## APPENDIX - I
### ITEM ANALYSIS - TOOL - I

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APPENDIX - II

ACHIEVEMENT TEST FOR ENVIRONMENTAL EDUCATION

Instructions:
- Read the questions given below carefully.
- Write the answers in the answer sheet supplied to you.
- Answer all questions.

PART – A

Choose the right answer and mark (✓) in the relevant box.

1. Ecofriendly method of disposal of biodegradable waste is
   a) Vermitech  b) Throwing in the sea  c) Burning

2. Bacteria like Pseudomonas used in sewage disposal are involved in what type of action?
   a) Arobic  b) Anaerobic  c) Both

3. Which of the following constitute 70% of the gases produced by degrading organic solids in sewage?
   a) Carbon di – oxide  b) Carbon Monoxide  c) Methane

4. What is the time taken by banana peel to decompose?
   a) 10 weeks  b) 4weeks  c) 12) weeks

5. Bio technology aimed at achieving benefits for human kind obeying all ecological principles is
   a) Ecotech  b) Biotech  c) incineration

6. The main source of fresh water on the earth is
   a) Tap water  b) Well water  c) Rain water

7. Percentage of water on the earth is
   a) 50%  b) 75%  c) 95%

8. In industrial areas rain water contains
   a) Acids  b) Salts  c) Germs

9. Which salts are found more in sea water?
   a) Insoluble  b) Soluble  c) Both

10. Mangrove forests in West Bengal are called
    a) Sundarbans  b) Deciduous  c) Evergreen
11. Carbon monoxide prevents _________ in blood from carrying O₂
   a) Platelets     b) White blood cells     c) Haemoglobin

12. Pollutants from agricultural fields are
   a) Pesticides     b) Fertilizers     c) Pesticides and fertilizers

13. Each plant and animal species we find today is the outcome of millions of years of
   a) Evolution     b) Hard work     c) Growth

14. Cattle belong to which type of consumers?
   a) Primary     b) Secondary     c) Tertiary

15. Balance in numbers between producers and consumers is called
   a) Food pyramid     b) Balance in nature     c) Food chain

16. In how many countries of the world is biodiversity endangered?
   a) 14     b) 16     c) 15

17. What is the source of energy in Neyveli?
   a) Lignite     b) Petrol     c) Thorium

18. What force of sun and moon cause tides in seas?
   a) Electromagnetic     b) Gravitational     c) Magnetic

19. What is the rate of annual increase in petroleum consumption?
   a) 3%     b) 4%     c) 6%

20. What cells are used to convert solar energy into electrical energy?
   a) Plant cell     b) Solar cell     c) Animal cell

21. The need for increased food production led to what revolution in 20th century?
   a) Green revolution     b) Agricultural revolution     c) Industrial revolution

22. Which is the most populated city in India?
   a) Delhi     b) Mumbai     c) Calcutta

23. Which of the following causes skin cancer?
   a) Global warming     b) Ultra violet radiation     c) Green house effect

24. Which of the following sources of energy cause air pollution?
   a) Solar energy     b) Coal     c) Wind

25. The type of deer found in arctic region is
   a) Caribou     b) Musk deer     c) Spotted deer
PART – B

**Fill in the blanks with suitable answers**

26. When rain fails and all surface water dries up _______ water becomes more important.

27. Sulphur dioxide in the air dissolves in rain water and forms _______ rain.

28. The only planet in the solar system favourable for survival of living organisms is ____________

29. Emphysema is a respiratory disease caused by _____ pollution.

30. The type of germination found in Rhizophora is _______.

PART – C

**Read the following statements carefully and put (✓) mark in the relevant box.**

True ☐ False ☐

31. Algal bloom results in increase in oxygen content of oceans and lakes.

32. Only green plants are producers.

33. DDT is a biodegradable pollutant.

34. Polythene bags thrown in the oceans kill hundreds of animals.

35. Plants growing in Mangrove forests are hydrophytes.

36. Encroachments of water bodies like lakes and tanks result in going down of water table.

37. Taj Mahal is one of the monuments degraded by air pollution.

38. Gobar gas is a non-renewable source of energy.

39. Freon gas liberated from refrigerators causes depletion of ozone layer in stratosphere.

40. Energy produced from organic matter is biomass energy.

41. Pesticides when applied in agricultural fields kill only harmful pests.

42. Fertilizers are responsible for change in acidic and alkaline properties of soil.

43. Use of concrete sleeper instead of wooden sleepers in railway tracks is an eco-friendly solution.

44. Non biodegradable pollutants from industries enter into food chain through soil and water.
45. Use of cotton and jute bags does not help in conservation of natural resources.
46. Tamilnadu stands last among the states in the production of electricity from wind mills.
47. Plants cannot live on this earth without the help of man.
48. Use of synthetic materials like plastics, have some advantages also.
49. Contamination of ground water is reversible.
50. Human beings are the masters of the earth.
ANSWER SHEET

Name of the school : 

Name of the student : 

Test : Pre test □ Post test □

PART – A

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PART – B

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PART - C

31. True □ False □ 
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APPENDIX – III
ATTITUDE SCALE FOR ENVIRONMENTAL EDUCATION

Instructions:

➢ Read the statements given below carefully.
➢ Put (✓) mark to indicate what you feel about each statement.

Strongly agree: SA
Agree: A
Disagree: DA

1. All of us have the responsibility to care for the environment.
2. Every organism on this earth does not interact with several species.
3. All parts of earth suffer from same environmental problems.
4. Effects of human activities disrupt not only his local environment but also the entire earth.
5. Only experts can take proper steps to protect environment.
6. Population growth has occurred uniformly throughout the world.
7. We should balance welfare of human society with ecological health of our earth.
8. Technology can solve all ecological problems.
9. Along with water tax we pay, we should also pay for the treatment of sewage we let out of our houses.
10. We can dispose used up battery cells along with other household waste.
11. When I notice a leakage in the toilet pipe at school, I inform it to the teacher in charge immediately.
12. Using water based paints is not an ecofriendly action.
13. Use of greeting cards made of recycled paper is an ecofriendly action.
14. We should not throw plastic covers while passing through wildlife sanctuaries.
15. Use of plastic carry bags must be prohibited.
16. Each one of us need not know what happens to the sewage we let out of our homes.
17. Using solar heater instead of electric water heater does not protect environment.
18. Students can take part in nature conservation activities along with other agencies.

19. Laying concrete floor on all open grounds around buildings is a correct action.

20. Students should observe the natural world around their homes.
ATTITUDE SCALE – ANSWER SHEET

State whether you

- Strongly agree - SA
- Agree - A
- Disagree - DA

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<thead>
<tr>
<th>Q. No</th>
<th>Answer</th>
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<tr>
<td>1.</td>
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APPENDIX - IV

MANUAL FOR ACTIVITY STRATEGY
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<th>S.NO</th>
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<tr>
<td>1</td>
<td>Waste Materials - the Present Scenario</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Waste Materials – 50 Years Ago</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Vermi compost</td>
<td></td>
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<tr>
<td>4</td>
<td>POPULATION – GLOBAL CHALLENGES</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Population Explodes</td>
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</tr>
<tr>
<td>6</td>
<td>Plastics! Everywhere</td>
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<tr>
<td>7</td>
<td>Too Much of Detergents</td>
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<tr>
<td>8</td>
<td>Land Usage</td>
<td></td>
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<tr>
<td>9</td>
<td>Changing Life styles</td>
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<td>10</td>
<td>Complete the Story of Sarona</td>
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<tr>
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<td>Choose Between Sanctuary and Industrial Complex</td>
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<tr>
<td>12</td>
<td>BALANCE OF NATURE</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Components of Ecosystem</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Food Web</td>
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</tr>
<tr>
<td>15</td>
<td>A Pyramid in Ecosystem</td>
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<td>16</td>
<td>Prey – Predator</td>
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<td>17</td>
<td>VEGETATION TYPE</td>
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<td>18</td>
<td>Where is My Home?</td>
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<td>19</td>
<td>Too Salty for Me</td>
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<td>POLLUTION</td>
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</tr>
<tr>
<td>21</td>
<td>Let Us Lock Our Organs - Drama</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Is It True! - Conversation</td>
<td></td>
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<tr>
<td>23</td>
<td>Algal Bloom</td>
<td></td>
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<td>24</td>
<td>Choose Between Chemical Factory and Pure Water</td>
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<td>WATER</td>
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<td>26</td>
<td>Little Drop of Water</td>
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<td>27</td>
<td>Water Cycle</td>
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<td>28</td>
<td>ENERGY</td>
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<td>29</td>
<td>Energy – Choice</td>
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<td>30</td>
<td>Solar Cooker</td>
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<td>31</td>
<td>Choose Between Dam and Livelihood</td>
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FORWARD

The new syllabus designed by NCERT for environmental education emphasized the development of healthy attitudes and encouraging positive actions through activities. Accordingly, this booklet gives a detailed account of activities like survey, games experiments, and discussions generated by half-stories, drama, etc.

While some of the activities can be carried out in the class room others can be done outside the class rooms.

TIPS FOR CONDUCTING ACTIVITIES:

- Although, material requirements have been suggested with each activity, most of them can be done with alternative materials.
- Feel free to adopt the games for the needs of your participants.
- Discussions after the activities are helpful in enriching the educational impact of the game.
- To make the players feel comfortable, it is better not to correct minor mistakes they may make.
- Let players slightly change the rules of the game if they wish to.
- It is not necessary to keep perfect order during games. There should be fun and noise.
1. WASTE MATERIALS - THE PRESENT SCENARIO

Objectives:

To understand the composition of solid waste
To know how waste materials are disposed
To know the sources of water
To know the types of impurities in sewage
To analyze the eco–friendly methods of disposal of waste

Materials: Sheets of paper

Activity:

Students are given the following ten questions the previous day and asked to discuss with their parents and fill in the data.

A list of solid materials gathered by the students is written on the board and then classified as bio–degradable, non–bio–degradable and poisonous.

A discussion on segregation at source and handling them in proper manner is done.

Conclusion:

Need for segregation of solid waste is arrived at.

Need for minimizing solid waste i.e., reduce, reuse and recycle is understood.

Need for proper treatment of sewage is arrived at.

QUESTIONS

1. List the solid waste materials produced in your home.
2. Do you segregate solid waste at home?
3. What do you do with solid waste?
4. During travel, how do you carry water?
5. What do you do with the sewage generated at your home?
6. Where do you get water from?
7. What type of bags do you use to bring grocery from shops?
8. What are the materials used in grocery shops for packaging?
9. What do you do with plastic covers after usage?
10. What happens to the toilet waste in your home?

2. WASTE MATERIALS – 50 YEARS AGO

(For students who have people, above 50 years of age, in their homes or in the neighborhood)

Find out what people did fifty years ago

1. What were the common solid wastes produced 50 years ago?
2. Did they have plastic carry bags in those days?
3. What did they do with the solid wastes generated in their homes?
4. During travel, how did they carry water?
5. Name the materials used for:
   a) washing cloths
   b) washing hair
   c) washing dishes
6. What did they do with the sewage generated at home?
7. Where did they get water from?
8. What types of bags were used to carry grocery from shops?
9. What were the materials used to pack grocery in the shops?
10. Did they throw away the bags after using them once?

3. VERMI - COMPOSTING

Objectives:

To understand that the dung of animals and organic waste can be recycled and used again, by the process of vermicomposting
Materials:

Shovel digger, pieces of broken bricks, loamy soil, cattle dung, organic waste and earthworm

Procedure:

1. Students identify a shady place in their school garden and make a compost pit.
2. The bottom layer of the pit is filled with bricks and coarse sand. This is the vermibed.
3. Earthworms (of any kind) are introduced into the layer.
4. Over the vermibed, fresh cattle dung is placed at random. Water is sprinkled and then the pit is covered with palm leaves. It is sprinkled with water, twice every day, in the following days.
5. After two weeks, cattle dung is spread over the loamy layer. Decomposable garbage, of any type, is added into the pit periodically. Now, the pit is called compost pit.
6. After a month, the compost pit is allowed to dry for 3 or 4 days. The worms usually occupy the vermibed and the vermicompost is dug out for use.
7. Vermicompost is used as manure in the field to enrich the soil.

Further activity:

Observe the moist skin of the earthworm. Pour some fertilizers over the earthworm and record the findings.

4. POPULATION EXPLODES

Objective:

To explore the effects of increase in human population of earth.
Materials:

Chalk piece, black board, pencil, scale, graph sheets.

Activity:

Ask each group to refer the text book and write down the world population (in millions), in the form of a tabular column. Ask them to convert the population in billions, to make it convenient for graphical representation.

Now, ask them to plot the population in a graph sheet, using x axis for years and y axis for population, in billions. Then, let them connect the plots.

Now, let them infer the sudden increase in population.

Let each group discuss the challenges posed by sudden increase in population.

<table>
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<tr>
<th>YEAR</th>
<th>POPULATION IN MILLIONS</th>
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<tr>
<td>1800</td>
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<tr>
<td>1850</td>
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<td>1980</td>
<td>4400</td>
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<td>2010</td>
<td>7500</td>
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</table>

Discussion:

Let one member of each group come forward and discuss their conclusions.
5. PLASTICS! EVERY WHERE!!

Objective:

To list out the ‘use and throw’ plastic items.

To understand the ‘use and throw’ culture of modern life and its effect on environment.

Materials:

Paper, pen.

Activity:

Students are asked to list out the plastic and polycoated articles used, by visiting any two of the following places or by discussing with their family members and neighbors.

Grocery Shops, Ice Cream Stalls, Eateries, Hotels, Hospitals, Temples.

Discussion:

1. Discuss the amount of plastic garbage thrown out carelessly after use.
2. Discuss in which of the above areas we can,
   a) Replace plastics with other materials.
   b) We can reuse plastic items i.e. put into other uses.
   c) We cannot replace or reuse plastics.
3. Discuss on developing a system to collect and recycle plastic items.

6. TOO MUCH OF DETERGENTS

Objectives:

To help students understand that the various detergents used in homes cause water pollution, leading to Eutrophication.
Activity:

Conduct a brain storming session, a day before this activity, on the kinds of detergents used in households. Make a list and put it up in the classroom.

Explain the students, that detergents contain $\text{PO}_4$, which softens water to improve the cleansing action.

Kinds of detergents:

- Detergents to wash clothes including bars and powders and liquids.
- Detergents to clean dishes (bars, pastes, liquids, and powders.)
- Detergents to clean floors (liquid cleaning agents)
- Detergents to clean bathrooms (liquid cleaning agents)
- Detergents to clean glass, electronic items (liquid cleaning agents).

Ask the students to prepare an inventory of detergents used in their home every month, by asking their parents or checking the monthly shopping list.

Let them calculate the amounts of various cleaners consumed over a period of one year.

Conclusion:

When excessive phosphates enter a water body, it leads to algal bloom. The algae decompose and deplete the dissolved oxygen in the water. This results in the death of fish. This phenomenon is known as Eutrophication.
7. LAND USAGE

Objectives:

To enable the students understand ‘the change in the pattern of land usage’, due to increased population and changing lifestyles.

Activity:

- Discuss the different purposes for which land is used: for building houses, factories, offices, shops, agriculture, etc.

- Ask the students to draw a map of the area around their school. Ask them to carefully record how the land is used in that particular area.

- Ask the students to classify their observations into different categories, e.g.:
  - Land used for human habitation
  - Land utilized for agriculture
  - Land used for transportation
  - Land utilized for commercial purposes (offices, shops, etc.)
  - Land not utilized for any purpose by humans

- Ask the students to calculate the percentage of area under each category, approximately.

- Let them interview some elders living in that area to find,
  - How the land was used 30 years ago?
  - Why is there a change in usage?
  - How they feel - do they feel that the change is for better or worse?

Evaluation:

Generate a discussion on the impact of population explosion and changing lifestyles on the patterns of land use.
8. CHANGING LIFE STYLES

Objective:

To enable participants examine the prevalent mode of development.

Background information:

Development in its true sense is more than just economic growth. Thus, development needs to be concerned with the quality of life of people and the health of the environment.

Preparation:

Four copies of the case study “Paradise squandered” can be distributed to four groups. Leaders make charts and discusses among the members of the group.

PARADISE SQUANDERED

Long, long ago on a little island far, far away, people lived happily. This island Karu, had everything they needed: coconut trees for food and drink, magnificent spreading tomato trees for shade, abundant bird life and an ocean full of fish. Two hundred years ago, an English sailor discovered Karu and called it pleasant island.

Another century passed, an expedition was carried out to Karu. It was then discovered that the island had one of the richest piles of phosphate rocks on the globe. For most of this century, millions of tons of phosphate were shipped to other countries, where they fertilized fields and farms.

Karu is a small island over 20 square kilometers. The population includes 7000 Karuan natives and another 3000 imported workers.

Karu has only one road around the island, but the average Karuan family has at least two vehicles. They also have microwave ovens, stereo equipment and multiple televisions per family. Nine out of every ten Karuans are obese, and young men weigh more than 135 kilos because their native
food was replaced by imported foods which are subsidized by the government. Meat brought from another country more than 3200 kilometers away is cheaper than it is in that country. Today Karuans even import fish! Their changed diet habits are showing their ugly effect on Karuans. A person on this island can be expected to live only for about 55 years. Diseases like hypertension, heart disease and diabetes are common in that island.

Karuans receive their housing, power supply, water, telephones, and education and medical services free or for a nominal charge. The tiny island has hospitals, and karuans needing specialist treatment are flown at government expense to other countries.

Where does all this wealth come from? The wealth comes from phosphate. What then is the problem? The phosphate could run out before the next century. The government is now desperately searching for more phosphate even as the interior of the island lies ravaged by mining. They even plan to demolish the president’s residence in their search. Karuans continue to tear their island apart, live and spend as if there is no tomorrow. At this rate there may not be one.

[Based on: “PARADISE SQUANDERED”. Reader's digest, August 1997].

Discussion:

This can follow the presentation by one of the group leaders.

- Karu is an example of economic growth without sustainability. It is unsustainable because:
  - The economic gains are a result of seriously depleting the natural resources of the Island and may not last into the future, as the phosphate reserves get exhausted.
  - Human well-being is threatened because of health conditions such as obesity, hypertension, heart disease and diabetes.
9. COMPLETE THE STORY SARONA

Objective:

To help students think on the consequences of developmental activities.

Complete the Story:

Sarona is a part of the growing Markutta city. The city’s population is increasing rapidly and there is a great demand for houses for people. Sarona has also seen a number of housing complexes which came up in the past two years. Sarona has a two square kilometer shallow lake. The lake is the only source of livelihood for fishermen and washer men who live along its banks. The grass growing along the lake banks is used by cattle grazers. The lake is also frequented by many water birds in the monsoon and winter months. ——A builder has proposed to the municipality that the lake be drained and a housing complex built over it. He has also offered to build a bus stop for the people of sarona in one part of the drained lake if his proposal is accepted. --- --The fisher folk, cattle grazers, washer men and members of bird watchers club of Sarona are up in arms saying that the lake needs to be protected

Discussion:

How can we take up developmental activities without upsetting environment?

10. CHOOSE BETWEEN SANCTUARY AND INDUSTRIAL COMPLEX:

Objective:

To facilitate thinking on the consequences of environment versus development conflict situations.
Background information:

The basic resources required for living come from the environment. It is the environment that provides raw materials for our industries, food for us, and fuel for our transport, etc. The environment also absorbs the waste that our activities create. That is, the environment is both a source and a sink for developmental activity.

For example, inland water bodies are a source of fish, water for irrigation, etc. for village economies. They also act as a sink for excess fertilizer and pesticides that may run off from agricultural fields.

This is the reason why we cannot look at development in isolation from the environment which supports it.

Attempting development only by increasing economic profits and in isolation from concerns of human and environmental well-being can have undesirable consequences. When this happens, development activities cannot be sustained.

Thus, for development that will be sustained, the challenge is to make economic growth, human well-being and environmental well-being compatible.

Preparation:

For this activity you will need “half-story” cards.

A sample ‘half-story’ is given here. Write the half-story on a sheet of paper taken from a note book or on a piece of chart paper cut to the size of an average note book. Let each group read and discuss their ‘half-story’ and then complete the story in the way they think is most suitable.

Ask each group to display their story on the floor or on the notice board, with all their possible endings. The other groups can comment upon or add new ideas to the story.
Complete the story

The Nimipur sanctuary occupies 550 sq.km of an economically backward state. The sanctuary is mostly covered by bushes. The rest of the area is flat and dry, except in the monsoon when grass covers it. An extremely rare species of deer which is not found at any other place in the country lives in the sanctuary. The sanctuary is also home to the ‘pakari’ tribe who has been living in the area for generations. The pakaris are nomadic, moving from place to place in the sanctuary with their grazing herds.

A large industrial house has approached the government for permission to start mining in the sanctuary and to build a big industrial complex in the area. It has been found that the land in the sanctuary has good deposits of minerals. Most of the pakaris feel that the industrial complex will provide those jobs and end their poverty. Many people in the state believe that the industrial complex will attract other industries and bring economic development to the state.

But there are protests from wildlife enthusiasts that mining and industry will destroy the only habitat of the rare deer. Some people feel that the industrial complex will not provide jobs to the unskilled, illiterate pakaris. They feel that the traditional way of life of the pakaris will also be in danger as the mining will destroy the land and grazing may no longer be possible.

Discussion:

What is the impact of the industrial complex?

11. COMPONENTS OF ECOSYSTEM

Objective:

To help students understand the various components of ecosystem.

To help students experience the relationship between various biotic components.
To help students form food chain and food web.

Materials:

Papers, sketch pens, safety pins, list of biotic and a-biotic components in ecosystems of various kinds.

Activity:

As the teacher reads aloud the names of various components, each student comes forward to act as a component, writes it on a cord and, fixes the cord on his/her chest using a safety pin. Then the students are asked to form a circle. Teacher asks those who don’t have life to come inside and form an inner circle. Now the teacher explains that the components in the outer circle are biotic and those in the inner circle are abiotic.

Now the teacher asks

1. The rock and its components to form one row.
2. Water and its sources to form another row.
3. Air and its variables to form a third row.
4. Sun and its components to form the fourth row.

The teacher explains

1. Lithosphere
2. Hydrosphere
3. Atmosphere
4. Energy

Now the teacher asks the biotic components to group under the headings producers, herbivores, carnivores and decomposers.

Now the teacher helps students form food chains in

1. Grassland
2. Forests
3. Oceans
And this leads to formation of food web as many food chains cross each other.

**Evaluation:**

Role of different levels of consumers is discussed. Students are asked to think “What will happen if one component in food chain is eliminated by human beings?”

12. WEB OF LIFE

**Objective:**

To help players identify linkages between different components in the ecosystem.

**Materials:**

A ball of string, cards of biotic and abiotic components in the environment.

**Activity:**

Ask the pupils to sit in a circle.

Distribute one card each to all of them. Make sure to include cards depicting the four elements of nature: sun, soil, air and water. Also distribute a paper clip each and ask the players to pin their cards on their dresses so that everyone in the group is able to see who they are. The players can take turn to tell the group who he/she represents.

After this, ask the group from whom the game shall start. There may be a variety of suggestions from the players. Prompt the players by asking them whose energy makes life possible on earth. It is appropriate to start with the sun because it is the primary source of all energy that makes life possible on earth.
Take a ball of string and give it to the sun. Ask the sun to wind one end of the string on his/her finger.

The sun calls out “Whoever wants my energy can come and get”.

Now the tree or any other plant comes and takes the ball from the sun and explains its relation with the sun.

The tree then winds the string firmly once or twice around his/her finger and then passes it to another component asking for its energy e. g fruit.

Fruit can give the string to monkey, and the line of relationships continues as the string unwinds and begins to form a pattern which the players hold together. The game continues till the ball of string is completely used up.

Ask players to raise their hands and see the web they made. They have to hold the web tight to prevent it from sagging.

**Discussion:**

Tell the players that the web they made is the “web of life”. It represents the relationships amongst different components in the ecosystem.

An ecosystem may be subjected to a variety of pressures, such as drought. Press the web down with your hand to illustrate this pressure.

What happens then? As the web is held firmly, it bounces back after you release the pressure. A healthy ecosystem, in which all the elements are in a viable state, bounces back to health even if an external pressure is applied.

Now ask the players what would happen if some elements of the ecosystem are destroyed, for example if all the trees are cut down. To illustrate this, ask the player with the tree to let go the string. All the players linked to the tree card, e. g fruit, leaf, roots, monkey, parrot, etc to let go their strings too. Now, there will be a noticeable sag in the web.
What happens when an external pressure is exerted on the ecosystem now? Press down the web and see. The web will not bounce back with as much vigour as before.

Conclusion:

Conclude the game by explaining to the players the interrelationships in an ecosystem and their importance.

13. A PYRAMID IN THE ECOSYSTEM

Objective:

To understand the quantitative relationship between different tropic levels in an ecosystem.

Materials:

Ten students and cards indicating 4 tropic levels in an ecosystem.

Activity:

Discuss with students that in a forest there are a large number of plants, which provide food and shelter to many animals. In any forest the producers or plants will be more, to supply food for the entire group of herbivororous animals. Similarly herbivore population is sufficient enough to become a prey for the entire primary consumer and then to the secondary consumer. Thus, there exists what is called a balance in nature i.e. food pyramid.

- Ask 4 students to act as plants.
- Ask 3 students to act as herbivore.
- Ask 2 students to act as primary consumer.
- Ask 1 student to act as secondary consumer.
- Ask them to form a human pyramid.
Discussion:

Ask them ‘What would happen if any one of them is removed from the pyramid?’

Tell them that just as this pyramid will collapse, in nature also too much of destruction of any one of these groups of organisms would up set the entire ecosystem. When there are mild disturbances nature will correct itself.

14. PREY – PREDATOR:

Objective:

To demonstrate how predator – prey relationships operate in nature and the role of adaptations in predator – prey.

Materials:

Chalk, pieces of crumpled waste paper or pebbles to represent food for the prey animals (there should be at least two food tokens per prey animal).

Activity:

Divide the players into two groups. One group represents the ‘prey’, and other is ‘predators’. There should be approximately one predator for every four to six prey animals.

Tell the players that one end of the playing area has food of the prey species and the other end is the shelter for the prey. Mark (with chalk powder or stick) four or five circles (about half a meter in diameter), between the ‘shelter’ and the ‘food’ ends of the playing area. These circles represent temporary shelters for the prey.

Place the food tokens at the ‘food’ end of the playing area. The prey animals have to stand at the ‘shelter’ end. The predators stand anywhere between the food and shelter ends, except in the temporary shelters.

Each round of the game begins at a whistle or clap. The prey animals have to move from the shelter end, and collect two food tokens each. After
collecting the food tokens, they must return to the shelter. Unless they collect two food tokens they “die” of starvation (that is, they are out of the game in the next round). As the prey animals run from the shelter end to the food end and back with their food tokens, the predators try and catch at least two prey animals each. Otherwise they die. Captured preys are taken to their side by the predator.

The prey animals have two ways to prevent themselves from being caught: they may ‘freeze’ i.e. stand still when a predator is about half a meter away from them; or they may stand in the circles which are marked as temporary shelters. If a prey animal freezes, the predator has to look for other prey. The prey can remain still or be in the temporary shelters for as long as it likes, but if it does not get enough food at the end of the activity, it dies. The game can have up to four rounds.

15. WHERE IS MY HOME?

Objective:

1. To understand the climatic conditions of 4 vegetation zones of earth.
2. To understand the plants and animals living in each zone.

Materials:

World map – plain

White paper – sketch pens

Procedure:

4 students come forward to represent four zones. They draw their zone on the map and write the climatic conditions prevailing there using the plain map.

Each one of the students in the class comes forward to be a plant or an animal living at any one of the zones, writes the name on a paper and pins it on the chest.
Step-1

Zona – Arctic zone.

The student representing the zone explains the climatic conditions and invites the plants and animals to come and live there.

Step-2

Respective plants and animals come forward and display their names to the whole class.

The same procedure has to be followed for all the four zones.

Step-3

Any student with his/her label can come forward and ask the class ‘Where is my home?’ Students should be able to locate the zone correctly.

Conclusion:

This is done repeatedly till the students are able to locate the zones of all plants and animals.

16. TOO SALTY FOR ME!

Objective:

To understand that saline water will not allow absorption of water by plants.

Materials:

2 potted plants of same size, salt, water.

Activity:

Take two potted plants of same size. In one pot pour salty water and in the other pour fresh water in equal quantities and observe for two days. Note down your observations.
Discussion:

Discuss how reverse osmosis takes place in the roots and the roots wither under salty conditions. Tell how only halophytes are equipped with a mechanism to live in saline water.

Further activities:

Similar experiments can be conducted by creating water logged conditions and explain to the students that roots and germinating seeds require aerated soil. Discuss how halophytes are equipped with pneumatophores and viviparous germination.

17. LET US LOCK OUR ORGANS: - DRAMA

Characters:

- Doctor
- Compounder
- Patients – 5 patients suffering from 5 different forms of pollution.

Materials:

Paper locks – 5 no, Coat to cover entire body,

Life is a celebration. Life in tune with nature is a pleasant experience all along. All organisms live in tune with nature, except, the selfish and narrow minded human being.

A life respecting nature is a pleasant one. Artificial, busy, monotonous life is a night mare not only to human beings, but also for all living beings on the earth. All organisms lead a natural life in tune with nature, but man alone is selfish, narrow minded and tortures himself and also the 5 elements of nature called panjabudhas by polluting them.

“Today, students carry water bottles and books to school.

In future, they would add an oxygen cylinder in their back pack.”
Now let us present you a comedy highlighting

“Each type of pollution..... Locking up an organ!”

This drama depicts the horrifying experiences of people, affected by pollution.

Today’s news:

Shocking news: Ears becoming useless!!! Many people turned deaf in Mumbai, due to industrial and automobile noise pollution.

Patient: Oh, Doctor..! Doctor...! I can’t bear the pain in my ears. Please give me an injection. Please Doctor. Oh!...

Doctor: For how long have you been suffering?

Patient: For past one month sir, but now it is unbearable. Please help me doctor.

Doctor: This is a problem caused by excessive noise. But, there is no medicine for this.

Patient: Please Doctor... , Doctor Please... do something for me.

Doctor: Don’t worry. I will give you a treatment. Compounder! Get a lock for his ears.

Compounder: Yes Doctor.

[Goes and gets two locks and fixes them on both the ears of the patient] Doctor: Don’t worry! Now that your ears are locked, no sound can enter your ears. You will have no more pains.

Today’s news:

City is in the grips of fear! Chaos every where!
According to research findings, the sulphur and carbon levels in the city are too high. Many people are suffering from respiratory problems and irritation of eyes.

Patient: Doc…tor, a….n… a….n (gasping for breath), I am not able to breathe. Haaa….a….n…. Look at my eyes. They are red.

Doctor: Why don’t you take a deep breath and have a good sleep.

Patient: If I breathe haaa….n…, I get sneezing. Ach..ooo...,Oh..., Please give me some medicine.

Doctor: Your problems are due to air pollution. Automobiles and industries pollute the air we breathe. You know, there is no medicine for this. But don’t worry. I will help you. Compounder! Get a lock for his nose. [The two people fix a lock to his nose]. From now on, no air can enter your nose. Go and sleep comfortably.

Today’s news:

An announcement for the people of the city! Drinking metro water has caused vomiting, nausea, and diarrhoea among hundreds of people in the city.

Doctor’s warning: Don’t drink water.


Doctor: Dear fellow there is no surgical solution for this problem. Medicines can’t help you. All you have to do is to take my advice. “Compounder! Get the instrument”

Compounder: Doctor, shall I bring a lock?

Doctor: ok, ok.
[They fix a lock to the mouth]

Doctor: Now, your mouth is locked and no water can enter your body. You will be relieved soon. Be careful don’t open the lock man!

Today’s news:

Central government warns people!! Lots of people suffer from cancer! Modern farming methods blamed! Pesticides and fertilizers are the main cause of cancer.

Patient: Doctor! Doctor! I am suffering from ulcer in the mouth and stomach. I am not able to eat anything.

Doctor: For how long have you been suffering?

Patient: Past one month doctor. Now… it is paining. I can’t drink even a drop of water. Please doctor! Give me an injection or do some surgery.

Doctor: This is due to pesticides and fertilizers that are used to get high yields in agriculture.

Dear man, there is no medicine for this. I will give a wonderful solution.

Compounder! Get a lock for his stomach. [They both fix a lock on the stomach.]

Doctor: My dear fellow, now, no food can enter your stomach. It is well protected by this lock. You are safe.

Today’s news:

A warning from world health organization: Hole in the ozone. If sunlight falls on you, then you are sure to get skin cancer. “Beware of sunlight”

Patient: Doctor! Doctor! I have rashes on my skin. I can’t bear this itching. Please help me! Help me! Oh! God… help me!
Doctor: I will help you dear son. Compounder! Get our instrument.

Compounder: Shall I bring a lock doctor?

Doctor: No, No, bring a coat. [He brings a coat to cover the whole body.]

(All the actors come to the stage and sing a chorus)

Oh….! Can we live without hearing? (Shake their heads to mean no)

Can we live without breathing? (Shake their heads to mean no)

Can we live without water? (Shake their heads to mean no)

Can we live without eating? (Shake their heads to mean no)

Can we live with a permanent hood? (Shake their heads to mean no)

Then… STOP POLLUTING (In a loud voice)

COME ON EVERYBODY....

LET’S TAKE AN OATH

Let us join together and create a healthy world

Healthy world!

Healthy world!

Healthy world!
18. IS IT TRUE? – CONVERSATION

Karthiga is a very inquisitive girl of eighth grade. Environment is a topic that interests her and she has plenty of doubts in store. You can see her pouring out a rain of questions to her brother.

Karthiga: Vinod! Today our teacher taught us about global warming. How is it that the earth becomes hot all of a sudden?

Vinod: Industrial revolution and increase in motor vehicles has increased the use of fossil fuels like petrol and diesel. This means that extra carbon dioxide is produced. This absorbs the heat of the sun and retains it without letting it out. Hence the atmosphere around the earth becomes hotter and hotter.

Karthiga: Why should we worry about it? We shall fit an AC to our home.

Vinod: Wait… think about this - when our earth becomes warmer, the ice caps over the Himalayas will melt. In due course, there won’t be ice on Himalayas or even in the Polar Regions.

Karthiga: Oh, then what will happen to the polar bears and penguins? They will die? The beautiful penguins that we watch in our animal planet channel will be wiped out of this globe. I just can’t imagine an earth without those enchanting bird! Then, what is an ozone hole?

Vinod: Earth’s atmosphere contains ozone molecules at a height of 15km to 60km from earth. It is a protective cover for us because it absorbs all the harmful ultra violet rays in the sun light. Slowly, the density of ozone molecules is getting reduced day by day. This is called ozone hole.

Karthiga: But…, why does the ozone layer get thinner?

Vinod: The Chlorofluorocarbons or CFCs that we use in refrigerators is one of the substances that cause thinning of ozone layer.
Karthiga: Oh! The ultra violet rays fall on us…. If we use cars.., it causes global warming; if we use refrigerators..., we end up in skin cancer! Oh!

Vinod: We human beings have not spared even our rivers, ponds, lakes and oceans.

Karthiga: Yes, it is true. The sewage from our households reaches these water bodies and promotes excessive algal growth.

Vinod: Another reason for this algal bloom is the fertilizers from agricultural fields.

Karthiga: But that’s fine. Algae are after all green plants! Let them grow luxuriantly and feed all our fish.

Vinod: No, no, there is a problem in this excess growth. The oxygen content in the water gets reduced. Now, what do you think will happen to fishes?

Karthiga: Oh! Oh! The fishes will die of suffocation!

Vinod: This phenomenon is called Eutrophication.

Karthiga: What is it?

Vinod: Eutrophication, i.e. the death of all aquatic organisms due to depletion of oxygen.

Karthiga: Vinod! My teacher said that there are pesticides even in our body. How is it possible! We spray pesticides like DDT to kill pests. How can it reach our body?

Vinod: Farmers spray pesticides on the crops. When it rains, they dissolve in rain water and reach the rivers, where they enter into bodies of fishes (i.e. aquatic food chain).
Karthiga: Our teacher said that the quantity of DDT inside the body of fishes goes on increasing.

Vinod: This phenomenon is called bioaccumulation of harmful chemicals in the bodies of organisms.

Karthiga: Terrible! If we eat those fish they will enter our bodies too!

Vinod: Very true. We should remember that the pure air, sweet water and the fertile soil are the vital sources of life on this earth.

Youth like us, should not tolerate the pollution of these precious resources any more.

Karthiga: Let us find alternate sources of energy!

Vinod: Let us practice organic farming!

Karthiga: We should find new techniques for sustainable development!

Vinod and Karthiga: We will SAVE OUR MOTHER EARTH!

Arise, awake and stop not till we SECURE OUR MOTHER EARTH!!!

19. ALGAL BLOOM:

Objectives:

To understand how phosphates in detergents and fertilizers affect algal growth.

Materials:

Two glass vessels, algae, one teaspoon full of detergent powder/any phosphate fertilizer.

Activity:

- Ask students to collect some algae from a pond or a ditch
- Let them take two glass vessels of equal size and fill three-fourths of one with tap water and the other with water containing some detergents or any phosphate fertilizer.

- Now let them add small but equal amounts of algae to both the jars. Let the jar remain in direct sunlight for two weeks.

- After two weeks which jar has more algal growth? Why?

**Evaluation:**

Discuss why this happens and relate this activity to the effects of polluted water containing phosphates in water bodies like lakes, oceans, etc.

**20. COMPLETE THE STORY**

**CHOOSE BETWEEN CHEMICAL FACTORY AND PURE WATER:**

Chetan chemical industries limited (CCIL) is a large chemical factory that supplies chemicals to many industries in the state. More than 5,000 workers are employed in the industry. Waste water from CCIL finds its way into the nearby river. Villagers living downstream have been protesting that the waste water has ruined their agricultural lands, has been responsible for cattle deaths and has also caused skin diseases. The pollution control authorities have recommended that the industry should be closed down as it has been causing severe pollution. The workers’ union protests that if the industry closes down, they will lose their livelihoods.

One student presents the story. Entire class discusses alternative solutions to the problem.
21. LITTLE DROP OF WATER:

Objective:
To demonstrate the distribution of water on earth.

Materials:
Large container (2.5 liters volume) with water, small transparent container, two small dishes, measuring cylinder, teaspoon and an ink-dropper.

Activity:
Ask the students to take a teaspoon and transfer 12 spoonfuls of water from the large container to the small transparent container. Tell them that the water in the small container is the total amount of fresh water on the earth, including the water found in lakes, rivers, ice-caps, and as groundwater. The water that remains in the large container represents salty water found in oceans and seas. From the small container (with 12 spoonfuls of water), let the students measure out two spoonfuls into a dish – dish A. The water in the dish A represents the groundwater. Let the students take another dish – B and transfer into it half-a-spoon of water from the small container, which now has 10 spoonfuls of water. The water in dish B represents the water found on the surface of the earth in freshwater lakes. From the remaining water in the smaller container, let the students remove one drop using an ink-dropper. This drop represents the amount of water found in rivers. The smaller container will now have about nine spoonfuls of water left in it. Tell the students that this represents the amount stored in ice-caps.

Ask the students to compare the qualities of water in the various containers.

Evaluation:
Ask the students how the fresh water stored as ice becomes available to us.
Ask how people use sea water and whether it can be converted to fresh water for our use.

<table>
<thead>
<tr>
<th>Distribution of water on earth in %</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Oceans</td>
<td>97.2</td>
</tr>
<tr>
<td>Ice-caps</td>
<td>02.0</td>
</tr>
<tr>
<td>Ground water</td>
<td>00.62</td>
</tr>
<tr>
<td>Fresh water lakes</td>
<td>00.009</td>
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<tr>
<td>Inland seas and salt lakes</td>
<td>00.008</td>
</tr>
<tr>
<td>Atmosphere</td>
<td>00.001</td>
</tr>
<tr>
<td>Rivers</td>
<td>00.0001</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>99.8381</strong></td>
</tr>
</tbody>
</table>

22. WATER CYCLE

Objectives:

1. To know water cycle.
2. To understand that rain water is the major source of fresh water.

Materials:

Glass/metal dish, drops of black ink, transparent glass or polythene sheet and water.

Activity:

Pour some water in a glass or metal dish. Add a few drops of black ink to the water. Cover the dish with a transparent glass or polythene sheet. Leave it in sunlight for 15 to 20 minutes. You will see droplets of water
condensing on the inner surface of the glass or sheet. Ask the students to note the color of the water drops. They may taste the water drops.

Repeat the experiment using salt water.

**Findout:**

Does condensed water taste salty?

### 23. ENERGY CHOICE

**Objective:**

To help students understand the various steps involved in energy generation and its impact on the environment.

**Activity:**

- Let students list all the sources of energy.
- Ask students to think of various steps involved in converting the different sources of energy into a source of useable energy.
- Draw energy sources matrix on the board. Assign one energy source to each group. Let them discuss within the group and write the nature of each source of energy and its impact on the environment.

After 10 minutes, one person from each group comes to the board and put a cross mark against each applicable consequence.

**Discussion:**

List out the consequences of using different sources of energy. Discuss the barriers in using renewable resources like wood, biogas, water, wind and solar energy.
<table>
<thead>
<tr>
<th>CONSEQUENCES</th>
<th>COAL</th>
<th>PETROL</th>
<th>KEROSENE</th>
<th>NATURAL GAS</th>
<th>HYDRO POWER</th>
<th>WIND ENERGY</th>
<th>SOLAR ENERGY</th>
<th>FIRE WOOD</th>
<th>NUCLEAR ENERGY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not renewable</td>
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<tr>
<td>Renewable</td>
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<td>Cause pollution</td>
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<td>Does not pollute</td>
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<td>Destroys forests</td>
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<td>Seasonal</td>
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<td>Potential risk</td>
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</table>

24. SOLAR COOKER

Objective:

To understand that solar energy can be used to heat water and cook food.

Materials:

Box – cardboard 2x2’, Waste news paper, Aluminum foil sheet

Procedure:

Fill the box with balls of news paper with a gap in the centre.

Fix the aluminum foil in a concave form, inside.
Let the lid be covered inside with aluminum foil in a concave shape.

Keep the box facing sunlight, so that the sunlight reflected by the lid converges on the box.

Keep a stainless steel vessel full of water in the box.

Note the temperature of water after 30 minutes.

**Inference:**

Note the temperature of water.

**Control:**

Keep another vessel of water outside the box.

Compare the temperature of water.

**25. CHOOSE BETWEEN DAM AND LIVELIHOOD**

One of the students presents the story to the class and the entire class comes out with probable solutions which are discussed.

The Harica River passes through the Girivar hills. The hills are covered with forests. Many dozens of tribal villages are nestled on the hills. In the valleys are located about a hundred small villages. The government is thinking of building a huge dam to generate hydroelectricity. This electricity will be useful in meeting the demands for more electricity in the growing cities and industrial complexes. The tribal communities and the villagers protest that the dam’s reservoir will submerge their homes and fields. Environmentalist are of the opinion that the dam may not yield as much electricity and water as promised after few years, and that it will submerge vast areas of forest land. They also feel that the dam may increase the chances of earthquakes occurring in that area.

One student presents the story to the class and the others discuss alternative solutions.