



Exploring our environment...

-A manual for green schools





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About NGC Program

The National Green Corps program has been launched by the Ministry of Environment and Forests to bring about a change in the attitudes in the society through children. The program focuses on educating children about their immediate environment and impart knowledge about the eco-systems, their inter-dependence and their need for survival, through visits and demonstrations as well as mobilising youngsters by instilling in them the spirit of scientific inquiry into environmental problems and involving them in the efforts of environmental preservation.

In Maharashtra the program was launched in February 2002. 9000 schools across 36 districts are part of the NGC network in the state.

The Department of Social Forestry, Government of Maharashtra has been appointed as the Nodal Agency for the state of Maharashtra for this program while the Institute of Environment Education and Research, Bharati Vidyapeeth University, Pune has been appointed as the Resource Agency.

In an attempt to network schools across the state, the '**Runanubandh**' is being produced. It is hoped that the '**Runanubandh**' will serve as a platform for sharing innovative ideas and experiences in implementing environment projects across the state.

'**Runanubandh**' will feature 'Green Schools' every month. If you as a teacher have been implementing any environment projects, we would love to hear from you. Send us your articles along with good quality hard copies of photographs and we will feature your school.

Send your articles to :



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Solid Waste Management



Solid waste management has been a concern for humans since the beginning of time. In ancient cities, food scraps and other wastes were simply thrown into the unpaved streets where they accumulated. Around 320 B.C. in Athens, the first known law forbidding this practice was established and a system of waste removal began to evolve in several eastern Mediterranean cities. Disposal methods were very crude and often were just open pits outside the city walls. As populations increased, efforts were made to transport the wastes out further thus creating city dumps. Until recently the disposal of municipal solid waste did not attract much public attention. The favoured means of disposal was to dump solid wastes outside the city or village limits.

Around most towns and cities in India the approach roads are littered with multi-coloured

plastic bags and other garbage. Waste is also burnt to reduce its volume. Lack of space for dumping solid waste has become a serious problem in several cities and towns all over the world. Dumping and burning wastes is not an acceptable practice today from either an environmental or a health perspective. In order to understand what one can do about waste, one needs to understand some basic facts about solid waste.

What is solid waste?

Solid wastes are organic and inorganic waste material such as product packaging, grass clippings, furniture, clothing, bottles, kitchen refuse, paper, appliances, paint cans, batteries, etc. produced in a society, which according to individual perceptions does not have any value.

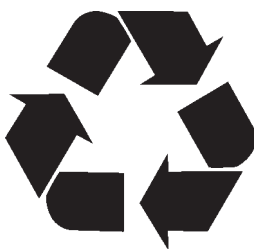




Classification of wastes

As wastes are of various different compositions we need to classify them according to their characteristics in order to be able to dispose them effectively.

Type	Description	Source
Garbage	Food Waste, waste from preparation, cooking and serving of food. Market refuse, waste from handling, storage and sale of produce and meat.	Household, Institutions and commercial concerns such as hotels, stores, restaurants, markets, etc.
Combustible and noncombustible	Combustible (primary organic) : Paper, cardboard, cartons, wood boxes, plastic bags, cloth, leather, rubber, grass leaves, yard trimmings etc. Non-combustible (primary inorganic); Metals, tin, cans, glass bottles, crockery, stones, etc.	
Bulky wastes	Large auto parts, tyres, refrigerators, other large appliances large crates, trees, branches etc.	Streets, sidewalks, vacant plots, etc.
Street wastes	Street sweepings, dirt, leaves etc.	
Dead animals	Dogs, cats, rats, donkeys etc.	
Abandoned vehicles	Automobiles and spare parts	
Construction and demolition wastes	Roofing scrapes, rubble, broken concrete, plaster, conduit pipes, wire, insulation etc.	Construction and
Industrial wastes	Solid wastes resulting from industrial processes, manufacturing operations such as food processing wastes, boiler, wood, plastic and metal scraps, shaving etc.	Factories, power plants etc.
Hazardous wastes	Pathological wastes, explosives, radioactive materials etc.	Households, hospitals, institutions, stores, industry etc.
Animals and agricultural wastes	Manure, crop residues etc.	Livestock, farms, feedlots and agriculture
Sewage treatment residues	Coarse deposits, Septic tank sludge, dewatered sludge	Sewage treatment plants and septic tanks.





What is Municipal Solid Waste ?

The term municipal solid waste (MSW) is generally used to describe most of the non-hazardous solid waste from a city, town or village that requires routine collection and transport to a processing or disposal site. Sources of MSW include private homes, commercial establishments and institutions as well as industrial facilities. However MSW does not include wastes from industrial processes, construction and demolition debris, sewage sludge, mining wastes or agricultural wastes. Municipal solid waste contains a wide variety of materials and can be classified as below.

Organic waste: kitchen waste, vegetables, flowers, leaves, fruits, meat waste usually called as wet garbage.



Toxic waste : old medicines, paints, chemicals, bulbs, spray cans, fertilizer and pesticide containers, batteries, shoe polish.



Recyclables : paper, glass, metals, plastics also called as dry wastes.



Soiled : hospital waste such as cloth soiled with blood and other body fluids.



There are different categories of waste generated, each take their own time to degenerate as can be seen in the table below.

Type of litter	Approximate time it takes to degenerate the litter
Organic waste such as vegetable, and fruit peels, leftover foodstuff, etc.	A week or two
Paper	10–30 days
Cotton cloth	2–5 months
Wood	10–15 years
Woolen items	1 year
Tin, aluminium, and other metal items such as cans	100–500 years
Plastic bags	One million years?
Glass bottles	Undetermined



How do we do effective waste management?

There are several steps to having an effective waste management strategy. This includes:

1. **Source reduction**
2. **Recycling**
3. **Disposal**

Source reduction is one of the fundamental ways to reduce waste. This can be done by using less material when making a product, reuse of products on site, designing products or packaging to reduce their quantity.

On an individual level we can reduce the use of unnecessary items while shopping, buy items with minimal packaging, avoid buying disposable items and also avoid asking for plastic carry bags.

Recycling is reusing some components of the waste that may have some economic value. Recycling has several benefits such as conservation of resources, reduction in energy used during manufacture and pollution levels. Some materials such as aluminum and steel can be recycled many times. Metal, paper, glass and plastics are recyclable. Mining of new aluminum is expensive and hence recycled aluminum has a strong market and plays a significant role in the aluminum industry.

Paper recycling can also help preserve forests as it takes about 17 trees to make one ton of paper. Crushed glass (cullet) reduces the energy required to manufacture new glass by 50 percent.

Problems with recycling

Plastics are difficult to recycle because of the different types of polymer resins used in their production. Since each type has its own chemical makeup, different plastics cannot be recycled together. Thus separation of different plastics before recycling is necessary, thus adding to costs. Similarly in recycled paper the fibers are weakened and it is difficult to control the colour of the recycled product. Recycled paper is banned for use in food containers to prevent the possibility of contamination. It very often costs less to

transport raw paper pulp than scrap paper. Collection, sorting and transport account for about 90 percent of the cost of paper recycling. The processes of pulping, deinking and screening wastepaper are generally more expensive than making paper from virgin wood or cellulose fibers. Very often thus recycled paper is more expensive than virgin paper. It is thus always better to limit the use. However as technology improves the cost will come down.

Disposal of solid waste is done most commonly through a sanitary landfill or through incineration or vermicomposting.

Landfills

A modern sanitary landfill is a depression in an impermeable soil layer that is lined with an impermeable membrane. In a municipal sanitary landfill, the solid waste is placed in a suitably selected and prepared landfill site in a carefully prescribed manner, the waste material is spread out and compacted with appropriate heavy machinery and then the waste is covered each day with a layer of compacted soil.

Problems with landfills

There are three problems associated with landfills. The first one being ground water pollution. This occurs when pollutants seeping out from the bottom of a sanitary landfill percolate down to the groundwater aquifer. This can be prevented by having suitable bottom liners and leachate collection systems along with the installation of monitoring systems to detect groundwater pollution.

The second problem is that of release of methane gas. The organic material buried in the solid waste decomposes due to the action of microorganisms. At first the waste decomposes aerobically until the oxygen present in the freshly placed fill is used up by the aerobic microorganisms. The anaerobes then take over producing methane which is poisonous and highly explosive when mixed with air in concentrations between 5 and 15 percent.

The movement of gas can be controlled by surface controllers where it can be safely diluted and dispersed into the atmosphere is thus a necessary component of the design of sanitary landfills.



The third problem associated with landfills is available space. It has become increasingly difficult to find suitable landfill sites where wastes can be transported economically. Very often citizens do not want landfills in their vicinity.

Incineration

This is the process of burning municipal solid waste in a properly designed furnace under suitable temperature and operating conditions. Incineration is a chemical process in which the combustible portion of the waste is combined with oxygen forming carbon dioxide and water, which are released into the atmosphere. This chemical reaction called oxidation results in the release of heat. For complete oxidation the waste must be mixed with appropriate volumes of air at a temperature of about 815°C for about one hour. Incineration can reduce the municipal solid waste by about 90 percent in volume and 75 percent in weight.

Problems with incineration

The problems associated with incineration are basically air pollution and disposal of the fly and bottom ash produced during the incineration process. Most of the incinerator ash is bottom ash while the remainder is fly ash. The possible presence of heavy metals in incinerator ash can be harmful.

Thus while sanitary landfills and incinerators have their own advantages and disadvantages, the most effective method of solid waste management is source reduction and recycling.

Vermicomposting



Nature has perfect solutions for managing the waste it creates, if left undisturbed and produced within limits. The biogeochemical cycles are designed to clear the waste material produced by animals and plants. We can mimic the same methods that are present in nature. In nature, all dead and dry leaves and twigs decompose and are broken down by organisms such as worms and insects, and is finally broken down by bacteria and fungi, to form a dark rich soil-like material called compost.

These organisms in the soil use the organic material as food, which provides them with nutrients for their growth and activities. These nutrients are returned to the soil to be used again by trees and other plants. This process recycles nutrients in nature.



Steps for Vermi-Compost

Dig a pit about half a meter square, one meter deep.

Line it with straw or dried leaves and grass.

Organise the disposal of organic waste in to the pit as and when generated.

Introduce a culture of worms that is now produced commercially.

Ensure that the contents are covered with a sprinkling of dried leaves and soil everyday.

Water the pits once or twice a week to keep it moist.

Turn over the contents of the pit every 15 days.

In about 45 days the waste will be decomposed by the action of microorganisms.

The soil derived is fertile and rich in nutrients.

The soil can be used as a manure for farms and gardens.



What are hazardous wastes ?



Hazardous wastes are those that can cause harm to humans or the environment. Wastes are normally classified as hazardous waste when they cause an increase in mortality or pose a present or potential hazard to human health or the environment when improperly treated, stored, transported or disposed of.

How do we know which wastes are hazardous?

If a waste is poisonous (toxic, eg: mercury) or has a tendency to react vigorously with air or water and generate toxic gases or explode (reactive, eg: gunpowder) or burns at relatively low temperatures (ignitable, eg: paint thinners) or can destroy materials and living tissue by chemical action (corrosive, acids) it is classified as a

hazardous waste. In addition to this, waste products that are either infectious (eg: used bandages, hypodermic needles) or radioactive are also classified as hazardous.

Why should we be concerned about hazardous wastes?

Hazardous wastes are dangerous and cause severe damage to human health through a variety of ways.

Groundwater pollution

This is the most serious environmental effect of as most of the hazardous wastes are disposed of on or in land. Once groundwater is polluted with hazardous wastes it is very often not possible to reverse the damage.

Minamata - an important lesson about mercury

A case of human mercury poisoning which occurred about forty years ago in the Minamata bay in Japan taught the world an important lesson about the dangers of mercury poisoning. A large plastic plant located near the Minamata bay used a mercury containing compound in a reaction to produce Vinyl Chloride a common plastic material. The left over mercury was dumped into the bay along with other wastes from the plant. Though the mercury was in its least toxic inorganic state when dumped microorganisms at the bottom of the bay converted the mercury into its organic form This organic mercury then entered into the tissues of the fish which were in turn consumed by the people living in the area. The contaminated fish thus caused an out break of poisoning killing and affecting several people. Mothers who had eaten the contaminated fish gave birth to infants who showed signs of mercury poisoning. In memory of this incident mercury poisoning is sometimes called as Minamata Disease.



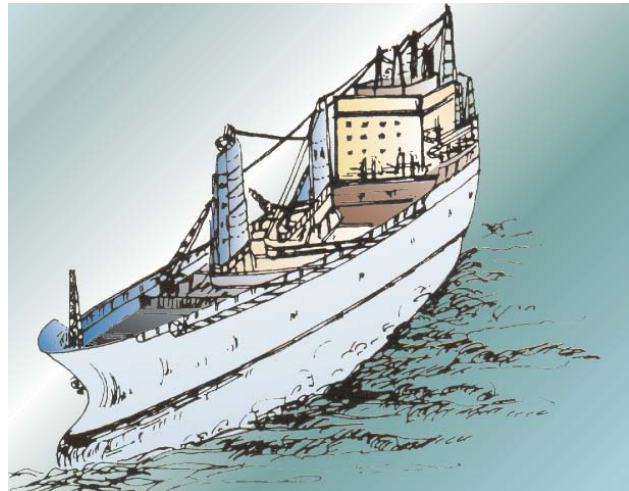
Health hazards

Pesticides are used increasingly to protect and increase food production. They form residues in the soil which are washed into streams which then carry them forwards. The residues may persist in the soil or in the bottom of lakes and rivers. Ingestion, inhalation and skin contact with these can result in acute or chronic poisoning. Today we have an alternative to the excess use of pesticides through the use of Integrated Pest Management (IPM). The IPM system uses a wide variety of plants and insects to create a more natural process of pest control. The natural balance between climate, soil and insect populations can help to prevent an insect from overpopulating an area and destroying a particular crop.



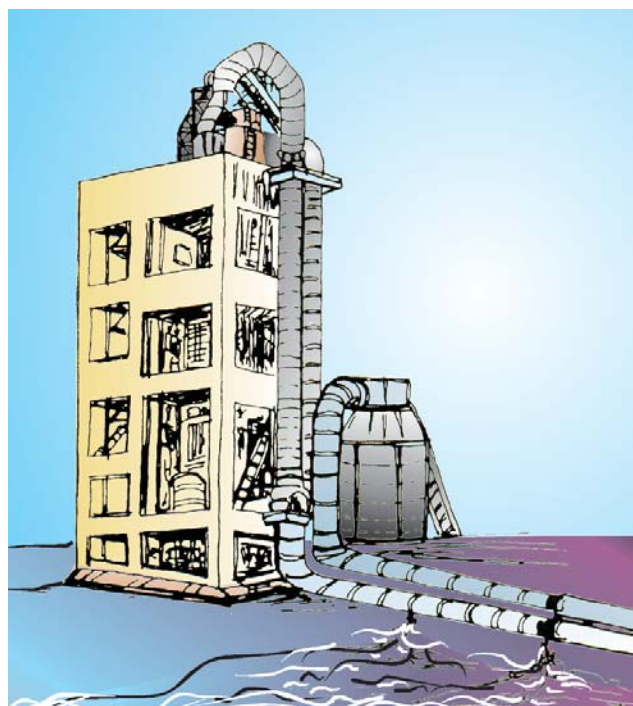
Lead, mercury and arsenic are hazardous substances which are often referred to as heavy metals. Lead is an abundant heavy metal and is relatively easy to obtain. It is used in batteries, fuel, pesticides, paints, pipes and other places where resistance to corrosion is required. Most of the lead taken up by people and wildlife is stored in bones. Lead can affect red blood cells by reducing their ability to carry oxygen and shortening their life span. Lead may also damage nerve tissue which can result in brain disease.

Mercury occurs in several different forms. Mercury is used in the production of chlorine. It is also used as a catalyst in the production of some plastics. Industrial processes such as the production of



chlorine and plastics are responsible for most of the environmental damage resulting from mercury. Our body has a limited ability to eliminate mercury. In the food web mercury becomes more concentrated as it is taken up by various organisms. In an aquatic environment, mercury can be absorbed by the plankton which are then consumed by fish. In addition, fish take up mercury through their gills and by eating other fish contaminated with mercury. Generally older the fish greater is the mercury concentration in its body. Birds that eat the fish concentrate even more mercury in their bodies. It is a cumulative poison, ie: it builds up in the body over long periods of time and is known to cause brain damage.

Thousands of chemicals are used in industry everyday. When used incorrectly or inappropriately they can become health hazards. PCBs (Polychlorinated biphenyls) are resistant to





fire and do not conduct electricity very well which makes them excellent materials for several industrial purposes. Rainwater can wash PCBs out of disposal areas in dumps and landfills thus contaminating water. PCBs do not break down very rapidly in the environment and thus retain their toxic characteristics. They cause long term exposure problems to both humans and wildlife. PCBs are concentrated in the kidneys and liver and thus cause damage. They cause reproductive failure in birds and mammals.

Vinyl chloride is a chemical that is widely used in the manufacture of plastic. Usually people are only exposed to high levels of vinyl chloride if they work with it or near it but exposure can also occur from vinyl chloride gas leaks. After a long continuous exposure (one to three years) in humans, vinyl chloride can cause deafness, vision problems, circulation disorders and bone deformities. Vinyl chloride can also cause birth defects.

What can we do about hazardous wastes?

It is essential to substitute the use of PCBs and vinyl chloride with chemicals that are less toxic. Polyvinyl chloride use can be lowered by reducing our use of plastics. Thus by reducing waste, encouraging recycling and using products that are well made and durable we can greatly reduce our consumption of these chemicals thus curtailing our exposure to these substances.

We may not realize it but many household chemicals can be quite toxic to humans as well as wildlife. Most of the dangerous substances in

our homes are found in various kinds of cleaners, solvents and products used in automotive care. When these products are used incorrectly they have the potential to be harmful.

Today the most common methods for disposing off hazardous wastes are land disposal and incineration. In countries where there is abundant land available for disposal for example, North America land disposal is the most widely used method. In countries like Europe and Japan where land is not readily available and is expensive, incineration is the preferred method for disposal. In India bigger cities have landfills despite lack of space thus bringing them in close proximity with human populations while smaller towns and villages still have open dumps. In spite of strong laws, illegal dumping of these wastes continues. Waste management must move beyond burying and burning. Industries need to be encouraged to generate less hazardous waste in their manufacturing processes. Although toxic wastes cannot be entirely eliminated, technologies are available for minimizing, recycling and treating wastes.

An informed public can also contribute in a big way towards this end. It is essential for us to understand the ill effects of chemical substances so that we can make informed decisions about its use. We might decide that the benefits of the use of a toxic substance do not outweigh the risks and choose not to use it at all or we may decide that it is acceptable to use a substance under certain specific circumstances where it is adequately controlled and exposure to toxic levels is prevented.





Garbage detective...

Objectives

To enhance students understanding about the various types of garbage produced at home and best ways to manage the garbage.

Let's do it...

Begin the activity by asking students to draw two pictures. One picture should be of his/her house. The other should be of any animal. Ask the students to look at their house and think of garbage. What is garbage? Do animals have to deal with garbage? Why do people have so much more garbage than animals? How do people get rid of garbage? Where does it go?

Let's find out!!

Ask the students to make the list of things that can be called as waste in their own homes. Ask them to review it for one week. After a weeks time ask them what is biodegradable and non biodegradable waste and ask them to quantify the waste per day.

Discussion

Teachers should clarify basic concepts about degradable and non-degradable, hazardous wastes and use this classification exercise to induce critical thinking among the students. The exercise must serve as a starting point to initiate environment friendly lifestyles.

Ask students to go through magazines and find pictures of things that often get thrown away after only one use. Ask them to create a poster from these pictures. How can we avoid throwing away so many things?

S. No.	Type of waste	Approx. amount	Repairable	Reusable	Recyclable (selling to waste collectors)	Compostable	Disposal in the Municipal dustbin	Any other
1	Milk polythene bag							
2	Vegetable waste							
3	Newspapers							
4	Empty toothpaste tube							
5	Rubber slippers							
6	Pepsi can							
7								
8								
9								
10								
11								
12								



Where does my garbage go?

Objective

To enhance students understanding of how their garbage affects the environment.

Let's do it...

Ask the students to map the journey of household waste from their own house to the waste dumping site. What are the resources (in monetary terms) spent in disposal of this garbage to its final destination? What are the environmental problems in this process?

Call a ward officer to talk about the waste generation in the area and money spent in collection or waste disposal system.

Let's find out....

Draw a map of the journey of the garbage from your house to its final destination. Include names of places, mode of transport and any other details. Try to put your information in the table given below.

S. No.	Type of waste	Amount in kgs	Transportation costs	Manpower costs	Disposing costs (landfill, etc)	Associated environmental hazards
1.	Biodegradable wastes					
2.	Dry wastes					
3.	Hazardous wastes					
4.						
5.						





The Compost Specialist

Objective

To develop skills of disposal of biodegradable waste.

Let's do it....

- Dig a rectangular pit (1 foot depth, 6 feet by 2 feet)
- Line it with broken bricks and then spread a layer of coconut coir followed by a thick layer (10 inches) of dry leaves.
- Pour a thin layer of fresh cow dung paste over the dry leaves and top it with a thin layer of vermiculture.
- Organize the disposal of organic waste (vegetable waste matter) in to the pit as and when generated.
- Cover the pit with a jute bag.
- Mix the layer everyday for the first month. Sprinkle a little water everyday just to keep it moist.
- Turn over the contents of the pit every 15 days.

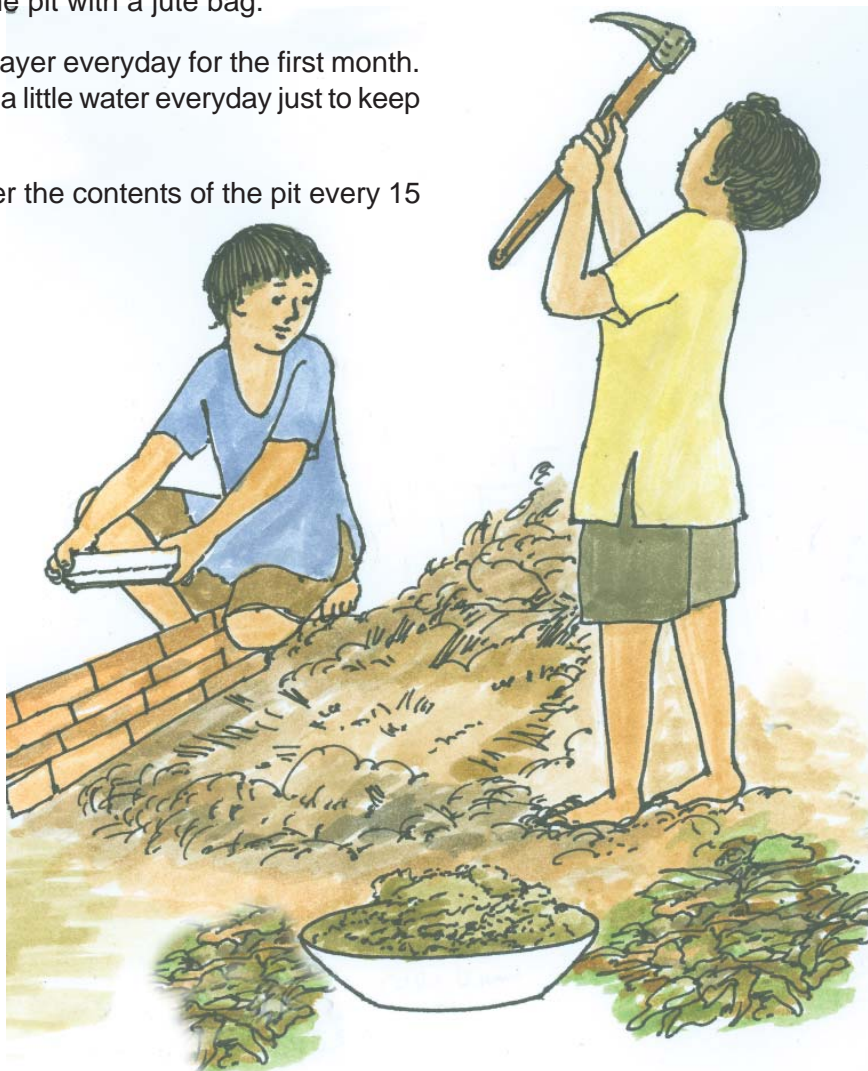
- In about 45 days the waste will be decomposed by the action of microorganisms.
- The soil derived is fertile and rich in nutrients.

The soil can be used as manure for farms and gardens.

Let's find out..

Keep a note of the changes that you see.

The waste starts degrading, first at a slow pace but as the microorganisms increase in number the degradation is faster. Fresh cow dung helps in developing the microorganism and even if vermiculture is not available it helps in initiating the decomposition process.





Shopping..the eco-friendly way...

Objectives

To inculcate values of an environmentally friendly lifestyle.

You could also make paper bags from newspapers

Let's do it....

Ask students to get any thick old cloth from home, which can be made into a cloth bag for regular market use. Cut the cloth material into any



and donate it to the local zoo so that they can ban plastic bags and provide paper bags to every visitor...Let's spread the message.

preferred shape and size (rectangular, round, square, etc.) Stick the sides and the upper edges



so as to make a bag. You can ask the student to paint or embroidery the front surface to decorate it. It is here that one needs to be innovative. Use patchwork, embroidery depicting traditional environment related stories, paintings, etc. Use catchy slogans...Let your creativity flow....





Green Consumer

Objectives

To enhance understanding of concepts related to packaging, their merits and demerits and alternatives.

Let's do it...

- Ask students to get different examples of packaging to class. The teacher should begin with a discussion by asking students the following questions.
- Why do we sometimes need packaging on the things we buy?
- Listing examples of packaging materials that are recyclable (glass, aluminium, cardboard, plastic).
- Which products need the protection of packaging? Specify purpose.
- Which natural resources were used to make the packaging?
- Could less resources have been used in the making of the packaging.
- Could a particular product be purchased in less wasteful packaging?
- Which packaging is recyclable?
- Is any of the packaging unnecessary or excessive?
- Which products can be sold in bulk?
- What steps can be taken at an individual level to use less packaging?
- What steps can be taken to advocate the use of less packaging?

Let's find out..

Get students to conduct a survey of the supermarket and conduct semi-structured interviews with shoppers to understand their awareness about and attitude towards packaging.

Present the findings in the form of a poster. Use it for active campaigning.





Your friendly neighbourhood waste manager

Objective

To enhance students' understanding about the social aspects of waste disposal and management.

Let's do it...

Ask the students' to find out if there are any waste pickers in their area. Ask them to get familiar with them and find out more about what they do and how they live.

Note: They may need guidance on doing this sensitively and in an appropriate manner.

Let's find out...

Teachers need to guide students on the appropriate way of conducting a semi-structured interview. It would be appropriate to observe the waste picker's activities for a day or two, befriend them and then ask questions. Guided questions to be asked could include...

- Name, age, number of family members, address, education
- Is it the primary occupation? What is the amount of earnings- per day / or per month?
- From where is the waste collected? How much is collected per day?
- Where is it sold? How is the segregation done?
- What are the problems involved in the job?
- Why have they chosen this as a profession?
- Given a chance would they like to do something else?

The responses should then be analysed and by the teacher and students together. Ask students to present their findings as a poster and display it on the school notice board. The poster could present the problems, their findings and solutions, focusing on action that can be taken at an individual level.





Eco-festivals

We celebrate festivals with great gusto and fervour but now its time for us to review our beliefs, daily activities and lifestyles. 'What we do' will play a very important role in keeping our environment clean. To begin with let us look at the major festivals celebrated throughout the year.

The Ganesh festival

The festival of Ganesh Chaturthi is a celebration of one of the most revered Hindu deities of India, 'Lord Ganesh', who is considered a symbol of wisdom and a harbinger of good luck. Ganesh is remembered on chauth or chaturthi, the 4th day of every month of the Hindu calendar, but most of all on Ganesh Chaturthi which is celebrated as his birthday. On this day, Ganesh puja is performed at all temples and prayer rooms using idols of Lord Ganesh, made specially for the occasion. At the end of the ten days, or sometimes even earlier these idols are immersed in the nearest water body, which may include rivers, lakes and the sea.

Origins of this festival...

Ganesh Chaturthi was promoted by Lokmanya Bal Gangadhar Tilak, who thought that this was a wonderful way of getting people together for the cause of independence. One of his strongest movements was thus to evoke nationalism through religious passions through the organisation of festivals like Ganesh chaturthi in Maharashtra, which not only inspired feelings of unity in Maharashtra, but gave freedom fighters an opportunity to meet when the British government did not permit any gatherings, writings and slogans that could incite violence.

Thus Ganesh Chaturthi became a major festival of Maharashtra, where thousands of gigantic idols of lord Ganesh are immersed by huge processions of worshipers shouting, 'Ganpati Bapa Morya', in the Arabian sea and rivers of the state. The festival has now gained popularity all over India.

The problems...

This festival that brings together thousands of





people is however in modern times also contributing to serious environmental pollution. Besides the noise created by the several *Ganesh mandals* during the festival, the immersion of idols made out of chemical materials causes significant water pollution. In the name Ganesh 'Ga' symbolizes Buddhi (intellect) and 'Na' symbolizes Vidyana (wisdom) Ganesh is thus considered the master of intellect and wisdom. But by dumping our gods and goddesses into our lakes and rivers, are we using ours?

The traditional clay, mud idols have been replaced by plaster of paris statues which are then painted using toxic chemical dyes to make them bright and attractive to buyers causing severe water pollution. Plaster of paris does not get dissolved or disintegrated fast. It contains gypsum, sulphur, phosphorus and magnesium. Moreover, the chemical dyes and colours being used to colour the idols contain poisonous elements. Particularly, red, blue, orange and green colours contain mercury, zinc oxide, chromium and lead, the potential causes of developing cancer.

These materials poison water bodies, by increasing chemical and organic content. In the process, ecosystems in these water bodies are harmed and plant and fish species die in large numbers. Water that has been polluted in this way can cause diseases when drunk by people living downstream as the same river, pond and lake water is used for bathing and drinking purposes. The high levels of lead can damage the heart, kidneys, liver, circulatory system and central nervous system.

According to one estimate, 7500 idols of Ganesh

weigh about 20,000 kg or in other words, 20 tonnes. The sea-shore of Mumbai absorbs the immersion of about 1.5 lakh idols every year. Can you imagine the extent of water pollution?

What are the alternatives ?

Switching to alternatives needs not only a deep understanding of environmental issues but also a major change in attitude to be able to adopt measures that are beneficial for the environment. Some of the alternatives that one could use are:

- Use a small unpainted idol made of unbaked clay or of *haldi* (as is prevalent in some states of India) if you immerse the idol.
- Use permanent idols made of brass or stone and reuse them again in the next year.
- Do a symbolic immersion of the permanent idols.
- Immerse the idol in a tub or a water tank and drain the water into the garden.
- Collect the flower offerings (*nirmalaya*) and compost them.
- Avoid the use of thermocol and plastic in decorations.
- Plant the '*Ganesh patris*' used for worshipping.

What are '*patris*'?

The word *Patris* means group of leaves offered to Lord Ganesh during the festival. In this offering, traditionally leaves of 108 different plants are used; of which 21 species are most preferred. The common amongst them are *Durva* (***Cynadon dactylon***), *Aghada* (***Achyranthes aspera***), *Tulsi* (***Ocimum sanctum***), *Bel* (***Agel marmelos***) *Shami* (***Prosopis sineraria***). Leaves of other flowering plants like Prajakta, Mogra, Madhumalati etc. are also used in *Patri*. Botanically this is a wonderful combination of various leaf types representing plants from different groups and habitats growing in his season. Most of these plants have medicinal properties and are used in household medicines. Thus collection of these extends a dual benefit of understanding plant diversity and its utilization. Considering the usage of the foliage from all these plants, there is an urgent need to conserve the constituents of *Patris*.





Holi

Origins of the festival...

Traditionally, Holi is a festival that celebrates the return of spring – a time when several trees are in bloom – and in earlier times, the colours that people used came from these flowering trees.

The problems...

Over the years, with the disappearance of some of these trees from urban areas, the natural colours gradually came to be replaced by cheaper industrial dyes. Often, the colours are sold loose in the market and consumers have little or no idea about the source of the colours and their contents.

Even when the colours are sold in a packaged form and carry a sign saying ‘for industrial use only’, consumers do not understand the implications. The dry colour powders, the oily pastes and the water colours all contain toxic substances capable of affecting human health.

Make your own colours!

With growing awareness, eco-friendly colours or colours made from natural materials are available in the market. It is also possible to make simple natural colors at home. Check the activities section for making natural colours.

Color	Chemical	Health Effects
Black	Lead oxide	Renal Failure
Green	Copper Sulphate	Eye Allergy, Puffiness and Temporary blindness
Silver	Aluminium Bromide	Carcinogenic
Blue	Prussian Blue	Contract Dermatitis
Red	Mercury Sulphite	Highly toxic can cause skin cancer

(Source: Vatavaran)





Diwali

The origins...

Diwali is one of the most widely celebrated festivals in India. What comes to your mind when you think of Diwali? Lights, lamps, candles, sweets, rangoli, new dresses, family reunions, rituals, but mainly bursting crackers. In fact, crackers have become an integral part of the festival, to the extent that Diwali today, is almost solely associated with the sound of crackers.

But did you know that Diwali was never such a noisy festival. Traditionally it was a festival of lights, when houses were decorated to please goddess Lakshmi and for attainment of health, wealth, wisdom, peace, etc.

However, over the years, the festival has lost its sanctity and has turned into a festival of pollution, noise, crackers, artificially coloured sweets and serious health hazards.

The problems...

Firecrackers and ill effects on health

Diwali is associated with lights and firecrackers. Lights are the essence of Diwali! However the



joy of Diwali is marred by the intense air and noise pollution caused by firecrackers. The toxic substances used in the firecrackers release toxic gases that are harmful to the health of all living beings. The high level of noise generated by the crackers also causes immense suffering to babies and older people.

Any of the following chemicals, which are potential health hazards, can be part of a fireworks device: potassium nitrate, barium chlorate, arsenic, strontium nitrate, potassium perchlorate, copper oxide, sodium bicarbonate, carbon, sulphur, perchlorate, aluminium powder.

There are several types of sparklers which contain different mixtures of chemicals. For example, the gold sparklers may contain barium and nitrate compounds, paste, chalk, dextrin, iron and aluminium; green sparklers contain barium and nitrate compounds, potassium perchlorate, wheat pastes, gum, dextrin and aluminium powder. Red sparklers contain strontium compounds, nitrate and potassium perchlorate, gums, wheat pastes, dextrin and aluminium powder.

The purposes of these different chemicals are to supply oxygen and carbon to give the various effects of that particular device, for example, the sound, the colours, the bursts and so on.

Few of us are aware of the harmful effects of firecrackers. The harmful chemicals emitted through smoke are known to cause asthma, allergic rhinitis, bronchitis and other respiratory problems. Moreover, the noise and dazzling light could cause optical as well as ENT-related problems. The blasting sounds caused by fire crackers which send the decibel levels soaring instantaneously could cause permanent or temporary impairment to the ear drums. All this is known to affect children, pregnant women, asthmatics and senior citizens much more than the rest of the population. They could experience irritability and watering of their eyes.

Chlorates present in firecrackers are principally toxic by inhalation and ingestion. Direct exposure can result in destruction of red blood cells. They are also directly nephrotoxic, (harmful to the kidney) and can result in acute renal failure.

A person can be exposed to barium compounds through inhalation and accidental ingestion. The soluble barium salts contained in firecrackers can cause vomiting, abdominal pain, bloody diarrhoea,



shallow breathing, convulsions, coma and death from respiratory or cardiac failure.



Exposure to nitrate compounds through inhalation can cause corrosion of the skin and other tissues from topical contact and acute pulmonary edema or chronic obstructive lung disease from inhalation. Although nitrates are generally not absorbed in toxic amounts from skin contact, it may be significantly absorbed in burned areas of the skin.

Exposure to sulphur compounds is through inhalation. Poisoning by sulphur compounds manifests itself with a number of clinical symptoms. It can irritate the skin, eyes, lungs and gastrointestinal tract. Acute inhalation of sulphur powder or dust may result in shortness of breath, cough, tightness and a feeling of burning in the chest. Molten sulphur may also cause severe skin damage.

We must remember that the cost of treating a fireworks injury far outweighs the cost of purchasing a single fireworks package.

Firecrackers and air pollution

According to several scientific studies, Diwali-related pollution affects atmospheric temperature. Extensive bursting of crackers may lead to an increase in temperature by as much as two degrees celsius, especially in densely populated areas, during those two days.

The smoke from the crackers forms thick layers of sulphur dust as well as particulate matter on the leaves of the plants, thus preventing basic functions exchange of gases. The edges of the stomata, get damaged and have signs similar to burn injuries. Even the fruits on the trees get blackened due to cracker smoke.

Firecrackers and noise pollution

Studies have shown that sound levels produced by fire crackers reach instantaneous peak levels of 145 to more than 160 decibels (dB) at the ear of an observer standing at 2 meter from a firecracker lying on a hard surface. These levels match those produced by firearms: from 145 dB for a carbine, to 152-155dB for a rifle, and up to 160 dB for a pistol at the ear of the gunman. Experience with noise from firearms has clearly demonstrated that impulse sounds reaching these peak levels are potentially hazardous to the ear, the reason why hearing protection is commonly used in outdoor shooting facilities. The noise from firecrackers has more disastrous effects on animals who have a more sensitive sense of hearing than humans.

The Central Pollution Control Board of India has banned firecrackers with a decibel level of more than 125 at a distance of 4 meters from the bursting point.

Noise pollution leads to hearing loss, high blood pressure, heart attack and sleeping disturbances in humans. Sudden exposure to loud noise could cause temporary deafness or permanent relative deafness.

Facts about bursting crackers

- An increase in air pollution by six to ten times on Diwali in terms of SPM, nitrogen oxides (Nox), sulphur dioxide (SO₂), etc.
- An increase in noise pollution above 125 decibel (dB), which is above the tolerable limits, and can cause deafness.
- An increase in incidents of respiratory diseases such as acute bouts of asthma, bronchitis and heart attacks.

Source: Delhi Pollution Control Committee



Firecrackers and child labour

As the dazzling fireworks lit up the sky, what also gets lost in the din is the darker side of firecracker manufacture. Most of these firecrackers are manufactured by child labour.

Sivakasi in Tamil Nadu has been infamous for employing children in manufacturing firecrackers. As a result of legislations brought in over the years, children have been removed from the factories, but they continue to do the same work from their homes even today.

In villages across Sivakasi district, one invariably encounters illegal makeshift firecracker manufacturing units, with young children working in them. Their soft and tiny fingers churn out fireworks for up to 10 hours a day. Children are paid just Rs. 30 a day and are a cheaper option than an adult worker, who will demand Rs. 80. People living here say that they have no option but to make their children work. This occupation fetches them more money than working for someone else and unless children work with adults they cannot afford anything, not even clothes or food.

Locals say about 15,000 people are dependent on these illegal firecracker units for a living, among them are thousands of children who spend their time making firecrackers.

While the small and illegal firecracker units justify the use of child labour, bigger factories are more discreet. They outsource the work to contractors, who get the job done in the villages. Eventually, it's the little child back home, who does the job and the contractor and the company simply evade the blame.



Harmful effects of chemicals used in crackers

Copper: Irritation of respiratory tract

Cadmium: Anaemia and damage to kidney

Lead: Affects the nervous system

Magnesium: Dust and fumes cause metal fume fever

Sodium: React violently with moisture and can attack the skin.

Zinc: Leads to vomiting

Nitrate: Could lead to mental impairment

Nitrite: Could lead to coma

To understand the ill-effects of water and noise pollution that are caused by the way we celebrate festivals, we need to understand some basic concepts of pollution. Let us understand these....

What is pollution?

Pollution is the effect of undesirable changes in our surroundings that have harmful effects on plants, animals and human beings. This occurs when only short-term economic gains are made at the cost of the long-term ecological benefits for humanity. No natural phenomenon has led to greater ecological changes than have been made by mankind. During the last few decades we have contaminated our air, water and land on which life itself depends with a variety of waste products.

What are pollutants?

Pollutants include solid, liquid or gaseous substances present in greater than natural abundance produced due to human activity, which have a detrimental effect on our environment. The nature and concentration of a pollutant determines the severity of detrimental effects on human health.

An average human requires about 12 kg of air each day, which is nearly 12 to 15 times greater

By refusing to use firecrackers, we can lessen the demand and contribute to banning them.





than the amount of food we eat. Thus even a small concentration of pollutants in the air becomes more significant in comparison to the similar levels present in food. Pollutants that enter water have the ability to spread to distant places especially in the marine ecosystem.

Classification of pollutants

From an ecological perspective pollutants can be classified as follows:

Degradable or non-persistent pollutants : These can be rapidly broken down by natural processes. Eg: domestic sewage, discarded vegetables, etc.

Slowly degradable or persistent pollutants: Pollutants that remain in the environment for many years in an unchanged condition and take decades or longer to degrade. Eg: DDT and most plastics.

Non-degradable pollutants : These cannot be degraded by natural processes. Once they are released into the environment they are difficult to eradicate and continue to accumulate. Eg: toxic elements like lead or mercury.

Water Pollution

Water is the essential element that makes life on earth possible. Without water there would be no life. We usually take water for granted. It flows from our taps when they are turned on. Most of us are able to bathe when we want to, swim when we choose and water our gardens. Like good health we ignore water when we have it.

Although 71% of the earth's surface is covered by water only a tiny fraction of this water is



available to us as fresh water. About 97% of the total water available on earth is found in oceans and is too salty for drinking or irrigation. The remaining 3% is fresh water. Of this 2.997% is locked in ice caps or glaciers. Thus only 0.003% of the earth's total volume of water is easily available to us as soil moisture, groundwater, water vapour and water in lakes, streams, rivers and wetlands.

Thus, if the world's water supply were only 100 litres our usable supply of fresh water would be only about 0.003 litres (one-half teaspoon). This makes water a very precious resource. The future wars in our world may well be fought over water. By the middle of this century, almost twice as many people will be trying to share the same amount of fresh water the earth has today. As freshwater becomes more scarce, access to water resources will be a major factor in determining the economic growth of several countries around the world.

Water that is found in streams, rivers, lakes, wetlands and artificial reservoirs is called surface water. Water that percolates into the ground and fills the pores in soil and rock is called groundwater. Porous water-saturated layers of sand, gravel or bedrock through which ground water flows are called aquifers. Most aquifers are replenished naturally by rainfall that percolates downward through the soil and rock. This process is called natural recharge. If the withdrawal rate of an aquifer exceeds its natural recharge rate, the water table is lowered. Any pollutant that is discharged onto the land above is also pulled into the aquifer and pollutes the groundwater resulting in polluted water in the nearby wells.

When the quality or composition of water changes directly or indirectly as a result of man's activities such that it becomes unfit for any purpose it is said to be polluted.

Point sources of pollution : When a source of pollution can be readily identified because it has a definite source and place where it enters the water it is said to come from a point source.

Eg: Municipal and industrial discharge pipes.

When a source of pollution cannot be readily identified, such as agricultural runoff, acid rain, etc, they are said to be **non-point sources** of pollution.



Causes of water pollution

There are several classes of common water pollutants.

Disease-causing agents (pathogens) which include bacteria, viruses, protozoa and parasitic worms that enter water from domestic sewage and untreated human and animal wastes. Human wastes contain concentrated populations of coliform bacteria such as *Escherichia coli* and *Streptococcus faecalis*. These bacteria normally grow in the large intestine of humans where they are responsible for some food digestion and for the production of vitamin K. These bacteria are not harmful in low numbers. Large amounts of human waste in water, increases the number of these bacteria which cause gastrointestinal diseases. Thus the greater the amount of wastes in the water the greater is the chances of contracting diseases from them.

Oxygen depleting agents are organic wastes that can be decomposed by aerobic (oxygen requiring) bacteria. Large populations of bacteria use up the oxygen present in water to degrade these wastes, degrading the water quality. The amount of oxygen required to break down a certain amount of organic matter is called the biological oxygen demand (BOD). The amount of BOD in the water is an indicator of the level of pollution. If too much organic matter is added to the water all the available oxygen is used up. This causes fish and other forms of oxygen dependent aquatic life to die. Thus anaerobic bacteria (those that do not require oxygen) begin to break down the wastes. Their anaerobic respiration produces chemicals that have a foul odour and an unpleasant taste that is harmful to human health.

Inorganic plant nutrients are water soluble nitrates and phosphates that cause excessive growth of algae and other aquatic plants. The excessive growth of algae and aquatic plants due to added nutrients is called *eutrophication*. They may interfere with the use of the water by clogging water intake pipes, changing the taste and odour of water and cause a buildup of organic matter. As the organic matter decays, oxygen levels decrease and fish and other aquatic species die.

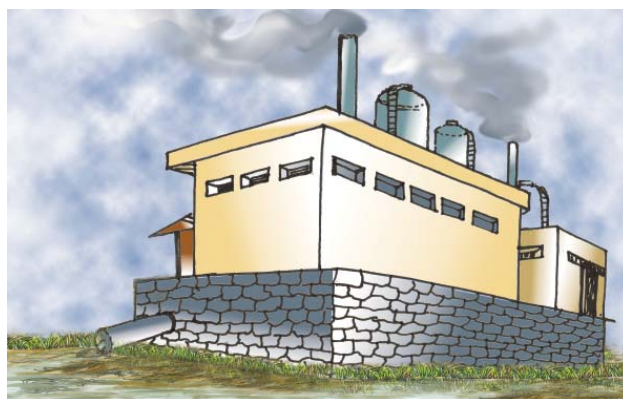
The quantity of fertilizers applied in a field is often many times more than is actually required by the plants. The chemicals in fertilizers and pesticides pollute soil and water. While excess fertilizers

cause eutrophication, pesticides cause bioaccumulation and biomagnification. Pesticides which enter water bodies are introduced into the aquatic food chain. They are then absorbed by the phytoplanktons and aquatic plants. These plants are eaten by the herbivorous fish which are in turn eaten by the carnivorous fish which are in turn eaten by the water birds. At each link in the food chain these chemicals which do not pass out of the body are accumulated and increasingly concentrated resulting in biomagnification of these harmful substances.

One of the effects of accumulation of high levels of pesticides such as DDT is that birds lay eggs with shells that are much thinner than normal. This results in the premature breaking of these eggs, killing the chicks inside. Birds of prey such as hawks, eagles and other fish eating birds are affected by such pollution. Although DDT has been banned in India for agricultural use and is to be used only for malaria eradication, it is still used in the fields as it is cheap.

Water soluble inorganic chemicals are acids, salts and compounds of toxic metals such as mercury and lead. High levels of these chemicals can make the water unfit to drink, harm fish and other aquatic life, reduce crop yields and accelerate corrosion of equipment that use this water.

Organic chemicals, include oil, gasoline, plastics, pesticides, cleaning solvents, detergents and many other chemicals. These are harmful to aquatic life and human health. They get into the water directly from industrial activity either from improper handling of the chemicals in industries



and more often from improper and illegal disposal of chemical wastes.

Sediments of suspended matter are insoluble particles of soil and other solids that become



suspended in water. This occurs when soil is eroded from the land. High levels of soil particles suspended in water, interferes with the penetration of sunlight. This reduces the photosynthetic activity of aquatic plants and algae disrupting the ecological balance of the aquatic bodies. When the velocity of water in streams and rivers decreases the suspended particles settle down at the bottom as sediments. Excessive sediments that settle down destroys feeding and spawning grounds of fish, clogs and fills lakes, artificial reservoirs etc.

Water soluble radioactive isotopes are yet another source of water pollution. These can be concentrated in various tissues and organs as they pass through food chains and food webs. Ionizing radiation emitted by such isotopes can cause birth defects, cancer and genetic damage.

Hot water let out by power plants and industries that use large volumes of water to cool the plant result in rise in temperature of the local water bodies. Thermal pollution occurs when industry returns the heated water to a water source. Power plants heat water to convert it into steam, to drive the turbines that generate electricity. For efficient functioning of the steam turbines, the steam is condensed into water after it leaves the turbines. This condensation is done by taking water from a water body to absorb the heat. This heated water, which is at least 15°C higher than the normal is discharged back into the water body. The warm water not only decreases the solubility of oxygen but changes the breeding cycles of various aquatic organisms.

Oil is washed into surface water in runoff from roads and parking lots which also pollutes groundwater. Leakage from underground tanks is another source of pollution. Accidental oil spills from large transport tankers at sea have been causing significant environmental damage.

While oil spills are highly visible and often get a lot of media attention, a much greater threat to human life comes from our groundwater being polluted which is used for drinking and irrigation. While groundwater is easy to deplete and pollute it gets renewed very slowly and hence must be used judiciously. Groundwater flows are slow and not turbulent hence the contaminants are not effectively diluted and dispersed as compared to surface water. Moreover pumping groundwater and treating it is very slow and costly. Hence it is

extremely essential to prevent the pollution of groundwater in the first place.

Ground water is polluted due to:

- Urban run-off of untreated or poorly treated waste water and garbage
- Industrial waste storage located above or near aquifers
- Agricultural practices such as the application of large amounts of fertilizers and pesticides, animal feeding operations, etc. in the rural sector
- Leakage from underground storage tanks containing gasoline and other hazardous substances
- Leachate from landfills
- Poorly designed and inadequately maintained septic tanks
- Mining wastes

The state of India's rivers

India has always had a tradition of worshipping rivers. Most of the rivers in India are named after gods, goddesses or saints. However a large majority of the Indian population including those who worship the rivers do not think twice before polluting a river. Urbanization, industrialization, excess withdrawal of water, agricultural run-off, improper agricultural practices and various religious and social practices all contribute to river pollution in India. Waters from the Ganga and the Yamuna are drawn for irrigation through the network of canals. As a result as soon as these rivers reach the plains the amount of water that flows downstream is reduced drastically. What flows in the river is water from small nalas, and





streams that carry with them sewage and industrial effluents. The residual freshwater, is unable to dilute the pollutants and the rivers turn into stinking sewers. In spite of data from scientifically competent studies conducted by the Central Pollution Control Board (CPCB), the Government has not been able to tackle this issue. Sewage and municipal effluents account for 75% of the pollution load in rivers while the remaining 25% is from industrial effluents and non-point pollution sources.

In 1985, India launched the Ganga Action plan (GAP) the largest ever river clean-up operation in the country. The plan has been criticized for, overspending and slow progress. The GAP Phase II in 1991 included cleaning operations for the tributaries of the Ganga, ie; the Yamuna, Gomti and the Damodar. Thus the Yamuna Action Plan (YAP), Gomti Action Plan and the Damodar Action plan were added.

In 1995 the National River Conservation plan was launched. Under this all the rivers in India were taken up for clean-up operations. In most of these plans, attempts have been made to tap drains, divert sewage to sewage treatment plants before letting out the sewage into the rivers.

The biggest drawback of these river cleaning programs was that they failed to pin responsibilities as to who would pay for running the treatment facilities in the long run. With the power supply being erratic and these plants being heavily dependent on power, most of these facilities lie underutilized. Moreover the problem of river pollution due to agricultural run-off has not been addressed in these programs. NRCP is

scheduled to be completed by March 2005. The approved cost for the plan is Rs. 772.08 crores covering 18 rivers in 10 states including 46 towns. The cost is borne entirely by the Central Government and the Ministry of Environment and Forests is the nodal agency that co-ordinates and monitors the plan. Under this plan the major activities include treating the pollution load from sewer systems of towns and cities, setting up of sewage treatment plants, electric crematoria, low cost sanitation facilities, riverfront development, afforestation and solid waste management.

Control measures for preventing water pollution

While prevention is one of the best remedies, setting up effluent treatment plants and treating waste through these can reduce the pollution load in the recipient water. The treated effluent can be reused for either gardening or cooling purposes wherever possible.

A few years ago a new technology called the *Root Zone Process* has been developed by Thermax. This system involves running contaminated water through the root zones of specially designed reed beds. The reeds, which are essentially wetland plants have the capacity to absorb oxygen from the surrounding air through their stomatal openings. The oxygen is pushed through the porous stem of the reeds into the hollow roots where it enters the root zone and creates conditions suitable for the growth of numerous bacteria and fungi. These micro-organisms oxidize impurities in the wastewaters, so that the water which finally comes out is clean.





Noise Pollution

Noise may not seem as harmful as the contamination of air or water but it is a pollution problem that affects human health and can contribute to a general deterioration of environmental quality.

Noise is undesirable and unwanted sound. Not all sound is noise. What may be considered as music to one person may be noise to another. It is not a substance that can accumulate in the environment like most other pollutants. Sound is measured in a unit called the 'Decibel'.

Decibel levels of common sounds

dB	Environmental Condition
0	Threshold of hearing
10	Rustle of leaves
20	Broadcasting studio
30	Bedroom at night
40	Library
50	Quiet office
60	Conversational speech (at 1m)
70	Average radio
74	Light traffic noise
90	Subway train
100	Symphony orchestra
110	Rock band
120	Aircraft takeoff
146	Threshold of pain

noticed at sound levels between 80 and 130 dBA. About 50 percent of the people exposed to 95 dBA sound levels at work will develop NIPTS and most people exposed to more than 105 dBA will experience permanent hearing loss to some degree. A sound level of 150 dBA or more can physically rupture the human eardrum.

The degree of hearing loss depends on the duration as well as the intensity of the noise. For example, 1 hour of exposure to a 100 dBA sound level can produce a TTS that may last for about one day. However in factories with noisy machinery workers are subjected to high sound levels for several hours a day. Exposure to 95

There are several sources of noise pollution that contribute to both indoor and outdoor noise pollution. Noise emanating from factories, vehicles, playing of loudspeakers during various festivals can contribute to outdoor noise pollution while loudly played radio or music systems, and other electronic gadgets can contribute to indoor noise pollution.

The difference between sound and noise is often subjective and a matter of personal opinion. There are however some very harmful effects caused by exposure to high sound levels. These effects can range in severity from being extremely annoying to being extremely painful and hazardous.

Effects of noise pollution on physical health

The most direct harmful effect of excessive noise is physical damage to the ear and the temporary or permanent hearing loss often called a temporary threshold shift (TTS). People suffering from this condition are unable to detect weak sounds. However hearing ability is usually recovered within a month of exposure. In Maharashtra people living in close vicinity of Ganesh mandals that play blaring music for ten days of the Ganesh festival are usually known to suffer from this phenomenon. Permanent loss, usually called 'noise induced permanent threshold shift' (NIPTS) represents a loss of hearing ability from which there is no recovery.

Below a sound level of 80 dBA hearing loss does not occur at all. However temporary effects are

dBA for 8 hours everyday for over a period of 10 years may cause about 15 dBA of NIPTS. In addition to hearing losses excessive sound levels can cause harmful effects on the circulatory system by raising blood pressure and altering pulse rates.

Effects of noise pollution on mental health

Noise can also cause emotional or psychological effects such as irritability, anxiety and stress. Lack of concentration and mental fatigue are significant health effects of noise. It has been observed that the performance of school children is poor in comprehension tasks when schools are situated in busy areas of a city and suffer from noise pollution.

As noise interferes with normal auditory communication, it may mask auditory warning



signals and hence increases the rate of accidents especially in industries. It can also lead to lowered worker efficiency and productivity and higher accident rates on the job.

Thus noise is just more than a mere nuisance or annoyance. It definitely affects the quality of life. It is thus important to ensure mitigation or control of noise pollution.

noise. In industries noise reduction can be done by using rigid sealed enclosures around machinery lined with acoustic absorbing material. Isolating machines and their enclosures from the floor using special spring mounts or absorbent mounts and pads and using flexible couplings for interior pipelines also contribute to reducing noise pollution at the source.

Permitted noise levels

Ambient Noise Levels dB

Zone	Daytime	Nighttime
Silent Zone	50	40
Residential Zone	55	45
Commercial Zone	65	55
Industrial Zone	70	70

A standard safe time limit has been set for exposure to various noise levels. Beyond this 'safe' time continuing exposure over a period of year will lead to hearing loss.

Duration

Duration	dBA
8 hours	90
4 hours	93
2 hours	96
1 hour	99
30 minutes	102
15 minutes	105
7 minutes	108
4 minutes	111
2 minutes	114
1 minute	117
30 seconds	120
Instantaneous rupture of membrane	150

Noise Control techniques

There are four fundamental ways in which noise can be controlled:

- Reduce noise at the source
- Block the path of noise
- Increase the path length
- Protect the recipient.

In general, the best control method is to reduce noise levels at the source.

Source reduction can be done by effectively muffling vehicles and machinery to reduce the

Blocking the path of noise is one of the best methods of noise source reduction is regular and thorough maintenance of operating machinery. Noise levels at construction sites can be controlled using proper construction planning and scheduling techniques. Locating noisy air compressors and other equipment away from the site boundary along with creation of temporary barriers to physically block the noise can help contribute to reducing noise pollution. Most of the vehicular noise comes from movement of the vehicle tires on the pavement and wind resistance. However poorly maintained vehicles can add to the noise levels. Traffic volume and speed also have significant effects on the overall sound. For example doubling the speed increases the sound

The alternatives....

With the growing recognition of the impacts of festivals, we need to reinterpret the rituals and traditions to become more sensitive to nature.

Can we refrain from the use of firecrackers? If not firecrackers, how else would you like to celebrate Diwali?

Let us enjoy festivals the safe, eco-friendly way!!



levels by about 9 dBA and doubling the traffic volume (number of vehicles per hour) increases sound levels by about 3 dBA. A smooth flow of traffic also causes less noise than does a stop-and-go traffic pattern. Proper highway planning and design are essential for controlling traffic noise. Establishing lower speed limits for highways that pass through residential areas, limiting traffic volume and providing alternative routes for truck traffic are effective noise control measures. The path of traffic noise can also be blocked by construction of vertical barriers alongside the highway. Planting of trees around houses can also act as effective noise barriers. In industries different types of absorptive material can be used to control interior noise. Highly absorptive interior finish material for walls, ceilings and floors can decrease indoor noise levels significantly. Sound levels drop significantly with increasing distance from the noise source.

Increasing the path length between the source and the recipient offers a passive means of control. Municipal land-use ordinances pertaining to the location of airports make use of this alternative to reduce the noise impact of planes.

Protecting the recipient through use of earplugs and earmuffs which are effective in shielding individuals effectively from excessive noise levels. Specially designed earmuffs can reduce the sound level reaching the eardrum by as much as 40 dBA. However very often workers tend not to wear them on a regular basis despite company requirements for their use.

Role of an individual in the prevention of pollution

There are a host of environmental problems caused by human actions on the environment. If we are to respond to these problems we have to recognize that each of us is individually responsible for the quality of the environment we live in. Our personal actions can either worsen or improve our environmental quality. Several people may feel that environmental problems can be solved with quick technological fixes. While a majority of individuals would want a cleaner environment, not many of them want to make major changes in their lifestyle that could contribute to a cleaner environment. Decisions and actions taken by individuals to a very large extent determine the quality of life for everyone. This necessitates that individuals should not only

be aware of various environmental issues and the consequences of their actions on the environment but should also make a firm resolve to develop environmentally ethical lifestyles.

With the help of solar energy, natural processes developed over billions of years can indefinitely renew the topsoil, water, air, forests and grasslands on which all forms of life depend, but only as long as we do not use these potentially renewable resources faster than they are replenished. Some of our wastes can be diluted, decomposed and recycled by natural processes indefinitely as long as these processes are not overloaded. Natural processes also provide services of flood prevention, erosion control at no costs at all. We must therefore learn to value these resources and use them sustainably.

Concepts that help individuals contribute towards a better quality of our environment and human life.

- Develop respect or reverence for all forms of life.
- Each individual must try to answer four basic questions:
 - Where do the things that I consume come from?
 - What do I know about the place where I live?
 - How am I connected to the earth and other living things?
 - What is my purpose and responsibility as a human being?
- Try to plant trees wherever you can and more importantly take care of them. They reduce air pollution.
- Reduce the use of wood and paper products wherever possible. Manufacturing paper leads to pollution and loss of forests which releases oxygen and takes up carbon dioxide. Try to recycle paper products and use recycled paper wherever possible.
- From the mail you receive reuse as many envelopes that you can.
- Do not buy furniture, doors, window frames made from tropical hardwoods such as teak and mahogany. These are forest based.
- Help in restoring a degraded area near your home or join in an afforestation program.
- Use pesticides in your home only when



absolutely necessary and use them in as small amounts as necessary. Some insect species help to keep a check on the populations of pest species.

- Advocate organic farming by asking your grocery store to stock vegetables and fruits grown by an organic method. This will automatically help to reduce the use of pesticides.
- Reduce the use of fossil fuels by either walking up a short distance using a car pool, sharing a bike or using public transport. This reduces air pollution.
- Shut off the lights and fans when not needed.
- Don't use aerosol spray products and commercial room air fresheners. They damage the ozone layer.
- Do not pour pesticides, paints, solvents, oil or other products containing harmful chemicals down the drain or on the ground.
- Buy consumer goods that last, keep them as long as possible and have them repaired as far as possible instead of disposing them off. Such products end up in landfills that could pollute ground water.
- Buy consumer goods ages in refillable glass containers instead of cans or throw away bottles.
- Use rechargeable batteries.
- Try to avoid asking for plastic carry bags when you buy groceries or vegetables or any other items. Use your own cloth bag instead.
- Use sponges and washable cloth napkins, dish towels and handkerchiefs instead of paper ones.
- Don't use throwaway paper and plastic plates and cups when reusable versions are available.
- Recycle all newspaper, glass, aluminum and other items accepted for recycling in your area. You might have to take a little trouble to locate such dealers.
- Set up a compost bin in your garden or terrace and use it to produce manure for your plants to ing. You have the option to make a choice rather than complain later on.
- It is important that you do not get discouraged at the first sign of trouble. Do not dwell on the negative aspects. But take positive actions wherever you can to make the world a better place to live in.
- When talking to elected officials always be courteous and reasonable. You may disagree with a particular position but be respectful in doing so as you will gain little by being hostile and brash.

Take care to put into practice what you preach. Remember environment protection begins with YOU.





Holi-the natural way

Objectives

To enhance understanding of the environmental threats of chemical colours and inculcate skills for making natural colours.

Let's do it...

The teacher should initiate the discussion by listing down the colours normally used during Holi and tracing their compounds and origins using the resource matter given in the manual above. Health hazards caused by these colours should also be discussed. As alternatives the teacher and the students could use the guidelines given below to make their own natural ecofriendly colours!

Ask students to prepare a poster about the benefits of natural colours and hazards of chemical colours. Use this for convincing other students in your school to use natural colours.

Red colour

Take some red roses and separate its petals. If petals are wet then spread them on some newspaper or on tissue paper and let them dry naturally. Once the rose petals are completely dried, keep them in an airtight bottle. Make sure



that you grind these petals soon and do not keep them for a long time. Make it into a powder, which you can use as gulal (red colour).

Orange colour

Take dried or fresh mehndi leaves and grind them to get a powder. Mix it with water to make it into the paste. You could also mix rose water with sandalwood powder and add a little turmeric to give a nice yellow-orange colour.

Yellow colour

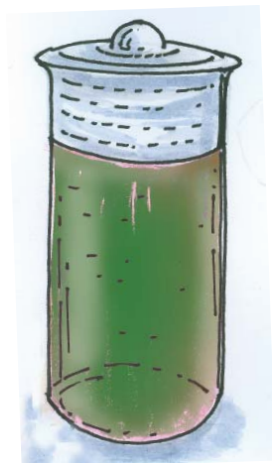
Soak 25 marigold flowers in one litre of water. Boil it till it exudes a fragrance. Leave it overnight. You will get rich wet yellow colour.

To obtain various shades of yellow you can dry the petals of yellow chrysanthemum, and grind them to obtain a powder form and then add water to the powder if you want it in liquid form.

Green colour

Dry gulmohar, spinach, coriander and mint leaves. Coriander leaves, mint and spinach dry even if kept in a refrigerator properly wrapped in a newspaper or in airtight bags. Once they are dried they can be ground in a mixer to get a fine powder.

These colours are safe and do not have any side-effects. So, bid farewell to synthetic, unhygienic colours and play holi with a renewed zest with herbal colours!!





Celebrating an Eco-Diwali

Objectives

To enhance students understanding of the hazardous process of fire-cracker manufacture and their ill effects on health.

Let's do it...

Getting students to adopt the concept of a fire cracker free Diwali will not be an easy task. The teacher should begin this process by talking about the harmful way in which fire crackers are made especially through the use of children who are then inflicted with life threatening diseases. Follow this up with the harmful effects of firecrackers on health, air and noise pollution. Brainstorm ideas for a fire-cracker free Diwali. Even if the students do not agree, let them feel guilty every time they are using fire-crackers. Even if the teacher has managed to achieve this, we are on our way to making environmentally conscious students.

Ask some of the creative students in class to write the script for a street play on the hazards of fire-crackers. Use this to convince the other students in the school to celebrate Diwali in an eco-friendly manner.

Key points to be included in the play:

- Diwali is the festival of joy and fun and time for re-enforcing personal relations by meeting people.
- It is the festival of light.
- Fire crackers mostly produced in Shivkasi and young children are involved in the producing these crackers. They handle hazardous chemicals, dangerous for their health.
- Use of fire crackers and sound pollution can only lead to health hazards not enjoyment.
- Air pollutants released during the burning of fire crackers are a serious health hazard.
- Accidents caused during the burning of fire crackers.
- Message to the audience - Not to use crackers during festival. Explore other means of celebrating the festival.





Green Ganesh

Objectives

To make students aware of the environmental problems associated with the Ganesh festival

Let's do it...

Ask students to talk to their grandparents or older members in the neighbourhood about how the Ganesh festival was celebrated 50 years ago. The teacher should initiate a discussion in the class about the various environmental problems caused by celebrating the Ganesh festival as it is presently done. Brainstorm with the students as to what they would like to do to minimize these problems. Some ideas are given below :

- Ensure composing of all offerings made to Lord Ganesh during the Ganesh festival. Demonstrate its simplicity by doing it in a pot. Ask students to avoid thermocole decorations.
- Encourage students to immerse the idols in a bucket at home. Try to use only metal, stone or unbaked clay idols without any chemical colours. Idols made of metal or stone are best as they can be worshipped every year. Some people sprinkle a little water on the idols as symbolic immersion. If idols have to be immersed see that they are made up of unbaked clay or mud. Do not buy idols painted with chemical colours or those having non

biodegradable material as decorations.

- Insist that the student must begin this at home before he/she can move on to convincing other friends and relatives and neighbours.
- Can you get your students to visit a potter and make a simple clay idol? Is it possible for the student to explore possibilities of setting up one Ganpati for his society on the concept of 'Ek Gaon, ek Ganpati'.
- Get students to identify and understand the value (religious and ecological) of the 'patis' offered to the Ganesh during the festival. Ask them to list down distinguishing features, the status of availability of these plants in their surroundings areas (common, uncommon, rare) and uses. These plants can be planted in their school garden or even in pots. Make a poster of your findings and let the Ganesh festival serve as a platform to conserve these and other species.

Note: *This module focuses on attitudinal change and action at an individual level for a better environment. It is essential for the teacher to have a through discussion in the class as attitudinal changes do not happen overnight. Traditional beliefs and way of doing things cannot change immediately. It can only happen when the student is sufficiently ware and is strongly motivated to bring about change.*





Making a water audit

Objectives

Enhancing understanding about use and misuse of water resources and skills for dealing with the problem.

Write a letter to the headmaster informing about the water wastage in the school and requesting to mend the water taps.

Let's do it...

The teacher should initiate a discussion in the class using the following points.

- Where does the water you use come from?
- How many litres of water do you need per person/per day at home and at school?
- When do the valves in your area open and close?
- Can you map the valves/water sources (wells, bore wells) in your immediate locality?
- How many taps do you have in your school?
- Do any of the taps in your school leak? Quantify the water lost by measuring water leaking out from the tap in one minute and hence for 24 hours.
- What is your water bill? If metered water, calculate the amount of money to be paid for the water leakages. (to calculate, all the details are given at the back of the water bill.)

How much does your local corporation/council spend on transporting and purifying water? (Call the local officer or any member from the water department to talk to students about the water facts).

How can wastage of water be avoided?

Form a water management team in your school. This team could monitor and get the school authorities to fix leaky taps. You could keep a watch on the surrounding water supply areas to see that they are clear of garbage, etc. and do not contaminate the water. Can a simple rain water harvesting system (where rain water is channelised to underground sources) be implemented in the school.





Biodiversity

What is biodiversity?

In extremely simple terms, biodiversity means the vast variety of life forms found in our planet.

Types of biodiversity

Biodiversity is broadly divided into three types:

- Genetic diversity: the genetic variability within a species
- Species diversity-the variety of species within a community
- Ecosystem diversity-the organisation of species in an area into distinctive plant and animal communities

Genetic diversity



Each member of any animal or plant species differs widely from other individuals in its genetic makeup because of the large number of combinations possible in the genes that give every individual specific characteristics. Thus, for example, each human being is very different from all others. It is also seen in crops. Rice varies from white to red to brown and black.

This genetic variability is essential for a healthy breeding population of a species. If the number of breeding individuals is reduced, the dissimilarity of genetic makeup is reduced and in-breeding occurs. Eventually this can lead to the extinction of the species. The diversity in wild species forms the ' **gene pool** ' from which our crops and domestic animals have been developed over thousands of years. Today the variety of nature's

bounty is being further harnessed by using wild relatives of crop plants to create new varieties of more productive crops and to breed better domestic animals through biotechnology.

Species diversity



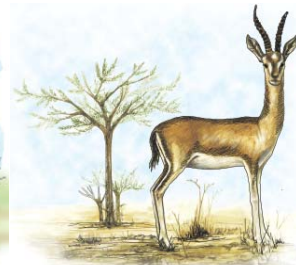
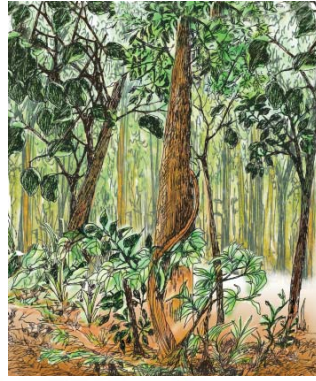
This is the number of species of plants and animals that are present in a region. Some areas are more rich in species than others. Natural undisturbed tropical forests have a much greater species richness than plantations.

At present conservation scientists have been able to identify and categorize about 1.8 million species on earth. However, many new species are being identified, especially in the flowering plants and insects. Areas that are rich in species diversity are called 'hotspots' of diversity. India is among the world's 15 nations that are exceptionally rich in species diversity.

Ecosystem diversity

There are a large variety of different ecosystems on earth, which have their own complement of distinctive inter linked species based on the differences in the habitat. Ecosystem diversity can be described for a specific geographical region, or a political entity such as a country, a State or a taluka. Distinctive ecosystems include landscapes such as forests, grasslands, deserts, mountains, etc., as well as aquatic ecosystems such as rivers, lakes, and the sea. Each region also has man-modified areas such as farmland or grazing pastures.

An ecosystem is referred to as 'natural' when it is



relatively undisturbed by human activities or 'modified' when it is changed to other types of uses, such as farmland or urban areas. Ecosystems are most natural in wilderness areas. If natural ecosystems are overused or misused their productivity eventually decreases and they are then said to be degraded. India is exceptionally rich in its ecosystem diversity.

Values of Biodiversity

Ecosystem services

Environmental services from species and ecosystems are essential at global, regional and local levels. Production of oxygen, reducing carbon dioxide, maintaining the water cycle, protecting soil are important services. It is now well accepted that the loss of biodiversity contributes to global climatic changes. Forests are the main mechanism for the conversion of carbon dioxide into carbon and oxygen. The loss of forest cover, coupled with the increasing release of carbon dioxide and other gases through industrialization contributes to the 'greenhouse effect'. Global warming is melting ice caps, resulting in a rise in the sea level which will submerge the low lying areas in the world. It is causing major atmospheric changes, leading to increased temperatures, serious droughts in some areas and unexpected floods in other areas.

Biological diversity is also essential for preserving ecological processes, such as fixing and recycling of nutrients, soil formation, circulation and cleansing of air and water, global life support

(plants absorb CO_2 , give out O_2), maintaining the water balance within ecosystems, watershed protection, maintaining stream and river flows throughout the year, erosion control and local flood reduction.

Consumptive use services

Food, clothing, housing, energy, medicines, are all resources that are directly or indirectly linked to the biological variety present in the biosphere. This is most obvious in the tribal communities who gather resources from the forest, or fisherfolk who catch fish in marine or freshwater ecosystems. For others, such as agricultural communities, biodiversity is used to grow their crops to suit the environment. Urban communities generally use the greatest amount of goods and services,





which are all indirectly drawn from natural ecosystems.

It has become obvious that the preservation of biological resources is essential for the well-being and the long-term survival of mankind. This diversity of living organisms which is present in the wilderness, as well as in our crops and livestock, plays a major role in human 'development'. The preservation of 'biodiversity' is therefore integral to any strategy that aims at improving the quality of human life.

Productive use services



Several marketable products are derived from biodiversity. The biotechnologist uses bio-rich areas to 'prospect' and search for potential genetic properties in plants or animals that can be used to develop better varieties of crops that are used in farming and plantation programs or to develop better livestock. To the pharmacist, biological diversity is the raw material from which new drugs can be identified from plant or animal products. To industrialists, biodiversity is a rich store-house from which to develop new products. For the agricultural scientist the biodiversity in the wild relatives of crop plants is the basis for developing better crops.

Genetic diversity enables scientists and farmers to develop better crops and domestic animals through careful breeding. Originally this was done by selecting or pollinating crops artificially to get a more productive or disease resistant strain. Today this is increasingly being done by genetic engineering, selecting genes from one plant and introducing them into another. New crop varieties (cultivars) are being developed using the genetic material found in wild relatives of crop plants through biotechnology.

Preservation of biodiversity has now become essential for industrial growth and economic development. A variety of industries such as pharmaceuticals are highly dependent on identifying compounds of great economic value

from the wide variety of wild species of plants located in undisturbed natural forests. This is called **biological prospecting**.

Biodiversity at Global, National and Local levels

There are at present 1.8 million species known and documented by scientists in the world. However, scientists have estimated that the number of species of plants and animals on earth could vary from 1.5 to 20 billion! Thus the majority of species are yet to be discovered.

Most of the world's bio-rich nations are in the South, which are the developing nations. In contrast, the majority of the countries capable of exploiting biodiversity are Northern nations, in the economically developed world. These nations however have low levels of biodiversity. Thus the developed world has come to support the concept that biodiversity must be considered to be a 'global resource'. However, if biodiversity should form a 'common property resource' to be shared by all nations, there is no reason to exclude oil, or uranium, or even intellectual and technological expertise as global assets. India's sovereignty over its biological diversity cannot be compromised without a revolutionary change in world thinking about sharing of all types of natural resources.

Countries with diversities higher than India are located in South America such as Brazil, and South East Asian countries such as Malaysia and Indonesia. The species found in these countries, however, are different from our own. This makes it imperative to preserve our own biodiversity as a major economic resource. While few of the other 'megadiversity nations' have developed the technology to exploit their species for biotechnology and genetic engineering, India is capable of doing so.

Throughout the world, the value of biologically rich natural areas is now being increasingly appreciated as being of unimaginable value. International agreements such as **The World Heritage Convention** attempt to protect and support such areas. India is a signatory to the convention and has included several protected Areas as World Heritage sites. These include Manas on the border between Bhutan and India, Kaziranga in Assam, Bharatpur in U.P.,



Nandadevi in the Himalayas, and the Sunderbans in the Ganges delta in West Bengal.

India has also signed the **Convention in the Trade of Endangered Species (CITES)** which is intended to reduce the utilization of endangered plants and animals by controlling trade in their products and in the pet trade.

India as a Mega Diversity Nation

Geological events in the landmass of India have provided conditions for high levels of biological diversity. A split in the single giant continent around 70 million years ago, led to the formation of northern and southern continents, with India a part of Gondwanaland - the southern landmass, together with Africa, Australia and the Antarctic. Later tectonic movements shifted India northward across the equator to join the Northern Eurasian continent. As the intervening shallow Tethys Sea closed down, plants and animals that had evolved both in Europe and in the Far East migrated into India before the Himalayas had formed. A final influx came from Africa with Ethiopian species, which were adapted to the Savannas and semi-arid regions. Thus India's special geographical position between three distinctive centres of biological evolution and radiation of species is responsible for our rich and varied biodiversity.

Among the biologically rich nations, India stands among the top 10 or 15 countries for its great variety of plants and animals, many of which are not found elsewhere. India has 350 different mammals (rated eight highest in the world), 1,200 species of birds (eighth in the world), 453 species of reptiles (fifth in the world) and 45,000 plant species, of which most are angiosperms, (fifteenth in the world). These include especially high species diversity of ferns (1022 species) and orchids (1082 species). India has 50,000 known species of insects, including 13,000 butterflies and moths. It is estimated that the number of unknown species could be several times higher.

It is estimated that 18% of Indian plants are **endemic** to the country and found nowhere else in the world. Among the plant species the flowering plants have a much higher degree of endemism, a third of these are not found elsewhere in the world. Among amphibians found in India, 62% are unique to this country. Among lizards, of the 153 species recorded, 50% are endemic. High endemism has also been recorded for various

groups of insects, marine worms, centipedes, mayflies and fresh water sponges.

Cultivar diversity

India is characterised by a complex mosaic of distinct agro-ecosystems, differentiated by their climatic, soil, geological, vegetational, and other natural features. A recent classification by the National Bureau of Soil Survey and Land Use Planning distinguishes 20 broad agro-ecological zones, separated by natural features and crop growing periods. Each of these agro-ecological zones is in turn comprised of myriad micro-habitats. It is within this diversity of habitats that an amazing variety of crops and livestock has been developed over the millions of years.

The Indian region is in fact one of the world's eight centres of crop plant origin, identified as such by the Russian scientist N.I. Vavilov. At least 166 crop species and 320 wild relatives of crops have originated here, according to the National Bureau of Plant Genetic Resources. But it is the genetic diversity within each species which is even more mind-boggling. To give some examples, one species of rice has diversified into at least 50,000 distinct varieties, and one species of mango into over 1,000 varieties ranging from the size of a peanut to a small pumpkin.





India perhaps also has the world's largest diversity of livestock, with some 26 breeds of cattle, 40 of sheep, 20 of goats, and 18 of poultry. All the world's eight buffalo breeds are found here.

Why this diversity?

Over generations, Indian farmers have continuously adapted and modified the rich genetic material available to them from nature. The diversity of crops and livestock is not only accidental, nor is it purely natural; it is more the outcome of thousands of years of deliberate selection, planned exposure to a range of natural conditions, field-level cross-breeding, and other manipulations which farmers have tried out. In other words, a single species of rice collected from the wild some time in the distant past, has diversified into 50,000 varieties as a result of the ingenuity and innovative skills of farming communities, a fact that the modern seed industry always conveniently sidesteps, and that the non-discerning consumer is ignorant of.

But why in the first place did Indian farmers do this? One obvious answer is that different crop varieties and livestock breeds were adapted to diverse local conditions of growth and survival that were available in the country.

However, adaptation to localised environments has been only one mechanism or reason for diversification. What is even more amazing is the use of a large diversity of the same crop within a single village, and sometimes within the same field. Many tribal villages have been known to grow over 20 rice varieties within a single year in their fields. The diversity was spread over both time (seasonal) and space (geographical), both vertical and horizontal layers within the same field, and both within and between species.

More than mere physical adaptation, a host of economic, cultural, religious, and survival factors have played a role in this diversification. Amongst the Warli tribals of Maharashtra a great diversity of rice is grown for different water and soil needs, varying maturity periods, resistance to different diseases, and various cultural events. Several varieties of rice and other crops were grown in many parts of India just for their use during festivals, marriages, or other auspicious occasions; several others were grown for their taste, colour, or smell; yet others for their pesticidal or soil-fertilisation characteristics.

The stability of a biodiverse agriculture is perhaps its most important characteristic, as recorded from many parts of the world. This is wonderfully illustrated by a once-common practice of the Garhwal Himalaya, the *baranaja*. Literally meaning "12 grains", this practice involves the sowing of a mixture of crops into a single plot of land. Kidney beans, black gram, green gram, horsegram, amaranthus, finger millet, barnyard millet, and other crops are grown in a manner which helps to obtain optimal and sustained yields. Since maturity periods of these crops vary, different crops are harvested at different times, helping to retain soil moisture, and providing a constant supply of food. Fertility is continuously recharged by the use of leguminous plants like pulses. According to some assessments, *baranaja* gives a higher overall productivity (apart from meeting diverse needs) than if the field was to be converted into a soybean monoculture, which is being propagated by agricultural agencies in the region.

Gene-banks have collected over 34,000 cereals and 22,000 pulses grown in India. India has 27 indigenous breeds of cattle, 40 breeds of sheep, 22 breeds of goats and 8 breeds of buffaloes.

Cultivar diversity in India	
Rice	Approximately two lakh varieties
Mango	1000 varieties
Jowar	5000 varieties
Cattle	30 varieties
Goat	20 varieties
Sheep	4 varieties
Poultry	18 varieties
Buffaloes	8 varieties

Rice	Ratnagiri- atleast 27 varieties Pune-atleast 12 varieties
Nachni	Ratnagiri-atleast 15 varieties
Cattle	Devni, Lal kandari, Khillar, Goulav, Dangi
Buffaloes	Pandarpuri, Nagpuri
Goat	Osmanabadi, Sangamnari
Sheep	Dakhani, Sangamnari
Poultry	Mansoli, Asil, Basra

(Source: Anthra)



A few decades ago, Indian farmers grew over 30,000 different varieties of rice. With the green revolution, most of the diverse varieties are headed towards extinction. What happened to rice, can also happen to many other crops. India is the global centre of genetic diversity for diverse crops such as the dwarf wheat, black pepper, cucumber, moth bean and several other crops. Especially the so-called 'poor people's crops' that might have no importance for the international market but are crucial for local subsistence economies are threatened with extinction as farmers adopt green revolution and commercial crops.

India is a large country with high diversity in ecosystems. Ecosystem diversity leads to diverse farming systems in which land, water and biodiversity are managed in different ways, with different linkages between livestock, trees and crops. These farming systems were built on distinctive knowledge of the ecosystem and biodiversity that farming communities have developed and friend over generations. The continued existence of species diversity and varietal diversity within species that is still found inspite of the threats of erosion is a result of the cultural practices and knowledge systems of millions of unknown and invisible farmers.

The erosion of genetic diversity and the extinction of seed varieties is a major threat to people's food security and survival. Genetic erosion is mainly caused when traditional varieties are replaced by

extremely uniform, advanced varieties over large tracts of land. Though uniformity may have the advantage of yield, it holds the risk of being attacked by pests. These uniform crop varieties have narrow genetic characteristics and are therefore potentially vulnerable to adverse environmental conditions. Hybrid varieties have replaced several thousands of traditional, drought and pest resistant varieties while several others are facing the threat of extinction. These varieties which have stood the test of time should not be allowed to become extinct. There is an urgent need to prevent further loss of traditional seeds.

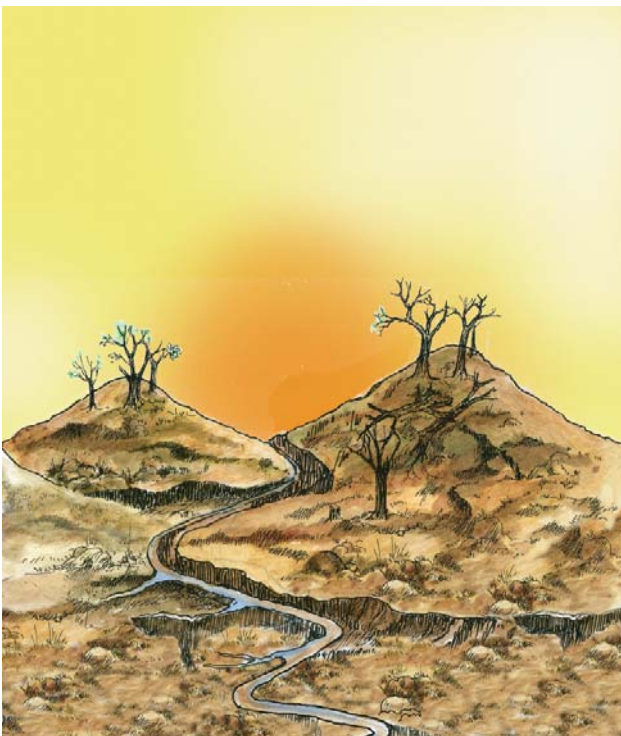
This range of diversity in crops is threatened by extinction due to several factors such as:

- Drought
- Diffusion of advanced cultivars
- Replacement of one crop by another
- Diseases and pests
- Deforestation
- Change in landuse

Agricultural biodiversity is the foundation of food security. Food security is not just grain in the godowns, it is enough food for each person in every home. While newer biotechnology techniques have considered to have made India secure in food, the reality is the opposite. The green revolution has succeeded in converting some areas, such as Punjab and Haryana into food producers for the whole nation and other parts of the country which were previously self sufficient in food production have become totally dependent on these states for food.

Advantages of traditional seeds

- Adapted to the condition of the area where they are grown
- Possess multiple uses such as food, medicine, fuel, fibre, fertilizer, craft material, feed for animals, religious symbols, etc.
- Resistant to pests, diseases and environmental conditions such as drought, etc.
- Possess high nutritional value





For the farmer the seed is not merely the source of future plants/food, it is the storage place of culture, of history. Seed is the first link in the food chain. Free exchange of seeds among farmers has been the basis of maintaining biodiversity as well as food security. A farmer who wants to exchange seed generally gives an equal quantity of seed from his field in return for the seed he gets. Free exchange of seeds among the farmers goes beyond mere exchange of seeds. It involves exchange of ideas and knowledge of culture and heritage. It is an accumulation of tradition, of knowledge of how to work the seed. Farmers gather knowledge about the seeds they want to grow in future by watching them actually grow in other farmers' field. This knowledge is based on the cultural, religious, gastronomic, drought and disease resistance, pest resistance, keeping and other values that the community accords to the seed and the plant it produces.

Rice for example has religious significance in most parts of the country and is an essential component of most religious festivals. Rice grains are considered auspicious. In most parts of India they are mixed with 'kumkum' and turmeric and is given as a blessing. Other agricultural varieties whose seeds, leaves or flowers form an essential component of religious ceremonies include coconut, betel leaves, arecanut, wheat, finger and little millets, horsegram, blackgram, chickenpea, pigeon pea, sesame, sugarcane, jackfruit seed, cardamom, ginger, bananas, gooseberry. Both the festivals before sowing seeds as well as the harvest festival which are celebrated in the fields symbolize people's intimacy with nature.

Very often newer technologies of green revolution devalue the cultural and traditional knowledge embodied in the seed and erode the holistic knowledge of the seed from the community. This results in the seed itself being extinct as the

existence of the seed is tied intimately with its holistic knowledge.

In today's context of biological and ecological destruction, seed conservation is the need of the hour. Seeds are the gift of life, of heritage and continuity. Conserving seed is conserving biodiversity, conserving knowledge of the seed and its utilization, conserving culture and ensuring sustainability.

Hotspots of Biodiversity



The earth's biodiversity is distributed in specific ecological regions. There are over a thousand major ecoregions in the world. Of these, 200 are said to be the richest, rarest and most distinctive natural areas. These areas are referred to as the Global 200 or 'hotspots'.

It has been estimated that 50,000 endemic plants which comprise 20% of global plant life, probably occur in only 18 'hot spots' in the world. Countries which have a relatively large proportion of these hot spots of diversity are referred to as 'megadiversity nations'.

The rate at which the extinction of species is occurring throughout our country remains obscure. It is likely to be extremely high as our wilderness areas are shrinking rapidly. Our globally accepted national 'hot spots' are in the forests of the **North-East** and the **Western Ghats**, which are included in the world's most bio-rich areas. The **Andaman and Nicobar Islands** are

Reviving biodiversity

Navdanya, is a large network of farmers, environmentalists, scientists, and concerned individuals which is working in different parts of India to collect and store indigenous crop varieties, evaluate and select those with good performance, and encourage their reuse in farmers' fields. The Academy of Development Science and the Indian Society for Rural Gene Banks, working with farmers in Maharashtra to document their rice diversity, set up community gene banks (currently holding over 300 rice varieties from western India), and propagate selected varieties. In a highly eroded landscape of the east Indian state of Andhra Pradesh, the Timbuktu Collective is trying out organic farming and has stated a grain bank of indigenous crop varieties.



extremely rich in species and many subspecies of different animals and birds have evolved. Among the endemic species i.e. those species found only in India, a large proportion are concentrated in these three areas. The Andaman and Nicobar Islands alone have as many as 2200 species of flowering plants and 120 species of ferns. Out of 135 genera of land mammals in India, 85 (63%) are found in the Northeast. The Northeast States have 1,500 endemic plant species. A major proportion of amphibian and reptile species, especially snakes, are concentrated in the Western Ghats, which is also a habitat for 1,500 endemic plant species.

Coral reefs in Indian waters surround the Andaman and Nicobar Islands, Lakshadweep Islands, the Gulf areas of Gujarat and Tamil Nadu. They are nearly as rich in species as tropical evergreen forests!

Threats to Biodiversity

Habitat loss

Man has begun to overuse or misuse most of these natural ecosystems. Due to this 'unsustainable' resource-use, once productive forests and grasslands have been turned into deserts and wastelands have increased all over the world. Mangroves have been cleared for fuelwood and prawn farming, which has led to a decrease in the habitat essential for breeding of marine fish. Wetlands have been drained to increase agricultural land. These changes have grave economic implications in the longer term.

There are about 1.8 million species of plants and animals, both large and microscopic, known to science in the world at present. The number of species however is likely to be greater by a factor of at least 10. Plants and insects as well as other forms of life not known to science are continually



being identified in the worlds' 'hot-spots' of diversity. Unfortunately at the present rate of extinction about 25% of the worlds' species will undergo extinction fairly rapidly. This may occur at the rate of 10 to 20 thousand species per year, a thousand to ten thousand times faster than the expected natural rate! The current destruction of the remaining large areas of wilderness habitats, especially in the super diverse tropical forests and coral reefs, is the most important threat worldwide to biodiversity. Scientists have estimated that human activities are likely to eliminate approximately 10 million species by the year 2050.

Much of this mega extinction spasm is related to human population growth, industrialization and changes in land-use patterns. A major part of these extinctions will occur in 'bio-rich' areas such as tropical forests, wetlands, and coral reefs. The loss of wild habitats due to rapid human population growth and short term economic development are major contributors to the rapid global destruction of biodiversity.

In India, forests and grasslands are continuously being changed to agricultural land. Encroachments have been legalized repeatedly. Similarly natural wetland systems have been drained to establish croplands resulting in loss of aquatic species. Grasslands that were once sustainably used by a relatively smaller number of human beings and their cattle are either changed to other forms of use or degraded by overgrazing.

Introduction of exotic species

Introduction of exotic weeds which are not a part of the natural vegetation can also destroy biodiversity. Common examples in India are lantana bushes, eupatorium shrubs and 'congress' grass. These have been imported into the country from abroad and have invaded several large tracts of our natural forests and have led to the extinction of several local species. These weeds spread at



the expense of the diverse range of indigenous undergrowth species. The impact on the diversity of insect, bird and other wildlife species, though not adequately studied, is quite obvious.



Habitat destruction

Loss of species occurs due to the destruction of natural ecosystems, either for conversion to agriculture or industry, or by over-extraction of their resources, or through pollution of air, water and soil.

Increasing human population on the fringes of our Protected Areas degrade forest ecosystems. This is a major factor to consider in evaluating the quality of the ecosystem. Repeated fires started by local grazers to increase grass growth ultimately reduces regeneration and lowers the diversity of plant species. Without alternate sources of fodder this pressure cannot be decreased.

In our country a variety of traditional farming techniques have evolved over several centuries. Cultivation by slash and burn in the Himalayas , and 'rab' by lopping of tree branches to act as a wood-ash fertilizer in the Western Ghats, are two such systems. When human population in these areas was low, these were sustainable methods of agriculture. Unfortunately these areas now have a large number of people who subsist largely on forest agriculture. These methods are now unsustainable and are leading to a loss of forest biodiversity.

Overexploitation

Overharvesting of fish, especially by trawling is leading to serious depletion of fish stocks. Turtles are being massacred off the coast of Orissa . The rare whale shark, a highly endangered species, is being killed off the coast of Gujarat .

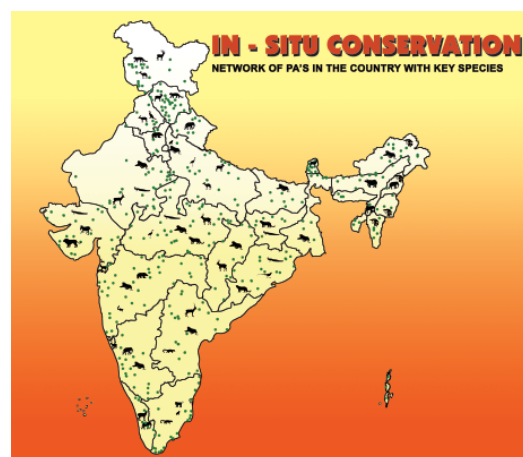
Poaching



Specific threats to certain animals are related to large economic benefits. Skin and bones from tigers, ivory from elephants, horns from rhinos and the perfume from the musk deer are extensively used abroad. Bears are killed for their gall bladders. Corals and shells are also collected for export or sold on the beaches of Chennai and Kanyakumari. A variety of wild plants with real or at times dubious medicinal value are being over harvested. The commonly collected plants include Rauvolfia, Nuxvomica, Datura, etc. Collection of garden plants includes orchids, ferns and moss.

Conservation of biodiversity: In-situ and ex-situ

In-situ conservation



Biodiversity at all its levels, genetic species and as intact ecosystems, can be best preserved in-situ by setting aside an adequate representation of wilderness as 'Protected Areas'. These should consist of a network of *National Parks and Wildlife Sanctuaries* with each distinctive ecosystem included in the network. Such a network would preserve the total diversity of life of a region.

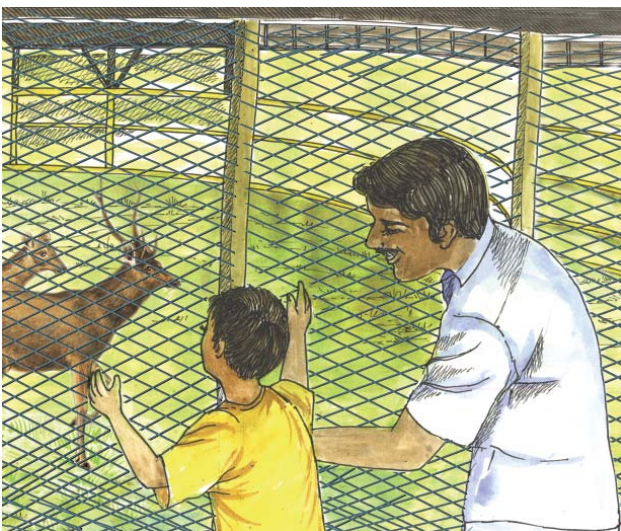


In the past National Parks and Sanctuaries in India were notified to preserve major wildlife species such as tigers, lions, elephants, and deer. The objective of these areas should be expanded to the preservation of relatively intact natural ecosystems, where biological diversity - from microscopic unicellular plants and animals, to the giant trees and major mammals - can all be preserved.

However species cannot be protected individually as they are all inter dependent on each other. Thus the whole ecosystem must be protected. As rare endemic species are found only in a small area these easily become extinct due to human activity. Such areas must be given an added importance as their biodiversity is a special feature of the region.

Animals such as elephants require different types of habitat to feed in during different seasons. They utilize open grasslands after the rains when the young grass shoots are highly nutritious. As the grasses dry, the elephants move into the forest to feed on foliage from the trees. A Protected Area that is meant to protect elephants must therefore be large enough and include diverse habitat types to support a complete complement of inter linked species.

Ex-situ conservation



Sometimes, there are situations in which an endangered species is so close to extinction that unless alternate methods are instituted, the species may be rapidly driven to extinction. This strategy is known as ex-situ conservation, i.e. outside its natural habitat in a carefully controlled situation such as a botanical garden for plants or

a zoological park for animals, where there is expertise to multiply the species under artificially managed conditions. These breeding programs for rare plants and animals are however more expensive than managing a Protected Area.

There is also another form of preserving a plant by preserving its germ plasm in a gene bank so that it can be used if needed in future. This is even more expensive.

When an animal is on the brink of extinction, it must be carefully bred so that inbreeding does not lead to the genetic makeup becoming weak. Breeding from the same stock can lead to poorly adapted progeny or even inability to get enough offspring.

Modern breeding programs are done in zoos that provide for all the animal's needs, including enclosures that simulate their wild habitats. There may also be a need to assist breeding artificially. Thus while most zoos are meant to provide visitors with a visual experience of seeing a wild animal close up, and provide the visitors with information about the species, a modern zoo has to go beyond these functions that include breeding of endangered species as a conservation measure.

In India, successful ex situ conservation programs have been done for all our three species of crocodiles. This has been highly successful. Another recent success has been the breeding of the very rare pygmy hog in Gauhati Zoo. Delhi zoo has successfully bred the rare Manipur brow antlered deer.

However the most important step of a successful breeding program is the reintroduction of a species into its original wild habitat. This requires rehabilitation of the degraded habitat and removal of the other causes such as poaching, disturbance, or other manmade influences that have been the primary cause of reducing the population of the species.

Conservation of cultivars and livestock breeds

There were an estimated thirty thousand varieties of rice grown in India till about 50 years ago. Now only a few of these are still grown. The new varieties which are now being cultivated everywhere have been developed using germ plasm of these original types of rice. If all the traditional varieties vanish completely it will be



difficult to develop new disease resistant varieties of rice in the future. Several varieties have been preserved in gene banks. However, this is both very expensive and risky. Encouraging farmers to continue to grow several traditional varieties is thus an important concern for the future of mankind. At present gene bank collections have over 34 thousand cereals and 22 thousand pulses.

The diversity of life on earth is so great that if we use it sustainably we can go on developing new products from biodiversity for many generations. This can only happen if we manage biodiversity as a precious resource and prevent the extinction of species.



Let's know our village...

Objective

To enhance students understanding of the natural resources of their village.

Let's do it....

Each village is an ecosystem by itself. To enable the students to visualize this entity, construct a map alongwith the students. By looking at the map, they begin to 'see' the different elements, like cultivated land, uncultivated or forest land, springs, etc. within the whole system. They then gain a mental picture of the parts within the whole which will later help them conceive the interrelationships among the parts especially when discussing the ecological balance of the ecosystem.

A relief map or a model will be more educative than a flat map. Make the map reasonably permanent. Use stones, bricks, etc. A plaster of dung and soil will make the surface resistant to erosion by rain. A well made map, if repaired from time to time will last several years and will be useful in discussing the progress of projects later on.

1. Begin by obtaining a copy of the official village map. This can be got by applying to the Tehsildar or making a copy from the one with the Patwari.
2. Walk around the boundary of the village and make rough sketches on paper with notes.

3. From the official map, your own sketches and observations make a layout map on the ground. Be sure to give it the same north-south axis as the village itself. Demarcate cultivated land (not individual fields), gairans, barren land, private land, panchayat land and forest land.
4. Once everybody has agreed that you have got the map right (get the elders in the village to also approve), raise the following questions:
 - Fifty years or so ago, what did the village forest look like? Was it different than today in density and types of trees? What are the reasons for the change over time?
 - From where did people bring fodder and fuelwood then? From where do they bring them today?
 - Were there more springs 50 years ago then are today? Was the outflow of springs more or less then it is today? What could be the possible reasons?
 - Has the area of cultivated land increased over the last 50 years? If so, indicate where in the map. Compare the quality of this land with that in cultivation before that. What did this land produce before?
 - In many villages, the forest has reduced over the years. If this is true of our village, what do you think the future holds for us.





How many in our village?

Objective

To build skills of censusing among the students.

Let's do it...

Make a list of all the households in the village. Visit each one and enquire the number of residents. Residents are people who live in the village. Family members who live outside the village and only visit from time to time should not be counted. Record your results as follows:

Number of families in the village	
Number of people in the village	

When you visit each household, also ask about the number of animals of different types, ie: bullocks, cows, calves, buffaloes and their calves, goats and sheep. Enter the data into the table below.

Table : Number of animal units

Type of animal	Number	Coefficient to convert to animal units	Number of animal units
(1)	(2)	(3)	(4)
Bullocks		1	
Cows		1	
Cow calves		0.5	
Buffaloes		2	
Buffalo calves		1	
Goats		0.1	
Sheep		0.2	
Total			





How much fodder to our cattle need?

Objectives

To inculcate skills of observation, data collection and analysis

Let's do it..

Fodder production can be estimated quite accurately by weighing the fodder fed in a sample of households on one day every month for a period of one year. Green fodder is converted to its dry equivalent by dividing by 2. The quantity of grazed fodder can be calculated by multiplying the area of the support areas that is grazed during the rainy season by a figure of 20. The total of these two figures is the total fodder consumption.

Fodder consumption/headloads/village/year =
Number of animal units X 100

Do this calculation for your village and write the result here:

_____ headloads air dry fodder/village/year

From this figure we calculate fodder production from the village land by adding the amount that may have been sold during the year from the village, subtracting the amount that was purchased.

Example :

Estimated fodder consumption (air dry basis)	10,000
Dry fodder purchased	100
Dry fodder sold, headloads	60
Estimated fodder production is thus: headloads	$10,000+60-100 = 9,960$

Do this calculation for your own village.



Know our surroundings

Objective

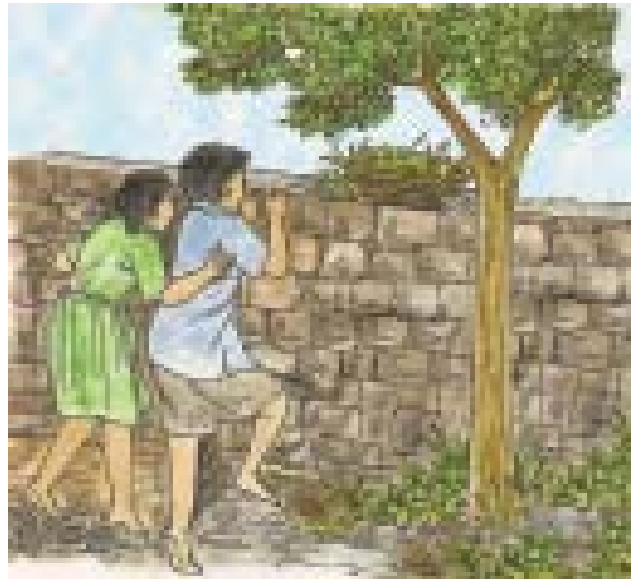
Enhancing skills of observation

Let's do it...

Diversity of life exists all around us. We must learn to observe it, appreciate it and conserve it. You could begin by understanding plants that are all around us. Begin by observing the leaves, bark, flowers and fruits that are important characteristics by which we are able to identify the tree. Crush a part of each leaf and smell it. Each leaf has its own kind of smell.

Let's find it...

Match the following to the forest types they are found in. Observe them and record their flowering season by colouring the relevant box. During the flowering season, which species of birds are attracted to the tree.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Teak												
Kadam												
Indian Coral tree												
Banyan												
Pipal												
Jamun												
Mango												
Red silk cotton												
Palas												
Babul												



Insect Count

Objective

Enhance students knowledge of observation

Let's do it...

How many insects do you think live in your school compound? Can you guess? One of the ways to know this is to actually count insects. But counting insects can be very tiresome. There may be several thousand ants in a particular area. However scientists have devised methods of counting insects.

Make a square frame with pipes. This could be 1m x 1m in length. You could even join four sticks together as shown in the figure to make this frame. Divide the class into different groups. Each group could look in a different area. Throw the frame

on the ground. Count all the insects that fall within the frame. Record your observations on the data sheet as shown.

Do this once a month with your 'Insect watchers Team'. At the end of each school term draw a graph and display it on your school notice board. You can make either a line graph or a bar graph. A line graph can be used to show how the population of a particular insect varies according to the month. A bar graph can tell you which is the largest group of insects that occur in your area.

Data Card	
Month _____	
Insect	No
01. Butterflies	
02. Moths	
03. Ants	
04. Bugs	
05. Beetles	
06.	
07.	
08.	
09.	
10.	
11.	
12.	
13.	
14.	
15.	
16.	
17.	

