



**Class:9th**

**Subject: Biology**

**Chapter 3: The Cell**







**Exercise MCQs:**

1. Which branch of Biology focuses on the study of the structure and function of cells?

- (a) Cytology
- (b) Ecology
- (c) Histology
- (d) Anatomy

2. The process of cellular respiration occurs in:

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



**3. The smooth endoplasmic reticulum (SER) is primarily involved in the synthesis of:**

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





**4. Ribosomes are composed of:**

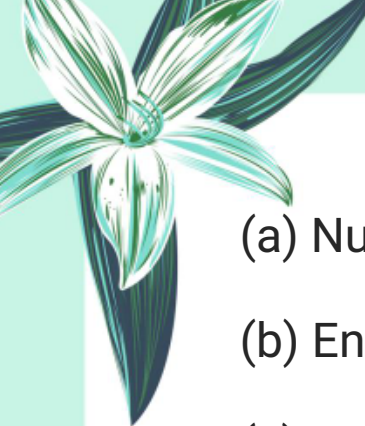

- (a) RNA and protein
- (b) DNA and protein
- (c) Carbohydrates and lipids
- (d) RNA and carbohydrates


**5. What is the primary function of ribosomes?**

- (a) Energy production
- (b) Protein synthesis
- (c) Lipid synthesis
- (d) DNA synthesis



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

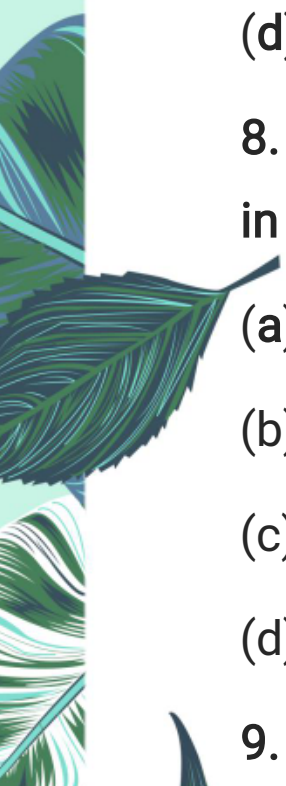
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- (a) Nucleus
  - (b) Endoplasmic reticulum
  - (c) Golgi apparatus
  - (d) Lysosome





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

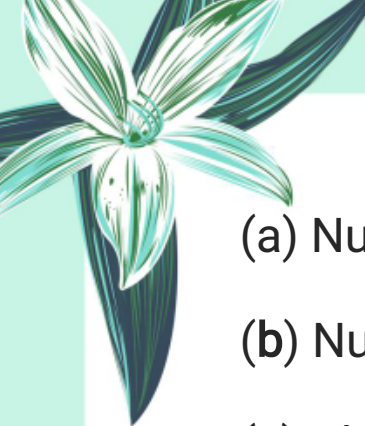


- (a) Golgi apparatus
- (b) Mitochondria
- (c) Nucleus
- (d) Lysosome

8. Which of the following cell structures is involved in maintaining cell shape?

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

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

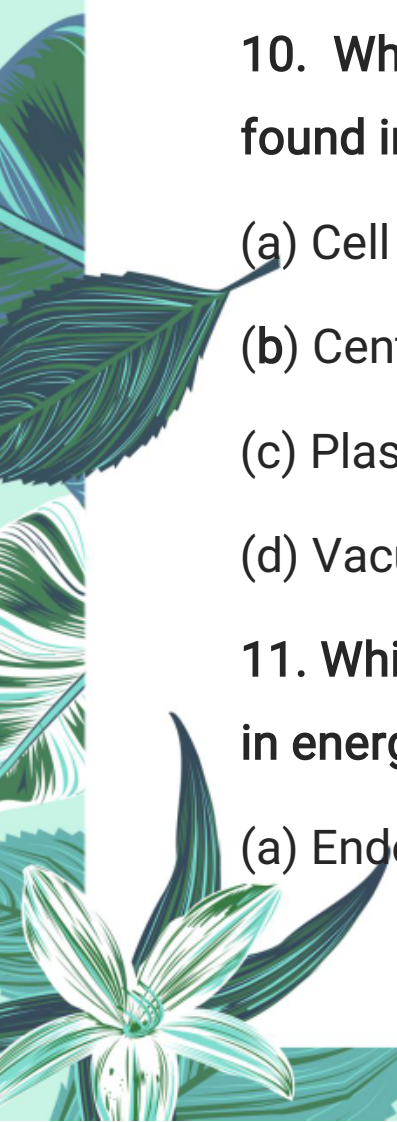


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- 
- (a) Nucleoplasm
  - (b) Nucleolus
  - (c) Chromatin
  - (d) Nuclear membrane

**10. What is the main function of the nuclear pores?**

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

**10. 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

**11. Which sub-cellular organelle plays a crucial role in energy production within the cell?**

- 
- (a) Endoplasmic reticulum



(b) Golgi apparatus

(c) Mitochondria

(d) Lysosomes

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



(a) Xylem

(b) Phloem

(c) Mesophyll

(d) Epidermal

13. Which organelle can double its number by itself?

(a) Ribosomes

(b) Lysosome

(c) Mitochondria

(d) Golgi apparatus

14. Which of these are present on the surface of rough endoplasmic reticulum?

(a) Ribosomes

(b) Lysosomes






(c) Mitochondria

(d) Vacuoles



### Important MCQs:



1. Who discovered the cell using a simple microscope in 1665?

(a) Robert Brown

(b) Robert Hooke

(c) Anton van Leeuwenhoek

(d) Schleiden

2. Which organelle is called the control center of the cell?



(a) Mitochondria

(b) Nucleus

(c) Golgi apparatus

(d) Lysosome

3. What is the function of cytoplasm?



(a) Protein synthesis





(b) Movement of chromosomes

(c) Provides medium for metabolic reactions

(d) Cell wall formation

**4. The primary component of plant cell wall is:**



(a) Peptidoglycan

(b) Chitin

(c) Cellulose

(d) Protein

**5. Which layer of plant cell wall contains calcium and magnesium pectate?**

(a) Secondary wall

(b) Primary wall

(c) Middle lamella

(d) Cytoplasm

**6. What is the function of nuclear pores?**

(a) Energy production

(b) Ribosome synthesis

(c) Exchange of materials between nucleus and





cytoplasm

(d) Chromosome formation

7. In which type of cells is the nucleus not prominent?



(a) Plant cells

(b) Animal cells

(c) Eukaryotic cells

(d) Prokaryotic cells

8. Which part of cytoskeleton helps in cell movement like crawling of white blood cells?

(a) Microtubules

(b) Intermediate filaments



(c) Microfilaments

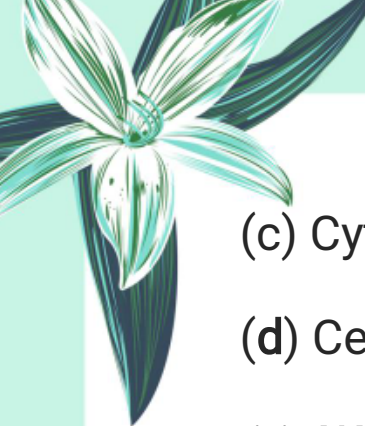
(d) Centrosome

9. The fluid-mosaic model describes the structure of:

(a) Cell wall

(b) Nucleus






(c) Cytoskeleton

(d) Cell membrane

**11. What is the main function of ribosomes?**

(a) Energy production



(b) Photosynthesis

(c) Protein synthesis

(d) Lipid metabolism

**12. Ribosomes are composed of:**

(a) DNA and proteins

(b) Lipids and RNA

(c) Proteins and rRNA

(d) Enzymes and RNA

**13. Which organelle is known as the "powerhouse" of the cell?**

(a) Chloroplast

(b) Ribosome

(c) Mitochondria

(d) Lysosome






**14. The inner folds of mitochondria are called:**

(a) Thylakoids

(b) Cristae

(c) Stroma

(d) Granum




**15. Which organelle contains its own DNA and ribosomes?**

(a) Golgi apparatus

(b) Lysosome

(c) Ribosome

(d) Mitochondria



**16. Which type of endoplasmic reticulum lacks ribosomes?**

(a) Rough ER

(b) Smooth ER

(c) Nuclear envelope

(d) Golgi body





17. Which organelle modifies and packs proteins into vesicles?

- (a) Ribosome
- (b) Mitochondria
- (c) Golgi apparatus
- (d) Lysosome

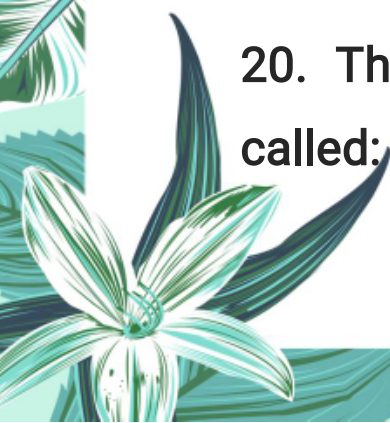
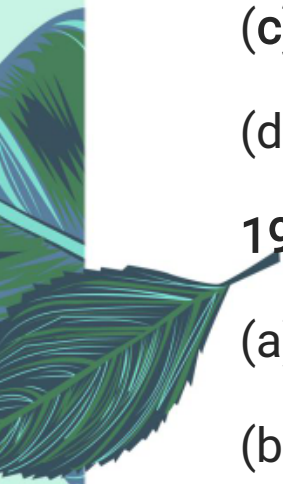
18. Which plastid is responsible for photosynthesis?

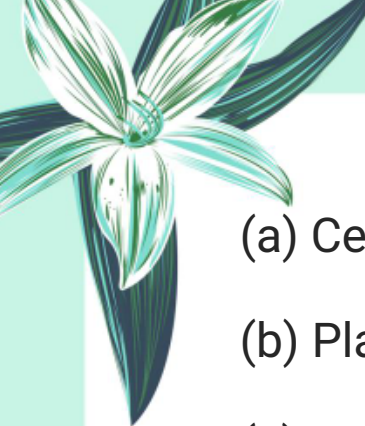

- (a) Leucoplast
- (b) Chromoplast
- (c) Chloroplast
- (d) Ribosome

19. What is the function of lysosomes?

- (a) Photosynthesis
- (b) Energy production
- (c) Digestion of food and wastes
- (d) Protein modification

20. The membrane of the plant cell vacuole is called:



- 
- 
- (a) Cell wall
  - (b) Plasma membrane
  - (c) Tonoplast
  - (d) Stroma



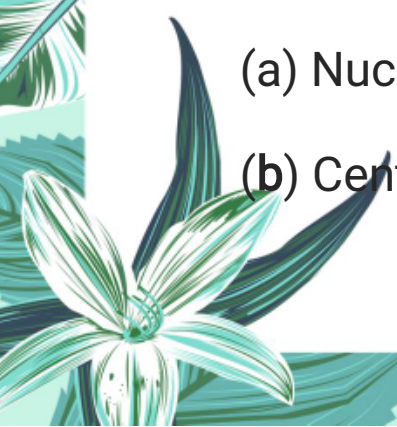

**21. Plant cells have a rigid cell wall made of:**

- (a) Protein
- (b) Lipid
- (c) Cellulose
- (d) Glucose

**22. Chloroplasts are responsible for:**

- (a) Digestion
- (b) Respiration
- (c) Photosynthesis
- (d) Excretion

**23. Which structure maintains turgor pressure in plant cells?**

- (a) Nucleus
  - (b) Central vacuole
- 
- 



(c) Mitochondria

(d) Ribosome

**24. Plasmodesmata are channels between plant cells for:**



(a) Energy production

(b) Movement

(c) Direct communication

(d) Protection

**25. Which organelle is responsible for cleaning waste in animal cells?**

(a) Nucleus

(b) Ribosome

(c) Lysosome

(d) Golgi body

**26. What is the function of guard cells in plant leaves?**

(a) Store starch

(b) Absorb water





(c) Regulate stomata

(d) Transport oxygen

**27. Mesophyll cells are specialized for:**

(a) Transpiration



(b) Photosynthesis

(c) Cell division

(d) Transport

**28. Red blood cells have a biconcave shape to:**

(a) Fight infection

(b) Increase oxygen-carrying surface

(c) Divide rapidly

(d) Transport glucose

**29. Which animal cells are responsible for movement and contraction?**

(a) Neurons

(b) Liver cells

(c) Muscle cells

(d) RBCs





**30. Division of labour in multicellular organisms means:**

- (a) All cells do all tasks
- (b) Each cell type performs a specific function
- (c) Only one type of cell works
- (d) Cells divide quickly

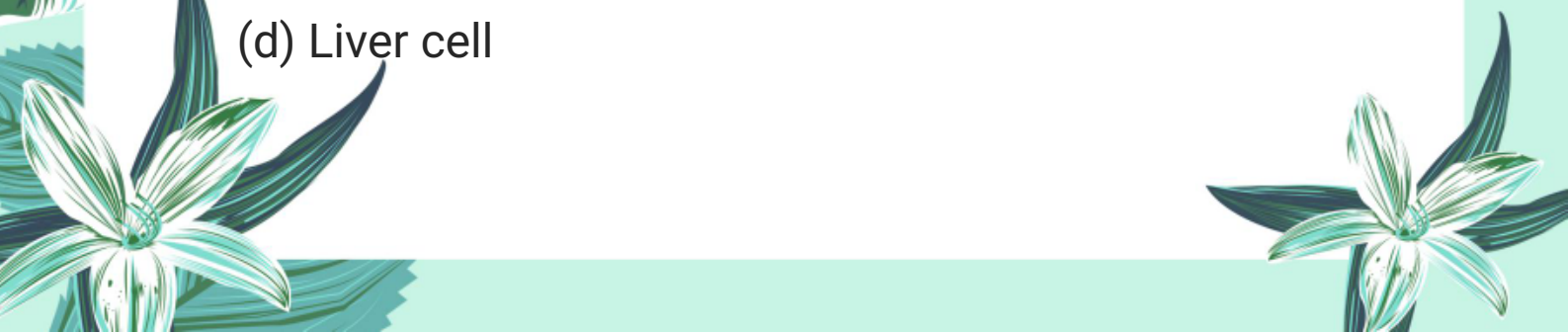


**31. Stem cell is:**

- (a) A fully developed cell
- (b) A cell that performs only one function
- (c) An unspecialized cell that can form specialized cells
- (d) A dead cell




**32. The first stem cell in a sexually reproducing organism is:**

- (a) Neuron
  - (b) Zygote
  - (c) RBC
  - (d) Liver cell
- 



**33. Stem cells in the bone marrow produce:**

- (a) Skin and muscle cells
- (b) Only red blood cells
- (c) Different types of blood and immune cells
- (d) Nerve cells only

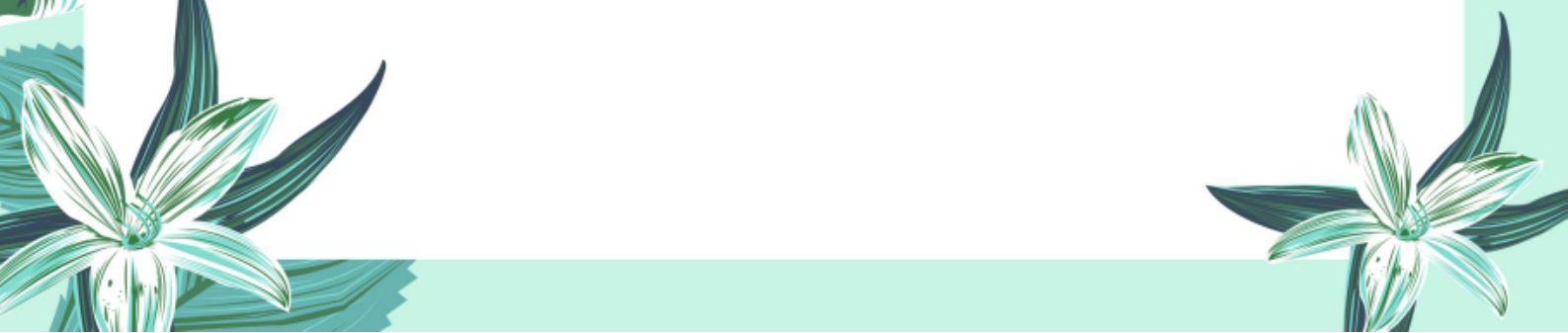


**34. Which body part uses stem cells for wound healing?**

- (a) Brain
- (b) Liver
- (c) Skin
- (d) Kidney



**35. Stem cells in the liver help to:**

- (a) Produce hormones
  - (b) Improve digestion
  - (c) Repair tissue after damage
  - (d) Make nerve cells
- 



## Exercise Short Questions:

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

- The cell membrane controls the movement of substances in and out of the cell.
- It provides protection and support to the cell and helps in cell communication.

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

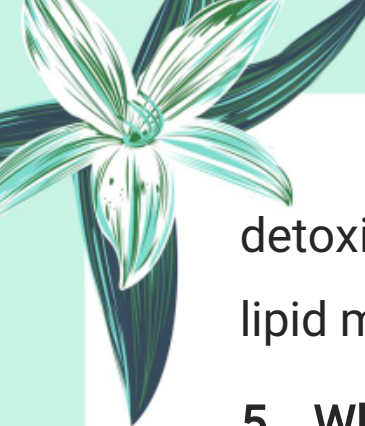
It modifies, sorts, and packages proteins and lipids for secretion or delivery to other organelles.

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

Lysosomes contain digestive enzymes that break down waste materials, damaged organelles, and foreign particles.


4. Which organelle detoxifies harmful substances and breaks down lipids?

The smooth endoplasmic reticulum (SER)



detoxifies drugs and poisons and is also involved in lipid metabolism.

**5. What is the smooth endoplasmic reticulum responsible for?**



It synthesizes lipids, detoxifies harmful substances, and helps in the metabolism of carbohydrates.

**6. How do the vacuoles in plant cells differ from vacuoles in animal cells?**

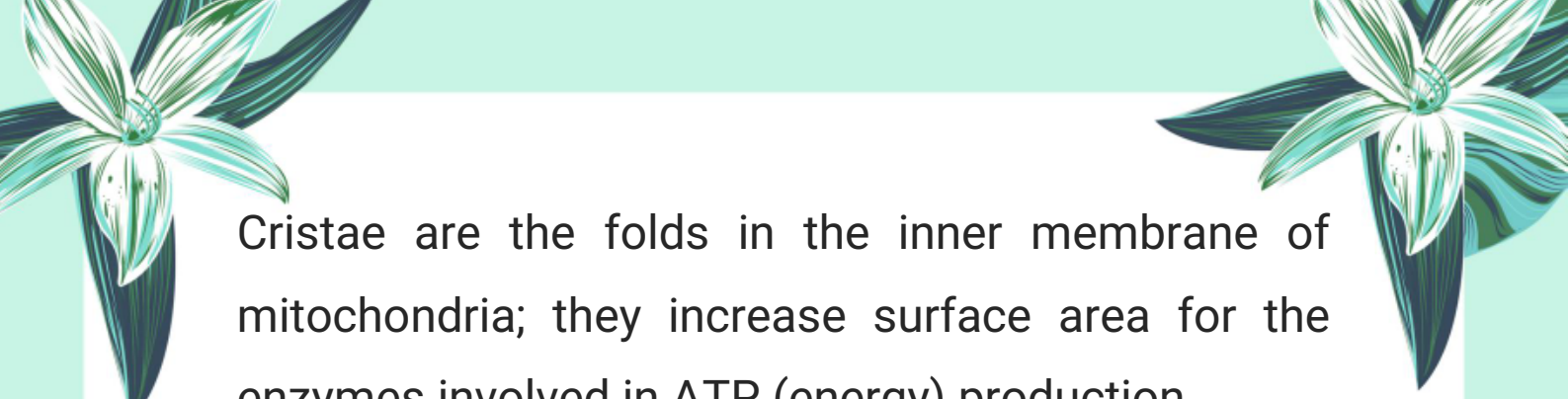
- Plant cells have a large central vacuole that stores water, nutrients, and waste and maintains turgor pressure.
- Animal cells have smaller, more numerous vacuoles mainly for storage and transport.

**7. What could happen if lysosomal enzymes stop working properly?**

Waste and damaged materials would accumulate in the cell, potentially leading to cell damage or disease (e.g., lysosomal storage disorders).


**8. Why are the cristae important for cellular respiration?**





Cristae are the folds in the inner membrane of mitochondria; they increase surface area for the enzymes involved in ATP (energy) production.

### **9. How are chromatin and chromosomes related?**



Chromatin is the uncoiled form of DNA present during the normal cell cycle, while chromosomes are the condensed form of chromatin during cell division.

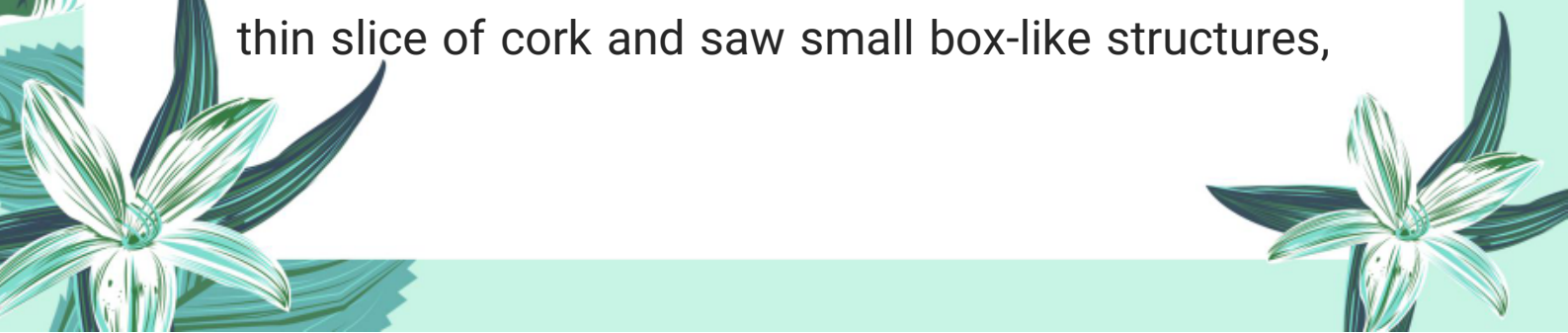
### **10. Which type of cell is responsible for sending nerve signals?**

Neurons (nerve cells) are specialized for transmitting electrical and chemical signals throughout the body.

## **Important Short Questions:**

### **1. Who discovered the cell and in which year?**

**Answer:** The cell was discovered by Robert Hooke in 1665. He used a simple microscope to observe a thin slice of cork and saw small box-like structures,





which he called "cells."

## **2. What is the basic unit of life?**

**Answer:** The cell is considered the basic unit of life because all living organisms are made up of cells, and all essential life functions occur within them.



## **3. What is the function of the cell membrane?**


**Answer:** The cell membrane is a thin, elastic, and selectively permeable layer that surrounds the cytoplasm. It controls the entry and exit of substances, provides protection, and helps maintain the internal environment of the cell.

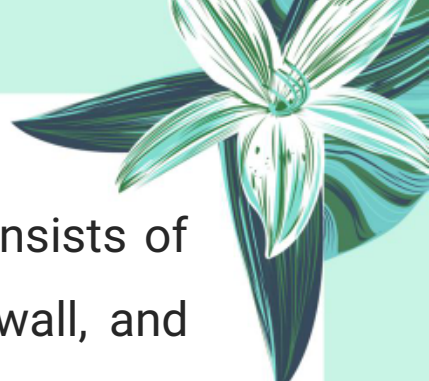
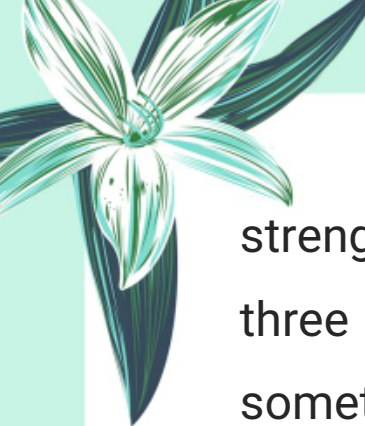
## **4. What is the difference between prokaryotic and eukaryotic cells?**

**Answer:** Prokaryotic cells are simpler and lack membrane-bound organelles like the nucleus, whereas eukaryotic cells are more complex and have distinct organelles enclosed in membranes.

## **5. What is the composition of the plant cell wall?**


**Answer:** The plant cell wall is composed mainly of cellulose, hemicellulose, and pectin. It gives shape,





strength, and protection to the cell and consists of three layers: the middle lamella, primary wall, and sometimes a secondary wall.

#### **6. What is the function of the cytoplasm in a cell?**



**Answer:** The cytoplasm is a jelly-like substance that fills the cell and provides a medium for the movement of organelles. It supports metabolic reactions and stores food and waste materials.

#### **7. What is the nuclear envelope?**

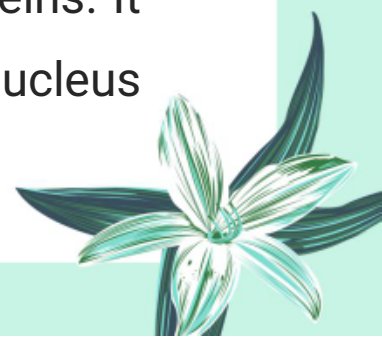

**Answer:** The nuclear envelope is a double membrane that surrounds the nucleus. It contains nuclear pores that allow the exchange of materials between the nucleus and cytoplasm.



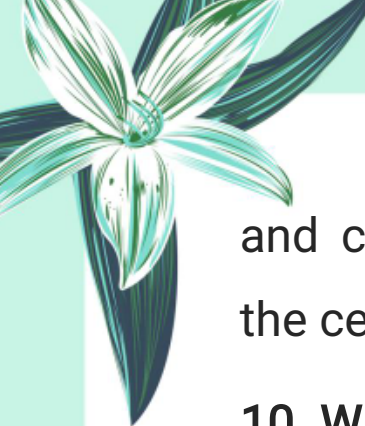
#### **8. What is the nucleolus responsible for?**

**Answer:** The nucleolus, found inside the nucleus, is responsible for assembling ribosomes, which are essential for protein synthesis.

#### **9. What is chromatin made of?**




**Answer:** Chromatin is made of DNA and proteins. It appears as a network of fine threads in the nucleus



and contains the genetic instructions that control the cell's activities.


**10. What happens to chromatin during cell division?**



**Answer:** During cell division, chromatin condenses and becomes visible as thick structures called chromosomes, which help in the accurate distribution of genetic material to daughter cells.



**11. Define cytoskeleton. Name its main components.**


Cytoskeleton is a network of thin tubes and filaments present throughout the cytoplasm. Its main components are: microtubules, microfilaments, and intermediate filaments.




**12. What are microtubules made of and what is their role in the cell?**

Microtubules are hollow tubes made of tubulin protein. They help in maintaining cell shape, hold organelles in place, and act as tracks for their movement. They also form mitotic spindle, cilia, and flagella.






**13. Differentiate between microfilaments and intermediate filaments.**



Microfilaments are thinner and made of actin protein; they help in cell movement. Intermediate filaments are thicker rods made of keratin or vimentin and provide structural support by anchoring organelles.

**14. What are ribosomes made of? Where are they located in the cell?**



Ribosomes are made of proteins and ribosomal RNA (rRNA). They are found freely floating in cytoplasm or attached to the surface of rough endoplasmic reticulum.




**15. How does the structure of eukaryotic ribosomes differ from prokaryotic ribosomes?**

Eukaryotic ribosomes are slightly larger than prokaryotic ribosomes. However, both types are made of two subunits and are not membrane-bound.

**16. Write two differences between rough ER and smooth ER.**





**Rough ER** has ribosomes on its surface and helps in protein synthesis.

**Smooth ER** lacks ribosomes and is involved in lipid metabolism and detoxification.



**17. What is the function of Golgi apparatus in protein processing?**

Golgi apparatus modifies proteins received from rough ER and packs them into vesicles for secretion or storage.



**18. What is the origin and role of lysosomes in animal cells?**

Lysosomes are formed from the Golgi apparatus. They contain digestive enzymes that break down food, waste, and damaged organelles in animal cells.

**19. Why are mitochondria called the powerhouse of the cell?**

**Answer:**

Mitochondria perform aerobic respiration to break down glucose and release energy in the form of






ATP, thus earning the name "powerhouse."

**20. Write any two differences between chloroplast and chromoplast.**

**Answer:**



Chloroplasts are green plastids that perform photosynthesis, while chromoplasts contain colorful pigments and help in pollination and fruit dispersal.

**21. What is the function of the cell wall in plant cells?**

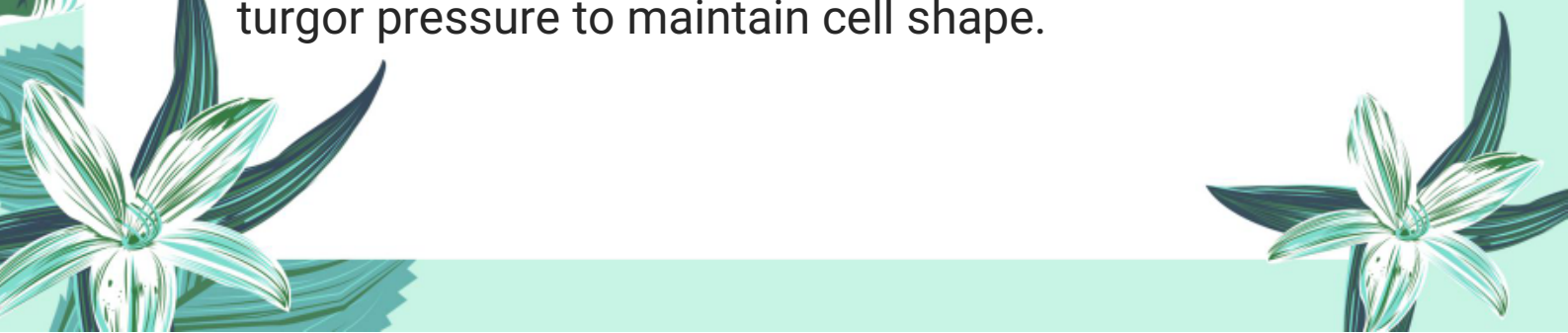
**Answer:** The cell wall provides structural support and protection to plant cells.

**22. Why do plant cells contain chloroplasts?**

**Answer:** Chloroplasts carry out photosynthesis by converting light energy into chemical energy.

**23. What is the role of the large central vacuole in plant cells?**

**Answer:** It stores water and nutrients and provides turgor pressure to maintain cell shape.





**24. What are plasmodesmata?**

**Answer:** Plasmodesmata are channels between plant cells that allow direct transport and communication.




**25. Name one function of lysosomes in animal cells.**

**Answer:** Lysosomes digest waste materials and recycle cellular components.

**26. How do centrioles help during cell division?**

**Answer:** Centrioles form spindle fibres that ensure accurate chromosome distribution.

**27. What is meant by cell specialization?**



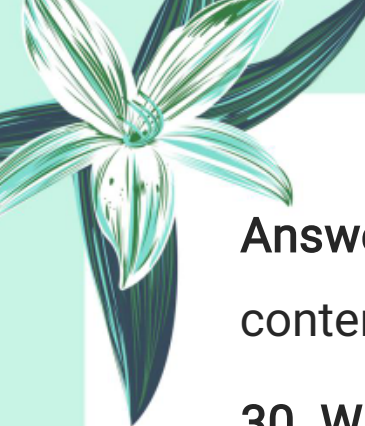
**Answer:** It is the process by which cells develop special structures and functions.

**28. Why are mesophyll cells rich in chloroplasts?**

**Answer:** To maximize absorption of light for photosynthesis.

**29. What makes red blood cells efficient in oxygen transport?**






**Answer:** Their biconcave shape and haemoglobin content enhance oxygen absorption and delivery.

### 30. What are stem cells?



**Answer:** Stem cells are unspecialized cells that can divide and differentiate into various specialized cell types.



### Important long Questions:


**Q1: What is a cell? Describe the discovery of the cell and explain its importance in living organisms.**

A **cell** is the basic structural and functional unit of all living organisms. It is the smallest unit of life that can carry out all life processes.






## Discovery of the Cell:

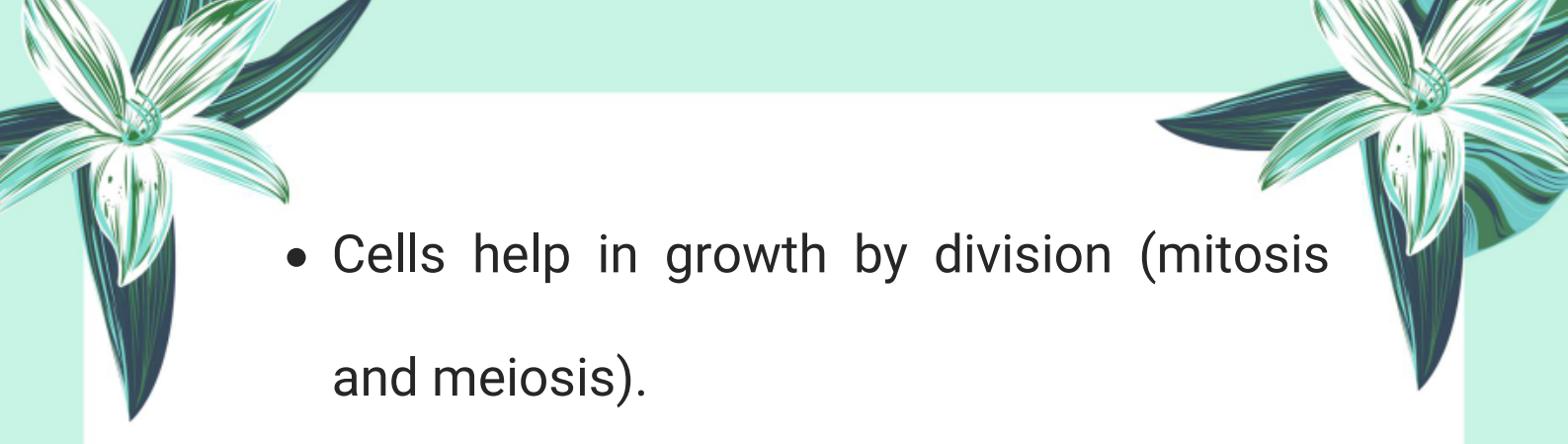



The cell was first discovered by Robert Hooke in 1665. He observed thin slices of cork under a simple microscope and saw small box-like structures which he called "cells" because they looked like the cells (rooms) of a monastery. However, he observed dead cells. Later, living cells were observed by Anton van Leeuwenhoek using a more powerful microscope.



## Importance of Cells:

- All living organisms are made up of cells.
  - They perform essential life functions like respiration, digestion, excretion, etc.
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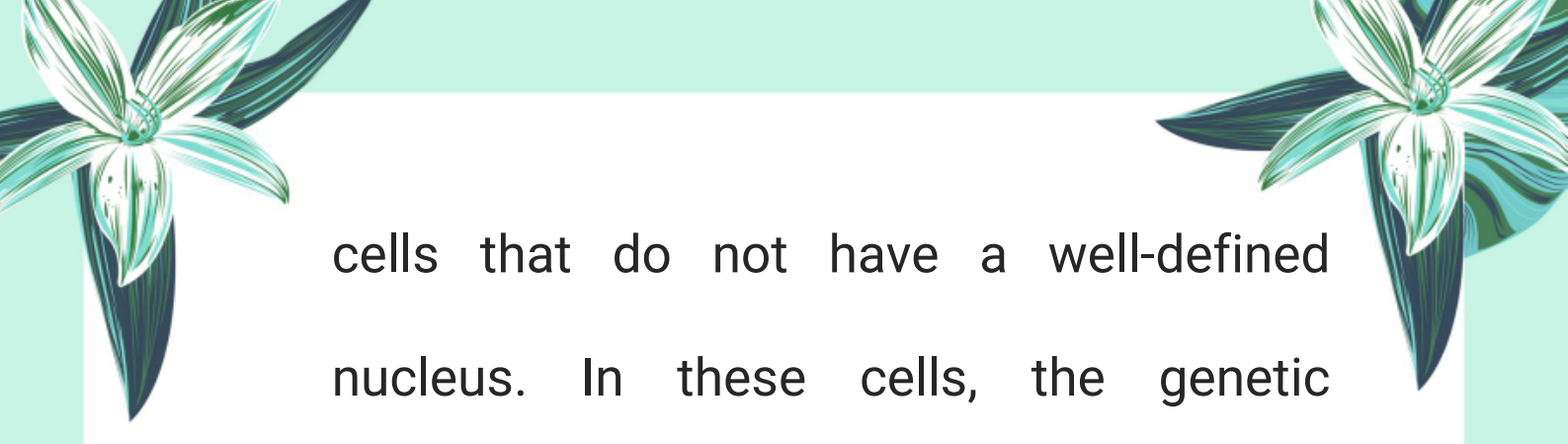
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- Cells help in growth by division (mitosis and meiosis).
  - They are responsible for heredity by carrying genetic material.
  - Specialized cells perform specific functions in multicellular organisms.
  - Thus, the cell is considered the basic unit of life.




**Q2: Differentiate between prokaryotic and eukaryotic cells. Describe the structure of a typical eukaryotic cell.**

**Difference between Prokaryotic and Eukaryotic Cells:**

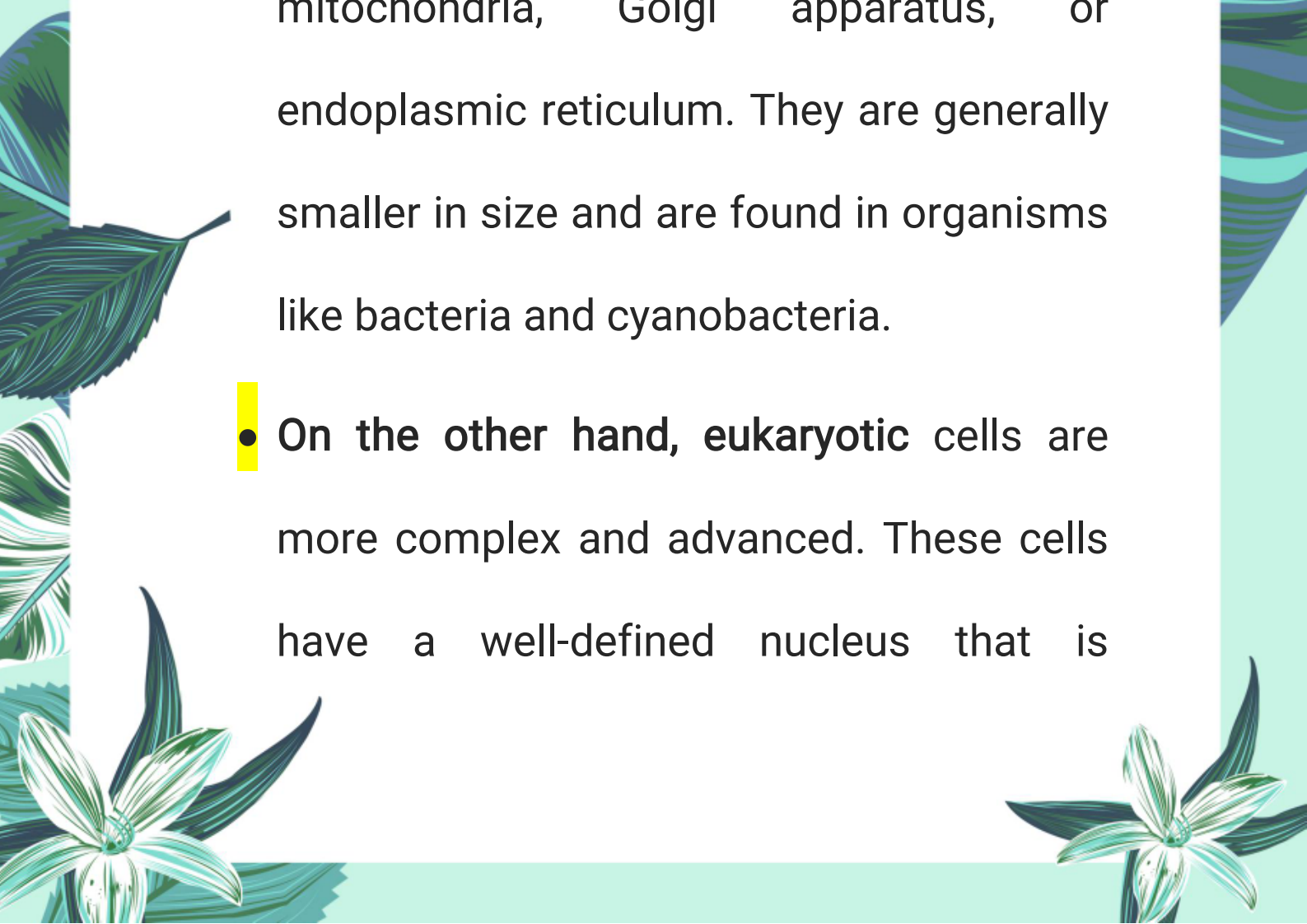
- Prokaryotic cells are simple and primitive
- 

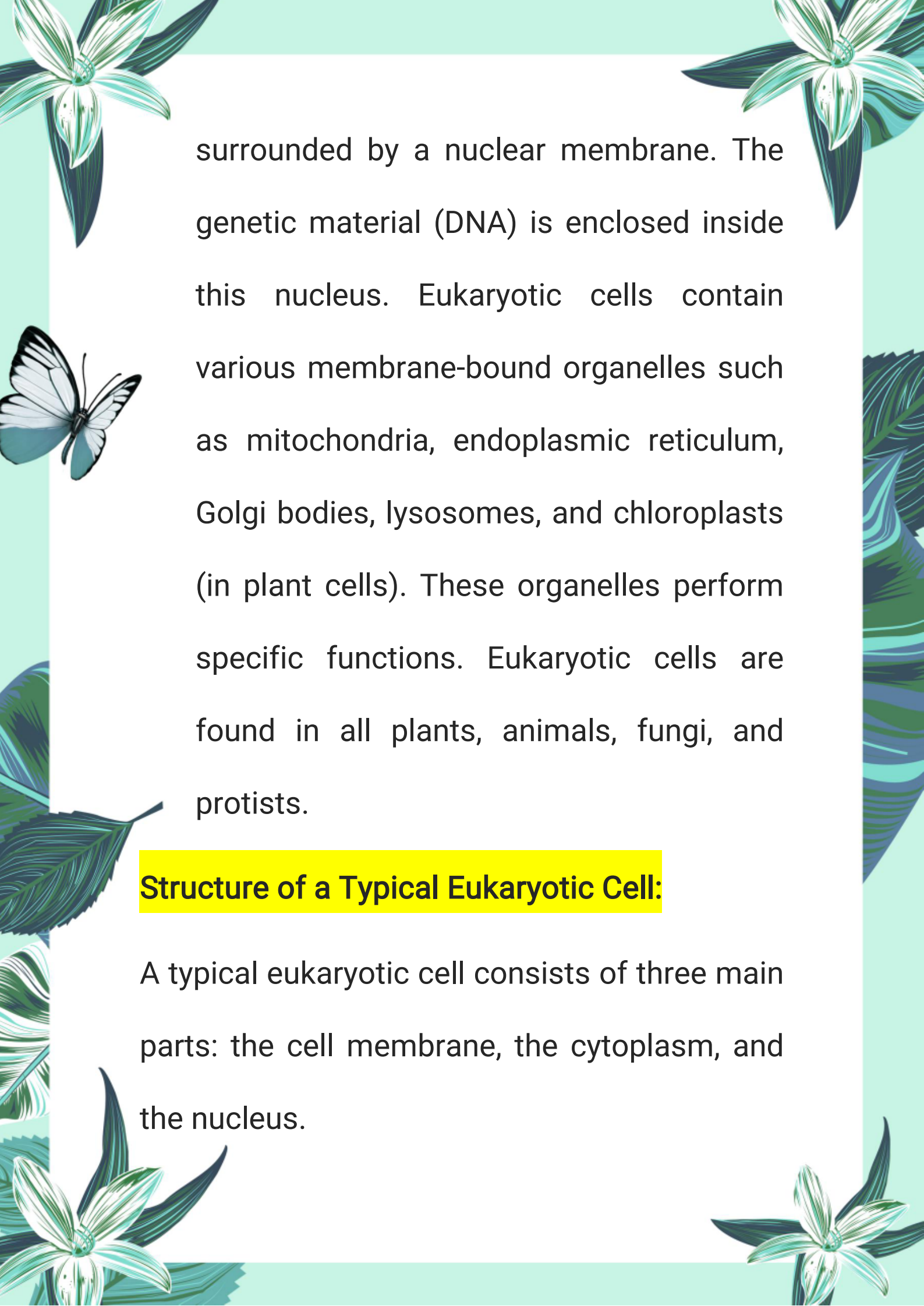


cells that do not have a well-defined nucleus. In these cells, the genetic material (DNA) is present in an irregular region called the nucleoid, and it is not enclosed within a nuclear membrane.



Prokaryotic cells also lack membrane-bound organelles such as mitochondria, Golgi apparatus, or endoplasmic reticulum. They are generally smaller in size and are found in organisms like bacteria and cyanobacteria.

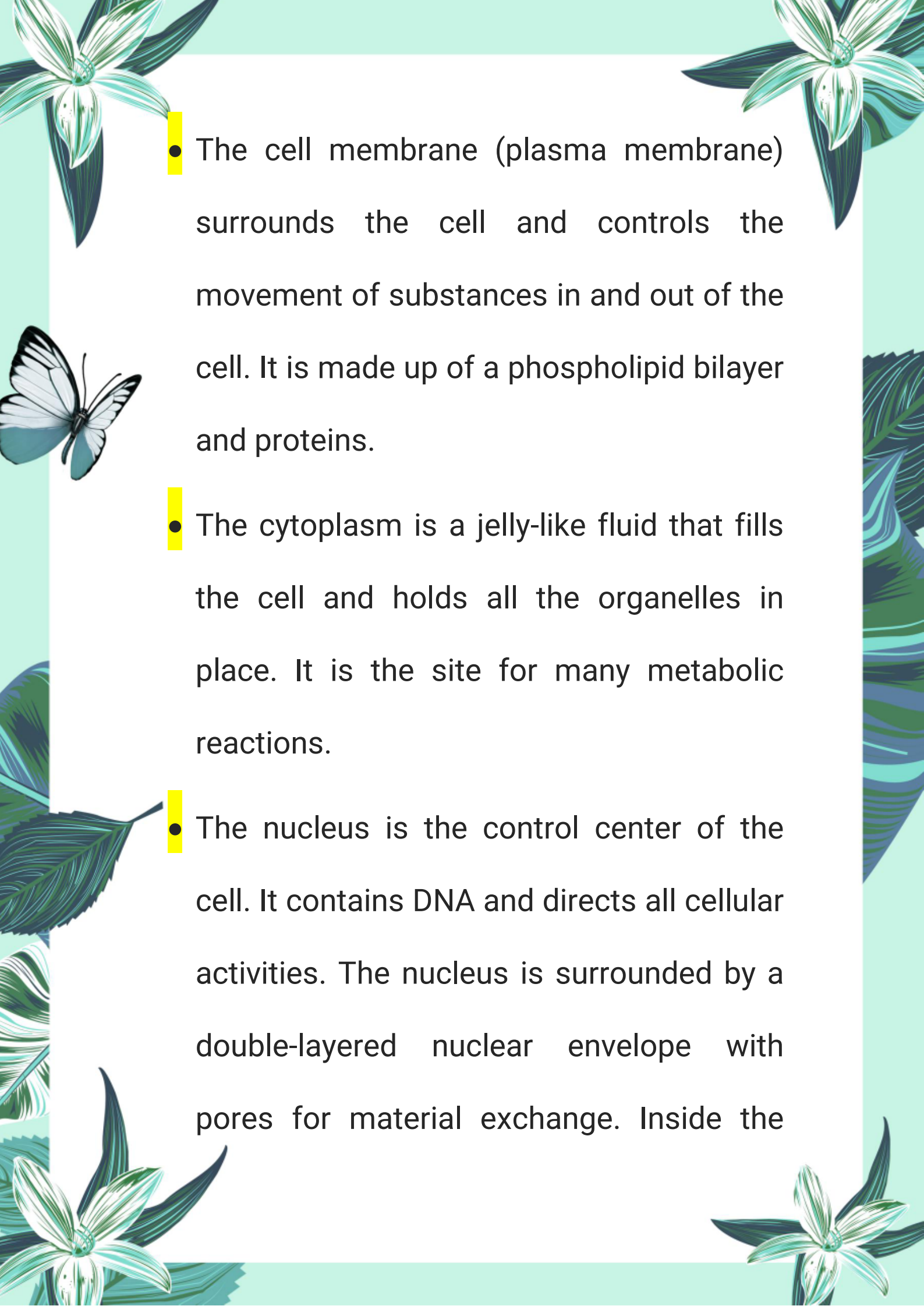
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- On the other hand, eukaryotic cells are more complex and advanced. These cells have a well-defined nucleus that is



surrounded by a nuclear membrane. The genetic material (DNA) is enclosed inside this nucleus. Eukaryotic cells contain various membrane-bound organelles such as mitochondria, endoplasmic reticulum, Golgi bodies, lysosomes, and chloroplasts (in plant cells). These organelles perform specific functions. Eukaryotic cells are found in all plants, animals, fungi, and protists.

### **Structure of a Typical Eukaryotic Cell:**

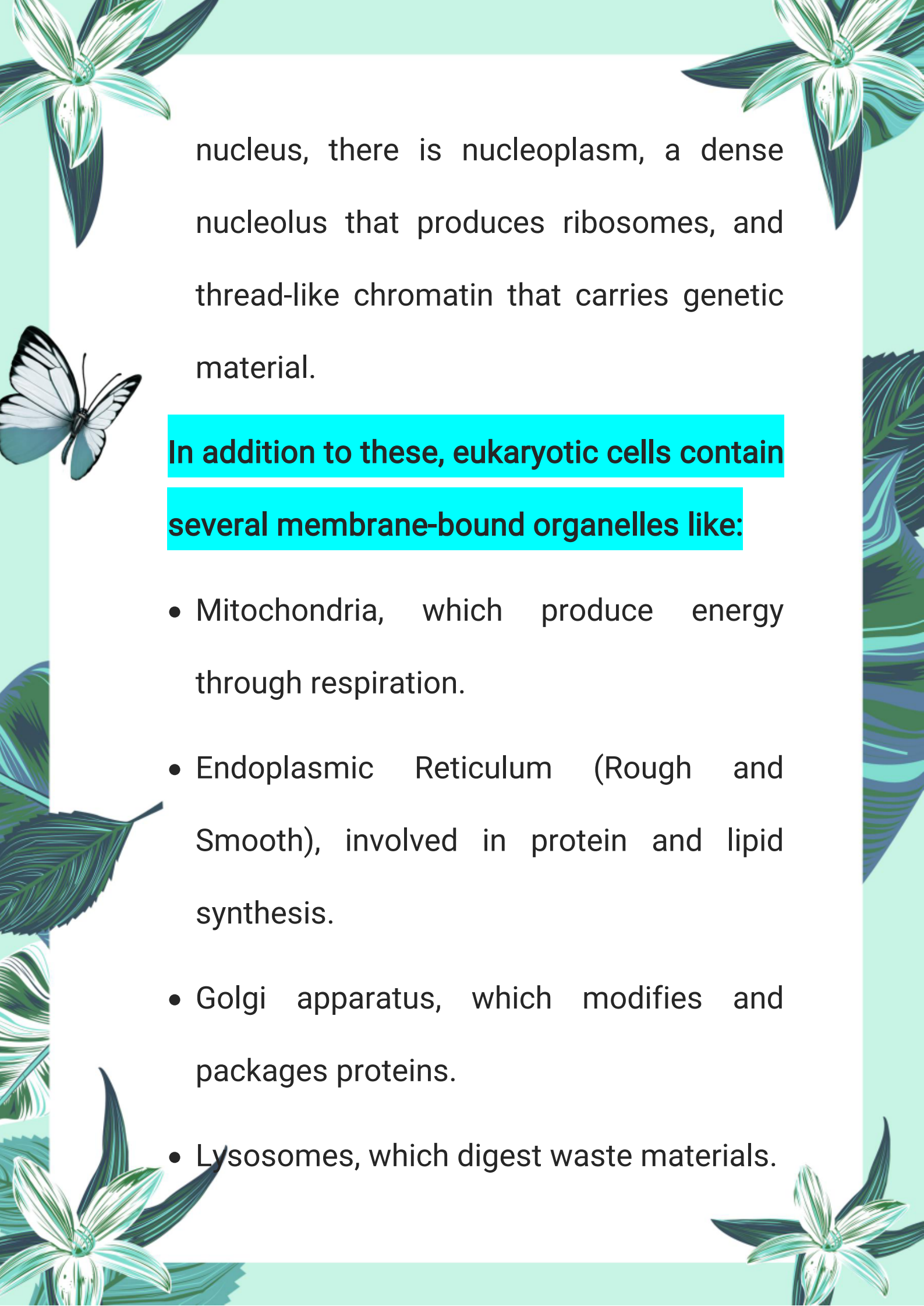
A typical eukaryotic cell consists of three main parts: the cell membrane, the cytoplasm, and the nucleus.

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- The cell membrane (plasma membrane) surrounds the cell and controls the movement of substances in and out of the cell. It is made up of a phospholipid bilayer and proteins.

- The cytoplasm is a jelly-like fluid that fills the cell and holds all the organelles in place. It is the site for many metabolic reactions.

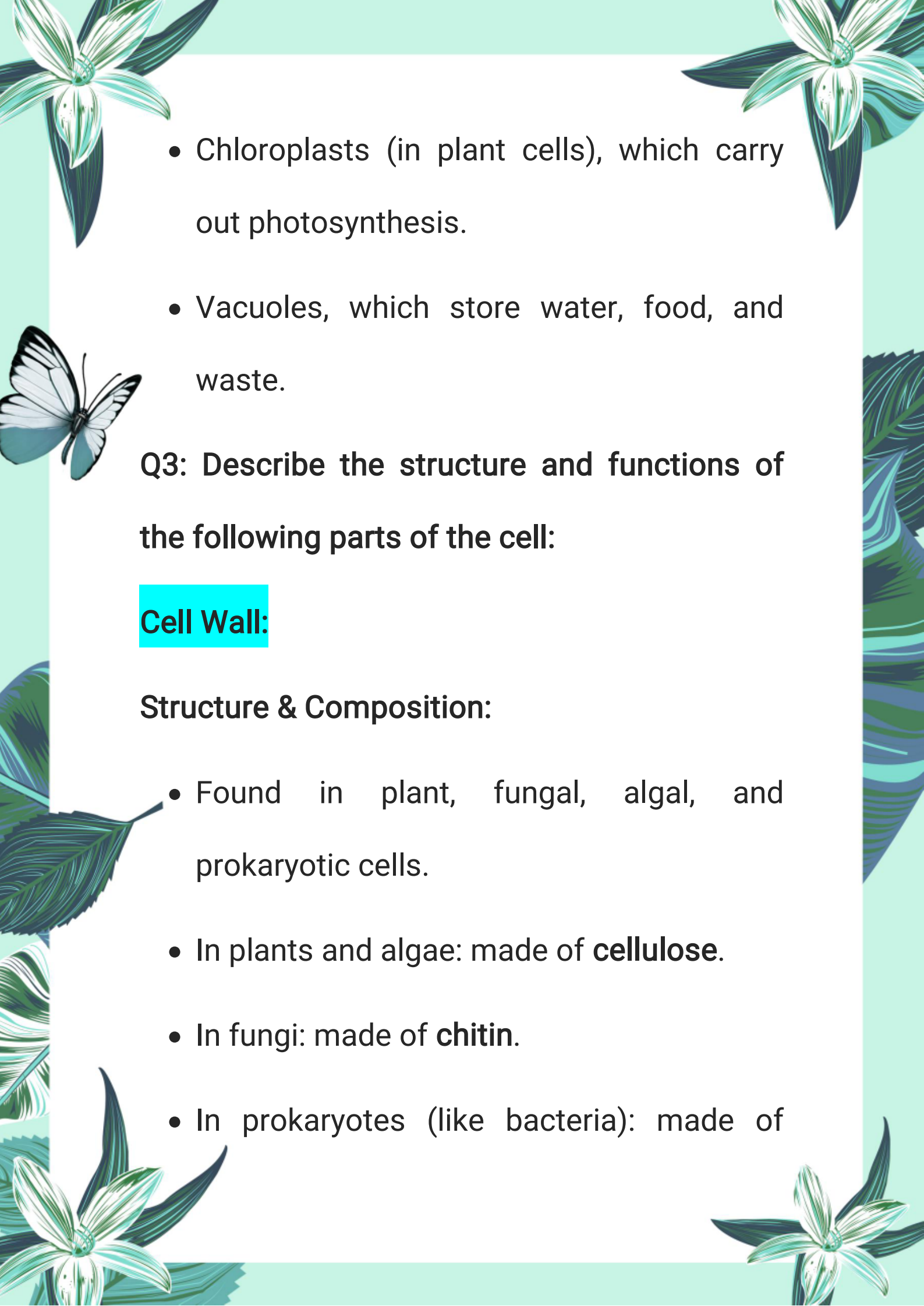
- The nucleus is the control center of the cell. It contains DNA and directs all cellular activities. The nucleus is surrounded by a double-layered nuclear envelope with pores for material exchange. Inside the

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nucleus, there is nucleoplasm, a dense nucleolus that produces ribosomes, and thread-like chromatin that carries genetic material.

**In addition to these, eukaryotic cells contain several membrane-bound organelles like:**

- Mitochondria, which produce energy through respiration.
- Endoplasmic Reticulum (Rough and Smooth), involved in protein and lipid synthesis.
- Golgi apparatus, which modifies and packages proteins.
- Lysosomes, which digest waste materials.

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- Chloroplasts (in plant cells), which carry out photosynthesis.
  - Vacuoles, which store water, food, and waste.

**Q3: Describe the structure and functions of the following parts of the cell:**

### **Cell Wall:**


#### **Structure & Composition:**

- Found in plant, fungal, algal, and prokaryotic cells.
- In plants and algae: made of **cellulose**.
- In fungi: made of **chitin**.
- In prokaryotes (like bacteria): made of




peptidoglycan.

### Functions:

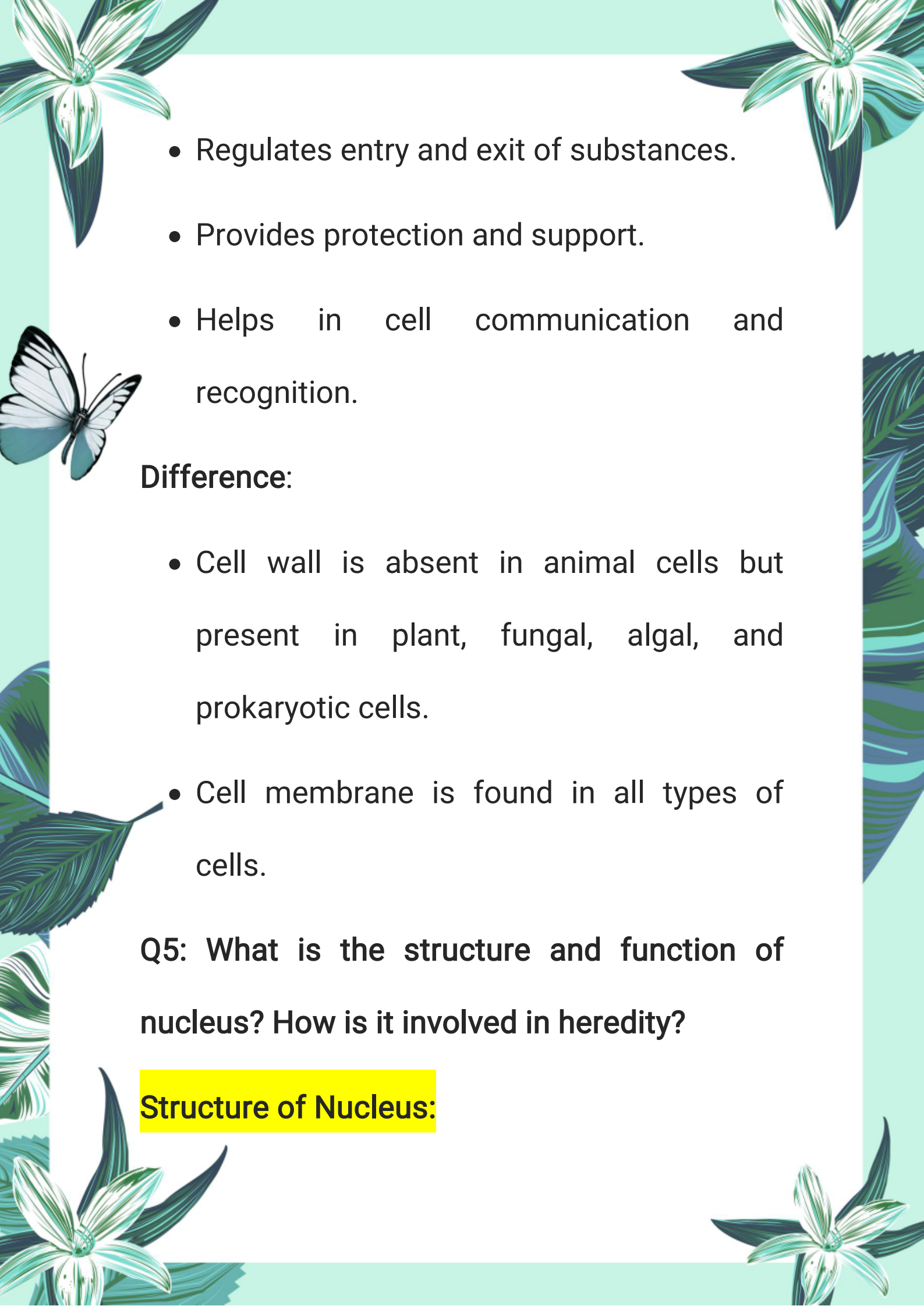
- Provides shape and rigidity to the cell.
  - Protects the cell from mechanical damage.
  - Prevents excessive water intake.
- 

### Cell Membrane (Plasma Membrane):

#### Structure & Composition:

- Present in all cells.
  - Made of a phospholipid bilayer with proteins embedded.
  - Semi-permeable (allows selective movement of substances).
- 

### Functions:

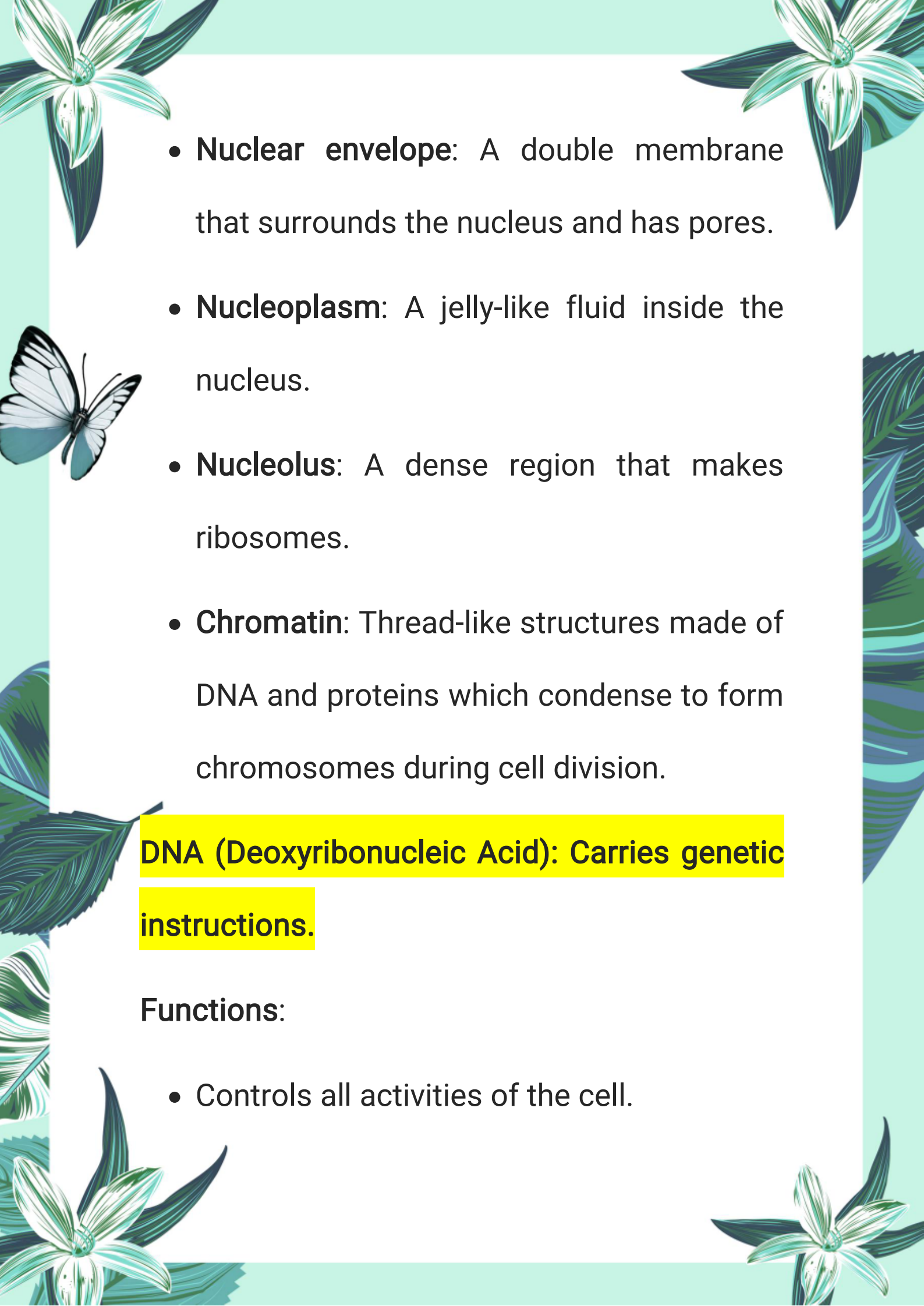
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- Regulates entry and exit of substances.
  - Provides protection and support.
  - Helps in cell communication and recognition.

### **Difference:**

- Cell wall is absent in animal cells but present in plant, fungal, algal, and prokaryotic cells.
- Cell membrane is found in all types of cells.

**Q5: What is the structure and function of nucleus? How is it involved in heredity?**



**Structure of Nucleus:**

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- **Nuclear envelope:** A double membrane that surrounds the nucleus and has pores.
  - **Nucleoplasm:** A jelly-like fluid inside the nucleus.
  - **Nucleolus:** A dense region that makes ribosomes.
  - **Chromatin:** Thread-like structures made of DNA and proteins which condense to form chromosomes during cell division.

**DNA (Deoxyribonucleic Acid): Carries genetic instructions.**

**Functions:**


- Controls all activities of the cell.

- 
- 
- Stores genetic information (DNA).
  - Directs protein synthesis.
  - Produces ribosomes in nucleolus.



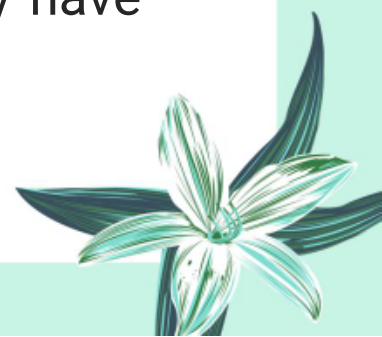

### Role in Heredity:

- DNA in the chromatin contains genes, which are units of heredity.
- These genes are passed from parents to offspring during reproduction.



**Q6: What are plastids? Describe the structure and function of chloroplasts, chromoplasts, and leucoplasts.**

Plastids are double-membraned organelles found only in plant cells and algae. They have






their own DNA and perform various functions.

## Types of Plastids:

### 1. Chloroplasts:

- 
- Green plastids containing chlorophyll.
  - **Structure:** Surrounded by a double membrane, contains internal stacked membranes called grana (site of light reaction) and stroma (site of dark reaction).
  - **Function:** Photosynthesis – converts sunlight into chemical energy (glucose).

### 2. Chromoplasts:

- Colored plastids (yellow, red, orange)
- 
- 



containing carotenoids.

- **Function:** Give color to fruits and flowers, attract pollinators.





### 3. Leucoplasts:

- Colorless plastids.
- **Function:** Store food materials such as starch, proteins, or oils.

**Q7: What are the structural advantages of plant cells and animal cells? Explain with examples.**

Plant and animal cells have structural adaptations that support their functions and survival. These structural advantages enable them to perform specialized roles efficiently.



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## Advantages of Plant Cell Structures:

1. **Cell Wall:** Plant cells have a rigid cell wall made of cellulose, which provides strength and protection. It helps the cell maintain its shape and prevents bursting in hypotonic environments.

2. **Chloroplasts:** These are found in plant cells and contain chlorophyll. They enable photosynthesis by converting sunlight into chemical energy, which allows the plant to make its own food.

3. **Large Central Vacuole:** It stores water, nutrients, and waste materials. The vacuole provides turgor pressure, which maintains the

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cell's shape and keeps the plant upright.

4. **Plasmodesmata**: These are microscopic channels between plant cells that allow the transport of water, nutrients, and signaling molecules, enabling coordination and communication between cells.

### **Advantages of Animal Cell Structures:**


1. **Centrioles**: Animal cells contain centrioles, which form spindle fibers during cell division.

This ensures the accurate distribution of chromosomes to daughter cells.


2. **Lysosomes**: These are small organelles containing digestive enzymes. They break down waste material and damaged organelles,




helping in cellular cleanup.



3. **Flagella and Cilia:** Some animal cells possess these structures for movement. For example, sperm cells have flagella that help them swim toward the egg.

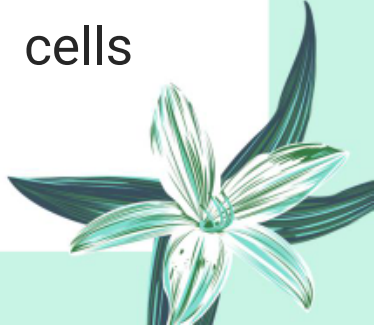





4. **Flexible Cell Membrane:** The absence of a rigid cell wall allows animal cells to change shape easily. This is essential for movement, such as white blood cells moving toward infection sites.



**Q8: What is cell specialization? Explain with examples from plants and animals.**

Cell specialization, also called differentiation, is the process by which unspecialized cells






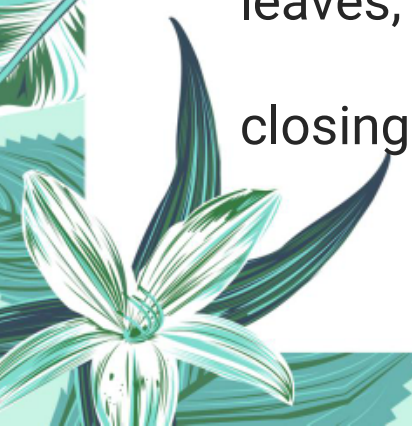
develop specific structures and functions. In multicellular organisms, each cell type is specialized to perform a particular task.



### Specialized Plant Cells:

1. **Mesophyll Cells:** Found in leaves, these cells are rich in chloroplasts and specialize in photosynthesis. Their structure allows maximum light absorption.

2. **Epidermal Cells:** These form the outer protective layer of plant organs. In roots, they form root hair cells, which increase surface area for water and mineral absorption. In leaves, guard cells regulate the opening and closing of stomata.



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## Specialized Animal Cells:


1. **Muscle Cells:** These are elongated cells that can contract. Skeletal muscle cells help in movement, cardiac muscle cells contract to pump blood, and smooth muscle cells move substances through internal organs.

2. **Neurons:** Specialized for transmitting nerve impulses. They consist of a cell body, dendrites (receive signals), and an axon (sends signals).


3. **Red Blood Cells (RBCs):** These cells transport oxygen using haemoglobin. They are biconcave in shape and lack a nucleus in mature form, allowing more space for




haemoglobin.





4. **Liver Cells (Hepatocytes)**: They perform various functions like detoxifying chemicals, producing bile, and storing glycogen. They contain many mitochondria, peroxisomes, and a large smooth ER for these tasks.

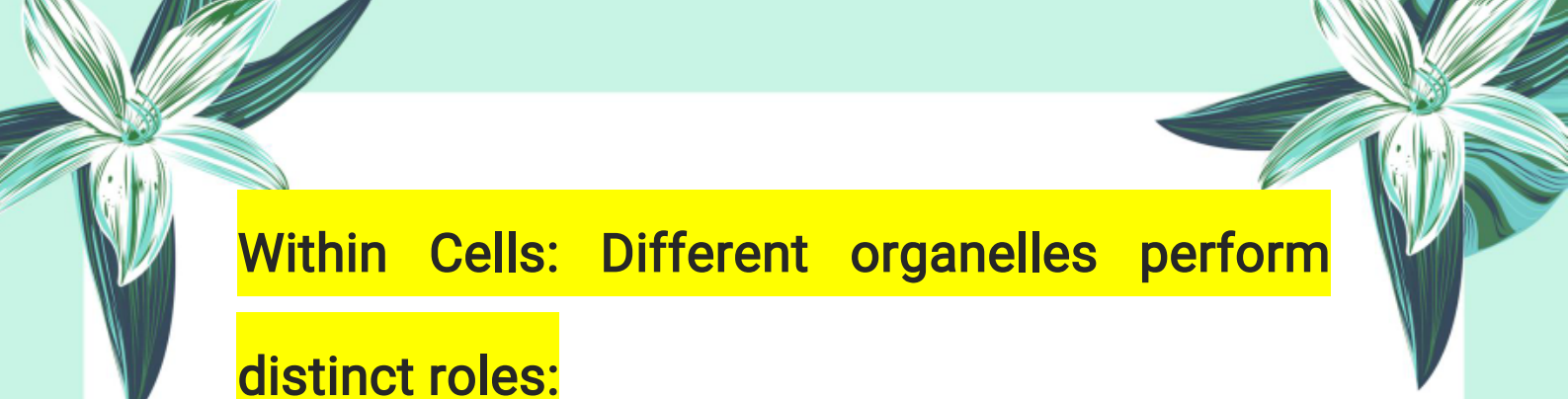


**Q9: What is division of labour in cells? How do stem cells help in repair and specialization?**




Division of Labour in biology refers to the distribution of different tasks among specialized structures or cells. This increases efficiency and allows complex functions to be performed more effectively.





**Within Cells: Different organelles perform distinct roles:**

- Nucleus controls genetic information.
- Mitochondria produce energy.
- Ribosomes make proteins.
- Lysosomes digest waste materials.

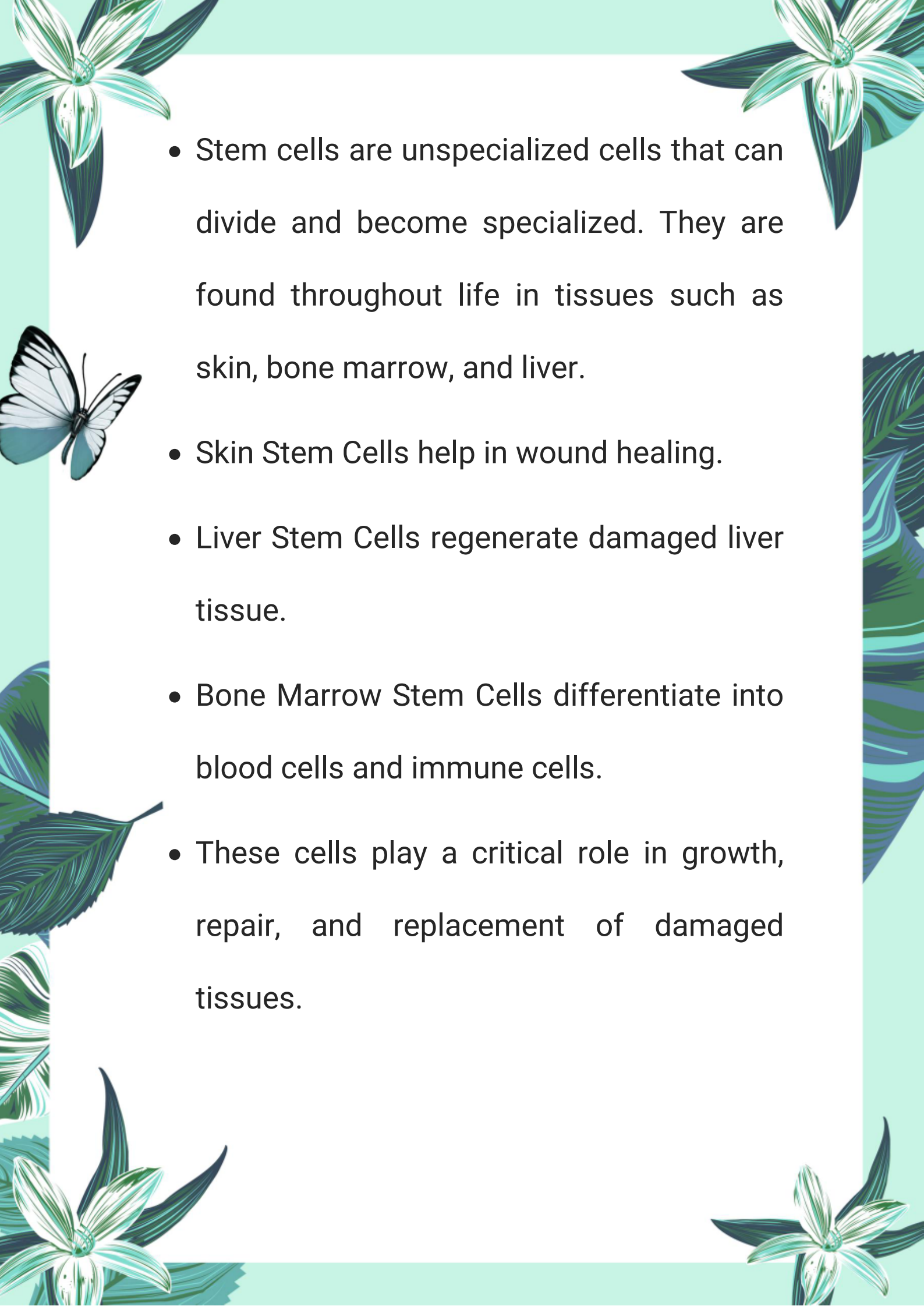


**Among Cells: In multicellular organisms, different cell types perform different roles:**

- Muscle cells contract for movement.
- Neurons transmit signals.
- Blood cells transport oxygen or fight infection.

**Role of Stem Cells:**



- 
- Stem cells are unspecialized cells that can divide and become specialized. They are found throughout life in tissues such as skin, bone marrow, and liver.
  - Skin Stem Cells help in wound healing.
  - Liver Stem Cells regenerate damaged liver tissue.
  - Bone Marrow Stem Cells differentiate into blood cells and immune cells.
  - These cells play a critical role in growth, repair, and replacement of damaged tissues.





## **Note:**

This chapter is designed to provide a solid foundation of knowledge, with the goal of deepening understanding and encouraging further exploration of the subject. The content has been carefully selected to support effective learning and inspire students to engage with the topic more deeply.


**Author: Muhammad Asghar**

**Purpose:** To contribute to education by offering insightful, valuable content that enhances learning and understanding.

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