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QUESTION 1

(A) CELL - CYTOPLASM, PLASTIDS AND NUCLEUS

Cell: Basic unit of life

Cell is the basic unit of life and is responsible for making up all the tissues, organs and organ systems of the body. Cell was discovered by Robert Hooke in 1665 and is so small that it can't be seen by naked eye. Cell has different components including cell membrane, cytoplasm and cell organelles. There are also different types of cell including prokaryotic and eukaryotic which differ in membrane bounded organelles. There are different types of organisms including unicellular (made of single cell) and multicellular (made of many cells).

Different Components of Cell: Structure and Function

(i) Cytoplasm

Living contents of the protoplast between plasma membrane and nucleus is called cytoplasm. These living contents along with nucleus makes up protoplasm.

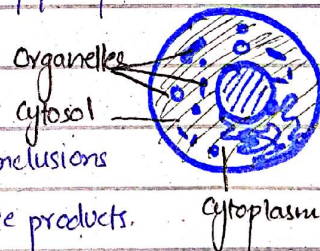
Structure: Cytoplasm is made of two components:

a. **Organelles**: Different cell organelles along with other inclusions e.g. nutrients, stored compounds and waste products.

b. **Cytosol**: Soluble part of cytoplasm forming ground substance of the cytoplasm. It consists of 90% water chemically along with other fundamental molecules of cell. Cytosol consist of

- i. True Solution - contain small molecules and ions
- ii. Colloidal Solution - contain large ions and molecules.

- a. Sol: Liquid form and less viscous.
- b. Gel: Viscous, semi-solid, at peripheries.



## Functions:

1. It acts as the storage house of the cell, keeping in all organelles, vesicles, secretions and waste molecules.
2. It is the site for many metabolic processes.
3. It consist of different organelles which perform different functions.
4. It show streaming movements which moves free floating organelles.

## ② Plastids

Plastids are membrane bounded, <sup>self-replicating</sup> pigment containing organelles present only in plant cells.

### Types: ① Chloroplast

Membrane bounded structure containing green pigment called chlorophyll necessary for photosynthesis.

### Structure:

- ① Envelope: Double membrane separating internal components from cytoplasm
- ② Stroma: Fluid filled around thylakoids containing different proteins and plasmid
- ③ Thylakoids: Flattened vesicles stacked like a stack of coin with chlorophyll in between different layers of thylakoids.
- ④ Grana: Stacked thylakoids form a granum. Around 50 thylakoids stack to form 1 granum. Chlorophyll within the layer makes it appear green.
- ⑤ Intergrana: Grana are connected through non-green part called <sup>inter-</sup>grana.

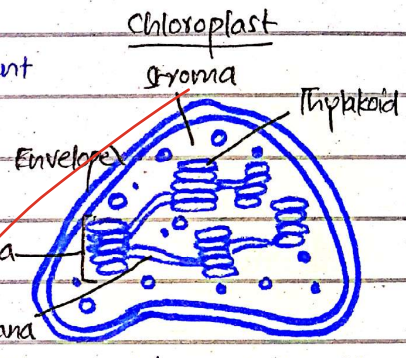
Function: Play its role in absorption of light and playing its role in food making process — photosynthesis.

### ② Chromoplast

- Membrane bounded structure containing coloured pigment found in petals, fruits and help in pollination and seed dispersal.

### ③ Leucoplast

- Membrane bounded structure containing no pigment found in roots



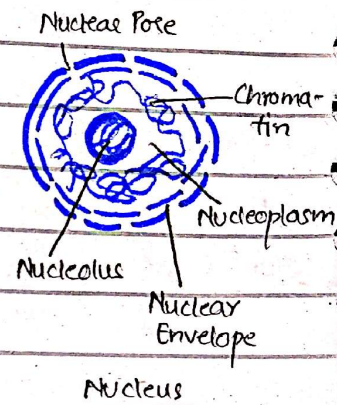
and used for storing food and nutrients in roots and stems.

### ③ Nucleus

Membrane bounded organelle controlling life activities of cell. It is the prominent organelle of cell. It is darkly stained and irregular in shape found in centre in animal's cells and at side in plant cells.

#### Structure:

- ① Nuclear Envelope - Nucleus is enclosed by double membrane. Outer membrane is discontinuous to inner membrane at spots forming pores for the transport of molecules from nucleus to cytoplasm.
- ② Nucleoplasm - It is the soluble nuclear sap filled inside the nucleus.



- ③ Nucleolus - Darkly stained body without any membrane. It produces rRNA which produces ribosomes and transport it through nuclear pores to cytoplasm.

- ④ Chromosomes - They are visible during dividing phase of the cell otherwise chromatin is present which is not visible. It is the basic hereditary material. Chromosome has two chromatids joined at centromere.

#### Functions:

- It controls all life activities of the cell.
- It <sup>has</sup> the hereditary material which is transferred from one generation to other.
- It produces RNA: rRNA, mRNA and tRNA.

### ⑤ NEPHRON — STRUCTURE AND FUNCTION

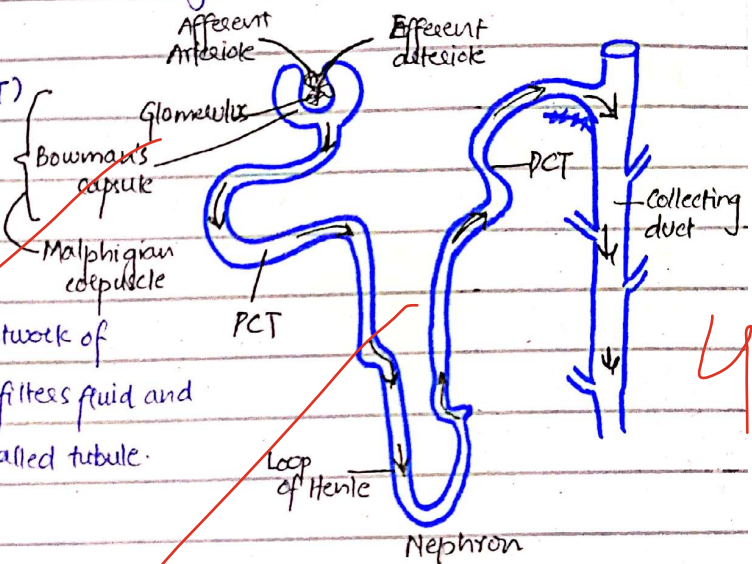
Kidney is the excretory organ of the body. Nephrons are the structural and functional unit of kidney. Each kidney has around 1 million nephrons present.

in it. ~~Each~~ Nephron in the kidney has its role in secretion. Each nephron has a length of 3cm

### Structure:

Nephron consist of a twisted tubule closed at one end and open at the other with a network of associated blood vessels. It has 4 regions:

- ① Bowman's Capsule
- ② Proximal Convoluted Tubule (PCT)
- ③ Loop of Henle
- ④ Distal Convoluted Tubule (DCT)



Each nephron has a glomerulus - network of blood vessels called capillaries which filters fluid and then it travels down a tiny tube called tubule.

### Functions:

#### ① Filtering and Reabsorption

Glomerulus filters amino acid and proteins but selectively reabsorbs them and keep electrolyte levels balanced. Filtered fluid goes in PCT where it is reabsorbed in peritubular capillaries by the help of microvilli present. Limbs of Loop of Henle also reabsorb solutes, water and ions. Ascending limbs reabsorb salts and descending limb reabsorb water and concentrated urine is passed into collecting duct.

### ② Causes and Preventive measures of smog

Smog, a harmful air pollution phenomenon, poses significant environmental and health risks. It is a dense mixture of air pollutants, including ground level ozone, particulate matter, and other toxic substances, primarily resulting from human activities.

#### Causes of Smog:

##### 1. Vehicular Emissions

Cars, buses, trucks emit nitrogen oxides (NO<sub>x</sub>) and volatile organic compounds

which react to <sup>sunlight forming</sup> ground-level ozone, a major component of smog.

### ② Industrial Pollution

Factories and power plants release large quantities of pollutants, including  $SO_2$ , CO and particulate matter, contributing to smog formation.

### ③ Burning Fossil Fuels

Combustion of coal, oil and gas in power plants, industries and households releases pollutants in the atmosphere.

### ④ Deforestation

Reduced vegetation diminishes the natural filtering of pollutants, leading to increased smog formation.

### ⑤ Urbanization

Rapid development increases construction dust, vehicle use, and energy demand, all of which contribute to smog formation.

### ⑥ Agricultural Activities

Burning crop stubble and using nitrogenous fertilizers lead to release of  $NO_x$  and ammonia, worsening air quality.

## Preventive Measures

### ① Adopt clean energy

Transition to renewable energy sources like solar, wind and use of energy-efficient appliances to reduce fossil fuel combustion.

### ② Promote Public Transportation

The lesser the number of vehicles on the road, the safer our environment. Encouraging use of public buses and vehicles and carpooling will reduce vehicular emissions.

### ③ Strict Industrial Regulations

Enforcement of strict pollution control mechanism will result in lesser emissions and will prevent smog formation.

## ④ Prevent Agriculture Burning

Providing alternatives to crop residue burning like composting or converting into biofuel is necessary to improve air quality.

## ⑤ Raise Awareness

Educate public about the health hazards of smog and promote eco-friendly measures including reducing energy usage and avoid waste burning.

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## ⑥ SWM: Weaknesses in SWM of Pakistan

Solid Waste Management refers to systematic management of the generation, collection, transfer, treatment, recycling, ~~recovery~~ and disposal of <sup>solid</sup> waste.

SWM in Pakistan today faces a lag despite several efforts by the concerned authorities. It includes efforts to minimize waste generation, promote recycling and reuse, and ensure safe disposal to protect public health and environment.

### Weaknesses in SWM of Pakistan:

#### ① Lack of Infrastructure

Insufficient waste collection system and disposal sites leads to uncollected waste, which often ends up in open areas, causing pollution. People ~~are~~ find it easier to dump their waste in open spaces rather than proper disposal because there is a lack of collection system which would work swiftly.

#### ② Improper Disposal Methods

Most of the waste is dumped without proper segregation of plastics, biodegradables and non-biodegradables. Lack of waste treatment or scientific measures result in most of the ~~most~~ waste being dumped into open areas which lead to environmental degradation and health hazards.

### ③ Low Recycling Rates

Recycling is largely informal and unregulated with minimal authorities to integrate it into formal waste management system. This leads to increase in solid waste in Pakistan.

### ④ ~~Inefficient~~ Rapid Urbanization and Population Growth

Existing waste management systems in Pakistan are unable to cater to the increasing growth of population. Rapid urbanization leads to rapid waste production which does not get treated and managed properly.

### ⑤ Lack of public awareness

Limited understanding among citizens about proper waste disposal and recycling contributes to littering and environmental degradation and pollution.

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## QUESTION. 2

### Ⓐ FORE BRAIN AND HIND BRAIN

Brain is a part of Central Nervous system which plays its major role in coordinating human activities. Central Nervous system is the processing centre of nervous system and receives and sends information to Peripheral Nervous system.

Brain is protected by ③ layers called meninges. Brain has ③ parts:

- ① Fore-Brain
- ② Mid Brain
- ③ Hind Brain

#### FORE-BRAIN :

It consists of cerebrum, thalamus and Hypothalamus.

① CEREBRUM : Largest part of the brain which is associated with higher functions — thoughts and actions.

It has ④ lobes associated to different functions.

a. Frontal Lobe — associated with reasoning, planning, movement, emotion and <sup>problem solving</sup>

b. Parietal Lobe — associated with movement, orientation, recognition and <sup>stimuli perception</sup>

c. Occipital Lobe — visual processing

d. Temporal Lobe — perception and recognition of auditory ~~and~~ stimuli, memory and speech.

② Thalamus: Associated with receiving message from five senses and sending to limbic system.

③ Hypothalamus: Controls pulse, appetite, thirst, sleep patterns and hormone production.

### Hind Brain:

Hind brain consist of cerebellum, pons, and medulla

① CEREBELLUM:

Regulates and coordinates movement, posture and balance

② MEDULLA:

Regulates involuntary functions e.g. Blood Pressure and Breathing.

③ PONS:

Regulates breathing and transmit functions from one part of the brain to the other.

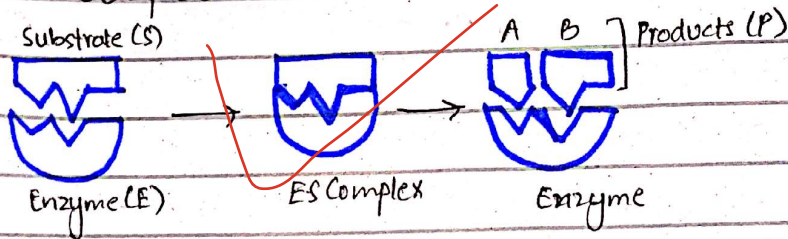
### ⑤ ENZYMES: CHARACTERISTICS AND ACTION

Enzymes are specialized organic substance composed of polymers of amino acids that act as catalyst to regulate the speed of chemical reactions involved in metabolism of living organism. Different enzymes have different functions and regulate



different form of reactions.

Mechanism of Action:



- ① Enzymes being highly specific act for only certain substrates. If the enzymes finds its perfect substrate for a metabolic reaction, they are ready to go in a reaction.
- ② Enzymes gets attached to the substrate forming ES Complex.
- ③ After the reaction is catalyzed by enzyme and gets finished, the substrate converts into products and gets separated from enzyme leaving space for a new substrate.

Characteristics of Enzymes:

1. Increase the rate of reaction upto million times faster.
2. Enzymes are all proteinaceous in nature.
3. Enzymes are mostly substrate specific, i.e. made to fit only a single substrate.
4. They are temperature and pH sensitive.

## ③ Renewable Energy Resources

Transition from the conventional fossil fuel to renewable energy resource is pivotal in addressing environmental problems and managing environmental costs. Renewable sources like solar, wind, geothermal and hydropower are cleaner alternatives that offer substantial benefits for reducing ecological footprint of energy production.

## Help in Reducing environmental costs:

1. Renewables produce electricity without emitting carbon dioxide, helping to mitigate climate change and reducing greenhouse gas emission.
2. They do not release harmful pollutants like  $\text{SO}_2$ ,  $\text{NO}_2$  and minimize air pollution by improving air quality and public health.
3. They use little to no water, reducing strain on freshwater resources as compared to conventional power plants.
4. They also produce minimal waste and prevent environmental degradation.
5. They protect biodiversity as they reduce reliance on resource extraction that damages ecosystems.

These measures collectively lower environmental costs and promote sustainability.