APPENDICES
SELF-LEARNING MODULES
ON
SCIENCE
AN - OVERVIEW

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THIS MODULE PRESENTS AN OVERVIEW OF THE SIX MODULES IN SCIENCE FROM YOUR SYLLABUS

READ IT CAREFULLY AS IT WILL HELP YOU TO UNDERSTAND THE SUBJECT MATTER EASILY

CONCEPT OF MODULE

Modules are relatively a new means of instructions. A self-learning module is one type of instructional material with which a learner can acquire knowledge, skills and attitudes in the absence of a teacher. It differs from other types of instructional materials. It is self-contained and independent of live instructions.

OBJECTIVES OF MODULE

The following are the main objectives of modules:
1. To inform the learner what they are supposed to learn.
2. To facilitate learning by motivating the students
3. To promote longer retention by active participation of the students
4. To accelerate the process of learning by providing immediate feedback

DIRECTIONS OF USING MODULE

To gain maximum benefits from these modules read the following instructions carefully
a) There are six modules. Each module is presented as a separate booklet.
b) Pages are numbered according to the module/unit
c) Each unit has a sequence of following activities.
OBJECTIVES
There are general and specific objectives for that unit. Objectives give an indication of what you should be able to do after learning through the module.

INPUT
This contains new information for you to learn.

PRACTICE TASK
Here, you are presented with a series of tasks based on the input, you must complete these tasks.

FEED BACK TO PRACTICE TASKS
This contains correct answers to practice tasks.

POST-TEST
After completion of all inputs and practice tasks, attempt the posttest given at the end of each module.

FEEDBACK TO POSTTEST
Compare your answers of posttest with those given in the feedback to post test if you answer all the questions correctly proceed to next module. Otherwise, go through the module again.

a) Begin working on the next unit in module only after you have completed the previous unit and you are confident that you have achieved the objectives of the module.
b) Don't mark/spoil the module in anyway. You will be given separate practice task sheets by investigator. Use separate sheets for writing answers.

THE BENEFITS YOU GET FROM THIS MODULE DEPENDS ON YOU AND HOW YOU USE IT

GOOD LUCK!
NOW GO TO MODULES
MODULE 1

SELF-LEARNING MODULE

TOPIC: NUTRITION

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PRE TEST

1. What is food?

2. What are the important functions of food?

3. List three causes that adversely affect the health

4. List three basic conditions for maintaining good health

5. Which solution is given to the patients in hospitals?
FEED BACK TO THE PRE TEST

1. Food is a nutritive substance, which helps in growth, repair, work and maintenance of life.

2. 1. Acts as a fuel to provide energy 2. Helps in repair of worn out tissues 3. Provides resistance to the diseases

3. (i) Overpopulation (ii) Unhygienic conditions (iii) Poverty

4. Personal cleanliness, exercise, rest and healthy habits

5. Glucose
OBJECTIVES

Learners will be able to achieve the following objectives after reading this self-learning module.

GENERAL OBJECTIVES

1. Develop the habit of self-learning.
2. Develop an interest in science.
3. Develop science process skills.

SPECIFIC OBJECTIVES

1. Write the definition of food in their own words.
2. Recollect seven components of food.
3. From the given list of sources, they will be able to identify the nutrient present in them.
4. Classify the given list of sources of food on the basis of nutrients present in them.
5. Identify the problems related to the deficiency of different nutrients.
6. Make hypothesis related to the problems.
7. Will be able to perform experiments to test the presence of proteins, carbohydrates and fats in a given food.
8. Explain the importance of various components of food for our body.
FOOD

Food is a substance which when taken, digested and absorbed provides materials for activity (i.e., energy production), growth, repair (maintenance) and reproduction.

We can consider the broad groups of foods 1. Energy giving foods, 2. Bodybuilding foods, 3. Protective foods.

ENERGY-GIVING FOODS

We need energy to move parts of our body, to make substances inside body and also for certain other functions of the body food provides energy.

BODY BUILDING FOODS

Foods such as proteins are required for growth and repair of damaged cells

PROTECTIVE FOODS

Certain food constituents such as vitamins and minerals are required in food for body functions. The absence of these food constituents causes deficiency diseases. So eating food rich in these constituents should prevent their deficiency.
COMPONENT OF FOOD

The components of food are certain organic substances, and certain minerals called nutrients.


They are called nutrients because they promote growth and repair of natural wastage of living organism i.e they are required for the survival of living beings.

Roughage (dietary fiber) and water are also essential for the body.
CARBOHYDRATES

Carbohydrates are a class of energy yielding substances. Chemically they are made up of carbon, Hydrogen and Oxygen.

Examples of carbohydrates are starch, sugar and glucose etc. Cereals, roots and tubers largely give us starch. Glucose is the simplest carbohydrate, which is an instant source of energy.

SOURCES

In our country major sources of carbohydrates are wheat, maize, rice, bajra, potato, sweet potato, banana, etc.

ACTIVITY 1

Test For Presence Of Starch In Food

Take a small amount of food to be tested in a test tube and add a few drops of iodine solution. Appearance of blue-black colour indicates the presence of starch in food.

ACTIVITY 2

Test For Presence Of Glucose (sugar) in food

Take a small amount of food in a test tube and crush it. Add a few drops of Benedict’s solution and heat it. The change of the colour of solution to reddish orange indicates the presence of glucose in given food stuff.
PROTEINS

The term protein was given by J. Berzelius (1938). Proteins are made up of smaller units, called amino acid. Most proteins present in body of living organisms are made of twenty amino acids.

FUNCTIONS

Proteins not only form the building material of our body but also carry out our other functions.

Various functions performed by different types of proteins are shown in the following table

FUNCTIONS OF SOME PROTEINS

<table>
<thead>
<tr>
<th>Type of body protein</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Enzymes</strong></td>
<td>Biocatalysts. They help in biochemical reactions occurring in the body all the time.</td>
</tr>
<tr>
<td><strong>Transport proteins</strong></td>
<td>Hemoglobin. Carry different substances in the blood to different tissues</td>
</tr>
<tr>
<td><strong>Contractile proteins</strong></td>
<td>Myosin, Actin etc. They are responsible for muscle contraction for movement and locomotion</td>
</tr>
<tr>
<td><strong>Hormones</strong></td>
<td>Some hormones are proteins. They regulate body functions</td>
</tr>
<tr>
<td><strong>Structural proteins</strong></td>
<td>Form parts of cells and tissues</td>
</tr>
<tr>
<td><strong>Protective proteins</strong></td>
<td>Antibodies. They help to fight infections</td>
</tr>
</tbody>
</table>
Deficiency of proteins causes two diseases in infants: **marasmus** and **kwashiorkor**.

**SOURCES**

Some of the best sources of plant proteins are: groundnuts, nuts (almond, cashew nuts and chestnuts), beans, whole cereals such as wheat, maize and pulses some of the best sources of animal proteins are lean meat fish, egg, milk, cheese and curd.

**ACTIVITY 3**

**Test for proteins in food**

Put a piece of hard-boiled egg white in a test tube. Add a few drops of nitric acid. Heat the test tube slightly. Throw away the acid and rinse with water three times. Add ammonium hydroxide. The piece of egg white, which may show yellow colour on heating with nitric acid, changes to orange when ammonium hydroxide is added. This indicates the presence of protein in egg white.
Now it’s The Time To check What You Have Learnt

PRACTICE TASK 1

FILL IN THE BLANKS

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Carbohydrates are ____________ food.</td>
</tr>
<tr>
<td>2.</td>
<td>Proteins are ____________ food.</td>
</tr>
<tr>
<td>3.</td>
<td>Vitamins and minerals are ______ food.</td>
</tr>
<tr>
<td>4.</td>
<td>Carbohydrates are made up of ____ , ____ and ______.</td>
</tr>
<tr>
<td>5.</td>
<td>______ Is used to detect presence of starch in food.</td>
</tr>
<tr>
<td>6.</td>
<td>______ Is used to detect presence of sugar in food.</td>
</tr>
<tr>
<td>7.</td>
<td>Biocatalysts are a type of ______ proteins.</td>
</tr>
<tr>
<td>8.</td>
<td>Haemoglobin is a _________ protein.</td>
</tr>
<tr>
<td>9.</td>
<td>Proteins are made up of __________.</td>
</tr>
</tbody>
</table>

Deficiency of proteins causes ______ and ___ diseases in Infants.
**FATS**

Fats are made of glycerol and fatty acids, like carbohydrates, fats contain carbon, hydrogen and oxygen atoms.

**FUNCTIONS**

1. Fat is a concentrated source of energy.

2. Fat stored in tissues beneath the skin insulates the body.

3. Fat forms the protective shock absorbing cushions around a number of organs like eyeball, kidney and ovaries.

**SOURCES**

Fats are divided into two groups, animal and vegetable fat. **Animal fat** is found in milk, cheese, butter, eggs, meat and oily fish. Vegetable fat is found in **vegetable oil** present in nuts such as walnut, almonds, groundnut and coconut. It is also found in mustard seed, sesame (til) seeds.

**Types Of Fatty Acids**

Fats are generally solid at 20 c. but if they are liquid at this temperature, they are called oils. This property depends on the type of fatty acid present in given type of fat.

There are two types of fatty acids- saturated and unsaturated.
Unsaturated fatty acids

Fats containing unsaturated fatty acids are in liquid form at room temperature. Unsaturated fatty acids are found in fish oil and vegetable oils such as groundnut oil, cottonseed oil, olive oil etc.

Saturated fatty acids

Fats containing saturated fatty acids are solid at room temperature. Coconut oil and palm oil are the only saturated vegetable oils. Saturated fatty acids occur in animal fat, vanaspati, butter, desi ghee.

The diet should contain less of saturated fat like butter, ghee, etc. because saturated fat easily changes into cholesterol, which is known to cause arteriosclerosis (thickening of walls of arteries), high blood pressure and heart disorder.

ACTIVITY 4

Test for the presence of fat in food

Take some peanuts and grind them with a stone on a piece of white paper. Hold the paper to light. The
appearance of translucent greasy spot on the sheet of paper indicates the presence of fat in the groundnut.

**VITAMINS**

The term vitamin was given by C. Funk in 1911. These are organic compounds needed in small quantities to maintain growth and normal metabolism. Vitamins are found in food and deficiency of vitamins causes diseases. Based on solubility, vitamins are grouped into two classes:

- **Water soluble** (Vitamin-B complex and vitamin-C) and
- **fat soluble** (Vitamins A, D, E, K,)

Vitamins cannot be synthesized by the cells of our body and must be supplied by food containing specific vitamins. However, the body can synthesize Vitamin D and K.
**IMPORTANT VITAMINS AND THEIR SOURCES**

The following table lists many important vitamins and their sources.

<table>
<thead>
<tr>
<th>Vitamin</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin A</td>
<td>Yellow and Green leafy vegetables, carrot, fish liver oil, liver</td>
</tr>
<tr>
<td>Vitamin $B_1$ (thiamine)</td>
<td>Milk, seafood, soyabean, whole cereals, green vegetables</td>
</tr>
<tr>
<td>Vitamin $B_2$ (riboflavin)</td>
<td>Milk, peas, beans, yeast, meat, egg, green leafy vegetables</td>
</tr>
<tr>
<td>Vitamin $B_3$ (niacin)</td>
<td>Meat, fish, fowl, potato, wholegrain, tomato, groundnut, green vegetables.</td>
</tr>
<tr>
<td>Folic acid</td>
<td>Green leafy vegetables, sprouted pulses</td>
</tr>
<tr>
<td>Vitamin $B_{12}$ (cyanocobalamin)</td>
<td>Meat, liver, milk</td>
</tr>
<tr>
<td>Vitamin C</td>
<td>Citrus fruits, especially amla, lime, lemon, orange, guava</td>
</tr>
<tr>
<td>Vitamin D</td>
<td>Milk, fish, liver oil, egg.</td>
</tr>
<tr>
<td>Vitamin E</td>
<td>Green leafy vegetables, milk, butter, tomato.</td>
</tr>
<tr>
<td>Vitamin K</td>
<td>Green leafy vegetables, tomato, soyabean oil, liver</td>
</tr>
</tbody>
</table>
Now it's The Time To check What You Have Learnt

PRACTICE TASK 2

FILL IN THE BLANKS

1. Fats are made of _______ and _______.

2. Fats containing _______ fatty acids are liquid at room temperature.

3. Fat stored in tissues beneath the skin _____ the body.

4. Fats form _________ cushion around many organs.

5. The term vitamin was coined by ______.

6. Two groups of vitamins are water-soluble and _____ soluble.

7. Our body can synthesize vitamin _______ and _______.

8. Vitamin _______ is contained in large amounts in citrus fruits.

9. Vitamins are organic substances required in _____ amounts to maintain _______ and metabolism.

10. On exposure to sunlight our body can synthesize vitamin_______.

MINERALS

Minerals are inorganic substances. At least 29 elements are found in our body.

IMPORTANT MINERALS, THEIR FUNCTIONS AND SOURCES

Minerals have no energy value but they do have important functions in the body, which are listed in the following table.

<table>
<thead>
<tr>
<th>MINERAL</th>
<th>MAJOR SOURCE</th>
<th>FUNCTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium</td>
<td>Common salt, fish, meat, egg, milk</td>
<td>1 contraction of muscles</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 transmission of nerve impulses in nerve fibre</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 maintenance of positive electrolyte balance in the body</td>
</tr>
<tr>
<td>Potassium</td>
<td>Widely distributed in all foods</td>
<td>1 many chemical activities inside cells</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 the contraction of muscles</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 transmission of nerve impulses</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 Maintenance of electrolyte balance in the body</td>
</tr>
<tr>
<td>Calcium</td>
<td>Milk, cheese, eggs, green vegetables, whole gram, cereals</td>
<td>1 in association with vitamin D, it is essential for hardening of bones and teeth.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 it plays an important part in coagulation of blood</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>Milk, cheese, green leafy vegetables, bajra, liver, kidney</td>
<td>Associated with calcium in hardening of bones and teeth</td>
</tr>
<tr>
<td>Nutrient</td>
<td>Sources</td>
<td>Functions</td>
</tr>
<tr>
<td>----------</td>
<td>------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| Iron     | Liver, kidney, egg, yolk, whole meal bread, bajra, ragi, apple, banana and other green vegetables | 1. It is essential for the formation of hemoglobin in the red blood cells  
2. It is necessary for tissue oxidation |
| Iodine   | Salt-water fish, seafood, green leafy vegetables, iodized common salt. | It is essential for formation of thyroxine, the hormone secreted by thyroid gland. Its deficiency causes goiter. |

**ROUGHAGE**

Roughage is the indigestible part of the diet, for example cellulose in fruits and vegetables and connective tissues in meat and vegetables and connective tissue in meat and fish.

**FUNCTIONS**

Roughage performs the following functions:

1. Roughage has water-holding capacity in the body.
2. It adds bulk to the food and prevents constipation.

**SOURCES**

Sources of roughage are-salad, vegetables and fruits with their skin as the skin have high fiber content. Cabbage is one such vegetable, which gives us a far greater amount of roughage. Cob (bhutta), and porridge (dalia), and porridge
(dalía), also provide good roughage material in addition to other nutrients.

**WATER**

Water is an important part of our diet. It makes 65-75% of the body weight. Excess loss of water due to vomiting and diarrhoea leads to dehydration, which may be fatal.

**FUNCTIONS**

1. Water regulates the temperature of our body by sweating and evaporation.

2. It provides an important means of excreting body wastes.

3. Most biochemical reactions occurring in the body take place in the aqueous medium.

4. It forms a good solvent.
Now it's The Time To check What You Have Learnt

PRACTICE TASK 3

FILL IN THE BLANKS

1) Minerals are _______ substances.

2) _______ is required for making haemoglobin.

3) _______ is required for making thyroxine.

4) _____ and _____ are needed for formation of bones.

5) _____ and _____ are needed for maintaining electrolyte balance in the body.

6) Deficiency of _______ causes goiter.

7) Undigestible fibrous material present in food is called _______.

8) _______ has water holding capacity.

9) Water regulates temperature of our body by _______ and _______.

10) Water forms a good _________________.

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Now it's The Time To check What You Have Learnt

POST TEST

A Fill in the blanks

1. Antibodies are a type of _______ proteins

2. Actin and _______ are _______ proteins.

3. Saturated fatty acids are _______ at room temperature.

4. Saturated fats easily change into _______ which causes high blood pressure and _______ disorders.

5. _______ prevents constipation.

B Choose the correct answer from the four alternatives given below

(1) Iodine test is used to detect

1 Malaria 2 Typhoid 3 Carbohydrates 4 Fats

(2) Fat soluble vitamins are

1 A B C D 2 ADEK 3 ACDK 4 None

(3) Which of the following is rich in vitamin A

1 Yeast 2 Apple 3 Amla 4 Green vegetables

(4) Which of the following will provide maximum roughage to your

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diet, if taken in equal amounts

1 Egg 2 Cabbage 3 Tomato 4 Rice

C MATCH THE FOLLOWING

Each of foods in the left hand list is closely related to one of the words in right hand side. Write them in correct pairs.

<table>
<thead>
<tr>
<th>Column I</th>
<th>Column II</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Whole meal bread</td>
<td>a. Protein</td>
</tr>
<tr>
<td>2. Sugar</td>
<td>b. Insulation</td>
</tr>
<tr>
<td>4. Eggs</td>
<td>d. Plant Protein</td>
</tr>
<tr>
<td>5. Soya Beans</td>
<td>e. Roughage</td>
</tr>
</tbody>
</table>

D How will you test the presence of protein in the given food?

E How will you test the presence of fats and starch in the given sample of food?
KEY TO ANSWER

PRACTICE TASK 1

1) Energy giving food
2) Body building foods
3) Protective food
4) Carbon, Hydrogen, oxygen
5) Iodine solution
6) Benedict’s solution
7) Enzymes
8) Transport
9) Amino acids
10) Marasmus, Kawashiorker
PRACTICE TASK 2

1) Glycerol, Fatty acids
2) Unsaturated
3) Insulate
4) Shock absorbing
5) C.Funk
6) Water insoluble
7) D, Vitamin K
8) C
9) Organic, small, growth
10) D

PRACTICE TASK 3

1) Inorganic
2) Iron
3) Iodine
4) Calcium, Phosphorous
5) Sodium, potassium
6) Iodine
7) Roughage
8) Roughage
9) Sweating, Evaporation
10) Solvent
POST TEST

A Fill in the blanks

1) Protective
2) Myosin, Contractile
3) Solid
4) Cholesterol, Heart
5) Roughage

CHOOSE THE CORRECT ANSWER

1. Carbohydrates (2) A D E K (3) Green vegetables (4). Cabbage

C Match the following

(1) d (2) e (3) b (4) a (5) c

D To test the presence of protein in given food

Put the given food in a test tube. Add a few drops of nitric acid. Heat the test tube slightly. Throw away the acid and rinse with water three times. Add ammonium hydroxide. The piece of food, which may show yellow colour on heating with nitric acid, changes to orange when ammonium hydroxide is added. This indicates the presence of protein in the given food.
To test the presence of fats and starch in the given food

Take a small amount of the given food in a test tube and add a few drops of iodine solution. Appearance of blue-black colour indicates the presence of starch.

To test the presence of fats in the given food

Crush the given food on a paper. Now remove the crushed food and hold the paper towards light. The appearance of translucent greasy spot on sheet of paper will show the presence of fats in the food.
MODULE 2

SELF-LEARNING MODULE

TOPIC: ADULTERATION OF FOOD

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PRE - TEST

Answer the following questions:

1. What type of food should we eat?

2. What do milkmen usually add to the milk?

3. Name the impurities that are separated from Pulses or Rice before cooking?

4. From where do the impurities (mentioned in above question) come?

5. In how many physical states does water exists?

6. You are provided with a sample of water in a beaker. How do you come to know this water is pure?

7. Name some commonly used devices used in your homes for purifying drinking water.
FEEDBACK TO THE PRE TEST

1) We should eat balanced, pure and hygienic food

2) Water

3) Stones

4) Shopkeepers add them

5) Three; solid, liquid and gaseous

6) Pure water will be colourless odourless and tasteless

7) Candle filter, Aqua guard, Earthen vessels
OBJECTIVES

The learners will be able to achieve following objectives after going through this module

GENERAL OBJECTIVES

1) Define the term adulteration in their own words.
2) Observe the cases of food adulteration in their daily life
3) Recognize the various problems related to food adulteration and make hypothesis for these problems
4) Conduct experiments to detect adulteration present in the given sample
5) Interpret the experimental data related to the topic
6) Suggest different ways to make the impure water fit for drinking
7) Conduct experiments to purify the water
FOOD ADULTERATION

Like air water and shelter, food is also very essential requirement of our life. We must get our food in its purest form. However as everyone wants to make easy money, they sometimes engage in food adulteration. **The deliberate contamination of food material with low quality, cheap, non-edible or toxic substances is called food adulteration.** The undesirable substances which are mixed with the food materials and degrade the quality of food stuff are called **adulterants** Adulteration of food consists of a large number of Practices such as mixing, substitutions, abstractions, putting up decomposed food for sales & addition of poison etc.

ILL EFFECTS OF ADULTERATION

Adulterants are much cheaper than the concerned foodstuffs. Thus selling adulterated food material can bring huge easy money for the dishonest traders, but it may spoil many precious lives.

FOR EXAMPLE

**Lead Chromate** is a highly toxic salt of lead. It is commonly used as an adulterant of haldi (tumeric) powder, Which is also a yellow colour substance obtained from the roots of Haldi plant. When such adulterated Haldi is eaten by consumer, the Lead Chromate present in this Haldi Powder can cause mental retardation & brain damage in children. It can also cause anaemia & Paralysis.
**Kesari dal** is used as an adulterant of arhar dal since Both Arhar & Kesari dal look alike but Kesari dal is much more cheaper than Arhar dal. Since Kesari dal is toxic, So eating Arhar dal adulterated with Kesari dal can cause a disease called LATHYRISM. Which can cause paralysis.

Other commonly known disorders due to consumption of adulterated foods are diarrhoea, ulcers, food poisoning, asthma and cancer. Indeed food adulteration is a very serious crime against humanity because it may lead to slow poisoning, which can even result in death.

In our country, in addition to above described adulterations of food items, the following adulterations are commonly done by the dishonest traders.

1. **Milk.** Milk is commonly adulterated by the addition of water, removal of cream and addition of starch, paper and skim-milk powder.

2. **Ghee.** It is adulterated with vanaspati and animal fats, such as pig's fat. In order to improve the flavour of adulterated ghee, tributyrin is added.

3. **Cereals.** Rice and wheat are mixed with stones, sand, grit and mud to increase bulk.

4. **Flour.** Wheat flour is mixed with soap stone (talc) powder and chalk powder, Besan (or Bengal gram flour) is adulterated with kesari dal or lathyrus flour.

5. **Pulses.** Stones are added to pulses, such as *moth*, *urad* and *masoor*. Toxic chemicals such as metanil yellow are added to old stocks of pulses to improve their colour and appearance.
6. **Edible oils.** Edible oils are mixed with cheaper oils, toxic oils (e.g., argemone oil) and mineral oils. (Note. Argemone oil is obtained from the seeds of a wild weed called prickly poppy or *Argemone mexicana*). This oil contains a toxic alkaloid, sanguinarine that causes a disease called epidemic dropsy. Symptoms of this disease are sudden, non-inflammatory swelling of legs, diarrhoea, glaucoma and ultimately cardiac failure and death.

7. **Tea and Coffee.** Tea leaves are adulterated with exhausted old tea leaves; and dust, black gram husk, saw dust and cashew husk. Coffee powder is adulterated with ground roasted dates, tamarind seeds, husk powder, etc.

8. **Honey.** Honey is adulterated with sugar or jaggery and boiled with empty beehives.

9. **Spices.** *Dhana powder* (ground coriander seeds) is adulterated with cow-dung, horse-dung or starch. Black pepper is adulterated with dried papaya seeds. Chilli powder is admixture with saw dust and brick powder. Mustard seeds are adulterated by argemone seeds.

**PREVENTION OF FOOD ADULTERATION**

Since food, like air, water and shelter, is an essential requirement of our life, any deliberate attempt to degrade its quality is punishable under the law. Still there are certain antisocial persons who adulterate food to make easy money, and their corrupt practices often lead to serious cases of food poisoning and even death of the consumers. Therefore, to
protect the health of consumers and to ensure foods of honest nutritive value, the Prevention of Food Adulteration Act (PFA) was enacted by the Indian Parliament in 1954 and this act was amended in 1976. The new Act provides for summary trial and deterrent punishment including life imprisonment of food adulterators under certain circumstances. Prevention of Food Adulteration and Food Product Orders (FPO) have following objectives:

1. Lay minimum standards for the quality of food and the hygienic conditions under which it should be manufactured, especially for canned food, powdered milk, spices and other ready-to-eat food products.
2. They also require that date of manufacture of product, as well as, the date of its expiry, the quantity of contents and retail price should also be indicated on the wrapper or tin of processed food.

AGENCIES INVOLVED IN PREVENTING FOOD ADULTERATION

a) The Central Bureau of Indian Standards (BIS) provides certificates of reliability of food manufacturers after a satisfactory inspection of their products.

b) The ISI mark (Indian Standard Institution) and Agmark (Agricultural Marketing) provide
certificates to testify the purity and quality of food especially of edible oils, butter and ghee.

c) **The FPO** mark on the bottles of squashes, soup and other ready-to-eat canned food testifies to the purity and quality of food.

We should buy only those food products which carry the FPO mark, Agmark or ISI symbols, because these symbols testify to the high purity and good quality of food products. The ISI mark and Agmark standards for various food-stuffs are somewhat superior to the FPO standards.

d) **Food-testing laboratory:** Every big Indian city has a food-testing laboratory. The Health Department of the city corporation takes samples of various food products such as oils, dais (pulses), spices, etc., from different shops periodically. These samples are tested in the food testing laboratories for adulteration, if any. The manufacturers and sellers of the adulterated food items are then prosecuted in a court of law.

**Tests for Detecting Adulteration In Food**

1. Vanaspati in ghee or butter: Take one teaspoonful of ghee or butter sample in a test tube and melt it by heating. Add an equal amount of concentrated hydrochloric acid (HCl) and a pinch of cane sugar. Shake well for about one minute and allow the tube to stand for five minutes. Appearance of crimson colour in the lower layer indicates the presence of vanaspati in ghee or butter.
2. Water in milk. The presence of water in milk can be detected by following tests:

(i) Viscosity test. Put a drop of milk sample on the surface of vertically held glass plate and observe. A drop of pure milk would either stay on the surface or flow very slowly leaving a white trail behind. However, if it is adulterated with water, it would run without leaving any trail.

(ii) Density test. The above drop test (viscosity test) cannot be applied to test the purity of skimmed milk (i.e., the milk from which cream has been removed). A device, called lactometer, is used to test the purity of skimmed milk. The lactometer is a long glass tube having a thin top and a bulb containing mercury at the bottom. It measures the relative density of a liquid. The lactometer tube has markings of relative density values. When the lactometer is put in the liquid, it starts floating above the liquid level. The relative density value on the lactometer tube in level with the surface of liquid, gives the relative density of the liquid.

The relative density of pure milk is 1.026. Since water is lighter than pure milk, so if water is mixed in pure milk, the density of milk decreases and this can be detected by using a lactometer. In order to test the presence of water in milk, the lactometer is made to float in sample of the milk (to be tested). If the lactometer shows a reading of 1.026, then the milk is pure. And if the lactometer reading is less than 1.026, then the milk is adulterated with water. For example, in Figure the
lactometer shows a reading of 1.020, so this sample of milk has been diluted with water and hence it is not pure.

3. Argemone oil in edible oil. Add concentrated HNO₃, (Nitric acid) to the sample and shake carefully. Observe the colour of acid layer. Appearance of red to reddish brown colour indicates the presence of argemone oil.

4. Metanil yellow in dal. Shake five grams of dal (pulse) sample with five ml of water. Add a few drops of HCl (Hydrochloric acid). Appearance of a pink colour indicates the presence of metanil yellow in the dal.

<table>
<thead>
<tr>
<th>PRACTICE TASK I</th>
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</thead>
<tbody>
<tr>
<td><strong>COLUMN A</strong></td>
</tr>
<tr>
<td>(i) Milk</td>
</tr>
<tr>
<td>(ii) Edible Oil</td>
</tr>
<tr>
<td>(iii) Honey</td>
</tr>
<tr>
<td>(iv) Haldi</td>
</tr>
<tr>
<td>(v) Arhar Dal</td>
</tr>
<tr>
<td><strong>COLUMN B</strong></td>
</tr>
<tr>
<td>(a) Jaggery</td>
</tr>
<tr>
<td>(b) Kesari Dal</td>
</tr>
<tr>
<td>(c) Water</td>
</tr>
<tr>
<td>(d) Argemone Oil</td>
</tr>
<tr>
<td>(e) Lead Chromate</td>
</tr>
</tbody>
</table>
QUALITY OF DRINKING (POTABLE) WATER

Rain or precipitation is the basic source of all water. A part of rainwater seeps into ground to form ground water, a part of it evaporates back into atmosphere and some runs off to ton streams and rivers which flow ultimately into sea. Traditionally wells are an important source of water in rural areas (i.e., in villages). Water works (Jal Sansthan) of urban areas (cities) such Delhi, Kolkata, Allahabad depend on river water for their needs. To meet the demand of water tubewells are also used by Jal Santhans of Indian cities.

Three Parameters of Water Quality

Water quality indices for drinking or potable water may be classified as follows:

1. Physical quality of drinking water. An ordinary consumer judges the water quality by its physical characteristics. Physical qualities of drinking water includes the following features:

   (1) Turbidity. On aesthetic grounds, drinking water should be free from turbidity. Turbidity interferes with disinfection and microbiological determinations. The prescribed limit of turbidity in the drinking water is less than 5 units.

   (ii) Colour. Drinking water should be free from colour, i.e., it should be quite transparent, in drinking water, colour should be less than 5 units.

   (iii) Odour. Drinking water should have no disagreeable odour.
(iv) **Taste.** Drinking water should be palatable and free from disagreeable taste.

2. **Chemical qualities of drinking water.** Drinking water should not have the following chemicals: ammonia, nitrates, nitrites, more dissolved oxygen and toxic substances (such as arsenic, cadmium, cyanide, lead, mercury and selenium).

3. **Bacteriological indicators.** These are based on presence of organisms in drinking water indicating faecal pollution. These indicative organisms are: (i) *Escherichia coli*, (ii) Faecal streptococci; and (iii) *Clostridium perfringens*. Furthermore, examination for viruses, protozoa and other organisms (parasitic worms and larvae) is also recommended.

**METHOD OF WATER PURIFICATION**

Water works or Jal Sansthans purify water based on various parameters, viz., physical, chemical, microbiological (bacteriological), etc. Water works adopt following steps for the purification of water: 1. **Storage**, 2. **Filteration** and 3. **Disinfection**.

1. **Storage.** When water is stored about 90 per cent of the suspended impurities settle down in 24 hours by gravity. This allows penetration of light and reduces the work of filter. For example, it is found that when river water is stored, the total bacterial count drops by 90 per cent in the first 5-7 days.

2. **Filtering.** About 98 to 99 per cent bacteria along with impurities are removed by filtration.
3. Disinfection. In water works, the disinfection of water is done by three methods:

A. Chlorination. It involves treatment of water with chlorine. Chlorine kills pathogenic (disease producing) bacteria but it has no effect on spores and certain viruses (e.g., polio, viral hepatitis, jaundice).

B. Ozonation. It involves treatment of water with ozone. Ozone eliminates undesirable odour, taste and colour and removes all chlorine from water. Ozone has vinicidal effect, i.e., ozone destroys or inactivates viruses very quickly.

C. Ultraviolet Irradiation. Ultraviolet radiations have also been used against many micro-organisms present in water supplies.

HOUSEHOLD TECHNIQUES FOR WATER PURIFICATION

If the source of water is doubtful or there is outbreak of water borne disease following methods are generally used:

(i) storage, (ii) filtration, (iii) disinfection.

1. Storage. Following methods are adopted to store the water in houses.

(a) Copper vessels. When water is stored in copper vessels then ionic copper tend to reduce the bacterial flora of water. This activity purifies the water.

(b) Earthen vessels. When water is stored in earthen vessels (Ghara, Matka, etc.), then population of bacterial flora will be reduced in the
porous clay of vessels. Further the age old practice of storing water in earthen vessels containing camphor or *Ocimum* (Tulsi) leaves reduces the microbial population due to the oxygenated mono terpenes (of camphor) and eugenol (of Tulsi).

2. Filtration. Filtration of water for drinking purpose can be done by the following techniques.

(a) *Candle filter*. Water can be purified on small scale by filtering through candle filters. Filter candle usually remove bacteria found in drinking water but not viruses. The filter candles are liable to be blocked with impurities and bacteria after some time. Therefore, they should be cleaned by scrubbing with a hard brush under running water at least once a week. Only clear water should be used in ceramic filters. Further to make water clean, small amount of alum (Fitkari) should be used. It precipitates the impurities of water.

(b) *Sand filtering technique*. In our villages a traditional sand filtering technique is used. It involves passing of the water through different containers (earthen pots) containing sand, gravel, charcoal, etc., respectively. In urban areas the same technology can be adopted in overhead storage tank of the individual houses.
LET’S DO IT
Using a funnel, make some filtering bags with sand & gravel. Pour impure water containing mud. Find out how water gets cleaned after passing through the sand. Add alum to the water to kill bacteria.

(c) Compact integrated electronic devices. These modern water devices are currently being used for personal and community drinking water. Such units (e.g., "aquaguard" filter) have porcelain filter and charcoal along with UV radiation.

3. Disinfection. Method that make water free from infection especially by destroying harmful microorganisms is called disinfection. Disinfection of water can be done by the following three methods:

(a) Boiling. Water should be boiled for 3 to 5 minutes for killing its all bacteria, spores, cyst and ova of pathogens. Boiling renders after safe for drinking.

(b) Chemical disinfection. Various types of chemical disinfectants such as bleaching powder, chlorine solution and high test hypochlorite, are used to disinfect the water. National Environmental Engineering Research Institute (NEERI), Nagpur has formulated chlorine* tablets. These tablets are commonly available in the Indian market and are quite cheap. A single chlorine tablet of 0.5 g weight is sufficient to disinfect 20 litres of water in one hour. Even Iodine may be used for emergency disinfection of water.
(c) Disinfection of well. When there is a epidemic of cholera, gastroenteritis, hepatitis, typhoid, etc., disinfection of wells' is done at mass scale. The most effective and cheapest method of disinfecting well is by treatment of well water with bleaching powder. Double pot method developed by NEERI, Nagpur ensure a supply of constant dose of chlorine to well water for its disinfection.

**PRACTICE TASK 2**

Answer the following

1. Give the physical qualities of drinking water.

2. How does ozonation help in disinfections of drinking water?

3. Name the method to disinfect a well

4. What is sand filtering technique?

5. How does the storage of water in copper vessels help in purification of water?
POST TEST

Fill in the blanks

1. The deliberate contamination of food material with low quality, cheap, non-edible or toxic substances is called ____________________.

2. ______ Provides certificates to testify the purity & quality of food, especially of edible oils, butter and ghee

3. The full form of BIS is______.

4. ______ is the device to test the purity of skimmed milk

5. The argemone oil contains sanguinarine, which causes a disease called______.

6. The turbidity in drinking water should be less than ______.

7. In water works the disinfection is done by Chlorination, ______ and ______.

8. The camphor contains ______ which reduces microbial population

9. The full form of NEERI is ______

10. ______ Can be used for emergency disinfections of water
Answer the following

1. How Acts and rules relating to food adulteration and food products help in maintaining the quality of food?

2. How will you test the presence of water in milk?

3. How will you test the presence of Metanil yellow in the given sample of dal?

FEED BACK

PRACTICE TASK 1

(1) C  (2) D  (3) A  (4) E  (5) B

PRACTICE TASK 2

(1) Turbidity. On aesthetic grounds, drinking water should be free from turbidity (ii) Colour. Drinking water should be free from colour (iii) Odour. Drinking water should have no disagreeable odour. (iv) Taste. Drinking water should be palatable and free from disagreeable taste.

(2) Ozone eliminates undesirable odour, taste and colour and removes all chlorine from water. Ozone has
vinicidal effect, i.e., ozone destroys or inactivates viruses very quickly.

(3) The most effective and cheapest method of disinfecting well is by treatment of well water with bleaching powder. Double pot method developed by NEERI, Nagpur ensure a supply of constant dose of chlorine to well water for its disinfection.

(4) It involves passing of the water through different containers (earthen pots) containing sand, gravel, charcoal, etc., respectively. In urban areas the same technology can be adopted in overhead storage tank of the individual houses.

(5) When water is stored in copper vessels then ionic copper tend to reduce the bacterial flora of water. This activity purifies the water.

**POST TEST**

Fill In The Blanks

Answer The Following

(1) The Acts and rules relating to food adulteration and food products

1. Lay minimum standards for the quality of food and the hygienic conditions under which it should be manufactured, especially for canned food, powdered milk, spices and other ready-to-eat food products.
2. They also require that date of manufacture of product, as well as, the date of its expiry, the quantity of contents and retail price should also be indicated on the wrapper or tin of processed food.

(2) The presence of water in milk can be detected by following tests:

(i) Viscosity test. Put a drop of milk sample on the surface of vertically held glass plate and observe. A drop of pure milk would either stay on the surface or flow very slowly leaving a white trail behind. However, if it is adulterated with water, it would run without leaving any trail.

(ii) Density test. In order to test the presence of water in milk, the lactometer is made to float in sample of the milk (to be tested). If the lactometer shows a reading of 1.026, then the milk is pure. And if the lactometer reading is less than 1.026, then the milk is adulterated with water.

(3) Shake five grams of dal (pulse) sample with five ml of water. Add a few drops of HCI (Hydrochloric acid). Appearance of a pink colour indicates the presence of metanil yellow in the dal.
MODULE 3

SELF-LEARNING MODULE

TOPIC: CROP PRODUCTION

SUPERVISOR
Dr.G.S.Sodhi

DEVELOPED BY
Seema Vig
PRE-TEST

(a) Fill in The blanks

1. The organisms which can synthesize their own food are known as _____

2. The organisms which depend on others for their food are known as _____

3. Man is a _____

4. ___ Are the major source of our food

5. In order to meet the food requirement of our increasing population production of ___ should be increased

(b) List some plant products

(c) List some animal products
FEED BACK TO THE PRE TEST

(a) Fill in the blanks
1. Autotrophes
2. Heterotrophes
3. Heterotrophes
4. Plants
5. Crops

(b) Cereals, vegetables, spices and fruits.
(c) Butter, milk, egg and meat
OBJECTIVES

Learners will be able to achieve the following objectives after reading this self–learning module

General objectives
1. Develop the habit of self-learning among the students.
2. Develop an interest in science among the students.

Specific objectives
1) Define the term plant nutrients in their own words
2) Classify the given list of plant nutrients on the basis of their sources
3) Differentiate between macro and micronutrients
4) Classify the given list of nutrients as micro and macronutrients
5) Recall the definition of manures and fertilizers.
6) Enumerate the differences between manures and fertilizers.
7) Recollect the formation of different types of manures discussed in the module
8) Identify the nutrients provided by the given fertilizers
9) Recollect the different ways to increase the efficiency of irrigation water.
10) Enumerate the different ways of irrigation
INPUT

HUMANS DEPEND ON PLANTS AND ANIMALS FOR FOOD

Among all the living things, only plants are autotrophs, i.e. They make their own food, whereas animal and human beings are heterotrophs and depend on plants and other animals for food. All the parts of one or the other plant (root, stem leaf, flower and fruit) are consumed by us in the form of cereals, vegetables, spices and fruits. Animals produce butter, milk, egg and meat that also supplement our food requirements. Plants are the major source of our food. It is, therefore, necessary to increase the production of crops (plants grown in community on larger area) to meet the food requirement of our population. But successful crop production, however, depends upon understanding of how crop growth and development and how each factor can be modified or managed. This can be done by following good farming practices and managing resources like nutrients and water efficiently. IN THIS MODULE WE WILL DISCUSS ABOUT THESE TWO RESOURCES

NUTRIENTS AS FOOD FOR PLANT

The food required by plant is composed of certain chemical elements from their environment, only 16 of these are found to be essential for plant nutrition. An element must fulfill the following requirements to be an essential nutrient.

1. In the absence of the element the plant is not able to complete its life cycle.
2. The deficiency of a particular element can be prevented or corrected only by supplying that nutrient.
3. The element must have a direct influence on the plant nutrition and metabolism.

**SOURCES OF ESSENTIAL PLANT NUTRIENTS**

There are three different sources from where a plant gets these nutrients. These sources are- air, water and soil. On the basis of these sources the plant nutrients are classified as follows

**Sources of plant nutrients**

<table>
<thead>
<tr>
<th>Air</th>
<th>Water</th>
<th>Soil</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Oxygen</td>
<td></td>
<td>2. Phosphorous</td>
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<tr>
<td></td>
<td></td>
<td>3. Potassium</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. Calcium</td>
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<tr>
<td></td>
<td></td>
<td>5. Magnesium</td>
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<td></td>
<td></td>
<td>6. Sulphur</td>
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<td></td>
<td></td>
<td>7. Iron</td>
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<td></td>
<td></td>
<td>8. Manganese</td>
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<tr>
<td></td>
<td></td>
<td>9. Boron</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10. Zinc</td>
</tr>
<tr>
<td></td>
<td></td>
<td>11. Copper</td>
</tr>
<tr>
<td></td>
<td></td>
<td>12. Molybdenum</td>
</tr>
<tr>
<td></td>
<td></td>
<td>13. Chlorine</td>
</tr>
</tbody>
</table>

Nutrients taken by plants from soil are many more in number (13) than those obtained from air and water (3). These 13 limit the plant growth depending upon their availability in soil

**CLASSIFICATION OF NUTRIENTS**

On the basis of quantities required, the 13 plant nutrients are classified into two groups: macronutrients and micronutrients
1. Macronutrients: The essential elements, which are used by plants in large quantities, are called macronutrients. Following six essential nutrients form the example of macronutrients:


Of these six macronutrients, only three namely nitrogen, phosphorous and potassium are required by plants in greater amounts; they are called primary elements or primary nutrients.

2. Micronutrients: The essential elements, which are used by plants in large quantities, are called micronutrients. Following seven essential nutrients form the example of micronutrients:


MODE OF INTAKE OF THIRTEEN ESSENTIAL NUTRIENTS BY THE PLANTS

The 13 soil nutrients remain dissolved in water. They are absorbed by roots from the soil by the plants. The most important nutrients required for plant growth are nitrogen phosphorus and potassium (NPK). NPK are primary plant nutrients, so if crop plants are grow in the same soil, year after year, then the primary nutrients present in the soil would go on decreasing more rapidly than other nutrients. Such a specific deficiency of nitrogen phosphorus and
potassium is recouped by adding chemical fertilizers and manures to the soil.

**PRACTICE TASK 1**

Try to answer the following questions

1. Enumerate different sources of plant nutrients.
2. From where do plants get Carbon?
3. From where do plants get Oxygen?
4. From where do plants get Hydrogen?
5. From where do plants get most of their micronutrients?
6. Name the most essential nutrients required by the plants.
7. From the given list choose plant’s micronutrients and macronutrients
   Iron, Chlorine, Gulper, Copper, Nitrogen, Calcium, Manganese, Potassium, Zinc, Magnesium, Molybdenum, Phosphorous.

**MANURES AND FERTILIZERS**

We have studied that crop plants need a number of mineral elements for their growth and development, which they get from soil. Repeated cultivation of crops on the same field decreases the mineral nutrients, organic matter and other useful content of the soil. Due to this the soil becomes infertile. The deficiency of plant nutrients and organic matter in soil is made up by adding manures and fertilizers.
to the soil of crop-fields. Manures and fertilizers are major sources of nutrients and hence used in crop production.

**Manures**

These are the bulky sources of organic matter, which supply nutrients in small quantities, but organic matter in large quantities. Manures include farmyard manure (FYM), compost, green manures, vermicompost, etc.

**Advantages of manures**

Manures affect the soil in three ways:

1. They enrich the soil with nutrients.
2. The manures add organic matter (called humus) to the soil, which restores the soil texture for better retention of water and aeration of the soil.
3. The organic manures provide food for soil organisms, which help in making nutrients available to plants.

**Types of Manures**

**Farmyard manure (FYM):** This is the decomposed mixture of cattle excreta (dung) and urine along with the litter (Bedding material used at night under cattle) and leftover organic matter such as roughage or fodder. This material is collected daily from the cattle shed and stored in a pit for decomposition by the microbes.

A well decomposed farmyard manure contains 0.5 percent nitrogen (N), 0.2 percent phosphorous penta oxide
Compost: Compost is prepared from farm and town refuse like vegetable and animal refuse, sewage waste, weeds, crop stubble, straw, etc.

Method of preparing Compost

Waste from the garden and kitchen does not have to be thrown away. It may be condensed and reused as a fertilizer through a process called composting. A compost pile may be built by layering different kinds of waste in a trench of suitable size 4 to 5 m long, 1.5 to 1.8 m broad and 1.0 to 1.8 m deep leaving space between the layers for air to circulate. Nitrogen is added to the pile in the form of manure, meal, or greenery to generate heat. Heat facilitates rotting and kills all undesirable organisms. Once the pile is slightly dampened, it is covered. As heat and steam build...
up, the waste decomposes over time into a nutrient-rich substance called compost. The compost is then applied to plants as a fertilizer.

**Green manuring:** This is a practice of turning or ploughing of green plants into soil for the purpose of improving physical structure as well as soil fertility. The green manure crops commonly grown are- sannhemp (Crotolaria juncea), dhaincha (Sebania aculeate) and guar

<table>
<thead>
<tr>
<th>How are green manures prepared</th>
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</thead>
<tbody>
<tr>
<td>The green manure crops are grown</td>
</tr>
<tr>
<td>In the fields for about 6 to 8 weeks</td>
</tr>
<tr>
<td>At tender stage, these plants are</td>
</tr>
<tr>
<td>Ploughed into fields</td>
</tr>
<tr>
<td>Left buried for 1 to 2 months</td>
</tr>
<tr>
<td>Decomposed</td>
</tr>
<tr>
<td>Ploughed again and mixed in the field</td>
</tr>
</tbody>
</table>
Fertilizers

These are the sources of plant nutrients, manufactured commercially from chemicals. They contain much higher amount of nutrients in comparison to manures and are, therefore used in very small quantities.

Type of Fertilizers

Nitrogenous Fertilizers: These fertilizers supply the macro nutrient nitrogen. The examples of nitrogenous fertilizers are:

I. Urea CO (NH₂)₂
II. Ammonium sulphate
III. Calcium ammonium nitrate
IV. Sodium nitrate
V. Ammonium nitrate

Phosphatic Fertilizers: They are the source of the major element phosphorus. Examples of Phosphatic fertilizers are:

I. Single super phosphate
II. Triple super phosphate
III. Dicalcium phosphate.

Potassic Fertilizers: These fertilizers supply potassium, which is one of the essential nutrients to the plants. Important potassic fertilizers are

I. Muriate of potash or potassium chloride, kcl
II. Potassium sulphate.
III. Potassium nitrate
Complex Fertilizers: When a fertilizer contains at least two or more nutrients (N, P₂O₅ and K₂O) it is called complex fertilizer. Some of the examples of complex fertilizers are:

I. Nitro phosphate
II. Ammonium phosphate
III. Urea ammonium phosphate

Modern agriculture depends greatly on chemical fertilizers. These chemicals increase the yield but they get washed off through irrigation or rainfall and reach rivers, lakes, streams and pollute them. So chemical fertilizers should be used carefully.

The following table shows the differences between manures and fertilizers.
Manure

Manure is a natural substance. It is obtained by the decomposition of animal wastes such as dung (Gobar) of cattle and buffaloes and plant residues.

Manure contains small amounts of essential plant nutrients such as nitrogen, phosphorous and potassium.

Manure adds a great amount of organic matter in the form of humus in the soil.

Manure is not nutrient specific and it tends to remove the general deficiency of the soil.

Manure is voluminous and bulky so it is inconvenient to store, transport and apply to the crop.

Manure is cheap and is prepared in rural homes or fields.

Fertilizer

A fertilizer is a human made substance. It is an inorganic salt or an organic compound.

Fertilizers are very rich in plant nutrients such as nitrogen, phosphorous and potassium.

A fertilizer does not add any humus to the soil.

A fertilizer is nutrient specific. It can provide specifically nitrogen, phosphorous and potassium to the soil according to the need.

A fertilizer is compact and concentrated so it is easy to store, transport and apply to the crop.

A fertilizer is costly and is prepared in factories.

Try to answer the following

1. Name two fertilizers supplying nitrogen.
2. What is the composition of farmyard manure?
3. What is the chemical formula of potassium sulphate?
4. How is green manure prepared?
5. Define manure.
WATER

Water is a key input for crop production. Water influences important processes of plants such as photosynthesis, respiration, absorption and utilization of nutrients etc. The process of supplying water to crop fields is known as irrigations.

**Uses of irrigation:**
There are many uses of irrigation

- Water supplies two essential components to the crop namely hydrogen and oxygen
- Irrigation of the soil provides moisture to the soil for the germination of the seeds.
- Irrigation loosens the soil and supports the growth and elongation of the roots
- Water at the time of irrigation dissolves the nutrients present in the soil. These nutrients dissolved in water are easily absorbed by the roots of the plants.

JUDICIOUS USE OF WATER

Water is a precious natural resource. It should be used in irrigation by exploiting proper techniques of soil and water management. The efficiency of existing irrigation system can be increased by its judicious use. **The efficiency of irrigation water can be increased by adopting following techniques**

1. Selecting appropriate crop and cropping system.
2. Application of optimum quantity of water at appropriate time.
3. Keeping weeds under control.
4. Time scheduling in operation,
5. Controlling pests.

Factors affecting the irrigation requirements

The irrigation or water requirement depends on the following two factors

I. Nature of the crop
II. Nature of the soil

Nature of crop: Each crop requires specific amount of water at various stages of its growth and ripening. Some crops require more water whereas some crops need less water. For example, Paddy (rice) crop is transplanted in standing water and requires continuous irrigation. On the other hand crops like wheat, gram, cotton etc do not require much water

The correct timing of irrigation is very important for getting a good crop yield. For example, cereal crops like wheat require irrigation before ploughing, at the time of flowering and at the time of development of grains. In case of wheat if the irrigation is done when the crop is fully matured, then the plants are unable to resist strong winds and may fall in the field and this is called lodging

Thus, from the above discussion we can say that each crop requires specific amounts of water through irrigation at proper time of development
and irrigation depends on nature of crop.

2. **Nature of soil:** Different soils have different requirements of water. For example the crops grown in sandy soil need more irrigation as compared to crops grown in clayey soil.

**Disadvantages of excessive irrigation:**

Excessive irrigation is harmful for crop production in the following ways:

- Too much water in the fields retards the process of seed germination
- The water logging causes accumulation of salts on soil surface because of more evaporation of water on the soil surface. This causes reduction in soil fertility.
- The water logging at the time of full maturation of crop may damage the crop

**Irrigation Systems**

The design, the equipment and the techniques of replenishing the soil water deficit by applying irrigation water is known as irrigation system. Irrigation systems are as under:

**Canal System:** In this system canals receive water from one or more reservoirs or from rivers. Main canal is distributed into branch canals and branch canals further have distributaries. Finally these field channels or distributaries may serve individual fields or a group of fields.
**Tanks:** These are small storage reservoirs, which intercept and store the run-off of smaller catchments areas.

**Wells:** Wells are constructed wherever exploitable ground water is present. There are two types of wells: dug, wells and tube wells. In dug wells, water is collected from water bearing strata. These dug wells have their bottom below the ground water table. The water from the shallow strata slowly accumulates in the pit. Tube well can tap water from the deeper strata. From these wells, water is lifted by diesel of electricity run pumps.

**River Valley System:** In southern part of the country, particularly in Western Ghats in Karnataka and Kerala, many steep and narrow riverine valleys are found. In these areas, rainfall is heavy and concentrated in four to five month period. This results in high run-off and discharge flows in the rivers during rainy season. This is followed by drying up during the rabi season. On the slopes of these, and in the valleys perennial crops such as coconuts, areca nuts, coffee, rubber and tapioca are cultivated. The bottomlands are used for growing a single rice crop.

**River Lift System:** In the areas where canal flow is insufficient or irregular due to inadequate reservoir release, lift system is more rational. Water is directly drawn from the rivers for supplementing irrigation in the areas near to rivers.
PRACTICE TASK 3

(I) Fill in the blanks:

a) The process of supplying water to crop fields is known as------------------.

b) Water supplies ------------------ and--------------------------
to the crops.

c) The irrigation requirement depends on------------------
and------------------.

d) Too much water in the fields retards the process of-----

(II) Make a working hypothesis for this

The crops grown in sandy soil need more irrigation than crops grown in clayey soil.

(hint: a hypothesis an intelligent guess to a problem)

POST TEST

I MULTIPLE CHOICE QUESTIONS:

1. All animals are:
   (a) Parasitic
   (b) Saprophytic
   (c) Autotrophic
   (d) Heterotrophic

2. The element, which is required in largest quantity by plants, is:
   (a) sulphur
   (b) Calcium
   (c) Phosphorous
   (d) Nitrogen

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3. Which of the following is a primary nutrient?
(a) Potassium
(b) Calcium
(c) Chlorine
(d) Zinc

4. Rotation of crops is essential for:
(a) Getting different kinds of crops
(b) Increasing quality of minerals
(c) Increasing quality of proteins
(d) Increasing soil fertility

5. River lift system of irrigation is used in the areas:
(a) Where rainfall is heavy
(b) Canal flow is insufficient
(c) Exploitable ground water is present
(d) None of these

II ANSWER THE FOLLOWING

1. What is Farmyard manure?

2. What is Green manuring?

3. Write names of essential micronutrients of Crop Plants.

4. Define Irrigation system.

5. Name some sources of irrigation in India.
6. What is the Canal system of irrigation?

7. Enumerate disadvantages of excessive irrigation.

8. Enumerate the differences between Manures and Fertilizers.

III MATCH THE WORDS

*Match the terms in column A with suitable terms in column B*

<table>
<thead>
<tr>
<th>COLUMN A</th>
<th>COLUMN B</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Micronutrient</td>
<td>a. Green Manure</td>
</tr>
<tr>
<td>II. Macronutrient</td>
<td>b. Urea</td>
</tr>
<tr>
<td>III. Fertilizer</td>
<td>c. Seed germination</td>
</tr>
<tr>
<td>IV. Manure</td>
<td>d. Potassium</td>
</tr>
<tr>
<td>V. Irrigation</td>
<td>e. Primary Nutrient</td>
</tr>
<tr>
<td>VI. Water Logging</td>
<td>f. Iron</td>
</tr>
<tr>
<td>VII. Ploughing of green plants in soil</td>
<td>g. Damage the crop</td>
</tr>
<tr>
<td>VIII. Nitrogen</td>
<td>h. compost</td>
</tr>
</tbody>
</table>
FEEDBACK

PRACTICE TASK 1

1. Air, Water, Soil  
2. Air  
3. Air  
4. Water  
5. Soil  
6. Nitrogen, Phosphorous, Potassium  
7. Micronutrients: Iron, Chlorine, Copper, Manganese, Zinc, Molybdenum, Macronutrients: Nitrogen, Calcium, Potassium, Sulphur, Magnesium, Phosphorous

PRACTICE TASK 2

1. Urea, Sodium Nitrate

2. 0.5% Nitrogen, 0.2% Phosphorus Penta Oxide and 0.5% Potassium monoxide.

3. K₂SO₄

4. The green manure crops are grown in the fields for about 6 to 8 weeks. At tender stage, these plants are ploughed into fields and left buried for 1 to 2 months. When they are decomposed, these are ploughed again and mixed in the field.

5. It is a natural substance, which provides organic matter to the soil.

PRACTICE TASK 3

(A) Fill in the blanks

1. Irrigation

2. Hydrogen, Oxygen

3. Nature of crop, Nature of soil

4. Seed germination
Sandy soil is highly porous and it has poor water retaining capacity and need irrigation more frequently. On the other hand, clayey soil is much less permeable, so it can retain water for a longer time. So when crops are grown in clayey soil are irrigated, the water remains in the soil for a longer time hence the plants can absorb adequate water in clayey soil.

**POST TEST**

---------

(I) Multiple Choice Questions:

1. (d) 2. (d) 3. (a) 4. (d) 5. (b)

(II) Answer the following

(1) This is the decomposed mixture of cattle excreta (dung) and urine along with the litter (Bedding material used at night under cattle) and leftover organic matter such as roughage or fodder. This material is collected daily from the cattle shed and stored in a pit for decomposition by the microbes.

(2) This is a practice of turning or ploughing green plants into soil for improving soil fertility.


(4) The design, the equipment and the technique of replenishing the soil water deficit by applying irrigation.

(5) Rain, Canals, Wells, River valley system
(6) **Canal System**: In this system canals receive water from one or more reservoirs or from rivers. Main canal is distributed into branch canals and branch canals further have distributaries. Finally these field channels or distributaries may serve individual fields or a group of fields.

(7) Excessive irrigation is harmful for crop production in the following ways:

- Too much water in the fields retards the process of seed germination
- The water logging causes accumulation of salts on soil surface because of more evaporation of water on the soil surface. This causes reduction in soil fertility.
- The water logging at the time of full maturation of crop may damage the crop
Manure is a natural substance. It is obtained by the decomposition of animal wastes such as dung (Gobar) of cattle and buffaloes and plant residues. Manure contains small amounts of essential plant nutrients such as nitrogen, Phosphorous and potassium. Manure adds a great amount of organic matter in the form of humus in the soil. Manure is not nutrient specific and it tends to remove the general deficiency of the soil. Manure is voluminous and bulky so it is inconvenient to store, transport and apply to the crop. Manure is cheap and is prepared in rural homes or fields.

A fertilizer is a human made substance. It is an inorganic salt or an organic compound. Fertilizers are very rich in plant nutrients such as nitrogen, phosphorous and potassium. A fertilizer does not add any humus to the soil. A fertilizer is nutrient specific. It can provide specifically nitrogen, phosphorous and potassium to the soil. A fertilizer is compact and concentrated so it is easy to store, transport and apply to the crop. A fertilizer is costly and is prepared in factories.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Manure</th>
<th>Fertilizer</th>
</tr>
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### III MATCH THE WORDS

(I ) f  (II) d  (III) b  (IV) h  (V) c  (VI) g  (VII) a  (VIII) e
MODULE 4

SELF–LEARNING MODULE

TOPIC: NATURAL RESOURCES

SUPERVISOR
Dr.G.S.Sodhi

DEVELOPED BY
Seema Vig
PRE TEST

Before going through this module try to answer the following questions

1. Name the natural materials needed to fulfill the basic needs of life.

2. What is atmosphere?

3. How is air useful to us?

4. How we use plants & animals?

5. How do we use soil?
Feed back to PRE TEST

1) Basic needs of Life are fulfilled by materials present in nature. These are Air, Water, Soil, Minerals, Coal, animals & plants.

2) The layer of air above the earth surface is called atmosphere.

3) Air is essential to grow crops and support animal life.

4) We use plants & animals for food, clothing, construction, paper & even for enjoyment.

5) We use soil to grow crops and build houses.
OBJECTIVES

The students will be able to achieve the following objectives after reading this self-learning module.

General Objective

1. Enjoy the science learning experiences.
2. Develop the interest in Science.
3. Develop the habit of self-learning.

Specific Objectives

1. Define exhaustible and inexhaustible natural resources in their own words.
2. Classify the given list of resources into the exhaustible and inexhaustible natural resources.
3. From the given list, identify the renewable resources from the non-renewable resources.
4. Interpret the composition of air from the given pie diagram.
5. Interpret the atmospheric zones from the given diagram.
6. Enlist six major types of soil through recall.
7. Locate the four zones of rainfalls from the given map of India.
8. Enlist the uses of air, soil, minerals, energy, and flora and fauna through recall.
9. Give example of renewable and non-renewable energy sources in their own words.
INPUT

TYPES OF NATURAL RESOURCES

Natural resources are broadly classified inexhaustible natural resources, and exhaustible natural resources.

**Inexhaustible Natural Resources:** These resources are present in unlimited quantity in the nature and they are not likely to be exhausted by human activities. They are *solar radiation, air and water.*

**Exhaustible Natural Resources:** The stock of these resources in the nature is limited. They are susceptible to be degraded in quantity and quality by the human activities. Some of the exhaustible natural resources are *soil, forests, wild life, minerals, coal, petroleum* etc. Exhaustible resources are further of two types, Renewable and non-renewable.

**Renewable** resources are those, which get recycled or replenished e.g. forests, water and wild life

**Non-Renewable** resources are those, which cannot be recycled or replenished e.g. fossil fuels and minerals
Air is an important form of inexhaustible natural resource, which is essential for our survival. Air consists of a mixture of gases, containing nitrogen (78%) and oxygen (21%). Carbon dioxide ammonia, ozone and noble gases constitute to 1% of the total volume of the air.

Atmosphere

The layer of air above the earth surface is called atmosphere. The density of air in the atmosphere varies at different altitudes from the surface of the earth. The atmosphere is thus divided into following different zones.

Troposphere

The air, which we breathe, exists in the first zone, 10 to 16 km from the surface of the earth. This zone of the atmosphere is called troposphere Life supporting gases like O2, CO2 and N2 are present in this zone.
**Stratosphere**

It extends between altitudes of 16-50 km. This is rich in ozone gas forming ozone layer. This layer is called ozonosphere. It absorbs many harmful solar radiations such as ultraviolet (UV) rays. This zone provides protection to our life.

In human beings UV radiations cause various ailments such as sunburn, eye-burn, inflammatory diseases and skin cancer.

**Mesosphere**

It lies between the altitudes of about 50-85 km.

**Thermosphere**

It extends from an altitude of 85 km upwards.
Divisions of the Atmosphere

Without our atmosphere, there would be no life on Earth. A relatively thin envelope, the atmosphere consists of layers of gases that support life and provide protection from harmful radiation. The illustration shows the temperature changes associated with the various layers of the atmosphere and their altitude from the Earth’s surface.

Role of atmosphere

1. Scientific studies have shown that a normal human being requires about 250-265 kg air per day for doing various activities.
2. Air is essential to grow crops and support animal life.
3. Air transmits sound for communication.

Air is very useful to us

WATER

Water is essential for sustenance of life. It is an important medium for all the life processes and facts as universal solvent. We are dependent on water for many purposes like drinking, cooking, cleaning, agriculture,
transportation, Hydel power, etc. Water is mainly present in three forms:
1 Rainwater
2 Surface water
3 Ground water

1. Rainwater
   It is the huge resource and largest in the world. In our country, the intensity of annual rainfall varies from region to region and accordingly we have four zones:
   **Wet zone:** Rainfall is very high in this region (i.e., over 200 cm)
   **Intermediate zone:** heavy rainfall (100-200)
   **Semi arid zone:** the rainfall is moderate (50-100cm)
   **Arid Zone:** annual rainfall in this zone is very low (20-50cm)

2 Surface water
   The water, which is present in water bodies such as rivers, lakes, streams and ponds is called surface water.

3 Ground water
   Water that percolates into the ground through the pore spaces of the rocks is available as ground water. The ground water
   1 provides soil moisture for plant growth
   2 Supplements water in lakes and streams
   3 is used for human consumption.
   The surface and ground water available to us come from rainfall and snow.
WATER LEVEL AND WATER TABLE.

The porous rocks are saturated with water at a certain level below the surface that is known as **zone of saturation**. The upper level of the zone of saturation is called the **water table**.

The vertical distance from a place to the water table is called **water level**.

**ACTIVITY 1**
**TO SHOW WATER TABLE AT A PLACE**

Dig a hole in the ground which is subject to water logging after rain & so find the depth at which hole fills with water. This is the level of water table. This level will rise & fall according to the amount of rainfall.

**PRACTICE TASK I**

Fill in the Blanks

1. **Natural resources** are classified as _______ and _______.
2. The layer of air above earth surface is called _______.
3. The air we breathe exists in _______ zone.
4. Ozone layer exists in _______ zone of atmosphere.
5. The rainfall is moderate in _______ zone.
6. The _______ water provides soil moisture.
7. In _______ zone the annual rainfall is between 20 to 50 cm.
8. The upper level of the zone of saturation is called _______.
SOIL

Soil is another main natural resource essential for our survival and development. Soil is the upper most crust of the earth.

Formation of soil

The formation of soil takes place by the interactions between the physical (weathering of rocks, rain, wind, temperature) and biological components (plants, animals and microbes).

Classification of soil

The soil is classified on the basis of its nature and composition. The six major types of soil in our country are

Alluvial soil: it is rich in loam and clay
Black soil: it has predominantly clay
Red soil: it is sandy soil, loam
Mountain soil: it is a stony sandy soil
Desert soil: it is sandy and poor in organic carbon
Laterite soil: it has porous clay rich in iron and aluminum hydroxides
Loam. Soil is composed of about 30-50 sand particles, 30-50 silt particles and less than 20 clay particles

Sand. A collection of rock particles with diameter in range 0.125-2.0 mm

Clay. Any soil material with a particle size of less than 2-4 μm in diameter

Silt. Soil composed of particles whose diameter range from $\frac{1}{256}$ to $\frac{1}{16}$ mm

Clay. Any soil material with a particle size of less than 2-4 μm in diameter

Sandy Soil and Loam Soil (right and left hand respectively).

**ACTIVITY 2**

To find out the proportion of different solid components in garden soil

Dig up a handful of garden soil & place it in a beaker. Add about 500cc of water & shake the beaker for a while. Now allow the soil to settle down. What do you notice? The particles of different sizes in the soil separate out to form different layers in the beaker. At the bottom will be a layer of gravel which are heaviest particles. Above this will be a layer of sand & then a layer of silt. The top layer consists of clay. The humus, being lighter than water floats on water.
Fertility of soil: The capacity of the soil to sustain the plant life with required Nutrients is called the fertility of the soil. The fertility of the soil tends to reduce mainly due to (1) soil erosion and (2) Monoculture i.e. growing the same type of crop in the same field successively. The soil fertility is sustained both by human efforts (such as application of manures and fertilizers) and natural processes (e.g. land fallowing) the soil is thus termed as maintainable natural resource.

MINERALS

For our industrial, technological and cultural growth, we have required and still need a great variety of inorganic materials, all of which come from earth’s crust. The coal, petroleum, iron, aluminum, copper, silver and gold are among the important natural resources to the mankind. Minerals form exhaustible, non-renewable or stock natural resources since the metals; non-metals, mineral fuels and lubricant are irreplaceable unlike air or water. They are not renewable so we cannot maintain these resources.

Uses of minerals

Today, in an era of technological advancement the minerals are utilized in innumerable ways. To list a few of them (1) They are used in the field of medicine and surgery, space, labour saving and luxury equipments, buildings, transport and national defense. (2) The nuclear or atomic energy is produced by the nuclear reaction occurring in
metals like uranium and thorium. 

(3) The mineral resources play a big role in the economy of the country.

<table>
<thead>
<tr>
<th>PRACTICE TASK 2</th>
</tr>
</thead>
</table>

**Fill in the blanks**

1. The soil is formed by interaction between ________ and ________ component.
2. Black soil has predominantly ____________.
3. Alluvial soil is rich in loam and ____________.
4. Laterite soil has porous clay rich in ____________ and ________.
5. Fertility of soil is reduced due to ____________ and ________.
6. The practice of growing the same type of crop in same soil successively is called ________.
7. Minerals formed exhaustible, ____________ natural resources.
8. ________ and ________ metals are used to obtain nuclear energy.

**ENERGY**

The chief sources of energy are coal, petroleum, natural gases, hydel power, solar, wind and nuclear power. These energy resources are classified in two categories (a) non-renewable or conventional energy resources and (b) renewable or non-conventional energy resources.

**Non-renewable or conventional energy resources:**

Fossil fuels such as coal and petroleum are present in limited quantity and they cannot be renewed. These are called as non-renewable or conventional energy resources.
Renewable or non-conventional energy resources: are the solar radiation, wind power, hydelpower, biomass and nuclear power. These are pollution free sources of energy. They can be recycled or renewed in the nature

Solar Energy

Solar energy is the biggest source of non-conventional source of energy. The Solar energy is being trapped and converted into thermal and electrical energy. The conversion takes place mainly by solar thermal pathways and through photo, voltaic conversions.

Uses of solar energy

1. The solar energy is used in devices such as solar cookers, solar heaters, solar dryers and solar cells. The application of these devices has been very successful.
2. Solar energy is also used for community lighting, pumping of water for small irrigation and drinking purposes.
Hydel power

Hydel power is next highest source of energy after thermal. To generate hydel power the flow of water is checked by building a dam. The water from the dam is allowed to flow through the tunnels with high pressure. The potential energy of the water is converted into electrical by turbines and generators.

Wind energy:

Use of wind energy is another important technological development. Wind power is converted into mechanical and electrical energy.
Tidal power:

Tidal power of the sea is also being used to generate mechanical and electrical energy in our country.

FLORA AND FAUNA

The term flora is used for plants and fauna for animal species. It includes all types of animals and plants, domesticated and living in a natural habitat. They constitute important renewable natural resources. India has rich diversity of flora and fauna. The plants are main source of our food. They also provide food for animals, fuel, fiber and other useful things for us. We also have medicinal plants, ornamental plants and fragrant plants.

The Indian fauna includes variety of animal life such as mammals, birds, reptiles, fishes, insects, mollusks, etc.

Flora and fauna of India form two most important natural resources 1 Forests and 2 Wildlife

Forests

Forest is an uncultivated and uninhabited piece of land. Normally trees dominate forest. They form an important renewable natural resource our forest cover is estimated to be 63.591 million hectare square km., which are about 23/ of the total available area.

Uses of forests

Forests are useful to us in many ways: They
1. Provide timber for building and furniture
2. Provide raw material for paper industry
3. Provide protection to wild life
4. Provide protection from adverse effect of solar radiation,
5. Help in balancing the CO2 and O2 of the atmosphere,
6. Regulate the earth’s temperature and water cycle
7. Check flood and soil erosion

Provide fruits, nuts and medicines

**Wild life**

The native population of a community makes up its wild life. The term wildlife means all those naturally occurring animals, plants and their species which are not cultivated, domesticated and tamed. India possess a rich and diverse Wild life Fauna. Wild life resources constitute major components of our ecosystem. Wild Life resources are most popular center of tourism and provide great aesthetics value for human beings.
PRACTICE TASK 3

Fill in the blanks.

1. Fossil fuels are a type of _________ energy resources.
2. Renewable energy sources are pollution free and can be _________ in nature.
3. Term flora is used for _________ and fauna for _________.
4. Forests check _________ and _________.
5. Forests help in balancing _________ and O₂ of atmosphere.
6. The term wild life means all natural occurring animals and plants, which are not cultivated _________ and _________.
7. _________ Resources are most popular center of tourism

POST TEST

A Fill in the blanks

1. Inexhaustible natural resources are present in _________ quantity in nature.
2. Air is a mixture of _________
3. Air contains _________ percentage of oxygen.
4. Mesosphere lies between the altitudes of about _____ km.
5. Air transmits _________ for communication.
6. Annual rainfall in wet zone is _________.
7. The water that percolates into the ground is called _________ water.
8. The vertical distance from a place to water table is called ______.
9. Desert soil is sandy and poor in ______.
10. ______ Power of sea is used to generate mechanical and electrical energy.
11. Solar energy is a type of ______ energy source.
12. The fertility of soil is the__________.
13. Coal and petroleum are _____ fuels.
14. Forests regulate the earth’s temperature and__________.
15. _______ Play a big role in economy of nation.

B Multiple choice questions
1. In the Atmosphere the layer above the troposphere is
   (a) Stratosphere (b) Mesosphere (c) Thermosphere (d) Exosphere
2. The life supporting gases such as O₂, CO₂ and N₂ are chiefly concentrated in the
   (a) Stratosphere (b) Mesosphere (c) Troposphere (d) Exosphere
3. Wind, tidal energy and precipitations are examples of
   (a) Exhaustible resources (b) Inexhaustible resources (c) both a & b (d) Man made resources
4 Which of the following are renewable resources
   (a) soil (b) Water (c) both (d) none of the above
5 Which of the following are non-renewable resources
   (a) soil (b) Water (c) Solar energy (d) coal and minerals
6 The common source of energy in Indian villages is
(a) Electricity  (b) Sun  (c) Coal  (d) Animal Dung cakes and wood

7 Of these the non conventional case of energy is
(a) Petroleum  (b) Coal  (c) wood  (d) the sun

8 Which of the following has the smallest soil particles
(a) sand  (b) Loam  (c) Silt  (d) Clay

9 Fertility of the soil is reduced by
(a) Decaying organic matter (b) crop rotation (c) Intensive Agriculture (d) Addition of nitrogen fixing bacteria

10 Stratosphere extends between altitudes of
(a) 10 to 16 Km  (b) 16 to 50 Km  (c) 50 to 85Km  (d) 85 Km upwards

C Match The terms in column A with suitable terms in column B

<table>
<thead>
<tr>
<th>COLUMN A</th>
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</tr>
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<tbody>
<tr>
<td>1  Inexhaustible resources</td>
<td>(a) Soil</td>
</tr>
<tr>
<td>2  Renewable</td>
<td>(b) Water, wood</td>
</tr>
<tr>
<td>3  Non-renewable</td>
<td>(c) Fossil fuels, and other metals</td>
</tr>
<tr>
<td>4  Maintainable natural resource</td>
<td>(d) Air, sand and clay</td>
</tr>
<tr>
<td>5  Pollution free sources</td>
<td>(e) Solar energy, hydel power</td>
</tr>
</tbody>
</table>

D Classify the following resources as exhaustible and inexhaustible
Soil, Forests, Coal, Wind, Petroleum, Minerals, Solar energy, Air, Water
Answer The Following

(a) How ozone layer is useful to us?

(b) List two non-conventional energy sources.

(c) Mention the uses of minerals.

(d) Give any 5 uses of forests?

FEED BACK

PRACTICE TASK 1

1. Exhaustible, in-exhaustible
2. Atmosphere
3. Troposphere
4. Stratosphere
5. Semi-Arid zone
6. Ground
7. Arid
8. Water table

PRACTICE TASK 2

1. Physical, biological
2. Clay
3. Clay
4. Iron, Aluminium
5. Soil erosion
6. Monoculture
7. Non-Renewable
8. Uranium, Thorium

PRACTICE TASK 3

1. Non-renewable
2. Renewed
3. Plants, Animals
4. Flood, soil erosion
5. \( \text{CO}_2 \)
6. Domesticated, Tamed
7. Wild-life

POST TEST

A Fill In The Blanks

1. Unlimited
2. Gases
3. \( 3.21 \)
4. \( 4.50 \text{ } 85 \text{ } \text{km} \)
5. Sound
6. \( \text{Over } 200 \text{cm} \)
7. Ground water
8. \( \text{Water level} \)
9. \( \text{Organic Carbon} \)
10. Tidal
11. Non-conventional
12. Capacity to sustain plant life
13. Fossil
14. Water cycle
15. Minerals
B  **Multiple Choice Questions**

(1) a  (2) c  (3) b  (4) c  (5) d  (6) d  (7) d  (8) c  (9) a  (10) b

C  **Matching Type Questions**

(1) d  (2) b  (3) c  (4) a  (5) e

D  **In Exhaustible:** Soil, Forests, Wind, Solar Energy, Air, and Water

**Exhaustible:** Coal, Petroleum, and Minerals

E  **Answer The Following**

(a) Ozone layer absorbs many harmful solar radiations such as ultra violet rays and provides protection to our life.

(b) Solar energy, Tidal energy and Wind energy.

(c) 1 They are used in the fields of medicine and surgery, space, labour saving and equipment, building transport and national defence 2 Atomic energy is produced by reactions occurring in metals like Uranium and Thorium 3 They play a big role in economy of the country

(d) Uses of forests

1 They provide Timber for building and furniture
2 Provide protections to wild life
3 Regulate the earth’s temperature and water cycle
4Check flood and soil erosion
5 Provide fruits and medicines etc
MODULE 5

SELF-LEARNING MODULE

TOPIC: MANAGEMENT OF NATURAL RESOURCES

SUPERVISOR: Dr.G.S.Sodhi

DEVELOPED BY: Seema Vig
PRE-TEST

ANSWER THE FOLLOWING QUESTIONS

1. How are the natural resources classified?

2. Name some energy resources

3. Name the factors, which reduce the fertility of soil.

4. What is flora?

5. What is fauna?
1. Natural resources are classified as Exhaustible and inexhaustible. Exhaustible resources are further classified as renewable and non-renewable.

2. Sun, Wind, coal, Oil and natural gas.

3. (a) Monoculture (b) soil Erosion

4. Plant population is called flora

5. Animal population is known as fauna
GENERAL OBJECTIVES

1. Develop interest in science
2. Develop the habit of self learning
3. Develop scientific attitude
4. Develop science process skills like observation, seeing a problem and seeking ways to solve it, making a hypothesis.

SPECIFIC OBJECTIVES

1. Define the terms conservation & management of natural resources in their own words.
2. Explain the need for conservation in their own words.
3. Enlist some alternative sources of energy.
5. Suggest the important measures to conserve wildlife.
6. Enlist the important methods for forest conservation.
7. Recall the management & conservation of water & natural resources.
8. Give the methods required for conservation of non-renewable resources
9. Suggest the ways to control air pollution
Management of Natural Resources

The natural resources should be used rationally, equitably and keeping in mind their replace ability. Such an approach is the management and conservation of natural resources. Thus, management and conservation means scientific utilization of resources while maintaining their sustained yield and quality.

Management of Fossil Fuels

Following measures may be taken for management and conservation of the fossil fuels:

Alternative Sources: To save the fossil fuels from total exhaustion, we should promote and practice the use of alternative sources of energy such as solar energy, wind energy and biomass energy. The use of natural gasses are a good alternative to these fossil fuels e.g.

Biogas: Biogas is a natural gas. It is produced from waste products such as cattle dung, human waste, garbage, farm wastes such as straw, weeds and other plants. It is a cheap, non-polluting and convenient fuel especially for vast rural population of India.

Applying techniques of Biotechnology: With the progress in Biotechnology

1. The present biomass can be increased
2. The present biomass can be used more effectively to obtain many Products of industrial and commercial use for e.g., sugarcane, cereals, potato, sweet potato etc., are starch containing raw materials and they form most suitable and most easily available biomass for biotechnological processing. Most of the biomass which is obtained from agriculture or forests exists in the form of Cellulose and lignocelluloses (Lignocelluloses is non degradable material of cell walls of trees and provides long life to trees) Both of these form the major source of raw material for biotechnological processing to get fuels and chemicals. Pure cellulose can be degraded by chemicals and enzymes, and fermented to form ethanol, butanol, acetone, single cell protein, methane and many other products Though lignocelluloses are most abundant and useful sources for getting carbon biotechnologically, yet we have no adequate biotechnique to deal with this biomass.

PRACTICE TASK 1 Fill in the blanks

1. Natural resources should be used ______, ______, and keeping in mind their _____.
2. To save the fossil fuels we should promote the use of ______.
3. Biogas is a __________.
4. With biotechnology ______ can be increased.
5. Sugarcane and cereals form most suitable ______ for biotechnological processing.
6. Most of the biomass obtained from agriculture and forests exists in the form of_______ and ______.
CONSERVATION OF FORESTS

India is losing forest at a rate more than 1.5 metric hectares each year. The conservation of forests includes the following methods:

1. Afforestation: Afforestation is a process of transforming an area into forest, usually when trees have not grown there.
2. Social and environmental forestry: In social forestry, forest trees are planted on community lands, individual holdings, and other public lands which are needed by local rural and tribal populations.
3. Agro-forestry programmes: It is developed to fulfill the needs of various forest-based industries requiring large quantities of raw materials.
4. Plantation of trees of aesthetic value and ornamental trees.

CONSERVATION OF WILD LIFE

Many wild life species have either been lost or are at the verge of extinction. The International Union for Conservation of Nature and Natural Resources (IUCN) has made five main categories of wild animals and plants. These are extinct, Endangered, Vulnerable, Rare and Insufficiently known species.
**Extinct species:** A species is considered extinct when there is no reasonable doubt that its last individual has died, e.g., Mountain Quail, Pink headed duck, Lesser one horned rhino and cheetah.

**Endangered species:** It the species which is in danger of extinction E.g., Brow antlered deer Indian rhinoceros, Asiatic lion, Crocodile, Musk Deer, Blue whale, etc.

**Vulnerable species:** Such a species contains sufficient number of individuals, but in near future it may represent the category of Endangered species if unfavourable conditions persist in the Environment, e.g., Golden langur, blood pheasant, chinkara deer etc.

**Rare species:** Such a species contains a small world population that are not presently endangered or vulnerable, but at risk, e.g., Indian Egg eating snake, Indian pied hornbill, Himalayan porcupine, Golden cat etc.

**Insufficiently known species:** Such a species require more information for its conservation.

To bring the focus to endangered species IUCN has started issuing lists of threatened plants and animals on a global basis. It has also started publication of a red data book, which gives information of threatened species of plants and animals.
Some of the important measures to conserve our wild life are

1. Protection of natural habitat and maintenance of endangered and other important species by creating protected areas such as national parks, sanctuaries and biosphere reserves
2. Introduction of successful captivity breeding programs
3. Public awareness programmes to realize value of forest and wild life
4. Protection through legislation to prevent wild life depletion, several acts have been made from time to time by states as well as central government for e.g., Indian wild life act, 1972 provides special legal protection to wild life in general and to endangered species of fauna in particular.
National park: A national park is an area which is dedicated to conserve the environment and natural objects and wild life there in. In India there are 73 national parks.

Sanctuaries: A wild life sanctuary is dedicated to protect the wild life, but it considers the conservation of particular species only. In India there are 416 sanctuaries.

Biosphere reserves: Biosphere reserves are undisturbed areas for scientific study. Biosphere reserves are multipurpose protected areas with following major objectives (1) To conserve diversity and integrity of plants, animals and micro-organisms; 2) To promote ecological conservations and (3) To educate, train and create awareness about environmental aspects and eco friendly living. In India 12 Biosphere reserves have been set up. They are Nilgiri, Nandadevi, Nokrok, Great nicobar, Gulf of Mannar, Manas, Sunderbans, Simplipal, Dibrusai khowa Debong-Deband, Panchmarhi and Kanchanjangha. These Biosphere reserves identify key species, develop data base and prepare awareness programs. Non- government organizations (NGO) are also participating for public awareness.
PRACTICE TASK 2

Fill in the blanks

1. To conserve forests we should plant _______ trees of _____ value.
2. The main categories of wild animals and plants according to IUCN are ________, ________, ________ and ________.
3. A species is _______ when its last individual has died.
4. A _______ species may represent the category of endangered species if unfavourable conditions persist in the environment.
5. Golden cat is a _______ species.
6. Indian wildlife act was passed in _______.
7. In India there are _______ National parks.
8. In India _______ biosphere reserves have been set up.
9. Biosphere reserves identify______ species, develop data base and prepare _______ programmes.

CONSERVATION AND MANAGEMENT OF WATER RESOURCES:

The conservation and management of water resources includes

1. Integrated water shed plan for drinking, irrigation and industrial uses
2. Flood control
3. Transfer of surplus water to water deficit basins by interlinking of rivers
4. Hydro geological survey to identify over exploited areas
5. Artificial recharging of the ground water
6. Mass awareness programmes through public /private agencies
SOIL CONSERVATION

The loss of soil fertility is mainly due to soil erosion and continuous cropping. The soil conservation practices are:

1. Crop Rotation: In this process, different types of crops having different requirements are grown alternatively in the same soil so that the soil is not depleted of any particular nutrient all the time.

2. Growing of leguminous crops such as pulses, peas, beans, gram, groundnut, etc

3. Application of optimum manures and fertilizers

4. Protection of soil erosion from wind and water by growing protective plants like sugarcane, pulses, groundnut etc. To cover the soil surface.

ACTIVITY

To show that vegetation checks soil erosion

Take equal quantities of garden soil in two shallow packing boxes A and B. Place them on a table in a slanting position. Plant grass or barley seeds in box B. Leave the box A as such after a few days when the plants have grown a little, sprinkle equal quantities of water in both the boxes. Collect the run-off water in two beakers-C and D. You will notice that the quantity of water in beaker C is more, and it also has more soil in it. What
do you conclude?

WE conclude that

- Soil with vegetation absorbs more water than soil without vegetation.
- There is less erosion of soil if it is covered with vegetation.

REGULATION OF AIR POLLUTION

Air carries many impurities, which are not good for our health. The chief constituents of the impurities are carbon Dioxide, carbon monoxides, oxides of sulphur and nitrogen, fluoride compounds, metals and hydrocarbons. These impurities are known as pollutants, which cause air pollution.

The government in consultation with international agencies prepares plans, policies and certain rules to check pollution. Some important recommendations includes

1. To identify The source and cause of pollution
2. To know the carrying capacity of the environment
3. To bring down the emission of pollutant within the carrying capacity of the environment
4. To develop neutralizer for each type of pollutants and to identity areas where pollution is caused by illiteracy and poverty.
Important methods to control pollution are:

(i) Solid organic wastes including faecal matter should be changed into compost
(ii) Installation of proper gas plants
(iii) Non-degradable wastes should be dumped in low lying areas
(iv) Recycling of wastes wherever possible
(v) Proper sewage and sludge treatment method should be installed
(vi) Complete combustion engines and antismog devices be feed in automobiles (such as the use of compressed natural gas, CNG)
(vii) Use of fertilizers, herbicides and pesticide should be judicious
(viii) Plants capable of fixing carbon monoxides and metabolizing nitrogen oxides should be grown.

PRACTICE TASK 3

Fill in the blanks

1) The surplus water should be transferred to ___________ by interlinking of rivers.
2) To conserve soil________ crops should be grown.
3) To prevent soil erosion, ___________ plants should be grown.
4) Solid organic wastes should be changed to ________.
5) Fertilizers, herbicides and pesticides should be used ________.
6) Automobiles should be fitted with________ engines and _______ devices.
7) To control air pollution non-degradable wastes should be ________.
8) To control air pollution plants capable of fixing _______ and metabolizing _______ should be grown.
POST TEST

(A) Give A Technical Term for The Following

1) The scientific use of resources while maintaining their sustained yield and quality
2) A cheap, non-polluting and convenient fuel especially for rural population of India
3) A process of transforming an area into forest, usually when trees have not grown there.
4) Plantation of those trees on community lands, individual holdings, and other public lands which local rural and tribal populations need.
5) Undisturbed areas for scientific study.
6) A species which is in danger of extinction
7) An area dedicated to conserve the environment and natural objects and wild life there in.
8) A species which contains a small world population that are not endangered or vulnerable, but at risk.
9) The process of growing different types of crops alternatively in the same soil.
10) The impurities causing air pollution.
B NAME THE FOLLOWING

1. Two alternate sources of energy
2. Non degradable material providing long life to trees
3. Two extinct species
4. Two endangered species
5. The organization that works towards conservation
6. The book published by IUCN
7. Two reasons for the loss of soil fertility
8. Two plants which protect soil from erosion caused due to wind and water
9. Two crops grown to increase soil fertility
10. Two constituents of impurities present in air

C ANSWER THE FOLLOWING

(I) Why is biogas becoming important fuel in our country?

(II) What is importance of biotechnology?

(III) What are the uses of cellulose?

(IV) Describe the important measures to conserve our wildlife

(V) What are the objectives of biosphere reserves?

(VI) Enlist the important methods of forest conservation
(VII) How are water resources managed and conserved?

(VIII) Enlist some methods to control pollution

(IX) What experiment will you perform to test that vegetation checks soil erosion?

FEED BACK

PRACTICE TASK 1
(1) Rationally, equitably, replaceability  (2) alternative sources (3) Natural
(4) Biomass  (5) Raw materials (6) Cellulose, lignocellulose

PRACTICE TASK 2
(1) Ornamental, aesthetic  (2) Extinct, Endangered, Vulnerable, Rare, Insufficiently known species (3) Extinct (4) Vulnerable (5) Rare  (6) 1972
(7) 73  (8) 12  (9) Key, awareness

PRACTICE TASK 3
(1) Water deficit basins  (2) Leguminous (3) Protective (4) Compost (5) Judiciously (6) Complete combustion, antismog (7) Dumped in low lying areas (8) Carbon monoxide, nitrogen oxide
POST TEST

(A) GIVE A TECHNICAL TERM FOR THE FOLLOWING

(1) Management and conservation of natural resources (2) Biogas (3) Afforestation (4) Agro-forestry programmes (5) Biosphere reserves (6) Endangered species (7) national park (8) Rare species (9) Crop Rotation (10) pollutants

(B) NAME THE FOLLOWING

(1) Solar energy, Wind energy (2) Lignocelluloses (3) Mountain Quail, Pink headed duck, lesser one horned rhino and cheetah. (4) Brow antlered deer Indian rhinoceros, Asiatic lion, Crocodile, Musk Deer, Blue whale, etc. (5) International Union for Conservation of Nature and Natural Resources (6) red data book (7) Soil erosion, Monoculture (8) sugarcane, pulses, groundnut etc. (9) pulses, peas, beans, gram, groundnut (10) carbon Dioxide, carbon monoxides, oxides of sulphur and nitrogen, fluoride compounds

(C) ANSWER THE FOLLOWING

I

Biogas is becoming important fuel because it is a cheap, non-polluting and convenient fuel.

II

With the progress in Biotechnology

1. The present biomass can be increased

1. The present biomass can be used more effectively to obtain many Products of industrial and commercial use.
Pure cellulose can be degraded by chemicals and enzymes, and fermented to form ethanol, butanol, acetone, single cell protein, methane and many other products.

1. Protection of natural habitat and maintenance of endangered and other important species by creating protected areas such as national parks, sanctuaries and biosphere reserves
2. Introduction of successful captivity breeding programs
3. Public awareness programmes to realize value of forest and wild life
4. Protection through legislation to prevent wild life depletion

(1) To conserve diversity and integrity of plants, animals and microorganisms; 2) To promote ecological conservations and (3) To educate, train and create awareness about environmental aspects and eco friendly living.

5. Afforestation: Afforestation is a process of transforming an area into forest, usually when trees have not grown there.
6. Social and environmental forestry: In social forestry those forest trees are planted on community lands, individual holdings, and other public lands which are needed by local rural and tribal populations
7. Agro-forestry programmes: It is developed to fulfill the needs of the various forest-based industries requiring large quantities of raw materials.
8. Plantation of ornamental trees
VII

1) Integrated water shed plan for drinking, irrigation and industrial uses
2) Flood control
3) Transfer of surplus water to water deficit basins by interlinking of rivers
4) Hydro geological survey to identify over exploited areas
5) Artificial recharging of the ground water
6) mass awareness programmes through public /private agencies

VIII

Important methods to control pollution are:

(i) Solid organic wastes including faecal matter should be changed into compost
(ii) Installation of the gober gas plants
(iii) Non-degradable wastes should be dumped in low lying areas
(iv) Recycling of wastes wherever possible
(v) Proper sewage and sludge treatment method should be installed
(vi) Complete combustion engines and antismog devices be feed in automobiles (such as the use of compressed natural gas, CNG)
(vii) Use of fertilizers, herbicides and pesticide should be judicious
(viii) Plants capable of fixing carbon monoxides and metabolizing nitrogen oxides should be grown.

IX

Take equal quantities of garden soil in two shallow packing boxes A and B. Place them on a table in a slanting position. Plant grass or barley seeds in
box B Leave the box A as such. After a few days when the plants have grown a little, sprinkle equal quantities of water in both the boxes. Collect the run-off water in two beakers-C and D. You will notice that the quantity of water in beaker C is more, and it also has more soil in it.
MODULE 6

SELF-LEARNING MODULE

TOPIC: BIOSPHERE

SUPERVISOR
Dr. G.S. Sodhi

DEVELOPED BY
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PRE TEST

ANSWER THE FOLLOWING QUESTIONS

1. Name the planet on which the life exists
2. Define atmosphere?
3. What is hydrosphere?
4. How are plants and animals interconnected?
5. Name the highest level in the hierarchy of organization on earth.
6. Name abiotic and biotic components of biosphere.
FEED BACK TO THE PRE TEST

1. Earth
2. The layer of air surrounding the earth is known as atmosphere
3. The region of water on the surface of earth.
4. There is a frequent exchange of materials between plants and animals.
5. Biosphere
6. Abiotic components: Air, water and Soil
   Biotic components: Plants and animals.
OBJECTIVES

GENERAL OBJECTIVES

1. To develop interest among the students for the subjects of science.

2. To make the teaching learning process more interesting.

SPECIFIC OBJECTIVES

After reading this module the students will be able to

1) Define the term biosphere in their own words
2) Define the term ecosystem in their own words.
3) Give examples of different types of ecosystems.
4) Recall the names of three parts of biosphere.
5) Give examples of biotic and abiotic components.
6) Identify producers, consumers and decomposers from the given list.
7) Define food chain and produce food chain by their own.
8) Identify the trophic levels of given food chain.
9) Calculate transfer of energy at each trophic level.
10) Recall the functions of ecosystem.
11) Define biogeochemical cycle.
12) Draw carbon cycle and nitrogen cycle.
OUR PLANET EARTH is the only one on which life exists. It consists of three components: the Land (Lithosphere), Water (Hydrosphere) and Air (Atmosphere). It is because of this unique combination that Life originated, and is still sustaining on this planet. The Life supporting zone of earth where atmosphere, hydrosphere and lithosphere meet, interact and make life possible is known as **biosphere**.

Lithosphere or outer layer (crust) of earth, hydrosphere or all water sources above and under ground, and atmosphere or air (a mixture of gases) comprise **abiotic** or non-living components of the environment. Among the **biotic** or living components come all sorts of living organisms like plants, animals and microbes living on the earth. A constant **interaction** between living and non-living components of the biosphere results in the **transfer of food and energy**, which makes it a **dynamic but stable system**. The biosphere is the biggest biological system but, in fact, it consists of smaller functional units known as **ecosystems** or ecological systems.

**ECOSYSTEM**

Ecosystem is a self sustaining, structural and functional unit of biosphere. It is an open system and depends upon solar energy from outside as its energy source. Ecosystems can be large or small and are placed in
nature contiguously. Between adjoining ecosystems there is frequent exchange of material and energy. Thus they are all interconnected and hence interrelated. The vast network of all interconnected ecosystems constitute the biosphere.

Ecosystems are mostly natural systems, but these can be artificial too. The natural system are terrestrial (land) as well as aquatic. The common examples of land ecosystems are a *forest, grassland or a meadow, a desert or a hillside*. A *pond, a lake, a river a seacoast and an ocean* are the examples of aquatic system. Artificial systems created by man are a *cropland (agro ecosystem), a garden, a park, a kitchen garden, or an aquarium*.

**STRUCTURE OF ECOSYSTEM**

An ecosystem consists of two major components: abiotic & biotic.

(a) **Abiotic Components**: The abiotic components are inorganic & organic substances, & climatic factors such as air, water, soil & sunlight.

(i) **Inorganic Substances**: There are various nutrient elements & compounds, such as carbon, nitrogen, sulfur, phosphorus, carbon dioxide, water, etc. These are involved in the cycling of the material in the ecosystem.
(ii) **Organic Compounds:** These are protein, carbohydrates, lipids, humic substance, etc. They largely form the living body & link the abiotic compounds with biotic.

(iii) **Climatic Factors:** These are of two types i.e. atmospheric such as sunlight, temperature, moisture & precipitation, & edaphic, such as soil texture & topography etc. These factors affect the distribution number, metabolism & behaviour of the organisms.

(b) **Biotic Components:** These are discussed below:

(i) **Producers:** are the chlorophyll bearing plants, such as algae, grass & trees. They convert solar energy into chemical energy during photosynthesis. This is the source of food for many organisms. The green plants are also called autotrophs as they synthesize their own food.

(ii) **Consumers:** are the organisms, whose food requirements are met by feeding on other organisms. They are referred to as heterotrophs (consumers). These are mostly animals. Those who feed directly on plants (autotrophs) are called herbivores (grasshopper, rabbit, goat, sheep). The animals who feed on herbivores are known as carnivores (hawk, lions). These may be either predators or parasites. The organisms which can feed on both plants & animals are omnivores (cockroaches, fox, humans).
(iii) **Decomposers:** are mainly bacteria & fungi. In terrestrial ecosystem bacteria generally act on animal tissue & fungi on plants. By digesting the dead tissue through enzyme secretion on it, the basic elements of protoplasm are released into environment. These elements are made available for reuse to the producers.

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**PRACTICE TASK 1**

**Fill In The Blanks**

1. The organisms, which are dependent on others for food, are called **_.**
2. The organisms which prepare their own food are called **_.**
3. Self sustaining, structural and functional unit of biosphere is called **_.**
4. The solid portion of earth containing soils and rocks is called **_.**
5. Forest is an example of ______ ecosystem

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**Food chains & Food webs**

We have seen above that the food prepared by green plants is consumed by a series of consumers (herbivores & carnivores) & finally decomposed by decomposers in nature. This process of food transfer from the source in plants through a series of organisms, with repeated eating & being eaten, is called a food chain. At each transfer a lot of energy from food is lost as heat. Therefore, the number of steps in any food chain is limited to four or five. The shorter the food chain, the greater is the available energy. A simple generalized food chain (arranged in a linear manner) may be presented as-
Or, taking organisms by example, a simple land food chain may be-

(a) Grass → Deer → Tiger

(b) Grass → Grasshopper → Frog → Snake → Eagle

The following figure shows a five step food chain

A food chain does not ever work in isolation. Often several food chains are interconnected under natural conditions. One animal based on its food habit may be linked in more than one food chain. This network of food chains is called a food web. For example, grass may be eaten by grasshopper as well as rabbits or cattle, and each of these herbivores may be eaten by many carnivores, such as frog, snake, bird or tiger depending on their food habits.
TROPHIC LEVELS

The different steps or levels in a food chain form different trophic levels. The green plants (autotrophs or the products) are the first trophic level which fix up the solar energy (producers) and make it available for others (consumers). Herbivores (primary consumers- insect, rabbit, rodents, deer, cattle etc.) who feed on plants are second trophic level. The animals that feed on the herbivores, called secondary consumers or carnivores (frog, small fish), make the third trophic level. These are eaten up by still larger carnivores.

SIGNIFICANCE OF FOOD CHAINS:

The study of food chain helps in understanding food relationship and interaction among various organisms in an ecosystem. The mechanism of transfer of food energy & nutrients through various components of nature also can be followed well through such studies. There is an applied aspect also of these studies. Just as for food, we can understand the movement of toxic substances also in an ecosystem and the problem of their biological magnification some harmful or poisonous substances such as DDT sprinkled to kill pests on food plants enter into the food chain. As DDT is not easily degradable, it goes on accumulating at every trophic level. Along with food he gets these toxic substances also in his body. The animals at higher trophic levels get still more poison along with their food. The phenomenon is known as biological magnification.
**ACTIVITY**

1. In any artificial ecosystem around you (such as aquarium, Kitchen garden, school lawn or park) try to find out different trophic levels.
2. Identify the plants (producers) and animals (herbivores and carnivores) at each level.
3. Draw a sketch of the food chain operating at your place of selection.

**PRACTICE TASK 2**

1) A man prepares his own food by cooking, etc. can we call him an autotroph?
2) Construct a food chain comprising the following:
3) snakes, Hawks, Rats, Plants
4) Which organism belong to the third and fourth trophic level in the above constructed food chain
5) Consider the food chain
   Grass ——> Grasshopper ——> frog ——> eagle
   What is the position of grass?
6) What is the position of frog in the above food chain?
7) In terms of energy, who is at an advantageous position- a vegetarian or a non-vegetarian?
8) What is the significance of food chains?
FUNCTIONS OF ECOSYSTEM

By now it is clear that in an ecosystem the two processes of energy movement (Energy Flow) & nutrient movement (Biogeochemical cycle) proceed side by side. The energy movement is in a single direction & non-cyclic (food chain), while the movement of nutrient is cyclic (any mineral cycle).

ENERGY FLOW

The sun energy is transformed by plant(producers) into chemical energy(carbohydrates) by the process of photosynthesis. In herbivores & carnivores this energy is then transferred further at various trophic levels. In these animals this chemical energy is transformed mostly into mechanical energy (work done) & heat. Heat part is lost to the atmosphere at each trophic level. Some energy is utilized in respiration by the organisms, & some energy which remains unutilized also goes waste. It is estimated that like this about 90% of the energy is used up at each trophic level & only 10% of it is transferred to the next trophic level. As a result at the last (decomposer) trophic level no energy is left for recycling. Hence energy flows from sun through producers, to consumers in a single direction only.
We find that there is maximum energy at the producer (plant) level & as you go further & further the energy in food goes on decreasing. Therefore herbivores (or vegetarians) get more energy rich food than carnivores at third & fourth profit levels.

(II) BIOGEOCHEMICAL CYCLES

You have noticed that some energy is lost at every trophic level but there is no such loss of nutrients. When finally the dead animal body is subjected to decomposition by decomposers, the nutrients are released to the environment. There they are again available for reuse and recycling.
The cyclic flow of nutrients between non-living environment (Soil, rocks, air and water) and living organisms is known as Bio geo chemical cycle.

**Characteristics of Bio geo chemical cycles:**

1) In Bio geo chemical cycles, materials are not lost but recycled.
2) It operates through air, water bodies, soil (non-living world) and living world.
3) It helps in maintaining nutrient food of the earth.

(a) **Carbon Cycle**: Carbon is the most insignificant element. The basic movement of Carbon is from atmospheric reservoir to producers, to consumers and then to decomposers. Other reservoirs for Carbon are Water, Fossil fuels and sedimentary rocks.

Plant utilizes the atmospheric Carbon Dioxide in photosynthesis to produce Carbohydrates. Plant food is taken by herbivores and then passes through small and large carnivores. The respiratory activities at each level help in returning the Carbon dioxide quickly to the atmosphere. The CO$_2$ is returned to the atmosphere by various activities such as respiration, decomposition of dead organic material, burning of fossil fuels and volcanic activities. The following figure shows the Carbon cycle in nature.
NITROGEN CYCLE

Nitrogen is another important element required by organisms for synthesizing proteins. Atmosphere is the reservoir for Free Nitrogen. But the nitrogen in the element form cannot be used by living system. First it has to be converted into nitrates for the use of plants. This can be done by Industrial nitrogen fixation or by some nitrogen fixing bacteria (Azobacter and Rhizobium) convert the atmospheric nitrogen into nitrates, which are soluble in water. The process is called as nitrogen fixation. These are absorbed by plants into their systems and utilized for making organic matter.

Organic matter of Plant and animal origin is decomposed to ammonia and amino acids by
microorganisms in soil. The ammonia may escape to atmosphere or be retained in the soil, and is sometimes oxidized to nitrates. The process of ammonia formation is called ammonification. Some microorganisms convert ammonia into nitrates. The process is called nitrification. Finally there are some other bacteria (decomposers), which reduce nitrates back to nitrogen or to ammonia or to some other oxides. The process is called denitrification. Free nitrogen returns to atmospheric pool and oxides are taken up by plants.

Types of Ecosystem

Broadly there are two main types of ecosystems namely
(i) Terrestrial
(ii) Aquatic

Each ecosystem has its unique combination of a variety of organisms and physical conditions. In terrestrial ecosystem, based on the dominant vegetation (grass, tree, etc.) and other climatic factors. Aquatic ecosystem can be Fresh water and marine ecosystem.

POST TEST

(A) Give one term for the following:

(1) Functional unit of environment comprising living and no-living components

(2) Saprophytic microorganisms, which feed on dead bodies of organisms and organic wastes of living organisms.
(3) World of living organisms together with the layers of Land, Water and Air
(4) Sequential Process, which represents who is whom
(5) Various links or steps representing organisms in a food chain in which transfer of food and energy takes place.
(6) The process of conversion of proteins into ammonia.

(B) MULTIPLE CHOICE QUESTIONS:

(1) For energy, earth is:
(a) a closed system (b) an open system
(c) an open as well as a closed system (d) Neither open nor a closed system

(2) What is not true for biosphere:
(a) Matter is received from outside
(b) Matter is used again and again
(c) Energy is received from the sun
(d) Energy is dissipated as heat

(3) Atmospheric Nitrogen can be utilized by:
(a) Fungi (b) Ammonia
(c) Plants (d) Bacteria

(4) The sphere of living organisms inhabiting the earth is:
(a) Atmosphere (b) Lithosphere
(c) Hydrosphere (d) Biosphere
(5) In a food chain, the producers form the:

(a) First Trophic level  
(b) Second Trophic level  
(c) Third Trophic level  
(d) None of the above

(6) The Primary consumers are:

(a) Carnivores  
(b) Herbivores  
(c) Autotrops  
(d) Omnivores

(7) A rat feeding on Potato is a:

(a) Carnivore  
(b) Producer  
(c) Decomposer  
(d) Primary Consumer

(C) Arrange the following in a food chain

Fish, Algae, Small Animal, Big Fish

(D) Consider the Food Chain:

Fish → Algae → Small Animal → Big Fish

What will happen if Lions are removed from the above food chain?

(E) In a food chain comprising Lion, Grass, and Deer Which one will transfer maximum energy to the next trophic level?

(F) In the following food chain Plants provide 2000J of energy to rats. How much energy will be available to hawks from snakes?
Plants ► Rats —► Snakes —► Hawks

FEED BACK

PRACTICE TASK 1
1. Heterotrophes
2. Autotrophes
3. Ecosystem
4. Lithosphere
5. Terrestrial

PRACTICE TASK 2
1. No 2. Plants —► Rats —► Snakes —► Hawks

3. Snakes is the third level and hawk is at fourth level
4. Producer 5. Secondary consumers 6. Vegetarian. 7. food chain helps in understanding food relationship and interaction among various organisms in an ecosystem. The mechanism of transfer of food energy & nutrients through various components of nature also can be followed well through such studies

POST TEST

A) GIVE ONE TERM FOR THE FOLLOWING
(1) Ecosystem
(2) Decomposers
(3) Biosphere
(4) Food chain
(5) Trophic level
(6) Biogeochemical cycle
(B) MULTIPLE CHOICE QUESTIONS:
(1) b  (2) a  (3) c  (4) d  (5) a  (6) b  (7) d

(C) Algae, Small Animal, Fish, Big Fish

(D) If all the Lions are removed by killing or capturing, then there will be no predator control over the deer. Due to this, the population of deer will increase greatly. The increased deer population will lead to excessive grazing of grass and other vegetation. The overgrazing even eliminates the grass and other green plants completely and may result into desert land.

(E) Grass

(F) 2J