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CHARACTERISTICS OF BIOSPHERE

What we have learned earlier

- ✍ Unless the natural resources are properly protected and maintained the equilibrium of the nature will be affected adversely.
- ✍ Each species has its own adaptations in relation to its ecosystem.
- ✍ The extensive utilization of fuels, including fossil fuels is becoming harmful to the living world.
- ✍ Over population leads to environmental pollution and it also affects ecological balance
- ✍ Air pollution and water pollution cause different kinds of ailments.
- ✍ Different living beings in an ecosystem are existing through food relations of commensalism, symbiosis and parasitism.
- ✍ Biosphere is formed of various ecosystems of different trophic levels.
- ✍ It is possible to schematise diagrammatically the interrelationships between different trophic levels of a food chain.
- ✍ Carbohydrates and lipids are formed of carbon, hydrogen and oxygen, while protein is composed of carbon, hydrogen, oxygen and nitrogen.

Even though there is diversity among the living organisms in the biosphere, their bodies are made up of same kinds of elements. Their cells, tissues and organs all have same type of materials. The body components of a living being become the food of another organism. Food being the chief source of energy, it is clear that along with food components, energy is also transferred through the food chains. This process should be regularly carried out for the proper maintenance of environmental equilibrium. But the indiscriminate invasion of the ecosystem by man has always adversely affected the natural environment.

In this chapter, let us first consider the flow of materials and energy through the food chains as the prime characteristic of the biosphere. This will help us to know the significance of the need for conservation of nature and natural resources.

The Biosphere

Do you know what the biosphere is? Biologically, the habitat which contains air, water and soil together make up the living world or the biosphere. It includes the entire surface of the earth and the water bodies. It also extends about 20 kilometers in height and about 11 kilometers in depth from the surface of the earth.

The ecosystem is the basic unit of biosphere. All the living organisms in an ecosystem together forms the biotic community. Each specific populations in a biotic community is called a species. After observing any one of the ecosystems, record the components which include the biotic factors, abiotic factors and the different species in a biotic community etc in your science diary.

The flow of energy

You have already learned about the food chains and the different trophic levels existing in an ecosystem. The green plants convert the solar energy in to chemical energy in the living world. Let us see, how this energy is transferred through the different trophic levels. Analyse the following diagrammatic representation (Illustration I) and discuss.

- How much amount of solar energy, in percentage is absorbed by the plants.
- How much percentage of the absorbed energy is stored in plant tissues.
- How do plants and animals differ from each other in the utilization of energy.
- Analyse the way in which energy transfer and utilisation occurs, based on a food chain.

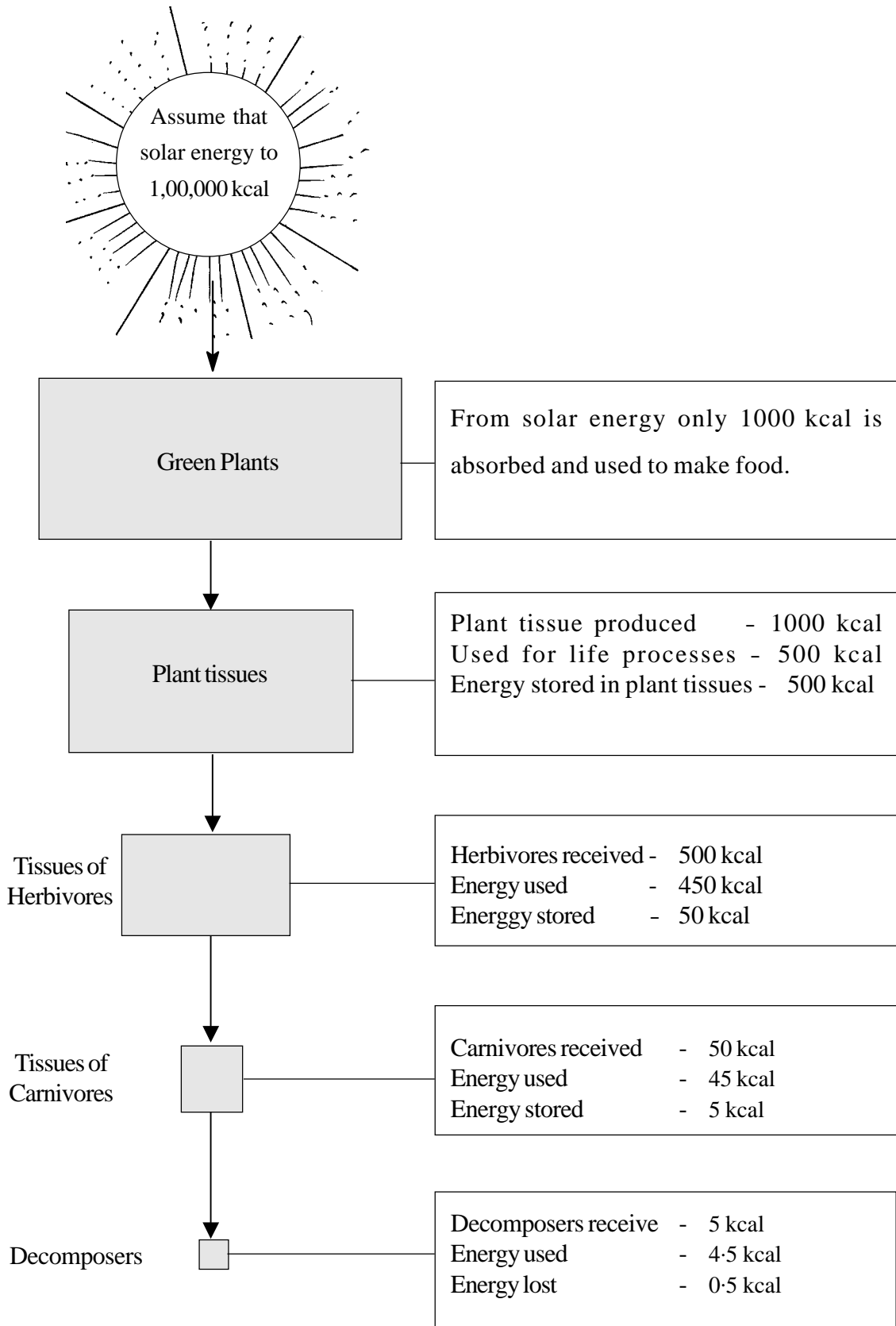


Illustration I

Let us examine the conclusions we arrived at.

- ✧ In the biosphere, energy transfer takes place only through the food chains.
- ✧ Each food chain can be considered as an energy chain.
- ✧ Plants utilize only 50% of the total available energy for their life processes. But each of the trophic levels utilizes 90% of their available energy for their metabolic activities. Remaining 10% of the energy alone is transferred to the next trophic level.

In relation to reduction in the number of trophic levels in a food chain, the measure of energy loss is also comparatively reduced. Now you have understood the reason why long food chains are not commonly seen in nature.

The pyramid of energy

You are well aware that it is possible to present diagrammatically the interrelationships between the different trophic levels in a food chain. Observe the illustration II showing the quantity of energy utilized by the living organisms in each trophic level for the construction of their tissues.

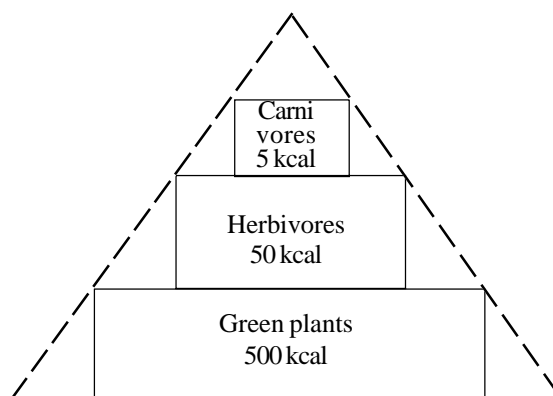


Illustration II

The above demonstration II looks like a pyramid and is thus said to be the pyramid of energy.

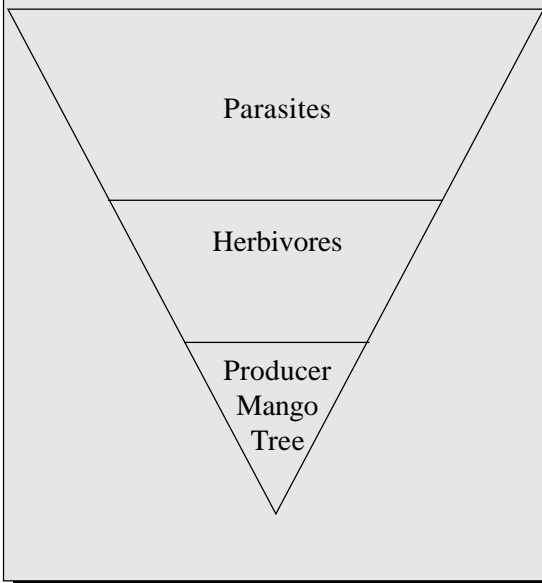
The Pyramid of Numbers

Now you are well aware of the fact that there is a reduction in the number of organisms when entering one trophic level to the other. The schematic representation based on the number of organisms at each trophic level is then called the pyramid of numbers. The lower part of the pyramid is represented by the green plants in the food chain and its upper part is represented by the higher levels of carnivores.

Demonstrate and examine the different trophic levels of a food chain based on their numbers. Examine whether the representation is in the form of a pyramid.

Inverted Pyramid!

Now you know what a pyramid number is? Consider a tall mango tree with ripe fruits as an ecosystem. On it there are several birds and mammals, which are consuming fully ripe fruits. These animals in turn bear several parasites like ticks and mites etc on their body. Now try to count the number of these individuals. There is only one producer. How many herbivores? What about the number of ticks and mites? Can you count their actual number? Then what will be the nature of the pyramid? No doubt, it is an inverted pyramid. Try to find out more examples of this kind of inverted pyramids.



The pyramid of biomass

Let us see, how we can represent the quantity of the loss of matter in the different trophic levels in the form of a pyramid.

Suppose the herbivores in a food chain feeds on 100 kgs of plant tissues. Is there an increase of 100 kgms in their body mass? It is sure that the answer is 'No'. If we consider that the increase is only 10 Kgms, it is clear that the body mass of the carnivores that feed on them does not show any proportional increase. At the upper trophic levels there is only a nominal increase in their body mass.

If the different living beings at different trophic levels are arranged one above the other on the basis of their biomass will it not form a pyramid? Such a representation is called pyramid of biomass. Demonstrate a biomass pyramid by considering a food chain.

Flow of Matter

Is energy alone transferred in a food chain? Is not there a transfer of matter also? Didn't the matter also transfer? Let us examine how it occurs? The chemical energy fixed in the plant tissues is utilized by different organisms as the source of their food. It is well known that food gives us the necessary energy requirement for the life activities as well as the building up of body tissues. It is also evident that tissues are transferred through food chain. These are decomposed into abiotic factors later. How do they get back in to the body of the living organisms?

Study the diagrammatic illustration III. Find out how matter flows and how it differs from the flow of energy. Record the observations in your science diary.

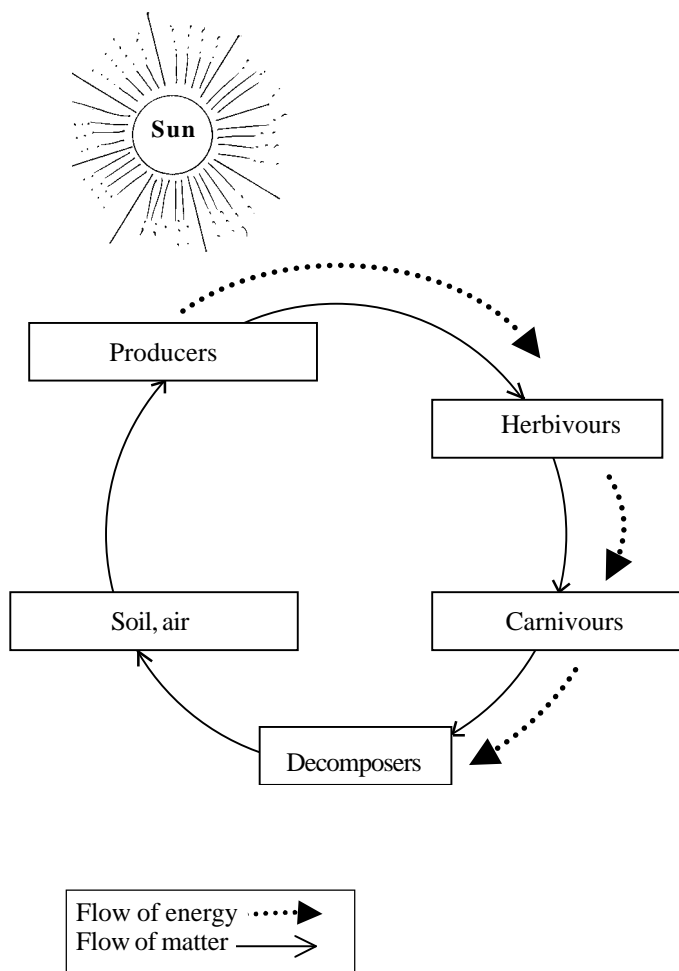


Illustration III

It is now clear that the flow of matter is cyclic and it thus differs from the flow of energy.

Carbon Cycle

You know that carbon, hydrogen, oxygen and nitrogen are important nutritive

elements of food substances. Organic substances are formed by the combination of these elements in different proportions. In the cyclic movements of materials in nature, these elements which are the building units of the organic substances have an important role. Carbon is the basic element of the organic compounds. Let us notice the cyclic flow of the carbon in nature.

After observing the Table I.a given below, show how the flow of carbon completes through the plants and animals.

Source	Utilization	Consumer	Decomposition Process
CO ₂ in the atmosphere	Plants - Photosynthesis	Animals	Decomposition Respiration, burning the fuels

Figure I.a

Carbon Compounds and its Decomposition Process

You have thus understood the role of carbon cycle in maintaining the constancy in the measure of carbon contents to an extent.

Nitrogen Cycle

Which gas is present in abundance in the atmosphere? No doubt it is Nitrogen, which is one of the most important element

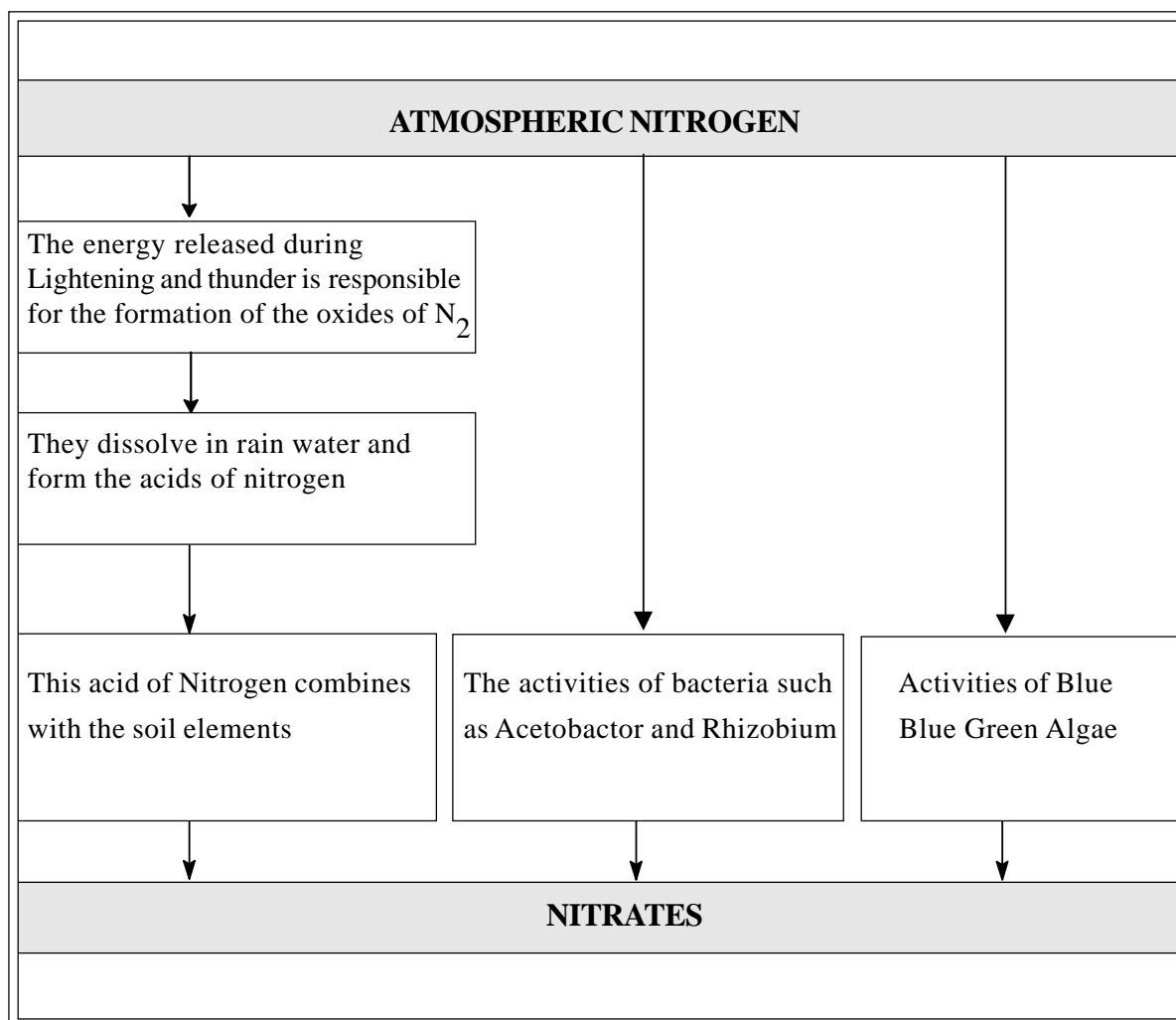


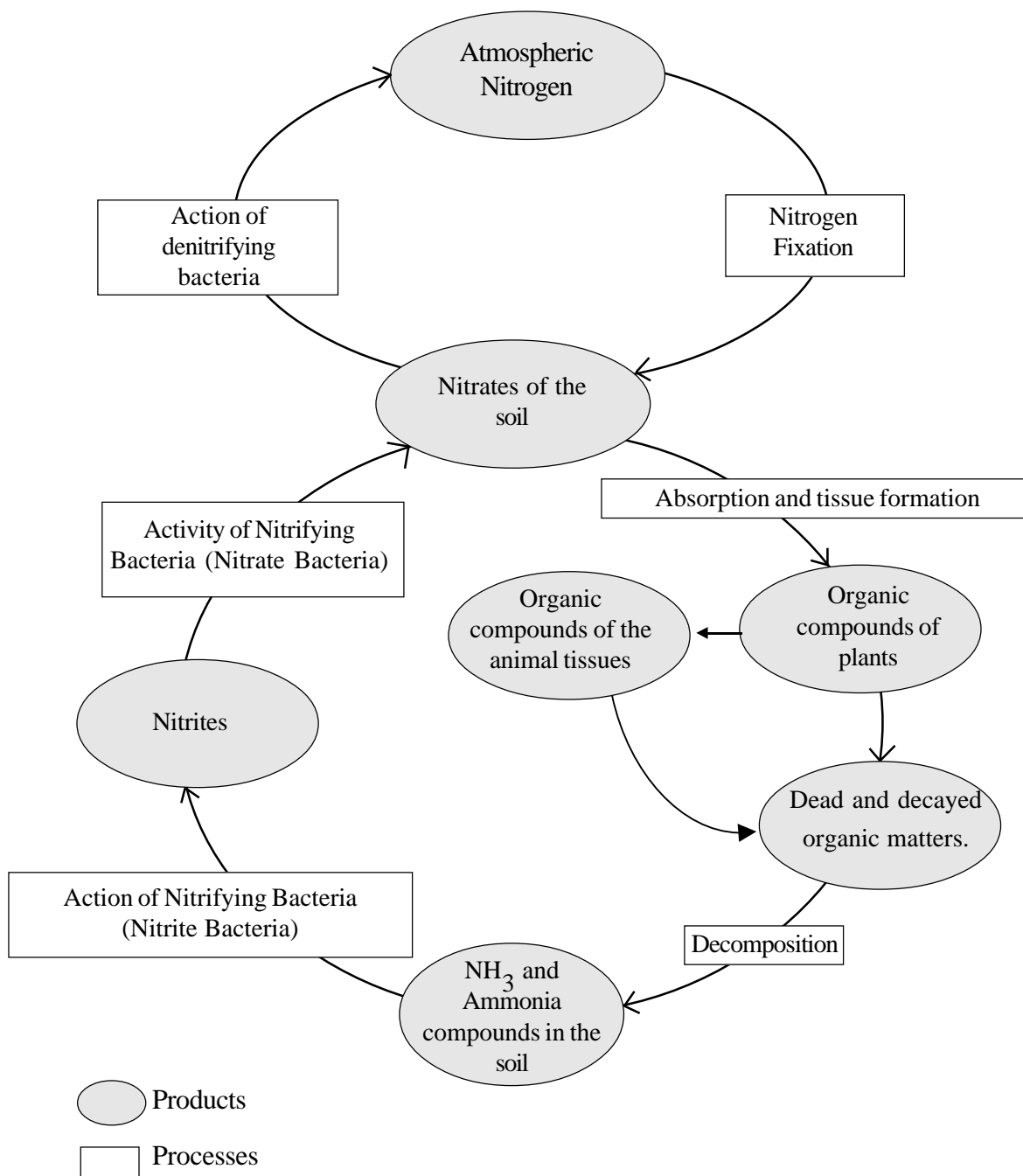
Illustration IV

used for the synthesis of proteins required for body building and also one of the most important constituents of nucleic acids.

It is not possible to absorb free N_2 directly from the atmosphere by the plants unlike the direct absorption of CO_2 and O_2 . The atmospheric nitrogen is converted in to its absorbable form as nitrates. This process is called nitrogen fixation.

Go through the illustration above and study different ways through which N_2 is converted in to nitrates. In addition to this, use of chemical fertilizers also increases the nitrate content in the soil.

Plants absorb the soil nitrates and use it for the biosynthesis of protein. This protein is transferred through the food chains. Observe the diagrammatic representation V and study the N_2 cycle.



N₂ Cycle - Diagrammatic representation V

- Prepare a table showing the types of bacteria involved in the N₂-cycle and their various roles.
- How does nitrate absorbed by the plants return to the atmosphere? Prepare a brief note after detailed discussion.

You have realized the role of N_2 -cycle in maintaining the constancy of atmospheric nitrogen content.

Other cycles

Phosphorus is one of the building units of nucleic acids and ATP. Plants absorb this element in the form of ions. It is utilized for the synthesis of plant tissues. This element comes back to the soil and water by the decomposition of dead and decayed organic matter and excretory products. From there it is again absorbed by the plants.

You have already studied how the O_2 content is stabilised in the atmosphere. What about the quantity of water? How does the process of photosynthesis in plants, respiration and transpiration help in maintaining the cycle of O_2 and water on the earth. Discuss and illustrate O_2 and H_2O cycles.

Sulphur is another element essential for the formation of tissues in plants and animals. In nature, the flow of this element is also cyclic.

Natural Resources

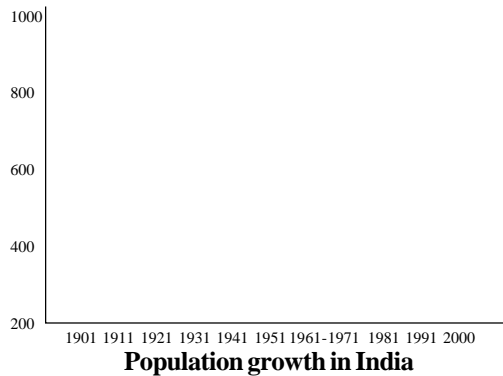
You must have understood the role of biotic and abiotic factors in the flow of energy and matter. It is from these that natural resources are formed. They include energy, air, water, soil, minerals, plants and animals.

We have already learnt that the natural resources could be divided in to renewable resources and non-renewable resources. Classify the different kinds of natural resources seen in your surroundings.

The balance sheet of energy consumption

We are living in the dark shadow of severe energy crisis. It is really surprising to know how the intelligent man has reached such a situation? The daily consumption of energy by primitive man was only 2000-4000 k cal per day. Do you know the present level of energy consumption? It is 7000 k. cal. Following the discovery of fire, man began to use more and more energy. Developments in the fields of agriculture, industry, transportation, telecommunication systems etc. further enhanced the energy consumption. The situation became more critical following the rapid increase in population. In energy consumption USA stands foremost, though the density of population is much less. How can this be justified? It is the primary duty of man, who loves this living world, to protect and conserve the natural resources.

A brief account of certain natural resources taken from the collection of a student is given below: Analyse and find out suitable answers for the following questions.



Sun	31	3	10	17	24
Mun	4	11	18	25	
Tue	5	12	19	26	
Wed	6	13	20	27	
Thu	7	14	21	28	
Fri	1	8	15	22	29
Sat	2	9	16	23	30

JUNE 2003
TUESDAY 5

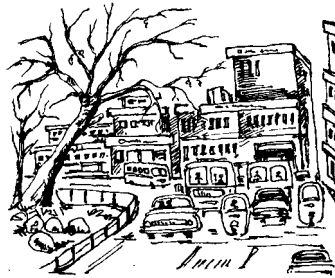
Today is world environmental day. Nearly 200 crores of people are suffering from the scarcity of drinking water..... this was the message of the year. The environmental club of the school celebrated this year's environmental day. The day

HERBAL RESOURCES

Yesterday



Today



Tomorrow



Fossil fuels have been formed in the earth by the steady process of crores and crores of years. Many years are required to formulate 1 Kg of fossil fuel.

What about consumption?

One Litre of petrol burned out when a Motor car runs about 10 Kms distance. How many such vehicles! How many Factories!

- Name the natural resources which are steadily increasing on the earth? How does it cause depletion of other resources.
- $\frac{2}{3}$ parts of the earth is water. How does this corroborate with media reports?
- The depletion of plant resources can be compensated, but the depletion in the fossil fuels deposits cannot be compensated. Why?

It is realized that all types of natural resources are not renewable. It is also known that there is necessity of restricting the use of non-renewable natural resources also. What is the usual trend in using natural resources

in your locality? Submit your data wise report after actively involving in a related project work.

Don't you know that organisms cannot exist on the earth without the use of natural resources. But apart from other organisms, the indiscriminate invasion by man is the chief cause of the depletion of natural resources. So it is the obligation of man to find out suitable solutions to this burning issue by restricting the exploitation of non-renewable natural resources and proper management in renewing the renewable resources in time and also by developing new energy resources.

SUMMARY

- ❖ Energy flow and flow of matter are essential for the existence of biosphere. Unlike the energy flow, flow of matter is cyclic.
- ❖ A large amount of energy is lost at each trophic level.
- ❖ In nature Carbon, Phosphorus, Nitrogen, Hydrogen and Oxygen are following cyclic path way.
- ❖ The energy flow through the different trophic levels, their biomass and numbers can be diagrammatically represented in the forms of pyramids.
- ❖ Along with the judicious and sensible utilization of natural resources, efforts must be made to find and develop new energy resources.

FURTHER ACTIVITIES

⇒ Imagine that the producers in an ecosystem are extensively destroyed. How does it affect the proportion of the biomass between different trophic levels? Explain briefly.

⇒ The following food chain may diagrammatically be represented as various levels of energy flow. Record the amount of available energy, utilized and transferred energy from one trophic level to another.

Grass → Rabbit → Snake → Eagle

⇒ Using the organism mentioned below prepare a pyramid of energy, a pyramid of biomass and a pyramid of numbers.

Rice → Rat → Owl → Vulture

⇒ Both the pyramid of energy and biomass pyramid are almost identical with each

other in the composition and stratification. Assess this statement and rectify, if there is any mistake.

⇒ Firewood is burnt. Draw the schematic representation of Carbon cycle based on this process.

⇒ Man still exploits natural resources indiscriminately. If the process continues, the ultimate results will be more tragic and dangerous. So every one of us should take a pledge that at least for a short period we do not utilize natural resources. Evaluate this statement and record your opinion.

⇒ The nitrogen content of soil is drastically depleting at a specific locality. What will be the cause of this event? Formulate any four suggestions.

