The School and It’s Environs

STRUCTURE
2.1 Introduction
2.2 Objectives
2.3 Exploring a Tree
2.4 Biomass Studies
2.5 Bird, Animal and Insect Study
2.6 Water Quality Monitoring
2.7 Conclusion
2.8 Unit-end Exercise
2.1

There is no denying that textbooks are the basis of teaching in schools. Even for transacting environmental education, the textbook can lead to many activities that can be done in and around the school. The idea is that you as a teacher should be able to link the theory (textbook lessons) and the practice (hands-on activities). There are various environmental projects that can be taken up – these could be research projects or action projects to solve problems. The important thing is that you should not just do these activities as one-time events but rather as a gradual progression in learning and understanding of concepts. For example, tree planting - without students understanding why or how or when, doing such an activity as a routine ritual in the school without worrying that all saplings will die within a month will defeat the very purpose of EE. It will become a superficial exercise that does not lead to studying or understanding the situation, discussing and finding solutions and trying to implement these.

So what could be such activities and projects? Is a good project the one where you can actually bring about an improvement in the environment or is it enough if students understand the problem. There is not one answer – every situation is different and you need to see what is logical and feasible in that situation and do that. This unit discusses various types of projects that can be taken up by you with your students in and around the school.

2.2

On completion of this unit, you should be able to:

- Use your school campus as a resource for EE
- Initiate various research and action project in and around your school

2.3 EXPLORING A TREE

If you were to ask students to identify and name the various trees, plants and flowers on the school campus, you can be sure to receive many wrong answers. The problem is that though students learn about these in textbooks, they hardly link it to what they see around them. As their teacher, you can do something to bridge this gap and help your students see the link between what they are studying in the class to what is around them.

Doing simple activities relating to the various life forms found on the school campus can help students identify and recognize the most commonly found trees and plant species in the area or region, appreciate the biodiversity existing on the campus, create an awareness in them as to how trees and plants support various life forms around them and therefore they are an environment in itself and also a part of the larger environment. As a teacher, you may set any or all of the following goals:
- Creating awareness about the commonly found plants
- Create an understanding about how trees support variety of life forms living on and around it
- Understand the various uses of trees by mankind
- Present the issues related to tree cutting and felling
- Initiate a discussion about depleting green cover on earth, its causes and effects
- What can be done to salvage the situation

2.3.1 Starting with Games

These set of games will help in introducing the child to the variety of information around him. These will work on the ‘feelings’ effective domain of a child’s punctuality. These will help by creating an interest and love in the child for nature.

**Game 1 Feel and Find**

Ask students to collect (without plucking) different bits of bark, leaves, flowers, fruits and twigs of a tree from its surroundings. Blindfold a student and let him/her feel one item for ten seconds (time allowed may be more or less, according to the age group). After the item has been returned, remove the blindfold and ask the student to point out the same item on or around the tree. To add an element of fun, include a few similar items like the twigs and leaves of Gulmohar and Subabul trees or the leaves or Mango and Asopalav trees, etc.

This game could even be played in the classroom. The student could pick out the item felt from the variety displayed in front of the group. One could add a piece of charcoal and a rock, a snake moult, various dead insects and their moults. In case a blindfold or large handkerchief is not available, a cloth bag made of thick and dark material can be used. Put the items to be identified in it while the groups face away. Ask the participant to put his/her hand inside the bag and identify the item without peeping in.

**Game 2 My Ears Told Me**

This game involves using one’s sense of hearing to identify forms of life that are usually heard around a tree, but too well camouflaged to be seen. Tell students about the various sounds commonly heard around trees like the ‘chuck chuck’ of tree lizards, the ‘hoop hoop’ of langurs, the ‘tonk tonk’ of the coppersmith bird, the chirping, scraping, sawing, gnashing and droning of bumble bees, the ‘pretty pretty’ of tailor birds, rustling leaves, distant footfalls, or a dripping water tap. Now ask the students to describe the sounds and express, in a word or two, their feelings when they heard that sound...loud, pleasant, noise, soothing, etc. You can also give students the following worksheet for this game:
Worksheet

Name of student(s) or group name if any _____________________

Standard/Class _____________________
Date ______________ Place ______________ Time ______________

<table>
<thead>
<tr>
<th>Description of sound</th>
<th>Possible source of sound/ location or who/what made it</th>
<th>Feelings on hearing the sound</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Game 3 Go and Touch

This game helps in strengthening and sharpening skills of observation in students.

Divide students into equal groups; ask each group to stand in a straight line. A line is drawn in front of each row from where the first member of the team is standing. In this game, the first student of every row is asked to leave her place and go touch an object that the teacher calls out. Therefore as a teacher you should have a list of such things/objects on hand.

For example, students may be asked to touch:

a) A living thing
b) Something green
c) Something brown
d) A mango tree
e) A neem tree
f) Grass
g) Something wet

h) A fruit
i) A flower (red, etc.)
j) A brown leaf
k) A compound leaf
l) A feather
m) A smooth bark
n) A fallen twig or branch
After the student has found and touched the objects, he then joins the end of her line and the next member now gets a chance. In each round, the row whose student returns first is given a credit point. Students should not speak, guide or advise others. Points may be deducted for any breach of rules. One good way to sharpen their observation is to ask for something to be touched and point out in the wrong direction.

Game 4 Memory Game

This game tests the power of concentration in students while observing as objectively as possible. It also encourages the retention of observations made.

Ask students to collect about 30 items from nature such as different types of leaves, branches, soil, stones, shells, snake moults, fruits, etc., without harming living things. Put these on a large tray. Cover it with a cloth.

Ask the group to assemble around the tray. Remove the cloth for 20-30 seconds. The time can vary depending on the age group of students. Then cover the tray again. Ask students to list the items they have seen.

Variation

Add ten or so man-made items like a rag, needle, button, watch, pencil, slipper, ring, etc., and ask the children to:

a) List only the natural items
b) Make separate lists of natural and man-made items.
c) Describe each object in terms of size, outstanding characteristics, main colour, associated colours, shape, texture, where it is found, and any other interesting aspect.

Game 5 The Poet in the Child

Ask each student to choose an object in nature (like Sun, soil, air, cloud, tree, grass, butterfly sparrow, tiger, water, river, fish, etc.) which he feels reflects his own personality or qualities. Students may then be asked to speak on how the chosen object reflects their personality.

Let them then pick up a paper and a pen and:

a) In the first line write the name of the object (subject/ noun).
b) In the second line write two words describing the qualities of the object (adjectives).
c) In the third line write three words of action about the object (verbs).
d) In the fourth line write four words describing how they feel about the object (phrase, sentence, expression).
e) In the fifth and last line write one word to replace the title (synonym).
f) Now let them read it like a poem.
Here is an example - **Butterfly**

Delicate Graceful  
Flutters, finds, sips,  
Seems weak but isn’t  
Beauty.

### 2.3.2 More Activities

The above mentioned games would help arouse interest about nature in the children. Once interested, then activities given in this section can help in taking children to the next level – from mere interest, to a level where they can study the natural objects of their interest.

**A) Physical Features**

**Measuring the height of a tree**

Select a tree in the school campus. Show it to your students and ask them how the height of that tree can be measured. There are many ways of estimating the height of a tree; one of them is suggested here which you can show to your students:

1. Ask students to walk away from the tree so that the full height of the tree is seen.
2. Take a pencil, scale or a straight stick in your hand and hold it with your arm fully outstretched.
3. Now hold the stick to the front so that the upper end of the stick in your hand appears to be in line with the top of the tree and its bottom matches that where the tree meets the ground.
4. If the two ends of the stick and the tree do not match, you may need to walk to the front of the back, till the two heights match.
5. Ask the student to stand next to the tree. Turn the stick through a right angle, i.e., from a vertical to a horizontal position on either the left or the right side.
6. Keep the thumb-end of the stick in line with the base of tree and ask the student standing next to the tree to (right or left) to a distance till his position makes a straight line with the end of the stick (now in a horizontal position). Ask the student to make a mark on the ground at his new position.
7. The distance between this mark and the tree gives an estimate of the height of the tree.
Measuring the tree-trunk

From the group of trees around you, find the tree with the thickest trunk and one with the thinnest or the most slender trunk. This activity is to measure the circumference or girth of the tree-trunk.

The girth or circumference of tree-trunks can be measured in various ways:

a) By using a piece of string
b) By holding hands with your friends around the tree trunk
c) By using as a measure the span of your hand from thumb end to the little finger end

You could use your discretion to teach standard and non-standard ways of measuring. Each team may be asked to measure the tree in a different way and compare results with others.

Tree autograph

From among the group of trees around you, find the tree with the smoothest bark and a tree with the roughest bark. Ask students if they can identify these trees by their names.

Ask students to take impressions of the different barks on paper. It can be done by holding a blank sheet of paper steadily against the bark and rubbing a crayon over the sheet to get the impression of the bark. This gives an autograph of the tree.

The ridges will be coloured while the cracks in the bark will remain blank. If possible, ask students to match the colour of the crayon they use with that of the bark of the tree. Try this with different kinds of trees and compare.

In a similar way, autographs from different kinds of leaves can also be taken.

Studying leaves of trees

Ask students to select one tree from those around them and ask them to collect different types of leaves from under that tree only. It is important to tell students that they should not pluck leaves from any tree or plant. Ask students to make note of the following:

Different Kinds of Tree Autographs

I. Silhouette print:

Place a leaf on a sheet of paper. Using a crayon make short strokes outwards from the edges of the leaf holding the leaf firmly in place.

II. Crayon print:

Place the leaf on a smooth solid surface with the veined side up. Cover the leaf with paper on which the print is to be made. Rub a crayon on the paper.
III Spatter print:
Place the leaf on the paper on which it is to be printed. Make sure that the leaf lies flat. Dip an old toothbrush in thin water colour. Shake off any surplus water colour. Holding the brush above the paper, scrape the bristles and spray the paper around the margins of the leaf. Label the print with relevant details.

a) Are all the leaves collected same? If not, which other trees could they have come from?

b) Which is the most common leaf present under the tree they have selected?

c) From the collection students could make a display of
   - the biggest leaf
   - the smallest leaf
   - leaves with holes
   - leaves with bumps, etc.

Ask the students how and why different leaves happened to be under the tree. Was it the wind that brought them there? Was some animal responsible? For a summary of the activities, each group may be asked to identify the tree(s) they have observed or taken autographs from.

B) Life around a tree
This section deals with helping students identify different life forms around the tree and establishing the relationships among them. Divide students into groups and ask each group to select a tree and to list all living things observed on and around that tree.

The following worksheet is designed to assist them in recording their observations systematically. Details on how to use the worksheet are also listed below.
Worksheet

Name of investigator(s) with group name if any __________________________

Standard _______________

Date ________________ Place ________________ Time ____________

Tips for Using the Worksheet

a) For the purpose of this activity, ‘living things may be classified as plants, small animals (like earthworms, slugs, spiders, scorpions, insects! etc.), birds and large animals (like lizards, snakes, squirrels, monkeys, etc.).

b) ‘Seen where’ should give location, e.g., in the top, middle or lower part of the tree; among leaves, branches, flowers, trunk; in the leaf litter; on dead branches in the shade/sunlight

c) ‘Size’ is very easy to record if associated with known objects or living things, e.g., a dove is smaller than a pigeon, which in turn is smaller than a crow. For insects, the size of a pin’s length or half its length, a nib (smaller or larger than it) can be used as a standard. The langur could be chest high for many students. Encourage students to express the measurements in metric terms.

<table>
<thead>
<tr>
<th>Name of living thing</th>
<th>Seen where</th>
<th>Size</th>
<th>Outstanding characteristics</th>
<th>Doing what</th>
<th>Comments and sketches</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plants</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small Animals</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Insects</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Birds</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Large Animals</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

RESOURCES AND OPPORTUNITIES FOR EE 35
d) ‘Outstanding Characteristics’ include the first aspect that strikes one about the particular living thing, e.g., the long tail of the langur or peacock, the crest of the hoopoe, the long legs of cranes, the bright colours (name these colours) of certain birds (e.g., peacocks), the hard covering of the beetle, the scales and tail of the lizard, the speed of dragonflies, bodies of bumblebees, etc.

e) ‘Doing what’ is not relevant to the plant category. It includes a variety of animal activities like sleeping, feeding, grooming itself/others, stalking, hiding, hunting, resting, nesting, feeding young ones, etc.

f) ‘Comments and sketches’ can have rough sketches to help quick identification. Everyone may not be an artist and our purpose here is only to get an idea of the shape etc., of what is seen.

At the end of this activity, the groups may exchange information and try to identify the common factor which unites or brings all these living things together. The inter-relationships are usually either symbiotic or pertaining to competition for food and space. For example, bees are pollinators and have a symbiotic relation with the tree since they get nectar from the flowers; or, the praying mantis uses the tree as an indirect source of food—attacking insects that visit the tree; others use the tree for shelter or as a convenient look-out point.

(For more information, refer to the ‘hints for insect, bird and plant study’ in Module 3)

C) Biodiversity and impacts of human activities

This activity helps students observe man’s impact on vegetation in the surroundings. Students are divided into teams and the teams are asked to observe and list within 10 minutes which human activities are affecting this area. These would include positive activities like planting trees, leaving nature undisturbed to take its own course, protecting the place, etc.; or negative ones, like cutting trees or branches, plucking leaves, flowers or fruits, harming wildlife either by killing directly or indirectly through pesticides; damaging trees by carving initials or peeling bark, etc. Each team should be asked to speak out their list one by one. Following this, you may point out the variety of life-forms dependent on a tree and highlight their independent and interdependent functioning, impact of human activity on these life forms and also discussing possible solutions to overcoming the problems of dwindling natural resources essential for the continued survival of all life forms of which man is only a part.

This discussion could then be linked to textbook concepts and the programme consolidated. An effective way for consolidating students’ understanding about interrelationships is by playing the ‘Web of Life’ game.

(For more information refer Module 1)

D) Studying seeds

Similar to studying trees and plants, students can also be asked to study seeds. You can collect few sample of seeds from around the school campus, stick them onto paper and make a chart of it. On the chart you can give basic information like its local name, its scientific name and basic information about
its host plant. You can then ask students to go around the campus and find similar/more variety of seeds. Also, as homework, you can ask students to go into the kitchen and make a list of all the different types of seeds being used in the daily Indian meal.

2.3.3 Some More Ideas

Apart from the above-mentioned activities students may also be asked to:

1. Find animals among the fallen and rotting leaves. Animals could be classified as those that hop, wriggle or do not move at all.
2. Find out how many trees and how many kinds of trees they can list on the way to school within 1 km or 1200 steps from the school gate.
3. Find out how many different birds visit the tree? When in the day and why?
4. Find out how many other kinds of plants grow under the tree and on it? Describe them and if possible, name them.
5. List the uses of the tree by animals while it is standing and also after it has been cut.
6. List the items you use in your house/school which are made from parts of a tree. Can any of these be replaced with something else which is easily available?
7. Sketch the shape of the tree.
8. Measure the shadow of the tree using Pythagoras theorem. This activity may be done at different times of the day to understand position of the sun and its relation to the shadow.

**Uses of a Tree**

**When Alive:**

- As food - for man, other plants, animals
- As shelter - for man, camouflage for birds, insects, etc.
- As habitat - for other plants, e.g., epiphytes
- As a look-out point - for birds of prey
- As part of the water cycle
- As a trapper of Sun's energy
- As a holder of soil
- As a source of humus.
When Dead (Rotting):
- As shelter - for insects, etc.
- As food - for beetles, termites, decomposers
- As habitat - for various insects, lizards, etc.

When Cut:
- For making various objects from matchsticks to ships
- For construction
- As implements
- As fuel
- As items of use when combined with other materials or processed, e.g., paper,
- matchsticks, clothes, etc.

Worksheets
You can also summarize the above-mentioned activities through worksheets:

Worksheet 1
1. How many trees can you name?

2. Of the trees that you have named, how many have you seen?

3. From the trees around you, how many can you name?

4. Take the leaves of any three trees around you. Do not pluck the leaves but pick the ones that have fallen on the ground.
Mention the similarities and differences between these leaves.

Similarities:
1. _____________________
2. _____________________
3. _____________________
Differences:
1. _____________________
2. _____________________
3. _____________________
4. _____________________
5. What are the differences in the trunks of these trees?
   ______________________________________________________________
   ______________________________________________________________
   ______________________________________________________________
   ______________________________________________________________
6. From the trees around you:
   Which tree has the thickest trunk?
   ______________________________________________________________
   Which tree has the thinnest trunk?
   ______________________________________________________________
7. How will you measure the thickness of the tree trunk?
   ______________________________________________________________
   ______________________________________________________________
   ______________________________________________________________
8. From the trees around you:
   Which tree has the smoothest bark?
   ______________________________________________________________
   Which tree has the roughest bark?
   ______________________________________________________________
9. With the help of the instructions (Activity No. 3) take bark prints.
10. With the help of the instructions, estimate the height of the tree.
11. Draw a picture of the tree.
Worksheet 2

1. Select any one tree.

2. Describe the leaves of this tree.

3. Are the branches of the tree spread out and full of leaves?

4. What is the colour of its trunk and branches?

5. Can you see any fruits on the tree? Name them.

6. Describe the trunk of the tree.

7. Measure the thickness of the tree trunk.

8. Can you see any insect on the ground?

9. Can you see any insects on the tree trunk? Name or describe them.

10. Can you see any birds or animals on the tree? Name them.
11. Can you describe one bird that you see on the tree?
   Colour _____________________
   Size _______________________
   Sound ______________________
   Tail ________________________
   How it flies _________________

12. Can you see any bird-nest on the tree? ___________________

13. Which bird do you think made the nest? ___________________

14. Estimate the height of the tree. _________________________

15. Take bark prints.

16. Use your imagination and find out what you can see in the bark prints.

17. Draw a picture of the tree.

2.4 BIOMASS STUDIES

Biomass is the weight of all living organisms in a given population or area. Quite often, biomass is considered as the weight of dry matter of living organisms at any given time per unit of area. Biomass studies give an understanding about the status and dynamics of the resources in an ecosystem. Biomass studies are primarily undertaken to promote better ecosystem resource planning at community and individual levels as well as planning and evaluating large-scale environmental projects.

For the purpose of this section, biomass is restricted to plants and vegetation. The population and production of plant biomass are affected by both abiotic factors such as rainfall, temperature, soil type and quality and biotic components such as microbial growth, predation, pollination, dispersal, diseases and many others. Not to forget the human interference such as cultivation, extraction, exploitation, etc.

Biomass plays an intimate role in the everyday life of 70 per cent of India’s population living in the rural areas. A variety of biomass products, ranging from rare local herbs and leaves for food, medicine, fodder and manure, to thatch for roofing and wood as cooking fuel, are used by the tribal and rural folk for basic subsistence. In addition, biomass related activities are the biggest source of employment and income for these people.

In this section, we will discuss a few types and methods of biomass studies useful for school students to gain an insight into ecosystem resources. It would be interesting to take students to study the diversity contained in these vast stretches of land and initiate a study of the vegetation of that area.
Let us look at few sample biomass studies:

2.4.1 Studying Vegetation Profile

This above study can be done through transect sampling method. This method is useful for studying large areas of land where vegetation is non-randomly distributed; i.e. an area which allows observation of the same plant species more than once. There are two types of sampling that can be done under this method:

Method 1 Belt transect

This method is particularly useful for studying vegetation profile and canopy cover. It is usable for studying all types of vegetation.

Procedure

Select a point on a plot of land to be studied. Lay a rope from that point in a straight line for a length of about 100 metres. This length may be decided by you depending upon the vegetation type and spread. Lay another rope parallel to the first keeping a distance of one to five metres between the two. The area between the two lines is called the belt transect. This will make the belt transect a long rectangular plot. Divide the belt transect into equal segments of convenient size. Record the information on vegetation separately for each segment. If the vegetation is dense, alternate segments may be studied.

In order to study the vegetation profile and canopy cover over a vast spread of land, few such transects are laid in the selected area and studied.

Method 2 Line Intercept method

Though not very accurate, this is a quick method to survey the vegetation. It may not give a complete picture of plant diversity as rare species may not get included in the sample.

Procedure

Mark a line from the selected points on a plot of land as in a belt transect. The line is divided into equal segments of convenient size (one to five meters). The plants which are physically intercepted by the line are also conducted starting from one end. Record the data for every segment separately. Also include the plants whose foliage fall across the transect line. At each 100 metre intercept point, a perpendicular line with a rope or a stick is marked. This creates four quarters - mark one herb plant within each quarter for studying herb vegetation.

2.4.2 Studying Species Richness and Abundance

Species Richness is the total number of species present in a given area at a given time. Species Abundance or evenness refers to the number of individuals of each species present in the total population. For example, in a habitat composed of say 10 species, if 90 percent of the individuals belong to a
single species and the remaining 10 percent are distributed among the nine other species, evenness or abundance would be considered low. On the other hand, if each of the ten species accounted for 10 percent of the total number of individuals, evenness would be considered maximum. It can be expressed as relative abundance, which is the percentage of individuals of each species, among all the others, in any given habitat.

Importance of studying Species Richness and Abundance

- They are measures of species diversity.
- They identify the dominant and rare species in the eco-system.
- They indicate the species that need to be conserved.

Procedure for estimating tree species richness and relative abundance using plots or transects

1. Define the plots or transects in different land categories for study.
2. Identify all the species in the plots or transects in these different land categories.
3. Do take help of local people in identification of the species.
4. All the species in the given area are recorded in their common English, local and botanical language (Botanical names may be obtained from taxonomy books or by contacting expert taxonomists).
5. The number of trees of each of the species is counted.
6. A herbarium is prepared for rare and unidentified species alone, for later identification.

2.4.3 Preparation of Herbarium

A herbarium is a store house of preserved plant materials. It helps in the identification and detailed study of the species

Procedure for collection of plant materials:

Collect plants to be identified or studied in detail in plastic bags or a container. The plant material collected should be fresh and healthy. Since the study is spread over a period of time, some specimens may have to be discarded mid-way due to their poor condition. Therefore, at least 4-5 specimens of the same species are collected.

1. The size of the plant specimens should be around 10-12 inches so as to mount it on normal size paper sheets (30cm. x 12cm).
2. In case of trees, shrubs and tall herbs, it is advisable to collect a small branch with flowers and/or fruits.
3. For small grasses and herbs the entire plant including the underground part with flowers and/or fruits should be collected.
4. Each specimen should be tagged with a reference number.
Field Notes
You may ask students to note the following details in their field notebooks with the reference number.

- Date and time of collection of the plant material
- Locality - the name of the place and the approximate distance and direction with reference to a familiar place
- Habitat - Marsh, aquatic, grassland etc.
- Habit - Herb, shrub, tree, grass or climber
- Local name and common English name if possible

Systematic recording of all these details will be of great help in identifying the species.

How to prepare a herbarium?
After collection, the specimens collected have to be well pressed as early as possible, in order to remove the moisture content and to retain the morphology.

1. The specimens are individually pressed between the blotting papers or old newspapers. If the fruits or flowers in the collected specimen are big, and therefore difficult to compress, these parts are removed and preserved in bottles containing 1 percent Formalin solution, with the reference number.

2. Individual specimens are stacked one above the other, preferably on a wooden surface.

3. A uniform weight is placed on the stack using wooden planks or books to develop good moisture-free specimens.

4. The papers have to be changed regularly in order to avoid fungal or insect attack. Note that a weak solution of Mercuric Chloride (HgCl₂ - 0.1%) may be sprayed on the specimens before pressing. As Mercuric Chloride is highly poisonous, it should be handled with care.

5. The drying process takes one month to 3 months, depending on the specimen. The well pressed specimens are mounted on white cardboard sheets with the reference number, using gum or by stitching.

2.4.4 Studying Species Density
Species Density means the number of individuals of a species in a unit area. For example, if there are hundred individual trees of neem in two hectares of land, the density of neem is given as 50 trees per hectare. However this does not indicate the distribution of species with regard to space.

Importance of Studying Species Density
- Density is also an indicator of the abundance of the species
It helps to identify the dominant and rare species

It is an indicator of the standing biomass and productivity in a region

**Method 1**

The number of each species in each plot or transect or land use type is counted and recorded.

**Analysis**

Using the data recorded by the census method in the Table 6.2 the density of different tree species or plantations or all trees in the village may be estimated. Two examples are given below:

**Example 1**

Density or Number of Individuals of a Tree Species/hectare

For example, the density of coconut trees can be estimated if the area of coconut gardens is also known. The approximate area under coconut cultivation in the village = 138 ha

\[
\text{Density of coconut trees} = \frac{\text{Total number of coconut trees}}{\text{Total area under coconut cultivation}}
\]

\[
= \frac{10,675}{138} = 77.22 \text{ trees/hectare}
\]

**Example 2**

Density of Trees in the Village

In this case the total number of trees of all species are considered

Total number of trees in the village = 59,021

Total area of the village = 340 ha

\[
\text{Tree density} = \frac{59021}{340} = 173.59 \text{ ha}
\]
Example 3
Density Estimation for a Sample Data from a Land Category (plot or transect method)

a. The total number of each species in each of the lots or transects are determined.

b. The total area (in hectares) of all the plots or transects sampled is known.

c. Density of a tree species in the land type per hectare

\[ \frac{\text{Total number of the species in the sample}}{\text{Total area of the land type sample}} \]

2.5 BIRD, ANIMAL AND INSECT STUDY

2.5.1 Studying Birds

Birds are the most intriguing of all two-legged creatures; their ability to fly makes children watch them in awe. As a teacher, you can further the interest of your students in birds by initiating simple bird studies in and around the school.

Birds can be identified based on their key physical characteristics like the shape of their beaks, legs and what they eat. Each and every bird has distinct behaviour and a distinct call that sets it apart from the others. Bird studies can be initiated by looking into all these aspects and also by studying the difference between male and female, off-springs, nesting and egg-laying patterns/behaviour etc. A step further would be to observe and understand the functions of birds in an ecosystem, study their migration patterns, differentiating between native species and visiting/alien species, and also classifying the birds according to the their overall size, size of their wings, eyes, beaks and eggs, fastest flying as against flightless birds. Another classification could be based on the sense of sight, smell and hearing—which is different in different birds.

2.5.2 Observing Insects

In spite of being all around us, the world of insects is commonly unnoticed by us. Insects make the largest group of organisms in the living world and are found in the most beautiful variety of shapes, sizes and colours. Yet, the educational potential of observation of insects is largely untapped. They can be best known through their inter-relationships, life cycles and usefulness or harmfulness to humans. In this section, we will discuss about insect observation. Insects are common in just about every environment, hence easy to find; they can usually be approached from close distance and are mostly harmless. Children can find them really fascinating!
Tools to get a better look at insects

Normally, a magnifying lens is sufficient to observe insects, but, if you find a dead insect, it would be well worth the effort to observe it under a microscope. Like entomologists do, you may also use various kinds of nets and jars for trapping insects for observation, only if need be.

How to recognize an insect?

Insects are most commonly confused with shrimps, millipedes, spiders etc. but these three fall into entirely different groups of organisms. The following features of insects may be kept in mind to facilitate insect identification:

1. Insects by rule have three major divisions in their bodies — head, thorax and abdomen.
2. Adult insects have three pairs of legs, all attached to the thorax — the middle section of the body.
3. Ant, fly, grasshopper, cockroach and beetle are insects, whereas, spiders are not. It is so because they have 4 pairs of legs and only two body-divisions.
4. Insects change their forms a great deal during their lives. Most of the time each stage is entirely different from the other.
5. By observing the development of a butterfly and a cockroach, students can learn about the two different types of development in insects — Complete Metamorphosis: egg, larva, pupa, adult; In-complete Metamorphosis: egg, nymph, adult.

The following is a sample activity for insect observation:

**Exercise A**

Observe the development of the following insects and say whether it has complete or incomplete metamorphosis.

- dragonfly
- beetle
- housefly
- moth
- mosquito
- leaf-hopper
- silverfish
- grass hopper
Eight major orders of insects

1. Hymenoptera — bees, ants, wasps
2. Diptera — houseflies, mosquitoes
3. Lepidoptera — moths, butterflies
4. Coleoptera — beetles
5. Orthoptera — crickets, grasshoppers, locusts
6. Odonata — dragonflies, damselflies
7. Homoptera — aphids, cicadas, leafhoppers
8. Hemiptera — bugs, backswimmers, water-striders

Exemplar Questions about Insects

- Did you know that bees, ants, and wasps are insects which build organized colonies and that these colonies are totally female colonies? What happens to the males? Do they exist? If yes, where?
- Ants have no wings, houseflies have two wings and cockroaches have four wings. Inspite of this difference, they are all insects. Why, what characteristics define an insect?
- What is the powdery stuff on the wings of butterflies and moths?
- Why do beetles have hard sheath wings?
- Can all insects smell?
- Can all insects hear?
- Can all insects produce sound?
- Have you heard insect sounds? If yes, which ones? How do insects produce sounds?
- How are dragonflies different from damselflies?
- Have you ever seen insects with transparent wings? Which are these insects?
- What are bugs? How can you identify them?
- Can you name some insects which are useful and some that are harmful to mankind?
- Can you tell the sources of lac, honey and silk?

Studying some more animals

Perhaps the most dramatic and unforgettable method of teaching children bio-sciences is to bring in live animals into the school/classroom.
Do's and Don’ts for Animal Study

- It is absolutely necessary that animals are very carefully handled and are not subjected to any form of stress. Students should be first told that animals are living things like themselves and can get hurt, and that it is cruel to cause any discomfort to them, howsoever slight it might be.

- You should be confident that the animals being used in a teaching situation are used to being handled and are not likely to get disturbed by a group of students. This is particularly important for the larger animals.

- Care needs also to be taken to see that children do not get bitten or scratched.

- Apart from this certain dangerous diseases are also transmitted by animals to people.

- Animals must be at ease if their normal functions are to be observed, for under stress they may behave abnormally.

The following are some examples for animal study within the school/classroom:

2.5.3 Observing an Aquarium

An aquarium full of fish is a very attractive facility, and a number of interesting concepts can be taught to the children, as, for example, the inter-relationship of plants and animals. After telling the students that fish take in oxygen from the water instead of from the air, you may initiate a discussion in the class about how the fish continue to get oxygen even though the amount of water in the aquarium is limited. This is an opportunity to explain the students that oxygen enters the water from the air touching the surface.

The next step could be to seal off this source of oxygen by spreading a thin layer of oil on the surface of the water. It may be observed that the fish will not feel unhappy for quite some time in an aquarium because the green plants in the aquarium give out oxygen. However, if you can show another aquarium which does not having green plants, the discomfort among the fish will be clearly visible by the layer of oil as they will come gasping for oxygen to the surface. The concept can then be enlarged to make them appreciate that the carbon-di-oxide we breathe out is removed similarly from the air by the plants around us.

Another very important concept that can be graphically illustrated by using three aquaria, one having plants and fish, one with clean water and plants and the other with dirty water and plants. The aquaria should be allowed to remain near an open window for several days. It will be seen that there will be mosquito larvae in the two aquaria without fish. You can initiate a discussion that brings out the fact that the fish have eaten up any larvae in their aquaria.
while there being no fish in the other two, the larvae survived. You may also further discuss that the aquarium with plenty of fish life has clear water even after several days and there will be no mosquito menace. Only wherever there are collections of stagnant water even in very dry areas, mosquitoes multiply.

Why mosquito larvae can thrive in dirty water and fish cannot, can also be further understood by the fact that the plants would die in dirty water as fish would too, while the larvae are able to live in it because the larvae come to the surface every now and then. That the larvae breathe from the surface can be proved by spreading a film of oil over the water; the larvae will soon die.

**Making a terrarium**

Terraria, like aquaria are very easy to set up. They are in fact aquaria but do not have any water in them; instead sand, rocks and land plants can be planted and the animals to be studied can be put into them. Some of the best animals for observation in a terrarium are the small reptiles like the garden lizard and the house gecko. Both these are insectivorous and are best kept during the rainy season. Insects like grasshoppers, praying mantis and cockroaches are all useful and a lot can be learnt about insects and their allies by observing them in carefully maintained surroundings. Scorpion, though not an insect, the difference between scorpion and a cockroach can be understood by observing live specimens.

Before taking any animal into the classroom, particularly if it is required to be kept for a number of days, the teacher should research on the creature’s basic requirements and be sure to provide these. During the rainy season, most butterflies and moths lay eggs and by carefully examining monsoon plant growth, eggs can be located. These can be placed in a terrarium and children can make observations on the hatching and subsequent behaviour of the larvae until they pupate and finally emerge as winged adults. It must be remembered that butterfly and moth caterpillars are very specific in their selection of food plants and the rule of the thumb is to give them fresh leaves of the type of plant on which the eggs or caterpillars were found.

Larger animals can also be brought into the classroom, but it is difficult to keep them in confinement. Snakes are a very fascinating group of animals for arousing the curiosity of the children, but handling snakes has to be done with great care. Domestic animals can serve as good example for students to study and recognize the differences between major classes of animals and between their major families. Some observations can be developed by studying pet animals. One obvious concept that can be transacted through use of live animals is the classification into carnivores, rodents and ruminants. Further observations can be made to show how the Canidae (Dog Family) differs from the Felidae (Cat Family) and so on and so forth.

The processes of evolution can also be explained by observing the varieties of domestic pigeons and comparing them with the wild species from which they have evolved. A separate discussion on body parts of animals can be initiated to explain their role in the very survival of the animal.
It is of course not possible to bring very large animals into the classroom, but children can learn about lions and tigers by first observing a domestic cat and then being taken to a nearby zoo and shown the bigger cats. A zoo visit can open up a wide opportunity for study of the animal kingdom, particularly the mammals and birds.

It is surprising but very few students know the difference and the similarity between the various groups of ruminants, such as the domestic ones like the cow, buffalo and camel and their wild relatives the deer, antelope and gazelle. You, as a teacher, have an innovative capacity to broaden your students' understanding about animals by bringing live animals into the educational experience of the children. We hope this section helps you do that to a certain extent.

2.6 WATER QUALITY MONITORING

Several interesting EE possibilities exist in environmental quality monitoring, among them water quality monitoring. Water is a basic support of life on earth, water has a direct and demonstrable bearing on the quality of our environment as a whole. You can do the following basic activities regarding Water Quality with your students

2.6.1 Odour in Water

Odour in water is due to natural or man-made causes. Natural causes may include decaying weeds and algae or the presence of micro-organisms. When organic matter decomposes, gases like ammonia and hydrogen sulphide are given off. These impart odour to water. Among human-generated causes, sewage and industrial wastes are also responsible for odour in water for they may contain halogens, sulphides or other chemical compounds. Odour is undesirable in drinking water, as also in the water used for certain industrial processes. Let us see the procedure for measuring odour in water.

**Equipment**
- 100 ml beaker

**Reagents**
- Nil

**Precautions**

1. Students testing odour should not have a cold or other nasal problems

2. Sense of smell varies from person to person. For good results, get about five students to smell the sample separately.

**Testing procedure**

Fill about 3/4th of the beaker with the sample water and smell it. Do this on the site itself immediately after collecting the sample water. If left for later, the water may lose its odour.

Record your observation in a table like the one given below by putting a tick mark (X) against the relevant odour.
2.6.2 Measuring temperature of water

Temperature plays an important role in certain biological and chemical processes. At high temperatures solubility of gases in water is low. Therefore the amount of dissolved oxygen will be low, while odour will be more.

Hot effluents

Increase in temperature normally occurs owing to the disposal of hot industrial effluents in the river. Temperature affects aquatic life both directly and indirectly by altering various parameters. There may be diurnal (i.e. through the day) or seasonal changes in river water temperature.

Equipments

Thermometer (0° to 50° C), 100 ml beaker

Reagents Nil

Precaution

Measure temperature at the site itself immediately after collecting the sample.

Testing Procedure

Fill about 3/4 of the beaker with the sample water and hold the thermometer upright in it. See that the bulb of the thermometer is completely under water. Observe the alcohol column and note whether it is rising or falling. When it stops moving, read the temperature indicated at the top of the alcohol column. Record the temperature in the Worksheet.

2.7 CONCLUSION

It is hoped that this unit will help you as a teacher in briefing the surrounding world into your classroom, thereby making education about the environment more contextual, hands on and effective.
2.8

Make a list of various outdoor studies that your students can carry out within and around the school campus. Match this to their curriculum and accordingly enlist which subject teachers could be consulted to provide guidance on these studies.