

Cell: The Unit of Life — Assignment 2

Class 11 Biology · Higher-difficulty challenge set + integrated problems · Answer key included · Narayan Gurukul Academy

Instructions: (1) Attempt all questions; start with the topic-wise challenge set, then attempt the integrated (multi-topic) problems.
(2) Give all answers with correct SI units. $g = 10 \text{ m/s}^2$ unless stated.
(3) A final answer key is provided at the end — try the full set before checking it.

Part A — Topic-wise challenge questions

Cell Theory

1. State two postulates of the cell theory.
2. Why is the cell called the structural and functional unit of life?
3. Describe the exceptions to the cell theory.

Prokaryotic vs Eukaryotic Cells

1. Distinguish between prokaryotic and eukaryotic cells.
2. Why are prokaryotes considered primitive?
3. Compare prokaryotic and eukaryotic cells in a table.

Prokaryotic Cell — Detailed Structure

1. Describe the cell envelope of a prokaryote.
2. What are plasmids?
3. Describe the structure of a prokaryotic cell.

Cell Wall and Plasma Membrane

1. State two functions of the cell wall.
2. State two functions of the plasma membrane.
3. Describe the structure of the plasma membrane (fluid mosaic model).

Eukaryotic Cell Organelles

1. State two functions of mitochondria.
2. Distinguish between rough and smooth endoplasmic reticulum.
3. Explain the functions of any four cell organelles.

The Nucleus

1. Describe the structure of the nuclear envelope.
2. State two functions of the nucleus.
3. Explain the functions of the nucleus and nucleolus.

Part B — Integrated problems (multi-topic)

1. State the cell theory and explain the contribution of Virchow to it.
2. Compare prokaryotic and eukaryotic cells on at least four points.
3. Describe the structure of a bacterial cell, naming its main components and their functions.
4. Explain the fluid mosaic model of the plasma membrane.
5. Describe the structure and functions of mitochondria and lysosomes.
6. Describe the structure of the nucleus and the functions of its parts.

Answer Key

Cell Theory

All living organisms are composed of cells, and the cell is the basic structural and functional unit of life. The cell is the structural and functional unit of life because all life activities occur within it. Exceptions: viruses (acellular), and mature sieve tubes and red blood cells (which lack a nucleus).

Prokaryotic vs Eukaryotic Cells

Prokaryotes lack a true nucleus and membrane-bound organelles, have 70S ribosomes and a single circular DNA; eukaryotes have a true nucleus, membrane-bound organelles and 80S ribosomes. Prokaryotes are considered primitive because they lack a nuclear membrane and membranous organelles and are the earliest forms of life. Tabular comparison: nucleus — absent vs true nucleus; organelles — absent vs present; ribosomes — 70S vs 80S; DNA — circular vs linear; size — smaller (1–10 μm) vs larger (10–100 μm).

Prokaryotic Cell — Detailed Structure

The cell envelope has a glycocalyx/capsule (outermost), a cell wall and a plasma membrane. Plasmids are small circular extra-chromosomal DNA molecules that carry accessory genes. A prokaryotic cell has a cell envelope, cytoplasm, a naked circular DNA (nucleoid), 70S ribosomes, mesosomes, and may have flagella, pili and fimbriae.

Cell Wall and Plasma Membrane

Two functions of the cell wall: gives shape and rigidity and protects the cell. Two functions of the plasma membrane: selective permeability and transport of substances. The fluid mosaic model (Singer and Nicolson): a lipid bilayer with proteins embedded in or spanning it — the lipids give fluidity and the proteins carry out transport and signalling.

Eukaryotic Cell Organelles

Mitochondria: the powerhouse of the cell; they carry out aerobic respiration and produce ATP, and have their own DNA and 70S ribosomes. Rough ER (with ribosomes) makes proteins; smooth ER (without ribosomes) makes lipids. Functions of four organelles: mitochondria (ATP), ribosomes (protein synthesis), lysosomes (intracellular digestion), Golgi apparatus (packaging and secretion).

The Nucleus

The nuclear envelope is a double membrane with nuclear pores. Two functions of the nucleus: it stores the genetic material (DNA) and controls cell activities. The nucleus has a double-membraned envelope with pores, nucleoplasm, chromatin (DNA + proteins) and a nucleolus; the nucleolus is the site of ribosome synthesis and the pores allow exchange of materials with the cytoplasm.

Integrated problems

1: All organisms are made of cells; the cell is the basic unit; Virchow added 'omnis cellula-e cellula'. 2: Nucleus (absent vs present), organelles (absent vs present), ribosomes (70S vs 80S), DNA (circular vs linear). 3: Cell envelope, nucleoid, 70S ribosomes, mesosomes, flagella/pili. 4: Lipid bilayer + embedded proteins; fluid because of moving lipids, mosaic because of scattered proteins. 5: Mitochondria — double membrane, cristae, ATP production; lysosomes — single membrane, hydrolytic enzymes, intracellular digestion. 6: Nuclear envelope (pores), nucleoplasm, chromatin and nucleolus; nucleolus synthesises ribosomes.