

# SMART SYLLABUS NOTES

ALP

9<sup>th</sup> Biology

(MCQs + Short Questions)



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## Chapter:01

**Choose the correct options;**

1.Which branch of biology focuses on the study of the structure and function of cell?

- a)**Cytology**                      b)Microbiology                      c)Histology                      d)Ecology

2.The study of the processes of hereditary and variation in living organisms is known as;

- a)Ecology                      b)**Genetics**                      c)Anatomy                      d)Embryology

3.Insulin made through bacteria is example of the technique of;

- a)Parasitology                      b)**Biotechnology**                      c)Biochemistry                      d)Histology

4.Heart pumps blood ,stomach digests food and kidneys excrete wastes.The statement comes from;

- a)**Physiology**                      b)Anatomy                      c)Morphology                      d)Histology

5.Which branch of biology involves the study of the classification of organisms?

- a)**Taxonomy**                      b)Physiology                      c)Palaeontology                      d)Biogeography

6.Which step comes between making hypothesis and doing experiments?

- a)**Making deductions**                      b)Making observations                      c)Summarizing results                      d)Analysing data

7.Which of the following is not a characteristic of the scientific method?

- a)It relies on evidence                      b)It involves formulating hypothesis  
c)**Hypothesis will always be correct**                      d)It requires rigorous testing

8.Choose the correct sequence of steps of scientific method?

- a)**Observations-hypothesis-deduction-experiments**                      b)Observations-hypothesis-law-theory  
c)Hypothesis-observations-deduction-experiments                      d)Law-theory-deduction-observations

**Write short Answers;**

**1.Define the following branches of biology.**

**Genetics,Anatomy,Palaeontology,Marine Biology,Pathology.**

**Genetics;**

Genetics is the branch of biology that deals with the study of transfer of characteristics from parents to offsprings.

**Anatomy;**

Anatomy is the branch of biology that explores the internal physical structure of organisms,particularly humans.e.g;the study of organs of the digestive system.

### **Palaeontology;**

Palaeontology is the branch of biology that deals with the study of fossils. For example, dinosaur fossils provide the evidence of giant reptiles on the earth million years ago.

### **Marine biology;**

Marine biology is the branch of biology that deals with the study of life in oceans. For example, coral reefs support a wide variety of marine life.

### **Pathology;**

Pathology is the study of diseases, their causes and effects. Pathology helps in disease diagnosis, prevention and treatment.

**2. Which branch of biology involves the study of the development of organisms from fertilization to birth or hatching?**

**Ans;**

The branch of biology that studies the development of organisms from fertilization to birth or hatching is called Embryology.

**3. Differentiate between morphology and physiology**

| <b>Morphology</b>                                                              | <b>Physiology</b>                                                                              |
|--------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------|
| Morphology is the study of the form and structure of organisms.                | Physiology is the branch of biology that deals with the functioning of body parts.             |
| Morphology studies the outward appearance such as shape, colour, pattern, etc. | For example, how the blood circulatory system transports vital substances throughout the body. |

**4. What is the role of observation and experimentation in the scientific method?**

#### **Observation:**

It involves carefully noticing and recording facts or events in nature. Observations help scientists **identify problems, ask questions, and form hypotheses.**

#### **Experimentation:**

It is the process of **testing hypotheses under controlled conditions** to verify their validity. Experiments provide **evidence to support or refute a hypothesis.**

## **Chapter:02**

**Choose the correct options;**

1. Which of the following taxonomic ranks represents the broadest rank?

- a) Species                      b) Genus                      c) Kingdom                      d) Domain

2. Which characteristic is unique to organisms in the domain Archaea?

- a) Cell walls made of peptidoglycan                      b) Presence of a nucleus  
c) Ability to live in extreme environment                      d) Lack of ribosomes

### 3.What are the shortcomings of the three-kingdom classification system?

The basic shortcomings of the three kingdom classification system are:

- It grouped unrelated organisms together.
- It did not separate fungi from plants.
- It also failed to distinguish prokaryotes from eukaryotes.

### 4.Which kingdom includes organisms that are multicellular and heterotrophic and lack cell walls?

Ans:

The kingdom that includes organisms that are **multicellular, heterotrophic, and lack a cell wall** is **Kingdom Animalia**.

### 5.Enlist the distinguishing characteristics of fungi?

Ans:

Here are the main distinguishing characteristics of fungi in bullet points:

- **Eukaryotic cells** (with a defined nucleus).
- **Cell wall made of chitin** (not cellulose).
- **Heterotrophic nutrition** (absorbing nutrients from external sources).
- Reproduce through **spores** (both sexually and asexually).
- **Non-motile** (cannot move).

### 6.List the three domains that encompass all living organisms?

The three main domains that encompass all living organisms are:

1. Bacteria
2. Archaea
3. Eukarya

### 7.Why cannot we classify viruses in any kingdom?

Ans:

Viruses cannot be classified in any kingdom because:

- They lack a **cellular structure** (not made of cells).
- They do not have **metabolism** or the ability to grow on their own.
- They cannot **reproduce independently** and require a host cell for replication.
- They are considered **non-living** outside a host organism.

### 8.How does binomial nomenclature facilitate clear communication about organisms across different languages?

Ans:

Binomial nomenclature helps clear communication by giving each species a unique two-part name in Latin or Greek. This prevents confusion from different local names and makes it easy for scientists around the world to identify and talk about organisms.

3. Which of these statements is NOT related to bacteria?

- a) Do not have a nucleus  
b) Cell wall made of peptidoglycan  
c) Most are heterotrophs  
d) **Have chlorophyll in their chloroplast**

4. Which of these organisms belong to the domain Eukarya?

- a) Escherichia coli  
b) **Yeast**  
c) Coronavirus  
d) None of these

5. Which of the following is a key characteristic that distinguishes eukaryotic cells from prokaryotic cells?

- a) Lack of a cell wall  
b) **Presence of a nucleus**  
c) Absence of ribosomes  
d) Smaller size

6. Which kingdom includes organisms that are primarily unicellular, eukaryotic and often heterotrophic?

- a) Archaea  
b) **Protista**  
c) Fungi  
d) Plantae

7. Why are fungi included in heterotrophic organisms?

- a) Have chitin in cell wall  
b) Absorb nutrients  
c) Reproduce by spores  
d) **Cannot prepare food**

## **B. Write down short Answers;**

1. What are the seven taxonomic ranks used in the Linnaean system?

The seven taxonomic ranks used in the Linnaean system are:

1. Kingdom
2. Phylum
3. Class
4. Order
5. Family
6. Genus
7. Species

2. What are the basic differences between archaea and bacteria?

| Archaea                                                | Bacteria                                |
|--------------------------------------------------------|-----------------------------------------|
| Cell wall lacks peptidoglycan                          | Cell wall contains peptidoglycan        |
| Membrane lipids are ether-linked                       | Membrane lipids are ester-linked        |
| Live in extreme environments (hot springs, salt lakes) | Found in a wide range of environments   |
| Genes and enzymes similar to eukaryotes                | Genes and enzymes unique to bacteria    |
| Not affected by most antibiotics                       | Often sensitive to antibiotics          |
| Ribosomes resemble those of eukaryotes                 | Ribosomes are different from eukaryotes |

## Chapter:03

Choose the correct options;

1.The process of cellular respiration occurs in;

- a)Nucleus                      **b)Mitochondria**                      c)Ribosomes                      d)Golgi apparatus

2.The smooth endoplasmic reticulum (SER) is primarily involved in the synthesis of;

- a)Proteins                      **b)Lipids**                      c)Carbohydrates                      d)Nucleic acids

3.Ribosomes are composed of ;

- a)RNA and proteins**                      b)DNA and proteins  
c)Carbohydrates and lipids                      d)RNA and carbohydrates

4.Which cell organelle is involved in packaging and modifying proteins?

- a)Nucleus                      b)Mitochondria                      **c)Golgi apparatus**                      d)Endoplasmic reticulum

5.Which cell organelle is responsible for breaking down waste materials?

- a)Golgi apparatus                      b)Nucleus                      c)Mitochondria                      **d)Lysosome**

6.Which of following cell structure is involved in maintaining cell shape?

- a)Cytoskeleton**                      b)Centrioles                      c)Nucleus                      d)Lysosome

7.Which specialized region of the nucleus is responsible for ribosome assembly?

- a)Nucleoplasm                      **b)Nucleolus**                      c)Chromatin                      d)Chromosome

8.Which is the main function of the nuclear pores?

- a)Regulation of cell division                      b)Protein synthesis  
c)Control of pH of the cell                      **d)Control of transport of molecules**

9.Which of the following cellular structures is found in animal cells and helps in cell division?

- a)Cell membrane                      **b)Centriole**                      c)Plasmodesma                      d)Vacuole

10.In a multicellular plant,which cell type is responsible for the production of glucose ?

- a)xylem                      b)phloem                      c)epidermal                      **d)mesophyll**

11.Which organelle can double its number by itself?

- a)Ribosomes                      b)Lysosomes                      **c)Mitochondria**                      d)Golgi apparatus

## 7. Why are the cristae important for cellular respiration?

Ans:

The cristae are the folds inside the mitochondria.

They are important because:

- They **increase the surface area** inside the mitochondria.
- This allows **more space** for enzymes and proteins that carry out the steps of **cellular respiration**.
- As a result, the cell can **produce more ATP (energy)** efficiently.

## 8. How are chromatin and chromosomes related?

Ans:

Chromatin and chromosomes are two forms of the same material (DNA + proteins):

- **Chromatin** → DNA is loose and uncoiled, found in the nucleus when the cell is **not dividing**.
- **Chromosomes** → DNA becomes tightly coiled and condensed into visible structures when the cell is **dividing**.

## 9. What do mesophyll cells do in plant leaves?

Ans:

Mesophyll cells in plant leaves are mainly responsible for **photosynthesis**.

- They contain many **chloroplasts** that capture sunlight.
- They make **food (glucose)** for the plant using carbon dioxide, water, and sunlight.

## 10. How would you define a stem cell?

Ans:

A **stem cell** is an unspecialized cell that can divide and develop into different types of specialized cells in the body.

Stem cells present in skin, liver and bone marrow etc.

## 11. Name the chemical compounds that make up:

a. Cell membrane

b. Fungal cell wall

c. Plant cell wall

d. Bacterial cell wall

12. Ribosomes

f. Chromosomes

- |                        |   |                                                                |
|------------------------|---|----------------------------------------------------------------|
| a. Cell membrane       | → | Phospholipids and proteins (also cholesterol in animal cells). |
| b. Fungal cell wall    | → | Chitin.                                                        |
| c. Plant cell wall     | → | Cellulose.                                                     |
| d. Bacterial cell wall | → | Peptidoglycan                                                  |
| e. Ribosomes           | → | RNA and proteins.                                              |
| f. Chromosomes         | → | DNA and proteins (histones).                                   |

## Chapter:04

**Choose the correct options:**

1. In which phase of cell cycle, maximum growth occurs in cell?

- a) M phase                      b) S phase                      c) **G1 phase**                      d) G2 phase

2. In which phase of cell cycle, the chromosomes duplicate?

- a) Mitosis                      b) G1 phase                      c) G2 phase                      d) **S phase**

3. At which stage of mitosis chromosomes line in the centre?

- a) Prophase                      b) **Metaphase**                      c) Anaphase                      d) Telophase

4. If you observe a cell in which nuclear membrane is reforming around two sets of chromosomes, what stage of cell cycle is this?

- a) Anaphase                      b) **Telophase**                      c) Prophase                      d) Metaphase

5. How does the centrosome contribute to mitosis?

- a) Initiates DNA replication                      b) **Makes mitotic spindle**  
c) Forms the nuclear envelope                      d) Duplicates organelles

6. Centrosomes make mitotic spindle in;

- a) **Animal cells**                      b) Plant cells                      c) Prokaryotic cells                      d) All of these

7. Which event is unique to meiosis but not mitosis?

- a) DNA replication                      b) Chromosome alignment                      c) **Crossing over**                      d) Nuclear division

8. Why is meiosis-2 necessary after meiosis-1?

- a) To replicate chromosomes                      b) To reduce chromosome number  
c) **To separate sister chromatids**                      d) To ensure genetic recombination

**B. Write short answers;**

**1. Enlist the events that occur during the G1 phase of interphase?**

Ans:

- Cell grows in size
- Makes proteins and enzymes
- Some organelles start to double
- Prepares materials for DNA copying
- Uses energy and nutrients actively

## B. Write down short answers;

### 1. What are the main functions of cell membrane?

#### Main functions of cell membrane:

1. Controls entry and exit of substances.
2. Protects the cell.
3. Helps in communication and recognition.
4. Maintains cell shape and support.

### 2. What key role does the Golgi apparatus play in eukaryotic cells?

Ans;

The **Golgi apparatus** plays a key role in **modifying, packaging, and transporting proteins and lipids** made in the cell to their proper destinations (inside or outside the cell).

### 3. How do lysosomes contribute to the cell's functioning?

Ans:

Lysosomes are the **digestive system of the cell**. They contain enzymes that **break down waste materials, old cell parts, and harmful substances**, keeping the cell clean and healthy.

### 4. What is the smooth endoplasmic reticulum responsible for?

Ans:

The **smooth endoplasmic reticulum (SER)** is responsible for:

- It is involved in lipid metabolism.
- It works for detoxification of harmful chemicals that enter the cell.
- It is also involved in transport of chemicals.
- In muscle cells, the SER is also involved in contraction process.

### 5. How do the vacuoles in plant cells differ from vacuoles in animal cells?

Ans:

In **plant cells**, vacuoles are:

- Very **large** (often one central vacuole).
- Store water, minerals, and waste.
- Help maintain **shape** and support (turgor pressure).

### 6. What could happen if lysosomal enzymes stop working properly?

If **lysosomal enzymes** stop working properly:

- Wastes and damaged cell parts will **not be broken down**.
- Harmful substances can **build up inside the cell**.
- The cell may become **sick or die** because of the waste accumulation.
- It can also lead to **diseases**, such as storage disorders.

#### 4.What is the function of palisade mesophyll in the leaf?

Ans:

It is located just beneath the upper epidermis.It consists of tightly packed elongated cells.

#### Function:

Palisade mesophyll absorbs sunlight and makes food for the plant.

#### 5.What is homeostasis,and why is it important for organisms?

Ans:

**Homeostasis** is the process by which organisms keep their **internal environment stable** (like temperature, water, and pH) even when the outside environment changes.

#### Importance:

It is important because it allows cells and organs to work properly and keeps the organism alive.

#### 6.Differentiate between the following

##### a) Tissue and organ

| Tissue                                                                      | Organ                                                                                 |
|-----------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| A group of similar cells that work together to perform a specific function. | A structure made of different tissues working together to perform a complex function. |
| Example: Muscle tissue, nervous tissue.                                     | Example: Heart, lungs, kidney.                                                        |

##### b)Root system and shoot system

| Root System                                                                      | Shoot System                                                                                           |
|----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|
| It is Found <b>below the ground</b> .                                            | It is Found <b>above the ground</b> .                                                                  |
| It Includes <b>roots</b> .                                                       | It Includes <b>stem, leaves, flowers, and fruits</b> .                                                 |
| <b>It Anchors</b> the plant and absorbs <b>water and minerals</b> from the soil. | <b>It Supports</b> the plant, makes <b>food by photosynthesis</b> , and helps in <b>reproduction</b> . |

##### c)Epidermal and mesophyll tissue

| Epidermal Tissue                                                         | Mesophyll Tissue                                                                |
|--------------------------------------------------------------------------|---------------------------------------------------------------------------------|
| Outer protective layer of the leaf.                                      | Inner tissue of the leaf between upper and lower epidermis.                     |
| Protects the leaf and reduces water loss (has stomata for gas exchange). | Performs photosynthesis (contains palisade and spongy cells with chloroplasts). |
| Usually a <b>single layer of cells</b> .                                 | Made of <b>many cells</b> (palisade + spongy mesophyll).                        |

## 2.What is the main purpose of the S phase in the cell cycle?

Ans:

- To **synthesize (copy) DNA**, so that each new cell will have a complete set of chromosomes after cell division.

## 3.During which phase of mitosis sister chromatids separate?

Ans:

Sister chromatids separate during the Anaphase of mitosis.

## 4.How does crossing over contribute to genetic variation in meiosis?

Ans:

Crossing over contributes to genetic variation in meiosis by exchanging genetic material between non-sister chromatids of homologous chromosomes during **prophase I** of meiosis. This creates new combinations of genes that are different from both parents.

## 5.What is the role of spindle fibres in mitosis?

**Role of spindle fibres in mitosis:**

- Spindle fibres help in the movement and separation of chromosomes during mitosis.
- They attach to the centromeres of chromosomes.
- During **metaphase**, they align chromosomes at the cell's equator.
- In **anaphase**, they **pull sister chromatids apart** to opposite poles of the cell.
- This ensures that **each new cell** gets the correct number of chromosomes.

## 6.How is cytokinesis in animal cell different from plant cell?

Ans:

- In **animal cells**, cytokinesis occurs by the formation of a **cleavage furrow**. The cell membrane **pinches inward** at the center due to the action of proteins like **actin and myosin**, eventually splitting the cell into two daughter cells.
- In **plant cells**, cytokinesis occurs by the formation of a **cell plate**. Since plant cells have a rigid cell wall, they **cannot pinch inward**. Instead, **vesicles from the Golgi apparatus** gather in the center of the cell to form a cell plate, which gradually develops into a **new cell wall** separating the two daughter cells.

## 7.What is the difference between prophase of mitosis and prophase-1 of meiosis-1?

Ans:

- In mitosis prophase, chromosomes condense, the nuclear membrane breaks down, and spindle fibres form, but no crossing over occurs.
- In prophase I of meiosis I, along with chromosome condensation and spindle formation, homologous chromosomes pair up (called synapsis) and crossing over happens. This leads to genetic variation.

## 8.What are the key events of anaphase in mitosis?

### Key events of anaphase in mitosis:

- **Centromeres split**, separating the **sister chromatids**.
- **Spindle fibres shorten**, pulling the chromatids to **opposite poles** of the cell.
- Each chromatid is now considered an **individual chromosome**.
- The cell begins to **elongate** to prepare for division.
- Ensures that **each daughter cell** gets an **equal set of chromosomes**.

## 9.What are sister chromatids,and when do they separate in meiosis?

Ans:

**Sister chromatids** are two **identical copies** of a single chromosome that are joined together at a **centromere**. They are formed during the **S phase** of interphase when DNA is replicated.

In **meiosis**, sister chromatids **separate during Meiosis II**, specifically in the **anaphase II** stage.

## 10.How is mitosis related to the process of regeneration?

Ans:

**Mitosis is directly related to regeneration** because it allows the body to **replace lost or damaged cells** by producing new ones.

- During **regeneration**, cells divide by **mitosis** to form **identical new cells**.
- These new cells **replace injured tissues** or **re-grow lost body parts** (like in lizards or starfish).
- In humans, mitosis helps heal **cuts, wounds**, and **repair tissues** like skin and liver.

### Chapter:05

### Choose the correct options;

1.Which of the following demonstrates the levels of organization of the body,from simplest to most complex?

- a)Cell -> Organ-> Tissue-> Organelle-> Organ system
- b)Organelle-> Cell-Tissue-> Organ-> Organ system**
- c)Tissue-> Cell-> Organelle-> Organ-> Organ system
- d)Organ system-> Tissue-> Cell-> Organelle-> Organ

2.The epithelial tissue in the stomach wall is responsible for producing;

- a)Mucus
- b)Pepsinogen
- c)Hydrochloric acid
- d)All of these**

3.In the wall of stomach,which tissue also contain blood vessels and nerves?

- a)Epithelial
- b)Muscle
- c)Inner connective**
- d)Outer connective

4. In a leaf, which tissue is responsible for photosynthesis?

- a) Xylem                      **b) Mesophyll**                      c) Epidermis                      d) Phloem

5. Which of these is a function of the human skeletal system?

- a) **Storing minerals and producing blood cells**                      b) Removing carbon dioxide from blood  
c) Filtering blood to remove waste products                      d) Breaking down food for energy

6. Which structures are responsible for the transport of food in plant body?

- a) Xylem tissue                      b) Palisade mesophyll                      **c) Phloem tissue**                      d) Spongy mesophyll

7. In a plant, which of the following is the primary function of the flower?

- a) Transporting water and minerals                      b) Supporting leaf growth  
**c) Facilitating reproduction through pollination**                      d) Regulating gas exchange

**B. Write short Answers;**

**1. Enlist the levels of organization from cells to organ systems.**

Ans:

Here is the sequence of levels of organization from **cells to organ systems**:

1. **Cell** – The basic structural and functional unit of life.
2. **Tissue** – A group of similar cells that work together to perform a specific function.
3. **Organ** – A structure made up of different tissues that work together to carry out a particular function.
4. **Organ System** – A group of organs that coordinate to perform major functions of the body.

**2. What are the major roles of the epithelial tissue present in the stomach?**

Ans:

- i. The inner wall of stomach is made up of epithelial tissue.
- ii. It is glandular in nature and secretes mucus.
- iii. The mucus lines the inner wall and protects it from acid.
- iv. This tissue also secretes gastric juice that contains enzymes pepsinogen for protein digestion and hydrochloric acid for activating pepsinogen to pepsin enzyme.

**3. How do the smooth muscles contribute to the stomach's function?**

Ans:

There are three layers of smooth muscles in the stomach.

- The outer longitudinal layer
- The middle circular layer
- The inner oblique layer

These muscles contract and relax to mix food with the gastric juice.

2.What can happen if an enzyme is exposed to temperature that is higher than its optimal temperature?

a)Enzyme activity rate will increase

**b)Enzyme's shape will change,potentially reducing its activity.**

c)Enzyme will speed up the reaction and remain stable

d)Enzyme will become a substrate itself

3.Prosthetic groups are;

a)Required by all enzymes

b)Protein in nature

c)Loosely attached with enzymes

**d)Tightly bound to enzyme**

4.How does increasing temperature affect enzyme activity?

**a)Increases activity to a point**

b)Always decreases activity

c)Makes enzymes non-functional

d)No effect on enzyme

5.How does competitive inhibitor affect enzyme action?

a)Attaches with the substrate

b)Changes enzyme shape

**c)Attaches and blocks the active site**

d)Blocks the cofactors

6.An enzyme works best at a pH of 7.4.It is placed in an acidic solution with a pH of 4.0.How will this affect the enzyme?

**a)The active site will be modified, reducing substrate binding**

b)The enzyme will catalyse reactions faster due to increased H ions.

c)The enzyme will gain additional active sites

d)The substrate will become inactive in an acidic environment.

7.What is TRUE according to the induced fit model of enzyme action?

**a)Enzyme's active site changes shape to bind the substrate**

b)Substrate changes shape to bind to active site

c)No shape changes occur in active site or substrate

d)Substrate attaches the enzyme at a site other than active site.

8.What is TRUE about the optimum pH values of the following enzymes of digestive system?

**a)Pepsin works at low pH while trypsin works at high pH**

b)Both work at high pH

c)Both work at low pH

d)Pepsin works at high pH while trypsin works at low pH

7.What are the end products of anaerobic respiration in animals and yeast?

### End Products of Anaerobic Respiration

- **In Animals:**  
Glucose → **Lactic acid + Energy**
- **In Yeast (and some plants):**  
Glucose → **Ethanol + Carbon dioxide + Energy**

8.How do muscles respond to oxygen deficiency during intense exercise?

Ans:

When muscles do not get enough oxygen during intense exercise, they perform **anaerobic respiration**. Glucose is broken down into **lactic acid** to release energy so muscles can keep working. The build-up of lactic acid causes **muscle fatigue and soreness**. Later, oxygen helps convert lactic acid back into glucose.

9.List ways in which respiratory renergy is used in the body?

### Uses of Respiratory Energy in the Body

Energy from respiration is used for:

1. **Muscle movement** – running, walking, and posture.
2. **Active transport** – moving substances in and out of cells.
3. **Cell growth and repair** – for tissue maintenance.
4. **Nerve impulses** – sending signals in the body.
5. **Keeping body warm** – maintaining body temperature.

### Chapter:09

Choose the correct options;

1.Which of the following plant nutrients is required in large amount?

- a)Iron                      b)Zinc                      c)**Potassium**                      d)Boron

2.Which element is required by plants for the formation of chlorophyll ?

- a)Phosphorus                      b)Calcium                      c)**Magnesium**                      d)Sulphur

3.The primary function of root hairs is;

- a)Transport of nutrients                      b)Storage of food  
c)**Increase surface area for absorption**                      d)Synthesis of proteins

4.Water moves from the soil into root cells by;

- a)**Osmosis**                      b)Active transport                      c)Diffusion                      d)Bulk flow

5.The transpiration is regulated by;

- a)Mesophyll                      b)**Guard cells**                      c)Xylem                      d)Phloem

## Role in Cellular Metabolism

ATP provides the energy needed for all cell activities (movement, transport, growth, and synthesis).

When ATP releases energy, it becomes ADP.

During respiration, ADP is changed back into ATP.

This ATP–ADP cycle keeps all metabolic processes running in the cell.

### 3. Why is chlorophyll important for photosynthesis?

Ans:

Chlorophyll is important for photosynthesis because it **absorbs sunlight**, especially red and blue light, and converts this light energy into chemical energy. This energy is then used by the plant to make **glucose** from carbon dioxide and water. Without chlorophyll, plants cannot capture light, so photosynthesis cannot take place.

### 4. How is oxygen produced during photosynthesis?

Ans:

Oxygen is produced when **water molecules (H<sub>2</sub>O) are split** during the light reactions of photosynthesis. Sunlight provides the energy to break water into **oxygen, hydrogen ions, and electrons**. This process is called **photolysis of water**.

The **oxygen released** during this splitting comes out of the plant as a **by-product**.

### 5. Which organisms carry out photosynthesis? Which cell organelle is responsible for the absorption of light for photosynthesis?

Ans:

Photosynthesis is carried out by:

- **Green plants**
- **Algae**
- **Some bacteria** (like cyanobacteria)

These organisms contain pigments that can capture sunlight.

> The **chloroplast** is the cell organelle responsible for absorbing light for photosynthesis.

### 6. Define anaerobic and aerobic respiration.

#### Anaerobic and Aerobic Respiration

- **Aerobic Respiration:**

A type of respiration that **requires oxygen** to break down glucose and release energy.

**Equation:**  $\text{Glucose} + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O} + \text{Energy}$

- **Anaerobic Respiration:**

A type of respiration that **does not require oxygen**. Glucose is partially broken down to release energy.

**Equation in animals:**  $\text{Glucose} \rightarrow \text{Lactic acid} + \text{Energy}$

**Equation in plants/yeast:**  $\text{Glucose} \rightarrow \text{Ethanol} + \text{CO}_2 + \text{Energy}$

#### d)Palisade and spongy mesophyll

| Palisade mesophyll                                                | Spongy mesophyll                                                                        |
|-------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| It is located just beneath the upper epidermis.                   | It is present below the palisade mesophyll.                                             |
| It consists of tightly packed elongated cells.                    | It consists of loosely arranged cells with air spaces between them.                     |
| Palisade mesophyll absorbs sunlight and makes food for the plant. | The spongy mesophyll allows gases to move in the leaf and also helps in photosynthesis. |

### Chapter:06

Choose the correct options;

1.How will you differentiate between monosaccharides and polysaccharides?

- a)Monosaccharides are single sugars  
b)Polysaccharides are sweet in taste  
c)Monosaccharides are present in plant cell wall.  
d)Polysaccharides dissolve easily

2.What is true about cellulose?

- a)It is sweet in taste  
b)It is digestible by human digestive system  
c)It provides structural support in plants.  
d)It is soluble in water

3.Which of the following proteins is involved in oxygen transport?

- a)Insulin  
b)Haemoglobin  
c)Collagen  
d)Keratin

4.Which component of an amino acid determines its unique properties?

- a)Amino group  
b)Carboxyl group  
c)R group (side group)  
d)Hydrogen group

5.Which proteins are involved in defence against pathogens?

- a)Antibodies  
b)Myosin  
c)Fibronogen  
d)Haemoglobin

6.Which of the following are the units most lipids?

- a)Amino acids  
b)Fatty acids and glycerol  
c)Nucleotides  
d)Simple sugars

7.Which of the following is NOT a function of proteins?

- a)Transport oxygen in the blood  
b)Carry genetic information  
c)Help in digesting food  
d)Fight against pathogens

8.Which components make up a nucleotide?

- a)Sugar,phosphate,nitrogenous base  
b)Amino acid,sugar,nitrogenous base  
c)Fatty acid,Phosphate,nitrogenous base  
d)Protein,sugar,nitrogenous base

9. Which nitrogenous base is found in RNA but not in DNA?

a) Adenine

b) Thymine

c) Uracil

d) Guanine

**B. Write short answers;**

**1. How do the three groups of carbohydrates differ in taste?**

Ans:

1. **Monosaccharides** (like glucose and fructose) taste **very sweet**.
2. **Disaccharides** (like sucrose and lactose) are **moderately sweet**.
3. **Polysaccharides** (like starch and cellulose) are **not sweet** in taste.

**2. Name two common monosaccharides and two disaccharides.**

Ans:

**Two common monosaccharides:** Glucose and Fructose.

**Two common disaccharides:** Sucrose and Lactose.

**3. Give an example of a storage polysaccharide in plants.**

Ans:

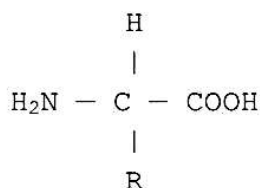
An example of a **storage polysaccharide in plants** is **starch**.

**4. Define amino acid and draw its structure.**

Amino Acid:

An **amino acid** is the basic building block of proteins. Each amino acid contains an **amino group** ( $-\text{NH}_2$ ), a **carboxyl group** ( $-\text{COOH}$ ), a **hydrogen atom**, and a **side chain (R group)** all attached to a central carbon atom.

**Structure:**



5.What are the basic components of lipids?Draw their structures.

**Basic components of lipids:**

Lipids are made up of **fatty acids** and **glycerol**.

| Glycerol Structure:                                                                                                                                                                                     | Fatty Acid Structure                                                                               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
| $\begin{array}{c} \text{H} \\   \\ \text{H} - \text{C} - \text{OH} \\   \\ \text{H} - \text{C} - \text{OH} \\   \\ \text{H} - \text{C} - \text{OH} \\   \\ \text{H} \end{array}$ <p><b>Glycerol</b></p> | $\begin{array}{c} \text{O} \\    \\ \text{R} - \text{C} - \text{OH} \end{array}$ <p>fatty acid</p> |

6.What are the types of RNA?Write their functions.

Ans:

**Types of RNA and their functions:**

- mRNA (Messenger RNA):**  
It carries the genetic information from DNA to the ribosome for protein synthesis.
- tRNA (Transfer RNA):**  
It brings amino acids to the ribosome during protein synthesis.
- rRNA (Ribosomal RNA):**  
It helps form ribosomes and takes part in assembling proteins.

7.Briefly describe the function of DNA.

**Functions of DNA:**

- DNA stores the genetic information of an organism.
- It controls all hereditary characteristics.
- It gives instructions for protein synthesis.
- It helps in cell growth and development.
- It transfers genetic information from parents to offspring.

**Chapter:07**

**Choose the correct options;**

1.Which best defines an enzyme?

a)A chemical that breaks down food

b)A hormone that regulates metabolism

c)A protein that speeds up reactions

d)A molecule that stores energy

## B. Write short answers;

### 1. Define metabolism, Differentiate between catabolism and anabolism.

#### Metabolism

**Metabolism** is the sum of all chemical reactions that occur inside the cells of a living organism to maintain life.

These reactions provide energy and build necessary molecules.

#### Differentiate Between Anabolism and Catabolism

| Anabolism                                                                    | Catabolism                                                                     |
|------------------------------------------------------------------------------|--------------------------------------------------------------------------------|
| It is the process of <b>building up</b> complex molecules from simpler ones. | It is the process of <b>breaking down</b> complex molecules into simpler ones. |
| <b>Energy is required</b> (endothermic process).                             | <b>Energy is released</b> (exothermic process).                                |
| Helps in growth, repair, and storage of energy.                              | Helps in providing energy for various activities.                              |
| Example: Formation of proteins from amino acids.                             | Example: Breakdown of glucose during respiration.                              |

### 2. Define an enzyme. What is its role in metabolism?

#### Enzyme:

An **enzyme** is a biological catalyst made of proteins that speeds up chemical reactions in living organisms without being used up in the reaction.

#### Role of Enzymes in Metabolism

Enzymes control and regulate the metabolic reactions in cells.

They **speed up both catabolic and anabolic reactions** by lowering the activation energy, helping the body to obtain energy, grow, and maintain life processes efficiently.

### 3. What is the active site of enzyme? State its importance in enzyme specificity.

#### Active site:

The **active site** is a specific region on an enzyme where the substrate (reacting molecule) binds and the chemical reaction takes place.

#### Importance in Enzyme Specificity

- The shape of the active site is **complementary to only a specific substrate**.
- Because of this unique shape, each enzyme can act on **only one type or a few specific substrates**.
- This ensures that metabolic reactions occur correctly and efficiently in the cell.

### 4. What is the effect of substrate concentration on enzyme activity?

#### Effect of Substrate Concentration on Enzyme Activity

- At **low substrate concentration**, enzyme activity is low because there are not enough substrate molecules for the enzymes to act on.
- As substrate concentration **increases**, enzyme activity **also increases** because more active sites of enzymes are occupied.

6. Which ion plays a role in the opening of stomach?

- a) Sodium( $\text{Na}^+$ )      b) Potassium( $\text{K}^+$ )      c) Calcium ( $\text{Ca}^{2+}$ )      d) Magnesium( $\text{Mg}^{2+}$ )

7. In most plants the food is transported in the form of;

- a) Glucose      b) Sucrose      c) Starch      d) Maltose

8. What is TRUE according to the pressure flow mechanism of food transport?

a) Water enters the source ,creating pressure

b) Water is pulled from the sink

c) Movement of food in phloem is due to gravity

d) Solutes move from low to high concentration

9. Succulent organs are present in;

- a) Xerophytes      b) Hydrophytes      c) Mesophytes      d) Halophytes

**B. Write short answers;**

**1. Define macronutrients and micronutrients and give examples.**

**Macronutrients:**

Nutrients needed by the body in **large amounts** to provide energy and build body structures.

**Examples:**

Carbohydrates, Proteins, Fats, Water

**Micronutrients:**

Nutrients required by the body in **small amounts** for proper growth and functioning.

**Examples:**

Vitamins (A, C, D, E, K), Minerals (Iron, Calcium, Zinc, Iodine)

**2. Define transpiration and its types.**

**Transpiration:**

Transpiration is the **loss of water in the form of vapor** from the aerial parts of plants, mainly from leaves.

**Types of Transpiration:**

1. **Cuticular Transpiration:**

Water loss through the **waxy cuticle** of leaves.

2. **Stomatal Transpiration:**

Water loss through **stomata** (tiny pores) of leaves. This is the **main type** of transpiration.

3. **Lenticular Transpiration:**

Water loss through **lenticels** (small openings) on stems and branches.

### 3.How is the transpirational pull important in plants?

#### Importance of Transpirational Pull

Transpirational pull is important because it:

1. **Moves water and minerals** from roots to leaves.
2. **Transports nutrients** to all parts of the plant.
3. **Cools the plant** through evaporation.
4. **Keeps cells firm** and supports the plant structure.

### 4.Transpiration is the loss of water from plants.Is it a harmful phenomenon?If no,what is its importance?

No, transpiration is **not harmful**; it is essential for plants.

#### Importance of Transpiration:

1. **Moves water and minerals** from roots to leaves.
2. **Transports nutrients** throughout the plant.
3. **Cools the plant** by evaporation.
4. **Maintains turgor pressure** to keep cells and plant firm.

### 5.Differentiate between;

#### a)Xylem and phloem

| <b>Xylem</b>                                                           | <b>Phloem</b>                                                                        |
|------------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| Tissue that <b>transports water and minerals</b> from roots to leaves. | Tissue that <b>transports food (sugars)</b> from leaves to other parts of the plant. |
| <b>Upward only</b>                                                     | <b>Both upward and downward</b>                                                      |

#### b)Transpiration and guttation

| <b>Transpiration</b>                                                       | <b>Guttation</b>                                                    |
|----------------------------------------------------------------------------|---------------------------------------------------------------------|
| Loss of <b>water vapor</b> from the aerial parts of plants, mainly leaves. | Loss of <b>liquid water drops</b> from the tips or edges of leaves. |
| Caused by <b>evaporation of water</b> due to sunlight.                     | Caused by <b>root pressure</b> pushing water out.                   |
| Occurs during <b>daytime</b>                                               | Occurs mostly during <b>night or early morning</b>                  |

#### c)Hydrophytes and halophytes

| <b>Hydrophytes</b>                                   | <b>Halophytes</b>                                       |
|------------------------------------------------------|---------------------------------------------------------|
| Plants that <b>live in water</b> or very wet places. | Plants that <b>live in salty soils</b> or saline water. |
| Freshwater ponds, lakes, rivers.                     | Coastal areas, salt marshes, saline deserts.            |
| Water lily, Hydrilla                                 | Salicornia, Mangrove                                    |

#### d)Hydrophytes and xerophytes

| <b>Hydrophytes</b>                                   | <b>Xerophytes</b>                                       |
|------------------------------------------------------|---------------------------------------------------------|
| Plants that <b>live in water</b> or very wet places. | Plants that <b>live in dry areas</b> with little water. |
| Ponds, lakes, rivers, marshes.                       | Deserts, dry regions, sandy soils.                      |
| Water lily, Hydrilla                                 | Cactus, Euphorbia                                       |

**vii. Male and female gametophyte**

| Male Gametophyte                                             | Female Gametophyte                                        |
|--------------------------------------------------------------|-----------------------------------------------------------|
| Haploid structure that produces male gametes (sperm/pollen). | Haploid structure that produces female gamete (egg cell). |
| Develops from microspore.                                    | Develops from megaspore.                                  |
| Pollen grain in flowering plants.                            | Embryo sac in flowering plants.                           |
| Produces sperm cells for fertilization.                      | Produces egg cell for fertilization.                      |

**viii. Calyx and corolla**

| Calyx                                                                     | Corolla                                                          |
|---------------------------------------------------------------------------|------------------------------------------------------------------|
| Outermost whorl of a flower made of sepals, protecting the flower in bud. | Second whorl of a flower made of petals, attracting pollinators. |
| Outer whorl                                                               | Inside calyx                                                     |
| Protects the flower                                                       | Attracts insects and animals for pollination                     |
| Sepals of Rose                                                            | Petals of Rose                                                   |

**ix. Stamen and carpel**

| Stamen                                          | Carpel (Pistil)                                                     |
|-------------------------------------------------|---------------------------------------------------------------------|
| Male part of a flower that produces pollen.     | Female part of a flower that contains ovules.                       |
| Anther (makes pollen) + Filament (holds anther) | Stigma (receives pollen) + Style + Ovary (contains ovules)          |
| Produces male gametes (sperm)                   | Produces female gamete (egg) and develops seeds after fertilization |
| Stamen of Sunflower                             | Carpel of Sunflower                                                 |

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5. Describe the advantages and disadvantages of vegetative propagation.

### Advantages and Disadvantages of Vegetative Propagation

| Advantages                                            | Disadvantages                                                                |
|-------------------------------------------------------|------------------------------------------------------------------------------|
| Produces <b>plants identical</b> to the parent.       | Less <b>genetic variation</b> , so plants may be more vulnerable to disease. |
| <b>Faster</b> than growing from seeds.                | Can <b>spread pests or diseases</b> from parent to offspring.                |
| Useful for <b>seedless or rare plants</b> .           | Requires <b>care and skill</b> for some methods.                             |
| Ensures <b>uniform quality</b> of fruits and flowers. | Not suitable for all plant species.                                          |

6. Name the four whorls present in a flower and also tell the component of each whorl.

### Four Whorls of a Flower and Their Components

1. **Calyx** – made of **sepals**, which protect the flower in bud stage.
2. **Corolla** – made of **petals**, which attract pollinators.
3. **Androecium** – made of **stamens** (anther + filament), the male reproductive part.
4. **Gynoecium** – made of **carpels** (stigma + style + ovary), the female reproductive part.

7. Briefly describe the formation of egg cell and polar nuclei within embryo sac of a flower.

### Formation of Egg Cell and Polar Nuclei in the Embryo Sac

1. In the ovule, a **diploid megaspore mother cell** undergoes **meiosis** to form **four haploid megaspores**, of which **one survives**.
2. The surviving megaspore undergoes **three mitotic divisions**, producing **eight haploid nuclei**.
3. **Arrangement of nuclei:**
  - **Micropylar end:** 3 nuclei → 1 **egg cell** + 2 **synergids**
  - **Chalazal end:** 3 nuclei → **antipodal cells**
  - **Center:** 2 nuclei → **polar nuclei**

8. Differentiate between;

#### i. Asexual and sexual reproduction

| Asexual Reproduction                                                            | Sexual Reproduction                                                                              |
|---------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| Reproduction that involves <b>only one parent</b> and does not involve gametes. | Reproduction that involves <b>two parents</b> and the fusion of <b>male and female gametes</b> . |
| One                                                                             | Two                                                                                              |
| Offspring are <b>genetically identical</b> to the parent.                       | Offspring are <b>genetically different</b> from parents.                                         |
| Binary fission in bacteria, budding in yeast, vegetative propagation in plants. | Fertilization in animals and flowering plants.                                                   |
| Usually <b>faster</b>                                                           | Usually <b>slower</b>                                                                            |

### e) Lenticular transpiration and stomatal transpiration

| Feature           | Stomatal Transpiration                                             | Lenticular Transpiration                                                             |
|-------------------|--------------------------------------------------------------------|--------------------------------------------------------------------------------------|
| <b>Definition</b> | Loss of water vapor through <b>stomata</b> (tiny pores) of leaves. | Loss of water vapor through <b>lenticels</b> (small openings) on stems and branches. |
| <b>Main Site</b>  | Leaves                                                             | Stems and branches                                                                   |
| <b>Time</b>       | Mostly during <b>daytime</b>                                       | Can occur <b>day and night</b>                                                       |

6. How do the plants of rubber and keekar excrete their wastes?

### Excretion in Rubber and Keekar Plants

- **Rubber Plant:**  
Excretes waste in the form of **latex**. Latex contains unwanted substances that are removed from the plant.
- **Keekar (Acacia) Plant:**  
Excretes waste through **resin** or gum, which collects harmful substances and protects the plant.

### Chapter:10

*Since 2023*

Choose the correct options;

1. Which of the following organisms commonly reproduce by binary fission?

- a) Yest                      b) **Bacteria**                      c) Rhizopus                      d) Plants

2. What is the primary method of reproduction in yeast?

- a) Binary fission                      b) Spore formation                      c) **Budding**                      d) Fragmentation

3. Which of the following statements is true about spore formation in fungi?

- a) They produce spores during sexual reproduction  
b) They produce two kinds of spores  
c) Spores can only grow into new fungi in dry environment

**d) Spores are produced to withstand harsh conditions**

5. Which plant propagates through tubers?

- a) Onion                      b) **Potato**                      c) Ginger                      d) Garlic

6. The horizontal aboveground stem, which produces leaves and roots at its nodes?

- a) **Stolon**                      b) Bulb                      c) Rhizome                      d) Corm

7. Which of these does NOT help a plant for vegetative propagation?

- a) Rhizome                      b) Corm                      c) Runner                      d) **Flower**

8. Which part of the flower is responsible for producing pollen?

- a) Stigma                      b) **Anther**                      c) Ovary                      d) Petal

9. Which structure forms the female gametophyte in flowering plants?

- a) Pollen grain                      b) Ovule                      c) Anther                      d) Sepal

10. The male gametophyte in flowering plants is known as;

- a) Pollen grain                      b) Embryo sac                      c) Ovary                      d) Carpel

11. In the life cycle of flowering plants, which structure is triploid ( $3n$ )?

- a) Egg                      b) Fusion nucleus                      c) Endosperm nucleus                      d) Sperm

12. Embryo sac is formed inside;

- a) Filament                      b) Anther                      c) Style                      d) Ovule

**B. Write short answers;**

**1. Write a short note on budding in yeast.**

### **Budding in Yeast**

Budding is a type of **asexual reproduction** in yeast. A **small bulge (bud)** forms on the parent cell, receives a **nucleus**, grows, and finally **detaches** to become a new yeast cell.

It produces **genetically identical offspring** and is a **quick way** for yeast to reproduce.

**2. Write a short note on spore formation in fungi.**

### **Spore Formation in Fungi**

Spore formation is a type of **asexual reproduction** in fungi. Fungi produce **spores** that are **light and easily dispersed** by wind or water. When spores land in a **favorable environment**, they **germinate** to form a new fungus.

It allows fungi to **reproduce quickly** and **spread widely**.

**3. Describe how vegetative propagation occurs through runners?**

### **Vegetative Propagation through Runners**

Runners are **horizontal stems** that grow along the soil. **Buds** on these runners form **new plants**, which are **genetically identical** to the parent. Once the new plant develops roots, it becomes **independent**.

**Example:** Strawberry, Grass

**4. State how potatoes reproduce through tubers.**

### **Reproduction of Potatoes through Tubers**

Potatoes reproduce **asexually** using **tubers** (swollen underground stems). Each tuber has **buds (eyes)** that grow into **new plants**, which are **genetically identical** to the parent.

This method allows potatoes to **reproduce quickly without seeds**.

## ii. Binary fission in bacteria and amoeba

| Bacteria                                                                                    | Amoeba                                                                                |
|---------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Asexual reproduction where a single bacterial cell <b>divides into two identical cells.</b> | Asexual reproduction where an amoeba <b>splits into two identical daughter cells.</b> |
| DNA <b>replicates</b> , cell <b>elongates</b> , and divides into <b>two cells.</b>          | Nucleus <b>divides by mitosis</b> , cytoplasm splits, forming <b>two cells.</b>       |
| Very <b>fast</b>                                                                            | Slower than bacteria                                                                  |
| Allows <b>rapid multiplication.</b>                                                         | Ensures <b>asexual reproduction and survival.</b>                                     |

## iii. Stolon and rhizome

| Stolon                                                                                    | Rhizome                                                                                    |
|-------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|
| A <b>horizontal stem</b> that grows above the ground and helps in vegetative propagation. | A <b>horizontal underground stem</b> that stores food and helps in vegetative propagation. |
| Above the ground                                                                          | Below the ground                                                                           |
| Produces <b>new plants at nodes</b>                                                       | Stores <b>food</b> and produces <b>new shoots</b>                                          |
| Strawberry, Grass                                                                         | Ginger, Turmeric                                                                           |

## iv. Bulb and corm

| Bulb                                                                                          | Corm                                                                                             |
|-----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| A <b>short, vertical underground stem</b> surrounded by <b>fleshy leaves</b> that store food. | A <b>short, swollen underground stem</b> without fleshy leaves, storing food in the stem itself. |
| Has <b>fleshy leaves</b> (food storage) and a small stem at the base.                         | Has a <b>thickened stem</b> with thin, papery leaves.                                            |
| Stores food and helps in <b>vegetative reproduction.</b>                                      | Stores food and helps in <b>vegetative reproduction.</b>                                         |
| Onion, Garlic                                                                                 | Gladiolus, Crocus                                                                                |

## v. Cutting and grafting

| Cutting                                                                                                                         | Grafting                                                                                                                 |
|---------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|
| A method of vegetative propagation where a <b>part of a plant (stem, root, or leaf)</b> is cut and planted to grow a new plant. | A method where a <b>part of one plant (scion)</b> is joined with another plant (stock) so they <b>grow as one plant.</b> |
| Involves <b>cutting a portion</b> and allowing it to develop roots.                                                             | Involves <b>joining scion and stock</b> carefully for growth.                                                            |
| To <b>produce new plants quickly.</b>                                                                                           | To <b>combine desirable traits</b> of two plants.                                                                        |
| Rose,                                                                                                                           | Mango                                                                                                                    |

## vi. Vegetative propagation and artificial propagation

| Vegetative Propagation                                                                        | Artificial Propagation                                                                                                |
|-----------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|
| Natural method of <b>asexual reproduction</b> in plants using <b>stems, roots, or leaves.</b> | Human-assisted method to <b>produce new plants</b> using techniques like <b>cutting, grafting, or tissue culture.</b> |
| Occurs <b>naturally</b> in plants.                                                            | Done <b>artificially by humans.</b>                                                                                   |
| Helps plants <b>reproduce quickly without seeds.</b>                                          | Helps humans <b>propagate plants with desired traits.</b>                                                             |
| Strawberry (runners), Potato (tubers)                                                         | Rose (cutting), Apple (grafting)                                                                                      |