

General Science E Ability

Mock 03

Part II

Q2: What are the main components of a cell, and how do they work together to maintain cellular functions? Discuss the difference between prokaryotic and eukaryotic cells. How do cells respond to external stimuli and maintain homeostasis?

The main components of a cell are cell membrane, cytoplasm and DNA. The cell membrane regulates the passage of substances while the cytoplasm is a jelly-like substance holding cell organelles together like nucleus, mitochondria, ribosomes. All of these work in coordination to serve the functions of the cells.

Plasma Membrane:

This outer boundary of a cell acts as a barrier controlling what enters or exits, hence maintaining a stable internal environment.

Cytoplasm:

It is a jelly like substance that fills up the cell and is home to many cell organelles as well as the site for many metabolic processes.

Nucleus:

It is the cell's main center as it includes DNA and controls activities like growth and reproduction.

DNA:

Located in the nucleus, it includes genetic (genes) instructions to carry all cellular activities.

Mitochondria:

It is the powerhouse of the cell and generates 'ATP' energy required by the cell through cellular respiration.

Ribosome:

They are tiny organelle responsible for synthesizing proteins, which are responsible for all cellular tasks such as chemical reaction and signaling.

Endoplasmic Reticulum And Golgi Apparatus:

These organelles work together so to transport molecules within the cell. This process is called endomembrane system, it also synthesizes, processes and sorts molecule.

Lysosomes:

These organelles digest waste materials keeping the cell clean.

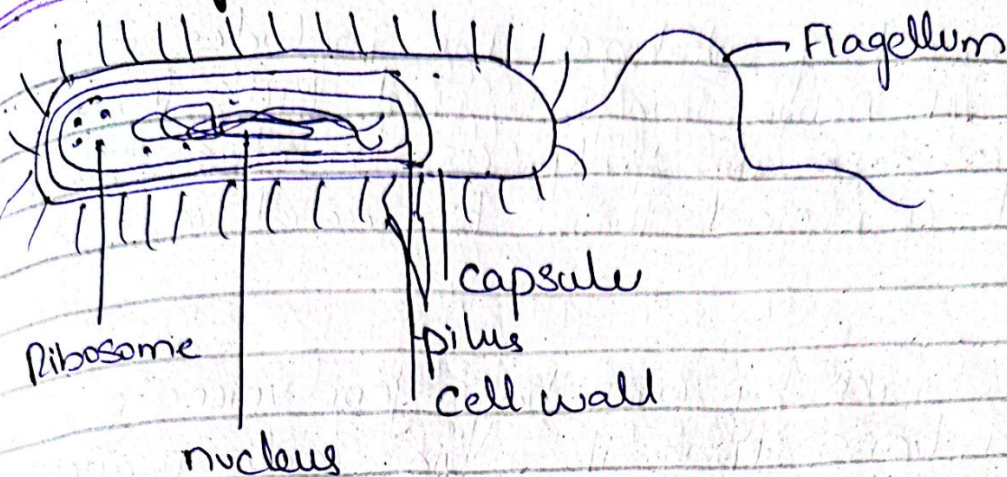
Cytoskeleton:

Network of fibres that help maintain cells shape and provide internal structural support.

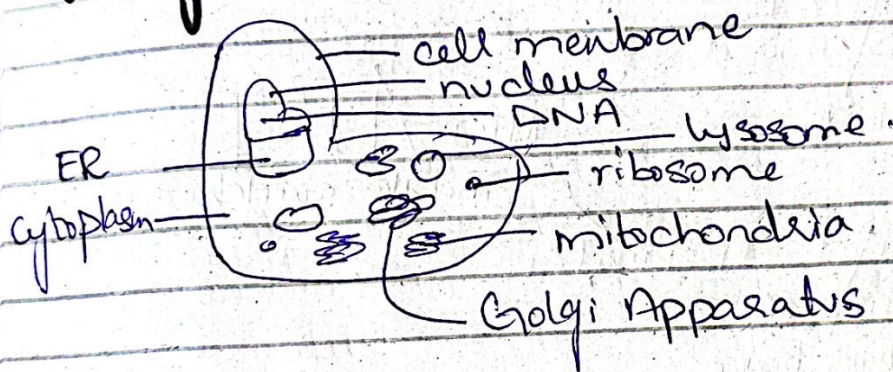
Key Differences between Cells

Feature	Prokaryotic	Eukaryotic
Nucleus	Absent	Present
Organelles	No membrane bound organelle	Present
DNA	Single circular chromosome	Linear chromosome with nucleus
Size	Smaller	Larger
Organisms	Always unicellular	uni or multicellular
Ribosome	70S	80S
Examples	Bacteria, Archae	Plants, Animals, Fungi etc

Prokaryotic Cell:



Eukaryotic Cell:



Cells Response to external stimuli and maintain Homeostasis:

Cells response to external stimuli and maintain homeostasis through a process called signal transduction.

Reception: Cells detect an external stimuli using specialized receptor proteins.

Transduction: The signal is relayed from the cells receptor into the cells interior through series of molecular interactions.

Response: The signal triggers a specific action, such as altering gene expression, changing shape.

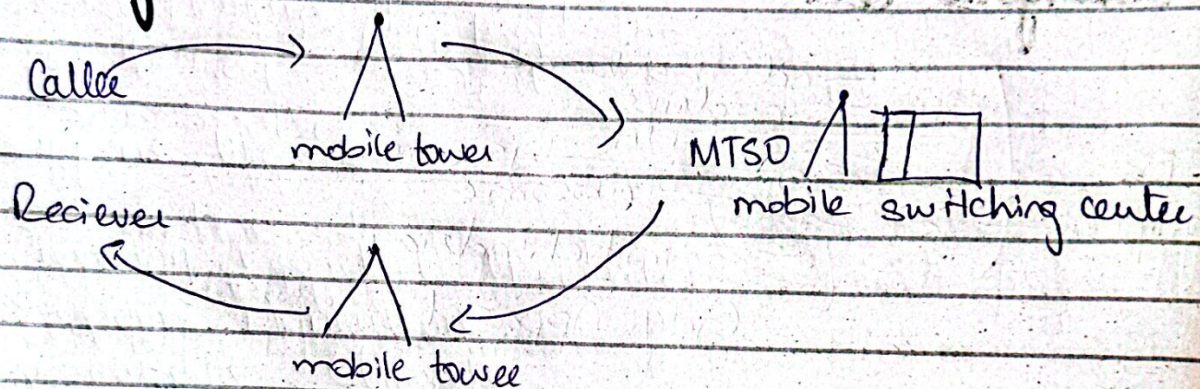
The cell membrane acts as selective barrier by

Controlling movement of substances. This includes Passive transport, Active Transport and Bulk transport. The **Feedback loops** also help as monitors internal changes and counteract them to maintain balance.

b.

Mobile phone works by converting your voice to digital data, transmitting it via radio waves to cellular towers and then routing it to receiver.

How they work:



Key technologies:

- ① Cellular Networks
- ② Wi-Fi
- ③ GPS
- ④ Satellite Technology
- ⑤ Bluetooth

Advantages

instant access
Safety measure
convenience
increased work productivity
Social connections

Disadvantages

over access
Status symbol
inconvenient by taking up time
increased work load
Mental health issues
Screen addiction

Mobile phones have significantly changed the way we communicate and access information. Everything is just a click away now, which has increased ~~patience and inconvenience~~ but decreased patience in people. Although we are now more updated about each other than ever before, we have lost actual physical connections. People who would travel to meet each other now find a phone call sufficient.

c.

Earth layers and their interactions:

1. Inner Core: Solid, dense sphere of iron and nickel at Earth's center.
2. Outer Core: A layer of molten iron and nickel that surrounds the inner core, generating earth's magnetic field.
3. Mantle: The largest layer made of hot, dense, flowing rock that moves through convection currents.
4. Crust: The thin solid outer layer where life exists.

Plate tectonics: The convection current in the mantle makes the plates of crust to move up. This causes phenomena such as earthquake and volcanic eruptions.

Geomagnetic Field: The outer core of the Earth's layer has conductive metals which produce a magnetic field which shields Earth's surface and biosphere from harmful charged particles.

Earth's Water Cycle:

The process through which water moves from Earth's hydrosphere, atmosphere and biosphere.



It supports life by:

- 1) Providing Essential Freshwater
- 2) Supports Agriculture
- 3) Regulates Climate
- 4) Supports Ecosystem
- 5) Shapes Landscapes

Human activities negatively impact Earth's ecosystem and resources through pollution, deforestation, urbanization, climate change, over exploitation of resources and overuse of agriculture.

d.

Sources of Air Pollution:

- ① Mobile Sources — Vehicles
- ② Stationary Sources — factories, power plant
- ③ Area Sources — cities, residential cooling
- ④ Natural Sources — Volcanoes, wildfires.

Impacts of Air Pollution:

- ① Human Health: Such exposure can lead to serious human health complications such as asthma, lung cancer, heart attack etc.
- ② Environmental Impacts: Air pollution causes acid rain, damages crop and ecosystems, reduces visibility and contributes to climate change.

Primary Pollutants

Emitted directly from source into atmosphere

Eg: Soot

Carbon monoxide
dust

Secondary Pollutants

These form in atmosphere when primary pollutants react with other substances

Eg: Ground level ozone

Collective Actions to reduce Pollution:

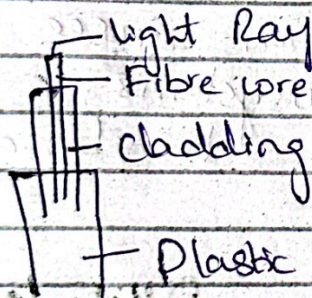
1. Renewable Energy
2. Stricter Regulations
3. Urban Planning

Individual Actions:

- ① Use Public Transport
- ② Conserve Energy
- ③ Support Sustainable Practice
- ④ Promote Greenery.

Q.4/

a. Fibre Optics use thin strands of glass or plastic to transmit data as pulses of light, enabling high-speed, high bandwidth data transfer over long distance with minimal signal lost.



Total Internal Reflection: It works through the process of Total Internal Reflection, where light is reflected internally within the core and bounces along fibre due to refractive difference between core and cladding.

Fiber Optic Vs Copper Wire Communications.

Feature	Fibre	Copper
Bandwidth	Very High	Limited
Speed	Faster	Slower
Distance Coverage	Tens of Km	Few hundred meters
Signal Loss	Very Low	High

Interference	No distortion	Prone to interference
Security	Difficult to tap	Easy to tap
Size & Weight	lightweight	Heavy
Durability	long life	degradation
Cost	High installation	low install
Maintenance	low	high

Fibre Optics enable high speed transmission because they use light signals confined by total internal reflection. Support high bandwidth via multiplexing, minimize signal loss and avoid interference.

by

Cause	Examples	Effects
Tectonic (plate mov)	subduction zone	Ground Shaking, tsunami
Volcanic activity	Magma movement	local tremors, volcano eruption
Human induced	Mining, dams	local quakes
Other	landslides	localized tremors, land subsidence

Types of Seismic Waves:

Type	Nature	Medium	Speed
P-Waves	Compressional	Solidst Liquid	Low
S-Waves	Shear	Solid only	Slower
Love wave	Horizontal Shear	Earth surface	Slow
Rayleigh	Rolling	Earth Surface	Severe

Measurement: A seismograph is used to measure the seismic waves. It produces a graph called Seismogram. P waves arrive first because they are fast, then S waves are detected and lastly Love or Rayleigh waves are measured.

Reducing impact of Earthquake:

1. Structural measures:

1. Reinforced concrete with steel frames
2. Flexible foundation absorb seismic energy.
3. Lightweight roofing & walls to reduce collapse.

2. Non-Structural measures:

1. Strong building codes & enforcement
2. Proper land-use planning

3. Mitigation:

1. Early Warning Sign can be adopted.
2. There should be public awareness drills.
3. Emergency services
4. Community Resilience.

Earthquake can not be prevented but their impact can be minimized through scientific monitoring, earthquake resistant construction, Strict building codes etc. Countries like Japan and Chile stand as successful models.

4

A Balanced Diet is the intake of food that provides all nutrients - carbohydrates, proteins, fats ~~and~~, vitamin, minerals, fibre and water. It is essential because it supports growth and development, maintains immunity, organ function and prevents malnutrition.

Macronutrients	Function	Sources
Carbohydrates	Primary energy sources	Rice, wheat.
Proteins	Growth, repair, enzymes	meat, eggs
Fats & Oils	Concentrated energy	Nuts, fish
Water	Biochemical reaction	water, fruits
Micronutrients	Function	Sources
Vitamins	Metabolism, immunity	Fruits, vegetable
Minerals	Bone, nerve, teeth	Milk, Salt
Fibre	Digestion	Vegetable, grains

Balanced Diet and Prevention of Chronic Diseases:

- ① Obesity / Diabetes: Balanced intake of carbs/fats prevent insulin resistance.
- ② Cardiovascular Disease: Healthy fats and fibre reduce Cholesterol and Blood pressure.
- ③ Osteoporosis & Anemia: Adequate calcium, vit D and iron strengthen bone.
- ④ Cancer: Antioxidants (vit A, E, C) protect against oxidative damage.

d/ Water Pollution:

Water Pollution is contamination of water bodies by harmful substances that degrade water quality and make it unsafe for human use, aquatic life and environment.

Main Source of Water Pollution:

Source	Example	Pollutant
Industrial Waste	Factories, chemical plants	Heavy metal, toxin
Agriculture Runoff	Fertilizers, pesticide	Nitrates
Domestic Sewage	Household wastewater	microbes
Oil Spills	Shipping accidents	Crude oil
Thermal Pollution	Power Plants	Hot water
Plastic waste	garbage	Microplastics

Effects:

- ① Human Health:
- ① Water borne diseases (Cholera)
 - ② Heavy metal cause kidney damage
 - ③ Nitrate contaminated causes Blue-baby syndrome

② Environment:

- ① Aquatic life: oxygen depletion kills fish
- ② Biodiversity loss
- ③ Eutrophication

Prevention & Control Measures:

Level

Strategies

Government → Strict enforcement of environmental laws.
industrial regulation.

Community → Waste segregation, awareness campaign
Individual → Reduce plastic use

Technology → Sewage treatment plant, Rain water
harvesting

Water Pollution is a global challenge with direct consequences for human health, food security and ecosystems. Through policy measures, community action and sustainable practice we can protect water resources and ensure cleaner, healthier environment.