has been one such. At one point when the children were growing up, we decided to slow down on many of the activities which would have otherwise occupied us. Those were formative years, when values, ethics are imbibed.

"A few years ago when we had some spare money, we invested in a piece of land which is in their name. It is their responsibility entirely. They have had to get the land records and other documents in order, measure the land, fence it, do the electrification and fix a bore well. We have let them decide on the crops and methods. That is where they can do and learn with independent charge, make their mistakes and learn from them. They have missed a planting season because of wanting to spend time with friends. But that is alright. How to use the money that comes in, how to plan for different stages of farming, is all part of the day's work for them.

"Because we do regular exhibitions of our products, that is another opportunity which is used for planning, preparing posters, hand bills. Apart from the skill of planning for a large event, it teaches them many soft PR (public relations) skills during

Vivek Cariappa

the exhibition. There is an opportunity to interact with people from different backgrounds and places.

"Once when they did not understand about electricity, we undertook a long journey all the way working backwards until we reached the dam and transmission site. It was a tedious way of doing things, but the trip was useful to clarify to them

Juli Cariappa

once and for all the concept of electric energy and related issues.

"When a Japanese friend offered to get our farm certified as per their standards, it was a huge learning process for the children because we had to create records to establish the authenticity of our farm produce documenting the traceability of each produce from seed to final product. Then we were growing some thirty different crops.

"Farming has taught us to care for health from the soil up. How to live on sustainable principles? Growing most of your food, clothing, shelter, health and personal care needs; health of the soil, health of animals…Animal care can be learnt through keen observation. Learning diagnostic techniques; an animal can never hide the way it is feeling."

The only mistake according to them was the bringing of a television set into the house when Azad was still quite young. They regret that there are no facilities readily available for alternative forms of learning, especially with regard to Azad whose artistic bent they have not been able to nurture.

Continues Juli, "The biggest challenge if you wish to be an organic farming family is to trust in yourself and in your instincts. One must be able to make a clear statement on where is it one wants to go and have faith. You have to set yourself up for questing, adventure, challenging yourself to think intelligently; to strengthen your powers of observation. One must strive to take ones learning and place it in a way that is practical and relevant to the microcosm, rather than only as fragmented applications."

"You have to build your own capacity to solve your problems, to respond to the world in an effective way and learn to deal with it. What else is education?", she asks.

Kabir, "I was brought up having to do my basic lessons of reading, writing and arithmetic that my mum and dad taught me. There was no set curriculum, and we investigated topics that held my fancy at the time. I went to school for a year when I was nine, but found it did not suit me and gave it up. I find it difficult to come to terms with a situation where people gather for the specific purpose of learning. To me, learning happens on the job, instinctively.

After a hard day's work Kabir and Azad at the dinner table

"On the other hand, I give a lot of importance to the role good books play in education. There is value in learning from books, I think it is necessary. It instills the discipline to apply oneself diligently. I applied a combination of systematic diligent work with doing things hands on. My research on bio-fuels is a good example of how I am doing things.

"I see no point in learning something, if I am not able to use it. I have taught myself computers and a lot of things about farm mechanics, through books and hands on application. The land gives you serious discipline because you are responsible for everything that happens there, and if you are not alert, things will deteriorate very quickly. It makes you a responsible person like nothing else can."

Azad, "My day begins at four in the morning. Open the cow shed, milk the cows (presently six), take the milk to the dairy by six in the morning, come back, clean the cow shed, wash the cows, wash the cow shed, start the generator, get the fodder, chop the fodder, get the feed, prepare the feed in the correct proportion, feed the cows and lock up the cow shed. By then it is time to let the chickens out and check the hen house to see if all is in order. The milking machine requires that it be kept extremely clean, that takes quite some time. Come back. By now it's time for breakfast and time with the family.

"After that it is time to go out into the field, start the water pumps, check the sprinklers; check the drips, clean the sprinklers (clean the orifices for easy flow). Repair damages if any (caused mostly by rats nibbling at them at night). And regularly check the fence and attend to maintenance jobs.

"About 10 in the morning, it is time to send the cows out – more for the purpose of exercise than for grazing. Then there are jobs that may have

*Recommended list of qualities and skills to be developed by children who wish to learn on the farm, arrived at through a discussion with Juli*

A love for reading, because as an organic farming community and farming family children should be capable of spending long hours on their own
Ability to use solitude to explore ones inner self and life in the world around
An urge to know beyond what there is
Taking on the responsibility to find out what is not clear
A keen power of observation
A love for physical work
Reading and writing as not functional tools but tools for refining and processing thought
Capacity to be responsive to living things
Learning to discern: how does one choose what is of value?
Grounding in ethical values
An exploratory childhood
A vocabulary built on the basis of a rich experience of life
The skill of effective communication
A practical approach to the cycle of life and death, as one comes across a lot of both on the farm
Learning how to look and feel things
To be able to see the farm as a manifestation of the beauty of life

cropped up which need to be attended to, so do those. Otherwise, help Kabir with his tractor work.

"I am generally free between 12 and 4 during which time I rest or pursue my personal interests. In the afternoon, when the rest of the family takes a short nap, it is my responsibility to keep the work going.

"At 4 it is time for the second round of feeding of the cows followed by milking them, delivering milk to the dairy and cleaning the milking machine. Then lock up the cow shed, round up the chickens and shut them in for the night.

"By now we are all ready to call it a day. Dinner time is a special time for the family and we spend a lot of time together talking, discussing matters, planning etc. Sometimes there are records to be written, accounts to be done all these are done after dinner."

Inspite of a schedule, just described by Azad above, he has taught himself karate, macramé, knotting ropes from vines, drawing and sketching. He has in-depth knowledge about farm animals, their care, snakes, knives, plant genetics, cropping practice of dozens of crops etc.

**Vishven and Bhargav Soneji: A success story of farming and enterprise**

Vishven and Bhargav, children of Dhirendra and Smita Soneji grew up on an organic farm in Gujarat. As children they played every morning and evening. Langauge and social studies were learnt from books published by Eklavya, school books and many other books. Their learning of maths, science and agriculture was totally connected to the activities on the farm where they worked every day during the morning hours. Since their parents had set up a workshop on the farm, they learnt repairs and maintenance of tools and machinery on the farm itself. Training in rural appropriate technology was taken at Vigyan Ashram in Pabal near Pune. Today they continue to work on the farm and run a thriving enterprise of farm processed foods and farm appropriate appliance production and services which attract advance booking orders.

Bhargav prepares the land for the planting season

Proud Parents : Dhirendra and Smita Soneji

Vishven

## MODULES

# FARMING FUNDAMENTALS

Husbanding the land, as is obvious from the modules listed below, is an activity that requires an in depth understanding of various topics; all interconnected; several overlapping. Because it deals with living systems, good intuitive knowledge and a scientific understanding of plants and animals and how they function in relation to one another and to natural phenomena becomes necessary. Each of the modules is fundamental to the practice of farming and each is a complete science by itself. A student may deal with them cursorily or may choose to study each in depth based on skill, need and interest. Topics within each module when dealt will initially offer a broad overview however as one begins to engage with actual practice, the interrelationship and interconnectedness will begin to unfold. Although designed for the upper level students, some may feel the need to carry on with the subject independently. Each of them is a journey of exciting discoveries. For the lower and middle levels the topics will serve as indicative guidelines to design task lists and experiments.

*List of Modules*

1. Soil – Pedology
2. Water – Hydrology
3. Soil and Water Inter-Relationship and Conservation Practices
4. Rainwater Harvesting
5. Ecology
6. Land Survey
7. Meteorology
8. Managing Natural Resources
9. Agriculture Theory
10. Agroforestry
11. Building Living Soils and Reclamation of Degraded Lands
12. Pests, Diseases and Methods of Natural Pest Control
13. Crop Production and Practice
14. Plant and Soil Health Supportive Preparations
15. Vermiculture and Vermicompost
16. The Process of Getting Healthy Seed
17. Raising a Nursery for Orchards and Agroforestry
18. Farm Records, Farm Accounts, Farm Crop Diary and Cow House Diary

# 1. Soil – Pedology

Healthy and nutrient rich topsoil is a primary requirement for farming. It's physical, chemical and biological aspects and moisture content play a critical role in deciding the kind of crop that may be grown as well as the expected yield. A good understanding of soil may be considered as the foundation for all further study related to farming.

*What is soil*
*How is soil formed*
Soil profile (the pit method, or the study of a road cut)
*Various types of soil*
Identifying various soil types ; soil colour; soil colour charts; soil profiles
*What is soil texture; properties and salient features of soils*
*Nutrients in the soil and trace metals essential for plant growth*
*Organic and inorganic components in various types of soils*
*Soil carbon content, its significance to soil health and to farming*
How to calculate soil carbon content
*Living soils – the biological component in soils*
Soil micro flora and fauna, their contribution to enhancing the quality of soil
The special role played by earthworms and fungi
*Properties of various soils : soil parameters*
*Water retention properties of soils*
Field capacity
Permanent wilting point
Water content at field capacity – water content at permanent wilting point
= available water content
*Measuring soil pH*
*Ideal pH for various crops*
*Soil erosion, causes of soil erosion*
*Measures to contain soil erosion*
*Soil pollution and preventive steps*
Methods of reclamation of polluted soils
*Soil salination (sodicity)*
*Reclamation of salinated soils*
*Regenerating degraded soils*
*Guidelines for creating and sustaining living soils*

## Resources

1) *Our Land Our Life – A Practical Course of Agriculture and Environmental Education* (Books for classes 6, 7, 8) published by Uttarakhand Seva Nidhi Paryavaran Shiksha Sansthan, Almora, Fifth edition, 2009. The complete series for classes 6 to 10 is available on the website www.ueec.org.in as free downloads. Books for classes 6, 7, 8 are available for reference with Taleemnet.
2) Wikipedia – topics related to soil
3) www.usgs.gov contains extensive modules on soil and data on soil
4) Food and Agricultural Organisation website www.fao.org
5) The NASA website www.nasa.gov
6) *Rural Engineering Technology: Soil and Water Management (Text Book) for Class XII, Paper IV* by C.R. Mehta published by NCERT, New Delhi, 1997. Contains outlines of various topics on soil and water.
7) *Rural Engineering Technology: Soil and Water Management (Practical Manual) for Class XII; Paper IV* by C.R. Mehta et al published by NCERT, New Delhi, 1997.
Contains several experiments on soil and water.
8) *Indigenous Techniques of Soil and Moisture Conservation and Runoff Management* by V.S.Surakod published by Publication Centre- University of Agricultural Sciences, Dharwar, 2003.
Techniques on watershed based approach to land management and various cropping practices.

# 2. Water – Hydrology

Water systems, rain cycles, water availability are deciding factors that determine farming activities. Most water is found underground and necessarily goes through an annual cycle to come down as rain for a few months during the year. Farming in India continues to be largely rain dependent. A systematic knowledge of the various aspects and properties of water is required if one is to use this resource efficiently.

*Hydrology – definition and scope*
*The water cycle or the hydrological cycle in nature*
*Quantification and measurement of different components of the water cycle*
*Hydro-meteorological parameters*

- Rainfall
- Temperature
- Humidity
- Infiltration (into the soil)
- Sunshine (duration and intensity using standard tables)
- Evaporation potential - using the evaporation pan
- Transpiration in plants
- Vegetative cover
- Land cover (without vegetation)

*Sources of water – perennial and seasonal*
*Surface water/ water bodies: rivers, lakes, ponds, tanks*
*Underground aquifers and aquitards/ groundwater aquifers*
*Wet land systems*
*Quality of water*

- Hard water, soft water
- Salts in water
- Pathogens
- pH of water

*Water quality standards*

- Potable water
- Water for irrigation purposes

*Properties of hard and soft water*
*Electro-conductivity of water*
*Testing for water hardness*
*Neutralising hard water*
*Turbidity*

- Dealing with turbidity – with alum
- Dealing with pathogens, using $KMnO_4$

*Irrigation systems*

- Surface water (SW) Irrigation: open channels, sprinklers, drip irrigation
- Groundwater (GW) Irrigation: Open wells, bore wells
- Land Subsidence
- Conjunctive Use of SW and GW:
- What is water logging?

*Soil salination (sodicity)*
*Neutralising salinated soils*
*Water management*

- Storing water
- Rainwater harvesting
  - Roof top

Catchment area
Watershed management
Groundwater/ aquifer management/ pumping
Artificial Methods of recharging of groundwater sources

*Living waters*

Solarisation of water
Traditional methods of oxygenating water (step cascades)

*Water pollution and prevention*

*Guidelines for judicious usage of water and sustainable irrigation water management*

## Resources

1) *Groundwater Hydrology* by David Keith Todd and Larry W. Mays by Wiley India Pvt Ltd
This book is an excellent university level book, and if one ignores the mathematics involved, may still be used by Upper level students for its explanations. Available through www.flipkart.com

2) *Handbook of Hydrology* by David R. Maidment by Mcgraw-Hill Professional Publishing (Feb 1993)
This book is encyclopedic in nature and touches on every aspect of hydrology. An expensive book.

3) *Our Land Our Life – A Practical Course of Agriculture and Environmental Education* (Books for classes 6, 7, 8) published by Uttarakhand Seva Nidhi Paryavaran Shiksha Sansthan, Almora, Fifth edition, 2009. The complete series for classes 6 to 10 is available on the website www.ueec.org.in as free downloads. Books for classes 6, 7, 8 are available for reference with Taleemnet.

4) *Rural Engineering Technology: Soil and Water Management (Text Book) for Class XII, Paper IV* by C.R. Mehta published by NCERT, New Delhi, 1997.
Contains outlines of various topics on soil and water.

5) *Rural Engineering Technology: Soil and Water Management (Practical Manual) for Class XII; Paper IV* by C.R. Mehta et al published by NCERT, New Delhi, 1997.
Contains several experiments on soil and water.

6) *Indigenous Techniques of Soil and Moisture Conservation and Runoff Management* by V.S.Surakod published by Publication Centre- University of Agricultural Sciences, Dharwar, 2003.
Techniques on watershed based approach to land management and various cropping practices.

7) For good explanations on various topics related to soil and water the following websites would be useful www.usgs.gov and www.fao.org
These site contain rich resource material for students as well as teachers.

8) Topics on soil and water in *Wikipedia*

## 3. Soil and water inter-relationship and conservation practices

Soil and water are like two sides of a coin. Their inter-relationship plays a determining role in matters concerning farming. Many factors influence this relationship, an understanding of which will hold a student in good stead for all further activities.

*Soil and water inter-relationship*

- How soils hold water
- Water percolation, infiltration and runoff
- Water retention properties of soils
  - Field capacity
  - Permanent wilting point
  - Water content at field capacity – water content at permanent wilting point = available water content

*Soil erosion*

- Agents of soil erosion – wind and water
- Types - splash, sheet, rill and gully erosion

*Water runoff - causes*

*Techniques of soil and water conservation*

- Bunds, inlets, spillways, weirs
  - Types of bunding- stone, murrum (lateritic) earth, agave (live bunding)
- Mulching- dry and green mulch
  - Stalks of the previous crop, coconut coir, twigs, leaf litter, palm etc
  - Gravel and sand mulching
  - Green mulch both for enhancing the soil nutrient value and water holding capacity
- Ploughing across the slope
- Application of tank bed silt to eroded areas
- Incorporation of groundnut shells into the soil.
- Set row cultivation
- Indigenous bamboo drip irrigation (as in some parts of north-east India)
- Contour bunding – (use of A-Frame to mark contours), spirit levels, and level marking using transparent water tubes
- Trenches along contours for water retention, increasing soil moisture content and for percolation to raise ground water levels

*Terracing and in-field earth work*

- Earth bunds on contours, on field boundaries, on gradients
- Stone and earth bunds on gradients
- Bench terracing
- Field leveling
- Gradonies (inward sloping terraces on steep land)

*Protection of terraces and disposal of surplus water*

- Diversion ditch (cut off drains)
- Field weirs

*Manipulating water course*

- Gully plugs
- Temporary check dams
- Permanent check dams
- Flumes and chutes
- Vegetative methods
  - Planting grass in strips, tree planting, strip cropping in low rainfall areas, shelter belts, earth bunds with vetiver, sand dune stabilization

*Water runoff management practices*

Vetiver as vegetative barrier
Ipomea as vegetative barrier across gullies
Cover cropping
Inter cropping, relay cropping, mixed cropping as water runoff management strategies

## Resources

1) Traditional water harvesting practices in the different eco-regions of India (www.rainwaterharvesting.org)

2) *Rainwater Harvesting* by Shree Padre, published by Altermedia, Thrissur. www.altermediaindia.com. Shree Padre has singlehandedly popularised rainwater harvesting by conducting innumerable workshops in remote corners of this country and by writing about it zealously in newspapers and magazines. The book offers a hands on approach to techniques of rainwater harvesting and related topics.

3) Practitioners of traditional water harvesting techniques in India (www.rainwaterharvesting.org)

4) Rainwater Harvesting (www.rainwaterharvesting.org)

5) Publications from Centre for Science and Environment (CSE), Delhi www.cseindia.org

6) The Central Institute for Soil and Water Conservation, Dehra Dun may be contacted for relevant publications

7) *Our Land Our Life – A Practical Course of Agriculture and Environmental Education* (Books for classes 6, 7, 8) published by Uttarakhand Seva Nidhi Paryavaran Shiksha Sansthan, Almora, Fifth edition, 2009. The complete series for classes 6 to 10 is available on the website www.ueec.org.in as free downloads. Books for classes 6, 7, 8 are available for reference with Taleemnet.

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9) *Rural Engineering Technology: Soil and Water Management (Practical Manual) for Class XII; Paper IV* by C.R. Mehta et al published by NCERT, New Delhi, 1997.
Contains several experiments on soil and water.

10) *Indigenous Techniques of Soil and Moisture Conservation and Runoff Management* by V.S.Surakod published by Publication Centre- University of Agricultural Sciences, Dharwar, 2003.
Techniques on watershed based approach to land management and various cropping practices.

11) *Some Reflections on Watershed Development* by the late Dr Venkat, published by Manchi Pustakam, Secunderabad.

# 4. Rainwater harvesting

Water which comes down as rain seasonally can be harvested using very simple techniques and put to good use during the rest of the year. Rainwater has been harvested traditionally in the dryer parts of this country using techniques that regulate rainwater flow such that it is stored underground in natural aquitards; in enclosed manmade structures; open freshwater bodies etc. Given the increasing uncertainty of timely rainfall and the steep fall in ground water tables, this module must be seen as an essential course of study.

*Rain the source of all water for human use*

*Harvesting rain*

Eco region specific systems of rainwater harvesting
What are water catchments
What is meant by catchment area
In homes-catching rain where it falls
Farms-based on land topography and soil conditions

*Harvesting potential* - dependent largely on area of the catchment, amount of rainfall, soil conditions
Traditional water harvesting structures and water conveyance systems specific to eco regions

*Estimating rainwater harvesting potential (RWHP)*

RWHP = rainfall (mm) x area of catchment x runoff coefficient

*Runoff coefficient for various catchment surfaces*

Roof catchment
Ground surface covered and uncovered (untreated) areas
Calculating the rainwater harvesting potential for a house/building

*Rainwater harvesting systems*

Storage in tanks
Recharge into the ground
Storage in open natural spaces
Storage in closed constructed spaces
Storage in open farm tanks lined with polythene sheets

*Potential rainwater harvesting sites*

Rooftops
Paved and unpaved areas
Water-bodies
Storm-water drains

*Components of rainwater harvesting systems for homes and buildings*

Catchment
Filters/mesh
Gutters and conduits
First flushing
Storage - tanks, wells, ground water aquifers

*Types of filters*

Charcoal water filter
Sand filter
Dewas filter
Readymade filter

*Considerations for storage facility*-shape, type of construction material, location and position of tank, cost

*Water recharge structure*

Functional and dysfunctional wells and abandoned tube wells
Settlement tanks
Service tubewells
Recharge pits
Soakaways and percolation pits
Recharge trenches and troughs

*Geo-morphological conditions affecting recharge methods*

*Understanding features* of the local ecoregion, agro-climatic region, geographical region in relation to water harvesting

## Resources

1) *Rainwater Harvesting* by Shree Padre, published by Altermedia, Thrissur. www.altermediaindia.com. Shree Padre has singlehandedly popularised rainwater harvesting by conducting innumerable workshops in remote corners of this country and by writing about it zealously in newspapers and magazines. The book offers a hands on approach to techniques of rainwater harvesting and related topics.

2) *Our Land Our Life – A Practical Course of Agriculture and Environmental Education* (Books for classes 6, 7, 8) published by Uttarakhand Seva Nidhi Paryavaran Shiksha Sansthan, Almora, Fifth edition, 2009. The complete series for classes 6 to 10 is available on the website www.ueec.org.in as free downloads. Books for classes 6, 7, 8 are available for reference with Taleemnet.

3) *Indigenous Techniques of Soil and Moisture Conservation and Runoff Management* by V.S.Surakod published by Publication Centre- University of Agricultural Sciences, Dharwar, 2003.
Techniques on watershed based approach to land management and various cropping practices.

4) *Some Reflections on watershed Development* by the late Dr. Venkat, published by Manchi Pustakam, Secunderabad

5) Centre for Science and Environment, New Delhi has published manuals, handbooks and source books on the subject. A catalogue of publications is available on their website.

6) Central Institute for Soil and Water Conservation, Dehra Dun.

# 5. Ecology

A sound understanding of the ecological underpinnings to every aspect of human life when understood makes way for responsible stewardship. All things are connected; humans being the dominant species have the responsibility to tread with care. How we engage with the environment determines our course in history as also the future of the planet. Ecology as an independent topic has been dealt with in Upper level biology. Apart from the topics mentioned below, topics related to ecology from Upper level biology may also be studied. It is hoped that this exposure to ecology will generate enough interest in the learner to pursue deeper engagements independently.

*The ecosystem and its components*
- Physical – land, air, water
- Biological – plants, animals, decomposers

*Types of ecosystems*
- Aquatic
  - Pond, lakes, rivers
  - Oceans
- Terrestrial
  - Forests
  - Deserts
  - Grasslands
  - High altitude regions

*Ecosystem functioning* – inter-relationships of components

*Nutrient cycles* – carbon, nitrogen, water

*Energy flow in ecosystems* – food chains, food webs, food pyramids

*Ecosystem services* – oxygen and carbon dioxide balance in nature

*Ecological succession*

*Ecological indicators* – keystone species

*Ecological adaptations*

*Ecosystem health* – concept of carrying capacity

*Concept of an ecosystem*
- Niche, community and habitats
- Earth as an ecosystem – the Gaia concept
- Village/farm as an ecosystem
- Soil as an ecosystem

*Plant indicators and their role in environmental monitoring*
- Plants as indicators of soil pH
- Plants as indicators of the nature of soils
- Plants as indicators of water
- Plants as indicators of altitude
- Plants as indicators of mineral and metal content
- Plants as indicators of pollution

*Utilization of plants*
- Domestication of plants and centres of origin
- Case studies of some crops to trace their origin, spread and domestication histories
- Plants put to the service of man
  - Legumes for food and fodder
  - Plants: the main source of nutrition – food crops
  - Fibres
  - Timber
  - Medicinal plants, herbs, essential oils, dyes

Rubber, paper, gums, resins, lacquer, cork, non edible oils, drugs (quinine, belladonna)
Beverages
Fumitories and masticatories
Alcohol and narcotics
Cash crops – human and environmental costs of such cropping systems

*Conservation and environmental movements*

The Chipko Andolan
Save the Western Ghats movement
The Nilgiri Biosphere Reserve – a land mark conservation initiative by the Government of India
The role of The Ministry of Environment and Forests and the Pollution Control Boards

*Global warming, climate change, environmental crisis and our response to it at local, regional, national and global levels*

## Resources

1) *Silent Spring* by Rachel Carson, available from Other India Bookstore, Goa was the first book to alert readers on the dangers of indiscriminate use of pesticides, environmental health, threats of pollution and consequences. It set the foundation for the many environment movements across the globe.

2) *Plant Ecology and Utilization of Plants* by Dr B A Patil et al published by Sunny Publications, Pune and Ahmednagar. The book is written in textbook format by a group of college professors form Pune and Ahmednagar. It contains many useful topics related to plant ecology and utilization, but falls short with regards to printing quality and use of good language. The practical portion of the book details procedures for extraction of essential oils and for measuring ecological parameters.

3) *Children's Britannica Nature Trail Series* published by Usborne Publishing Ltd, London in the late 1970s served as excellent books for introducing young children to nature study. Written more on the lines of a field guide, it enthuses children to take up nature study. Presently out of print. A sample copy of one of the series – *Ponds and Streams* is available for reference at the *Taleemnet* library. It is strongly recommended that similar books may be used by parents and teachers.

4) *Biodiversity: Nurture Nature for Our Future (Activity Guide)* published by NCSTC-NETWORK New Delhi, 2006
This book contains several activities suitable for Middle and Upper level. Biodiversity being its theme, most of the activities can be suitably adapted for understanding ecological concepts in rural and farm habitats.
A copy of the book would be available for reference in local science centres that coordinate Children's Science Congress activities. Reference copies available with Taleemnet.

5) *Environmental Education: A Book of Activities (Climate Change, Natural Resources,)* published by Centre for Science and Environment (CSE) New Delhi 2011.
The book introduces children to climate change in the context of its impact on natural resources. The human element in these issues is clearly brought out through activities.

6) *Glimpses of Plant Life Part I and II* published by NCERT, 2001
These two low cost books are excellent reference books for introducing children to the world of plants and trees.

7) *Our Tree Neighbours* by Chakravarti S. Venkatesh, published by NCERT 1976.
A good resource for children for identification of common trees.

8) *Our Land Our Life – A Practical Course of Agriculture and Environmental Education* (Books for classes 6, 7, 8) published by Uttarakhand Seva Nidhi Paryavaran Shiksha Sansthan, Almora, Fifth edition, 2009. The complete series for classes 6 to 10 is available on the website www.ueec.org.in as free downloads. Books for classes 6, 7, 8 are available for reference with Taleemnet.

9) *Hamare Jaunpurke Paed Paudhe* (Hindi) Volume 1 Part I and II by the children of SIDH, Uttarakhand, published by Society for Integrated Development of Himalayas (SIDH), Mussoorie, 2001.

   A compilation of the biodiversity documentation, indigenous knowledge and village history undertaken by the children of SIDH School, Uttarakhand. May be used with suitable adaptations for other regions.

10) Bombay Natural History Society, Botanical Survey of India, Zoological Survey of India, Centre for Environment Education, Centre for Science and Environment, National Book Trust, NCERT, Homi Bhabha Centre for Science Education and World Wide Fund for Nature have publications that children will enjoy reading.

    Sanctuary Asia publishes the *Sanctuary* magazine and the *Sanctuary Cub* magazine on nature and wild life. *Gobar Times* comes as a supplement with the *Down to Earth* magazine, a CSE publication, addressing the young reader on contemporary environmental issues.

    Centre for Environment Education (CEE) publications on various topics related to environment and ecology.

    Centre for Science and Environment (CSE) publications on various topics related to environment and ecology.

# 6. Land survey

Being able to represent an area on paper to-scale is a skill that can be easily mastered with some amount of diligent work. Mapping an area and the ability to read maps and topo sheets will come in very handy in innumerable situations which require taking informed decisions on the farm.

*What is land survey?*

*The need for surveying land*

*Land survey: tools and methods, field book*

*Basics of Cartography: map making/ map projection systems/ units/ measurements, map scales/ dimensions etc.*

*Survey of India/ Geological survey of India*

*Identifying a plot of land from a revenue land map*

*Marking boundaries of a given plot of land*

*Calculating the area of a plot*

*Geomorphological parameters: slope/ aspect ratio/ elevation/ etc.*

*Contour mapping of a plot to indicate equal elevations*

*Drawing a map of a plot of land to scale indicating*

- Area
- Cardinal directions
- Contours and elevations and highest and lowest points
- Water sources
- Trees
- Land marks
- Significant farming activities, built up areas and sheds
- Power lines
- Underground irrigation pipelines
- Underground channels, conduits
- Underground telecommunication lines
- Underground sumps, soakpits and tanks
- Different soil types

*Using Google Earth to create a map of the given plot*

*Introduction to GPS (Global Positioning Systems), the use of mapping software along with GPS*

*Introduction to GIS (Geographical Information Systems)*

*The working of NIC (National Informatics Centre)*

*What are satellite images*

*Learning to read topo sheets*

*Land survey institutes*

- Remote sensing institute, Dehra Dun
- Remote Sensing Institute, Hyderabad
- Geographical Survey of India
- Geological Survey of India

## Resources

1) *Principles of Geography* by Charles Farro, for contour maps

2) Practical Geography – Field books by various publishers

3) GIS – Global Information Systems

4) NIRC – National Informatics Centre www.nic.in

5) Google Earth

6) Wikipedia – topics related to remote sensing and land survey

7) *Our Land Our Life – A Practical Course of Agriculture and Environmental Education* (Books for classes 6, 7, 8) published by Uttarakhand Seva Nidhi Paryavaran Shiksha Sansthan, Almora, Fifth edition, 2009. The complete series for classes 6 to 10 is available on the website www.ueec.org.in as free downloads. Books for classes 6, 7, 8 are available for reference with Taleemnet.

# 7. Meteorology

In the days of yore people had a feel for the weather and had developed many fool proof thumb rules for making predictions. These formed the basis for taking important decisions regarding the seasonal activities on a farm. Weather is dependent on a multiplicity of physical factors working in tandem. Micro-climatic conditions are region specific. A sound understanding of how to generate, interpret and analyse data regarding various physical parameters is an interesting field of study for its own sake. Meteorology is a very advanced science that can be put to good use in taking critical decisions on several aspects of farming.

*What is meteorology?*

*Basics of meteorology*

*Earth atmosphere: constituents, layers, physical and chemical properties*

*Vertical Temperature structure of the atmosphere*

Lapse rates

*What is weather?*

*Clouds and weather systems*

*What is climate?*

*Hydro-meteorological observatories*

*What does IMD (India Meteorological Dept) do?*

*WMO (World Meteorological Organisation)*

*Meteorological parameters and their measurement*

*Ambient temperature*

Maximum temperature
Minimum temperature
Daily mean temperature
Normal temperature range of a place

*Rainfall*

*Evaporation*

*Atmospheric humidity*

*Agricultural meteorology*

Importance of meteorology in agriculture

*Dew point*

*Frost*

*Field capacity*

*Permanent wilting point*

Water content at field capacity – water content at permanent wilting point
= available water content

*Soil temperature*

*Weather and plant growth*

*Atmosphere, weather and climate, seasons*

Atmosphere
Composition of air
Atmospheric strata

Elements of climate
Temperature, radiation, atmospheric pressure, wind and humidity (including water vapour, clouds, precipitation, evaporation).

Factors governing climate
Latitude, altitude, local topography, nearness to sea, mountains etc.

Understanding climatology in the context of agriculture

Elements of weather

Wind velocity and its direction, atmospheric humidity, atmospheric pressure, temperature of air, hours of sunlight and sunshine, evaporation from land surfaces and water bodies, rainfall and other forms of precipitation

Understanding weather science in the context of agriculture

Effects of elements of weather on farming

Solar radiation

Light intensity

Quality of light

Duration of light

Direction of light

Temperature

Atmospheric pressure

Wind

Evaporation

Relative humidity

Rainfall: the monsoon and its importance to farming in India

Seasons

Summer or pre-monsoon

Monsoon

Post monsoon

Winter

Aberrant weather and its effects on farming

Drought

Flood

Cyclone

Cold waves and frost

Heat injury

Thunder storms

Dust storms

Hailstorms

Weather predictions: general/agricultural applications

Role of weather forecasts in farming activities

Advantages of weather forecasts

Elements of weather that can be forecast

Types of weather forecast-short range, extended, long range

Cloud patterns as indicators for short term weather predictions

Agro climatic zones of India and their salient features

*Air pollution*

*Acid rains*

*Smog*

*What is climate change?*

*Adapting agriculture to changing weather patterns*

Local phenology studies as bio-indicators of changing weather conditions

*Calendars for agricultural activities*

Solar

Lunar

Panchang – (The Indian calendar)

Bio-dynamic

*Understanding the Panchang in the context of farming*

*The Asian Agricultural History journal – for regional calendars*

*Regional farm calendars*

*Regional farming practices based on various calendars in use locally*

*Community knowledge on farm practices with reference to lunar / solar cycles and cosmic events like eclipses, full moon and new moon, dawn and dusk*

# Resources

*For Meteorology*

1) Indian Meteorological Dept website (www.imd.gov.in)
2) World Meteorological Organisation (website www.wmo.int)
3) British meteorological department (www.metoffice.gov.uk) – offers weather related activities for children
4) Local and state level meteorological departments
5) Newspaper, television, radio bulletins
6) Lakshmi Ashram at Kausani in Uttarakhand and Centre of Learning Organic Agriculture and Appropriate Technology (www.sholaicloaat.org) has setup equipment for recording meteorological data. Students record observations on a regular basis. Such practices can be emulated by others.

*For Lunar and solar calendars*

7) Local Panchang
8) Newspapers
9) Farmer – radio programmes
10) Community wisdom on farm practices following lunar / solar cycles and cosmic events like eclipses, full moon and new moon, dawn and dusk.

*Other*

11) *Our Land Our Life – A Practical Course of Agriculture and Environmental Education* (Books for classes 6, 7, 8) published by Uttarakhand Seva Nidhi Paryavaran Shiksha Sansthan, Almora, Fifth edition, 2009. The complete series for classes 6 to 10 is available on the website www.ueec.org.in as free downloads. Books for classes 6, 7, 8 are available for reference with Taleemnet.
12) *Crop Production: Elements of Crop Production Textbook for Class XI; Paper I* by K.N. Bansal published by NCERT, New Delhi, 2000.

    Covers a wide range of topics on agricultural practices
13) *Crop Production: Elements of Crop Production (Practical Manual)* for Class XI (Paper I) by K.N. Bansal published by NCERT, New Delhi, 2000.

    Contains topics on measuring weather parameters

# 8. Managing natural resources

Natural resources are the mainstay of any community at the local level and the backbone of a region/nation at the macro level. How we use, abuse or manage them has both short term and long term implications to every aspect of human life. A holistic landscape approach to managing them has always proved beneficial to man. This module integrates several others such as soil, water, agro-forestry, ecology, water harvesting, construction etc. It is best approached by drawing on relevant aspects from related topics within the farming modules. The topics mentioned below serve only an indicative purpose.

*What are natural resources?*

*Mapping natural resources – farm/village*

Quantification of natural resources – availability, consumption

Patterns of consumption – quantification in datasheets

How much is available

How much is being used

*Traditional ways of resource management in farms / villages*

*Arriving at an understanding (definition) of sustainable use*

*Formulating a strategy for sustainable use for a given area*

*Planning and implementation*

## Resources

1) Centre for Science and Environment, New Delhi has published manuals, handbooks and source books on the subject. A catalogue of publications is available on their website.

2) *Our Land Our Life – A Practical Course of Agriculture and Environmental Education* (Books for classes 6, 7, 8) published by Uttarakhand Seva Nidhi Paryavaran Shiksha Sansthan, Almora, Fifth edition, 2009. The complete series for classes 6 to 10 is available on the website www.ueec.org.in as free downloads. Books for classes 6, 7, 8 are available for reference with Taleemnet.

3) *Managing our Land* (Workbook) published by Uttarakhand Paryavaran Shiksha Kendra, Almora. Available for reference with Taleemnet.

4) *Indigenous Techniques of Soil and Moisture Conservation and Runoff Management* by V.S.Surakod published by Publication Centre- University of Agricultural Sciences, Dharwar, 2003.

5) Techniques on watershed based approach to land management and various cropping practices.

6) *Some Reflections on Watershed Development* by the late Dr. Venkat, published by Manchi Pustakam, Secanderabad

7) Google Earth for mapping

8) Land records with the revenue department

9) Community knowledge

10) Local forest department, revenue department, hydrology department, agriculture department or Panchayat office

# 9. Agriculture theory

This module is theoretical in nature and has been designed to provide the student with a broad overview of all matters related to agriculture. Most of the topics covered here may be found in the comprehensive book on the subject – *The Organic Farming Sourcebook*, edited by Claude Alvares. This book makes a good beginning for a student interested in farming and farm related activities.

*What is agriculture?*

History of Indian agriculture
Importance of agriculture in India
Characteristics of Indian agriculture
Agro climatic/ agro ecological regions of India
Agriculture in India - a way of life

*Agricultural practices in India*

Organic farming
Permaculture
Ecological farming
Natural farming
Biodynamic farming
Sustainable agriculture
Homa farming
NATECO farming
Traditional regional practices

*Crop diversity of India*

Rice, millets, pulses, oil seeds, vegetables, fruits, spices, herbs, medicinal plants, minor forest produce, tubers
Traditional seed savers and keepers of germ plasm
The work of Dr Richharia
Revival of interest in the growing of millets – the work of Vijay Jardhari, Deccan Development Society and Millet Network of India

*Pioneers, practitioners, promoters and associations*

*Pioneers*

Albert Howard
Fukuoka
Dhabolkar
Dr Venkat
Bernard Declerq

*Practitioners*

Bhaskar Save
Narayan Reddy
Deepika Kundaji
Clea Chandmal
Subash Sharma

*Promoters*

Claude Alvares
Kapil Shah
G. Nammalwar
P. V. Satheesh
Sultan Ismail
Vanaja Ramprasad
Vandana Shiva
K. Vijayalakshmi

*Associations*

Organic Farming Association of India
Navdhanya
Deccan Development Society
Sahaja Samrudha
Green Foundation
Annadana

*Modern agriculture systems*

Green revolution and chemical farming
Operation white flood and loss of indigenous cattle breeds
Hybrids, monoculture farming, loss of traditional seeds and its effects on traditional farming practices, cropping for cash, cropping for export
Seed and crop patents - turmeric, basmathi rice, neem
Genetically Modified Organisms in agriculture – the case of BT brinjal, BT cotton, corn, golden rice

*The negative impact of modern agricultural systems on traditional farming practices*

*Capitalistic interests in the farming sector*

Seed, fertilizer and pesticide industry
Retail chains

*Government policy on agriculture and infrastructure*

National and state policy on organic farming
National Horticulture Mission
National crop boards and agricultural councils
Research Institutions
Agricultural universities
Outreach centres and extension offices
Meteorological information centres
Farmer training schools
Krishi Vigyana Kendras

*International bodies*

IFOAM
FAO

*Certification*

PGS
Certification agencies

*Markets*

Farmer markets and bazaars
Agricultural Produce Marketing Cooperative (APMC)
Organic Stores
The export market
Retail chains
Fair trade

## Resources

1) *The Organic Farming Sourcebook* edited by Claude Alvares, published by Other India Press, Goa, 2010 is a comprehensive book on all matters related to non chemical practices. Within the book one will find case studies of practitioners, pioneers as well as matters related to organic practices, policy, stores, farm centred schools, book reviews etc. It would be useful to begin any study of agriculture with reading this book. Available with the Other India Bookstore. MAPUSA, Goa www.otherindiabookstore.com

2) *One Straw Revolution* by Masanubo Fukuoka, published by Other India Press, Goa

3) *An Agricultural Testament* by Albert Howard, published by Other India Press, Goa. An abridged version of the same book has been published by Manchi Pustakum, Secanderabad

4) www.ofai.org is the official website of the Organic Farming Association of India. It is a source of useful information on many topics on agricultural practices. It offers a link to power point presentations of proven practices by experts in the field.

5) The *Asian Agri-History* journal published by Asian Agri-History Foundation, Secunderabad (www.agri-history.org) carries interesting articles. Archival copies are available on their website. They have also published several books and translations from ancient texts on traditional agricultural practices.

6) *A History of Agriculture in India* by M.S.Randhawa published by ICAR in 4 large volumes. It covers a period of over a thousand years, providing a panoramic view of what has happened on the Indian subcontinent with respect to traditional agriculture over the ages. Instructors and strongly motivated students may find these volumes useful.

7) *Our Land Our Life – A Practical Course of Agriculture and Environmental Education* (Books for classes 6, 7, 8) published by Uttarakhand Seva Nidhi Paryavaran Shiksha Sansthan, Almora, Fifth edition, 2009. The complete series for classes 6 to 10 is available on the website www.ueec.org.in as free downloads. Books for classes 6, 7, 8 are available for reference with Taleemnet.

8) *Crop Production: Elements of Crop Production (Practical Manual)* for Class XI (Paper I) by K.N. Bansal published by NCERT, New Delhi, 2000.

   Contains topics on measuring weather parameters, various implements used in crop production. Also topics related to seed and germination. The topics on fertilizers and chemical weed and pest control measures may be dropped.

9) *Dairying Volume-IV- Forage Production Conservation and Recycling of Farm Wastes (Instruction-cum-Practical Manual)* by A.K. Sacheti, published by NCERT, New Delhi, 1991.

   Agroforestry practices mainly for the production of fodder and recycling of farm waste from cattle.

10) *Horticulture: Fruit Production Text Book for Class XI* by A. A. Faroogi et al published by NCERT, New Delhi, 1999.

    Contains topics related to horticulture practice. Contents mentioning chemical inputs may be dropped.

11) *Exemplar Instructional Material for Pre-vocational Course under Work Experience on Plant Protection (Instructional-cum-Practical Manual) for Classes IX – X* by A. K. Dhote published by NCERT, New Delhi, 1987.

    The book covers topics related to pests, their control and equipment used. Topics related to chemical practices may be ignored.

12) *Crop Production: Elements of Crop Production Textbook for Class XI; Paper I* by K.N. Bansal published by NCERT, New Delhi, 2000.

    Covers a wide range of topics such as agricultural practices, farming tools, post harvesting practices. Topics related to chemical practices may be ignored.

**Shree Padre**

The rural curriculum makes it possible to acknowledge the validity of inherent knowledge systems. A farmer who has never dreamed that what he knows is of real value can be a teacher to the children in this programme.

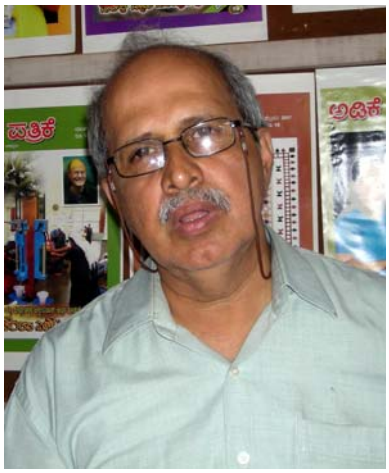
Soil erosion and deforestation are the two important issues that affect us. We have forgotten the significance of soil preparation to cultivation. Double digging is worth teaching children. The logic is simple - prepare the top soil with good aeration and good water holding capacity.

Instead of speaking on topics like freedom and empowerment, show it in practice. The children can be asked to write letters to their parents, they can then ask a post man, how it would reach their parents. Make him your resource person. Why should only white collared persons be considered fit to be resource persons?

Of the many things that can be taught, to me, the most important are: general water conservation and the role of water bodies, and the knowledge of location specific practices. Our area, in old times, had food security. There was crop security. If you take the records of the past 3-4 years there is no crop or at the very least a minimum yield each crop cycle. A farmer achieving a crop every year is an outstanding achievement. Farmers with large areas are going in for sand mulching. They have also devised innovative financial systems, where they lease part of the land for a few years, just enough to see them through, while rebuilding soils in the not so fertile patches.

If I have a separate school running for rural children, I would make Bushnoor Math, a successful farmer, the teacher. He has not lost a single crop for the past 25 years, not only that, he has successfully taken two crops in a year.

We have now a generation of young adults with aspirations to see their parents 'living well'. They take up jobs in big towns and wish to 'upgrade' their parents from being farmers to pre maturely retired idle folk. They are persuaded to abandon farming, lock up the house and move in into their children's home in big towns. They feel their parents have worked very hard and should now spend their time in leisure. What happens on the farming front then? If there is no maintenance, it lies fallow. This is another big threat whose repercussions have not yet fully manifested. A farm is not like an industry that you may lock up. What will you do if there are cows?



Shree Padre

Veterinary science is also an area where the children have to be made aware and be made to understand that animals are very much part of their life. I have known children who look at real animals in the neighbourhood with great unease but will look at an animal documentary with rapt attention. This alienation from nature in our children should be a cause for anxiety.

Somehow we seem to be conveying the message to our children and to society that farming is the last job option one must take. I don't know how we are going to achieve the vision of a hunger free society with that attitude.

What I am saying is that, if we really care, there should be SOS centres where the problem of debt, finances and technical issues related to farming can be solved through counseling. If these centres can have successful farmers as counselors who are able to inspire, then farming will get a big boost.

Today there are economic problems because the knowledge of the best practices has not been disseminated widely. There is a total disconnect between the farmers, the scientific body of knowledge and technology available and the agriculture department. Farmers are treated like destitutes. Nobody wants to address their real issues. There has to be a conscious effort if we are to give due recognition to the farmers and the farm labourers as the food feeders of the country. None want their children to farm today.

# 10. Agroforestry

Apart from growing food crops, a farm grows many different plant and tree varieties for different purposes. Trees and plants are required to fulfill needs such as fencing, windbreaks, animal fodder, green manure, fuel, timber etc. The growing of such trees is broadly classified as agroforestry. Within this practice there is opportunity for supplementing the farm income, as many trees have commercial value. Fruit trees on the farm can be improved for quality of fruit and yield through grafting which further adds to the income. This module may be dealt with by understanding theoretical aspects combined with practical work.

*What is agroforestry?*

*Types of agroforestry – alley cropping, trees on the perimeter of a farm, mixed cropping*

*Causes for loss of green cover in village common lands and fringes of forest areas*

*Human demand for timber, fuel wood, fodder, minor forest produce*

*The need for incorporating agroforestry practices in farming*

*Systematic management of tree plantations as a renewable resource*

*Field study and survey of the village common lands, farms and homesteads and forest fringes for*

Identifying local tree species
Study of the health of the green cover
History of the green cover – original forests, secondary forests, plantations
Reasons for degradation
Possible interventions for regenerating of green cover
Developing a time bound action plan to regenerate green cover

*Categorise local species based on their use, economic value and characteristics with the assistance of village elders or forest officials*

*Drawing up an activity chart for collection of seeds, raising a nursery, caring for saplings, preparing planting beds or pits, planting and post planting care*

*Raising at 3-4 saplings each of a few local varieties from seed or vegetative shoots (e.g. bamboo)*

*Maintaining records for the above*

*Improvement of fruit trees for better yield through grafting*

*Improving the productivity of wild/inferior/old trees such as mango, ber, wood apple through grafting techniques*

*Making a plan on the map of a farm plot for planting of trees on bunds, in watershed areas, on the farm perimeter to meet various farm needs such as fencing, fodder, timber, windbreaks, shade etc.*

*Growing natural fences with local varieties of fencing shrubs*

## Resources

Agroforestry has been practiced by communities on individual farms and community lands for centuries. Many plant species ideal for fuelwood, fodder, green manure, timber, seasonal fruit, wind breaking qualities, shade etc are region specific. This knowledge is available locally and may be used in the study of agroforestry.

The international community at Auroville, Pondicherry have been pioneers in regenerating highly degraded landscapes. Practices within Auroville are based on sound ecological principles. Anyone interested in agroforestry and ecorestoration would benefit greatly by spending time as apprentices there. Bernard Declerq from Pebble Garden, Joss Brooks from Pichandikulam Forest, Lucas Dengel from the Bio Dynamic Association among others have done pioneering work in this field.

1) *Tree Rearing Social and Agroforestry* by G.Guru and others published by NCERT New Delhi, October 1992

2) *Tree Rearing, Social and Agroforestry (Work Experience Manual)* by G.Guru published by NCERT, New Delhi, 1992. Good book on agroforestry topics.

3) *Glimpses of Plant Life Part I and II* published by NCERT, 2001

   The above two low cost books are excellent reference books for introducing children to the world of plants and trees.

4) *Our Tree Neighbours* by Chakravarti S. Venkatesh, published by NCERT 1976.

   A good resource for children for identification of common trees.

5) Green teachers' guides on farming practices are available from Centre for Environment Education, Ahmedabad

6) *Our Land Our Life – A Practical Course of Agriculture and Environmental Education* (Books for classes 6, 7, 8) published by Uttarakhand Seva Nidhi Paryavaran Shiksha Sansthan, Almora, Fifth edition, 2009. The complete series for classes 6 to 10 is available on the website www.ueec.org.in as free downloads. Books for classes 6, 7, 8 are available for reference with Taleemnet.

7) *Dairying Volume-IV- Forage Production Conservation and Recycling of Farm Wastes (Instruction-cum-Practical Manual)* by A.K. Sacheti, published by NCERT, New Delhi, 1991.

   Agroforestry practices mainly for the production of fodder and recycling of farm waste from cattle.

## 11. Building living soils and reclamation of degraded lands

Albert Howard was the first to observe that the indigenous methods used by Indian farmers for nurturing soils, using compost and farm yard manure, produced excellent results. With the introduction of chemical agriculture much of this knowledge was discarded. Very shortly however farmers began to realise the pitfalls of chemical intensive farming. With the revival of organic farming, there has been renewed interest in the indigenous practices complemented with scientific knowledge. This module takes into account multiple factors that go into the building of living soils and regenerating degraded lands.

*The soil as a living entity*

*Traditional wisdom of nurturing soils*

*How soil becomes dead – unhealthy practices that affect soil health*

*What is soil health?*

*Features of healthy soil*

Organic content, microbes, subterranean flora and fauna, colour, texture, moisture, temperature, pH

*Soil fertility, its suitability for certain crops*

*What is degradation of soil and land*

*Causes of soil and land degradation*

*Faulty practices that have caused degradation of soil*

*Faulty practices that can cause degradation of soil*

*Self regeneration cycles seen in nature*

*Indicators of soil and land degradation – tendency towards desertification*

*Symptoms of soil and land degradation*

*Impact of degraded soil and land on other systems*

On farming
On animals
On cropping patterns

*On productivity*

On the village community – debts, migrations, suicides, economy
Water systems – flood, erosion, drought. Their effect on the water table

*Soil reclamation practices*

Mulching, green manuring, increasing green cover, no till farming, compost, mixed cropping practices

*What is humus?*

*Mycorrhiza – the symbiotic association of fungi within plant roots*

*Significance of rhizomes and mycorrhiza in soil health*

*Rhizomes in legumes – the symbiotic association of fungi and roots*

The significance of intercropping and crop rotation of legumes in enhancing soil health

# Resources

1) *The Organic Farming Sourcebook* written & edited by Claude Alvares, published by Other India Press, Goa, 2010 is a comprehensive book on all matters related to non chemical practices. Within the book one will find many resources related to building living soils. It would be useful to begin any study of agriculture with reading this book. Available with the Other India Bookstore. MAPUSA, Goa www.otherindiabookstore.com

2) *Compost* by the late Dr Venkat published by Manchi Pustakam, Secunderabad is a small booklet providing a sound background to understanding the value and practice of composting.

3) *Regenerating the Soil* by Claude Bourguignon available with Other India Bookstore, MAPUSA, Goa. This book reiterates the importance of nurturing the soil and the fact that only living soils will support an agriculture of permanence.

4) Many pioneers have discovered ingenious methods of building living soils and enriching soil nutrient and microbial content. The work of B. N. Nandish, of Karnataka, Shoor Veer Singh of Uttar Pradesh, Chetana Vikas of Wardha, Maharashtra, Bernard Declerq from Auroville is worth detailed study. Their work is featured in the *Organic Farming Sourcebook*.

5) *Our Land Our Life – A Practical Course of Agriculture and Environmental Education* (Books for classes 6, 7, 8) published by Uttarakhand Seva Nidhi Paryavaran Shiksha Sansthan, Almora, Fifth edition, 2009. The complete series for classes 6 to 10 is available on the website www.ueec.org.in as free downloads. Books for classes 6, 7, 8 are available for reference with Taleemnet.

6) *Dairying Volume-IV- Forage Production Conservation and Recycling of Farm Wastes (Instruction-cum-Practical Manual)* by A.K. Sacheti, published by NCERT, New Delhi, 1991.
Agroforestry practices mainly for the production of fodder and recycling of farm waste from cattle.

7) *Indigenous Techniques of Soil and Moisture Conservation and Runoff Management* by V.S.Surakod published by Publication Centre - University of Agricultural Sciences, Dharwar, 2003.
Techniques on watershed based approach to land management and various cropping practices.

*8)* *Some Reflections on Watershed Development* by the late Dr. Venkat, published by Manchi Pustakam, Secunderabad.

# 12. Pests diseases and methods of natural pest control

Traditionally farmers had developed several natural methods and formulations for control of farm pests and crop diseases. The most common one that one notices even today in farms is the scare-crow. Natural biological controls meant setting up bird perches for owls and other carnivores to conveniently hunt for mice, crabs etc., leaving anthills undisturbed as readymade homes for snakes, or the growing of aromatic plants to keep away insect pests. With the onset of chemical agriculture came chemical pesticides, weedicides and herbicides. Pests, mostly insects that bred in un-controllable numbers were seen to target specific parts of specific crops. With the revival of non-chemical farming, farmers revisited traditional knowledge to invent effective formulations for pests and disease control. To understand why and how natural pest control methods work, a good knowledge of insect life cycle, morphology and habits would be essential. Insect specific bio-formulations can then be worked out.

*Pests and diseases of important crops and their control*

Insect pests

Types

Leaf eaters or defoliators
Sap suckers
Stem and root borers
Leaf rollers
Leaf miners
Bark and wood feeders
Fruit borers
Insects in store houses and godowns
Transmitters of viral, bacterial and fungal diseases causing mould, blight, wilt etc.

Pests of field crops, nature of attack and control measures
Diseases in field crops, their symptoms and control measures
Various biological formulations for the control of pests and diseases

## Resources

1) *Our Land Our Life – A Practical Course of Agriculture and Environmental Education* (Books for classes 6, 7, 8) published by Uttarakhand Seva Nidhi Paryavaran Shiksha Sansthan, Almora, Fifth edition, 2009. The complete series for classes 6 to 10 is available on the website www.ueec.org.in as free downloads. Books for classes 6, 7, 8 are available for reference with Taleemnet.

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   The book covers topics related to pests, their control and equipment used. Topics related to chemical practices may be ignored.

3) *The Organic Farming Sourcebook* written & edited by Claude Alvares, published by Other India Press, Goa, 2010 is a comprehensive book on all matters related to non chemical practices. Within the book one will find case studies of practitioners who have mastered techniques of natural pest control. It would be useful to begin any study of agriculture with reading this book. Available with the Other India Bookstore. MAPUSA, Goa www.otherindiabookstore.com

4) www.ofai.org is the official website of the Organic Farming Association of India. It is a source of useful information on many topics on agricultural practices. It offers a link to power point presentations of proven practices of natural pest control methods by experts in the field.

# 13. Crop production and practice

This module covers a range of topics that are necessary to learn in theory and skills if one has to have a good grip on working with the land to produce food. There are many aspects to growing food is what one will discover in the process of studying this module. At the end of this study one will grow in his/her respect for the tremendous knowledge and practical skills that farmers have and the hard work that goes into farming. One will also realise that women play a major role in contributing to farming activities.

*Elements of crop production*

*Crops and their classification*

- Definition of crop
  - Classification of crops based on various criteria
    - range of cultivation
      - garden crops
      - plantation crops
      - field crops
    - taxonomy
      - the grass family- Gramineae
        - annual, biennial, perennial
      - the legume family-Leguminosae
        - annual, perennial
      - other crop families
        - Asteraceae (Compositae): Sunflower,safflower
        - Chenopodiaceae: Spinach, beet
        - Convolvulaceae: Sweet potato
        - Cruciferae: Rapeseed and mustard, toria and taramira
        - Cucurbitaceae: Pumpkin, sweet gourd, ash gourd, bitter gourd, cucumber
        - Euphorbeaceae: Castor, tapioca
        - Liliaceae: Onion, garlic
        - Malvaceae: Cotton, mesta, lady finger
        - Pedaliaceae: Sesame
        - Solanaceae: Potato, tomato, brinjal, chili, tobacco
        - Umbelliferae: Coriander, carrot, cumin
        - Ziliaceae: Jute
        - Zingiberaceae: Ginger, turmeric
    - Season
      - Kharif/monsoon crop
      - Rabi/winter crop
      - Zaid/summer crop
      - (Sunlight and temperature resilient varieties are grown round the year irrespective of the season)
    - Duration of life cycle
      - Annual
      - Biennial
      - Perennial
    - Use of crop plant and their products
      - Cereals
      - Millets
      - Oil seeds
      - Pulses
      - Vegetables

- Forage crops
- Fibre crops
- Sugar crops
- Medicinal crops
- Beverages
- Spices and condiments
- Narcotics

Special purpose crops

- Cash crops
- Green manure crops
- Cover crops
- Smother crops
- Catch crops
- Mulch crops
- Trap crops
- Augmenting crops
- Alley crops

*Factors affecting crop production*

Genetic factors-based on variety, food habits, adaptability to climatic and edaphic factors

Environmental (climate) factors - air, temperature, relative humidity, solar radiation, wind velocity and direction, evaporation etc.

Edaphic (soil) factors

- physical (soil texture, temperature, moisture content and structure)
- chemical (pH, electrical conductivity, redox potential)
- biological (micro soil flora and fauna)

Biotic factors - activities of man, animals, birds, micro and macro organisms, pest attacks

*Farming systems*

Cropping pattern based on farming practices

Shifting cultivation

Settled permanent agriculture

Mixed cropping and its advantages

Inter cropping

- Advantages and limitations
- Types
  - Parallel cropping
  - Companion cropping
  - Synergistic cropping
  - Ratooning
  - Strip cropping

Mono cropping

Multiple cropping

Double cropping

Sequential cropping

Relay cropping

Crop rotation

Principles of crop rotation

Ideal rotation pattern

Advantage of crop rotation

Common rotations based on various agro-climatic and geographical zones

Cropping scheme

Principles and parameters for selection of cropping schemes

- Area of the farm-cultivable and non-cultivable area
- Number of plots

Crop selection based on location and available resources, markets, post harvest processing facilities
Calculation of cropping intensity
Agro forestry incorporations into farming

*Tillage and tilth*

Practice, objectives, advantages and disadvantages of tillage operations
Tilth - good, ideal, fine and rough
Types of tillage
On season tillage
Off season tillage
Preparatory tillage - ploughing
Inter tillage
Minimum tillage
Zero or no tillage - benefits and limitations
Agricultural implements
Tillage implements
Based on power used
Hand operated tools and implements
Animal drawn implements
Tractor drawn implements
Based on purpose
Primary tillage
Ploughs - indigenous or wooden plough, soil turning plough, mouldboard plough, disc plough, listers, sub-soiler, sweeps, ridger, puddlers
Secondary tillage
Harrows - disc harrow spike-tooth harrow, spring tyne harrow, blade harrow
Cultivators
Hoes
Clod crushers and levellers – planks, rollers, bund formers
Implements and their function
Plough
Wooden indigenous plough
Iron plough
Harrow
Cultivators
Clod crushers
Plank
Leveller
Puddler
Bund former
Implements in common use
Familiarising with use and maintenance of tillage implement
Sowing implements
Seed drill
Planters
Transplanters
Familiarising with the use and maintenance of sowing implement
Calculating seed rate for a given plot size
Inter - culture implements their use and maintenance
Hand hoe
Garden rake
Shovel

- Paddy weeder
- Cultivator
- Green manure trampler
- Familiarising with the use and maintenance of inter-culture implements

Common tools and materials
- Spanner set
- Screwdriver set
- Grease and oils

Harvesting implements
- Sickle
- Mechanised harvesting implements
- Familiarising with the technique and practices for harvesting different kinds of crops

Post harvest tools, metho ds, implements and equipment
- Indigenous practices of harvesting different kinds of crops
- Mechanised and semi-mechanised equipments
  - Thresher
  - Maize sheller
  - Groundnut kernel sheller
  - Winnower
  - Ground nut digger and potato digger
  - Local innovations
- Familiarising with the local techniques and practices of post harvest processing of different crops and their preservation
- Plant protection
  - Sprayers

*Seed and sowing*

Seed - definition, roll and characteristics of good seed

Types of seed
- Breeder or nucleus seed
- Foundation seed
- Certified seed
- Hybrid seed
- Composite seed

Seed quality
- Seed purity - (based on proportion of pure seeds, other crop seeds and inert matter in a given seed sample)

Seed viability
- Test for seed viability - germination test

Germination
- Test for germination - in petri-dish, sand, rag - roll

Seed dormancy
- Importance
- Kinds-innate, induced, enforced
- Causes for dormancy - seed coat impermeable to water or oxygen, hard seed coat, rudimentary dormant embryo, dormant embryo, synthesis of accumulation of germination inhibitors in seed
- Methods to break seed dormancy
  - Local practices for various crops
  - Scarification
  - Temperature treatment
  - Exposure to light
  - Application of pressure
  - Removal of seed inhibitors
  - Application of chemicals

- Seed Treatment
  - Local traditional practices
  - Physical, chemical, biological (application of microbial cultures such as rhizobium)
- Sowing
  - Time of sowing
  - Depth of sowing
  - Methods
    - Direct seeding (broadcasting )
    - Drilling
    - Nursery raising and transplanting

*Weeds and their management*

- Definition of weeds
- Familiarisation with different types of weeds, their habits, crop association, features
- Making a weed herbarium collection
- Losses caused by weeds due to:
  - Reduction in crop yield
  - Contamination of main farm produce - loss in quality
  - Harmful to human and animal health
  - Contamination of water body
  - Host to pest and pathogens
  - Competition for nutrients, sunlight, water and space
- Uses and advantages
  - As forage
  - As green manure
  - As food by humans
  - As medicinal plants
  - As controller of soil erosion
  - As fencing, thatching, rope making material
  - As raw material in paper and pulp industry
- Characteristics of weeds
  - High persistence and resistant to control and eradication methods
  - Large seed producers
  - Remain viable and dormant for long durations
  - Hardy with high ability to withstand adverse soil, climatic and disease conditions
  - Deep root systems
  - Similar in morphological features to crop seeds - making segregation difficult
- Classification of weeds
  - Based on duration of life cycle - annual, biennial and perennial
  - Based on cotyledon-monocotyledonous, dicotyledonous
  - Based on place of occurrence - crop land, fallow land, grass land, pastures, range land, orchards, aquatic, forest or woodlands
  - Noxious weeds
- Critical period of weed competition
  - Common weeds associated with particular crops and their identification
  - Management of weeds
    - Preventive measures
    - Eradication
    - Weed control
- Agronomic methods or good crop husbandry methods
  - Local practices
  - Selection of crop and varieties
  - Manures

- Appropriate crop plant population
- Stale seed methods
- Planting methods
- Crop rotation
- Irrigation and drainage
- Summer ploughing
- Minimum tillage
- Mulching

Physical and mechanical methods

- Hand weeding
- Hand hoeing
- Digging
- Mowing and cutting
- Dredging and chaining (for aquatic weeds)
- Burning and flaming
- Tillage and inter-culture (inter-cultivation)

Biological weed control

- Insects
- Carp fish and snails (for aquatic weeds)
- Crop plants that compete with target weeds
- Biological preparations

Preparations, dosage, application; precautions during preparation, application and storage

Familiarising with the use and maintenance of weed control equipment

Advantages and disadvantages

*Pests and diseases of important crops and their control*

Insect pests

- Leaf eaters or defoliators
- Sap suckers
- Stem and root borers
- Leaf rollers
- Leaf miners
- Bark and wood feeders
- Fruit borers
- Insects of store houses and godowns
- Transmitters of viral, bacterial and fungal diseases causing mould, blight, wilt etc.
- Pests of field crops, nature of attack and control measures
- Diseases in field crops, their symptoms and control measures

*Harvesting and post harvest handling*

Harvesting
Time of harvesting
Physiological maturity - symptoms and indicators
Complete maturity - symptoms and indicators
Criteria for harvesting crops
Harvesting fodder crops
Methods of harvesting
Post harvest operations

- Winnowing
- Drying
- Treatments and processing
- Storage

Climatic Factors

- Difference between climate and weather
- Visit to a meteorological observatory to familiarise with various equipments
- Elements of weather and the meteorological equipments for its measurement
  - Temperature: maximum - minimum thermometer (Stevenson screen)
  - Relative humidity: dry - wet thermometer
  - Rainfall: rain gauge
  - Wind direction: wind vane
  - Wind speed: anemometer
  - Sunshine hours: sunshine recorder
  - Evaporation: pan evaporator
  - Soil temperature: soil thermometer
  - Atmospheric pressure: barometer

  *Note:* Read all written instructions before handling any equipment. Safety instructions must be followed carefully. When recording observations always write the date, time and place at the top of the page
- Rainfall
  - The meaning of precipitation, its various forms – rain, snow, hail
  - Rain gauge and its parts
  - Conditions for installation of rain gauge
  - Installation of rain gauge
  - Measuring rainfall
  - Determination of the amount of rainfall received in a particular area
- Precautions to be taken during taking measurements
  - The correct procedure of taking measurements
  - Recording observations
  - Interpretation of data
- Temperature
  - The meaning of temperature of air
  - The Stevenson screen, its various components and functions
  - Difference between heat and temperature
  - How and why does temperature vary during day and night
  - Measuring maximum and minimum air temperature
  - What is the meaning of mean air temperature and temperature range for a given day
  - Precautions to be taken while taking measurements
  - The correct method of taking measurements
  - Recording observations
  - Interpretation of data
- Humidity
  - What is meant by humidity
  - The measures of humidity – vapour pressure, relative humidity, dew-point, temperature
  - The meaning of wet-bulb temperature
  - The principles and working of the wet-bulb thermometer
  - Calculating the dew-point temperature and relative humidity from wet - bulb and dry-bulb temperatures
  - Computation of relative humidity
  - Computation of dew-point temperature
  - Vapour pressure
  - Difference between mist and fog
- Wind direction and wind velocity
  - Wind vane
  - Construction, installation and reading a wind vane

Wind velocity
Measuring wind speed using an anemometer
Calculating mean daily wind speeds from anemometer readings

Soil temperature
The importance of soil temperature in crop growth
The soil thermometer
Installation of soil thermometer
Taking readings at different soil levels using a soil thermometer
Interpreting soil temperature data and drawing conclusions with regard to soil conditions for crop growth
Precautions

*Crop Calendars*
How crop patterns have changed over time
Understanding crop patterns of the past
Area under cash crops / water philic crops has increased
Impact on cropping, soil and farm health, loss to agri-biodiversity
Impact on traditional food habits
Impact on nutrition
Crop cycles and crop seasons
Restoring a sustainable crop pattern in farms
Design a suitable crop pattern for a farm

## Resources

1) *The Organic Farming Sourcebook* written & edited by Claude Alvares, published by Other India Press, Goa, 2010 is a comprehensive book on all matters related to non chemical practices. Within the book one will find case studies of practitioners, pioneers as well as matters related to organic practices, policy, stores, farm centred schools, book reviews etc. It would be useful to begin any study of agriculture with reading this book. Available with the Other India Bookstore. MAPUSA, Goa www.otherindiabookstore.com

2) www.ofai.org is the official website of the Organic Farming Association of India. It is a source of useful information on many topics on agricultural practices. It offers a link to power point presentations of proven practices by experts in the field.

3) The Indian Council of Agricultural Research (ICAR), state agriculture departments, boards promoting organic agriculture and agriculture universities publish region specific manuals and books on successful practices for specific crops. One can obtain these publications from them.

4) Traditionally people have practiced multi-cropping throughout the different cropping seasons. These practices are part of community knowledge and must be imbibed through active engagement. The Asian Agri-History Foundation (www.agri-history.org) based at Secunderabad over the years has made special efforts to document and publish this knowledge. These publications may be referred to for cropping systems and crop calendars that have worked.

5) *Our Land Our Life – A Practical Course of Agriculture and Environmental Education* (Books for classes 6, 7, 8) published by Uttarakhand Seva Nidhi Paryavaran Shiksha Sansthan, Almora, Fifth edition, 2009. The complete series for classes 6 to 10 is available on the website www.ueec.org.in as free downloads. Books for classes 6, 7, 8 are available for reference with Taleemnet.

6) *Crop Production: Elements of Crop Production Textbook for Class XI; Paper I* by K.N. Bansal published by NCERT, New Delhi, 2000.

   Covers a wide range of topics such as agricultural practices, farming tools, post harvesting practices. Topics related to chemical practices may be ignored.

7) *Crop Production: Elements of Crop Production (Practical Manual)* for Class XI (Paper I) by K.N. Bansal published by NCERT, New Delhi, 2000.

Contains topics on measuring weather parameters, various implements used in crop production. Also topics related to seed and germination. The topics on fertilizers and chemical weed and pest control measures may be dropped.

8) *Horticulture: Fruit Production Text Book for Class XI* by A. A. Faroogi et al published by NCERT, New Delhi, 1999.

Contains topics related to horticulture practice. Contents mentioning chemical inputs may be dropped.

9) *Repair and Maintenance of Tillage and Sowing Equipments (Instructional-cum-Practical Manual) for Classes IX – X* by M. Vandana Harishchandra et al pubished by NCERT, New Delhi, 1998.

Covers topics related to farm machinery and equipment. It also contains topics related to chemical inputs that may be dropped. Offers an introductory overview on farm related technology.

10) *Repair and Maintenance of Power Thresher (Instructional-cum-Practical Manual) for Classes IX – X* by Janardan Prasad et al published by NCERT, New Delhi, 1998.

Covers topics related to farm machinery and equipment. It also contains topics related to chemical inputs that may be dropped. Offers an introductory overview on farm related technology

11) *Repair and Maintenance of Plant-Protection Equipment (Instructional-cum-Practical Manual) for Classes IX – X* by Manoj Mathew et al published by NCERT, New Delhi, 1998.

Covers topics related to farm machinery and equipment. It also contains topics related to chemical inputs that may be dropped. Offers an introductory overview on farm related technology

12) *Rural Engineering Technology: Farm Machinery and Processing Equipment; Textbook for Class XII; Paper VI* by Banshi D. Shukla published by NCERT, New Delhi, 2000.

Covers topics related to farm machinery and equipment. It also contains topics related to chemical inputs that may be dropped. Offers an introductory overview on farm related technology

13) *Exemplar Instructional Material for Pre-vocational Course under Work Experience on Plant Protection (Instructional-cum-Practical Manual) for Classes IX – X* by A. K. Dhote published by NCERT, New Delhi, 1987.

The book covers topics related to pests, their control and equipment used. Topics related to chemical practices may be ignored.

14) *Indigenous Techniques of soil and Moisture Conservation and Runoff Management* by V.S.Surakod published by Publication Centre- University of Agricultural Sciences, Dharwar, 2003.

Techniques on watershed based approach to land management and various cropping practices.

# 14. Plant and soil health supportive preparations

Practicing organic farmers across the country have invented various formulations with proven results. One will find many variations of the same formulations, as their application is site specific. The basic 'recipe' may be taken as a guideline to develop formulations that serve ones purpose.

*Panchagavya*

Preparation, properties and benefits, dilutions, applications, disadvantages
Precautions during preparation, application and storage
Locale specific variations, local recipes standardised by farmers in the locality

*Vermiwash*

Preparation, properties and benefits, dilutions, applications, disadvantages
Precautions during preparation, application and storage
Locale specific variations, local recipes standardized by farmers in the locality

*Effective Micro-organisms (EM technology)*

Readymade preparations available in the market
Properties and benefits, dilutions, applications, disadvantages, precautions

*Farmers EM*

Preparation, properties and benefits, dilutions, applications, disadvantages
Precautions during preparation, application and storage
Locale specific variations, local recipes standardised by farmers in the locality

*Biodynamic preparations*

Preparation, properties and benefits, dilutions, applications, disadvantages
Precautions during preparation, application and storage
Locale specific variations, local recipes standardized by farmers in the locality

*Pest repellants*

Preparation of botanical extracts, properties and benefits, preferred combinations, dilutions, application, disadvantages
Precautions during preparation, application and storage

*Some beneficial microbes*

Azospirillum, Azetobacter, Trichoderma, Lactobacillus

*Some microbial growth mediums*

Molasses, jaggery, whey, coconut water, ripe banana, agar agar

*Common plant pathogens*

Algae and fungi (moulds)
Bacteria and viruses
nematodes

*Sterilisation*

Techniques, need for sterilization

*Fermentation*

Role in biological preparations
Yeast
Enhancing and curbing the fermentation process

## Resources

1) www.ofai.org is the official website of the Organic Farming Association of India. It is a source of useful information on many topics on agricultural practices. It offers a link to power point presentations of proven practices of plant and soil health supportive preparations by experts in the field

2) Many local preparations have been standardised by pioneering organic farmers. Dr K.Natarajan, G.Gopalakrishna, S.R.Sundararaman, Fr Inaz Almeida have standardised many useful preparations. Practitioners of biodynamic agriculture have their own unique preparations. Details may be found in *The Organic Farming Sourcebook* edited by Claude Alvares, published by The Other India Press, Goa, 2010. Available with the Other India Bookstore. MAPUSA, Goa www.otherindiabookstore.com

3) *Panchagavya* by Dr. K Natarajan available with Other India Bookstore, Goa is a small, easy to understand instructional manual

4) *Our Land Our Life – A Practical Course of Agriculture and Environmental Education* (Books for classes 6, 7, 8) published by Uttarakhand Seva Nidhi Paryavaran Shiksha Sansthan, Almora, Fifth edition, 2009. The complete series for classes 6 to 10 is available on the website www.ueec.org.in as free downloads. Books for classes 6, 7, 8 are available for reference with Taleemnet

5) *The Organic Farming Sourcebook* written & edited by Claude Alvares, published by Other India Press, Goa, 2010 is a comprehensive book on all matters related to non chemical practices.

   Within the book one will find material on the topic. Available with the Other India Bookstore. MAPUSA, Goa www.otherindiabookstore.com

# 15. Vermiculture and vermicompost

The humble earthworm, popularly known as the farmer's friend, rose to fame when chemical agriculture began to fail in India. Initially several foreign varieties of the worm were introduced into the country. Overtime the local variety of the worm proved to be the best performer. Vermiculture is practiced by all organic farmers today. Vermicompost of high nutrient quality can be prepared in small and large quantities as per needs. The technique is fairly simple, requires very little infrastructure and investment. Many farmers also prepare vermicompost to supplement income from the farm.

*Earthworm - the farmer's friend*
*Preparing a compost bed*
*Vermicomposting*
*Optimal conditions for a healthy population of earthworms in a compost bed*
*Precautions while vermicomposting*
*Recording observations*
*Storage of compost*
*Application of vermicompost and vermiwash in gardens and farms*
*Application of vermiculture techniques in domestic, farmyard, municipal waste management*
*Vermicomposting, vermiculture, vermicasts, vermiwash*
*Anatomy, habits and lifecycle of earthworms*
*Classification of earthworms based on ecological strategies, types and characteristics*

## Resources

1) *The Earthworm Book* by Sultan Ahmed Ismail, published by the Other India Press, MAPUSA, Goa and available at the The Other India Bookstore, MAPUSA, Goa. The book contains practical information about composting, Vermiwash production and its application in organic farming. The biological and ecological aspects of the earthworm are also discussed in the book

2) *Earthworm: Cinderella of Organic Farming* by Radha D.Kale, available with Other India Bookstore, MAPUSA, Goa. The book takes the reader through the biological and ecological functions of the earthworm and details methods of vermiculture and vermicomposting

3) *Our Land Our Life – A Practical Course of Agriculture and Environmental Education* (Books for classes 6, 7, 8) published by Uttarakhand Seva Nidhi Paryavaran Shiksha Sansthan, Almora, Fifth edition, 2009. The complete series for classes 6 to 10 is available on the website www.ueec.org.in as free downloads. Books for classes 6, 7, 8 are available for reference with Taleemnet

# 16. The process of getting healthy seed

Seed selection is as ancient as agriculture itself. Selecting good quality seed is central to crop improvement practices. Traditionally, seed keeping has been the forte of women folk. Selecting good seed and keeping it such that its potency is intact until sowing time requires keen observation and patience. Keeping meticulous records also is useful. Village markets have played an important role in seed keeping and selection as these places offer the farmer opportunity to exchange crucial information as also seeds. Companies with commercial interests are doing their best to deprive the farmer sovereignty over seeds. This module deals with the theory, practice and initiatives taken by people and organisations in this area.

*Crop seed diversity*

*Crop diversity and farm health*

*Seed selection process*

*Traditional methods of selecting a plant for seed*

*Traditional methods of seed selection, preservation and storage*

*Traditional practices of keeping live germ plasm*

*Mendel's laws of inheritance and selection*

*Seed exchange practices*

*Festivals, customs, methods and traditions related to seed, precautions during preparation, application and storage*

*Folklore connected with seed precautions during preparation, application and storage*

*Work of Dr Richharia*

*Beej Badro Andolan*

*Revival of the millet tradition*

Pioneering work of individuals and associations such as Deccan Development Society, Dinesh Kumar, Vijay Jardhari, Sahaja Samrudha, Millet Network of India, Green Foundation, Beej Vidyapeeth

*Seed keeper and promoters*

The work of individuals and associations such as Deepika Kundaji, Annadana, Green Foundation, Navdhanya, Sahaja Samrudha, Deccan Development Society

## Resources

1) *Our Land Our Life – A Practical Course of Agriculture and Environmental Education* (Books for classes 6, 7, 8) published by Uttarakhand Seva Nidhi Paryavaran Shiksha Sansthan, Almora, Fifth edition, 2009. The complete series for classes 6 to 10 is available on the website www.ueec.org.in as free downloads. Books for classes 6, 7, 8 are available for reference with Taleemnet

2) The Kokopelli Association of France has done extraordinary work concerning the conservation of heirloom seed varieties of the world. In India Kokopelli is associated with Annadana in Karnataka and Auroville in Pondicherry. www.kokopelli-seeds.com

3) Seed saving and seed saver's resources: www.homemage.eircom.net/~merlyn/seedsaving.html is an excellent link for everything on seeds, seed saving and seed savers

4) Deepika Kundaji of Auroville is considered an expert in India on seed selection and maintaining pure seed lines at home scale levels. Anyone interested in learning these techniques would benefit as an apprentice under her guidance

5) *Beej Vidyapeeth* initiated by Vandana Shiva at Dehra Dun offers training programmes on various aspects of organic farming including techniques of keeping seeds

6) Millet Network of India (MINI), Deccan Development Society (DDS) and Green Foundation are associations where one can access information on topics related to this module. (Check master resource list for details)

# 17. Raising a nursery for orchards and agroforestry

This module deals with the practical skills of raising a plant nursery and may be best learnt practically. A good place to begin with would be to visit a farm or the local nursery that is involved in such work.

*Techniques and methods of raising a tree seedling*

- From seeds
- From cuttings
- Through grafts
- Through rhizomes
- Through root cutting

*Precautionary measures*

*Care of saplings*

*Planning of a nursery and tending a nursery plot*

*Visiting a local orchard nursery*

*Visiting a local forest nursery*

*Volunteering at a nursery to learn techniques*

*Principles of grafting*

*Techniques and methods of grafting*

*Precautions and post grafting care*

*Planning for plantation site – agroforestry, orchard*

*Growing a mixed tree orchard*

*Post plantation care*

## Resources

1) *Tree Rearing Social and Agroforestry* by G.Guru and others published by NCERT New Delhi, October 1992

2) *Tree Rearing, Social and Agroforestry (Work Experience Manual)* by G.Guru published by NCERT, New Delhi, 1992

   Good book on agroforestry topics

3) *Our Land Our Life – A Practical Course of Agriculture and Environmental Education* (Books for classes 6, 7, 8) published by Uttarakhand Seva Nidhi Paryavaran Shiksha Sansthan, Almora, Fifth edition, 2009. The complete series for classes 6 to 10 is available on the website www.ueec.org.in as free downloads. Books for classes 6, 7, 8 are available for reference with Taleemnet

4) Local nurseries maintained by the forest department, horticulture department or by individual persons

## 18. Farm records, farm accounts, farm crop diary and cow house diary

Children must grow up with the confidence that traditional ways, may with some modifications, still work for us. Since records don't lie, successful established processes can be emulated based on records of what worked and what did not. Traditionally people would have relied on memory. However, children today can be encouraged to keep records so that their experiences may be systematized and best practices taken forward.

An important aspect of farming activity is to maintain meticulous records of various processes. A good way to start this is with maintaining a seasonal diary of the crops grown. Young children should be encouraged to maintain a diary of their activities and observations of their vegetable garden. In later years this will translate into maintaining records of crops, cropping practices, accounts and farm animal records. Maintaining crop and animal records is essential for taking important decisions related to selection of quality seeds, isolation and propagation of improved varieties and decisions regarding animal breeding, culling, introducing new breeds etc. Over the years it is not possible to remember many of the important facts and figures that one may need in order to make a decision. It is in such situations that a diary comes in handy.

It is also useful to learn simple double entry book-keeping and drawing up of a balance sheet. A balance sheet reflects on operations and provides clues regarding possible lacunae or shortcomings. It is essential that children have a good foundation in basic mathematics to feel comfortable with numbers. This is especially useful when dealing with farm operations of a large scale. Accounts and record keeping is best done on a day to day basis.

Animals, especially cows are an intrinsic part of a farm. For a farm to function well its draught animals and cows should be well cared for and kept in good health at all times. Apart from milk which may be an important component of the family's farming income cow-dung and cow-urine are essential components of several farm input preparations. Keeping meticulous records of each animal's history will prove to be useful in taking important decisions from time to time. Particularly in case of cows one needs to be right on top of the situation since they can go down in health very easily. Hence a daily record becomes all the more essential. Detailed record of crossings and family trees help to obtain good breeds with the best characteristics of milk-yield and mothering healthy calves in case of cows and draught power in case of bulls.

Rather than rely on external resources, it may be best to arrive at criteria for the record books by oneself. This may be done either through consultations and discussions with persons already following such practices or through periodic review and necessary amendments/improvements in ones own design.

*Farm records and farm crop diary*

*Seasonal diary of crops grown*

A drawing of the crop/vegetable patch
Source of seed
Seed, sowing, irrigation details
Techniques used for growing a particular crop
Crop health-measures taken to ensure a healthy crop
Application of biological preparations-date, concentration, method
Flowering, seed-setting, time season and duration
Harvesting, sale/storage
Record of seed selection in case of exceptional yields
    Record of selective isolated breeding of seed for quality such as yield, straw, hardiness to physical parameters
    Record of seed selection methods such as staggered flowering and seeding time
Weather records
Record of pest and disease attacks and control measures followed, results
Develop a format for a crop diary

*Farm records*

Maintaining records of farm-land, licenses, moveable and immoveable assets, machinery etc on the farm

Records of energy consumption-fuels, bio-gas, electricity

Stock register

*Farm accounts*

Attendance register, payment register

Sales and purchase register

Cash register and ledger, register for petty cash transactions

*Cow house diary*

A cow house diary may be designed such that it provides for recording the following information:

Date

Cow names

Behavior: active/ lethargic; food intake – normal or otherwise (possible reason if otherwise)

General health: normal or otherwise (possible reason if otherwise - low appetite, bloated stomach, illness, soar udders etc.); treatment if any

Milk-yield data: record of quantity of milk-yield for every milking for every cow

Reproductive details: crossing (date and identity/name of bull); expected calving date; date of actual calving; date of next reproductive cycle (in heat); details of lactating periods

Visits by the vet: date and reason for visit, details of treatment

Descriptive notes and remarks

## Resources


1) *Tree Rearing Social and Agroforestry* by G.Guru and others published by NCERT New Delhi, October 1992

2) *Tree Rearing, Social and Agroforestry (Work Experience Manual)* by G.Guru published by NCERT, New Delhi, 1992
Good book on agroforestry topics

3) *Our Land Our Life – A Practical Course of Agriculture and Environmental Education* (Books for classes 6, 7, 8) published by Uttarakhand Seva Nidhi Paryavaran Shiksha Sansthan, Almora, Fifth edition, 2009. The complete series for classes 6 to 10 is available on the website www.ueec.org.in as free downloads. Books for classes 6, 7, 8 are available for reference with Taleemnet

4) Local nurseries maintained by the forest department, horticulture department or by individual persons

**Syamantak**

Syamantak is inspired and mentored by Dr S. S. Kalbag, a scientist turned educator. It is driven by the conviction that every individual should be able to live and learn in his/her own natural surroundings and that nobody should ever have to leave their place of birth for the lack of educational or livelihood opportunities. The philosophy aligns

Palm leaf weaving in progress

with M. K. Gandhi's Nai Talim and the Gotul education system of Bhil and Gond adivasis.

All learning is self-directed and is based on one's personal interests, observations, exploration and experimentation. Students live as a family and all housekeeping chores are shared. Students learn to grow organic vegetables, recycle and compost all waste, build toilets and sewage disposal system, construct energy units for example a *gobar* gas plant that uses animal and human waste, design their own

A student demonstrates the working of the water pump, an improvised mechanism

Solar drier and cowdung cakes being dried for preparing washing powders developed in-house

build-ings, make architectural drawings, carry out constructions, identify flora and fauna and even handle snakes, analyse blood, soil and water samples, sew and knit and do much more. The nuances of figuring out how things work, is done very simply by pulling things apart and then reassembling. Be it a cycle, generator set or a motor bike, there is no restriction on the child to have a go at dismantling it into its individual components of nuts, bolts, plastic, glass, wires and metal.


Record keeping is an important activity at Syamantak

## Modules

# FARM RELATED TECHNOLOGY

Energy is a prerequisite to work. Conventional source of energy, being a scarce and expensive resource, is beginning to show its limitations. Natural and renewable forms of energy are slowly taking over. Technology has made tremendous advances in offering alternatives. Although still in its nascent state, many pioneers have been able to use it successfully. The first three modules deal with this.

Technology is an essential part of running a farm. By having adequate knowledge of how things work, and how to repair and maintain tools, implements, machinery and equipment the functioning of a farm becomes smooth and efficient. Many of the modules under this section expose children to this skill and knowledge.

Computers have brought in professionalism and efficiency into how we do things today. With the internet, free information on every topic is at our disposal. A good knowledge of computer and internet usage is a necessity. It has also been dealt with in the language section of this curriculum.

1. Watershed Based Approach to Land Management
2. Understanding Energy
3. Appropriate Technology
4. Designing and Setting up a Farm Workshop
5. Materials and Structures
6. Paints and Glues
7. Repair and Maintenance on the Farm
8. Civil Constructions around the Farm
9. Computers

# 1. Watershed based approach to land management

The many benefits of a landscape approach to managing natural resources have now been established for some time. Watersheds when managed well can accrue much benefit to the community or individual farmland. In most cases, arid lands can be transformed. This module is about a landscape approach to water and land management.

*What is a watershed?*

*How a watershed is demarcated*

*The importance of watershed*

*Why a watershed based approach?*

*Terminology used in the watershed approach*

- Runoff
- Infiltration
- Soil erosion rates

*Land management activities in watershed based approach*

- Plantations
- Check dams
- Gully plugs
- Trenches
- Contour bunds
- Graded contour bunds
- Drainage channels
- Percolation tanks

*Use of an A-frame to mark contours*

*Use of transparent water pipes to mark contours*

# Resources

1) *Soil and Water Management*, Class XII textbook, published by NCERT, New Delhi.

2) *Our Land Our Life – A Practical Course of Agriculture and Environmental Education* (Books for classes 6, 7, 8) published by Uttarakhand Seva Nidhi Paryavaran Shiksha Sansthan, Almora, Fifth edition, 2009. The complete series for classes 6 to 10 is available on the website www.ueec.org.in as free downloads. Books for classes 6, 7, 8 are available for reference with Taleemnet.

3) *Indigenous Techniques of Soil and Moisture Conservation and Runoff Management* by V.S.Surakod published by Publication Centre-University of Agricultural Sciences, Dharwar, 2003.

4) Techniques on watershed based approach to land management and various cropping practices.

5) *Some Reflections on Watershed Development* by the late Dr Venkat, published by Manchi Pustakam, Secunderabad.

6) *Rainwater Harvesting* by Shree Padre, published by Altermedia, Thrissur. www.altermediaindia.com. Shree Padre has singlehandedly popularised rainwater harvesting by conducting innumerable workshops in remote corners of this country and by writing about it zealously in newspapers and magazines. The book offers a hands on approach to techniques of rainwater harvesting and related topics.

7) The office of the state's Soil and Water Conservation Department would have local and region specific resources.

8) Centre for Science and Environment, New Delhi, publications. Catalogue available on website www.cseindia.org

Centre for Environment Education, Ahmedabad, publications. Catalogue available on website: www.ceeindia.org

# 2. Understanding energy

Given the current global energy crisis, it would be to one's advantage to understand the various renewable sources of energy available, the energy requirements of the farm and managing energy in a sustainable manner. This unit is an outline of energy resources on the farm.

*What is energy?*

*The sun as a primary source of all energy*

*Energy needs for various activities, e.g. cooking, boiling water etc.*

*Understanding calorific value*

*Calorific value of various fuels e.g. coal, biogas, firewood, LPG gas etc.*

*Consumption measurement*

Fuel wood
Electricity
Biogas
Petrol/diesel

*Energy management calculations e.g. Energy available from the sun, wind, running water, firewood etc.*

How much energy available
How much energy required

*Renewable energy resources*

Solar, wind, biogas, hydroelectricity

*Locally available or locally produced energy from*

Fuel wood, biogas, solar, wind, bio fuel

*Fuel tree species cultivation and management*

*Energy from outside the locality e.g. electricity, petrol*

*Light and heat proportions*

*Wind proportions*

*Wise / judicious / economical use of energy*

Energy efficient appliances, e.g. a good gas stove, electric appliance, smokeless chulla

## Resources

1) *Energy Applications II*, class XII textbook, published by NCERT, New Delhi
2) Website of The Energy Research Institute (TERI), New Delhi: www.teriin.org. TERI is a premier research institute for energy studies. Publications are listed on their website
3) Centre for Science and Environment, New Delhi, publications. Catalogue available on website www.cseindia.org
4) Centre for Environment Education, Ahmedabad, publications. Catalogue available on website: www.ceeindia.org
5) *Our Land Our Life – A Practical Course of Agriculture and Environmental Education* (Books for classes 6, 7, 8) published by Uttarakhand Seva Nidhi Paryavaran Shiksha Sansthan, Almora, Fifth edition, 2009. The complete series for classes 6 to 10 is available on the website www.ueec.org.in as free downloads. Books for classes 6, 7, 8 are available for reference with Taleemnet
6) *What on Earth is Energy?* By D.P. Sen Gupta published by NCERT, New Delhi, 1989
Contains energy related explanations, often in story from

# 3. Appropriate technology

For energy conservation and to save costs, a good understanding and skill in making use of appropriate technology would be very useful on the farm. This module is about a few basic aspects of appropriate technology.

*What is appropriate technology?*

*Technologies best suited for local conditions*

*Technology related to land, water and crops*

*Units of measurement*

*Electricity*

*Iron and steel*

*Wood*

*Work, energy, power, force*

*Strength, elasticity, pressure, shear*

*Cement*

*Bricks*

*Drawings*

*Bore wells and hand pumps*

*Tools, equipment, machines – their distinction*

*Identifying appropriate tools, equipment and machines according to needs*

*Precautions and maintenance*

*Improvisations based on needs*

*Poly-houses and plastic lined water tanks*

# Resources

1) A note on Vigyan Ashram publications

   In 1983, Dr S.S. Kalbag, began an initiative at Pabal, near Pune in Maharashtra to educate rural youth in appropriate rural technology. He developed a syllabus under four broad categories of agriculture, environment, home science and appropriate rural technology. The centre has created many successful rural entrepreneurs. The syllabus has been introduced in many rural schools across Maharashtra for middle school levels. The books are available in Marathi at present. A set of these books are available for reference with Taleemnet. We understand that there is an effort to translate them into English

2) The NCERT has published books under two broad categories: textbooks (based on the National Curriculum Framework 2005) and general publications that contain supplementary readers, teacher guides, research monographs, vocational education books, journals etc.

   The department of vocationalisation of education of the NCERT has prepared books under the *Exemplar Instructional Material for Work Experience* series and under the *Rural Engineering Technology* series. These books contain introductory material for many of the farm related modules. Although these books are rather outdated, they contain some material that is still relevant. Since the government was then promoting chemical agriculture and still does not categorically reject chemical fertilizers and pesticides, this sentiment continues to be articulated in these books. Those who use these books should be careful when they come to topics that promote this harmful technology. These books are mentioned here because in our search for resource material we have found that NCERT is the only publication in India that has addressed this issue to an extent. Another advantage is that these books are low priced. A list of publications is available on www.ncert.nic.in

3) *Our Land Our Life – A Practical Course of Agriculture and Environmental Education* (Books for classes 6, 7, 8) published by Uttarakhand Seva Nidhi Paryavaran Shiksha Sansthan, Almora, Fifth edition, 2009. The complete series for classes 6 to 10 is available on the website www.ueec.org.in as free downloads. Books for classes 6, 7, 8 are available for reference with Taleemnet

4) *Technology and Children* by P.K Bhattacharyya published by NCERT, New Delhi, 2004
   Contains several technological innovations by children for everyday use

5) *Domestic Appliances Repairer Vol. I to VI* published by NCERT, New Delhi
   Contains practical experiments to learn about appliance repair. Somewhat outdated. Contains a large number of reference books recommended for reading

6) *Audel* Series of books

   The Audel's series, originally from USA and now published all over the world is a series of books giving detailed instructions on various branches of engineering. They have been popular with several generations of engineers. Currently published in India by Wiley India Pvt Ltd. Contains a number of technical books on electricity, pumps, motors and various other engineering topics. According to the website, the Indian editions appear to be affordably priced. www.wileyindia.com

## 4. Designing and setting up a farm workshop

A good workshop with appropriate tools and the knowledge of how to use and maintain them is important on any farm. Some thought before building a workshop can go a long way in improving efficiency. With a workshop at hand, the farm can be self-reliant in most jobs involving plumbing, carpentry, pump repair, electrical work and civil construction.

Defining the various jobs that may be required to be done in the workshop e.g. :

Woodworking
Repair of appliances
Small electrical repairs
Repair of farm machinery

*The need to know before hand what jobs will be required to be done in the workshop*

*Choosing a work space keeping in mind light and ventilation, storage of tools and raw materials*

*Making a workbench of the right height and size. A tool well attached to the workbench*

*Vises for holding jobs*

*Choosing tools according to the need*

*Caring for tools, instruments for sharpening or maintaining tools*

*Storing tools*

*Hazards in a workshops and safety practices in a workshop*

The use of safety goggles, gloves, masks, respirators, fire extinguishers

*Provision to expand the workshop depending on the need*

## Resources

*A note on Reader's Digest books*

Reader's Digest has published books on repair and maintenance, crafts and hobbies, health and nutrition etc. These books are well written, brief and contain pictorial instructions. Although these are written for a western readership, a large amount of the material is still useful for Indian conditions. Reader's Digest offers mail order facility in India. Many of these books are also available at lower prices in second hand book shops in the larger cities.

Some of the books useful in the farm related modules are:

1) *New Fix-it-Yourself Manual*
2) *Complete Do-it-yourself Manual: Home Repair and Home Improvement*
3) *How to Fix Just About Anything: Quick and Easy Ways to Solve the Most Common Problems in Your House, Garage and Garden*
4) *Crafts and Hobbies: A Step-by-Step Guide to Creative Skills*

# 5. Materials and structures

Materials can include such things as timber, plastic, concrete, bamboo and steel. It is necessary to know their properties and how to arrange them to build structures.

*The choice of different materials for different purposes*

Why wood for furniture
Why glass for windows
Why aluminium for saucepans
Why plastic for buckets
Why cotton and polyester for clothes
Why rubber for rubber bands

*Timber*

Various types of timber, such as teak, rosewood, mango, jack, arjun, bamboo, cane their characteristics and uses
The annular rings in wood
Seasoning wood
Sawing logs into boards – how the method of sawing affects the board's resistance to distortion and its appearance
Plane sawed wood and quarter sawed wood
How plane sawed wood is more prone to warping compared to quarter sawed wood

*Plywood*

What is plywood. What are plies. 3-ply and 5-ply wood
Why plywood is strong

*What is compression and what is tension*

The behaviour of concrete under compression and tension
The behaviour of steel under compression and tension
Why concrete is reinforced using steel rods

*Beams*

Beams or girders as parts of larger structures such as roofs and bridges
Simple beams : compression and tension in beams
The advantage of using beams
Common types of girder: I-beams, L-beams, T-beams, circular beams
Trussed beams-what is a truss – struts (in compression) ties (in tension)
Bridges – parts of a bridge – the bridge deck – piers

*Different types of bridges*

The beam and pier bridge
Arch bridge – arch bridge supported above the bridge deck
Arch bridge supported below the bridge deck
Suspension bridge – support from steel cables (in tension) hanging from tall towers (pylons)
Girder bridges – truss girder bridges
Lattice girder bridges
Box girder bridges

*Cantilever – a beam supported at only one end*

*Other structures – the roof truss of a house*

*Commonly used local building materials*

Sand, mud and clay
Stones and bricks
Mortar – traditional local formulations

*Live Fencing*

## Resources

1) Laurie Baker's books on building construction and materials using locally available eco-friendly materials are available from the Other India Bookstore, MAPUSA, Goa

   Laurie Baker's books are available as free downloads in pdf file format from www.arvidguptatoys.com

2) *Building Maintenance: Building Material Textbook* for Class XI (Paper I) by Krishna C. Pandey published by NCERT, New Delhi, 1999

3) *Building Maintenance: Building Material Practical Manual* for Class XI (Paper I) by V.K. Tiwari published by NCERT, New Delhi, 1999

   The above two books contain the basics of building materials, some of the topics are outdated

4) *Reader's Digest Crafts and Hobbies*

   Some excellent information on timber and sawed timber

# 6. Paints and glues

For a farmer to be self reliant, it would be necessary to know about paints and glues. There are a variety of paints and glues available and knowing the properties of each type and how to apply it would be very useful knowledge.

*Broad range of paint types*

Pigment in oil
Pigment in water

*Advantages and disadvantages of water based paints*

*Advantages and disadvantages of oil based paints*

*Various types of finish: matt and gloss and various other finishes in between termed as silk, satin, semi-gloss, suede, eggshell etc.*

*Some specific paint types*

Gloss
- What it is
- Where it is usually applied, method of preparing the surface before application, method by which it is applied

Polyurethane gloss
- What it is
- Where it is usually applied, method of preparing the surface before application, method by which it is applied

Silthane
- What it is
- Where it is usually applied, method of preparing the surface before application, method by which it is applied

Emulsion
- What it is
- Various finishes available
- Where it is usually applied, method of preparing the surface before application, method by which it is applied

Thixotropic (non drip)
- What it is
- Where it is usually applied, method of preparing the surface before application, method by which it is applied

Undercoat
- Where it is used and why

Enamel (name used synonymously with gloss or any alkyd modified paint)

Anticondensation
- Where it is used and why

Fire-retardant
- Where it is used and why

Anti-burglar
- Where it is used and why

Bituminous
- Where it is used and why
- Precaution if normal gloss or oil-based paint is applied over bituminous paint

Primers
- The need for a primer
- Various types of primers
- Using the right type of primer for a surface – wood, metal or plaster

- Thinners
  - Liquids used as thinners
  - The need for thinners
- Paint brushes
  - Artificial fibre bristles
  - Pure hog's bristles
  - Sizes and types
  - Cutting-in-brushes
  - Crevice and radiator brushes
  - Care of brushes
  - Temporary storage
- Paint rollers
  - When they are used
  - What paints to apply with paint rollers
  - Types of paint roller
  - How to use paint rollers
  - Care and storage of paint rollers
- Stripping paint to prepare a surface for a new coat
  - Hand sanding
  - Mechanical sanding
  - Chemical stripping
  - Heat stripping
- Painting doors, walls and windows
  - General preparation of surfaces
  - Painting techniques
  - Method and order of painting walls, doors, windows
- Painting faults

*Glues*

- Various types of glues, their specific uses and precautions when using
  - Superglues
  - Epoxy resin
  - Wood adhesive
  - Clear glue
  - Purpose-made adhesives for
    - Gluing soles onto shoes
    - Fixing ceramic tiles to walls
    - Fixing flooring tiles
  - Paper and card adhesives
  - UV-active acrylic
  - Fabric adhesive
  - Expanded-polystyrene adhesive
  - Contact adhesive
  - Hard-plastic cement
  - PVA and synthetic resin adhesives
  - Panel-and-flooring adhesives
  - PVC adhesive
  - Two-part acrylic adhesives
- Preparing the surface to be glued
- Solvents or cleaners to remove surplus glue
- Home-made glues using refined flour, corn starch etc.
- Natural resins – gum Arabica

## Resources

1) A note on Reader's Digest books

Reader's Digest has published books on repair and maintenance, crafts and hobbies, health and nutrition etc. These books are well written, brief and contain pictorial instructions. Although these are written for a western readership, a large amount of the material is still useful for Indian conditions. Reader's Digest offers mail order facility in India. Many of these books are also available at lower prices in second hand book shops in the larger cities

*Reader's Digest How to Fix Just About Anything*
Has a good section on glues

2) *The Complete Book of DIY** edited by Mike Lawrence, Orbis Publishing Limited 1991
Contains useful information on paints and painting. The book is generally available in bookstores in the metropolitan cities.

* DIY stands for Do-it-Yourself

# 7. Repair and maintenance on the farm

Farming makes use of a variety of tools, gadgets and equipment. It is necessary that these be maintained in proper working order. Buildings, sheds, tanks, pumps, plumbing, irrigation systems, tolls etc need regular repairs, maintenance and care. Knowing how they work and their care is an essential component of farming activity. Also, some tools are region and crop specific. The list below mentions only some of the common repair and maintenance work on a farm.

*How to fix and adjust handles on hammers, chisels, spades, pickaxes and shovels*

*Sharpening knives, chisels, axes and other cutting tools*

*Sharpening saws*

*Building a new rack or shelf*

*Making various types of joints for woodwork*

*Making knots and lashings to tie timber or bamboo*

*Working with bricks and masonry*

*Building makeshift sheds with bricks, bamboo and thatch*

*Using mud in construction*

*How to replace broken floor tiles*

*How to concrete or cement a floor*

*How to replace broken bathroom tiles*

*Minor repair works involving repairing and plastering of broken walls*

*Whitewashing walls with lime*

*How to paint walls, wood and metal surfaces*

*Changing water taps and valves in bathrooms or on the farm*

*Fitting new water pipes: cutting, threading and joining pipes*

*Replacing corroded or defective water pipes*

*Maintenance of drip irrigation systems*

*Maintenance and repair of sprinkler systems*

*Maintenance of spraying equipment*

*Care and servicing of motors, generators and pumps*

*Maintenance of biogas plants, solar panels and other equipment involving appropriate technology*

*Replacing electrical fuses*

*Rewiring or replacing defective electrical wirings*

*Wiring to fix a new electrical point*

*The method of storing tools*

*The habit of putting back tools and any equipment in their allotted places*

*The practice of routinely greasing and oiling moving parts and hinges of machinery, door, gates etc*

*Safety practices when using tools and carrying out repair and maintenance work*

## Resources

1) *The Complete Book of DIY** edited by Mike Lawrence, Orbis Publishing Limited 1991
Contains useful information on repair and maintenance. The book is generally available in bookstores in the metropolitan cities

   * DIY stands for Do-it-Yourself

2) *Exemplar Instructional Material for Pre-vocational Course under Work Experience: An Introduction to Plumbing (Instructional-cum-Practical Manual)* Classes IX-X by A.P.Verma published by NCERT, New Delhi, 1987

   Contains some basic information on plumbing

3) *Lineman Practice Volume I* for Class XI (Instructional-cum-Practical Manual) by Sachchidananda Ray published by NCERT, New Delhi, 1988

4) *Lineman Practice Volume II* for Class XII (Instructional-cum-Practical Manual) by Sachchidananda Ray published by NCERT, New Delhi, 1990

   Contains topics related to basic skills required by an electrician cum lineman

5) *Basic Materials and Related Workshop Volume I* (Instructional-cum-Practical Manual) for Class XI by Sachchidananda published by NCERT, New Delhi, 1989

   Contains topics on workshop skills with guidelines for working

6) *Basic Materials and Related Workshop Volume II* (Instructional-cum-Practical Manual) for Class XII by Sachchidananda Ray published by NCERT, New Delhi, 1989

   Contains topics related to basic electrical work with guidelines

7) *Exemplar Instructional Material for Pre-Vocational Course under Work Experience – Introduction to House-Wiring (Instructional-cum-Practical Manual)* for Classes IX and X by Sachchidananda Ray, published by NCERT, New Delhi, 1987

   Contains useful information on house-wiring

8) *Repair and Maintenance of Tillage and Sowing Equipments (Instructional-cum-Practical Manual) for Classes IX – X* by M. Vandana Harishchandra et al pubished by NCERT, New Delhi, 1998

   Covers topics related to farm machinery and equipment. It also contains topics related to chemical inputs that may be dropped. Offers an introductory overview on farm related technology

9) *Repair and Maintenance of Power Thresher (Instructional-cum-Practical Manual) for Classes IX – X* by Janardan Prasad et al published by NCERT, New Delhi, 1998

   Covers topics related to farm machinery and equipment. It also contains topics related to chemical inputs that may be dropped. Offers an introductory overview on farm related technology

10) *Repair and Maintenance of Plant-Protection Equipment (Instructional-cum-Practical Manual) for Classes IX – X* by Manoj Mathew et al published by NCERT, New Delhi, 1998

    Covers topics related to farm machinery and equipment. It also contains topics related to chemical inputs that may be dropped. Offers an introductory overview on farm related technology

11) *Rural Engineering Technology: Farm Machinery and Processing Equipment; Textbook for Class XII; Paper VI* by Banshi D. Shukla published by NCERT, New Delhi, 2000

    Covers topics related to farm machinery and equipment. It also contains topics related to chemical inputs that may be dropped. Offers an introductory overview on farm related technology

12) *Exemplar Instructional Material for Pre-vocational Course under Work Experience on Plant Protection (Instructional-cum-Practical Manual) for Classes IX – X* by A. K. Dhote published by NCERT, New Delhi, 1987

    The book covers topics related to pests, their control and equipment used. Topics related to chemical practices may be ignored

# 8. Civil constructions around the farm

*(Constructing bunds, pits, compost areas, check dams, trenches, tanks, masonry work, sheds, biogas digesters, building animal sheds)*

Planning the layout of a farm, its various activities, marking out spaces for various purposes, digging pits, trenches growing trees for shade or protection against wind, all need to be seen as a whole. Though constructions involve much skill and it would take much time to develop these skills, it would be useful to know many basic things listed below.

- Basics of civil construction
- Planning
- Design
- Drawings
- Principles of Vaastu
- Ecofriendly local construction materials
- Ecofriendly designs
- Incorporating traditional architectural designs in construction
- Incorporating rainwater harvesting, drainage in construction
- Construction plans for various purposes
    - Community use
    - Storage
    - Animals sheds
    - Post harvest processing
    - Multipurpose
- Farm design planning based on ecofriendly and permaculture principles
- Design of water management and composting areas
    - Pond and water reservoir design
    - Canals
    - Tanks
    - Pits
    - Compost areas
    - Biogas digesters
    - Trenches

## Resources

1) Laurie Baker's books on building construction and materials using locally available eco-friendly materials are available from the Other India Bookstore, MAPUSA, Goa

   Laurie Baker's books are available as free downloads in pdf file format from www.arvidguptatoys.com

2) Website of The Energy Research Institute (TERI), New Delhi: www.teriin.org. TERI is a premier research institute for energy studies. Publications are listed on their website.

3) Centre for Science and Environment, New Delhi, publications. Catalogue available on website www.cseindia.org

4) Centre for Environment Education, Ahmedabad, publications. Catalogue available on website: www.ceeindia.org

5) *Farm design – A Handbook,* published by DRCSE (Development Research Communication and Services Centre), Kolkata

6) *Our Land Our Life – A Practical Course of Agriculture and Environmental Education* (Books for classes 6, 7, 8) published by Uttarakhand Seva Nidhi Paryavaran Shiksha Sansthan, Almora, Fifth edition, 2009. Books in this series for classes 6 to 10 are available on the website www.ueec.org.in as free downloads. Books for classes 6, 7, 8 are available for reference with Taleemnet.

7) *Cheap Tanks for Water Storage* published by Uttarakhand Seva Nidhi Paryavaran Shiksha Sansthan, Almora.

8) *Indigenous Techniques of Soil and Moisture Conservation and Runoff Management* by V.S.Surakod published by Publication Centre-University of Agricultural Sciences, Dharwar, 2003.
   Techniques on watershed based approach to land management and various cropping practices.

9) *Vaastu* has seen a revival in the past few decades. Books on the subject are available from various publishers.

10) A note on Vigyan Ashram publications
    In 1983, Dr S.S. Kalbag, began an initiative at Pabal, near Pune in Maharashtra to educate rural youth in appropriate rural technology. He developed a syllabus under four broad categories of agriculture, environment, home science and appropriate rural technology. The centre has created many successful rural entrepreneurs. The syllabus has been introduced in many rural schools across Maharashtra for middle school levels. The books are available in Marathi at present. A set of these books are available for reference with Taleemnet. We understand that there is an effort to translate them into English.

# 9. Computers

Computers are a useful tool used to store data, to type out documents and to communicate through the internet. The most important thing about learning computers is having access to one. Youngsters with access to the internet are able to quickly learn how to use it. Learning to use computers is self instructional as programmes are designed with a built in help menu. What is not available on the help menu is available on the internet. (e.g. assembling computers etc). Being adept at using computers is a matter of practice.

*Assembling the components of a computer – CPU, monitor, keyboard, mouse, UPS, printer, scanner, webcam, internet data card, LCD projector*

*Operating a computer*

*Working on paint brush, keyboard – typing practice*

*Working on Word*

Making a file, saving a file, copying a file, deleting a file
Choosing fonts, font colour, font size
Basic formatting of text
Cutting, pasting, copying and pasting, inserting image into a document, inserting tables into a document

*Internet basics*

Web browsing
Opening an email account
Sending messages
Attaching files to emails
Using search engines

*Loading new software*

*Attaching new hardware and loading its software on the computer*

*Formatting a hard disk*

*External hard drives for keeping backups – using pen drives, CDs, VCDs etc*

*Printing a document*

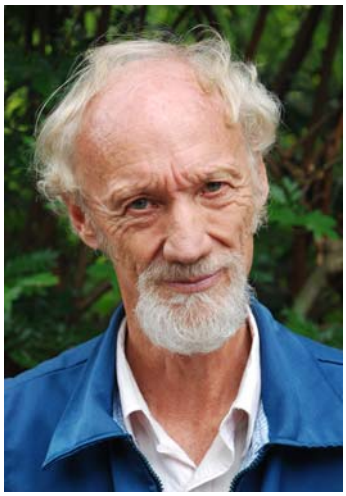
*Scanning and saving a document*

*Converting files to PDF*

*Working on Excel and Powerpoint*

*Playing media files on computer – CD, DVD, VCD*

**Sholai School**
**Centre for Organic Agriculture and Appropriate Technology (CLOAAT)**


Brian Jenkins, founder of Sholai

CLOAAT offers a 10 to 20 month Mature Student Programme to young people in the age range 18 to 28 years. Students are provided facilities to follow creative, supervised self-study with a practical handson orientation in the following subjects:

Organic, Bio-dynamic farming and Permaculture.
Appropriate Technologies (Solar, Micro-hydro, Biogas etc.)
Environmental Management
World Affairs
Food and Nutrition
The Art of Teaching
Art and Design
English Literature
Geograhical Information Systems to develop Sustainable Lifestyles in Rural India.

*The Sholai School within the same premises offers the same (simplified) facilities for younger children.*


Pet keeping


Bridge constructed by students of Sholai leading to the prayer hall


Hideout for bird and animal observation and study at Sholai


Drying space constructed by students of Sholai


Working in the vegetable garden

## MODULES
# SUPPLEMENTARY FARMING ACTIVITIES

*An overview*

Farming activity is not just about growing crops. Although growing crops is the major activity, farming can accommodate several allied activities. The list below mentions a select few. Harvesting and storage are closely connected with farming itself, they have been included here as independent modules. Many farms today practice value addition to the farm and dairy products. Cattle and chickens have always been part of farming households. Many small farmers especially in low rainfall areas with natural scrubland also rear sheep and goats. A typical farming family would keep its farm animals within its own living quarters. Hence most children in rural areas grow up learning animal handling skills quite naturally.

The modules here are concerned with this rather than large scale enterprise. Since in recent years we have degraded our environment callously, beekeeping must be seen today as an essential activity to facilitate pollination. The income from honey is only incidental. Sericulture should be seen as an activity of choice that will require skilled training.

People, especially in the North eastern parts of this country have always kept fish in their farm/ village/community ponds. Traditionally it served to keep water bodies clean and as a source of protein. A systematic approach to pisciculture is a rather recent phenomenon and is seen more as an enterprise rather than a farm related activity. Aquaponics, a technique of combining keeping fish and vegetable gardening for recycling nutrient rich water is also gaining in popularity. It can take the form of an interesting hobby for children which when mastered may be upscaled. Although we have not come across books that illustrate this technique, one can find numerous demonstration video clipping on the internet on *Youtube*. Pisciculture may be best learnt through hands on engagement, a prelude to which could be to introduce young children to the hobby of keeping aquarium fish.

Ethno-veterinary practices along with homeopathy, growing of medicinal and aromatic plants have seen a revival in recent decades. Extensive documentation is available on these subjects. Once the technique is known and mastered mushrooms can be easily cultivated. They are not only a good source of protein, but also fetch a good price. Many people have been able to make it a financially rewarding enterprise requiring marginal investment.

Good health, good housekeeping and crafts are intrinsic to living well. And knowledge of community hygiene, first aid and what to do in the face of a calamity should be considered as part of essential training.

*List of Modules*

1. Harvesting and storage
2. Post harvest processing
3. Animal husbandry: Cattle rearing, goat rearing, sheep rearing, piggery
4. Poultry
5. Bee keeping
6. Sericulture
7. Healthcare practices for animals
8. Mushroom cultivation
9. Growing medicinal and aromatic plants and extraction of oils and essences
10. Natural produce related processing and crafts (such as making candles, herbal soaps, herbal teas and herbal cosmetics, vegetable dyes)
11. Essentials: Food and nutrition, health, hygiene and well being, good housekeeping, sewing and needle craft
12. Community hygiene, first aid, natural and manmade disasters

# 1. Harvesting and storage

Harvesting at the right time plays an important role in the quality of the harvest and for maximizing yield and profit. Later, storing the produce in weather proof conditions and in places free from pests and rodents is an aspect which all farmers should know. The topics below are a necessity for every farmer.

*Traditional harvesting practices of various farm crops, horticultural crops, other minor crops, minor farm / forest produce*

*Traditional harvesting practices of various fodder crops, their storage and processing for silage*

*Traditional storage techniques of various crops, fruit, vegetable and fodder*

*Traditional storage containers / spaces, their care and maintenance*

*Pests in storage places*

*Traditional pest control practices in storage areas e.g. neem, ash etc*

*Traditional methods of storing vegetables, gourds, pumpkins, corn, yams, ginger, garlic, onions etc*

*Shelf life of various stored grain, fruit and vegetables*

## Resources

1) *Asian Agri-History* published by the Asian Agri-History Foundation, Secunderabad, www.agri-history.org. Asian Agri-History is a journal which regularly publishes articles related to various aspects of agriculture. Archival copies are available on the website

2) Centre for Indian Knowledge Systems (CIKS), Chennai, has published books on various topics related to agriculture. The books are reasonably priced. A complete catalogue is available on their website www.ciks.org

3) Community knowledge: Most harvesting and storing practices are region specific and many useful skills can be picked up locally by active participation

4) *Crop Production: Elements of Crop Production Textbook for Class XI; Paper I* by K.N. Bansal published by NCERT, New Delhi, 2000

   Covers a wide range of topics such as agricultural practices, farming tools, post harvesting practices. Topics related to chemical practices may be ignored

5) www.india.gov.in/sitemap.php: This is the official portal of the Indian Government hosted by National Informatics Centre. It provides a single window access to the information and services being provided by the Indian Government for citizens. It is a comprehensive source of information about India. Links at various places have been provided to other Indian Government Portals/ websites

   This website contains resources related to many of the farming modules. Everyone will benefit from a thorough study of this website

## 2. Post harvest processing

Post harvest processing while making available perishable agricultural produce throughout the year, adds value to bare farm produce. It also protects the farmer from the vagaries of the market. On farm value addition to farm produce can be a highly profitable enterprise if quality and marketing are handled professionally.

*Sun drying and dehydrating techniques*

*Value addition practices*

- Pickles
- Jams
- Preserves
- Biscuits
- Papads
- Dry papad like items

*Local practices*

*Traditional preservation techniques*

*Use of solar dryers in farm scale post harvest processing*

*Preservation mediums*

- Salt
- Sugar
- Oil
- Vinegar

# Resources

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3) Community knowledge: Most harvesting and storing practices are region specific and many useful skills can be picked up locally by active participation

4) Central Food Technological Research Institute (CFTRI), Mysore provides short term training in food processing and many post harvest processing practices. They have published several booklets on various techniques. The research wing has developed easy to use machinery and equipment for processing farm produce. www.cftri.com

5) Indian Council of Agricultural Research (ICAR) website is a rich source of information on many post harvest practices. www.icar.org.in

6) State agriculture departments and agriculture universities as part of their mandate conduct training programmes based on recent developments in the field. Posters and publications are also available on various topics

7) *Our Land Our Life – A Practical Course of Agriculture and Environmental Education* (Books for classes 6, 7, 8) published by Uttarakhand Seva Nidhi Paryavaran Shiksha Sansthan, Almora, Fifth edition, 2009. The complete series for classes 6 to 10 is available on the website www.ueec.org.in as free downloads. Books for classes 6, 7, 8 are available for reference with Taleemnet.

8) *Food Preservation and Processing: Food Packaging* Textbook for Class XII Theory Paper VI by S. K Sood published by NCERT, New Delhi, 2002

   Various topics on packaging, packing materials and processes

9) *Food Preservation and Processing: Food Preservation Techniques (Practical Manual) for Class XI; Paper III* by Mridula Saxena published by NCERT, New Delhi, 2002

   How to make jams, pickles, juices, wines along with dehydration techniques. In some cases the book recommends chemical preservatives. This recommendation may be ignored

10) *Crop Production: Elements of Crop Production Textbook for Class XI; Paper I* by K.N. Bansal published by NCERT, New Delhi, 2000

    Covers a wide range of topics such as agricultural practices, farming tools, post harvesting practices. Topics related to chemical practices may be ignored

11) www.india.gov.in/sitemap.php: This is the official portal of the Indian Government hosted by National Informatics Centre. It provides a single window access to the information and services being provided by the Indian Government for citizens. It is a comprehensive source of information about India. Links at various places have been provided to other Indian Government Portals/ websites

    This website contains resources related to many of the farming modules. Everyone will benefit from a thorough study of this website

# 3. Animal husbandry

Animal rearing is an integral part of farming and farming families. Most children growing up in rural areas learn about farm animals naturally through first-hand experience. Pastoral communities in India have mastered techniques of maintaining pure breed lines, especially of cows and draft animals. Much of this work remains as community knowledge, undocumented. A few elders in every village would have mastered the technique of animal care and medication and these are passed on as oral tradition.

Animal rearing within farms is a practical endeavour. The best way children can learn animal rearing practices is through first-hand experience within the family or the neighbourhood. Encouraging rearing of pets is the first step in this direction. The most useful farm animal being the cow, cattle rearing skills have been perfected by farmers over millennia. Rearing of small ruminants - sheep and goats is generally seen not as an integrated part of farming, but as an activity for supplementing the family income. Although sheep and goats are reared routinely in village homes, their systematic breeding and keeping are mostly the forte of the pastoral communities who still continue with a semi-nomadic life style. Piggery does not enjoy the same prominence, except in the North-eastern parts of India where it is common.

District headquarters and most taluka places across the country have a veterinary dispensary facility. The extension services at these facilities offer useful material on animal care in the form of free booklets and posters. The internet offers many websites dedicated to humane animal care. These may be explored along with some books mentioned in the resource section.

Only a broad outline for learning about cattle rearing has been detailed below. The rearing and care of other farm animals may be explored along similar lines.

*What is animal husbandry?*

*Animals as an integral part of farming*

*How animals help enrich the farm*

*The close connectedness between animal rearing and fertility of the land; recycling of domestic and farm wastes.*

*Cattle – local and indigenous breeds*

- Advantages and disadvantages of indigenous breeds

*Care of cattle*

- Sheds
- Feeding and grazing
- Hygiene
- Rest and exercise
- Handling and controlling cattle: halters, bull nose rings, muzzles
- Shoeing bulls
- Dentition and estimation of age in cattle
- Breeding
- Care of calves
- Pre and post natal care practices
- Care of milch cows
- Diseases and remedies
  - Ethno veterinary practices
  - Homeopathic practices
- Disposal of dead animals

*Products and services*

- Milk and milk products
- Draught power
- Dung and urine as base ingredients in farm input preparations
- Animal protein and leather

*Records*

- The cow house diary (dealt in detail in the module *Farm records, farm accounts, farm crop diary and cow house diary* under Farming Fundamentals)

## Resources

1) *Handbook of Animal Husbandry* published by Indian Council of Agricultural Research (ICAR), New Delhi
   ICAR regularly publishes a revised edition of this book. It covers major topics of cattle, sheep, goat, poultry, pig rearing, beekeeping and fisheries. Has good theoretical content and is affordably priced
2) *Organic Farming Sourcebook* written & edited by Claude Alvares, published by Other India Press, Goa, 2010. Contains an entire chapter on the significance of cattle in organic farming, with detailed information on indigenous breeds, books, traditional breeding practices, the history of the dairy industry in India, farm input preparations etc. Available at the Other India Bookstore. MAPUSA, Goa
3) *Dairy Animal Management: Textbook for Class XI* by B.K.Dave published by NCERT, New Delhi, May 1999.
   Slightly outdated, however, suitable for basic information on cows and cow rearing. The dairy practices mentioned are western in orientation and may be dropped.
4) *Dairying Volume-IV- Forage Production Conservation and Recycling of Farm Wastes (Instruction-cum-Practical Manual)* by A.K. Sacheti, published by NCERT, New Delhi, 1991
   Agroforestry practices mainly for the production of fodder and recycling of farm waste from cattle
5) A note on NCERT publications on Cattle and dairy farming
   NCERT has published several books on cattle rearing and dairy animals. Although slightly outdated and western in orientation, they contain useful material that may be used to build on further. Cattle rearing practices have seen many developments over the years towards making conditions humane for farm animals and a bent towards ethno-veterinary practices in animal care. This is not reflected in NCERT publications. A complete list of books is available on the NCERT website www.ncert.nic.in
6) The website www.ciwf.org.uk offers interesting information on farm animals as intelligent and sensitive beings
7) A note on ANTHRA publications
   ANTHRA was started by a group of women veterinary scientists to address the concerns of rural livestock rearers. Their initial work resulted in extensive documentation of livestock rearing practices and alternative (ethno-veterinary) systems in the country. The publications (in English, Marathi and Telugu) cover most topics in animal care and management especially related to sheep and goat rearing. Their offices in Pune and Hyderabad stock nearly 2,000 books besides reports, journals, magazines, CD's and documentaries, and offer a reading library and photocopy facility. Website: www.anthra.org
8) A note on SEVA
   SEVA, Madurai has consistently documented and published people's knowledge on animal care, ethno-veterinary practices and medicinal plants for animal care. SEVA works closely with Honeybee Network (www.sristi.org/hbnew/partnership.php) on farmer innovations
   SEVA Phone: 0091 – 452 – 2380082
9) A note on National Innovation Foundation
   It is an autonomous body under the Department of Science and Technology. They have several innovations related to animal care, especially formulations and publish a journal on innovations: Honeybee. Website: www.nif.org.in
10) *Our Land Our Life – A Practical Course of Agriculture and Environmental Education* (Books for classes 6, 7, 8) published by USNPSS, Almora, Fifth edition, 2009. The complete series for classes 6 to 10 is available on the website www.ueec.org.in as free downloads. Books for classes 6, 7, 8 are available for reference with Taleemnet
11) www.india.gov.in/sitemap.php: This is the official portal of the Indian Government hosted by National Informatics Centre. It provides a single window access to the information and services being provided by the Indian Government for citizens. It is a comprehensive source of information about India. Links at various places have been provided to other Indian Government Portals/ websites. This website contains resources related to many of the farming modules. Everyone will benefit from a thorough study of this website

# 4. Poultry

Rearing indigenous poultry does not require much technical knowledge. All one needs is a little experience with keeping chickens and some understanding of their behaviour. Rearing chickens can be an enjoyable hobby with much potential as a supplementary farming activity. Poultry science promotes large scale industrial model of rearing birds. On the other hand free range chickens and eggs are seen as better products. Many agricultural practices promote the keeping of poultry for the benefits that chickens provide to the farm such as manure, control of small soil insect pests and grubs and soil aeration. Most government run veterinary facilities have provisions for short term courses in poultry farming. These provide some basic theoretical inputs but are more oriented towards factory scale poultry farming.

*Keeping chickens*

- Chicken coups
- Feeding
- Place for egg laying
- Ideal male-female ratio in a group of chickens
- Brooding hens
- Period of incubation and hatching
- Diseases and remedies

*Products and services*

- Aerating soil
- Control of insect pests
- Manure
- Eggs and animal protein

*Various indigenous poultry breeds and their characteristics*

*The importance of poultry in farming*

## Resources

1) The best way children can learn about poultry is to keep a few chickens

2) *Handbook of Animal Husbandry* published by Indian Council of Agricultural Research (ICAR), New Delhi

   ICAR regularly publishes a revised edition of this book. It covers major topics of cattle, sheep, goats, poultry, pig rearing, beekeeping and fisheries. Has good theoretical content and is affordably priced.

3) *Poultry Farming: Poultry Production and Breeding, Textbook for Class XI Paper I* by D.C. Johari and R.C. Hazary, published by NCERT New Delhi. Only some chapters may be useful

4) *Poultry Farming: Poultry Diseases and their Control, Textbook for Class XII Paper VI* by H.K. Pradhan, published by NCERT, New Delhi. Only some chapters may be useful

5) www.india.gov.in/sitemap.php: This is the official portal of the Indian Government hosted by National Informatics Centre. It provides a single window access to the information and services being provided by the Indian Government for citizens. It is a comprehensive source of information about India. Links at various places have been provided to other Indian Government Portals/ websites

   This website contains resources related to many of the farming modules. Everyone will benefit from a thorough study of this website

# 5. Bee keeping

Bees play a significant role in pollination. With the steady degradation of forests and the widespread use of chemical pesticides in agriculture honey bee populations in the wild have declined drastically. It has been proved that rearing of bees on the farm results in a marked increase in crop yields and crop quality. Honey in such cases is often considered as an incidental byproduct. Rearing of bees is a specialised skill but can be mastered quite easily with patience. It also requires getting over ones fear of these quite harmless insects. Honey is known for its medicinal value and fetches a good price in the market.

*Rearing of Apis cerana indica*

*The three types of bees in a bee colony: Queen, workers and drones*

*Queen bee*

Identifying the queen bee and where in the hive it is usually located
The functions of a queen bee
The uniqueness of the queen bee in a hive
How a queen bee is formed
Where in the hive a queen bee is formed
Time taken for a queen bee to hatch
The mating of the queen bee
Egg laying period and life span of the queen bee
Eggs laid per day

*Workers*

Identifying worker bees
The function of worker bees
Time taken for workers to hatch
Life span of workers

*Drones*

Identifying drones
The function of drones

*The average size (number of bees) of a bee colony*

*The honey comb and its various parts*

Where honey is stored
Where pollen is stored
Where eggs/larvae are located

*Bee hive boxes*

Their various parts
Wood from which they are made, no paints to be used inside

*Behaviour of bees during different seasons*

When honey is most plentiful
When new hives are introduced / acquired

*Setting up a colony in a bee hive box*

Time of the year and time of the day this is done
Equipment needed

*Catching a colony from the wild and introducing it into a bee hive box*

*Division of hives*

What happens during division
Why this happens
How to identify symptoms when a hive is about to divide

*How to prevent division*
*How to artificially divide a bee hive*
*How to identify a hive that contains no queen bee*
*Introducing a queen bee into a strange hive*
*The activities of bees during the monsoons*
*Care of bees during the rains and the monsoons*
*Using sugar/jaggery syrup to feed bees during the monsoons and when a new hive is caught*
*Various honey flavours depending on the flowers from which bees gather nectar*
*Extraction of honey*
Seasons for extraction
*Detecting adulterated honey*
*The advantages of bee colonies on a farm*
*Common bee types in India*
*Bee types reared in India*

## Resources

1) *Bee-keeping for Pleasure and Profit* by Mohammad Naim, published by Kalyani Publishers, New Delhi – Ludhiana

2) *Bee-keeping, Instructional-cum-Practical Manual*, Classes IX and X, V.S.Mehrotra, NCERT, New Delhi 1997

3) For training on various bee-keeping techniques, including indigenous methods, you may contact:

   Palni Hills Conservation Council
   P.O. Box No. 34
   Lower Shola Road
   KODAIKANAL 624 101
   Tamil Nadu

4) The Khadi and Village Industries Commission (www.kvic.org.in) promotes bee keeping, conducts training programmes from time to time and provides bee boxes and honey extraction equipment at subsidised rates.

5) www.india.gov.in/sitemap.php : This is the official portal of the Indian Government hosted by National Informatics Centre. It provides a single window access to the information and services being provided by the Indian Government for citizens. It is a comprehensive source of information about India. Links at various places have been provided to other Indian Government Portals/ websites.

   This website contains resources related to many of the farming modules. Everyone will benefit from a thorough study of this website.

# 6. Sericulture

Silkworm rearing has been a practice in several parts of the world for hundreds of years. The Southern states of India, especially, have mastered this skill over millennia. The rearing of worms and the cultivation of their host plants are seen as co-activities. Once mastered, the technique becomes a matter of routine practice. It is best learnt by apprenticing with an expert grower. Hand spinning of silk is rarely done these days. Growers of silkworms sell cocoons and the rest of the process i.e. of reeling and weaving, is taken over by machines. Several Indian agriculture universities offer undergraduate and post graduate programmes in sericulture. Many states have an official Sericulture Board. Their websites provide region specific information.

*Broad outline of activities involved in sericulture*

- Cultivation of mulberry
- Seed production (silkworm)
- Silkworm rearing and cocoon production
- Reeling
- Weaving

*Cultivation of mulberry*

- Different species of silkworms feed on different species of plants
- The mulberry plant, its morphology and anatomy
- Ideal leaf types for silkworms

*Propagation*

- Types of media for propagation
  - Media for potting and air layering
  - Nursery beds for raising healthy saplings
  - Advantages and disadvantages of each method
- Types of propagation
  - Through seeds, cutting, grafting, budding, layering-ground and air
  - Advantages and disadvantages of each method

*Weather studies*

- Study of ideal weather conditions for mulberry cultivation

*Keeping weather records*

*Soil sampling*

- Testing the soil for its suitability for mulberry cultivation

*Farm tools and implements*

- General and specific tools and implements used in mulberry cultivation practices

*Land preparation for planting*

- Selection of a region specific planting method

*Irrigation of mulberry farms*

- Determination of soil moisture, field capacity and wilting point
- Choosing the right method of irrigation practice based on the above-basin or channel method

*Manures their application and schedule*

- On farm compost preparation using farm waste and the silkworm rearing-house waste
- Application of organic manure
- Application of green manure

*Pruning methods*

*Weeds and their control*

- Types of weeds
- Control methods–mechanical, organic applications

*Pests and their control*

Types of pests
Identification and control of major and minor pests of mulberry plants
Identification, prevention and control of foliar diseases
Mechanical removal, application of organic preparations and foliar sprays
Identification, prevention, control and treatment of root-rot disease
Identification, prevention, control and treatment of root-knot nematode disease
Keeping a field diary on pests, outbursts of pest attacks, action taken

*Leaf Harvesting*

Harvesting methods
Transportation and preservation of leaves
Assessment of quality and quantity of mulberry leaf and yield
Calculating the leaf requirement for a batch of cocoons

*Farm records*

*Visit to a mulberry farm*

*Hands on training through apprenticeship*

*Seed production and activities in the grainage house*

Seed production is a specialised process requiring special training. This can be availed from universities and colleges offering short term training programmes or at an established silkworm farm

*Silkworm rearing and cocoon production*

*Morphology of the different stages – egg, larva, pupa, cocoon, moth (female and male)*

*Classification*

*Identification of non mulberry silkworms*

*Salient features of different silk worms*

*Dissecting the silkworm larvae, pupa, moth*

*Observation of the egg under a microscope*

*Study of the rearing house*

Study of tools and appliances
Study of disinfectants and methods of disinfection of the rearing house and appliances
Handling of silkworm eggs for hatching
Brushing methods, keeping records of brushing
Rearing methods for young larvae
Rearing methods for late age larvae
Feeding at different stages
Different types of mountages, their advantages and disadvantages
Preparation for mounting
Methods of mounting
Care during mounting
Harvesting and sorting of cocoons

*Cocoon assessment*
*Cocoon crop assessment*
*Keeping records of moulting and harvesting*
*Diseases and infection during different stages of the silkworm's growth*
*Identification and preventive measures*
*Reeling and weaving - are specialised practices that are best learnt as an apprentice*
*Visit to a silk farm*
*Working at a silk farm as an apprentice*
*Ahimsa silk*

## Resources

The books listed below, though outdated, provide a good introduction to the practices involved in sericulture. There is some mention of chemical fertilizers, pesticides and disinfectants which may be avoided and replaced with suitable organic preparations. Many universities offering courses in sericulture have provided much information on their websites. These may be consulted for details.

1) *Sericulture Vol I, Moriculture: instructional cum practical manual* by Dr A. K. Dhote, published by NCERT, New Delhi, 1989

2) *Sericulture Vol II, Silkworm biology and rearing: instructional cum practical manual* by Dr A. K. Dhote, published by NCERT, New Delhi, 1990

3) *Sericulture Vol III, Mulberry and Silkworm crop protection: instructional cum practical manual* by Dr A. K. Dhote, published by NCERT, New Delhi, 1989

4) *Sericulture Vol IV, Seed production: instructional cum practical manual* by Dr A. K .Dhote, published by NCERT, New Delhi, 1989

5) *Sericulture Vol V, Silk reeling, testing and spinning: instructional cum practical manual* by Dr A. K. Dhote, published by NCERT, New Delhi, 1989

6) *Sericulture Vol VI,Sericulture extention and management: instructional cum practical manual* by Dr A. K. Dhote, published by NCERT, New Delhi, 1989

7) www.india.gov.in/sitemap.php: This is the official portal of the Indian Government hosted by National Informatics Centre. It provides a single window access to the information and services being provided by the Indian Government for citizens. It is a comprehensive source of information about India. Links at various places have been provided to other Indian Government Portals/ websites.

   This website contains resources related to farming modules. Everyone will benefit from a thorough study of this website.

# 7. Healthcare practices for animals

Ethno veterinary practices are based on peoples' knowledge, skills, methods, practices and beliefs about care of their animals. Ethno veterinary medicines are developed by local livestock holders. The information and skill is generally passed on through practice and word of mouth within communities and in most cases is region specific. Generally, the medicines are herbal extracts that may involve some processing prior to administration. The *Asian Agri-History* journal is a good source of information on popular ethno veterinary practices. Much of this being locally specific knowledge and practice it is best learnt through keen observation over a period combined with apprenticeship and practice. The use of homoeopathy in animal care especially for cows is gaining in popularity. Standard texts for study are available. For practicing homoeopathy, medicine kits along with tables and charts indicating medication and dosage are available. Mastering these techniques is a matter of patient self study and practical application which may be carried out under the supervision of a competent authority.

*Components of ethno veterinary practice*

Information: symptoms of disease, seasonal variations in disease occurrence, knowledge about pastures

Practice: Skills in bone setting, preventive administrations against infectious diseases, management practices

Location: generally animal housing adapted to local conditions

Beliefs: preventing animals from using pasture lands which have been the site of recent animal deaths etc.

Breeds: Careful selection of breeds for certain purposes/traits

Personnel: local practitioners

*Limitations*

Raw materials may be available in certain seasons only

Remedial potions may involve elaborate preparation procedures

Non standarised dosage

Symptomatic diagnosis may be misleading / inaccurate

Limited application in case of epidemic outbreaks

Not fast acting

Unsure potency

High reliability on skill that comes only with practice

*Strengths*

Useful in cold, skin and parasitic infections, wounds, nutritional deficiencies, mild diarrhea

Cheap, mostly readily available within the village

No side effects and residue problems

*Medicines*

Plant origin

Animal origin

Mineral origin

*Regional and local practices*

*Organisations dealing with ethno veterinary practices*

ANTHRA, Hyderabad and Pune

SEVA, Madurai

*Introduction to homeopathic practices in animal care through self learning, apprenticeship and practice*

# Resources

1) A note on ANTHRA publications
ANTHRA was started by a group of women veterinary scientists to address the concerns of rural livestock rearers. Their initial work resulted in extensive documentation of livestock rearing practices and alternative (ethno-veterinary) systems in the country. The publications (in English, Marathi and Telugu) cover most topics in animal care and management especially related to sheep and goat rearing. Their offices in Pune and Hyderabad stock nearly 2,000 books besides reports, journals, magazines, CD's and documentaries, and offer a reading library and photocopy facility. Website: www.anthra.org

2) A note on SEVA
SEVA, Madurai has consistently documented and published people's knowledge on animal care, ethno-veterinary practices and medicinal plants for animal care. SEVA works closely with Honeybee Network (www.sristi.org/hbnew/partnership.php) on farmer innovations.
SEVA Phone: 0091 – 452 – 2380082

3) A note on National Innovation Foundation
It is an autonomous body under the Department of Science and Technology. It encourages innovations in rural appropriate technology and supports innovators with professional assistance. It has several innovations related to animal care, especially formulations. It brings out a journal on innovations: Honeybee. Website: www.nif.org.in

4) The website, www.ethnovetweb.com contains extensive information on the subject from across the world. It provides detailed explanations on several topics.

# 8. Mushroom cultivation

Mushroom cultivation can be a profitable hobby/supplementary farm activity requiring very little investment. The syllabus below is for cultivation of oyster mushrooms which are much easier to grow than other varieties. They have high protein content and can be made into rich creamy soups of much value in rural areas where the protein component in diets is generally low. They are in much demand in the pharmaceutical and processed foods (soups) industry, fetching a good price when in dehydrated powder form.

*Material and shed requirements*

*Selection of growing medium – hay*

*Preparation of hay – chopping to size*

Steaming hay for sterilization

*Layering of hay and inoculation of spawn*

*Maintenance of beds during the growth period*

*Harvesting of mushrooms*

*Post harvest processing-packing/dehydration in controlled conditions/sun drying*

*Precautions for contamination free growth*

*Maintenance of optimal temperature and moisture conditions*

*Farm scale cultivation of mushrooms*

*Spawn production*

*Nutritional and dietary value*

*Commercial value of dehydrated mushrooms in packaged foods and the pharmaceutical industry*

*Introduction to fungi, lifecycle of mushrooms*

*Other cultivable varieties of mushroom, eg. button mushrooms*

*How to identify poisonous varieties*

## Resources

1) Mushroom Growing by S.C.Dey, available from Other India Bookstore, Mapusa, Goa, http://www.otherindiabookstore.com/listBooks.jsp?catID=38.
The book deals with every aspect of mushroom cultivation

2) Mushrooms for Livelihood by Vijaya Khander, available from Other India Bookstore, Mapusa, Goa, http://www.otherindiabookstore.com/listBooks.jsp?catID=38
For information on growing, cooking and preserving mushrooms.

3) Mushroom Cultivation, Instructional-cum-Practical Manual, Class IX and X, V.S. Mehrotra, published by NCERT, New Delhi, 1997

4) The link below provides a detailed article on growing of mushrooms as a small scale enterprise.
http://www.yentha.com/news/view/4/natures-treat-self-sustained-indoor-mushroom-farming

## 9. Growing medicinal and aromatic plants and extraction of oils and essences

Traditionally the kitchen garden, sacred groves, forests, village common lands, river and lakesides have been a source of many plants and herbs for treating common ailments. These practices have seen a revival in many alternate therapeutic remedies. Many of these plants are region specific and can be easily grown for personal use or on a larger scale for economic purposes. Many aromatic plants apart from their medicinal value also yield oils and essences. The Foundation for Revitalization of Local Health Traditions (FRLHT), Bangalore has done extensive work in this area.

*Traditional community knowledge on local plants of medicinal value*

Identification of medicinal plants

Getting to know the botanical and local names of medicinal plants in the area

*Planning and growing a medicinal and aromatic plant garden*

*Medicinal value of different plant parts*

*Techniques of collection and storage*

*Techniques of processing and application*

*Extraction of oils and essences*

What are distillers?

Functioning of home scale distillers

Oil extraction processes

Precautions

Storage and applications

*Visit to a local vaidya to learn about alternate therapeutic remedies*

## Resources

1) Community and family knowledge of medicinal and aromatic plants

2) The Institute of Ayurveda and Integrative Medicine is the new face of FRLHT according to their website. Established in 1993, FRLHT has made enormous efforts to reclaim local health, traditions and knowledge. They have many programmes and publications aimed at spreading this knowledge far and wide. www.iaim.edu.in

3) *Our Land Our Life – A Practical Course of Agriculture and Environmental Education* (Books for classes 6, 7, 8) published by Uttarakhand Seva Nidhi Paryavaran Shiksha Sansthan, Almora, Fifth edition, 2009. The complete series for classes 6 to 10 is available on the website www.ueec.org.in as free downloads. Books for classes 6, 7, 8 are available for reference with Taleemnet.

4) On the internet one can find instructive material for the extraction of aromatic oils and essences on a home scale.

# 10. Natural produce related processing and crafts

*(e. g. bee wax products, herbal soaps, teas and cosmetics, vegetable dyes)*

Apart from regular crops, there are plenty of other things that are produced on a farm in small and medium quantities. Many of these can be processed to produce useful products that can be a source of supplementary income. Traditionally, this was a seasonal practice. Honeycombs would yield wax for making of candles or serve as the base for home made balm and cosmetics; some aromatic plant extracts would be used for making personal care products; basil, lemon grass, mint went into the making of herbal tea powders and therapeutic decoctions *(kashaiyas)*. With the revival of the use of herbal and natural products, there is much scope for processing seasonal and natural products imaginatively. This can very easily become a source of additional income.

There are several Do-it-Yourself resource materials available on these topics and on the internet. Apart from this, within the community itself many of these processes are common knowledge.

*List the local minor produce growing on the farm and in the village*

*Techniques of collection and storage*

*Techniques of farm level value addition*

*Identifying a range of possible value added products with market value*

*Processing, packaging, marketing and sale*

# 11. Essentials

*(Food and nutrition; health, hygiene and well being; good housekeeping)*

The key to having a healthy and productive life is good nutrition, proper rest, exercise and hygiene. Illness tends to occur in the absence of one or more of these factors. Good housekeeping to a large extent creates an environment which is conducive to good health and a productive life.

*Food and nutrition*

What is nutrition?
The importance of wholesome food for good health
Traditional knowledge about local food, nutrition and health
Locally available fruits / vegetables according to seasons
Disadvantages of off-season vegetables and packaged food
Calorie content in various foods
Calorie requirements for different age groups and lifestyles
The need for a variety of foods for a healthy growing body
Ideal dietary requirements for nutrition
Different categories of foods for different activities and functions of the body
Carbohydrates, proteins, fats, vitamins and minerals, water and roughage
Different types of food for different stages of growth / conditions
Infants, children, youth, adults, elderly, nursing mothers, sick and convalescing persons
The importance of clean, regular, wholesome meals
Foods to avoid for different health conditions
Obesity, starvation and malnutrition – their causes and consequences
Ailments due to dietary deficiencies
Food allergies

*Health hygiene and well being*

What is health ?
Physical, emotional, mental and spiritual health and factors conducive to these aspects of health
Traditional health and well being practices
Yoga
Exercise
Meditation
Regular habits of physical activity, mental work and rest
The value of recreational activities
AYUSH (Ayurveda, Unani, Siddha, Homoeopathy), nature cure

*Hygiene*

What is hygiene?
The necessity of hygienic habits for good health
Everyday body care, cleanliness practices
How common ailments can be avoided by maintaining hygiene
Hygiene related to toilet activities: washing hands with soap and water
Washing hands before cooking or handling any food item

*Good housekeeping*
*Cleanliness at home and the area surrounding the home*
*Organising spaces in the home for comfort, utility and aesthetics*
*Organising things in the home for orderliness, easy access for all the family*
*Cleanliness routines for linen and upholstery*
*Keeping all washing, bathing and toilet areas regularly sanitized*

*Planning regular wholesome meals for the family*

*Why meals should be had in a pleasant atmosphere*

*Repair and maintenance in and around the home*

*The benefits of regular and timely maintenance of all household articles and gadgets*

*Sharing household chores*

*Maintaining a peaceful atmosphere within the home and cordial relations with neighbours*

*The role of aesthetics in the home*

*Traditional ways of blending hygiene and aesthetic practices of decorating homes – alpana, rangoli, wall paintings etc*

*Kitchen gardens and flower gardens for aesthetic, cultural and medicinal uses*

*Traditional ways of storing seasonal foods: pickles, papads, jams, preserves, drying and dehydrating*

*Sewing and needle craft, dyeing fabrics, vegetable dyes, weaving etc*

*Pets and their care*

## Resources

Most practices within this module are picked up naturally by virtue of participating in the everyday activities of the family. Elders in the home and community are a storehouse of sound knowledge in these matters. All newspapers, popular magazines carry articles regularly on many of these issues. The Reader's Digest brings out regular publications on the above topics. National Institute of Open Schooling runs a home-science course; its prescribed textbooks deal with many of the topics listed above. Today with the internet, there is no dearth of information. However, all this is of little use if it is not put into practice and made a part of the daily routine.

1) *Our Land Our Life – A Practical Course of Agriculture and Environmental Education* (Books for classes 6, 7, 8) published by Uttarakhand Seva Nidhi Paryavaran Shiksha Sansthan, Almora, Fifth edition, 2009. The complete series for classes 6 to 10 is available on the website www.ueec.org.in as free downloads. Books for classes 6, 7, 8 are available for reference with Taleemnet.

2) *Exemplar Instructional Material for Pre-vocational Course under Work Experience on Care of the Household (Instruction-cum-Practical Manual* Classes IX-X by Ritu Verma published by NCERT, New Delhi, 1987.

   Fairly good book on home science and house care

3) *Science around us series, Booklet- I to V: The Science of Transportation; Kitchen, Construction, Chemicals, Garden-* by Anshuman Das – published by Development Research Communication and Services Centre (DRCSC), Kolkata, 2009.

   Contains many interesting tips on various everyday science topics. The story form of the books is a bit of a distraction from the useful content.

4) *Homoeopathy: An Introduction for Children* by Mohammad Qasim published by NCERT, New Delhi, 2010.

   A good introduction to homeopathy, explains how homeopathy works.

5) *Food Preservation and Processing: Food Preservation Techniques (Practical Manual) for Class XI; Paper III* by Mridula Saxena published by NCERT, New Delhi, 2002.
   How to make jams, pickles, juices, wines along with dehydration techniques. In some cases the book recommends chemical preservatives. This recommendation may be ignored.

6) *Tie and Dye: Instructional cum Practical Manual for Classes IX-X*, published by NCERT, New Delhi 1998

7) *Textile Craft: Textbook for Class XI*, published by NCERT, New Delhi 1999

8) *Batik: Instructional cum Practical Manual*, published by NCERT, New Delhi 1998

9) *Where there is no Doctor: a village healthcare handbook* by David Werner, published by The Voluntary Health Association of India, New Delhi

A complete book on issues related to health and hygiene, especially in rural India. Regularly updated editions are published from time to time. An easy to read book, is ideal to get one started on issues related to food, nutrition, health, first aid, aliments, prevention, treatment and care.

## 12. Community hygiene, first aid, natural and manmade hazards

*Community hygiene*

Hygiene is a way of life. It is the quality of living that is expressed in the clean home, the clean farm, the clean enterprise, the clean neighbourhood and the clean community. Being a way of life, it must come from within the community (people); it is nourished by knowledge and grows as an obligation of responsible community life. It is critical to bear in mind that community hygiene must first begin with practising hygiene in person and at home. This is necessary in rural areas where illness caused by parasites and due to urinary tract infections are high. Knowledge of first aid and preparedness for emergency situations are critical for personal and community wellbeing at all time.

*The need and importance of community hygiene*
*Mapping the village for*

- Water resources
  - Perennial and seasonal water bodies (rivers, lakes, ponds, water supply, open wells and tube wells), human and animal activities around them
- Waste disposal practices in the village and human and animal activities around them
  - Effluents
  - Sewage and gutters
  - Public garbage dumps
  - Open effluent pits
  - Public and private lavatories, open toilet practices
- Community spaces in the village and human and animal activities around them
  - Places of religious and cultural gatherings
  - Bazaars
  - Grazing grounds
  - Open spaces
  - Cremation grounds and cremation practices
- Assessment of potential hotspots/situations for parasitic, communicable disease propagation and outbreaks

*Measures to be followed to keep community water bodies clean and hygienic*

- Dos and don'ts when using water bodies

*Proper location of the waste disposal and sanitary facilities of the community in relation to water bodies and dwellings*

*Measures to be followed for waste disposal*

- Dos and don'ts in waste disposal practices

*Proper disposal of treated effluents*
*Potential spots and situations for vector propagation*

- Measures for vector control

*Safe sanitation practices for community spaces*

*Safe temporary sanitation facilities at community gatherings such as fairs, shandies, religious and cultural gatherings, community events with respect to*

- Drinking water
- Garbage disposal
- Sanitation

*The threat to community health caused by stray animals such as pigs and dogs, kites and crows*
*Ideal characteristics of a healthy and hygienic community*

*First aid*

*What is first aid?*

*What it takes to be a giver of first aid*

Confidence, calm disposition, an eye on personal safety, skill and knowledge

*Action at an emergency*

Assess the situation
Alert others, call for expert assistance
Administer basic first aid according to the need

*Precautions when moving an injured person*

*Handling and transport of the victim*

*Bandages and dressings*

*First aid kit*

Components of a first aid kit
Location of the kit at a strategic place
List of emergency telephone numbers at strategic places
Routine for replenishment of the kit

*First aid drills*

*How to use a fire extinguisher*

*Joints and muscles*

Strains: Symptoms, first aid and treatment
Sprains: Symptoms, first aid and treatment
Dislocations: Symptoms, first aid and treatment
Fractures: Symptoms, first aid and treatment, handling the patient
Skull fracture: Symptoms, first aid and treatment, handling the patient
Spine fracture: Symptoms, first aid and treatment, handling the patient

*Foreign body in the eye: precautions and first aid*

*Foreign body in the ear: precautions and first aid*

*Foreign body in the nose: precautions and first aid*

*Fish bone/foreign objects in the throat: precautions and first aid in case of adults and children*

*Shock: symptoms, first aid*

*Unconsciousness*

The common faint: first aid and treatment
Head injuries first aid and treatment
Concussions: Symptoms, first aid and treatment
Stroke: Symptoms, first aid and treatment
Diabetic coma: precautions and first aid

*Convulsions and fits: first aid*

*Heart attack: Symptoms, first aid, strategy to follow*

*Overuse of medical drugs: first aid and strategy to follow*

*Food poisoning: symptoms, detecting food poisoning, first aid, strategy*

*Vomiting and diarrhea: detecting the cause, oral rehydration, strategy and first aid*

*Poisonous plants: Knowledge of local poisonous plants, berries and fruits to animals and humans – symptoms of poisoning, knowledge of antidotes and local treatment, first aid*

*Poisons: Strategy to handle poisoning, first aid*

*Knowledge of local poisonous snakes: Learning to identify these: symptoms of poisoning, precautions, antidotes, treatment and first aid.*

*Scorpion, bee, wasp stings: symptoms, precautions, antidotes, first aid*

*Dog bites: identify if the dog is rabid, symptoms of a rabid dog*. First aid

*Drowning: Strategies to rescue a drowning person. First aid*

*Method of heart massage and artificial respiration*

*First aid for bleeding*

- When there is a foreign body in the wound
- Bleeding nose
- Coughing blood in quantity from the lungs
- Vomiting blood from the stomach

*Electric shock: Strategy to follow and first aid*

*Asthma attack: first aid and strategy to follow*

*Burns and scalds: first aid, handling the victim and strategy to follow*

*Heat stroke: symptoms, first aid*

*Sun stroke: symptoms, first aid*

*Child birth in an emergency – strategy to follow, seeking experienced assistance, precautions*

*Automobile accident: strategy to follow, handling the victim, alert others, first aid*

*Carbon monoxide poisoning: symptoms, first aid and strategy to follow*

*Cold, hypothermia and frostbite: first aid, strategy to follow*

## *Natural and manmade hazards*

*Broad understanding of the causes of natural hazards, such as*

- Floods
- Drought
- Forest fires
- Epidemics
- Earthquakes
- Landslides
- Avalanches
- Cyclones and winds

*General precautions against these hazards*

*Multiple hazards/Compounded hazards – e.g. Earthquakes – landslides – obstruction of rivers – floods – epidemics*

*Manmade hazards on the farm e.g.*

- Open drains, sewers, farm effluent pits etc
- Fire
- Improper storage of hazardous chemicals
- Improper storage or location of tools and machinery
- Uninsulated electrical wires etc.

*Developing safety consciousness*

*Survival skills for various natural and manmade hazards*

- Qualities of a rescue worker
- Duties of a rescue worker
- Planning a rescue based on availability of material and human resources
- Assessing a casualty
- Providing assistance for recovery

*Various casualty situations*

- Asphyxiation
- Fainting or losing consciousness

Heatstroke
Dehydration
Burns
Frostbite
Bleeding
Electrocution
Stings and snakebite
Sprains and fractures
Poisoning

*The ABC (airway, breathing and circulation) of life support in various casualty situations*

*Alternative network and communication systems in times of disaster rescue work*

*Hazard safe construction practices*

*Measures for protecting vulnerable buildings and areas against hazards*

*Taking up responsibilities during disasters, the role of individuals, communities, volunteer organisations, institutions, local, state and national bodies*

*Planning ahead*

Community based planning for hazard mitigation and risk minimization
How to draw up community contingency plans
Resource and vulnerability mapping of the locality

*Training and mock drills*

*Action to be taken during medical emergencies e.g. epidemics, food poisoning, alcohol poisoning, epidemics in animals*

*Personal medical records to be maintained*

*Age, blood group, allergies, blood pressure, blood sugar level and other medical conditions / history if any*

## Resources


1) *Where there is no Doctor: a village healthcare handbook* by David Werner, published by The Voluntary Health Association of India, New Delhi

   A complete book on issues related to health and hygiene, especially in rural India. Regularly updated editions are published from time to time. An easy to read book, is ideal to get one started on issues related to food, nutrition, health, first aid, aliments, prevention, treatment and care.

2) *Park's Textbook of Preventive and Social Medicine* by K. Park, published by Banarsidas Bhanot, Jabalpur is a comprehensive book on the subject and may be used for reference by the instructor or highly motivated students

3) *Reader's Digest Handbook of First Aid* 1987

4) *First Aid Manual* published by Dorling Kindersley, 7th edition 1997 www. dk.com

5) *Disaster Management for Class IX* by J.P. Singhal, published by Laxmi Publications (P) Ltd

6) *Together, Towards a Safer India, Part III, A Stride Ahead: A Textbook on Disaster Management for Class X*, published by NCERT, New Delhi 2006

7) www.asc-india.org: Website of Amateur Seismic Centre, a comprehensive website carrying details of state wise seismicity of the country. Also contains extensive reports on past earthquakes.

**Richard Rebello**

My father, my great grandfather, they all farmed and we have improved on it by using some education that we have. I am not saying that education is not needed. No it is a question of the type of education. Is it good, relevant? No, the type of education children commonly get is not needed. Education is required to read and write by which they can read from books and self learn. For that one skill alone, it is not required to go to school for 10 years. They can learn for 2 years and do it. By the time a child is mature, some formal education would be very useful. I am not arguing about formal education, my point is the content. Is the content relevant . .? is my concern. After the present kind of formal education, everybody wants to be an engineer, a doctor. Nobody wants to come back and do farming. It is because the schools and colleges are sending out the wrong signals. In our times we had people who studied only till class 5th or 6th and that was found to be more than adequate.


Richard Rebello

The question is why do educated children not stay back on the farm? It is not the defect of education entirely. If the coconut we grow can fetch Rs 20 each, all my children will come and stay here. Same is the case with my labourers. They prefer to go to Bangalore, Bombay to work in hotels as waiters. They get ten times what they are paid here. There is no money in farming which is why farm land is left fallow. The whole problem is, for his services he is not getting the remunerative price. If you can rectify that, if the farmer gets the remunerative price for his services the whole problem would be solved.

If we have agricultural schools or farming schools, what should be the content there? Children should be taken out and shown what the progressive farmers have done. They should be shown how they have done it; there are so many successful farmers. There are many sound farming systems being followed. The children should be taken out, not made to sit in the class only. They should be taken out to a farm, and there an interaction between the farmers and the children should be arranged. Instead of just talking, there should be questioning amongst them. You question me, I question you. I contradict you, you contradict me, in this way ideas become clear. Then later on what are you going to give them, just talk will not be sufficient. They need to learn by experience, by actually doing things. There are many aspects to farming, working with one's hands being the most basic.

I have 42 acres of land. Because my children can see that they don't get the money that others get, they think why should our father toil and work on the farm? Why not sell it instead? They see that if they do engineering or some other thing they can get Rs 40 to 50 thousand where as working in the farm fetches Rs 8 to 10 thousand. By selling the farm I can gain in crores and I can invest in flats or some resort and they can also get a share. Why should I go on farming? Even labourers are not available. In the village we don't see a single person who is under the age of 40 working on the farm. So the question, as you have pointed out is, where will we get our food from? Food is the most basic necessity. Suppose I don't have clothes, I will find a way to do something about it. But food we cannot live without. Man does not live on bread alone, but the scientists have not invented a species which can live without bread. So food is the most basic necessity. It does not just appears on a platter, it has to be grown. It is like a maze you go this way or the other, you are stuck. So according to me the only way to revive is to make farming and farm related services remunerative.

# MODULES
# ACCOUNTS, TRADE, RECORDS AND PERMITS

By virtue of highly organised cooperative functions, the natural world maintains harmony and balance. The human world has reached such a high level of complexity that it demands certain norms be followed if its smooth functioning and balance are to be maintained. To achieve this, societies have laid down certain guidelines. Convenient facilities have been put in place to make life as comfortable as possible. These aspects may have come through during the study of *Understanding Governance*. Some of the practical aspects are dealt through the modules under this section. A good understanding of the topics listed in these modules will assure that one can avail maximum benefit from facilities offered within a given system; be successful in commercial ventures; and can function as a law abiding citizen of the nation.

*List of Modules*

1. Basic accounts and book-keeping
2. Bank related transactions
3. Transport and communication
4. Government permits and licenses
5. Agricultural markets and bazaars
6. Organic certification
7. Taxes, exemptions, filing income tax returns
8. Records and documentation
9. Land records
10. Cooperative societies and agricultural banks

# 1. Basic accounts and book-keeping

A few basic skills in book keeping will go a long way in systematizing things on a farm. Keeping a systematic record of all financial transactions and the knowledge of handling finances correctly is not only a sound practice but requires to be made a habit. How well or poorly a farm/enterprise is doing in terms of returns for all the efforts put in are reflected at a glance in a balance sheet. The topics listed below would be useful for anyone keeping personal accounts or accounts of a small scale enterprise. Standard books dealing with accounting practices are available from various publishers. Many of the skills can also be picked up from a practicing accountant or any established enterprise locally. Regularity in writing the books of accounts and keeping all necessary backup bills, vouchers, memos etc in order may be emphasised.

*How to write the cash book (for all cash transactions)*

*How to write the ledger book*

*The need to keep receipts and payment vouchers*

*Using the bank passbook to keep track of all bank transactions*

*Keeping a salary book or wage book*

*Keeping an attendance book for staff*

*Maintaining records of petty cash transactions*

*Postage book (if necessary)*

*Maintaining record of taxes paid to the state and central govenment*

*Statement of accounts: monthly, quarterly, half yearly, yearly*

*Making a trial balance*

*Balance sheets*

*Audited statements of accounts*

## 2. Banking related transactions

Banks play an important role in financial transactions. A thorough knowledge of banking systems and procedures is necessary if one is to take advantage of all the facilities of hassle free financial transactions that banks offer. The government offers many financial schemes to rural persons which can be taken advantage of if one is aware of banking procedures. Apart from this, the good practice of saving money can be inculcated. Post offices offer a wide range of saving schemes and since there is a post office in or near every village in India, post offices are most useful to villagers who wish to save money.

For the benefit of easy reference, in some places, this syllabus contains within itself detailed explanations.

*What is a bank?*

*Functions of banks*

*Apex banking Institutions*

IDBI (Industrial Development Bank of India)
SIDBI (Small Industries Development Bank of India)
NABARD (National Bank for Agriculture and Rural Development)
Exim Bank (Export Import Bank)
NHB (National Housing Board)

*Types of bank*

Scheduled Commercial Banks
Regional Rural Banks Sponsored and linked to Commercial banks
Agricultural banks provide short, medium and long term financial assistance to farmers
Co-operative Banks

*The Reserve Bank of India (RBI) and its functions*

Banker to the Government
Banker's bank
Supervisory and controlling authority
Licensing of banking companies
Permission for opening branches
Power to inspect banking companies
Power to issue directions to banks
Controller of credit
Empowered to fix the retention limit for a given bank
Currency note issuing authority
It is the only body which can issue coins and currency notes
Currency chests (in a bank for retaining cash in safe custody)
Assigned and approved by RBI for cities and towns
Collecting and furnishing credit information
Deposit insurance and Credit Guarantee Corporation
- Insurance cover to each depositor up to one lakh in the event of liquidation of the bank
- The premium is charged from insured banks and deposit insurance fund is credited
- Premium is paid on a six monthly basis (March and September) on the total deposits (excluding State and Central government deposits, embassy accounts)

Manager of foreign exchange
Monetary authority
Important rates formulated by RBI to regulate the money supply in the economy
- Cash reserve ratio (CRR)
- Statutory liquidity requirement (SLR)
- Repo rate
- Reverse repo rate

*Banker and Customer*

- The relationship between banker and customer
  - Debtor-creditor
    - Savings account
  - Creditor-Debtor
    - Overdraft account
  - Service Provider
    - Issue of demand draft (DD)/pay order (PO)
  - Bailee-Bailor
    - Safe custody
  - Lessor-lessee
    - Lockers

*Agent-Principal*

- Bill collection
- Types of customer
  - Individual
    - An individual like you and me
  - Non individual
    - Proprietorship, partnership
    - Private and public limited company
    - Trust, societies/associations and the Hindu undivided family
  - Non resident
    - Types of account
      - Individual
      - Resident and non-resident
        - Savings
        - Recurring deposit
        - Fixed deposit
      - Non-individual
  - Minor accounts (below 18 years)
    - Account can be opened under guardian of natural/legal guardian

*Basic Banking Products*

- Savings Account - most commonly operated account for individual and other for non-commercial transactions.
  - Helps people to carry out routine banking transactions besides earning some return on savings
- Rules of a savings account
  - Banks stipulate certain minimum balance to be maintained in savings accounts
  - Restriction on number of withdrawals (150 per year), however not exercised.
  - Multiple accounts under the same name in one bank are not allowed
  - No overdraft facility
  - Cheque book and ATM (automated teller machine)/debit card facility given
  - No TDS (tax deduction at source) is charged
  - Interest to be credited to savings account every half yearly
- Documentation to open a savings bank account
  - Proof of identity - Permanent Account Number (PAN) card /driving licence/passport
  - Proof of residence (driving licence/utility bills/ration cards)
  - 2 recent passport sized photographs
- Operation of accounts
  - Accounts by individuals can be opened singly or jointly
  - Joint account can be operated by either or survivor (Any one can operate the account)
  - Former or survivor (first applicant will operate the account and only when the former expires can the survivor operate the account)
  - Jointly- both the account holders are required to sign to operate the account

*Nomination in accounts*

Nomination is a process of nominating a person to receive the sum of money in the name of depositor(s), in the unforeseen circumstances of the depositor(s) demise

Nomination is a must to safeguard the legal heirs from legal issues to claim the money in the name of the depositor(s) from the bank

In the case of a minor being a nominee, then the account holder(s) also need to mention the name of the guardian until the minor turns major

*Current Account*

A current bank account can be opened in the name of an individual or non- individual entity (any firm or company)

No interest is paid on the money held in this account

These accounts are generally commercial in nature

Power of attorney (POA) is allowed for transactions

No restriction on number of withdrawals

Multiple accounts in the same name are allowed

Overdraft facility is permitted

Cheque book and ATM/debit card facility given

No TDS is charged

*Documentation for a current bank account*

Documents that prove the entity e.g. partnership deed, MOA (memorandum of association) and AOA (article of association) Society by-laws, trust deeds

Documents to prove that the entity is in business e.g. certificate of incorporation, certificate of commencement of business, sales tax registration, importer/exporter number etc

Proof of identity (PAN card/driving licence/passport) of the owners/authorized signatory of the entity

2 recent passport sized photographs

PAN card/declaration in Form No.60 or 61 as per the Income Tax Act 1961 of the entity

Account operation mandate

Board resolution, partnership declaration

(Documentation requirements vary from bank to bank and are guided by the internal control policies of the bank)

*Overdrafts*

Overdrafts are allowed to current accounts by the bank if and when necessary and an interest is charged on a day to day basis at an agreed rate

Cash credit

Term deposits

Fixed deposit and reinvestment deposit

Fixed deposit

Interest rate

Interest paid on contracted rate for a certain specified amount

Interest can be paid monthly, quarterly, half yearly

Deposits can be negotiated (15 lakhs and above) or non negotiated (less than 15 lakhs)

Penalty for premature withdrawal of deposits

Special rates for senior citizens

Documentation

Proof of identification as mentioned in the case of savings and current accounts

PAN card/declaration in Form No.60 or 61 as per the Income Tax Act 1961

*Reinvestment deposit*

Interest earned on the deposit is added to the principal amount on a quarterly/half yearly frequency, thus increasing the return on the deposit (compound interest)

Premature withdrawal of a deposit will be charged a penalty as per bank rules

*Recurring deposit*

A recurring deposit is a fixed deposit with a slight difference in the way it operates
Instead of a one-time lump-sum investment, a monthly deposit of a fixed amount is made for the agreed period of time
After maturity the lump-sum amount can be withdrawn by the depositor along with the accrued interest
A penalty will be charged for any delayed payment of monthly installments

*Rules of a recurring deposit*

This is not a transaction account, though a sum of fixed amount is added each month to the account
Power of attorney (POA) is not allowed
Multiple accounts in the same name are allowed
No cheque book facility is given
No TDS is charged

*Negotiable Instruments*

There are three types of negotiable instruments

Promissory currency notes

A promissory currency note is a contract where the issuer makes an unconditional promise in writing to pay a sum of money to the payee, either at a fixed or determinable future time or on demand of the payee
It must be in writing. A mere verbal promise to pay is not a promissory note. It must contain an express promise or clear undertaking to pay

Bills of exchange

An unconditional order issued by a person or business which directs the recipient to pay a fixed sum of money to a third party at a future date. The future date may be either fixed or negotiable. A bill of exchange must be in writing and signed and dated by the drawer. It must contain an express order to pay a certain sum of money. A mere request to pay on account will not amount to an order

Cheques, bankers demand draft, pay order

An unconditional order issued by a person or business which directs the recipient to pay a fixed sum of money to a third party at a future date. The future day may be either fixed or negotiable
A cheque – is addressed by one person to another, signed by the person giving it, requires the bank to pay on demand a certain sum of money

*Features of a cheque*

Instrument in writing
Unconditional order to pay
Drawn on and payable by a banker
Amount must be certain
Payable on demand
Bears signatures of the drawer
Payee must be a certain person
Should be dated
Magnetic Ink Character Recognition (MICR) contains a 9 digit code indicating the city, bank and branch of the bank. The first 3 digits give the city pin code. In the case the first three digits are "000" it means payable at par. The next 3 digits indicate the bank. Each bank has a clearing code given by the RBI. The last 3 digits indicate the branch of the bank the cheque is payable. If it contains "000", it means payable at par at any branch of the bank
The transaction code (TC) is different for savings and current accounts

*Parties to a cheque*

Drawer: The person who gives the order (writes out the cheque)
Drawee: The financial institution upon whom the cheque is drawn, also known as paying bank
Payee: The person or organisation named to receive payment. There may also be an endorser and/or an endorsee
Endorser: Person who negotiates the cheques by endorsing (signing) it over to someone else
Endorsee: Person to whom the cheque is endorsed

*Types of cheques*

Self/Bearer- payable to the holder of the cheque
Crossing- General (two parallel lines on the face of the cheque and "& Co" or "account payee" mentioned between the lines) and
Special Crossing (two parallel lines on the face of the cheque and "name of the bank" mentioned between the lines)
Order- payable to a specific entity/individual

*Defective cheques*

Cuttings/overwriting on cheques not authenticated by the drawer
Post dated/stale/undated cheques
Signatures missing/mismatch
Amount in figures and words mismatch
(On presentation of a defective cheque the bank will return the cheque to the person or collecting bank)
The customer has the right to stop payment of a cheque by giving proper instructions in writing to the bank

*Dishonour of cheques*

In case the balance in the drawer's account is insufficient
In case of death, insolvency of the drawer
In case the bank doubts the title of the holder
In case of instructions from the drawer
On receipt of a garnishee order (court order)
In case the bank has to claim funds from the drawer
In case of mutilated cheques

*Pay order (PO)/cashier's cheques (CC)*

Payment is guaranteed unless it is cancelled or a stop payment order has been placed in the case of a lost instrument
A banker's cheque payable at the branch of issuance of the PO/CC
Used for local currency funds transfer within the same city

*Demand draft (DD)*

Payment is guaranteed unless it is cancelled or a stop payment order has been placed due to loss of instrument
A banker cheque drawn on another branch of the bank or on a correspondent
bank to transfer funds to other places
DD on correspondent banks are issued if customer wants a DD drawn on a place where the issuing bank does not have a branch.
If the DD amount is more than Rs.50, 000/- then the PAN number of the person / party making the DD is necessary

*Clearing*

Clearing is the process of realising proceeds of cheques and other similar instruments from other banks
Clearing is transacted among banks through the Reserve Bank of India
Clearing may be understood from a perspective of local and outstation cheques
In case of payable at par cheques, even if the branch of the paying bank is located in a city

other than the collecting bank, the cheque is sent in the local clearing
Most banks have a centralised clearing department in each city and carry out the function for the bank

*E-payment systems*

Electronic fund transfer (EFT) and national electronic fund transfer (NEFT)
ATM cards, debit cards and credit cards
RTGS (real time gross settlements)

*Using credit cards and debit cards*

Precautions when using credit cards and debit cards

*Loan facility*

Loan facility is available to all customers according to their goodwill.
Secured cash credit and unsecured cash credit and secured overdraft facility only to current account holders
Term loan is available to individual, proprietorship/partnership/private limited company and limited company accounts
There is also a Housing Loan Scheme for individual and Builders
Personal (clean loan) loan is available to individual customer on higher rate of interest according to Bank's rule
Farmers get loan under Agriculture Scheme, which carries low interest rate
There are several government schemes such as PMRY (Prime Minister's Rozgar Yojana) on low interest rates for the benefit of professionals, cottage industries, artisans etc.
Proper documents need to be submitted by the customers to avail all these types of loans

*I.O.U. (I owe you)*

An acknowledgement of debt given in writing by a debtor to the creditor
Valid evidence of debt

## Resources


1) *Modern Banking* by C.M. Patil and Dr M.L. Gulegudd, Sri Sai Publications, Gadag, Karnataka, 2010
Contains information about banking and e-banking

2) *General Commercial Knowledge, Textbook for Class XI*, R.Muthuraj, NCERT Publications, New Delhi 2003
Contains a chapter on banking

3) The Reserve Bank of India website http://rbi.org.in contains a lot of information on banking

4) www.india.gov.in/sitemap.php: This is the official portal of the Indian Government hosted by National Informatics Centre. It provides a single window access to the information and services being provided by the Indian Government for citizens. It is a comprehensive source of information about India. Links at various places have been provided to other Indian Government Portals/ websites
This website contains resources related to many of the farming modules. Everyone will benefit from a thorough study of this website

# 3. Transport and communication

Transport is essential for the movement of people and goods. Presently the most favoured means of transport in rural areas is road transport for short distances and rail for long distances. A good knowledge of transport and courier service operations in the country makes it convenient for travel and for transporting goods and commodities. Air transport is generally used for delicate and perishable items like medicines and flowers while shipping of commodities by sea is favoured for large scale exports and imports. India has progressed extremely well in the area of telecommunication and this is being used by all, even in the remotest corners of the country, to communicate freely and cheaply. The Indian postal department is the most efficient and reliable. Its various services are available at very affordable rates

*Transport*

*Various means of transport of goods*

Road transport (including various cargo services)
Rail transport
Air transport
Sea transport

*Advantages and disadvantages of each means of transport*

*Deciding the mode of transport based on*

Availability
Regularity of the service
Transit time
Costs

*Rules and regulations concerning the transport of various types of goods by various means*

*Documents for road transport*

Lorry receipt (LR) issued by the transport company, railway receipt (RR): contains name and address of consignor, name and address of consignee, receipt number and date, place of destination and the place of receipt of goods, description, weight and value of the goods, freight charges 'paid' or 'to pay' or 'to be paid', whether the goods are insured or not, terms and conditions of carriage etc.

Declaration form furnished by the customer giving details of goods contained in package

*Documents to receive delivery of consignments*

Lorry receipt copy or number
Proof of identity of the consignee
Letter head and rubber stamp in case of a company/office

*Insurance*

Insurance procedures in case of goods of high value, short shelf life or fragile nature

*Claims*

Settlement of claims in case of damage or loss to goods
A visit to various types of local transport offices (rail, lorry, cargo carriers etc) to get acquainted with the prevailing rules and procedures

*Communication*

*Various means of communication*

Postal services
A visit to the post office to learn about the various services provided
Courier services
Cellular phones
SMS alerts for farmers providing market rates, weather data, region specific farm related activity information such as sowing time, pest and disease outbreaks etc.

Internet: exclusive, region specific websites for farmers
Television
Radio
Closed circuit television: essentially used for central monitoring and control of large scale operations
HAM radio: its critical role in times of disaster and calamities

## Resources


1) *General Commercial Knowledge, Textbook for Class XI*, R.Muthuraj, NCERT Publications, New Delhi 2003

   Contains chapters on commercial correspondence, transport and insurance

2) www.india.gov.in/sitemap.php: This is the official portal of the Indian Government hosted by National Informatics Centre. It provides a single window access to the information and services being provided by the Indian Government for citizens. It is a comprehensive source of information about India. Links at various places have been provided to other Indian Government Portals/ websites

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## 4. Certificates, permits and licences

For administrative purposes and in the interest of the welfare of all citizens, the government issues various permits, licences and certificates. As responsible citizens it is required that these documents be obtained and kept up to date. Local panchayats, taluka and relevant district level departments have the power and obligation to issue these documents. Most documents require proof of identity and address. Details are available with respective departments and on their websites.

*Ration card* – issued by the state's department of Food and Civil Supplies. Uses and significance

*Election card* – issued by the Election Commission of India. Uses and significance

*Passport* – issued by the Ministry of External Affairs on behalf of the president of India. Uses and significance

*Permanent Account Number (PAN) card* – issued by the department of Income Tax. Uses and significance

*Birth certificate* – issued by the local panchayat / taluka level governing office based on records submitted by the primary health care centre or medical officer / doctor / hospital handling the birth case. Uses and significance

*Death certificate* – issued by the local panchayat / taluka level governing office / cantonment board based on certificate issued by a medical centre/doctor/hospital. Uses and significance

*Marriage certificate* – registrar of marriages

*Vehicle related records. Significance and uses*

Driving licence – issued by the local Road Transport Office (RTO)
Registration book - issued by the local Road Transport Office (RTO)
Vehicle pollution control certificate – issued by authorized facilities
Vehicle insurance – Insurance companies

*Licences related to operations or activities such as on farm post harvest processing and packaging*

*Enterprise related regulations as per factory laws and labour laws*

*Labeling and certification of produce*

*Veterinary certifications* - for keeping farm animals on a large scale. Issued by local veterinary officer Significance and uses

*Death certificate* - in case of insured farm animals. Issued by local veterinary officer Significance and uses

*ISO certification* - where relevant by Indian Standards Certification Agency. Significance and uses

*A visit to relevant offices and familiarization with these documents for prevailing rules*

## Resource

1) www.india.gov.in/sitemap.php: This is the official portal of the Indian Government hosted by National Informatics Centre. It provides a single window access to the information and services being provided by the Indian Government for citizens. It is a comprehensive source of information about India. Links at various places have been provided to other Indian Government Portals/ websites

   This website contains resources related to many of the farming modules. Everyone will benefit from a thorough study of this website

# 5. Agricultural markets and bazaars

The demand for organically grown foods and vegetables has seen a steady growth over the past two decades. The apprehensions and anxieties of farmers about marketing their produce seems to be easing by the day with organic stores, shandies, bazaars, food clubs, pop up shops gaining steady popularity. Fair trade is another recent phenomenon in this area. Most produce is readily picked up by customers once they are aware of the source of the safe food either through direct interactions with the farmer or by word of mouth. In many cases the farmer becomes the brand name. Participatory guarantee systems and other certifying systems lend legitimacy. It is seldom necessary for organic farmers to use the services of Agricultural produce marketing cooperatives (APMCs) and warehouses. However, knowledge of the same and its operations helps in gaining a broad overview of how markets function.

*Agricultural markets*

Organic stores
Shandies and bazaars
Periodic organic farmer markets
Vending through mobile kiosks (pop up shops)
Mixed vegetable baskets vended through organic food clubs
Agricultural produce marketing cooperatives (APMCs)
Farmer cooperatives
Outlets run by the department of agriculture and horticulture
Auctions
Fair trade
Barters and exchanges
Warehouses and cold storage facilities

## Resources

1) www.india.gov.in/sitemap.php: This is the official portal of the Indian Government hosted by National Informatics Centre. It provides a single window access to the information and services being provided by the Indian Government for citizens. It is a comprehensive source of information about India. Links at various places have been provided to other Indian Government Portals/ websites

   This website contains resources related to many of the farming modules. Everyone will benefit from a thorough study of this website

2) *The Organic Farming Sourcebook* written & edited by Claude Alvares, published by Other India Press, Goa, 2010 is a comprehensive book on all matters related to non chemical practices. Within the book one will find case studies of practitioners, pioneers as also all matters related to organic practices, policy, stores, book reviews etc. Available with the Other India Bookstore. MAPUSA, Goa www.otherindiabookstore.com

# 6. Organic certification

In India the need to certify organically grown poison free and safe food emerged as a remedial measure when export consignments from India to Europe were rejected in the late 90's due to unacceptable levels of pesticide residues. Initially international certifying agencies were employed for the purpose. These agencies offered their services at exorbitant fees. To ease the situation, the government of India took the initiative to authorize government bodies to come up with certification procedures. Simultaneously, within civil society, there was a move to set up a realistic certification system. This has emerged as the participatory guarantee system (PGS) which is directly managed and controlled by stake holders. Presently PGS is also being explored in several countries of the global south.

*Certification*

Brief overview of agencies that decide on policy and procedure
FAO (Food and Agriculture Organisation of the United Nations)
IFOAM (International Federation of Organic Agriculture Movements)
APEDA (Agricultural and Processed Food Products Export Development Authority)
NPOP (National Programme for Organic Production)
NCOF (National Centre for Organic Farming)
NSOP (National Standards for Organic Products)
State organic missions
Promoter NGOs
Organic Farmers' Associations

*Participatory Guarantee System (PGS)*

Key features
Certifying procedures
PGS Organic India (www.pgsorganic.in) : functions

*Accredited certification bodies under NPOP*

Certification agencies
Rules and regulations
Certification procedure and fees
Documentation requirements and tests
Agmark certification and guidelines
Agmark India Organic

*Ministry of Commerce and Industry*

Export of certified organic produce
Requirements for export
Licences
Benefits and tax holidays

## Resources

1) www.india.gov.in/sitemap.php: This is the official portal of the Indian Government hosted by National Informatics Centre. It provides a single window access to the information and services being provided by the Indian Government for citizens. It is a comprehensive source of information about India. Links at various places have been provided to other Indian Government Portals/ websites.

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# 7. Taxes, exemptions, filing income tax returns

While income from a farm is not taxable as of today, this module is useful if one wishes to start a farm related processing and packaging enterprise e.g. manufacture of jams, pickles, juices, nutritional blends etc.

A prerequisite for this module is the module *Basic Accounts and Book-keeping*. From that module, books of accounts – the cash book, ledger and bank book would be the necessary prerequisite. Following that, the topics below may be dealt with.

*What is 'assessment'*
*Meaning of 'assessment year'*
*Computation of income*

Salaries
Income from house / property
Profit or gain from business or profession
Capital gains
Income from other sources

*Determination of tax payable*

*Meaning of 'previous year'*

*Who is an assessee – the various categories – individual, firm, company etc*

*Residential status of an assessee – who is a resident Indian and who is a non-resident Indian*

*Rates of income tax – general and for different categories*

*The PAN (Permanent Account Number) card, how to obtain a PAN card, uses of PAN card*

*The need to quote the PAN card number in income tax returns and all correspondence with the income tax department*

*Due dates by which the income tax returns are to be filed*

*Forms on which income tax returns are to be filed*

*Refunds – claims for refunds*

*Exemptions, deductions, depreciations*

*Deductions in respect of the following under the Income Tax Act*

1. Savings, i.e. LIP (Life Insurance Premium), PF (Provident Fund), PPF (Public Provident Fund), NSC (National Saving Certificate) etc (Under section 80C)
2. In respect of contribution to certain pension funds
3. In respect of contribution to pension schemes of the central government
4. Under section 80CCE, aggregate amount of deduction under section 80C, 80CCC, 80CCD shall not in any case exceed Rs 1,00,000/-
5. Under section 80CCF in respect of subscription to long term infrastructure bonds etc.

The balance figure obtained is the taxable income after deduction from the gross income for that financial year

*Other taxes*

Wealth tax

*Depreciation of*

Buildings, machinery, vehicles etc

*Functions of the Income Tax department*
*The work of a chartered accountant*
*The work of a tax consultant*
*The work of an investment consultant*

## Resources

1) *V.G. Mehta's Income Tax Ready Reckoner, Assessment Year 2011-2012* by N.V.Mehta, published by Shrikumar Publishing House, www.vgmehtasitrr.com for archival copies of the IT Ready Reckoner.

2) www.india.gov.in/sitemap.php: This is the official portal of the Indian Government hosted by National Informatics Centre. It provides a single window access to the information and services being provided by the Indian Government for citizens. It is a comprehensive source of information about India. Links at various places have been provided to other Indian Government Portals/ websites.

   This website contains resources related to many of the farming modules. Everyone will benefit from a thorough study of this website.

# 8. Records and documentation

Record keeping is important for systematic farming activities. By noting exact facts, figures and routines on the farm, it becomes convenient to refer to these later. One's memory may not always be reliable. Also, by recording facts, we learn to discern what facts are important and what are not. Farming is influenced by a multiplicity of factors such as seed, soil, rain, weather, irrigation, biological preparations applied on the farm, the duration of an activity etc. Consulting such notes is useful when one runs into a problem on the farm. Record keeping also helps to improve upon previously used techniques.

Photography apart from being an engaging hobby is a useful skill to learn. Presently with digital cameras it has also become extremely affordable (almost free). Designing an organising system for keeping photographs, CDs and educative documentaries, files, paper cuttings of useful articles etc makes for easy access when needed.

Record keeping for a farm may involve writing diaries, tables, taking photographs, keeping herbariums, insect collections etc. Details of farm record and farm diaries have also been dealt with in the module *Farm Records, Farm Accounts, Farm Crop Diary and Cow house Diary*

*Date wise diary of the activities on the farm*

*Crop wise diary indicating major activities related to a particular crop*

*Notes on crop behaviour and pest and disease attacks in case of individual crops and crop interaction*

*Keeping herbariums of weeds and other significant flora around the farm*

*Insect collection and preservation in case of outbreaks with records of damage and measures taken for control*

*Keeping well organised digital photographic records of significant farm activity on a regular basis*

*Designing an organising system for books, records and documents of all types*

*A visit to a well run farm in the neighbourhood to learn about their record keeping practices*

# 9. Land records

In rural areas, land records are often not properly maintained. This can give rise to disputes over property.

This module is about what records a farmer should maintain and also what documents a farmer should look for when buying or selling property. While most of the records to be maintained and procedures to be followed are given here, it must be remembered that property dealings are somewhat technical in nature and the services of a competent lawyer should be availed of. The matter given here should be treated as guidelines so that the farmer is not completely ignorant of what needs to be done.

*What documents relating to land ownership a farmer needs to maintain*

* Name of present owner / owners should be in the record of rights.
* It is recommended that a fresh record of rights be obtained every six months from the concerned authority (Panchayat Development Officer/Tahsildar's office). This is a precautionary measure.
* Yearly agricultural tax paid receipt: This tax is paid to the Panchayat revenue officer.
* Yearly house property tax paid receipt: Paid to the Panchayat revenue officer or tahsildar

*Procedures when there is a death and property is to be transferred to the legal heirs*

* Heirship certificate: This certificate shows who are the legal heirs - an affidavit mentioning the legal heirs is to be submitted to the Tahsildar's office (or court) by the legal heirs and the tahsildar issues an heirship certificate. It is recommended to hire the services of a lawyer for this matter.
* On obtaining an heirship certificate the new owner(s) name(s) are to be entered into the record of rights (at the Tahsildar's office or Panchayat office)

It often happens that in rural areas the names of heirs have not been entered in the record of rights. A person's name for example, may persist in the record of rights well after his death for two or more generations. This is a source of problems. To avoid these problems the names of all legal heirs should be entered in the record of rights at the earliest, on the death of the owner. Attention should be paid to the contents of the latest will if any and the prevailing law of inheritance while transferring property.

*When buying agricultural land*

(Once again it is recommended that the services of a competent lawyer be availed of)

* Obtain a fresh record of rights of the property concerned from the Panchayat office/ tahsildar's office
* The agricultural tax paid receipt of the previous owner(s)
* Get the land surveyed (measured) by the Land Record Officer. The record of rights of the property is to be submitted to the Land Record Officer along with an application for this purpose. The Land Record Officer will then send notices to summon all the owners of the properties touching the concerned property so that they are present when the officer checks or fixes the boundaries of the property. The names of the owners of these neighbouring plots are once again ascertained and noted.
* Before buying the property obtain a nil encumbrance certificate from the sub-registrar's office. This shows that the property has not been pledged to obtain a loan. If a loan has been taken with this property as security, and the loan has not been repaid, the bank or financial institution could attach this property.
* There are certain numbers (mutation entries) written on the record of rights. These are diaries of the land giving the history of ownership of the land. These diaries may be obtained from the tahsildar's office.
* It must be ascertained whether the land to be purchased is *Watan*[1] land or *inam* land or *Maharki* land. Such land cannot be purchased without special permission and this

permission is not given easily. Whether the land is of this special type or not may be ascertained from the tahsildar's office.

* If the buyer is not an agriculturist, most states in India have rules that prevent a non-agriculturist from buying land. However, there are some exceptions and these exceptions vary from state to state. As of now, for example, in Karnataka if a buyer has an annual family income under Rs 2 lakhs, he may be eligible to purchase agricultural land. However, he will need the assistant commissioner's permission to purchase the land. The assistant commissioner grants permission only if he is convinced that the buyer is really interested in cultivating or tending the land and will use it for agriculture or horticulture or other farm related activities.
* If the buyer thinks it is necessary, he/she may insert a notice in a newspaper stating that he wishes to buy the land and that anyone claiming rights to the land may contact him/her within a week. However, this is only for the buyer's satisfaction and has no legal standing.
* When signing the sale deed, all the persons whose names are on the seller's title deed should be present in the sub-registrar's office. (This exercise is not valid if done before a notary public). If the owner(s) is (are) not present a power of attorney holder (PA) should be present to sign. The sales deed may be prepared previously in consultation with an expert in the matter. Also attached should be an affidavit mentioning details of the purchaser and buyer and details of the property. The stamp duty and registration fee are paid at the appropriate office. The stamp duty is fixed according to the guidelines framed by the government.
* After buying the property, apply to the Panchayat Development Officer (PDO) to get the new name(s) entered in the record of rights. A notarized copy of the sale deed and record of rights of the previous owner must be submitted for this purpose. In case the value of the transaction exceeds Rs 5 lakhs, photocopies of the PAN cards of both the buyers and the sellers need to be furnished

*When buying non-agricultural (NA) land*

(Obtain the services of a competent lawyer)

* The seller should possess a certificate which mentions that the land is NA land and the purpose for which it was converted to NA land is for one of the following:
  For residential purposes
  For commercial purposes
  For industrial purposes
* Map showing the layout of the said land from the Urban Development Authority or Town Planning Authority
* Whether the house tax has been paid or not
* Water tax has been paid or not
* Electricity bill has been paid or not
* Whether tax has been paid or not (with Panchayat)
* If the property lies within the area of the Comprehensive Development Plan (CDP) the following points should be checked with the Urban Development Authority:
  Whether the property is meant for
  Residential purposes
  Commercial purposes
  Industrial purposes
  Agricultural purposes (Also known as green belt area)

If the property is meant for agricultural purposes, it may be rather difficult to be converted for any other purpose. However, in some cases conversion may be possible with special permission.

* If the buyer thinks it is necessary, he/she may insert a notice in a newspaper stating that he wishes to buy the land and that anyone claiming rights to the land may contact him/

her within a week. However, this is only for the buyer's satisfaction and has no legal standing.

* When signing the sale deed, all the persons whose names are on the seller's title deed should be present in the sub-registrar's office. (This exercise is not valid if done before a notary public). If the owner(s) is (are) not present a power of attorney holder (PA) should be present to sign. The sales deed may be prepared previously in consultation with an expert. Also attached should be an affidavit mentioning details of the purchaser and buyer and details of the property. The stamp duty and registration fee are paid at the appropriate office. The stamp duty is fixed according the guidelines framed by the government.
* After buying the property, apply to the Panchayat Development Officer (PDO) / sub-registrar's office to get the new name(s) entered in the record of rights. A notarized copy of the sale deed and record of rights of the previous owner must be submitted for this purpose. In case the value of the transaction exceeds Rs 5 lakhs, photocopies of the PAN cards of both the buyers and the sellers need to be furnished.

## Resources

Laws and regulations pertaining to land are under the purview of the state government and hence differ from state to state. Most states have their own laws concerning land. This module has been designed in the form of an explanatory note to present an overview of maintaining land records and sale and purchase of land. It is best to use this as a guideline for understanding these matters with respect to one's own state. e.g. in Karnataka, the Karnataka Land Reforms Act with its amendments may be referred to.

1) For a comprehensive source of Indian laws,
The Laws of India database, a project of PRS Legislative Research (www.prsindia.org), may be referred to.

2) www.india.gov.in/sitemap.php: This is the official portal of the Indian Government hosted by National Informatics Centre. It provides a single window access to the information and services being provided by the Indian Government for citizens. It is a comprehensive source of information about India. Links at various places have been provided to other Indian Government Portals/ websites.

This website contains resources related many of the farming modules. Everyone will benefit from a thorough study of this website.

[1] *Watan*, *Inam* and *Maharki* lands are generally allotted by the government to persons or communities based on certain considerations.

# 10. Co-operative societies and agricultural banks

The co-operative movement was started in India in 1904 with the objective of providing finance to farmers and artisans for productive purposes at low rates of interest and thereby relieving them from the clutches of moneylenders (indigenous banks) who charged exorbitant rates of interest.

The Co-operative Societies Act of 1912 contributed to the establishment of co-operative banks and state co-operative banks to provide refinance to primary credit societies.

The farming sector today is financially supported through several schemes and incentives of the government. These are generally made available through rural co-operative societies and agricultural banks and through the Panchayat. A good knowledge of the functioning of these bodies is useful in availing such benefits.

*Co-operative Banks*

History of co-operative banks
Why co-operative banks were formed
The three tiers of the Indian co-operative banking system
Functions of co-operative banks
Advantages and disadvantages of co-operative banks

*Indigenous banks*

What are they
Who make up these banks (moneylenders)
Who patronises these banks
Why people go to these banks
Consequences of going to these banks
Legal status of these banks (they are illegal)

*Regional rural banks*

Purpose of these banks (to liquidate rural indebtedness in stages)
Provision of institutional credit to farmers and artisans in rural areas
Functions
Their advantages and disadvantages

*NABARD (National Bank for Agriculture and Rural Development)*

Functions and facilities

## Resources

1) *Modern Banking* by C.M. Patil and Dr M.L. Gulegudd, Sri Sai Publications, Gadag, Karnataka, 2010

   Contains information about co-operative societies, co-operative banks and regional rural banks.

2) www.india.gov.in/sitemap.php: This is the official portal of the Indian Government hosted by National Informatics Centre. It provides a single window access to the information and services being provided by the Indian Government for citizens. It is a comprehensive source of information about India. Links at various places have been provided to other Indian Government Portals/ websites.

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## Education – Practitioners and Experts

**Anuradha and Krishna**
**Thulir**
Sittilingi P.O
Theerthamalai H.P.O
Dharmapuri Dt – 636 906
Tel: 04346 – 299043 / 299197
Email:thulir@gmail.com
Email:anukrish65@yahoo.co.uk
*Expertise: Appropriate technology and education*

**Arvind Gupta**
**Children's Centre**
**Inter-University Centre for Astronomy and Astrophysics**
Pune University
Ganeshkhind, Pune 411007
Maharashtra
Ph: 020-25604602
Cell: 9890290213
Email:arvindguptatoys@gmail.com
Website: www.arvindguptatoys.com
*Expertise: Education, learning by doing*

**Barefoot College**
Village Tilonia, via Madanganj
District Ajmer, Rajasthan 305816
Phone: (01463) 288 204
Fax: 01463-288206
Website Links
www.barefootcollege.org
*Expertise: Appropriate technology*

**Claude Alvares (Dr)**
G-8, St Britto's Apartments
Fiera Alta, Mapusa 403 507, Goa
Email: multiversityindia@gmail.com
Ph: 0832-2263305
www.multiworldindia.org
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**Dileep Kamat**
**Parivartan**
56, Sahyadri Colony
Angol, Tilakwadi
Belgaum 590 006
Cell: 09448157588
Email: kamatdileep@gmail.com
Ph: 0831-2481718
*Expertise: Trainer in rural governance and community action*

**Director (Philately)**
Dak Bhavan, Snasad Marg
New-Delhi 110 001
Ph: 011 3710154
Email: directorphilately@indiapost.gov.in
www.indiapost.gov.in
*Expertise: Philately*

**Eklavya**
E-10, BDA Colony,
Shankar Nagar, Shivaji Nagar
Bhopal - 462016, Madhya Pradesh
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Website: www.eklavya.in
Email: info@eklavya.in
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**Jane Sahi**
SITA School
Vishram
Silvepura
Bangalore North – 560 090
Tel: 28466274
Email: jane_sahi@hotmail.com
janehelensahi@gmail.com
*Expertise: Education, Teaching English as a second language*

**Juli and Vivek Cariappa**
**Kabir and Azad Cariappa**
Krac-a-Dawna Organic Farm
Halasur Village
Birwal P.O.
H.D Kote Taluka - 571121
Karnataka India
Phone: 08221 – 21010
Email: krac_a_dawna@yahoo.com
Website: geocites.com/kracadawnaorganiks
*Expertise: Farm based education, Bio-dynamic and Organic Farming Practices*

**G Gautama**
The School (KFI)
Besant Avenue
Adyar
Chennai 600 020
*Expertise: Educator*

**Kaigal Education and**
**Environment Programme (KEEP)**
Krishnamurti Foundation India
Kaigal, Thotakanam Post
Baireddipalle Mandal
Chittoor - 517415 Andhra Pradesh
Phone: 080-28425867
Email: keepkfi@yahoo.com
Web link: www.kaigalconserve.info
Contact persons: **Sudha Premnath (Dr)**
*Expertise: Teaching children living in forest environments*

**Homi Bhabha Center for Science Education**
Homi Bhabha Centre for Science Education
Tata Institute of Fundamental Research
V.N. Purav Marg, Mankhurd
Mumbai, Maharashtra 400088
Phone: (022) 2555 8036, 2556 7711
*Expertise: Publications*

**Kalpavriksh**
Kalpavriksh
Apt 5 Shree Dutta Krupa
908 Deccan Gymkhana
Pune, Maharashtra 411004
Phone: (020) 2565 4239 / 2567 5450
www.kalpavriksh.org
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Kumbham, Aruvacode
Nilambur, 679329 Kerala
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Cell: 09447121544
Email:jinankb@gmail.com
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Nadavayal P.O
Wayanad – 670 721
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**Majhihira National Basic Educational Institution (MNBEI)**
Purulia, West Bengal,
Ph: 03252-2284499/2284333 Cell: 09732023093
E-mail: maptti@gmail.com:
manik.dasgupta@gmail.com
Web: www.majhihira-ashram.org
Contact: Prasad and Manik Dasgupta
*Expertise: Nai Talim institution*

**Manish Jain**
**Shikshantar:** The Peoples' Institute for Rethinking Education and Development
Adinath Nagar 83, Udaipur 313004, Rajasthan,
Ph: 0294-245-1303
Email: manish@swaraj.org ; reva@post.com
Web: www.swaraj.org/shikshantar
Contact: **Manish Jain and Reva Dandage**
*Expertise: Self directed learning, home schooling, Swaraj University*

**Manu K.**
Mysore Amateur Naturalists
227, 3rd. Main, A-1 Block, III Stage
Vijayanagara, Mysore - 570 017
*Expertise: Birding and environment studies.*
*Publisher of the book 'Carbon Footprint'*

**M.C.Malathi**
**" Vikasana"**
Doddakalasandra P.O
Bangalore – 560 062
Tel: 9449347042, 28435356
Email: malavikasana@yahoo.co.in
*Expertise: Education, trained by David Horsburgh*

**Meenakshi Umesh**
**Puvidham Learning Centre**
Nagarkoodal P.O
Indur – 636 803
Dharmapuri District
Cell: 9345620626
04342-291100
Email: puvidham@gmail.com
*Expertise: Architecture using locally available materials, farm based education*

**M. G. Jackson (Dr)**
D-92, Sector 36, First Floor
Noida -201303
Uttar Pradesh
Phone: 0120- 4349237
Email: mgordonjackson@yahoo.co.in
*Expertise: Ecosystem based approach to education*

**Neema Vasihnava**
**Laxmi Ashram,** Kausani – 263 639
District Almora, Uttarakhand
Ph: 05962 - 25008
Cell: 09761619675
Email: neemavaishnava@gmail.com
*Expertise: Nai Talim institution*

**Nyla Coelho**
No.5, High street camp
Belgaum - 590001
Tel : 0831-2255913
Goa Off: 0832 – 2460991
Mob: 9343413193
Email: taleemnet@gmail.com/ nylasai@gmail.com
www.multiworldindia.org
*Expertise: Coordinator, Taleemnet*

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560 005 Bangalore
Karnataka
Ph: 080 25472241 / 25473318
Email: phyllis.farias@gmail.com
*Expertise: Curriculum development and teacher training*

**Raghu Babu**
6PMC Office
MIG II, Block -19, Flat 6
Baghlingampally, Hyderabad – 500 044
Email: babu.rg@rediffmail.com
Mob: 9441957212
*Expertise: Farm based education*

**Rama Sastry and B.Ramdas**
**Vidyodaya School**
P.B.No.28
Gudalur – 643 212
The Nilgiris (Dist)
Tel: 04262 – 261927 (Sc)
Email : bramrama@gmail.com
*Expertise: Relevant education for tribals'*

**Ramesh Panse**
**Gram Mangal**
Trustee
Sugandh, 2118
Sadashiv Peth
Pune, Maharashtra 411030
Phone: (020) 433-0343
www.grammangal.org
*Expertise: Education*

**Ravi Gulati**
**Manzil**
Flat No. 13, Khan Market, New Delhi - 110003.
Ph. 24618513, 31010396
Email: ravi@manzil.in
Website: www.manzilindia.org.in
*Expertise: Creating spaces for the spirit of voluntarism in education*

**Sarang**
Agali-Chittoor P O. 678581
Palakkad, Kerala
Ph: 0492-4209038, Cell: 09446239429
Contact: **Gopalakrishnan and Vijayalekshmi : Gautam and Anuradha**
Email: sarangfamily@gmail.com
*Expertise: Holistic approach to education*

**Saraswathi L.S (Dr)**
Flat . B
Prajawal Symantaka Apartments
New No. 3, Old No. 2
Pinjala Subramania Street
T Nagar, Chennai – 600 017
Tel: 044 – 24343250
Email: lssaraswathi@dataone.in*Expertise: Indigenous knowledge systems, mathematics*

**Shivaji Kagnikar**
Gandhighar
Devgiri, Kadoli P.O.
Dist. Belgaum – 591 143
*Expertise: Education and land based approach to learning*

**Sholai School**
**Centre for Organic Agriculture and Appropriate Technology (CLOAAT)**
P.O.Box 57, Kodaikanal 62401, Tamil Nadu
Ph: 04542 - 30297
Email: contact@sholaischool.in,
bhbjenkins@gmail.com
Contact: **Brian Jenkins**
*Expertise: Encourages self directed learning, appropriate technology and organic farming*

**Shree Padre**
Water Journalist
Post Vaninagar
Via: Perla - Kerala, 671 552
Phone : 04998 - 266148
E-mail : shreepadre@gmail.com
Web : www.adikepatrike.com
*Expertise: Publications, rainwater harvesting*

**SIDH (Society for Integrated Development of Himalayas)**
PO Box 19
Hazelwood, Landour Cantt
Mussoorie 248179, Uttarakhand
Ph: 0135-6455416, 2631304.
Email: pawansidh@gmail.com
Web: http://www.sidhsri.com/
Contact: **Pawan Gupta:**
Cell : 97600-49414; pawansidh@gmail.com
*Expertise: Using farming in education, cultural knowledge systems, history*

**State Laws of India Project**
PRS Legislative Research
Centre for Policy Research
Dharma Marg, Chanakyapuri
New Delhi - 110021
Phone : (011) 2611 5273-76
Fax : (011) 2687 2746
Email : statelaws@prsindia.org
www.lawsofindia.org
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**Director**
**Ecoscience Research Foundation**
98, Baaz Nagar, 3/621, East Coast Road
Palavakkam, Chennai - 600 041
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Cell: 09384898358
Email: sultanismail@gmail.com
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*Expertise: Vermitech, science education*

**Suprabha Seshan**
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*Expertise: Forest systems, conservation, biological systems in nature*

**Sushama Sharma**
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Nai Talim Area, Sewagram Post
Dist. Wardha - 442 102
*Expertise: Nai Talim institution.*
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**Syamantak**
163, At Post Dhamapur -416605
Tal.Malvan, Dist.Sindhudurg
Maharashtra
Ph: 02365-255 620, 94041-64945
Email: info@syamantak.org
sachin@syamantak.org, indiafime@gmail.com
www. syamantak.cfsites.org
Contact: **Sachin and Minal Desai**
*Expertise: Self directed learning, appropriate technology, farming*

**U. Subba Raju**
**C/o Timbaktu Collective**
Chennekothapalli Post
Anantapur District – 515 101
Tel:08559 –240335 / 240337 / 240149
Email: u_subbaraju@yahoo.com
*Expertise: Education, publishing, using local knowledge systems in education*

**Taleemnet**
G-8, St Britto's Apartments
Fiera Alta, Mapusa 403 507, Goa
Ph: 0832-2255913
Ph: 0831-2460991, Cell: +9343413193
Website:www.multiworldindia.org
Email: taleemnet@gmail.com
Contact: Nyla Coelho
*Expertise: Networking and support to learner directed leaning*

**Uttarakhand Environmental Education Centre**
**Uttarakhand Seva Nidhi Paryavaran Shiksha Kendra**
Jakhan Devi, Mall Road
Almora 263601
Uttarakhand
Ph: 05962-234430
Email: an.lalit@gmail.com ; pande.gp@gmail.com
Contact**: Lalit (Dr) and Anuradha Pande; G.P.Pande(Dr)**
*Expertise: Ecological approach to education*

**Vasant Palshikar**
No.2, Sairaj Aptmts,
(Near Vishwas Bank)
Sharda Nagar
Savarkar Nagar
Gangapur Road
Nashik - 422 013
Tel: 0253-2344390
Email: deepapalshikar@rediffmail.com
*Expertise: thinker, educator*

**Vidya Patwardhan**
"Yamuna"
I.C.S. Colony
Ganeshkhind Road
Pune – 411 017
Tel: 020 – 25537955
Email: aksharvidya@gmail.com
*Expertise: Joyful education*

**Vishven and Bhargav Soneji**
Village Sakawa, P.O. Samariya,
Taluka: Rajpipla, Dist: Narmada,
Gujarat. Phone: 02640-291173
Email: bhargav1989@gmail.com Cell: 9426558897
Email: vishven1986@gmail.com Cell: 9427400257
*Expertise: Self directed learning and enterprise*

**Yogesh Kulkarni (Dr),**
**Ranjeet Shanbag**
**Vigyan Ashram**
Pabal, Dist. Pune 412403, Maharashtra
Ph: 02138 292326
Email: vapabal@gmail.com
Website: www.vigyanashram.com
Contact: Dr Yogesh Kulkarni +9730005016;
Anand Gosavi +9960865463
*Expertise : Rural alternate and appropriate technology trainers*

## Farm related education – Institutions and Practitioners

**Organic Farming Association of India**
Website: www.ofai.org
Email: myofai@gmail.com/ofaigoa@gmail.com
Ph: 0832-2255913
Contact: Dr Claude Alvares

**Natural Farming Institute**
Website: www.multiworldindia.org
Contact: Dr. Claude Alvares
Email: multiversityindia@gmail.com
Ph: 0832-2263305
*The postal address for the above two is:*
G-8, St Britto's Apartments
Fiera Alta, Mapusa 403 507, Goa

**Om Prakash Rupela (Dr)**
Principal Consultant (FAO Delhi),
120, Phase I, Saket, Kapra, PO: ECIL
Hyderabad – 500062
Andra Pradesh
Phone: 9490621798
Email: oprupela@gmail.com
*Expertise: Retired scientist from ICRISAT. Conducts training in soil health enhancement techniques and organic practices.*

**G V Ramanjaneyulu (Dr)**
**Centre for sustainable Agriculture**
12-13-5, Street No. 1, Tarnaka
Secunderabad 500017
Andra Pradesh
Phone: 040-27017735
Cell: +91-9391359702
Email: gvramanjaneyulu@gmail.com.
*Expertise: Expert trainer in Non-Pesticide Management (NPM) of dry land farming*

**P V Satheesh**
**Deccan Development Society**
Pastapur Village, Zaheerabad Mandal,
Medak, 502110 Andhra Pradesh
Phone: 08451 282271/282785
Email: hyd2_ddsppvr1@sancharnet.in
satheeshperiyapatna@gmail.com
*Expertise: Conservation of millets and ecological farming practices. Founder of Pacha Shaale, the green school*

**K. Suresh.**
**Manchi Pustakam**
C/o Wassan, 12-13-452, Sr.No.1
Tarnaka, Secunderabad- 500015
Andhra Pradesh
Phone: 040-27015295/96
Cell: 09440804860
*Expertise: Wassan and Manchi Pustakam produce and publish resource materials and posters on farming and water management techniques*

**Timbaktu Collective**
Chennekothapalli Village- 515 101
Anantapur District
Andhra Pradesh
Phone: 08559-202149, 202149, 202335, 202339
Email: info@timbaktu.org/
timbaktu.collective@gmail.com
Website: www.timbaktu.org

Contact: Subba Raju
*Expertise: PGS and organic practices, reclamation of degraded lands, farm based learning centres*

**Bija Vidyapeeth and Navdanya**
A-60, Hauz Khas, New Delhi – 110 016
Ph: 26968077, 26853772
Fax: 26856795
Web: www.navdanya.org
Contact: **Vandana Shiva (Dr)**
*Expertise: Internship programmes in organic practices, publications*

**Sustainable Agriculture Information**
Net Work-Sustainet India
B-4, Greater Kailesh Enclave Part II
New Delhi – 110 048
Ph: 011 40520139, Fax: 011 40520133
Cell: 09871766826,
Email: poonam.pande@gmail.com
poonam.pande@gtz.de
Web: www.sustainet.org
Contact: **Poonam Pande (Dr)**
*Their website carries useful information and publications*

**Fr. Inaz Almeida**
Address: Our Lady of Fatima Chapel
Bironem, Valpoi
Goa
Cell: 9420820726
*Expertise: Use of effective micro-organisms; medicinal plant gardens; panchagavya*

**Mohan M. Tendulkar**
Malkpan Malkarnem
Sanguem – 403704
Taluka-Quepem
Goa
Ph: 0832 2678286
Cell: 09765185353
*Expertise: Training in vermiculture and organic practices*

**Clea Chandmal**
Foyts Farm
Dongurli, Satteri -403506, Goa
Ph: 0832-2379474 Cell: 9423993635
Email:cleachandmal@gmail.com
*Expertise: Practicing permaculturist, trained with Bill Mollison, the inventor of permaculture*

**Sarvadaman Patel**
Bhaikaka Krushi Kendra, At:Ravipura,
P.O: Ghuteli, Anand Sojitra Road, District Anand
Gujarat
Phone: 02692-281664
Cell: 09825045730
*Expertise: Biodynamic farming; appropriate green farm technologies*

**Bhasker Save**
**Kalpavruksha Farm**
PO: Deheri, Taluka: Umbergaon,
District: Valsad-396 170, Gujarat
Phone: 0260-2562126
*Expertise: Farming on ecological principles*

**Nu Tech Farm**
Near Rayan Village, Mandvi Taluka
Kutch District-370 465
Gujarat
Telefax: 02834-288911/288361
Cell: 09825235811
E-mail: vijaykusum@nugroup.in; nutech-farm@yahoo.com
Contact: **Vijay and Manesh Shah**
*Expertise: Organic dates and aloe-vera products*

**Kapil Shah**
**Jatan**
Vinobha Ashram, Gotri
Vadodara 390 021
Gujarat
Ph: 0265 2371429,
Cell: 09427054132
Email: jatantrust@gmail.com
*Expertise: Organic farming trainer. Jatan has an exhaustive collection of resource material on farming and related issues*

**Vikram Rawat**
Kursog Valley Farmers' Group
Thandapani
District Mandi
Himachal Pradesh
*Expertise: Use of tissue culture techniques for vegetables and fruit crops*

**Rajinder Chaudhary**
Department of Economics
M.D. University
Rohtak – 124001
Haryana
Cell: 09416182061
Email: rajinderc@gmail .com
*Expertise: Organic farming practices*

**Annadana**
'Ishana' Gopathi farms
Singapura Village,
Post:Vidyaranyapura
Bangalore – 560097
Karnataka
Cell: 9448068347
Email: sangita@annadana.com
Contact: **Sangeeta Sharma**
*Expertise: Organic farming, seed keeping and organic seed conservation, heritage seeds*

**Krishna Prasad**
**Sahaja Samrudha**
'Nandana', No.7, 2nd Cross, 7th Main
Sultanpalya
Bangalore – 560032
Karnataka
Cell: 98-808-62058
Email: sahajasamrudha@gmail.com
Website: sahajasamrudha.org
*Expertise: Marketing of agriculture product, live gene pools of indigenous varieties, millets*

**Bio-Cenre**
Hulimavu
Bangalore-60 076
Karnataka
Phone: 080 26582784
Cell: 09448999207
Email:jdhbiocentre@gmail.com
Contact: Joint Director of Horticulture ( Biotechnology Division)
*Open pollinated seed varieties and training are available here*

**Vanaja Ramprasad**
**Green Foundation**
No.30, Surya, P.O.Box.7651
IV Main, 19th cross, N.S. Palya
BTM 2nd Stage
Bangalore - 560 076
Karnataka
Phone: 080 26784509, 080 26783858(R)
Tele-fax: 080 26680995
Cell: 09449861040
Email: green@greenfoundation.org.in/ earthbuddy@gmail.com
Website: www.greenconserve.com
*Expertise: Saving indigenous seed varieties through farmer women's groups*

**Narayan Reddy**
Srinivasapura, Via Maralenanahalli
Doddaballapur Taluk
Hanabe-561 203,
Karnataka
Phone: 080 27601103
Cell: 09343533632, 09367713963
*Expertise: Organic farming practices*

**Suresh Desai**
Organic Farmers Club
Bedkihal,Chikodi Taluka
Belgaum -591214
Karnataka
Phone: 08338-261052
Cell: 09480448256
*Expertise: Sugarcane farming; organic jaggery; organic turmeric*

**Kailash Murthy**
No.12, 9th Cross, Adhi Sakhi Road
Shakti Nagar
Mysore - 570019
Karnataka
9880185757 and 9845125808
Email: kailashnatufarm@gmail.com
*Expertise: Ecological farming*

**Patil Shivganda Malagouda**
Vidyanagar, Athani
Belgaum -591 304
Karnataka
Cell: 9448432172
*Expertise: Processing and marketing of farm products. Many innovations*

**Vanastree**
(The Malnad Forest Garden and Seed Keepers Collective)
**Sunita Rao**
80/1, Asare, Vishal Nagar
Marathi koppa, Sirsi
Karnataka- 581 402
Phone: 08384-290404
Cell: 09480299200. Email:vanastree@gmail.com
Website: www.vanastree.org
*Expertise: Organic kitchen gardening through women's collectives*

**Mojo Plantation**
Galibeedu Post, P.O Box 101
Madikeri 571 201, Karnataka

Phone: 08272-265636
Email: majoplantation@gmail.com
Contact: **Sujata Goel (Dr) and Anurag Goel (Dr)**
*Expertise: Growth and inhibitor hormones and how they can be used in organic practices. Both Sujata and Anurag are plant molecular biology scientists*

**I. K. Subbaiah**
Prabhu Estate, Mythadi Village,Via Virajpet
Kodagu - 571236
Karnataka
Phone: 08272-201355
Cell: 9448219355
Email: lifecoorg@rediffmail.com
*Expertise: Organic coffee, organic rice, building of soil humus*

**B. N. Nandish**
Chrchugundi
Shikaripura
Shimoga - 577201
Phone: 9845553078
*Expertise: Legume culture for green manuring to build living soils*

**Richard Rebello**
Maria, Post Santhekatte
Udupi - 576 125
Karnataka
*Expertise: Organic practices*

**Golden Mist Plantation**
Galibedu Village, Dist:Kodagu
Madikeri - 571 201
Karnataka
Phone: 08272-265629
Cell: 9480788192
Email: gmohp2000@yahoo.com
Web: www.golden-mist.net
Contact: **Ludwig**
*Expertise: Processing of organic green tea and herbal tea*

**Jaivik Krishak Society (JKS)**
Nurseryemen Co-operative Society Premises
Lalbagh (Double Road Entrance)
Bangalore-560 004
Karnataka
Phone: 080 65624197
Email: jk_society@rediffmail.com
Contact: Executive Officer, Jaivik Krishik Society
*Expertise: Organic seeds, mushroom cultivation, horticulture*

**K V Deyal**
Organic Farms
Sreekovi, Kayippuram, Muhamma P.O.
Alappuzha - 688525
Kerala
Phone: 0478-2583289
*Expertise: Ecological farming*

**Suman, Jalaja and Nityananda**
Anuragam Organic Farm, Mechira
Muthalamada
Palakkad - 678581, Kerala
Phone: 04923 275439
Email: sradhaa@rediffmail.com, Sradhaa @yahoo.co.in
www.myspace.com/sradharetreat
www.kumbham.in/organicfarming.html
*Expertise: Organic practices – vegetables, traditional construction and cultivation techniques, pottery*

**Abhay Mutalik Desai**
Post Yamakanmardi
203, Shukrawar Peth, Tilakwadi
Belgaum – 590006
Karnataka
Cell: 09900775633
Email: homafarming@rediffmail.com
*Expertise: Homa farming; use of termites for composting and organic jaggery production*

**Tomy Mathews**
elements
4/1418b
Customs Road
Kozhikode 673032
Kerala
Ph: 0495- 2765 783
Email: tomy@elementsindia.net
www.elementsindia.net
*Expertise: Fair trade and organic stores*

**Kavita Mukhi**
Mermaid Building Juhu –Tara Road
(Near Palm Grove Hotel)
Juhu Mumbai – 400049
Maharashtra
Ph: 022-26184365/ 26149626
Email: info@consciousfood.com
www.consciousfood .com
*Expertise: Organic stores and health foods*

**Karuna and Vasant Putane**
SAMVAD,
At Rawala, Taluka Warud
District Amravati 444907
Maharashtra
Phone: 072143-2871 07229 238171
Cell: 9421815621
Email: chinmay_futane@sancharnet.in
*Expertise: Organic rain-fed dry land farming*

**Niranjana Maru**
**Chetana Vikas**
(Alternative Agriculture Resource Centre)
P.O Gopuri, Wardha-442001, Maharashtra
Phone: 07152-241931, 240806
Cell: 9890308597
Email: chetana_wda@bsnl.in
Web: www.chetanavikas.org
Contact Person: Niranjana Maru and Ashok Bang
*Expertise: Multi-Cropping Practices in Dryland Area*

**Manohar Parchure**
258, Ramnagar
Nagpur- 440033
Maharashtra
*Expertise: Organic farming practices*

**Joy Daniel**
**Institute For Integrated Rural Development [IIRD]**
Kanchan Nagar,Nakshatrawadi,
PO Box:562,Aurangabad – 431002
Maharashtra
Land Line 0240 2376 336,2376 828, 02431 841534
Cell: 9823067272, 9850676145, +91-9372076828
Fax: 91 240 2376 866
Email: jdaniel@iird.org.in
Website: http://www.iird.org.in
*Expertise: Organic farming practice,; organic bazaars, Participatory Guarantee System of Organic Certification (PGS) and organic food bazaars*

**Pradeep Sambhajirao Nikam**
Tarali Gramvikas Pratisthan, Indoli
At & Post Indoli
Karad, Satara - 415 109
Maharashtra
Phone : 02347 - 264805 / 02164 2651756
Cell: 09850117790
*Expertise: Organic practices*

**Jayant Barve**
Organic Farm and Sustainable Agriculture Research Institute
No.484, Kaushik Vita, Taluka – Khanapur
Distict: Sangli-415 311, Maharashtra.
Phone: 02347-272141
Cell: 09422615878
Email: jjbarve@yahoo.com
*Expertise: Organic grape, compost, making farming a successful enterprise.*

**Subhash Sharma**
At Chhoti Gujri, Yeotmal-445001
Maharashtra
Phone: (07232) 240956
Mobile: 9422869620
*Expertise: Alley cropping and organic practices, contour based farm design*

**Sudhir Arvind Chivate**
Village & Post Talbid
Satara-415 109
Maharashtra
Phone: 02164-258028 (pp)
Cell: 09822320983
*Expertise: Organic ginger and sugarcane*

**The Health Awareness Centre (THAC)**
C/o Streehitavardhini, Lokmanya Nagar
K. Gadgil Marg
Mumbai - 4000025, Maharashtra
Phone: 022 24361672, 24320788/ + 9323310005
Email: thacindia@yahoo.com
**Contact: Vijaya Venkat (Dr)**
*Expertise: Health foods, nutrition and well being*

**T. G. K. Menon**
46, Samvad Nagar, Navlakha, Indore – 452001,
Madhya Pradesh. Ph: 0731 2403013
*Expertise: Biodynamic agriculture, diversity of food plants in home gardens*

**Deepak Suchde**
Bajwada, Post Nemavar, Taluka Kathegaon
District Dewas-455 339, Madhya Pradesh
Phone: 0214 3281527
Cell: 09329570960
Email: deepaksuchde@gmail.com
Web: www.natuecofarmingscience.com
*Expertise: Natural and ecological farming, amrit mitti*

**Sambhavna's Organic Medicinal Herb Garden**
C/o Sambhavna Clinic, 44, Sant Kanwar Ram Nagar
Berasia Road, Bhopal-462018
Madhya Pradesh
Phone: 755-273-0914
Email: terrykisan@yahoo.com
*Expertise: Medicinal plants and herbs*

**Debjeet Sarangi**
**Living Farms**
77,B. Brhameswar Patna,
Tankapani Road, PO Baragada Brit Colony
Bhubaneswar - 751018
Orissa
Phone: 0674-5524011
Cell: 093-371-02146
Email: livingfarms@gmail.com
*Expertise: Conservation of rice varieties, promoter of organic practices*

**Jacob Nellithanam**
Richharia Campaign,
B 3, Parijat Colony
Nehru Nagar, Bilaspur 495001
Cell: 092425560950
Email: farmersrights@gmail.com
*Expertise: Tribal knowledge systems*

**Prof. Radhamohan**
Address: Sambhav,
At/Post Rohi Bank via Kural-752090
Dist: Nayagarh, Orissa
*Expertise: Trainer in organic farming practices*

**Shambu Prasad (Dr)**
Xavier's Institute of Management,
Xavier Square, Bhubaneswar-751013
Orissa
Phone: 0674-3012345, Fax: 0674-2300995
Email: Shambuprasad@gmail.com
Web: www.ximb.ac.in
*Expertise: Promoter of organic farming practices and rural enterprise management training*

**Kheti Virasat Mission (KVM)**
Post Box No.1, Jaiu
District Faridkot
Punjab
Ph: 01635 503415;
Cell: 09872682161, 09915195061
Email: umendradutt@gmail.com
Web: www.khetivirasatmission.org
Contact: **Umendra Dutt**
*Expertise: Promoter of organic agriculture in Punjab*

**Bernard Declerq and Deepika Kundaji**
Aurobrindavan
Auroville
Pondicherry
605101
Phone: 0413-2677792
Email: pebblegardenforest@gmail.com,
pebblegarden@vsnl.net
*Expertise: Alley cropping, regenerating degraded soils, creating living soils, agroforestry practices. Deepika is an expert in home scale vegetable gardening and seed keeping.*

**Arun K. Sharma (Dr)**
House No.14, Sector 29, Chopasani Housing Board
Jodhpur-342 003, Rajasthan
Phone: 0291-2703547, Cell: 09414172436
Email: arun.k_sharma@yahoo.co.in
*Expertise: Training in organic farming practices*

**K. Natarajan (Dr)**
Rural Community Action Centre
R.S. Hospital Complex, By-pass Road
Kodumudi-638151
Tamil Nadu
Phone: 094433358379
Email: rcacngo@yahoo.com
*Expertise: Inventor of Panchgavya*

**Keystone Foundation**
Keystone Centre, P. B. No. 35
Groves Hill Road
Kotagiri, Tamilnadu
Phone: 04266-272277
Website: www.keystone.foundation.org
Email: kf@keystone.foundation.org
*Expertise: Participatory Guarantee System of Organic Certification (PGS) and processing and marketing of non-timber minor forest produce*

**G. Nammalwar (Dr)**
17/9, 5th Street, Srinivasa Nagar,
Thiruvanai Koil
Trichy – 620 005
Tamilnadu.
Phone: 04326-240555
Cell: 09442531699
Email(PP):m.nair@csuohio.edu

*Expertise: Master trainer in ecological practices and organic farming. First person to receive an honorary doctorate degree for farming*

**Sugavanam**
(Medicinal Plant Conseration Park and People's Agricultural Farm)
27, Ayyanar Nagar
Pudukkotai-622 303
Tamil Nadu
Phone: 04322-265094/266613
Email: paf@eth.net
*Medicinal plant conservation and cultivation*

**Centre for Indian Knowledge Systems (CIKS)**
30,Gandhi Mandapam Roa, Kotturpuram,
Chennai-600085
Tamil Nadu
Phone: 2447 1087/ 2447 5862
Fax: 2447 1114
Email: ciks2vsnl.com/info@ciks.org
Website: www.ciks.org
*Interesting, affordable publications*

**Vivekananda Kendra**
NARDEP, Vivekanandapuram
Kalluvilai
Kanyakumari-629 702
Tamil Nadu
Phone: 04652 246296
Email: ngc_vknarep@sancharnet.in
Or
Technology Resource Centre, VK-NARDEP
Tamil Nadu, Ph: 04652 270755, 271270
*Expertise: Farm related technology*

**S. Poongodi/ R.Selvam**
Pudhu Nilavu Organic Farm/Manonmani Vermi Farm,
Thalavumalai, Arachaloor
Erode District-638 101
Tamil Nadu
Phone: 0424 2357537
Email: manpulu@rediffmail.com
*Expertise: SRI method of rice cultivation, organic practices, biological preparations*

**V. Ravi**
Rajchettyar Thottam, uppupallam, Kenjanur P.O.
Sathya-mangalam via Erode District-638 401
Tamil Nadu
Phone: 04295 24779
*Expertise: Ecological farming*

**TOFarM**
64-A Kalaimagal Illam, Periasamy Servai Street
Sundarapuram (PO)
Coimbatore – 641 024
Tamil Nadu
Revati : Cell: 09443343336
Swami- Cell: 09994033551
Email: revathima@gmail.com
*Expertise: Reclamation of salinated soils for farming*

**N. Gopalakrishnan**
No.4/19, Akila Nagar First cross, Ganapathy Nagar
South Extension, Mambazhasalai, Thiruvanaikoil
Trichy-620 005
Tamil Nadu
*Expertise: Fish and lime organic preparations and large scale vermi composting, vermiculture*

**John Joseph**
Pillukurichi, Idappadi
637 101 Tamil Nadu
Phone: 04283 637742 vegetables and seed keeping
*Expertise: Organic seeds and vegetables*

**Vijay Jardhari**
Beej Bachao Andolan
Village at P.O. Nagani
District Tehri
Garhwal-249175
Uttarakhand
Cell: 09411777758
Email: vijayjaradhari@gmail.com
*Expertise: Mixed millet cropping*
**Also, Seed Saving and Seed Savers' Resources**
http:/homepage.eircom.net/-merlyn/seedsaving.html
*Excellent link for everything on seeds for seed savers and Farmers.*

**Bharatendu Prakash (Dr)**
Address: Kisan Vigyan Kendra, Tindwari P.O.
Banda District-210 128, Uttar Pradesh
Cell: 094525028251
Email: ofai.north@gmail.com, vskbanda@yahoo.com
*and*
Kisan Vigyan Kendra
Badausa road, Atarra(Banda) 219 201, Uttar Pradesh.
Phone: 05192-224587
*Expertise: Training in organic practices*

**Ardhendhu Chatterjee**
Address: (DRCSC), 58A, Dharmotola Road
Bosepuku, Kasba, Kolkata-700042, West Bengal
Ph: 033-24427311, 2441 1646
Fax: 91-033 2442 7563
Cell: 9433079847
*Expertise: Integrated farming, permaculture*

**Asal – The Organic Food & Natural Products Store**
5, Tejpal Society, Nr.Fatehnagar Bus Stand
Paldi, Ahmedabad-380 007, Gujarat.
Phone: 079 26622020/26622022
Cell: 9824019888
Email: asalworld@yahoo.co.in
Web: www.asalworld.org
Contact: Shripal Shah
*Expertise: Organic stores*

**Anil Gupta**
Sustainable Technologies-Sristi
AES Boys Hostel Campus, Near Gujarat University Library
& SBI Bank, Navarangpura
Ahmedabad-380 009
Gujarat
Phone: 079-27913293/27912792
Email: info@sristi.org
Contact: Anil K. Gupta E-mail:anilg@iimahd ernet in
Ramesh Patel Email: ramesh@sristi.org
*Expertise: Rural technology innovations*

**Era Organic**
No.348, Dollars Colony, RMV Club
Double Road, RMV II Stage, Bangalore-560 094
Karnataka
Phone: 41606003/41606004
Cell: 9900911777
Email; info@eraorganic.org,
eraorganic07@gmail.com
Web: www.eraorganic.in
Contact: H.R. Jayaram, Chairman
*Expertise: Organic stores*

**Alter Media**
Brahmaswam Madam Building
M.G.Road, Thrissur-680 001, Kerala
Phone: 0487 422974
Email: info@altermedia-india.com
*Expertise: Publications*

**P.K. Thampan**
**Peekay Tree Crops Development Foundation**
M.I.G. 141, Gandhi Nagar
Cochin - 682 020
Phone: 0484 2204271
Cell: 9388602105
Email: pkthampan@yahoo.com
*Expertise: Provides training on Integrated Farming, CDOs, Agroecosystem models, Income Generation etc*

**Raju Titus**
Same as Shalini Titus (Sl no:895)
Phone: 07574 280084
Cell: 9425040610
Email: rajuktitus@yahoo.co.in
*Expertise: Ecological farming*

**David Hogg**
www.biodynamics.in
Biodynamic Farming and Preparations and training

**S.R. Sundararaman**
Tamil Nadu Farmer's Technology Association
Sundaram Iyer Farm, Kombupallam
Satyamangalam, Erode - 638 401
Tamil Nadu
Phone: 04295 - 225047
Cell: 09842724778
*Expertise: Gaudi preparation, sugarcane, turmeric cultivation*

**P. Vivekanandan**
**SEVA**
45, T.P.M Nagar
Virattipathu, Madurai
Tamil Nadu, India
Phone: 0091 – 452 – 2380082
Email: numvali@sancharnet.in
www.seva-ngo.org
*Expertise: Ethno-veterinary Practices*

**M. Kartikeyan**
Kolunji Farm
Kudumbam,
Ezhil Nagar, Keeranur,
Pudukottai - 622502
Tamil Nadu
*Expertise: Organic Farming Practices*

# Our Land Our Life

*A curriculum for children of rural communities in India*

Presented as a contemporary design for a land based education programme, this curriculum addresses the needs of rural children of this large subcontinent. Core academic subjects and farm related modules are offered in a practical combination of syllabi and curricular ideas, complemented by an extensive section on learning resources for each subject/module. Interspersed are voices of practitioners whose spirit and wisdom it has drawn upon.

Spread across a ten year learning period as lower, middle and upper levels, the curriculum is designed such that it:

- facilitates learning through active participation in the day-to-day activity on a farm
- frees children from the unnecessary drudgery of the overuse of pen and paper and brings them out of the confining environs of classroom spaces
- encourages flexibility in the choice of subject as well as level of study
- draws deeply on local community wisdom
- provides opportunity for building the necessary skills and knowledge for land-based livelihoods
- rejects the present day education system's urban bias and presumption that 'one shoe fits all'

This curriculum is an attempt to revisit Gandhiji's vision of Nai Talim and present it in the present context. Coincidentally, 2012 is the diamond jubilee of Nai Talim.

If adopted in the right spirit, this curriculum holds promise of changing for the better the way rural children of this country learn and live.