Chapter 1

CORROSION

- When a metal is attacked by substances around it such as moisture, acids, etc., it is said to corrode and this process is called corrosion.
- The black coating on silver and the green coating on copper are other examples of corrosion.
- Corrosion causes damage to car bodies, bridges, iron railings, ships and to all objects made of metals, specially those of iron

Rancidity

- When fats and oils are oxidised, they become rancid and their smell and taste change.
- Usually substances which prevent oxidation (antioxidants) are added to foods containing fats and oil. Keeping food in air tight containers helps to slow down oxidation.
- chips manufacturers usually flush bags of chips with gas such as nitrogen to prevent the chips from getting oxidised

Importance of pH in Everyday Life

- Our body works within the pH range of 7.0 to 7.8. Living organisms can survive only in a narrow range of pH change.
- When pH of rain water is less than 5.6, it is called acid rain. When acid rain flows into the rivers, it lowers the pH of the river water. The survival of aquatic life in such rivers becomes difficult.

pH in our digestive system

- our stomach produces hydrochloric acid. It helps in the digestion of food without harming the stomach. During indigestion the stomach produces too much acid and this causes pain and irritation. To get rid of this pain, people use bases called antacids.
- These antacids neutralise the excess acid. Magnesium hydroxide (Milk of magnesia), a mild base, is often used for this purpose.

pH change as the cause of tooth decay

- Tooth enamel, made up of calcium phosphate is the hardest substance in the body.
- It does not dissolve in water, but is corroded when the pH in the mouth is below 5.5.
- Bacteria present in the mouth produce acids by degradation of sugar and food particles remaining in the mouth after eating.
- The best way to prevent this is to clean the mouth after eating food. Using toothpastes, which are generally basic, for cleaning the teeth can neutralise the excess acid and prevent tooth decay.
- Self defence by animals and plants through chemical warfare Bee-sting leaves an acid which causes pain and irritation.

- Use of a mild base like baking soda on the stung area gives relief.
- Stinging hair of nettle leaves inject methanoic acid causing burning pain

Bleaching powder is used –

- for bleaching cotton and linen in the textile industry, for bleaching wood pulp in paper factories and for bleaching washed clothes in laundry;

- as an oxidising agent in many chemical industries; and
- for disinfecting drinking water to make it free of germs

Uses of sodium hydrogencarbonate

- Sodium hydrogencarbonate is also an ingredient in antacids.
- Being alkaline, it neutralises excess acid in the stomach and provides relief.
- It is also used in soda-acid fire extinguishers

Uses of washing soda

- Sodium carbonate (washing soda) is used in glass, soap and paper industries.
- It is used in the manufacture of sodium compounds such as borax.
- Sodium carbonate can be used as a cleaning agent for domestic purposes.
- It is used for removing permanent hardness of water
- A neutral solution has a pH of exactly 7,
- an acidic solution has a pH less than 7
- a basic solution a pH more than 7.

CHAPTER 3

Metals and Non-metals

Properties of some metals

- The above activity shows that metals are good conductors of heat and have high melting points. The best conductors of heat are silver and copper. Lead and mercury are comparatively poor conductors of heat.
- The metals that produce a sound on striking a hard surface are said to be sonorous
- All metals except mercury exist as solids at room temperature.
- Iodine is a non-metal but it is lustrous.
- (Carbon is a non-metal that can exist in different forms. Each form is called an allotrope.
- Diamond, an allotrope of carbon, is the hardest natural substance known and has a very high melting and boiling point. Graphite, another allotrope of carbon, is a conductor of electricity.
- Alkali metals (lithium, sodium, potassium) are so soft that they can be cut with a knife. They have low densities and low melting points.
- Metals such as potassium and sodium react so vigorously that they catch fire if kept in the open. Hence, to protect them and to prevent accidental fires, they are kept immersed in kerosene oil.
- At ordinary temperature, the surfaces of metals such as magnesium, aluminium, zinc, lead, etc., are covered with a thin layer of oxide. The protective oxide layer prevents the metal from further oxidation.
- Iron does not burn on heating but iron filings burn vigorously when sprinkled in the flame of the burner.
- Copper does not burn, but the hot metal is coated with a black coloured layer of copper oxide.
- Silver and gold do not react with oxygen even at high temperature
- Anodising is a process of forming a thick oxide layer of aluminium. Aluminium develops a thin oxide layer when exposed to air. This aluminium oxide coat makes it resistant to further corrosion

Aqua regia,

- (is a freshly prepared mixture of concentrated hydrochloric acid and concentrated nitric acid in the ratio of 3:1.

- It can dissolve gold, even though neither of these acids can do so alone.
- Aqua regia is a highly corrosive, fuming liquid. It is one of the few reagents that is able to dissolve gold and platinum

CHAPTER 4

Carbon and its Compounds

- Carbon has the unique ability to form bonds with other atoms of carbon, giving rise to large molecules. This property is called **catenation.**
- These compounds may have long chains of carbon, branched chains of carbon or even carbon atoms arranged in rings. In addition, carbon atoms may be linked by single, double or triple bonds.
- Compounds of carbon, which are linked by only single bonds between the carbon atoms are called saturated compounds. Compounds of carbon having double or triple bonds between their carbon atoms are called **unsaturated compounds**.
- . The carbon-carbon bond is very strong and hence stable. This gives us the large number of compounds with many carbon atoms linked to each other.
- Compounds of carbon are formed with oxygen, hydrogen, nitrogen, sulphur, chlorine and many other elements giving rise to compounds with specific properties
- . Again the bonds that carbon forms with most other elements are very strong making these compounds exceptionally stable..

COAL FORMATION:

- Coal and petroleum have been formed from biomass which has been subjected to various biological and geological processes.
- Coal is the remains of trees, ferns, and other plants that lived millions of years ago. These were crushed into the earth, perhaps by earthquakes or volcanic eruptions.
- They were pressed down by layers of earth and rock
- . They slowly decayed into coal.
- Oil and gas are the remains of millions of tiny plants and animals that lived in the sea.
- When they died, their bodies sank to the sea bed and were covered by silt.
- Bacteria attacked the dead remains, turning them into oil and gas under the high pressures they were being subjected to. Meanwhile, the silt was slowly compressed into rock.
- The oil and gas seeped into the porous parts of the rock, and got trapped like water in a sponge

CHAPTER 10

Light – Reflection and Refraction

REFLECTION OF LIGHT

- The angle of incidence is equal to the angle of reflection, and
- The incident ray, the normal to the mirror at the point of incidence and the reflected ray, all lie in the same plane

- Image formed by a plane mirror is always virtual and erect. The size of the image is equal to that of the object. The image formed is as far behind the mirror as the object is in front of it.

SPHERICAL MIRRORS

- A spherical mirror, whose reflecting surface is curved inwards, that is, faces towards the centre of the sphere, is called a concave mirror.
- A spherical mirror whose reflecting surface is curved outwards, is called a convex mirror
- The centre of the reflecting surface of a spherical mirror is a point called the pole. It lies on the surface of the mirror.

Uses of concave mirrors

- Concave mirrors are commonly used in torches, search-lights and vehicles headlights to get powerful parallel beams of light.
- They are often used as shaving mirrors to see a larger image of the face.
- The dentists use concave mirrors to see large images of the teeth of patients. Large concave mirrors are used to concentrate sunlight to produce heat in solar furnaces.

Uses of convex mirrors

- Convex mirrors are commonly used as rear-view (wing) mirrors in vehicles.
- These mirrors are fitted on the sides of the vehicle, enabling the driver to see traffic behind him/her to facilitate safe driving.
- Convex mirrors are preferred because they always give an erect, though diminished, image.
- Also, they have a wider field of view as they are curved outwards.
- Thus, convex mirrors enable the driver to view much larger area than would be possible with a plane mirror.

REFRACTION

- When a beam of light encounters another transparent medium, a part of light gets reflected back into the first medium while the rest enters the other. A ray of light represents a beam.
- The direction of propagation of an obliquely incident ray of light that enters the other medium, changes at the interface of the two media. This phenomenon is called **refraction of light.**
- The incident ray, the refracted ray and the normal to the interface at the point of incidence, all lie in the same plane.
- The ratio of the sine of the angle of incidence to the sine of angle of refraction is constant

TOTAL INTERNAL REFLECTION

When light travels from an optically denser medium to a rarer medium at the interface, it is partly reflected back into the same medium and partly refracted to the second medium. This reflection is called the **internal reflection**

Total internal reflection in nature and its technological applications:-

1)MIRAGE:

- In hot summer days, the air near the ground becomes hotter than the air at higher levels.

- To a distant observer, the light appears to be coming from somewhere below the ground. The observer naturally assumes that light is being reflected from the ground, say, by a pool of water near the tall object.
- Such inverted images of distant tall objects cause an optical illusion to the observer. This phenomenon is called **mirage.**
- This type of mirage is especially common in hot deserts. Some of you might have noticed that while moving in a bus or a car during a hot summer day, a distant patch of road, especially on a highway, appears to be wet. But, you do not find any evidence of wetness when you reach that spot. This is also due to mirage.

2) DIAMOND:

- Diamonds are known for their spectacular brilliance. Their brilliance is mainly due to the total internal reflection of light inside them.
- Diamonds found in nature rarely exhibit the brilliance for which they are known.
- It is the technical skill of a diamond cutter which makes diamonds to sparkle so brilliantly.
- By cutting the diamond suitably, multiple total internal reflections can be made to occur

3) PRISM:

Prisms designed to bend light by 90º or by 180º make use of total internal reflection Such a prism is also used to invert images without changing their size

4) OPTICAL FIBRE:

- optical fibres are extensively used for transmitting audio and video signals through long distances. Optical fibres too make use of the phenomenon of total internal reflection
- Optical fibres are extensively used for transmitting and receiving electrical signals
- optical fibres can also be used for transmission of optical signals.

CHAPTER 12

Electricity

Practical Applications of Heating Effect of Electric Current

- The generation of heat in a conductor is an inevitable consequence of electric current.
- However, heating effect of electric current has many useful applications.
- The electric laundry iron, electric toaster, electric oven, electric kettle and electric heater are some of the familiar devices based on Joule's heating.
- The electric heating is also used to produce light, as in an electric bulb.
- Here, the filament must retain as much of the heat generated as is possible, so that it gets very hot and emits light. It must not melt at such high temperature.
- A strong metal with high melting point such as **tungsten** is used for making **bulb filaments.**
- The filament should be thermally isolated as much as possible, using insulating support, etc.
- The bulbs are usually filled with chemically inactive nitrogen and argon gases to prolong the life of filament.
- Most of the power consumed by the filament appears as heat, but a small part of it is in the form of light radiated.

- Another common application of Joule's heating is the **fuse used in electric circuits**.
- It protects circuits and appliances by stopping the flow of any unduly high electric current.
- The fuse is placed in series with the device. It consists of a piece of wire made of a metal or an alloy of appropriate melting point, for example aluminium, copper, iron, lead etc.
- If a current larger than the specified value flows through the circuit, the temperature of the fuse wire increases. This melts the fuse wire and breaks the circuit..

CHAPTER 13

Magnetic Effects of Electric Current

- A compass needle is a small magnet. Its one end, which points towards north, is called a north pole, and the other end, which points towards south, is called a south pole.
- An electromagnet consists of a core of soft iron wrapped around with a coil of insulated copper wire
- A generator converts mechanical energy into electrical energy. It works on the basis of electromagnetic induction
- In our houses we receive AC electric power of 220 V with a frequency of 50 Hz.
- One of the wires in this supply is with red insulation, called **live wire**.
- The other one is of black insulation, which is a **neutral wire**. The potential difference between the two is 220 V.
- The third is the **earth wire** that has green insulation and this is connected to a metallic body deep inside earth. It is used as a safety measure to ensure that any leakage of current to a metallic body does not give any severe shock to a user.

FUSE

- A fuse in a circuit prevents damage to the appliances and the circuit due to overloading. Overloading can occur when the live wire and the neutral wire come into direct contact.
- (This occurs when the insulation of wires is damaged or there is a fault in the appliance.)
- In such a situation, the current in the circuit abruptly increases. This is called short-circuiting. The use of an electric fuse prevents the electric circuit and the appliance from a possible damage by stopping the flow of unduly high electric current.
- The heating that takes place in the fuse melts it to break the electric circuit.
- Overloading can also occur due to an accidental hike in the supply voltage. Sometimes overloading is caused by connecting too many appliances to a single socket.

CHAPTER 14

Sources of Energy

CONVENTIONAL SOURCES OF ENERGY

Fossil Fuels:-

- fossil fuels – coal and petroleum.

- But these fuels were formed over millions of years ago and there are only limited reserves.
- The fossil fuels are non-renewable sources of energy, so we need to conserve them. If we were to continue consuming these sources at such alarming rates, we would soon run out of energy!
- In order to avoid this, alternate sources of energy were explored. But we continue to be largely dependent on fossil fuels for most of our energy requirements
- Burning fossil fuels has other disadvantages too.
- the **air pollution caused** by burning of coal or petroleum products.
- The **oxides of carbon, nitrogen and sulphur that are released on burning fossil fuels are acidic oxides.** These lead to **acid rain** which affects our water and soil resources.
- the green-house effect of gases like carbon dioxide.

Thermal Power Plant

- Large amount of fossil fuels are burnt every day in power stations to heat up water to produce steam which further runs the turbine to generate electricity.
- The transmission of electricity is more efficient than transporting coal or petroleum over the same distance
- Therefore, many thermal power plants are set up near coal or oil fields.
- The term **thermal power plant** is used since fuel is burnt to produce heat energy which is converted into electrical energy.

Hydro Power Plants

- Another traditional source of energy was the kinetic energy of flowing water or the potential energy of water at a height.
- Hydro power plants convert the potential energy of falling water into electricity.
- a quarter of our energy requirement in India is met by hydro power plants.
- In order to produce hydel electricity, high-rise dams are constructed on the river to obstruct the flow of water and thereby collect water in larger reservoirs.
- The water level rises and in this process the kinetic energy of flowing water gets transformed into potential energy. The water from the high level in the dam is carried through pipes, to the turbine, at the bottom of the dam
- Since the water in the reservoir would be refilled each time it rains (hydro power is a renewable source of energy)
- But, constructions of big dams have certain problems associated with it.
- The dams can be constructed only in a limited number of places, preferably in hilly terrains.
- Large areas of agricultural land and human habitation are to be sacrificed as they get submerged. Large eco-systems are destroyed when submerged under the water in dams.
- The vegetation which is submerged rots under anaerobic conditions and gives rise to large amounts of methane which is also a green-house gas.
- It creates the problem of satisfactory rehabilitation of displaced people
- Opposition to the construction of **Tehri Dam on the river Ganga and Sardar Sarovar project on the river Narmada a**re due to such problems.

Improvements in the Technology for using Conventional Sources of Energy

Bio-Mass:-

- cow-dung cakes as a fuel.

- Given the large live-stock population in India, this can also assure us a steady source of fuel.
- Since these fuels are plant and animal products, the source of these fuels is said to be bio-mass.
- These fuels, however, do not produce much heat on burning and a lot of smoke is given out when they are burnt.
- Therefore, technological inputs to improve the efficiency of these fuels are necessary.
- When wood is burnt in a limited supply of oxygen, water and volatile materials present in it get removed and charcoal is left behind as the residue.
- Charcoal burns without flames, is comparatively smokeless and has a higher heat generation efficiency.

➢ Similarly, cow-dung, various plant materials like the residue after harvesting the crops, vegetable waste and sewage are decomposed in the absence of oxygen to give bio-gas. Since the starting material is mainly cow-dung, it is popularly known as '**gobar-gas'**.

- The plant has a dome-like structure built with bricks
- . A slurry of cow-dung and water is made in the mixing tank from where it is fed into the digester. The digester is a sealed chamber in which there is no oxygen.
- Anaerobic micro-organisms that do not require oxygen decompose or break down complex compounds of the cow-dung slurry.
- It takes a few days for the decomposition process to be complete and generate gases like methane, carbon dioxide, hydrogen and hydrogen sulphide.
- The bio-gas is stored in the gas tank above the digester from which they are drawn through pipes for use. Bio-gas is an excellent fuel as it contains up to 75% methane.
- It burns without smoke, leaves no residue like ash in wood, charcoal and coal burning. Its heating capacity is high. Bio-gas is also used for lighting.
- The slurry left behind is removed periodically and used as excellent manure, rich in nitrogen and phosphorous.
- The large-scale utilisation of bio-waste and sewage material provides a safe and efficient method of waste-disposal besides supplying energy and manure.

Wind Energy

- kinetic energy of the wind can be used to do work.
- This energy was harnessed by windmills in the past to do mechanical work.
- For example, in a water-lifting pump, the rotatory motion of windmill is utilised to lift water from a well. Today, wind energy is also used to generate electricity.
- A windmill essentially consists of a structure similar to a large electric fan that is erected at some height on a rigid support .
- To generate electricity, the rotatory motion of the windmill is used to turn the turbine of the electric generator.
- The output of a single windmill is quite small and cannot be used for commercial purposes.
- Therefore, a number of windmills are erected over a large area, which is known as wind energy farm.
- The energy output of each windmill in a farm is coupled together to get electricity on a commercial scale

✓ **Denmark i**s called the **country of 'winds'**. More than 25% of their electricity needs are generated through a vast network of windmills.

- In terms of total output**, Germany** is the leader, while India is ranked fifth in harnessing wind energy for the production of electricity.

✓ It is estimated that nearly 45,000 MW of electrical power can be generated if India's wind potential is fully exploited.

- The largest wind energy farm has been established near **Kanyakumari in Tamil Nadu and it generates 380 MW of electricity.**
- Wind energy is an environment-friendly and efficient source of renewable energy.
- It requires no recurring expenses for the production of electricity. But there are many limitations in harnessing wind energy.
- Firstly, wind energy farms can be established only at those places where wind blows for the greater part of a year.
- The wind speed should also be higher than 15 km/h to maintain the required speed of the turbine.
- Furthermore, there should be some back-up facilities (like storage cells) to take care of the energy needs during a period when there is no wind.
- Establishment of wind energy farms requires large area of land.
- For a 1 MW generator, the farm needs about 2 hectares of land. The initial cost of establishment of the farm is quite high.
- Moreover, since the tower and blades are exposed to the vagaries of nature like rain, Sun, storm and cyclone, they need a high level of maintenance

ALTERNATIVE OR NON-CONVENTIONAL CONVENTIONAL SOURCES OF ENERGY

Solar Energy

- India is lucky to receive solar energy for greater part of the year.
- It is estimated that during a year India receives the energy equivalent to more than 5,000 trillion kWh.
- Under clear (cloudless) sky conditions, the daily average varies from 4 to 7 kWh/m2.

- *A black surface absorbs more heat as compared to a white or a reflecting surface under identical conditions*. **Solar cookers and solar water heaters** use this property in their working. Some solar cookers achieve a higher temperature by using mirrors to focus the rays of the Sun.
- limitation of using solar energy is overcome by using **solar cells that convert solar energy into electricity**
- ✓ A typical cell develops a voltage of 0.5–1 V and can produce about 0.7 W of electricity when exposed to the Sun.
- A large number of solar cells are, combined in an arrangement called solar cell panel (Fig. 14.7) that can deliver enough electricity for practical use.
- The principal advantages associated with solar cells are that they have no moving parts, require little maintenance and work quite satisfactorily without the use of any focussing device.
- Another advantage is that they can be set up in remote and inaccessible hamlets or very sparsely inhabited areas in which laying of a power transmission line may be expensive and not commercially viable.
- Silicon, which is used for making solar cells, is abundant in nature but availability of the special grade silicon for making solar cells is limited.
- The entire process of manufacture is still very expensive, silver used for interconnection of the cells in the panel further adds to the cost.
- In spite of the high cost and low efficiency, solar cells are used for many scientific and technological applications.
- Artificial satellites and space probes like Mars orbiters use solar cells as the main source of energy.
- Radio or wireless transmission systems or TV relay stations in remote locations use solar cell panels.
- Traffic signals, calculators and many toys are fitted with solar cells.

- The solar cell panels are mounted on specially designed inclined roof tops so that more solar energy is incident over it.
- The domestic use of solar cells is, however, limited due to its high cost.

Energy from the Sea

Tidal Energy:-

- Due to the gravitational pull of mainly the moon on the spinning earth, the level of water in the sea rises and falls.. This phenomenon is called **high and low tides** and the difference in sea-levels gives **us tidal energy.**
- Tidal energy is harnessed by constructing a dam across a narrow opening to the sea.
- A turbine fixed at the opening of the dam converts tidal energy to electricity.
- the locations where such dams can be built are limited.

Wave Energy :-

- the kinetic energy possessed by huge waves near the seashore can be trapped to generate electricity.
- The waves are generated by strong winds blowing across the sea.
- A wide variety of devices have been developed to trap wave energy for rotation of turbine and production of electricity.

Ocean Thermal Energy

- The water at the surface of the sea or ocean is heated by the Sun while the water in deeper sections is relatively cold.
- This difference in temperature is exploited to obtain energy in ocean-thermal-energy conversion plants.
- These plants can operate if the temperature difference between the water at the surface and water at depths up to 2 km is 20 K (20°C) or more.
- The warm surface-water is used to boil a volatile liquid like ammonia. The vapours of the liquid are then used to run the turbine of generator.
- The cold water from the depth of the ocean is pumped up and condense vapour again to liquid.
- The energy potential from the sea (tidal energy, wave energy and ocean thermal energy) is quite large, but efficient commercial exploitation is difficult.

Geothermal Energy

- Due to geological changes, molten rocks formed in the deeper hot regions of earth's crust are pushed upward and trapped in certain regions called **'hot spots'.**
- When underground water comes in contact with the hot spot, steam is generated. Sometimes hot water from that region finds outlets at the surface. Such outlets are known as hot springs.
- The steam trapped in rocks is routed through a pipe to a turbine and used to generate electricity.

Nuclear Energy

- In a process called **nuclear fission**, *the nucleus of a heavy atom (such as uranium, plutonium or thorium), when bombarded with low-energy neutrons, can be split apart into lighter nuclei.*
- When this is done, a tremendous amount of energy is released if the mass of the original nucleus is just a little more than the sum of the masses of the individual products.
- The fission of an atom of uranium, for example, produces 10 million times the energy produced by the combustion of an atom of carbon from coal.

- In a nuclear reactor designed for electric power generation, such nuclear 'fuel' can be part of a selfsustaining fission chain reaction that releases energy at a controlled rate
- The released energy can be used to produce steam and further generate electricity
- ***Nuclear power reactors*** located at **Tarapur (Maharashtra**), **Rana Pratap Sagar (Rajasthan**), **Kalpakkam (Tamil Nadu), Narora (UP), Kakrapar (Gujarat) and Kaiga (Karnataka)** have the installed capacity of less than 3% of the total electricity generation capacity of our country..
- The major hazard of nuclear power generation is the storage and disposal of spent or used fuels – the uranium still decaying into harmful subatomic particles (radiations).
- Improper nuclear-waste storage and disposal result in environmental contamination. Further, there is a risk of accidental leakage of nuclear radiation.
- The high cost of installation of a nuclear power plant, high risk of environmental contamination and limited availability of uranium makes large-scale use of nuclear energy prohibitive.

Nuclear fusion

- Currently all commercial nuclear reactors are based on nuclear fission.
- But there is another possibility of nuclear energy generation by a safer process called **nuclear fusion.**
- ***Fusion means joining lighter nuclei to make a heavier nucleus, most commonly hydrogen or hydrogen isotopes to create helium,*** such as $2\,H + 2H \rightarrow 3He\ (+ n)$
- It releases a tremendous amount of energy, according to the Einstein equation, as the mass of the product is little less than the sum of the masses of the original individual nuclei. Such nuclear fusion reactions are the source of energy in the Sun and other stars.
- It takes considerable energy to force the nuclei to fuse.
- The conditions needed for this process are extreme – millions of degrees of temperature and millions of pascals of pressure.
- The **hydrogen bomb** is based on **thermonuclear fusion reaction**.
- A **nuclear bomb** based on the **fission of uranium or plutonium** is placed at the core of the hydrogen bomb. This nuclear bomb is embedded in a substance which contains deuterium and lithium. When the nuclear bomb (based on fission) is detonated, the temperature of this substance is raised to 107 K in a few microseconds. The high temperature generates sufficient energy for the light nuclei to fuse and a devastating amount of energy is released.

CHAPTER 15
Our Environment

- Substances that are broken down by biological processes are said to be **biodegradable.** Substances that are not broken down in this manner are said to be **non-biodegradable**. These substances may be inert and simply persist in the environment for a long time or may harm the various members of the eco-system.

ECO-SYSTEM — WHAT ARE ITS COMPONENTS?

An ecosystem consists of biotic components comprising living organisms and abiotic components comprising physical factors like temperature, rainfall, wind, soil and mineral.

- All green plants and certain bluegreen algae which can produce food by photosynthesis are called the **producers.**
- These organisms which consume the food produced, either directly from producers or indirectly by feeding on other consumers are the **consumers.**
- Consumers can be classed variously as **herbivores, carnivores, omnivores and parasites.**

Energy flow diagram

- **TOP CARNIVORES**
- **CARNIVORES**
- **HERVIBORES**
- **PRODUCERS**
- **SUNLIGHT**

- chemicals are either washed down into the soil or into the water bodies.
- From the soil, these are absorbed by the plants along with water and minerals, and from the water bodies these are taken up by aquatic plants and animals.
- This is one of the ways in which they enter the food chain.
- As these chemicals are not degradable, these get accumulated progressively at each trophic level. As human beings occupy the top level in any food chain, the maximum concentration of these chemicals get accumulated in our bodies. This phenomenon is known as **biological magnification.**
-
- This is the reason why our food grains such as wheat and rice, vegetables and fruits, and even meat, contain varying amounts of pesticide residues. They cannot always be removed by washing or other means

HOW DO OUR ACTIVITIES AFFECT THE ENVIRONMENT?

Ozone Layer and How it is Getting Depleted Ozone

- (O3) is a molecule formed by three atoms of oxygen.
- While O2, which we normally refer to as oxygen, is essential for all aerobic forms of life.
- Ozone, is a deadly poison.
- However, at the higher levels of the atmosphere, ozone performs an essential function.
- It shields the surface of the earth from ultraviolet (UV) radiation from the Sun.
- This radiation is highly damaging to organisms, for example, it is known to cause skin cancer in human beings.
- Ozone at the higher levels of the atmosphere is a product of UV radiation acting on oxygen (O2) molecule.
- The higher energy UV radiations split apart some moleculer oxygen (O2) into free oxygen (O) atoms.
- The amount of ozone in the atmosphere began to drop sharply in the 1980s.
- This decrease has been linked to synthetic chemicals like **chlorofluorocarbons (CFCs) which are used as refrigerants and in fire extinguishers.**
- In 1987, the United Nations Environment Programme (UNEP) succeeded in forging an agreement to freeze CFC production at 1986 level

CHAPTER 16

Management of Natural Resources

- Ganga Action Plan.
- This multi-crore project came about in 1985 because the quality of the water in the Ganga was very poor
- Coliform is a group of bacteria, found in human intestines, whose presence in water indicates contamination by disease-causing microorganisms

Pollution *of the Ganga*

- . The Ganga runs its course of over 2500 km from Gangotri in the Himalayas to Ganga Sagar in the Bay of Bengal.
- It is being turned into a drain by more than a hundred towns and cities in Uttar Pradesh, Bihar and West Bengal that pour their garbage and excreta into it.
- Largely untreated sewage is dumped into the Ganges every day.
- In addition, think of the pollution caused by other human activities like bathing, washing of clothes and immersion of ashes or unburnt corpses.
- ✓ And then, industries contribute chemical effluents to the Ganga's pollution load and the toxicity kills fish in large sections of the river.

the three R's to save the environment: *Reduce, Recycle and Reuse*.

Reduce:

- This means that you use less. You save electricity by switching off unnecessary lights and fans. You save water by repairing leaky taps. You do not waste food.

Recycle:

- This means that you collect plastic, paper, glass and metal items and recycle these materials to make required things instead of synthesising or extracting fresh plastic, paper, glass or metal.
- In order to recycle, we first need to segregate our wastes so that the material that can be recycled is not dumped along with other wastes.

Reuse:

- This is actually even better than recycling because the process of recycling uses some energy.
- In the 'reuse' strategy, you simply use things again and again. Instead of throwing away used envelopes, you can reverse it and use it again.
- The plastic bottles in which you buy various food-items like jam or pickle can be used for storing things in the kitchen.
- The concept of **sustainable development** encourages forms of growth that meet current basic human needs, while preserving the resources for the needs of future generations.
- Economic development is linked to environmental conservation. Thus sustainable development implies a change in all aspects of life.
- It depends upon the willingness of the people to change their perceptions of the socio-economic and environmental conditions around them, and the readiness of each individual to alter their present use of natural resources

WHY DO WE NEED TO MANAGE OUR RESOURCES?

- Because these are not unlimited and with the human population increasing at a tremendous rate due to improvement in health-care, the demand for all resources is increasing at an exponential rate
- The management of natural resources requires a long-term perspective so that these will last for the generations to come and will not merely be exploited to the hilt for short term gains
- This management should also ensure equitable distribution of resources so that all, and not just a handful of rich and powerful people, benefit from the development of these resources
- Another factor to be considered while we exploit these natural resources is the damage we cause to the environment while these resources are either extracted or used.
- Mining causes pollution because of the large amount of slag which is discarded for every tonne of metal extracted. Hence, sustainable natural resource management demands that we plan for the safe disposal of these wastes too.

FORESTS AND WILD LIFE

- Forests are 'biodiversity hot spots
- A loss of diversity may lead to a loss of ecological stability

Stakeholders

- ✓ **the people who live in or around forests** are dependent on forest produce for various aspects of their life
- ✓ The **Forest Department of the Government** which owns the land and controls the resources from forests.

- ✓ **The industrialists** – from those who use 'tendu' leaves to make bidis to the ones with paper mills – who use various forest produce, but are not dependent on the forests in any one area.
- ✓ **the wild life and nature enthusiasts** who want to conserve nature in its pristine form
- ✓ Before the British came and took over most of our forest areas, people had been living in these forests for centuries.
- ✓ They had developed practices to ensure that the resources were used in a sustainable manner.
- ✓ After the British took control of the forests (which they exploited ruthlessly for their own purposes), these people were forced to depend on much smaller areas and forest resources started becoming over-exploited to some extent.
- ✓ The Forest Department in independent India took over from the British but local knowledge and local needs continued to be ignored in the management practices.
- ✓ Thus vast tracts of forests have been converted to monocultures of pine, teak or eucalyptus
- ✓ In order to plant these trees, huge areas are first cleared of all vegetation.
- ✓ This destroys a large amount of biodiversity in the area.
- ✓ There have been enough instances of local people working traditionally for conservation of forests.
- ✓ For example, the case of the **Bishnoi community in Rajasthan**, for whom conservation of forest and wildlife has been a religious tenet.
- ✓ The Government of India has recently instituted an '**Amrita Devi Bishnoi National Award for Wildlife Conservation'** in the memory of **Amrita Devi Bishnoi**, who in 1731 sacrificed her life along with 363 others for the protection of '**khejri'** trees in Khejrali village near Jodhpur in Rajasthan

Sustainable Management

- Forest resources are often made available for industrial use at rates far below the market value while these are denied to the local people.
- The Chipko Andolan ('Hug the Trees Movement') was the result of a grassroot level effort to end the alienation of people from their forests.
- The movement originated from an incident in a remote village called Reni in Garhwal, high-up in the Himalayas during the early 1970s.
- There was a dispute between the local villagers and a logging contractor who had been allowed to fell trees in a forest close to the village.
- On a particular day, the contractor's workers appeared in the forest to cut the trees while the men folk were absent.
- Undeterred, the women of the village reached the forest quickly and clasped the tree trunks thus preventing the workers from felling the trees.
- Thus thwarted, the contractor had to withdraw. Inherent in such a competition to control a natural resource is the conservation of a replenishable resource. Specifically the method of use was being called into question. The contractor would have felled the trees, destroying them forever.
- The communities traditionally lop the branches and pluck the leaves, allowing the resource to replenish over time.
- The Chipko movement quickly spread across communities and media, and forced the government, to whom the forest belongs, to rethink their priorities in the use of forest produce.
- Experience has taught people that the destruction of forests affected not just the availability of forest products, but also the quality of soil and the sources of water.
- Participation of the local people can indeed lead to the efficient management of forests.
- An Example of People's Participation in the Management of Forests In 1972, the West Bengal Forest Department recognised its failures in reviving the degraded Sal forests in the southwestern districts of the state.
- Traditional methods of surveillance and policing had led to a Management of Natural Resources 273 'complete alienation of the people from the administration', resulting in frequent clashes between forest officials and villagers.
- **Forest and land related conflicts** in the region were also a major factor in fuelling the militant peasant movements led by the **Naxalites.**

Kulhs in Himachal Pradesh

- Parts of Himachal Pradesh had evolved a local system of canal irrigation called **kulhs** over four hundred years ago.
- The water flowing in the streams was diverted into man-made channels which took this water to numerous villages down the hillside.
- The management of the water flowing in these kulhs was by common agreement among all the villages.
- Interestingly, during the planting season, water was first used by the village farthest away from the source of the kulh, then by villages progressively higher up. These kulhs were managed by two or three people who were paid by the villagers.
- In addition to irrigation, water from these kulhs also percolated into the soil and fed springs at various points.
- After the kulhs were taken over by the Irrigation Department, most of them became defunct and there is no amicable sharing of water as before

Dams

- Large dams can ensure the storage of adequate water not just for irrigation, but also for generating electricity
- Canal systems leading from these dams can transfer large amounts of water great distances.

- the **Indira Gandhi** Canal has brought greenery to considerable areas of Rajasthan.
- However, mismanagement of the water has largely led to the benefits being cornered by a few people.
- There is no equitable distributionof water, thus people close to the source grow water intensive crops like sugarcane and rice while people farther downstream do not get any water.
- The woes of these people who have been promised benefits which never arrived are added to the discontentment among the people who have been displaced by the building of the dam and its canal network.
- the protests by the Narmada Bachao Andolan ('Save the Narmada Movement') about raising the height of the Sardar Sarovar Dam on the river Narmada.

Criticisms about large dams address three problems in particular –
(i) Social problems because they displace large number of peasants and tribals without adequate compensation or rehabilitation,
(ii)Economic problems because they swallow up huge amounts of public money without the generation of proportionate benefits, Environmental problems because they contribute enormously to deforestation and the loss of biological diversity.

- The people who have been displaced by various development projects are largely poor tribals who do not get any benefits from these projects and are alienated from their lands and forests without adequate compensation.
- The oustees of the Tawa Dam built in the 1970s are still fighting for the benefits they were promised.

Water Harvesting

- Watershed management emphasises scientific soil and water conservation in order to increase the biomass production.
- The aim is to develop primary resources of land and water, to produce secondary resources of plants and animals for use in a manner which will not cause ecological imbalance.
- Watershed management not only increases the production and income of the watershed community, but also mitigates droughts and floods and increases the life of the downstream dam and reservoirs.
- indigenous water saving methods to capture every trickle of water that had fallen on their land; dug small pits and lakes, put in place simple watershed systems, built small earthen dams, constructed dykes, sand and limestone reservoirs, set up rooftop water-collecting units.
- This has recharged groundwater levels and even brought rivers back to life.
- Water harvesting is an age-old concept in India.
- **Khadins, tanks and nadis in Rajasthan, bandharas and tals in Maharashtra, bundhis in Madhya Pradesh and Uttar Pradesh, ahars and pynes in Bihar, kulhs in Himachal Pradesh, ponds in the Kandi belt of Jammu region, and eris (tanks) in Tamil Nadu, surangams in Kerala, and kattas in Karnataka** are some of the ancient water harvesting, including water conveyance, structures still in use today
- Water harvesting techniques are highly locale specific and the benefits are also localised.
- Giving people control over their local water resources ensures that mismanagement and over-exploitation

of these resources is reduced/removed

- In largely level terrain, the water harvesting structures are mainly crescent shaped earthen embankments or low, straight concrete-andrubble “check dams” built across seasonally flooded gullies.
- Monsoon rains fill ponds behind the structures.
- Only the largest structures hold water year round; most dry up six months or less after the monsoons.
- Their main purpose, however, is not to hold surface water but to recharge the ground water beneath.
- The advantages of water stored in the ground are many.
- It does not evaporate, but spreads out to recharge wells and provides moisture for vegetation over a wide area.
- it does not provide breeding grounds for mosquitoes like stagnant water collected in ponds or artificial lakes.
- The ground-water is also relatively protected from contamination by human and animal waste.

COAL AND PETROLEUM

- Since coal and petroleum have been formed from bio–mass, in addition to carbon, these contain hydrogen, nitrogen and sulphur.
- When these are burnt, the products are carbon dioxide, water, oxides of nitrogen and oxides of sulphur. When combustion takes place in insufficient air (oxygen), then carbon monoxide is formed instead of carbon dioxide.
- Of these products, the oxides of sulphur and nitrogen and carbon monoxide are poisonous at high concentrations and carbon dioxide is a green-house gas.
- Another way of looking at coal and petroleum is that they are huge reservoirs of carbon and if all of this carbon is converted to carbon dioxide, then the amount of carbon dioxide in the atmosphere is going to increase leading to intense global warming.
- Thus, we need to use these resources judiciously.