

# Cell Biology & Biochemistry



## Cell Biology & Biochemistry

Challenging concepts are presented clearly and in a manner accessible even to those with limited background in chemistry. Cell Biology & Biochemistry covers the structure, function, and study of cells and their components and is an ideal support volume for a wide range of biology courses.

### Suitability:

- Grades 10-12
- Community College

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*Biozone's unique formula encourages self direction, while dovetailing with traditional resources.*

## Chapters

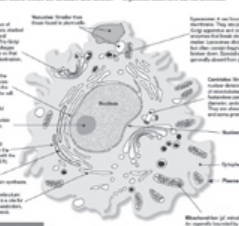
- Molecules of Life
- Cell Structure
- Cell Membranes & Transport
- Cellular Energetics
- Processes in the Nucleus

## Features

- **Introduction to the topic:**  
A concise introduction to the concepts in the activity.
- **Easy to understand diagrams:**  
Highly visual, clearly annotated diagrams improve the accessibility of information.
- **Consolidation and branching out:**  
Activities provide information to consolidate basic knowledge, while allowing scope for exploring. Differential instruction becomes easier and students at all levels are encouraged to be 'thinkers'.
- **Write-on format:**  
Activities provide information to consolidate basic knowledge, while allowing scope for exploring.
- **Tear-out pages:**  
Each page has a perforation to allow easy removal for marking, or placement in a ring binder.
- **Activity Code:**  
Each activity is coded to identify the skills required for its completion.

**42 Animal Cells**

Animal cells, unlike plant cells, do not have a rigid outer cell wall. Most animal cells lack a large central vacuole. The organelles within the cell are more numerous and smaller than those in plant cells. The organelles within the cell are more numerous and smaller than those in plant cells.



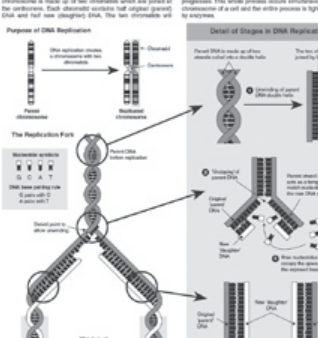
**Generalized Animal Cell**

- The two photographs both show several types of animal cells. Identify the features indicated by the letters A-D.
- White blood cells are white, phagocytic cells, whereas red blood cells are smaller than white blood cells and, in humans, lack a nucleus.
- Do you respect to the features that you can see, explain how you identify your decision.

Code: RA 2

**81 DNA Replication**

Cells carry out the process of DNA replication (DNA synthesis) prior to cell division (mitosis and meiosis). This process ensures that each daughter cell receives a complete set of genetic information. The process involves the synthesis of two new DNA molecules from one parent DNA molecule.



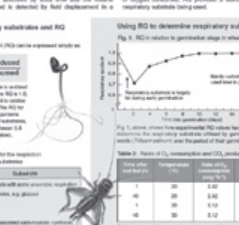
**Processes in the Nucleus**

- State the purpose of DNA replication.
- Summarize the three main steps involved in DNA replication.
- For a cell with 22 chromosomes, state how many chromatids would exist following DNA replication.

Code: A 2

**71 Measuring Respiration**

In small animals or germinating seeds, the rate of cellular respiration can be measured using a respirometer. The respirometer measures the volume of oxygen consumed and carbon dioxide produced during cellular respiration.



**Using RO to determine respiratory substrate**

Table 1: RO values for the respiration of various substrates

Substrate	CO <sub>2</sub> produced (vol)	O <sub>2</sub> consumed (vol)	RO
1.0 Carbohydrate with equal amounts of glucose and fructose	1.00	1.00	1.00
1.0 Protein	0.80	1.00	0.80
1.0 Fat	0.70	1.00	0.70
1.0 Carbohydrate with equal amounts of glucose and fructose	1.00	1.00	1.00
1.0 Protein	0.80	1.00	0.80
1.0 Fat	0.70	1.00	0.70

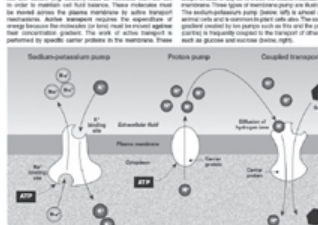
Table 2: Rates of O<sub>2</sub> consumption and CO<sub>2</sub> production in a small animal

Time (min)	O <sub>2</sub> consumed (vol)	CO <sub>2</sub> produced (vol)	RO
0	0.00	0.00	-
5	0.10	0.10	1.00
10	0.20	0.20	1.00
15	0.30	0.30	1.00
20	0.40	0.40	1.00
25	0.50	0.50	1.00
30	0.60	0.60	1.00

Code: DA 2

**Ion Pumps**

Cells cannot supply the cells with the energy required for the transport of ions across the cell membrane. The transport of ions across the cell membrane is an active process that requires energy.



**Cell Membrane and Transport**

- The sodium-potassium pump plays an important role in the active transport of ions. In terms of osmosis, explain the consequences of the sodium-potassium pump not working.
- Explain how the transport of molecules such as sucrose can be coupled to the activity of an ion exchange pump.
- Explain why the ATP is required for membrane pump systems to operate.
- Name a type of cell that relies on coupled transport to perform its function.

Code: A 2

# Cell Biology & Biochemistry

## Content Overview

### MOLECULES OF LIFE

The Biochemical Nature of the Cell  
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 Nucleic Acids  
 Amino Acids  
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 Biochemical Tests  
 Enzymes  
 Enzyme Reaction Rates  
 Enzyme Cofactors and Inhibitors

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### CELLULAR ENERGETICS

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### PROCESSES IN THE NUCLEUS

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 DNA Replication  
 Cell Division  
 Mitosis and the Cell Cycle  
 Root Cell Development  
 Differentiation of Human Cells  
 Meiosis  
 The Genetic Code

10 **The Biochemical Nature of the Cell**

The molecules that make up living things can be grouped into the classes: water, carbohydrates, acids, proteins, and nucleic acids. Water is the most abundant of organic molecules and provides an environment in which metabolic reactions can occur. Water molecules attract each other, forming large networks of hydrogen bonds. It is this feature that gives water many of its unique properties, including its low viscosity and its chemical behaviour as a universal solvent, apart from water, most other substances in cells are composed of carbon, hydrogen, oxygen and nitrogen. The combination of carbon atoms with the groups of other elements provides a huge variety of molecular structures. These are described on the following pages.

**Important Properties of Water**

Water is a liquid at room temperature and very hard to compress. It is this feature that gives water many of its unique properties, including its low viscosity and its chemical behaviour as a universal solvent, apart from water, most other substances in cells are composed of carbon, hydrogen, oxygen and nitrogen. The combination of carbon atoms with the groups of other elements provides a huge variety of molecular structures. These are described on the following pages.

**Carbohydrates form the structural components of cells. They are important in energy storage and are used in the synthesis of cell receptors.**

**Proteins are the structural (e.g. collagen), catalytic (enzymes), and the most abundant of organic molecules. They are important in energy storage and are used in the synthesis of cell receptors.**

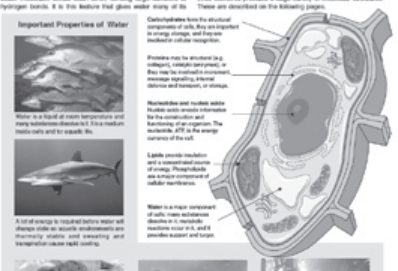
**Nucleic acids and nucleic acids form the structural components of cells. They are important in energy storage and are used in the synthesis of cell receptors.**

**Lipids provide insulation and a waterproof barrier to water. They are important in energy storage and are used in the synthesis of cell receptors.**

**Water is a major component of cells. It is important in energy storage and is used in the synthesis of cell receptors.**

**Water has a high surface tension and can move through narrow tubes.**

**Water is important, with a high percentage of water in cells, in the synthesis of cell receptors.**



1. Explain the biological significance of each of the following physical properties of water:

- Low viscosity:
- Colourless and transparent:
- Universal solvent:
- Ice is less dense than water:

2. Identify the biologically important role of each of the following molecules:

- Carbohydrate:
- Protein:
- Nucleic acids:

Code: A 1

11 **Plant Cell Specialisation**

Plants show a wide variety of cell types. The vegetative part of a plant consists of three organs: stems, leaves, and roots. Flowers, fruits, and seeds contain reproductive organs that are concerned with reproduction. The eight cell types illustrated below are representative of those present in a plant.

**Epidermal cells:** They are the outermost cells of the plant. They are thin and flat, and they form a protective barrier against the environment.

**Palisade cells:** They are the main photosynthetic cells of the leaf. They are columnar and contain many chloroplasts.

**Sieve tube elements:** They are part of the phloem tissue and are responsible for the transport of organic nutrients.

**Phloem parenchyma cells:** They are part of the phloem tissue and are involved in the storage and transport of nutrients.

**Tracheids:** They are part of the xylem tissue and are responsible for the transport of water and minerals.

**Vessel elements:** They are part of the xylem tissue and are responsible for the transport of water and minerals.

**Root hair cells:** They are specialised for the absorption of water and minerals from the soil.

**Guard cells:** They are specialised for the regulation of the opening and closing of stomata.

1. Using the information given above, describe the specialised features and role of each of the cell types (a)-(h) below:

- Guard cell: Features: Curved, kidney-shaped cell, unevenly thickened.  
 Role in plant: Target changes after the cell shape to open or close the stomata.
- Palisade cell: Features: Columnar, elongated cell, many chloroplasts.  
 Role in plant: Photosynthesis.
- Phloem parenchyma cell: Features: Thin-walled, rectangular cells.  
 Role in plant: Storage and transport of nutrients.
- Vessel element: Features: Long, narrow, tapered cells with thickened corners.  
 Role in plant: Transport of water and minerals.
- Sieve tube cell: Features: Thin-walled, rectangular cells with sieve plates.  
 Role in plant: Transport of organic nutrients.
- Root hair cell: Features: Long, thin, hair-like projections.  
 Role in plant: Absorption of water and minerals.

Code: RA 2

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