

# 5 The Cell Interior and Function

## 5.0 CHAPTER PREVIEW

- Investigate and understand the organization and function of the cell interior.
- Define the differences between eukaryotic and prokaryotic cell structure.
- Discuss the structure and function of the following eukaryotic organelles and structures:
  - Protoplasm
  - Cytoplasm
  - Nucleoplasm
  - Cytoskeleton
  - Nucleus
  - Ribosome
  - Endoplasmic reticulum
  - Golgi apparatus
  - Lysosomes and peroxisomes
  - Mitochondria
  - Plastids
  - Vacuoles
  - Middle lamella
  - Extracellular matrix

## 5.1 OVERVIEW

- This chapter focuses on the interior cell structure and function.

### Topic question

Which cell type is structurally more complex, eukaryotic or prokaryotic? **Eukaryotic. They have many more organelles than prokaryotic cells.**

## 5.2 ORGANELLES—GENERAL

- Organelles are units contained inside a cell that carry out specific functions.

### Topic question

What are the organelles and intracellular substances discussed in this chapter? **Protoplasm, cytoplasm, nucleoplasm, nucleus, nucleolus, cytoskeleton, ribosome, endoplasmic reticulum, Golgi apparatus, mitochondria, lysosome, peroxisome, vacuoles, plastids, centrioles.**

## 5.3 PROTOPLASM

- The protoplasm refers to all the substances inside of a cell. Protoplasm is basically everything inside the cell membrane, including the organelles, cytoplasm, and nucleus.
- Cytoplasm is everything inside the cell, but outside of the nucleus. The cytoplasm does not include the nucleus.
- Cytosol is the fluid component of the cytoplasm. It has the consistency of jelly.

### Topic questions

Does the cytoplasm include the nucleus? **No. The cytoplasm includes everything inside the cell except the nucleus.** What is the cytosol? **It is the aqueous part of the cytoplasm. It is about 70% water and 30% ions and proteins.**

## 5.4 NUCLEOPLASM

- The nucleoplasm is the name of the interior substance of the nucleus.

### Topic question

What is contained in the nucleoplasm? **Ions, water, proteins, and DNA.**

## 5.5 CYTOSKELETON

- The cytoskeleton is a complex meshwork of proteins which maintains the structure of the cell.

### Topic question

What functions does the cytoskeleton serve? **It maintains the shape (structure) of the cell. It also serves as an anchoring point for organelles and as the pathway for organelles and materials to be transported in the cell.**

## 5.6 CYTOSKELETAL PROTEINS, CILIA, AND FLAGELLA

- The cytoskeletal proteins are microtubules, intermediate fibers, and microfilaments.
- Cilia and flagella are composed of microtubules.

### Topic question

What is the main function of cilia and flagella? **Cilia and flagella are composed of microtubules. They are both mobile; that is they move. Cilia and flagella both beat to move organisms in their environment or to move material past the organism or cell. Therefore, the main function of cilia and flagella is involved in transport.**

## 5.7 EUKARYOTIC ORGANELLES—GENERAL

- Eukaryotic cells contain more organelles than prokaryotic cells.

### Topic question

none

## 5.8 NUCLEUS

- The nucleus contains DNA and nucleoplasm.
- The nuclear membrane is a double-membrane structure surrounding the nucleus.
- Nuclear pores are holes within the nuclear membrane that allow substances to pass through.
- The nucleoplasm, nuclear lamina, DNA (in the form of chromosomes), and nucleolus are contained in the nucleus.

### Topic questions

Where is the nucleus found? **Inside all eukaryotic cells. Prokaryotic cells do not have a nucleus. Further, the nucleus is found within the cytoplasm of the cell, although it is not considered part of the cytoplasm.**

How many lipid bilayers make up the nuclear membrane? **There are two lipid bilayers which make up the nuclear membrane. This means there are four individual lipid layers in the nuclear membrane.**

What is the function of the nucleolus? **The nucleolus manufactures ribosomal pieces that are transported out of the nucleus and assembled into ribosomes in the cytoplasm.**

What is the nuclear lamina? **The nuclear lamina is the skeleton of the nucleus. It is composed of proteins called intermediate fibers and maintains the structure of the nucleus.**

### Christian perspective

Be in this world not of this world.

## 5.9 RIBOSOMES

- Ribosomes are found in the cytoplasm and manufacture proteins.

### Topic question

What is a polysome? **A polysome is a collection of many ribosomes in the cytoplasm.**

## 5.10 ENDOPLASMIC RETICULUM (ER)

- Endoplasmic reticulum is made up of folded layers of membranes in the cytoplasm. ER is important in protein modification and transport.
- ER with ribosomes attached to it is called rough ER. ER without attached ribosomes is called smooth ER.

### Topic question

What is the structure and function of ER? **ER is a series of folded membranes connected directly to the nuclear membrane. ER functions to modify and transport proteins/molecules within the cell.**

## 5.11 GOLGI APPARATUS AND VESICLES

- The Golgi apparatus is also a series of folded membranes. The Golgi further modifies, stores, and packages proteins after they are made. Golgi also makes lysosomes and peroxisomes.
- A vesicle is formed by the ER and the Golgi to transport certain molecules in the cell. A vesicle is a membrane-bound compartment into which molecules and other substances are placed for transport or digestion.

### Topic question

What is a signal group and why is it important? **A signal group is a short series of molecules added to a protein that tells the cell where the protein should be taken after it is made. If there were no signal groups added by the Golgi, then the cell would not know where to take proteins after they have been made.**

## 5.12 LYSOSOMES AND PEROXISOMES

- Lysosomes and peroxisomes are organelles that contain digestive enzymes to break down various substances the cell absorbs or needs to process.

### Topic question

Where are lysosomes made? **The Golgi apparatus.** Where are peroxisomes made? **They are self-assembling in the cytoplasm.**

## 5.13 MITOCHONDRIA

- Mitochondria are organelles that manufacture the cell's energy molecule, ATP. Like the nucleus, this is also a double membrane-bound organelle.

### Topic question

What are cristae? **Cristae are the folds of the inner membrane of mitochondria.**

## 5.14 PLASTIDS

- Plastids are organelles found only in plants. The plastid called a chloroplast performs photosynthesis. Other plastids function to store substances.

### Topic question

How many membranes do plastids have? **Like mitochondria and the nucleus, plastids are double membrane-bound organelles. This means they have two lipid bilayers, or four individual layers of membrane.**

### 5.15 VACUOLES

- Vacuoles are storage organelles that are membrane bound.

#### Topic question

What is the function of a vacuole? **Vacuoles function to store substances within the cell.**

### 5.16 HOLDING PLANT CELLS TO ONE ANOTHER—THE MIDDLE LAMELLA

- The middle lamella is a sticky layer of polysaccharides secreted by plant cells that holds plant cells to one another.

#### Topic question

Where is the middle lamella found and what is its function? **The middle lamella is found only in plants. It is a layer secreted outside the plant cell walls and holds plant cells together.**

### 5.17 HOLDING ANIMAL CELLS TO ONE ANOTHER—THE EXTRACELLULAR MATRIX (ECM)

- The extracellular matrix is found only in animals. It serves to hold animal cells to one another. It is composed of the glycoprotein collagen, proteoglycans, and fibronectin.

#### Topic question

If you were standing on the outside of a cell and found that the molecules around you were fibronectins, collagen, and proteoglycans, would you be standing in a plant or animal organism? **Animal. Plant cells are held together by sticky sugar molecules called polysaccharides.**

### 5.18 PROKARYOTE CELL STRUCTURE

- Prokaryotic cell structure will be covered more in the bacteria chapters. What is important to understand now is that prokaryotic DNA is not contained in a nucleus. Prokaryotes have no nucleus. Their DNA is free in the cytoplasm

#### Topic question

What is the nucleoid? **The area of the cytoplasm where prokaryotic DNA is stored.**

### 5.20 KEY CHAPTER POINTS

- Organelles are special structures inside of cells that perform specialized functions.
- The inside of a cell is filled with a jelly-like substance called cytoplasm, and the inside of the nucleus contains nucleoplasm.
- The cytoskeleton holds the cell together.
- The nucleus is surrounded by a double lipid bilayer with holes in it, called pores. The nucleus contains the DNA and nucleolus.
- Mitochondria, ribosomes, endoplasmic reticulum, Golgi apparatus, vesicles, vacuoles, peroxisomes, and lysosomes are organelles found in all eukaryotic cells. All of them are bound by a membrane except ribosomes.
- Plants have plastids, a type of organelle not found in animal cells.
- Animal cells have centrioles, a type of organelle not found in plant cells.
- Almost all plant cells are also surrounded by a cell wall. No animal cells have cell walls.
- Animal cells are held to one another by the extracellular matrix.
- Plant cells are held to one another by the middle lamella.