APPOLO STUDY CENTRE

ADDITIONAL CONTENT FOR RAPID REVISION V

SCIENCE AND TECHNOLOGY - SCHOOL BOOK SOURCE

PAPER – II

UNIT – II: ROLE AND IMPACT OF SCIENCE AND TECHNOLOGY IN THE DEVELOPMENT OF INDIA

6TH TERM 1
UNIT 2 FORCE AND MOTION

2.2 Science Today - Robot

Robots are automatic machines. Some robots can perform mechanical and repetitive jobs faster, more accurately than people. Robots can also handle dangerous materials and explore distant planets. The term comes from a Czech word, 'robota' meaning 'forced labour'. Robotics is the science and study of robots.

What Can Robots Do?

Robots can sense and respond to their surroundings. They can handle delicate objects or apply great force-for example, to perform eye operations guided by a human surgeon, or to assemble a car. With artificial intelligence, robots will also be able to make decisions for themselves.

How Do Robots Sense?

Electronic sensors are a robot's eyes and ears. Twin video cameras give the robot a 3-D view of the world. Microphones detect sounds. Pressure sensors give the robot a sense of touch, to judge how hard to grip an egg. Heavy luggage built-in computers send and receive information with radio waves.

Artificial Intelligence

Artificial intelligence attempts to create computer programs that think like human brains. Current research has not achieved this, but some computers can be programmed to recognize faces in a crowd.

Can Robots Think?

Robots can think. They can play complex games, such as chess, better than human beings. But will a robot ever know that it is thinking? Humans are conscious-we know we are thinking-but we don't know how consciousness works. We don't know if Robots can ever be conscious.

Nano robotics

Nano-robots or Nano bots are robots scaled down to microscopic size in order to put them into very small spaces to perform a function. Future Nano bots could be placed in the blood stream to perform surgical procedures that are too delicate or too difficult for standard surgery. Imagine if a Nano bot could target cancer cells and destroy them without touching healthy cells nearby.

UNIT 6 HEALTH AND HYGIENE

Introduction

The word "health" refers to a state of complete emotional and physical well-being. Healthcare exists to help people maintain this optimal state of health.

As defined by World Health Organization (WHO), it is a "State of complete physical, mental, and social well-being, and not merely the absence of disease or infirmity." Health is a dynamic condition resulting from a body's constant adjustment and adaptation in response to stresses and changes in the environment for maintaining an inner equilibrium called homeostasis.

Hygiene is a science of the establishment and maintenance of health conditions or practices (as of cleanliness) conducive to health has poor personal hygiene. Brushing your teeth regularly is an important part of good oral hygiene. Hygiene is the practice of keeping yourself and your surroundings clean, especially in order to prevent illness or the spread of diseases.

Deepa's family was preparing their monthly provision list When Deepa saw the list, she had some questions to ask her parents, Why do we eat, comparatively more amount of rice and wheat? Why do we consume less amount of oil and ghee? Discuss the given list with your teacher.

6.1. Components of Food

The Chemical constituents of food which give us energy, help to build our body and protect us from diseases are called Nutrients.

1. Carbohydrate
2. Proteins
3. Fats
4. Vitamins
5. Minerals
5. Water

6.1.1. Carbohydrates

Carbohydrates are energy giving component of the food. We can obtain carbohydrates in the form of Sugar, starch and dietary fibres

6.1.2. Fats

Fat is also an energy-giving food and provides more energy than Carbohydrates. Some important sources of fats are butter, ghee, milk, cheese, paneer, nuts, meat, fish, egg yolk etc. Apart from giving energy, they insulate our body and protect the cells.

6.1.3. Protein

Body Building Foods

Proteins are necessary for our growth and repair, as well as for regulating various body functions such as digestion. The sources of proteins are pulses, eggs, fish, milk, chicken, soya bean, nut, grams etc, Proteins are body building foods.

Soyabean is the highly rich source of protein.

6.1.4. Vitamins

Vitamins are required for carrying out various biochemical reactions in our body. Fruits, vegetables, grains, meat products are good sources of vitamins. Vitamins are called as protective food. There are six major vitamins A, B, C, D, E and K. Vitamins B and Vitamins C are water soluble, Vitamins A, D, E and K are fat soluble. Gooseberries contain nearly 20 times the vitamin C than Orange.

6.1.5 Minerals

Minerals are required for growth as well as for the regulation of normal body function. Green leafy vegetables like spinach, pulses, eggs, milk, fish and fruits are important sources of minerals in our diet. Minerals are also protective foods.

80% of the world production of Moringa Leaves is in India. The Major countries which import Moringa Leaves are China, US, Germany, Canada, South Korea and European countries.

6.1.6. Water

Our body needs an adequate supply of water is order to maintain good health. Any human being should take minimum eight tumblers (2 Litres) of water every day.

1.11 Science Today – Bullet Trains

Electromagnetic train is called as suspension train and also called as flying train. It does not require diesel or petrol. This technology uses the property of magnetic attraction and repulsion to run these super-fast electromagnetic trains.

How does the electromagnetic train work?

Electromagnets are used in Electromagnetic train. Electromagnets are magnetised only when current flows through them. When the direction of current is changed the poles of the electromagnets are also changed. Like poles of the magnets which are attached at the bottom of the train and rail track repel each other. So, the train is lifted from the track up to a height of 10 cm.

We Know that we can move any magnetic object with the force of attraction or repulsion properties of magnets. This train also moves with the help of the magnets attached on the sides of track and the magnets fitted at the bottom sideway of the train. By controlling the current we can control the magnets and movement of the train.

As there are no moving parts, there is no friction. So, the train can easily attain a speed of 300 km per hour. These trains are capable of running up to 600 km/ hour.

They do not make any noise. They require less energy and they are eco-friendly. Even though, many countries have taken effort to use these trains, such trains are used for public transport only in China, Japan and South Korea. In India the possibilities of introducing these trains are under consideration.

UNIT 3 CHEMISTRY IN EVERYDAY LIFE

3.3 Cement

In ancient period, the houses were constructed by using the mixture of lime, sand and wood. At present, the people are widely use the cement for construction of houses, dams and bridges. The cement is manufactured by crushing of naturally occurring minerals such as lime, clay and gypsum through milling process.

Cement becomes hardened when it is mixed with water. Gypsum plays a very important role in controlling the rate of hardening of the cement. During the cement manufacturing process, a small amount of gypsum is added at the final grinding process. Gypsum is added to control the "setting of cement".

Uses of cement

Cement is used as **mortar, concrete and reinforced cement concrete.**

Mortar

Mortar is a paste of cement and sand mixed with water. In houses, mortar is used to bind building blocks for constructing walls, to apply coating over them and to lay floor.

Concrete

Concrete is a mixture of cement, sand and gravel. It is used in the construction of buildings, bridges and dams.

In 1824, Joseph Aspdin invented Portland cement by burning finely ground chalk and clay in a kiln. It was named "Portland" cement because it resembled the high-quality building stones found in Portland, England.

Uses of cement

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Reinforced Cement Concrete

Reinforced cement concrete is a composite material by mixing iron mesh with cement. This is very strong and firm. It is used in the construction of dams, bridges, centering works in houses and construction of pillars. Huge water tanks, water pipes and drainages are built with this.

3.4 Gypsum

Gypsum is a soft white or grey, naturally available mineral. The chemical name of gypsum is calcium sulphate dihydrate. molecular formula of gypsum is $CaSO4 \cdot 2H2O$.

Uses

- Used as fertilizers.
- Used in the process of making cement.
- In the process of making Plaster of Paris.

3.5 Epsom

Epsom salt is magnesium sulphate hydrate. The molecular formula of Epsom is MgSO4 . 7H2O. It offers a wide range of uses.

Uses

- Eases stress and relaxes the body
- Helps muscles and nerves function properly
- Medicine for skin problems
- Improving plant growth in agriculture

3.6 Plaster of Paris

Plaster of Paris consists of fi ne white powder (calcium sulphate hemihydrate) Themolecular formula of Plaster of Paris is CaSO4 . 1/2H2O. Known since ancient times, plaster of paris is so called because of its preparation from the abundant gypsum found near Paris, capital of France. Plaster of paris is prepared by heating gypsum, where it gets partially dehydrated.

Uses

- In making black board chalks.
- In surgery for setting fractured bones.
- For making casts for statues and toys etc.
- In construction industry.

3.7 **Phenol**

Have you ever observed the oily material which is used to clean your house? Do you know what it is? It is a chemical named as Phenol. Phenol is a **carbolic acid** of an organic compound. It is a necessary ingredient for preparing variety of phenol products. The molecular formula of phenol is C6H5 OH, it is a weak acid. It is a volatile, white crystalline powder.

It is a colorless solution, but changes into red in the presence of dust. It irritates when exposed on human skin. It is widely used for industrial purposes. Phenol itself is used (in low concentrations) in mouthwash and as a disinfectant in household cleaners. Phenol used as surgical antiseptic since it kills microorganisms.

3.8 **Adhesives**

What will you do when a page of your book is torn accidentally? It can be fi xed by using a cello tape. How cello tape works? There is a paste like material in one surface of the cello tape. Have you ever discussed about this material? The paste like substance is called adhesive.

It is commonly known as glue, mucilage, or paste. The substances applied to one surface, or both the surfaces of two separate items that binds them together and resists their separation are called **adhesives**.

Adhesives are substances that are used to join two or more components together through attractive forces acting across the interfaces.

A practical experience

Do you notice how puncture of your bicycle is repaired by the shop keeper? He ensures the punctured surfaces are clean, dry and free of dust, and roughens the area around the hole using a metal scraper.

He takes an appropriate patch of tyre-tube and applies a suitable adhesive to both the roughened area and to the underside of the patch, apply fi rm pressure and allows drying completely. Why does he apply pressure? This increases the adhesive capacity at both the surfaces and ensures proper binding.

Types of adhesives

There are two kinds of adhesives, one is natural made from starch and another one is artifi cial made from chemicals. The one used in puncture shop is an artifi cial adhesive. Artifi cial adhesives may be classifi ed in a variety of ways depending on their utilities. Their forms are paste, liquid, fi lm, pellets, tape. It is used in various conditions such as hot melt, reactive hot melt, thermo setting, pressure sensitive, and contact.

7TH TERM 3

UNIT 3 POLYMER CHEMISTRY

3.4 PLASTICS

Ask yourself what is the first plastic thing you touched today! Maybe it was your alarm clock or the filling in your pillow or the synthetic clothes that you were wearing. Almost everything around us today is plastic. You have seen water and oil in polythene pouches.

Right! In the past, people used to bring milk, oil and other liquids from a shop in vessels made of materials such as metal and glass. Think about what the containers, buckets, mugs, chairs and tables used in the past were made of? What do we use today to make many of these products?

Plastic as a material has taken over and replaced metal and wood which were previously used. Plastics have also replaced many glass items. If we continue to write the list of everyday items that are made of plastic, it will be endless! Why is plastic so popular? What are the different uses of plastic? What are the various types of plastics? Let us now learn about plastics:

Plastics have helped us to make advancements in technology, building, healthcare, transport and food safety. Plastics have completely occupied our life because of their characteristic qualities. Plastics have many positive qualities such as lightweight, strong and they can be moulded into complex shapes. They are also flexible and waterproof and some plastics are even UV resistant. Plastics are also cheap and convenient for us to use. Now that you have discovered why plastics are so popular, let us find out more about the different uses of plastics.

3.4.1 Uses of plastics

There are different types of plastics that are excellent materials when they are used for the right application. For example, let us take a syringe that is made from a type of plastic called polypropylene. These syringes do not have to be sterilized and reused; hence they provide a high standard of hygiene and eliminate the risk of spreading diseases.

Just as plastic is a material that can be used for a good application, it can also be used for the wrong application. Think about the different items you use that are plastic. For example, a You use this bag for a very short time and then throw it in a dustbin. Many of these carry bags do not get recycled and they litter and pollute our environment for a long time.

If you want to learn more about plastic which is used for the wrong application then you can refer to the Government of Tamil Nadu's ban on one-time use and throwaway plastics (Environment and Forests Department, T.N. G.O. No: 84, dated 25/06/2018, with effect from 1st January 2019).

3.4.2 Types of plastics

Th e plastics we use in our daily life are also made up of polymers. All plastics do not have the same type of arrangement of units. In some articles, the arrangement of a monomer is linear, and in some other items, the arrangement of articles is cross-linked. Depending on the type of arrangement, we have two main types of polymers – thermoplastics and thermoset. Let us see what these are!

Thermoplastics:

Polyethylene (also called polythene) is an example of a plastic. It is used for making polythene carry bags which are commonly used. When you burn a polythene carry bag, it melts and turns into liquid along with the production of an offensive odour, a bright flame and soot. Another example is a **PET (Polyethylene Terephthalate)** bottle, when we fill it with boiling water, it gets deformed. Plastics which can be easily softened and bent when heated are known as thermoplastics. These plastics can be modified and turned into another plastic item through the process of recycling.

Thermoset:

On the other hand, there are some plastics, which once they are moulded, cannot be softened through heating them. These are called thermosetting plastics. Bakelite and melamine are some examples of thermosetting plastics. Bakelite is a poor conductor of heat and electricity. It is used for making electrical switches and handles of various utensils. Melamine resists fi re and can tolerate heat. It is used for making floor tiles and fabrics that resist fire.

3.4.3 Resin code of plastics

Now that you have learnt about the differences between Thermoplastic and Thermosetting polymers, let us find out more about the different types of plastics that you use in your daily life. Plastics are very useful in our daily life but some types contain dangerous chemicals. Did you know that there are many different types of plastics?

You can tell these plastics apart by searching for a resin code. Th e resin codes are a universal way of categorising different types of plastic, which helps us separate plastics so that it is easier to recycle them. How can you identify the resin code? Where can you find the resin code on a plastic item?

Look at the chasing arrow triangle-shaped symbol on the bottom of a bottle, on the brand label sticker or on the lid of a container. What number is marked in the centre of the triangle? What letters (acronym) are below this? Th is is what we call a resin code.

If the number is 1 within the chasing arrow triangle and/or has the acronym PET or PETE, then it is a type of plastic which is called PET. Now that you have found out that the bottle has a specific resin code, let us see what gives the bottle and other plastic products certain qualities. Different chemicals (additives) are added to plastic to give them various qualities and characteristics, for example flexibility, strength, soft ness or transparency. There are some chemicals that are used in plastics that are dangerous for our health, animals and the environment.

For example, Polyvinyl Chloride- PVC resin code #3 has heavy metals such as cadmium and lead which are toxic chemical which are harmful to your health. Polystyrene- PS resin code #6 has styrene which is a toxic chemical known to cause cancer.

Look at the resin code chart on the previous page to find out more about the different types of plastic, what are common items and which plastics are safe and unsafe for us, animals and the environment.

Look at the resin code chart to find out more about the different types of plastic, the common items and the plastics that are safe and unsafe for us, animals and the environment.

3.4.4 Impacts of plastics

Plastics are cheap, light weight, strong and durable and have contributed to a range of advances and benefits to our modern life. But the increase in the use of plastics, particularly the one-time use and throwaway plastics has serious impacts on the environment, animals and our health.

We have seen garbage dumps with different plastics. One big problem with plastics is that they do not decompose or biodegrade. This leads to large amounts of waste that will not disappear and end up accumulating and polluting the environment.

A lot of one-time use plastic such as polythene bags and food packaging that are thrown away are responsible for littering the environment and clogging drains. Standing water breeds mosquitoes that can spread diseases such as malaria, dengue and chikungunya and also lead to flooding.

Why do you think some animals eat plastic? Many animals confuse plastic for food and eat it by accident. When left over food is thrown away it is often packed in plastic. Animals smell the leftover food and eat the plastic by accident. For example animals in urban areas, particularly cows, often eat polythene plastic bags by accident as they contain food waste. Can you imagine the consequences?

A lot of the plastic waste we use such as plastics bags, bottles and straws end up in the oceans. Plastics in the ocean are exposed to sunlight, water and the physical movement of the waves, which breaks it down in tiny pieces called microplastics. Some microplastics are also found in household products.

Examples are microbeads that can be found in toothpaste, face wash and body scrubs. Microbeads are washed down in drains and end up in the soil, rivers, lakes and the ocean Microbeads are washed down in drains and end up in the soil, rivers, lakes which cause pollution.

Many birds eat plastic items and small pieces of plastic, which are covered in algae. Once in the stomach of animals, plastics cannot be digested and this decreases the amount of space for food and can lead to starvation. In 2015, plastics were found in 90% of seabirds.

We have already read that Government of Tamil Nadu has banned one-time use and throwaway plastics such as plastic carry bags, plates, straws and water pouches. This is an indication that important efforts are taking place to reduce negative consequences of plastics on the environment.

3.4.5 PLA Plastics

Can you see how much plastic litter pollutes our environment? How nice would it be if a material that had similar qualities to plastic could be biodegradable, be absorbed by the soil and give nutrients to the soil!

Yes, scientists have thought about alternatives to synthetic plastics and have found Poly Lactic Acid (PLA) –a substitute for some types of plastics. Poly Lactic Acid or polylactide is compostable and bioactive thermoplastic.

This polymer is obtained from plant starch such as corn, sugarcane and pulp from sugar beets. PLA is a biodegradable material. It is useful for making food packaging, garbage bags and disposable table ware.

3.4.6 Various methods of disposing plastics

Plastics are everywhere! Our increasing consumption and production of plastic waste needs a solution. Let us find out more about how and where plastic waste is disposed of and the better methods of disposing plastics.

Organic waste such as the peels of vegetables, fruits and food remains can get broken down by bacteria in the soil to create a rich source of nutrients in the form of compost. A material that gets decomposed through natural processes and action by bacteria is called biodegradable.

Plastics do not decompose by natural processes and action of bacteria and are therefore not biodegradable. It is important for us to separate our biodegradable and non-biodegradable waste and dispose of them separately. A lot of the plastic produced globally is designed to be used only once and thrown away, creating a large amount of plastic waste. Plastic waste ends up being recycled, incinerated, landfilled, dumped or ends up littering our environment. It is estimated that from all the plastic waste ever produced, 79% is in landfills, dumps or in the environment, 12% has been incinerated and only a small 9% is recycled.

Let us learn more about what happens with the plastic waste. One way to look at plastic disposal is the 5R Principle – Refuse, Reduce, Reuse, Recycle and Recover. We have already learned about the waste pyramid and how the different methods of waste disposal can be seen in terms of the best option to the least favourable in this order: Refuse (Avoid), Reduce, Reuse, Recycle, Recover (Compost and Incinerate) and Landfill.

Refuse (Avoid)

The best thing to do is to avoid using plastic products. One-time use throwaway plastics can often be avoided. For example, we can carry cotton or jute bags when we go shopping and say no when a shopkeeper offers us a plastic bag.

Reduce

Reducing the amount of plastic we use is important. Before buying a plastic product we can check to see if there are any substitutes or alternatives that can be used. If we use fewer plastics, we will create less plastic waste.

However, even if we try to reduce the amount of plastics we use and throw away, it is impossible to stop using plastics completely.

Reuse

If possible products made of plastics can be used again and again. For example, if we have a plastic bag in good condition, instead of throwing it away we can use it again the next time we go for shopping. If we have a plastic product and if you do not feel like using it again, we can give it to others instead of throwing it out.

Recycle

It is better to recycle plastic waste. Separating plastic waste and making sure it gets recycled is good as it turns waste materials into something new. Then it will not be thrown away in landfills, open dumps or ending up as litter in the environment. Many thermoplastics can be recycled. They can be softened by heating and can be made into another article by recycling, but

thermosetting plastics cannot be recycled. Recycling of plastics is challenging and it is important to know that plastics cannot be recycled forever.

There are so many different types of plastics, which are often mixed together making it difficult to separate them back into the original material. Every time plastic is melted and recycled it loses quality, this is called 'downcycling'. Recycling of plastic waste cannot be the only solution to plastic pollution.

Recover (Compost And Incinerate)

Solid waste can be converted into resources such as electricity and compost through thermal and biological means. Burning plastics in a large furnace or in the open is bad for the environment. Open burning releases toxic pollutants into the air and soil, which are harmful to our health, animals and the environment. Burning plastics at high temperatures in incinerators and trapping the gases and collecting the toxic ash is widely used to produce energy.

This is often seen as a positive way to deal with plastic waste. However, burning plastics releases super toxic gases, and the remaining ash contains toxic chemicals and heavy metals. Burning of plastics is not a good solution, as we end up wasting non-renewable resources and produce super toxic chemicals that are difficult to store or dispose safely.

Landfill

Plastic waste often ends up in landfills that are huge holes where waste is buried to keep it separate from the environment. This is the most common way for plastics to be disposed of around the world. Plastics make up 7-13% of waste that is sent to landfills on a global scale. Plastics in landfills can still lead to pollution of the air, soil and groundwater. Over time landfills can degrade, and the toxic chemicals in certain plastics can leak out into the environment.

3.4.7 Biodegradable plastics

The concept of biodegradable plastics or bio-plastics was first introduced in the 1980s. Based on the nature of degradation, there are two main types of plastics: degradable plastic and compostable plastic.

Degradable plastics are made from petroleum oil or gas which is the same as conventional plastics. The difference is that they have a chemical or additive added to them to make them breakdown faster than conventional plastics when they are exposed to sunlight, oxygen or water.

What do you think will happen to degradable plastics? Degradable plastics breakdown into tiny pieces called microplastics and these stay in our environment for a very long time. It is very important to understand that degradable plastics do not breakdown completely in the environment! Scientists have found that microplastics in the ocean are really bad and it is likely that these tiny pieces in the soil are also harmful.

Compostable plastics are derived from renewable resources such as corn, sugar cane, avocado seeds or shrimp shells. Compostable plastics can be broken down completely by microbes and turned back into food for plantscarbon dioxide, methane, water and other natural compounds.

A recipe for PLA a compostable plastic!

What you need

i) 1 tablespoon of corn starch
ii) 1 teaspoon of vegetable glycerin (available at the pharmacy)
iii) 1 teaspoon of vinegar (5% acidity)
iv) 4 Tablespoons of water.
v) Cooking spoon
vi) Cooking pot
vii) Stove
viii) Aluminium foil

Method

Mix the water with the starch in a cooking pot. Add the vinegar and the glycerin. Mix all the ingredients on medium heat. Make sure you continuously stir. The mixture should turn from liquid white into a clear gel. When it begins to bubble, then it is ready and should be taken off the stove.

Spread the gel onto the aluminium foil. Let it cool down for one hour. You can then shape the material to form a cup or bowl. Let the article you made cool for another 24 hours before you try and use it.

3.4.8 Plastic Eating Bacteria

In 2016, scientists from Japan tested different bacteria from a bottle recycling plant and found that Ideonellasakaiens is 201-F6 could digest the plastic used to make single-use drinks bottles that are made of polyethylene terephthalate (PET). The bacteria works by secreting an enzyme known as 'PETase', that breaks down plastic into smaller molecules.

These smaller molecules are then absorbed by the bacteria as a food source. The working of the enzyme is diagrammatically shown below:

Although the discovery of the bacteria breaking down plastics is seen as a potential solution to the plastic pollution – it is still very complex! A big issue is the scale of the plastic pollution problem. We consume and produce such large quantities of plastics and this is only increasing. The scale of the bacteria breaking down plastics is much slower and will therefore not solve the crisis we are facing.

Another limitation is that it is restricted to PET resin code #1 plastics, which currently is one of the most recyclable plastics worldwide. It will not be a feasible solution to the issue of the large quantities of non-recyclable low-grade plastics which are polluting the environment. That is why it cannot be the solution to plastic pollution on its own!

UNIT 4 CHEMISTRY IN DAILY LIFE

Introduction

During the Bangladesh liberation war, Therapy with Oral Rehydration Solution (ORS) in 1971 reduced cholera death rates from 50% to 3% among thousands of refugees. An Indian doctor, Dilip Mahalanabis, had to manage the shortage of saline bottles and coup up with the dehydration faced by the refuges. Dr. Dilip

Mahalanabis showed the efficacy of ORS in cholera cases among Bangladeshi refugees (1971-72). Further field trial during the cholera epidemic in Manipur attested to its efficacy, ORS has since saved the lives of millions of children around the world.

Look at the above information. What do you infer from this? Now you get the curiosity to know about ORS and its function. Don't you? In addition to this, let us know about some of the common medicines and how do they work.

In the normal healthy intestine, there is a continuous exchange of water through the intestinal wall. Up to 20 liters of water is secreted and very nearly as much is reabsorbed every 24 hours. This mechanism allows the absorption of soluble metabolites into the bloodstream from digested food. However when a person becomes sick, due to diarrhea, water is expelled and the body is not able to retain the liquid balance. This is called as 'dehydration'. It is not the diarrhea that kills, but the dehydration' resulting from the infection that kills. If more than 10% of the body's fluid is lost death occurs.

UNICEF / WHO norms the O.R.S should be prepared as follows					
S. No	**New ORS**	**grams / Litre**	**%**	**New ORS**	**mmol / litre**
	Sodium choride	2.6	12.683	Sodium	75
	Glucose, anhydrous	13.5	65.854	Choride	65
	Potassium choride	1.5	7.317	Glucose, anhydrous	75
	Trisodium citrate, dehydrate	2.9	14.146	Potassium	20
				Citrate	10
	Total	20.5	100.00	Total Osmolarity	245

4.1 Oral Rehydration Solution (ORS)

ORS (Oral Rehydration Solution) is a special combination of dry salts that is mixed with safe water. It can help to replace the fluids lost due to diarrhea. In a state of diarrheal disease there is imbalance and much more water is secreted than reabsorbed causing a net loss to the body which can be as high as several liters a day. In addition to water loss, sodium and potassium are also lost.

Certain concentration of sodium (Na) is needed for proper functioning of the body. For example, only with adequate sodium concentration in the intestinal wall, water can be absorbed by it through a process known as osmosis. If there is inadequate salt in the intestinal wall the body will not be able to absorb water.

The saline bottle directly transfers water and sodium into the blood stream. However, for the saline water is administered through mouth, intestinal wall, is a not able to absorb neither

water nor sodium. Dr. Dilip Mahalanabis found that if glucose (sugar) is added to the salt solution, then all the three- water, sodium and glucose are absorbed by the body.

During diarrhea the intestine is still able to absorb glucose molecules. Thus, the ORS solution uses the glucose molecules to enable the sodium to be is carried through by a cotransport coupling mechanism. ORS is an effective treatment for 90 – 95% of patients suffering from diarrhea, regardless of the cause. As the water is replaced balance is attained saving the patience in most cases.

Let us see homely made of ORS, be very careful to mix 6 level teaspoons of sugar and 1/2 level teaspoon of salt dissolved in 1 litre of clean water. Too much sugar can make diarrhea worse. Too much salt can be extremely harmful to the child. Making the mixture a little too diluted (with more than 1 litre of clean water) is not harmful.

Through the process of osmosis, the salts and sugars pull water into your bloodstream and speed up rehydration.

4.2 Antacid

Acidity is a set of symptoms caused by excess production of acid by the gastric glands of the stomach. Your stomach naturally produces gastric or hydrochloric acid (HCl) to help digest and break down food. Acidity issues arise when there is excess production of this acid due to triggers such as acidic foods, spicy food, alcohol, dehydration and stress. When acidity occurs, the excess acid may move up from your stomach to your esophagus.

The lining of your stomach with a pH of 1 to 3 is designed as such to withstand a high acidic environment.

When we have acidity or heartburn, we are administered a class of medicines known as antacids. They are actually weak bases. As learned in chemistry, when a base is mixed with an acid a neutralization reaction occurs. When antacids are consumed, it creates a chemical reaction in the stomach lowering the acidity and makes the digestive acids less corrosive and damaging.

Most of the common antacids are Sodium Bicarbonate ($NaHCO_3$), Calcium Carbonate ($CaCO_3$), Magnesium Hydroxide ($Mg(OH)_2$), Magnesium Carbonate ($MgCO_3$) and Aluminium Hydroxide $Al(OH)_3$.

The chemical reaction created when Magnesium Hydroxide neutralizes HCI in the stomach and intestine

4.3 Antibiotics

Ages ago, there was a time where even a small infected wound can cause death in human beings. The discovery of antibiotics changed all. Now armed with antibiotics, many deadly infectious diseases can be tackled, which once meant to cause serious illness and death.

The discovery of antibiotics was an accident, which happened in 1928 while a British bacteriologist, Dr. Alexander Fleming was involved in research on staphylococcus bacteria. This bacterium was meant to cause deadly diseases such as pneumonia, sour throat, etc.

The discovery happened while he was culturing the bacteria on a nutrient agar media in a Petri dish. He went on a holiday carelessly leaving the dish in his laboratory table without cleaning and sterilization.

After several days, when he returned back, he observed the growth of mould (kind of common fungus, which grows on stale bread/ cheese) on a part of the Petri dish. He also

observed that there was no bacterial growth surrounding the mould, which indicated that something in the mould had prevented the growth of bacteria in the culture medium. On further research, Fleming identified that the "mold juice" was capable of killing a wide variety of harmful bacteria, such as streptococcus, meningococcus and diphtheria bacillus.

And that was how the world's first antibiotic – penicillin – was discovered. Fleming named the mould penicillum notatum, from which the antibiotic penicillin was isolated. However, Fleming was not the first using moulds and other living micro organisms to treat infections. Thousands of years ago, the ancient Egyptians, had used mouldy bread to treat infected wounds. Similar practices were observed among ancient Greeks, Serbians and even among Indians. While these were perhaps partially effective, their efficacy is nowhere near the modern antibiotics.

Naturally, many microorganisms and plants synthesize chemicals which are toxic in nature to protect them from invading organisms. The biosynthesized chemicals isolated from the plants/micro organisms and used as medicines against infectious diseases. These substances were called as antibiotics. Ex: Chloramphenicols, tetracyclines, Penicillin derivatives, cephalosporin's and their derivatives. Today, many infectious diseases in the world are rare due to the advancement in antibiotic research.

However, the overuse of antibiotics makes it inactive or less effective. Antibiotic resistance is defined as the ability of the microorganisms to resist the effects of an antibiotic to which they were once sensitive. Th us the antibiotics become less effective and we are forced to either consume a larger dose or shifting towards the use of other virulent variants of antibiotics. Thus the research on antibiotics is of great importance to combat the virulent and mutated microorganisms.

4.4 Analgesics:

Injury, burn, pressure from sharp objects and other conditions cause pain in our body. Th e unpleasant feeling may be a burning sensation in the tissue around the injury, throbbing headache or ache of arthritis. Back pain, neck pain, joint pain, headaches, pain from nerve damage, pain from an injury and pain related to diseases are some of the most common pains.

The unpleasant emotion of 'pain' is created in the brain and not at the spot of the injury. If the pain is severe, say from burn, the impulse sent to brain trigger immediate response. Reacting to the signal from the brain, muscle pull our hand from the fi re.

Reacting to the message received from the pain spot, the brain sends back messages that initiate healing process. It can trigger to release pain suppressing chemical and additional flow of additional white blood cells and platelets to help repair tissue at an injury site.

Analgesics or pain killers are the pain suppressing chemicals released by the body. They suppress the feeling of 'pain'. Th is analgesics drug selectively relieves pain by acting either in CNS (Central Nerves System) or on peripheral pain mechanism, without significantly altering consciousness.

When we are affected by fever, oft en we are administered Paracetamol. Paracetamol interact with the receptors and reduce the intensity of pain signals to the brain, also suppresses the release of substances, called prostaglandins that increase pain and body temperature.

Anesthetics

The first local anesthetic was cocaine was isolated from coca leaves by Albert Niemannin Germany, 1860.

Traditional an inflammatory agents

These are classified as follows,

i) Non – narcotic (Non – additive) analgesics Eg. Aspirin

ii) Narcotic drugs. E.g. codeine

4.5 Antipyretic:

In normal course our body temperature is ranges from 98.4 to 98.6 degrees Fahrenheit. When the temperature goes above this level it is called fever. Most common cause of fever is infection. Bacteria and virus cannot thrive above a certain temperature. To defend the invading virus and bacteria the immunity system increases the body temperature.

Once infection is sensed, the immune system releases a chemical called pyrogen. These pyrogens released into bloodstream reaches the hypothalamus, present at the basal part of the brain. The function of Hypothalamus is to control the body temperature. Sensing the pyrogens, hypothalamus increases the body temperature by releasing a chemical called prostaglandin.

Normally little fever is good as it helps to arrest the growth of infection. However if the internal body temperature exceeds 105°F, this may cause damage to our body protein and the brain may experience seizures and delirium. The prolonged high fever may also cause death.

Antipyretics (anti - against and pyretic -Feverish) are chemical substances that reduce fever. They suppress the release of prostaglandin and reduce fever. The most common and well known anti pyretic is paracetamol. Other antipyretics and anti inflammatory agents include Aspirin, Ibuprofen, Diclofenac.

4.6 Antiseptic

Antiseptics are substances applied to the exterior of a body that kill or inhibit microbes and infective agents. Antiseptics can be effective against one or a combination of bacteria, fungi, viruses or other microorganisms.

Difference between Antiseptic and Disinfectants	
Antiseptic	Disinfectants
1. All antiseptic are disinfectants.	All disinfectants are not antiseptic
2. It can be applied on the live tissues	It can be apply on in animate object
For example, skin/ Mucous	For example, Surface, lab working tables, floor.

4.7 Antihistamine

Anti histamines are defined as drugs that combat the histamine in the body that are used for treating allergic reactions and cold symptoms. Histamine is a chemical messenger involved in number of complex biological reactions. When a foreign body such as pollens enters the body, the immune system believes those substances to be harmful and generates the release of histamine. When histamine is released, it will interact with the histamine receptors on the cell surface or within a target cell and cause changes in the bodily functions.

This stimulates many smooth muscles to contract,\ such as gastrointestinal tract and bronchi. In certain smooth muscles, they cause relaxation of blood capillaries which increase the flow of lymph and its protein content and lead to the formation of edema (redness and rashes).

Antihistamines or histamine receptor antagonists oppose selectively all the pharmacological effects of histamines. For, Ex. Diphenhydramine, chlorpheniramine, cimetidine. The adverse effects of antihistaminics are mouth dryness and sleepiness.

UNIT 8 UNIVERSE AND SPACE SCIENCE

Introduction

Have you ever watched the clear sky in the night? We will be delighted when we see countless number of stars and the beautiful Moon. The science, which deals with the study of stars, planets and their motions, their positions and compositions, is known as astronomy. The stars, the planets, the Moon and many other objects like asteroids and comets in the sky are called celestial objects. The Sun and the celestial bodies revolving around it, form the solar system.

A collection of billions of stars, held together by mutual attraction, is called 'Galaxy'. Our Sun belongs to a galaxy called 'Milky Way'. Billions of such galaxies form the universe. Hence, the solar system, the stars and the galaxies are the constituents of the universe. In the recent years many countries are showing interest to explore the space and they are sending manned and unmanned rockets to the Moon and other planets.

Our country also has launched a number of rockets into the space and achieved a lot in space research. In this lesson we will study about launching of rockets, types of rocket fuels, Indian space research programmes and NASA.

8.1 Rockets

The universe is a great mystery to all of us. Our minds always try to know about the space around us. Understanding the space will be helpful to us in many ways. Space research provides information to understand the environment of the Earth and the changing climate and weather on Earth. Exploring the space will help us to answer many of the challenges we are facing these days

Discovery of rockets has opened a small portion of the universe to us. Rockets help us to launch space probes to explore the planets in the solar system. They also help us to launch space-based telescopes to explore the universe.

> Rockets were invented in China, more than 800 years ago. The first rockets were a cardboard tube packed with gunpowder. They were called fire arrows. In 1232 AD, the Chinese used these 'fire arrows' to defeat the invading Mongol army. The knowledge of making rockets soon spread to the Middle East and Europe, where they were used as weapons.

More than all rockets enable us to put satellites, which are useful to us in a number of ways. Our country has effective rocket technology and has applied it successfully to provide so many space services globally.

8.1.1 Parts of Rockets

A rocket is a space vehicle with a very powerful engine designed to carry people or equipment beyond Earth and out into space. There are four major parts or systems in a rocket. They are:

- Structural system
- Payload system
- Guidance system
- Propulsion system

Structural system (Frame)

The structural system is the frame that covers the rocket. It is made up of very strong but lightweight materials like titanium or aluminum. Fins are attached to some rockets at the bottom of the frame to provide stability during the flight.

Payload system

Payload is the object that the satellite is carrying into the orbit. Payload depends on the rocket's mission. The rockets are modified to launch satellites with a wide range of missions like communications, weather monitoring, spying, planetary exploration, and as observatories. Special rockets are also developed to launch people into the Earth's orbit and onto the surface of the Moon.

Guidance system

Guidance system guides the rocket in its path. It may include sensors, on-board computers, radars, and communication equipments.

Propulsion system

It takes up most of the space in a rocket. It consists of fuel (propellant) tanks, pumps and a combustion chamber. There are two main types of propulsion systems. They are: liquid propulsion system and solid propulsion system.

Polar Satellite Launch Vehicle (PSLV) and Geosynchronous Satellite Launch Vehicle (GSLV) rockets are India's popular rockets.

8.1.2 Types of Propellants

A propellant is a chemical substance that can undergo combustion to produce pressurized gases whose energy is utilized to move a rocket against the gravitational force of attraction. It is a mixture, which contains a fuel that burns and an oxidizer, which supplies the oxygen necessary for the burning (combustion) of the fuel. The propellants may be in the form of a solid or liquid.

a. Liquid propellants

In liquid propellants fuel and oxidisers are combined in a combustion chamber where they burn and come out from the base of the rocket with a great force. Liquid hydrogen, hydrazine and ethyl alcohol are the liquid fuels. Some of the oxidizers are oxygen, ozone, hydrogen peroxide and fuming nitric acid.

b. Solid propellants

In solid rocket propellants fuel and oxidiser compounds are already combined. When they are ignited they burn and produce heat energy. Combustion of solid propellants cannot be stopped once it is ignited. Solid fuels used in rockets are polyurethanes and poly butadienes. Nitrate and chlorate salts are used as oxidizers

c. Cryogenic propellants

In this type of fuel, the fuel or oxidizer or both are liquefied gases and they are stored at a very low temperature. These fuels do not need any ignition system. They react on mixing and start their own flame.

8.1.3 Launching of Satellite

Before being launched into the space, rockets will be held down by the clamps on the launching pad initially. Manned or unmanned satellites will be placed at the top of the rocket. When the fuel in the rocket is burnt, it will produce an upward thrust.

There will be a point at which the upward thrust will be greater than the weight of the satellite. At that point the clamp will be removed by remote control and the rocket will move upwards. According to Newton's third law, for every action there is an equal and opposite reaction. As the gas is released downward, the rocket will move upward.

To place a satellite in a particular orbit, a satellite must be raised to the desired height and given the correct speed and direction by the launching rocket. If this high velocity is given to the rocket at the surface of the Earth, the rocket will be burnt due to air friction. Moreover, such high velocities cannot be developed by a single rocket. So, multistage rockets are used. To penetrate the dense lower part of the atmosphere, initially the rocket rises vertically and then it is tilted by a guidance system.

8.2 India's Space Programmes

Within few years after the independence, India initiated space research activities. In 1969, Indian Space Research Organisation (ISRO) was formed with the objective of developing space technology and its application for different needs of the nation. India is focusing on satellites for communication and remote sensing, space transportation systems and application programmes. The first ever satellite Aryabhata was launched in 1975. Since then India has achieved a lot in space programmes equal to that of the developed nations.

> Rakesh Sharma, an Indian pilot from Punjab was selected as a 'Cosmonaut' in a joint space program between India and Soviet Russia and become the first Indian to enter into the space on 2nd April, 1984.

8.2.1 Chandrayaan – 1

Our country launched a satellite Chandrayaan-1 (meaning Moon vehicle) on 22nd October 2008 to study about the Moon. It was launched from Sathish Dhawan Space Center in Sriharikota, Andhra Pradesh with the help of PSLV (Polar Satellite Launch Vehicle) rocket. It was put into the lunar orbit on 8th November 2008.

The spacecraft was orbiting around the Moon at a height of 100 km from the lunar surface. It collected the chemical, the mineralogical and the geological information about the Moon.

This mission was a major boost for the Indian space programs and helped to develop its own technology to explore the Moon. Chandrayaan-1 was operated for 312 days and achieved 95% of its objectives. The scientists lost their communication with the space craft on 28th August 2009. On the successful completion of all the major objectives, the mission was concluded.

a. Objectives of Chandrayaan-1

The following were the objectives of Chandrayaan – 1 mission.

- ❖ To find the possibility of water on the Moon.
- ❖ To find the elements of matter on the Moon.
- ❖ To search for the existence of Helium-3.
- ❖ To make a 3-dimensional atlas of the Moon.
- ❖ To study about the evolution of the solar system.

Kalam Sat is the world's smallest satellite weighing only 64 gram. It was built by a team of high school students, led by Rifath Sharook, an 18 year old school student from 'Pallapatti' near Karur, Tamil Nadu. It was launched into the space on 22nd June 2017 by NASA.

b. Achievements of Chandrayaan-1

The following are the achievements of Chandrayaan-1 mission.

- ❖ The discovery of presence of water molecules in the lunar soil.
- ❖ Chandrayaan-1 confirmed that the Moon was completely molten once.
- ❖ Chandrayaan-1 has recorded images of the landing site of the US space-craft Apollo-15 and Apollo-11.

Know your Scientist

Dr. Mylsamy Annadurai was born on 2nd July 1958, at Kodhavadi, a small village near Pollachi in Coimbatore district. He pursued his B.E. degree course at Government College of Technology, Coimbatore. In 1982, he pursued his higher education and acquired an M.E. degree at PSG College of Technology, Coimbatore.

In the same year he joined the ISRO as a scientist. And later, he got his doctorate degree from Anna University of Technology, Coimbatore. Annadurai is a leading technologist in the field of satellite system. He has served as the Project Director of Chandrayaan-1, Chandrayaan-2 and Mangalyaan. He has also made significant contributions to the cost effective design of Chandrayaan.

- It has provided high-resolution spectral data on the mineralogy of the Moon.
- The existence of aluminium, magnesium and silicon were picked up by the X-ray camera.
- More than 40,000 images have been transmitted by the Chandrayaan-1 camera in 75 days.
- The acquired images of peaks and craters show that the Moon mostly consists of craters.
- Chandrayaan-1 beamed back its first images of the Earth in its entirety.
- Chandrayaan-1 has discovered large caves on the lunar surface that can act as human shelter on the Moon.

8.2.2 Mangalyaan (Mars vehicle)

After the successful launch of Chandrayaan-1, ISRO planned an unmanned mission to Mars (Mars Orbiter Mission) and launched a space probe (space vehicle) on 5th November 2013 to orbit Mars orbit. This probe was launched by the PSLV Rocket from Sriharikota, Andra pradesh. Mars Orbiter Mission is India's first interplanetary mission. By launching Mangalyaan, ISRO became the fourth space agency to reach Mars.

Mangalyaan probe traveled for about a month in Earth's orbit, and then it was moved to the orbit of Mars by a series of projections. It was successfully placed in the Mars-orbit on 24th September 2014.

Mars Orbiter Mission successfully completed a period of 3 years in the Martian orbit and continues to work as expected. ISRO has released the scientific data received from the MOM in the past two years (up to September 2016).

More to know

Mars is the fourth planet from the Sun. It is the second smallest planet in the solar system. Mars is called as the Red Planet because of its reddish colour. Iron Oxide present in its surface and also in its dusty atmosphere gives the reddish colour to that planet. Mars rotates about its own axis once in 24 hours 37 minutes. Mars revolves around the Sun once in 687 days. The rotational period and seasonal cycles of Mars are similar to that of the Earth. Astronomers are more curious in the exploration of Mars. So, they have sent many unmanned spacecrafts to study the planet's surface, climate, and geology.

a. Objectives of Mangalyaan

The following are the objectives of Chandrayaan – 2 mission.

- To develop the technology required for interplanetary mission.
- To explore the surface of Mars.
- To study the constituents of the Martian atmosphere.
- To provide information about the future possibility of life and past existence of life on the planet.

India became the first Asian country to reach Mars and the first nation in the world to achieve this in the first attempt. Soviet Space Program, NASA, and European Space Agency are the three other agencies that reached Mars before ISRO.

8.2.3 Chandrayaan - 2

ISRO has currently launched a follow on mission to Chandrayaan-1 named as Chandrayaan-2, on 22nd July 2019. Chandrayaan 2 mission is highly complex mission compared to previous missions of ISRO. It brought together an Orbiter, Lander and Rover. It aims to explore South Pole of the Moon because the surface area of the South Pole remines in shadow much larger than that of North Pole.

Orbiter

It revolves around the moon and it is capable of communicating with Indian Deep Space Network (IDSN) at Bylalu as well as Vikram Lander.

Lander

It is named as Vikram in the memory of Dr.Vikram A. Sarabhai, the father of Indian space program.

Rover

It is a 6 wheeled robotic vehicle named as 'Pragyan' (Sanskrit word) that means wisdom. Chandrayaan-2 was successfully inserted into the lunar orbit on 20th August 2019. In the final stage of the mission, just 2.1 km above the lunar surface, Lander 'Vikram' lost its communication with the ground station on 7th September 2019. But the Orbiter continues its work successfully.

UNIT 15 CHEMISTRY IN EVERYDAY LIFE

15.2 Natural Gas

Natural gas is a naturally occurring hydrocarbon gas mixture consisting primarily of methane along with other higher alkanes and a small percentage of carbon dioxide, nitrogen and hydrogen sulphide (H_2S). If the natural gas contains lower hydrocarbons like methane and ethane, it is called dry gas. If higher hydrocarbons like propane and butane are also present in the gas, it is called wet gas.

Natural gas is always found above the oil in the oil wells. This gas is trapped inside the small spaces in underground rocks called reservoirs. Conventional natural gas can be extracted through drilling wells. Natural gas can also be found in reservoirs with oil and is extracted along with oil. This is called associated gas.

Natural gas is a fossil fuel used as a source of energy for heating, cooking and electricity generation. Natural gas occurs in Tripura, Rajasthan, Maharashtra, Andhra Pradesh (Krishna, Godavari Basins) and Tamil Nadu (Cauveri Delta). It is also formed by the decomposition of organic matter in marshy areas and waste sewages. The natural gas formed by this way contains mainly methane.

15.2.1 Uses of Natural Gas

- Natural gas is used as an industrial and domestic fuel.
- It is used in thermal power stations.
- It is used as fuel in vehicles as an alternative for petrol and diesel.
- When heated it decomposes and forms hydrogen and carbon. Hydrogen thus formed is used in the manufacture of fertilizers.
- It is used to manufacture chemicals, fabrics, glass, steel, plastics and paints.
- It is also used in electricity generation.

Moderate temperature and humidity is needed to keep paintings and other ancient artifacts from being destroyed by environmental factors. Thus natural gas is used in museums to protect the monuments.

15.2.2 Advantages of Natural Gas

- It produces lot of heat as it is easily burnt.
- It does not leave any residue.
- It burns without smoke and so causes no pollution.
- This can be easily supplied through pipes.
- It can be directly used as fuel in homes and industries.

15.2.3 Compressed Natural Gas

When the natural gas is compressed at high pressure, it is called Compressed Natural Gas (CNG). Nowadays it is used as fuel in automobiles. The primary hydrocarbon present in CNG is methane (88.5%).

Natural gas is liquefied for shipping in large tankers. This is called Liquefied Nitrogen Gas (LNG). CNG is stored at high pressure whereas LNG is stored in ultra cold liquid form. CNG has the following properties.

- ❖ It is the cheapest and cleanest fuel.
- ❖ Vehicles using this gas produce less carbon dioxide and hydrocarbon emission.
- ❖ It is less expensive than petrol and diesel.

The average composition of CNG.

Constituents	Percentage
Methane	88.5
Ethane	5.5
Propane	3.7
Butane	1.8
Pentane	0.5

15.3 Other Gases

Apart from natural gas, there are some other gases used as fuel. Producer gas, coal gas, bio gas and water gas are some of them.

Producer Gas

Producer gas is a gaseous mixture of carbon monoxide and nitrogen. It is produced by passing air mixed with steam, over red hot coke at a temperature of 1100 ˚C. It is used as an industrial fuel for iron and steel manufacturing.

Producer gas is known by different names in different countries. It is referred as Wood gas in USA and as Suction gas in UK.

Coal Gas

It is a mixture of gases like hydrogen, methane and carbon monoxide obtained by the destructive distillation of coal. Heating coal in the absence of air is called destructive distillation. It is used in heating open hearth furnace in the manufacture of steel. It is also used as a reducing agent in certain metallurgical operations.

Water Gas

It is a gaseous mixture of carbon monoxide and hydrogen. It is made by passing steam over incandescent coke at a temperature of 1000°C.

$$C_{(g)} + H_2O_{(g)} \xrightarrow{1000^oC} CO_{(g)} + H_{2(g)}$$

It is also called as syngas or synthesis gas as it is used to synthesize methanol and simple hydrocarbons. It is used as an industrial fuel also.

Bio Gas

Bio-gas is a mixture of methane and carbon dioxide. It is produced by the decomposition of plant and animal waste which form the organic matter. The breaking down of organic matter in anaerobic condition (ie. in the absence of oxygen) leads to the formation of biogas. It is an example for renewable source of energy.

15.4 Coal and its types

Coal is one of the fossil fuels. It is a mixture of free carbon and compounds of carbon containing hydrogen, oxygen, nitrogen and sulphur. Three hundred million years ago, some plants grew into giant ferns and mosses. These plants got buried into the bottom of the soil. They slowly started to decompose and formed a dense, sponge like material called peat. Over time peat was compressed due to high temperature and pressure and coal was formed. As coal contains mainly carbon, the slow process of conversion of dead vegetation into coal is called carbonization.

15.4.1 Extraction of Coal

Coal is extracted from the coal beds found below the surface of the earth. Coal found inside the earth is broken into pieces by explosives and brought above. Depending on the depth of the coal bed, coal is extracted in two ways.

Surface mining

If the coal beds lie within 22 feet of the earth's surface, the top soil is removed and coal is dug out. This is called surface mining.

Underground mining

In some places, coal beds are found very deep inside the earth. In that case underground tunnels are made to get this coal. This is called underground mining or deep mining.

Coal reserves can be found in about 70 countries worldwide. The largest coal reserves are available in United State, Russian, China, Australia and India. The US is the international leader in coal reserves, with nearly 30% of the world's supply. Coal mining was started in India in 1774. India now ranks third among the coal producing countries in the world. USA and China have two third of the world's coal reserve.

15.4.2 Types of Coal

Coal is classified into four main categories based on the amounts of carbon it contains and the heat energy it can produce. They are lignite, sub bituminous, bituminous and anthracite. Among these four types anthracite is the most desirable one due to its high heat content.

Lignite

Lignite is a brown colored coal of lowest grade. It has least content of carbon. The carbon content of lignite is 25 – 35%. Lignite contains a high amount of water and makes up almost half of our total coal reserves. It is used for electricity generation. The other uses include generating synthetic natural gas and producing fertilizer products.

Sub bituminous

When lignite becomes darker and harder over time sub-bituminous coal is formed. Sub bituminous coal is a black and dull coal. It has higher heating value than lignite and contains 35-44% carbon. It is used primarily as fuel for electricity power generation. This coal has lower sulfur content than other types and burns cleaner.

Bituminous

With more chemical and physical changes, sub-bituminous coal is developed into bituminous coal. Bituminous coal is dark and hard. It contains 45-86% carbon. It has high heating value. It is used to generate electricity. Other important use of this coal is to provide coke to iron and steel industries. By-products of this coal can be converted into different chemicals which are used to make paint, nylon, and many other items.

Anthracite

It is the highest grade coal. It is hard and dark black in colour. It has a very light weight and the highest heat content. Anthracite coal is very hard, deep black and shiny. It contains 86-97% carbon and has a heating value slightly higher than bituminous coal. It burns longer with more heat and less dust.

15.4.3 Uses of coal

- Coal is used to generate heat and electricity.
- It is used to make derivatives of silicon which are used to make lubricants, water repellents, resins, cosmetics, hair shampoos, and toothpaste.
- Activated charcoal is used to make face packs and cosmetics.
- Coal is used to make paper.
- Coal helps to create alumina refineries.
- Carbon fibre which is an extremely strong but lightweight material is used in construction, mountain bikes, and tennis rackets.
- Activated carbon, used in filters for water and air purification and in kidney dialysis machines is obtained from coal.

15.4.4 Products obtained from coal

Coal when heated in the absence of air does not burn but produces many by-products. This process of heating coal in the absence of air is called destructive distillation of coal. Thousands of different products have coal or coal by-products as their components. Some of them are soap, aspirins, solvents, dyes, plastics, and fibres, such as rayon and nylon. The main by products obtained during destructive distillation are coke, coal tar, ammonia and coal gas.

Destructive Distillation of Coal

The destructive distillation of coal can be carried out in the laboratories. The apparatus is as shown in

Finely powdered coal is taken in a test tube and heated. At a particular temperature coal breaks down to produce coke, coal tar, ammonia and coal gas. Coal tar is deposited at the bottom of the second test tube and coal gas escapes out through the side tube. The ammonia produced is absorbed in the water, forming ammonium hydroxide. Finally a black residue called coke is left in the first tube.

Coke:

Coke contains 98% carbon. It is porous, black and the purest form of coal. It is a good fuel and burns without smoke. It is largely used as a reducing agent in the extraction of metals from their ores. It is also used in making fuel gases like producer gas and water gas which is a mixture of carbon monoxide and hydrogen.

Coal tar:

Coal tar is a mixture of different carbon compounds. It is a thick, black liquid with unpleasant smell. The fractional distillation of coal tar gives many chemical substances like benzene, toluene, phenol and aniline. They are used in the preparation of dyes, explosives, paints, synthetics fibers, drugs, and pesticides. Another product obtained from coal tar is naphthalene balls which are used to repel moth and other insects.

Coal Gas:

Coal gas also known as town gas is mainly a mixture of gases like hydrogen, methane and carbon monoxide. The gases present in coal gas are combustible and hence, it is an excellent fuel. It has high calorific value.

Ammonia:

The other by product obtained from coal is ammonia. It is used for making fertilizers such as ammonium sulphate, ammonium superphosphate etc.

It is also known as Black Diamond owing to its precious nature. On destructive distillation, 1000 kg of coal gives 700 kg of coke, 100 litres of ammonia, 50 litres of coal tar and 400 m3 of coal gas.

15.5 Petroleum

The term 'petroleum' is derived from the latin words 'petra' meaning rock and 'oleum' meaning oil. It is a fossil fuel formed from the remains of ancient marine organisms through death and decay. Petroleum is a complex mixture of hydrocarbons that occur in Earth in liquid, gaseous, or solid form.

The term petroleum commonly denotes the liquid form, crude oil. But technically petroleum also includes natural gas and bitumen, a solid form. The natural gas and the crude oil constitute the primary fossil fuels.

Ancient cultures used crude oil for binding materials. It was also used as a sealant for waterproofing various surfaces.

15.5.1 Occurrence of Petroleum

The chief petroleum producing countries are U.S.A, Kuwait, Iraq, Iran, Russia and Mexico. In India, petroleum is found in Assam, Gujarat, Maharashtra (Mumbai), Andhra Pradesh (Godavari and Krishna basin) and Tamil Nadu (Cauveri Basins). By drilling through the earth the crude oil is pumped out from the well as a black liquid.

The first oil well in the world was drilled in Pennsylvania, USA in 1859. The second oil well was drilled in Makum, Assam, India in 1867.

15.5.2 Refining of crude petroleum

The crude petroleum obtained from the well is a dark colored viscous liquid which contains many impurities such as water, solid particles and gases like methane and ethane. To make it useful for different purposes, it must be separated into various components. The process of separating petroleum into useful by-products and removal of undesirable impurities is called refining. The steps involved in this process are given below.

Separation of water

The crude oil obtained from the oil wells will have salt water mixed with it. As the first step the water is removed from the crude oil.

Removal of sulphur compounds

The crude oil will have harmful sulphur compounds as impurities. In this step these impurities are removed.

Fractional distillation

Petroleum is a mixture of various constituents such as petroleum gas, petrol, diesel, kerosene, lubricating oil, paraffin wax, etc. The process of separation of various constituents or fractions of petroleum is done by fractional distillation in fractionating columns. The process of heating a mixture of liquids having different boiling points and then separating them by cooling is called fractional distillation.

Crude petroleum is first heated to about 400°C in a furnace. As the vapours of crude oil move up the tower, the various fractions condense according to their boiling point ranges. The various fractions of petroleum obtained are tabulated below. Many useful substances are obtained from petroleum and natural gas. These are termed 'petrochemicals'. These are used in the manufacture of detergents, fibres, and other man-made plastics like polythene. Hydrogen gas obtained from natural gas, is used in the production of fertilizers. Due to its great commercial importance, petroleum is also called 'black gold'.

15.5.3 Uses of Petroleum

Products obtained from crude oil have a number of uses.

- Liquefied Petroleum Gas or LPG is used in houses as well as in the industry.
- Diesel and petrol are used as fuels for vehicles. It is also used to run electric generators.
- Petrol is used as a solvent for dry cleaning.
- Kerosene is used as a fuel for stoves and also in jet planes.
- Lubricating oil reduces wear and tear and corrosion of machines.
- Paraffin wax is used to make candles, ointments, ink, crayons, etc.
- Bitumen or asphalt is mainly used to surface roads.

15.6 Fuel

Any substance that can produce heat and energy on burning is called fuel. We use this heat for various purposes such as cooking, heating and many industrial and manufacturing purposes. Some of the fuels that we use in our daily life are wood, coal, petrol, diesel and natural gas.

15.6.1 Types of fuel

Fuels are classified into different types according to their physical state. They are classified into solid, liquid and gaseous fuels.

Solid fuels

Fuels like wood and coal are in solid state and they are called solid fuels. This type of fuel was the first one to be used by man. These fuels are easy to store and transport. The production cost is also very low.

Liquid fuels

Most of the liquid fuels are derived from the fossil remains of dead plants and animals petroleum oil, coal tar and alcohol are some of the liquid fuels. These fuels give more energy on burning and burn without ash.

Gaseous fuel

Coal gas, oil gas, producer gas and hydrogen are some of the gaseous fuels. These fuels can be easily transported through pipes and they do not produce pollution.

15.6.2 Characteristics of fuel

An ideal fuel should have the following characteristics.

- It should be readily available
- It should be easily transportable
- It should be less expensive
- It should have high calorific value
- It should produce large amount of heat
- It should not leave behind any undesirable substances

15.6.3 Efficiency of Fuel

Any fuel contains carbon as its main constituent. During the combustion of fuel carbon combines with oxygen and liberates large amount of heat. It is expected that a fuel liberates maximum amount of heat in the short time. The efficiency of a fuel can be understood from the following terms.

Specific Energy

Specific energy is the amount of energy produced by unit mass of a fuel. It is defined as the energy per unit mass. It is used to measure the stored energy in certain substances. Its unit is Jkg-1.

Calorific Value

It is the quantity of heat produced by the complete combustion of fuel at constant pressure and normal conditions. It is measured in terms of 125kg-1.

Calorific value of fuel

Fuel	Calorific Value (KJ/kg)
Cow dung cake	6000 – 8000
Wood	17000 – 22000
Coal	25000 – 33000
Petrol	45000
Kerosene	45000
Diesel	45000
Methane	50000
CNG	50000
LPG	55000
Biogas	35000 – 40000
Hydrogen	150000

Octane Number

Octane number denotes the amount of octane present in petrol. The fuel having high octane number is called as an ideal fuel.

Cetane Number

Cetane Number measures the ignition delay of the fuel in diesel engine. When cetane number is higher the ignition delay is shorter. The fuel with high cetane number is called as the ideal fuel.

Difference between Octane number and Cetane number

Octane Number	Cetane Number
Octane rating is used for petrol	Cetane rating is used for diesel
It measures the amount of octane present in petrol.	It measures the ignition delay of the fuel in diesel engine.
Octane number of petrol can be increased by adding benzene or toluene.	Cetane number of diesel can be increased by adding acetone.
The fuel with high octane number has low cetane number	The fuel with high cetane number has low octane number.

15.7 Alternative Fuel

The natural resources in the world have been used by man in a rapid way and so very soon they will be exhausted. The traditional fuel that we use today including petroleum are non renewable and they would be depleted soon. It is estimated that coal will last for 148 years, petroleum for 40 years and natural gas for 61 years. So we need to find alternative sources of energy.

More over fossil fuels emit harmful gases like carbon dioxide, carbon monoxide and sulfur dioxide which pollute the atmosphere. Burning fossil fuels also cause temperature rise in the earth's atmosphere. Many believe that fuel which does not cause pollution is needed to enhance the quality of our environment. Some of the alternative fuels are given below.

Bio diesel

Bio diesel is a fuel obtained from vegetable oils such as soya bean oil, jatropha oil, corn oil, sunflower oil, cotton seed oil, rice-bran oil and rubber seed oil.

Hydrogen - The future fuel Hydrogen could be the best alternative fuel in the future. It is a clean fuel as it gives out only water while burning. Moreover, it has the highest energy content. It does not pollute air.

Wind energy

Wind energy is obtained with the help of wind mills. When wind blows, they rotate the blades of the wind mills and current is produced in the dynamo. Wind mills are mostly located at Kayathar, Aralvaimozhi, Palladam and Kudimangalam in Tamil Nadu.

Gobar Gas

Gobar gas is obtained by the fermentation of cow dung in the absence of air (anaerobic conditions). It mainly contains methane and a little ethane. It is widely used in rural areas for cooking and operating engines.

15.8 Solar Energy

Sun is the first and foremost energy source that makes life possible on our earth. Solar energy is the only viable fuel source of non depleting nature for, sun provides a free and renewable source of energy. It is the renewable type of energy without endangering the environment. It is the potential source to replace the fossil fuel in order to meet the needs of the world.

With the advancements in science and technology, solar energy has become more affordable, and it can overcome energy crisis. Solar energy is a clean energy. With the minimum efforts maximum energy can be harnessed using various equipments.

15.8.1 Applications of Solar Energy

Solar energy has wider applications in various fields.

- It is used in solar water heater.
- It is used in drying of agricultural and animal products.
- It is used in electric power generation.
- It is used in solar green houses.
- It is used in solar pumping and solar distillation. It is used for solar cooking and solar furnaces also.

UNIT 21 CROP PRODUCTIONS AND MANAGEMENT

Indian Agricultural Research Institute (IARI)

The Indian Agricultural Research Institute is a national institute for agricultural research, education and extension. IARI is commonly known as the Pusa Institute. It is financed and administrated by the ICAR (Indian Council of Agricultural Research). This was responsible for research leading to the green revolution in India during 1970s. The policies, plans and programs of IARI have helped to meet the needs of the nation. Several popular high yielding varieties of major crops have been developed by IARI.

Indian Council of Agricultural Research (ICAR)

The Indian Council of Agricultural Research is an autonomous body responsible for co-ordinating agricultural education and research in India. The union minister of agriculture serves as its president. It functions under the Department of Agricultural Research and Education, Ministry of Agriculture. It is the largest network of agricultural research and education institutes in the world.

Krishi Vigyon Kendra

Krishi Vigyan Kendra is a farm science centre. These centres serve as the ultimate link between ICAR (Indian council of Agricultural research) and farmers. Their aim is to apply agricultural research findings in practical localized settings. The first KVK was established in 1974 in Pondicherry. Since then, KVKs have been established in all states and the number continues to grow. KVKs are expected to undertake their own projects. They are also expected to serve as a resource center for extending government initiative to local areas. KVKs can be formed under a variety of host institutions, including agricultural universities, state departments, ICAR institutes, other educational institutions or non government organisations.

Responsibilities of KVK

Each KVK operates a small farm to test new technologies, such as seed varieties or innovative farming methods developed by ICAR institutes. This allows new technologies to be tested at the local level before being transferred to farmers. It also organizes programs to show the efficacy of new technologies on farmer's fields. KVKs organise workshops to discuss modern farming techniques with groups of farmers. KVKs provide advisory service to the farmers about weather and market pricing through radio and mobile phones. It focuses on crops and cultivation methods. It also facilitates rapport between the institution and the local community.

21.8 Bio control Methods

Bio-control or biological control is a method of controlling pests such as insects, mites, weed and plant diseases using other organisms. Bio predators, bio-pesticides, bio-repellents' and bio-fertilizers are used for controlling microorganisms which cause damage to the crops, pests and insects.

21.8.1 Bio-predators

These are naturally occurring insects that use pests for feeding or multiplication. By introducing large numbers of predators in a greenhouse we can destroy the pest. Predators like Chrysopa spp. and Menochilus spp. are highly useful in controlling a wide variety of pests like aphids, white flies, cotton bollworms, leaf insects etc.

The black kneel capsid is an insect found on fruit trees. It eats more than 1000 fruit tree red spider mites per year.

21.8.2 Bio-pesticide

Bio-pesticides are living organism or their derived parts which are used as bio-control agents to protect crops against insect pests. Entomopathegenic viruses, bacteria insecticides, particularly bacillus thuringiensis, entamofungal pathogens, protozoans and insect parasitic nematodes have been found to control important pests which affect crops. These bio-pesticides are commercially available but quite difficult to formulate in field conditions. Bio-pesticides are of different types based on their origin.

a. Fungal bio-pesticides:

Trichodermaviride is a fungus used as a biological pesticide. It is useful to control various disease caused by fungi such as wilt, rusting of leaves and root disease.

Bacterial bio pesticide: A culture of bacillus thuringiensis bacteria is effectively used to control the pest Lepidoptera that attack cotton, maize plants. Panchagavya and leaves decoction of some plants are also used as bio-pesticides.

21.8.3 Bio - repellant

Compound Azadiractin obtained from seeds of neem serves as a good insect-repellant. One of the earliest pesticides used by man was margosa leaves. The dried leaves repel the pests from stored grains.

21.8.4 Bio-fertilizer

Bio fertilizers are organisms which can bring about soil nutrient enrichment. Nitrogen fixing microorganisms have the capability of converting free nitrogen into nitrogenous compounds and make the soil fertile. The main source of bio-fertilizers is cyano bacteria and certain fungi. Although the chemical fertilizers increase food production, they degrade the natural habitat.

Free living bacteria live freely in the soil and fix atmospheric nitrogen and make it available to the crops like cereals, millets, fruits and vegetables. Eg. Azosprillum. Free living cyano bacterium involves in nitrogen fixation along with photosynthesis. Eg. Anabeana, Nostoc. Symbiotic bacteria fix atmospheric nitrogen. eg. Rhizobium

9.6 International Space Station

International Space Station

ISS is a large spacecraft which can house astronauts. It goes around in low Earth orbit at approximately 400 km distance. It is also a science laboratory. Its very first part was placed in orbit in 1998 and its core construction was completed by 2011. It is the largest man-made object in space which can also be seen from the Earth through the naked eye.

The first human crew went to the ISS in 2000. Ever since that, it has never been unoccupied by humans. At any given instant, at least six humans will be present in the ISS. According to the current plan, ISS will be operated until 2024, with a possible extension until 2028. After that, it could be deorbited, or recycled for future space stations.

Benefits of ISS

According to NASA, the following are some of the ways in which the ISS is already benefitting us or will benefit us in the future.

Supporting water-purification efforts

Using the technology developed for the ISS, areas having water scarcity can gain access to advanced water filtration and purification systems. The water recovery system (WRS) and the oxygen generation system (OGS) developed for the ISS have already saved a village in Iraq from being deserted due to lack of clean water.

Eye tracking technology

The Eye Tracking Device, built for a microgravity experiment, has proved ideal to be used in many laser surgeries. Also, eye tracking technology is helping disabled people with limited movement and speech. For example, a kid who has severe disability in body movements can use his eye-movements alone and do routine tasks and lead an independent life.

Robotic arms and surgeries

Robotic arms developed for research in the ISS are providing significant help to the surgeons in removing inoperable tumours (e.g., brain tumours) and taking biopsies with great accuracies. Its inventors say that the robot could take biopsies with remarkable precision and consistency.

Apart from the above-mentioned applications, there are many other ways in which the researches that take place in the ISS are helpful. They are: development of improved vaccines, breast cancer detection and treatment, ultrasound machines for remote regions etc,.

ISS and International Cooperation

As great as the ISS' scientific achievements are, no less in accomplishment is the international co-operation which resulted in the construction of the ISS. An international collaboration of five different space agencies of 16 countries provides, maintains and operates the ISS. They are: NASA (USA), Roskosmos (Russia), ESA (Europe), JAXA (Japan) and CSA (Cananda). Belgium, Brazil, Denmark, France, Germany, Italy, Holland, Norway, Spain, Sweden, Switzerland and the UK are also part of the consortium.

UNIT 20 BREEDING AND BIOTECHNOLOGY

Dr. M. S. Swaminathan

Dr. Mankombu Sambasivan Swaminathan is an Indian scientist known for his leading role in India's Green Revolution. His research on potato, wheat, rice and jute are well known plant breeding experiments. Due to his efforts the wheat production increased from twelve million tonnes in 1960's to seventy million tonnes now. He is aptly called as the "Father of Indian Green Revolution".

20.2.4 Plant Breeding for Improved Nutritional Quality

Undernutrition and protein malnutrition among human population is a major health problem which has been receiving much focus throughout the world.

Apart, from humans it also aff ects the health of farm animals. To combat these conditions, human and animal health are to be determined by the nutritional quality of the feed crops. Th e nutritional quality of crops depends on quality and quantity of nutrients. The nutritional quality may be improved with respect to its 1. Protein content and quality of protein

2. Oil content 3. Mineral content **Bio fortification** Bio fortification is the scientific process of developing crop plants enriched with high levels of desirable nutrients like vitamins, proteins and minerals. Some examples of crop varieties developed as a result of bio fortification are given below:

1. Protina, Shakti and Rathna are lysine rich maize hybrids (developed in India).

   Figure 20.2 Protina–lysine rich Maize

2. Atlas 66, a protein rich wheat variety.

   Figure 20.3 Atlas 66-protein rich Wheat

3. Iron rich fortified rice variety.
4. Vitamin A enriched carrots, pumpkin and spinach.

20.5 Genetic Engineering

- Genetic engineering is the manipulation and transfer of genes from one organism to another organisms to create a new DNA called as recombinant DNA(rDNA). The term recombinant is used because DNA from two diff erent sources can be joined together. Hence, genetic engineering is also called as recombinant DNA technology.

Techniques of Genetic Engineering – Basic Requirements

Important discoveries that led to the stepping stone of rDNA technology were

- Presence of plasmid in bacteria that can undergo replication independently along with chromosomal DNA.
- Restriction enzymes cuts or break DNA at specifi c sites and are also called as molecular scissors.
- DNA ligases are the enzymes which help in ligating (joining) the broken DNA fragments.

Gene Cloning

- What reminds to your mind when you hear the word clone? Of course, 'DOLLY' the cloned sheep. The carbon copy of an individual is oft en called a clone. However, more appropriately, a clone means to make a genetically exact copy of an organism.

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Biotechnology in Medicine

- Using genetic engineering techniques medicinally important valuable proteins or polypeptides that form the potential pharmaceutical products for treatment of various diseases have been developed on a commercial scale.

Pharmaceutical Products developed by rDNA technique

- Insulin used in the treatment of diabetes.
- Human growth hormone used for treating children with growth deficiencies
- Blood clotting factors are developed to treat haemophilia.
- Tissue plasminogen activator is used to dissolve blood clots and prevent heart attack.
- Development of vaccines against various diseases like Hepatitis B and rabies.

Gene Therapy

- Gene therapy refers to the replacement of defective gene by the direct transfer of functional genes into human to treat genetic disease or disorder. The genetic makeup of the patient' cell is altered using recombinant DNA technology. It was first successfully implemented in 1990.

Somatic gene therapy is the replacement of defective gene in Somatic cells.

- **Germ line gene therapy** replacement of defective gene in germ cell (Egg and Sperm) targeted only somatic (non –reproductive) cells. Correction of genetic defects in Somatic cells may be beneficial to the patient but the Corrected gene may not be carried to the next generation.

20.7 Stem Cells

- Our body is composed of over 200 specialised cell types, that can carry out specific functions. eg. Neurons or nerve cell that can transmit signals, or heart cells which contract to pump blood or pancreatic cells to secrete insulin. These specialised cells are called as differentiated cell.In contrast to differentiated cells.
- In Contrast to differentiated cells, stem cells are undifferentiated or unspecialised mass of cells. The stem cells are the cells of variable potency. Potency refers to the number of possible fates that a cell can acquire. The two important properties of stem cells that differentiate them from other cells are:
- Its ability to divide and give rise to more stem cells by self-renewal
- Its ability to give rise to specialised cells with specific functions by the process of differentiation.

Types of stem cells

- **Embryonic stem cells** can be extracted and cultured from the early embryos. These cells are derived from the inner cell mass of blastocyst. These cells can be developed into any cell in the body.
- **Adult stem cell** or somatic stem cell are found in the neonatal (new born) and adults. They have the ability to divide and give rise to specific cell types. Sources of adult stem cells are amniotic fluid, umbilical cord and bone marrow.

Stem-cell therapy

- Sometimes cells, tissues and organs in the body may be permanently damaged or lost due to genetic condition or disease or injury. In such situations stem cells are used for the treatment of diseases which is called stem-cell therapy. In treating neurodegenerative disorders like Parkinson's disease and Alzheimer's disease neuronal stem cells can be used to replace the damaged or lost neurons.

20.8 DNA Finger Printing Technology

- The human genome has 3 billion base pairs. Did you know that the DNA pattern of two individuals cannot be same except for identical twins. Each person's DNA sequence is unique due to the small difference in the base pairs. Therefore, if we want to compare the genetic difference among the two individuals, DNA fingerprinting is the easier and quicker method. This technique was developed by Alec Jeffrey.
- The technique analyses each individual's unique DNA sequences and provides distinctive characteristics of individual which helps in identification. Variable number of tandem repeat sequences (VNTRs) serve as molecular markers for identification.
- In human beings, 99 % of the DNA base sequences are the same and this is called as bulk genomic DNA. The remaining 1 % DNA sequence differs from one individual to another.

This 1 % DNA sequence is present as small stretch of repeated sequences which is known as satellite DNA. The number of copies of the repeat sequence also called as VNTRs differs from one individual to another, and results in variation in the size of the DNA segment.

VNTRs illustration of three persons

- As shown in the illustration, the sequence AGCT is repeated six times in fi rst person, fi ve times in second person and seven times in third person. Because of this, DNA segment of third person will be larger in size followed by DNA segment of first person and then the second person. Thus, it is clear that satellite DNA bring about variation within the population. Variation in DNA banding pattern reveals differences among the individuals.

Applications of DNA Fingerprinting

- DNA fingerprinting technique is widely used in forensic applications like crime investigation such as identifying the culprit. It is also used for paternity testing in case of disputes.
- It also helps in the study of genetic diversity of population, evolution and speciation.

20.9 Genetically Modified Organisms (GMOs)

- One of the most tremendous development of genetic engineering is the production of genetically modified (GM) plants and animals. Genetic modification refers to the alteration or manipulation of genes in the organisms using rDNA techniques in order to produce the desired characteristics. The DNA fragment inserted is called transgene. Plants or animals expressing a modified endogenous gene or a foregin gene are also known as transgenic organisms.
- The transgenic plants are much stable, with improved nutritional quality, resistant to diseases and tolerant to various environment conditions. Similarly transgenic animals are used to produce proteins of medicinal importance at low cost and improve livestock quality.

Genetically Modified Plants

Objective	**Gene inserted**	**Achievement**
Improved nutritional quality in Rice	Beta carotene gene (In humans, Beta carotene is required for the synthesis of Vitamin A)	Golden Rice (Genetically modified rice can produce beta carotene, that can prevent Vitamin A deficiency)
Increased crop production	Bt gene from bacteria Bacillus thuringiensis. (Bt gene produces a protein that is toxic to insects)	Insect resistant plants (These plants can produce the toxin protein that kills the insects which attack them)

Genetically Modified Animals

Objective	Gene inserted	Achievement
Improved wool quality and production	Genes for synthesis of amino acid, cysteine	Transgenic sheep (gene expressed)
Increased growth in fishes	Salmon or Rainbow trout or Tilapia growth hormone gene	Transgenic fish (gene expressed)

UNIT 22 ENVIRONIMENTAL MANAGEMENT

Introduction

Environmental management deals with the different aspects of environment, its structure, function, its quality and its maintenance including conservation of its living and non-living components. The diversified natural resources on this earth provide the necessities for survival of all forms of life including man. Everything that comes from nature has some utility for man but its utilization is possible based on the availability of appropriate technology.

Resources can be renewed simultaneously along with their exploitation (forests, crops, wildlife, groundwater, wind and solar energy). They can maintain themselves by natural recycling or can be replenished by proper management. Simultaneously, non-renewable resources cannot be recycled and can get exhausted by unlimited and continous use (mineral ores, coal, petroleum etc). They cannot be replaced easily. This would lead to a situation where non-renewable resources may come to an end after a certain period of time.

Expanding human population resulted in expanding needs of man. With scientific and technological advancement man started utilizing natural resources at a much larger scale. Continuous increase in population caused an increased demand for resources. Therefore, conservation of natural resources makes important contributions to the social and economic development of the country.

22.1 Conservation and Judicious Use of Resources

Natural resources are conserved for their biological, economic and recreational values. The use of natural resources in excess and unplanned way leads to imbalance in the environment. A judicious balance should be maintained between exploitation of resources and its replenishment. Proper utilization and management of nature and its resources is termed as conservation.

We have to build a sustainable world, which should last forever. Some of the ways to sustain continuous use of resources are practices to utilise energy efficiently, avoid wastage of water, avoid usage of plastics and other non-biodegradable materials and to take care for the environment we live. It is important that we manage and use our resources carefully so as to preserve for the future generations.

22.2 Forest and its Importance

Forests are an important component of our environment and are dominated by microorganisms, flowering plants, shrubs, climbers, dense trees and provide a vast habitat for wild animals. Forests also contribute to the economic development of our country. Forests are vital for human life, it is a source for a wide range of renewable natural resource. They provide wood, food, fodder, fibre and medicine.

Forests are major factor of environmental concern. They act as carbon sink, regulate climatic conditions, increase rainfall, reduce global warming, prevent natural hazards like flood and landslides, protect wildlife and also act as catchments for water conservation. They also play a vital role in maintaining the ecological balance.

22.2.1 Deforestation and its Effects

Deforestation is the destruction of large area of forests. This happens for many reasons like intensive agriculture, urbanization, construction of dams, roads, buildings and industries,

hydroelectric projects, forest fires, construction of mountain and forest roads. It is a threat to the economy, quality of life and future of the environment. India is losing about 1.5 million hectares of forest cover every year.

Effects of Deforestation

Deforestation gives rise to ecological problems like floods, drought, soil erosion, loss of wild life, extinction of species, imbalance of biogeochemical cycles, alteration of climatic conditions and desertification.

22.2.2 Conservation of Forests

India has an area of 752.3 lakh hectare classified as reserved forests and 215.1 lakh hectare as protected forests. The important measures taken for conservation of forests are as follows

Afforestation: Activities for afforestation programme (Van Mahotsav) includes planting and protecting trees with multiple uses which help in restoration of green cover. Destruction of trees should be curtailed.

Social forestry programme: It should be undertaken on a large scale with active participation of the public and utilization of common land to produce firewood, fodder and timber for the benefit of the rural community. This relieves pressure on existing forests and to safeguard future of tribals.

Forest Conservation through Laws: Adopting stringent laws and policies to conserve and protect forests are through National Forest Policy, (1952 and 1988) and Forest Conservation Act, 1980.

22.3 Wildlife and its Conservation

Wild life refers to the undomesticated animals living in their natural habitats (forests, grasslands and deserts) an area without human habitation. They are needed for maintaining biological diversity. It also helps in promoting economic activities that generates revenue through tourism. Conservation of forest and wildlife is interrelated with each other.

22.3.1 Decline in Wildlife Population

Wildlife of India is a great natural heritage. Exploitation of wildlife resources has decreased global wildlife population by 52% between 1970 and 2014. Over exploitation and shrinking of forest cover areas has resulted in animals becoming extinct, some are threatened and some are on the verge of extinction. In recent years, increase in human encroachment has posed a threat to India's wildlife.

22.3.2 Aims of Wildlife Management

The main aim of wildlife conservation are:

- To control and limit exploitation of species.
- To preserve the plants and animals from extinction.
- Maintenance of threatened species and protect species which are on the verge of extinction.
- Preserve the endangered species.

- To study the ecological relationship of the plants and animals in natural habitat.
- Hunting and poaching should be prohibited.
- Establishment of National parks, Wild life sanctuaries, protected areas and Bios phereserves.

The Wildlife protection Act was established in 1972. The provisions of the act are

- Prohibit killing and hunting of specifiedanimals.
- Constitute sanctuaries, national parks,and closed areas for wildlife conservation.
- Special schemes for preservation ofendangered species.
- Constitute Central Zoo Authority andrecognition of zoos.
- Restrict, regulate or prohibit trade in wildanimals and products obtained from them.

- Jim Corbett National Parkwas the first to be establishedin 1936 in Uttarakhand, India.
- There are 15 biosphere reserves in India.
- The Nilgiris is a biosphere reserve in Tamil Nadu.

22.3.4 Organisations Involved in Conservation of Wildlife

(i)Indian Board for Wild Life (IBWL)
(ii)World Wildlife Fund (WWF) for Nature
(iii)World Conservation Union (WCN)
(iv)International Union for Conservation of Nature and Natural resources (IUCN)
(v)Convention of International Trade in Endangered Species (CITES)
(vi)Bombay Natural History Society
(vii)Wild life Preservation Society of India, Dehradun

Wildlife Conservation Initiatives In India.

- Project Tiger and Project Elephant has been launched in 1973 and 1992 respectively
- Crocodile Conservation Project was launched in 1976.
- Sea Turtle Conservation Project was launched in 1999.
- Indian Rhino Vision 2020 is to conserve at least 3000 greater one-horned rhinos in Assam, India by 2020.

22.4 Soil Erosion

The top layers of soil contain humus and mineral salts, which are vital for the growth of plants. Removal of upper layer of soil by wind and water is called soil erosion. Soil erosion causes a significant loss of humus, nutrients and decrease the fertility of soil.

22.4.1 Agents of Soil Erosion

Agents of soil erosion are high velocity of wind, air currents, flowing water, landslide, human activities (deforestation, farming and mining) and overgrazing by cattle.

22.4.2 Management of Soil Erosion

- Retain vegetation cover, so that soil is not exposed.
- Cattle grazing should be controlled.

- Crop rotation and soil management improve soil organic matter.
- Runoff water should be stored in the catchment.
- Reforestation, terracing and contour ploughing.
- Wind speed can be controlled by planting trees in form of a shelter belt.

22.5 Renewable and Non-Renewable Energy Resources

Energy is an important input for development. The expansion of possible energy resources has been directly related with the pace of agricultural and industrial development in every part of the world. Energy resources can be classified as non-renewable and renewable.

Non-renewable (Exhaustible) energy resources

Energy obtained from sources that cannot renew themselves over a short period of time is known as non-renewable energy. These are available in limited amount in nature. They include coal, petroleum, natural gas and nuclear power. These conventional energy resources account for 90% of the world's production of commercial energy and nuclear power account for 10%.

Renewable (Inexhaustible) energy resources

These energy resources are available in unlimited amount in nature and they can be renewed over a short period of time, inexpensive and can be harvested continuously. These comprise the vast potential of non-conventional energy resources which include biofuel, biomass energy, geothermal energy, water energy (hydroelectric energy and tidal energy), solar energy, wave energy and wind energy.

22.5.1 Fossil Fuels

Fossil fuels are found inside the earth's crust and are energy rich substances formed by natural process, such as anaerobic decomposition of buried dead organisms, over millions of years. As the accumulating sediment layers produce heat and pressure, the remains of the organisms are gradually transformed into hydrocarbons. e.g. petroleum, coal and natural gas.

22.5.2 Coal and Petroleum

Coal and Petroleum are natural resources. They are called fossil fuels as they are formed from the degradation of biomass buried deep under the earth millions of years ago.

India is the third largest consumer of crude oil in the world, after the United States and China.

Coal is used for generation of electricity at Thermal power plants. Petroleum also known as crude oil is processed in oil refineries to produce petrol and diesel which are used to run automobiles, trucks, trains, ships and airplanes etc. Kerosene and LPG (Liquefied Petroleum Gas) obtained from petroleum is used as domestic fuel for cooking food.

The coal and petroleum reserves can get exhausted if we continue using them at a rapid rate. The formation of these fossil fuels is a very slow process and takes very long period of time for renewal.

22.5.3 Steps to Conserve Coal and Petroleum Resources

It is necessary to conserve or save coal and petroleum resources for the future use, which can be done by reducing their consumption.

(i)If electricity is saved, it will inturn reducethe use of coal

(ii)Using bicycle for covering short distancesinstead of using cars, scooters or motorcycles

(iii)Using pressure cooker can reduce the consumption of kerosene and LPG while cooking food. Solar cooker and solar heaters can be used wherever possible

(iv)Motor vehicles should be designed with fuel efficient engines to increase efficiency and also reduce air pollution

Case study of Taj Mahal

The Taj Mahal is one of the seven wonders of the world and is located in Agra, Uttarpradesh. It is built with white marble. The Mathura oil refinery owned by Indian Oil Corporation present around this area produce sulphur and nitrogen oxides. The white marble became yellow due to air pollution. The Government of India has set up emission standards around the monument to protect it from the damage.

22.6 Non-Conventional (Alternative) Energy Resources

The energy crisis has shown that for sustainable development in energy sector we must conserve the non-renewable conventional resources from its rapid depletion and replace them by non-polluting, renewable sources which are environmentally clean.

Efforts are made to develop new sources of energy which is called non-conventional sources of energy. It would provide greater initiative to local people who could assess their needs and resources and plan a strategy that could be useful to them.

22.6.1 Solar Energy

Solar energy is the energy obtained from the sun. The sun gives out vast amount of light and heat. It is only a little less than half (47 %) of solar energy which falls on the atmosphere reaches the earth's surface. If we could use just a small part of this energy it would fulfill all the country's need for power. Solar energy has advantages and also certain limitations.

Solar Energy Devices

The energy from the sun can be harnessed to provide power. The various devices used for harnessing sun's energy are called solar energy devices.

Solar Cells

Solar cells (Photovoltaic devices) is made up of silicon that converts sunlight directly into electricity. Solar cell produces electricity without polluting the environment. Since it uses no fuel other than sunlight, no harmful gases, no burning and no wastes are produced. These can be installed in remote and inacessible areas (forests and hilly regions) where setting up of power plant is expensive.

Uses of Solar cells

(i)It can be used for street lighting, traffic signals, water pumping, battery charging system etc.

(ii) It is used in artificial satellites and space probes

(iii) It provides radio and TV transmission to remote areas

(iv)It is used in calculators, electronic toys and watches.

Solar Panel

Arrangement of many solar cells side by side connected to each other is called solar panel. Th e capacity to provide electric cuurent is much increased in the solar panel. But the process of manufacture is very expensive. Figure

22.1 Solar Panel Solar Cooker

It consist of an insulated metal box or wooden box which is painted from inside so as to absorb maximum solar radiations. A thick glass sheet forms the cover over the box. The reflector is the plane mirror which is attached to the box. Th e food is cooked by energy radiated by the sun.

Solar thermal power plant

In solar thermal power plants, many solar panels are used to concentrate sun rays, to heat up water into steam. Th e steam is used to run the turbines to produce electricity.

A capacity of 100 litres solar heater can save up to 1500 units of electricity per year.

Advantages of Solar Energy

(i) It is available in abundance in our country and is free of cost.

(ii) It is a renewable source of energy.

(iii) It can be used for generating electricity or heat.

(iv)It does not cause pollution.

22.6.2 Biogas

Biogas is the mixture of methane (nearly 75 %), hydrogen sulphide, carbon dioxide and hydrogen. It is produced by the decomposition of animal wastes (cow dung) and plant wastes in the absence of oxygen. It is also commonly called as 'Gobar gas' since the starting material used is cow dung which means gobar in Hindi.

Uses of biogas

(i) It is used as fuel for cooking .

(ii) It is used to run motors and pump sets.

(iii) It is used to generate electricity.

Advantages of biogas

(i)It burns without smoke and therefore causes less pollution.

(ii)An excellent way to get rid of organic wastes like bio-waste and sewage material. (iii) Left over slurry is a good manure rich in nitrogen and phosphorus

(iv)It is safe and convenient to use (v)It can reduce the amount of greenhouse gases emitted.

22.6.3 Shale gas

Shale refers to the soft finely stratified sedimentary rock that is formed from the compaction of small old rocks containing mud and minerals – such as quartz and calcite, trapped beneath earth's surface. These rocks contain fossil fuels like oil and gas in their pores.

The fuel is extracted by a technique called hydraulic fracturing (drilling or well boring of sedimentary rocks layers to reach productive reservoir layers).

Environmental concerns of shale gas

(i)Shale drilling could affect groundwater reserves, which can contaminate the drinking water resources and also affect the fertility of the soil.

(ii)Million gallons of water is needed to break and release the shale gas, which inturn can affect the water table.

India has identified six basins as areas for shale gas exploration: Cambay (Gujarat), Assam-Arakan (North East), Gondwana (Central India), Krishna Godavari onshore (East Coast), Cauvery onshore and Indo-Gangetic basins.

22.6.4 Wind Energy

The kinetic energy possessed by the wind is due to its high speed, that can be converted into mechanical power by wind turbines. The wind energy can be used for

(i) generating electricity (ii) Run water pumps, flour mills etc. (iii) Rotatory motion of windmill is used to draw water from wells.

- The world's largest and tallest wind turbine is situated in Hawaii.
- One wind turbine can produce electricity for 300 homes.

Windmill

Windmill is a machine that converts the energy of wind into rotational energy by broad blade attached to the rotating axis. When the blowing air strikes the blades of the windmill, it exerts force and causes the blades to rotate. The rotational movement of the blades operate the generator and the electricity is produced. The energy output from each windmill is coupled together to get electricity on a commercial scale.

Advantages of Wind energy

(i)Wind energy is free, eco-friendly, renewable source of energy.

(ii)It does not cause pollution.

(iii)Expenses on periodic maintenance is low when compared to the other power sources.

22.6.5 Water Energy

Earth's surface is covered with nearly 71 % of water. Harnessing the energy from the flowing water can be used to produce electricity. The technique to harness the water energy is called Hydropower.

The electrical energy is derived from water flow, water falling from a height. Hilly areas are suitable for this purpose where there is continous flow of water in large amounts falling from high slopes. It does not cause environmental pollution or waste generation.

Hydropower plants convert the kinetic energy of flowing water into electricity. This is called hydroelectricity.

22.6.6 Tidal Energy

Tidal energy is the energy obtained from the movement of water due to ocean tides. Tides are the rise and fall of sea levels caused by the combined effects of the gravitational forces exerted on the oceans of the earth.

A tidal stream is a fast flowing body of water created by tides. Turbines are placed in tidal streams. When the tides hit the turbine, the turbine rotates and converts the tidal energy into electric energy

Advantages of tidal energy

(i) Tidal energy does not produce any pollution.

(ii) It does not use any fuel and does not produce any waste.

(iii) Tides are predictable, so tidal energy can be produced at any time.

(iv) Water is denser than air and therefore can generate electricity at lower speeds than wind turbines.

22.7 Rainwater Harvesting

Rainwater harvesting is a technique of collecting and storing rainwater for future use. It is a traditional method of storing rain water in underground tanks, ponds, lakes, check dams and used in future.

The main purpose of rainwater harvesting is to make the rainwater percolate under the ground so as to recharge 'groundwater level'.

Methods of rainwater harvesting

(i) Roof top rainwater harvesting:

Roof-tops are excellent rain catchers. The rain water that falls on the roof of the houses, apartments, commercial buildings etc. is collected and stored in the surface tank and can be used for domestic purpose.

(ii) Recharge pit:

In this method, the rainwater is first collected from the roof tops or open spaces and is directed into the percolation pits through pipes for filtration. After filtration the rainwater enters the recharge pits or ground wells.

People living in rural areas adopt a variety of water collecting methods to capture and store as rain water. Some of the methods used are

(i) Digging of tanks or lakes (Eris):

It is one of the traditional water harvesting system in Tamil Nadu. Eris are constructed in such a way that if the water in one eri overflows, it automatically gets diverted to the eri of the next village, as these eris are interconnected.

(ii) **Ooranis:**

These are small ponds to collect rainwater. The water is used for various domestic purposes (drinking, washing and bathing). These ponds cater the nearby villages.

Advantages of rainwater harvesting

Rainwater harvesting helps to

kallanai Dam, also known as Grand Anicut, is the fourth oldest dam in the world, constructed by King Karikala Chola of the Chola Dynasty in the 2nd century A.D.(CE). It still serves the people of Tamilnadu, The dam is located on the River Kaveri, approximately 20 km from the city of Tiruchirapalli.

(i)Overcome the rapid depletion of groundwater levels.
(ii)To Meet the increase demand of water.
(iii)Reduces flood and soil erosion
(iv)Water stored in ground is not contaminatedby human and animal wastes and hencecan be used for drinking purpose.

22.8 Electrical Energy Management

Electricity or electric power is produced by generators. The generators are operated by the turbines attached to it. The turbines are rotated by steam, moving water or wind power to produce electricity.

Conservation of electrical energy

The following measures can be taken even at home and school to save electricity

(i)Use energy efficient appliances to save electricity like Compact FluorescentLamps (CFL), Light Emiting Diode (LED)bulbs and other electric equipments.
(ii)Switch off the lights and fans, television and other electrical appliances when notin use.
(iii)Switch of the mobile phone chargerswhen not in use.
(iv)Maximise the use of solar radiation. Solarwater heating system can be used insteadof electric geysers.
(v)Minimise the use of air conditioners.

22.9 E-Wastes and its Management

E-wastes are generally called as electronicwastes, which includes the spoiled, outdated, non-repairable electrical and electronic devices. These wastes contain toxic metals like lead, cadmium, chromium and mercury, though also contain iron, copper, silicon, aluminum and gold which can be recovered. Neverthless, only 5 % of e-wastes produced are recycled.

Sources of e-wastes

Electronic devices: Computers, laptops, mobile phones, printers, monitors, televisions, DVD players, calculators, toys, sport equipments, etc.

Household electrical appliances:

Refrigerators, washing machine, microwave oven, mixer, grinder, water heater, etc.

Accessories:

Printing cartridges, batteries and chargers.

E-wastes include
Computer components -66%
Telecommunication components - 12 %
Electronic components -5 %
Biomedical components -7 %
Other components -6 %

Environmental impact of e-wastes

Disposal of any kind of electrical and electronic devices without knowledge can become the landfill and water pollutants.

Electronic equipments contain many hazardous heavy metals such as lead, cadmium that can cause severe soil and groundwater pollution.

E-waste dumping yards and the places nearby are polluted and cause severe health hazard.

22.10 Sewage Management

Untreated sewage or wastewater generated from domestic and industrial process is the leading polluter of water sources in India. Sewage water results in agricultural contamination and environmental degradation.

Sources of Sewage/wastewater

- Domestic purpose or household activities
- Dye and textile industries
- Leather industries
- Sugar and breweries industries
- Paper and pulp industries

Sewage/wastewater treatment method

The conventional wastewater treatment methods involve the following steps

(a) Pre-screening

(b) Aeration

(c) Sludge Management

(d) Water Reuse.

Pre-screening:

Wastewater generated from domestic and industrial activities is screened to remove soil and solid particulates.

Aeration:

Screened wastewater is then pumped to an aeration tank. Here the microbial contaminants are removed by the biological degradation that occurs in the presence of air.

Sedimentation process:

In this process, the solid particles in suspension form are allowed to settle. The particles that settle out from the suspension is known as sludge.

Sludge removal:

The sludge generated by the degradation process is transferred periodically from the tank for safe disposal.

Disinfection:

Chlorination and ultraviolet (UV) radiation of treated water is required to remove any microorganism contamination.

Water recycling:

The water will then be supplied for domestic or industrial purposes.

22.11 Solid Waste Management

Solid wastes mainly include municipal wastes, hospital wastes, industrial wastes and e-wastes etc. The solid wastes are dumped in the soil which results in landscape pollution.

Solid-waste management involves the collection, treatment and proper disposing of solid material that is discarded from the household and industrial activities.

Methods of solid wastes disposal

(i) **Segregation:** It is the separation of different type of waste materials like biodegradable and non-biodegradable wastes.

(ii) **Sanitary landfill:** Solid wastes are dumped into low lying areas. The layers are compacted by trucks to allow settlement. The waste materials get stabilised in about2-12 months. The organic matter undergoes decomposition.

(iii) Incineration: It is the burning of non-biodegradable solid wastes (medical wastes) in properly constructed furnace a thigh temperature.

(iv) Composting: Biodegradable matter of solid wastes is digested by microbial action or earthworms and converted into humus.

Recycling of wastes

- Papers from old books, magazines and newspapers are recycled to produce papers in papermills.
- Agricultural wastes like coconut shells, jute cotton stalk, bagasse of sugarcane can be used to make paper and hard board. Paddy husk can be used as livestock fodder.
- Cowdung and other organic wastes can be used in gobar gas plant to provide biogasand manure for fields.

3R Approach

The 3R approach such as Reduce, Reuse and Recycle may be followed for effective waste management.

Points to Remember

- Conservation is a process which is concerned with the use, preservation and proper management of natural resources from destructive activities of human being.
- Conservation of natural resources contributes to the social and economic development of the country.
- Forests of a country constitute a major asset for the people of the country.
- National park is a reserved area for the conservation of entire wildlife including plants and animals.
- Sanctuary is a place reserved exclusively for the use of animals.
- Solar cell is a device that absorbs sunlight and converts it into electric energy.
- Solar water heater does not require electricity, they heat up water directly from sunlight.
- Biogas is produced by the anaerobic decomposition of cow dung.
- The technique of collecting and storing grain water for future purpose is known as rain water harvesting.
- Unwanted, non-working and out dated electronic products become e-waste.