PEER-LED TEAM LEARNING
ANATOMY & PHYSIOLOGY

MODULE 5: CELL STRUCTURE AND FUNCTION

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I. Introduction

The cell is the simplest organization of molecules that show the properties of life. Cells are highly diverse in their sizes and structures—often related to specializations in function. In some simpler living things, a single cell is the entire organism performing all the life functions. In multicellular organisms, cells tend to be more specialized—each doing one or a few of the life functions, but depending on different cells to do the rest. In our bodies, for example, muscle cells produce movement and nerve cells (neurons) are communication specialists.

In this module your goal is to understand the important structural components of cells and how these subunits work together in carrying out life processes. Prepare for your workshop by reading in your textbook (Chapter 3: 94-106, 115-124), and completing the Pre-Workshop Activities below. Show your work in these pages.

II. Pre-Workshop Activities

Activity A. Work on the activities on the CD-ROM (Cell Structure) which accompanies your text to review the structures and functions of the components of cells.

Activity B. In defining each of the following give information about structure, location, function, and connections to other terms in the list.

nucleus	endoplasmic reticulum	peroxisomes
chromatin	Golgi body (or apparatus)	extracellular matrix
nucleolus	gap junctions	mitochondria
cytosol	cytoskeleton	membrane proteins
ribosomes	lysosomes	tight junctions
cytoplasm	plasma membrane	nuclear pores

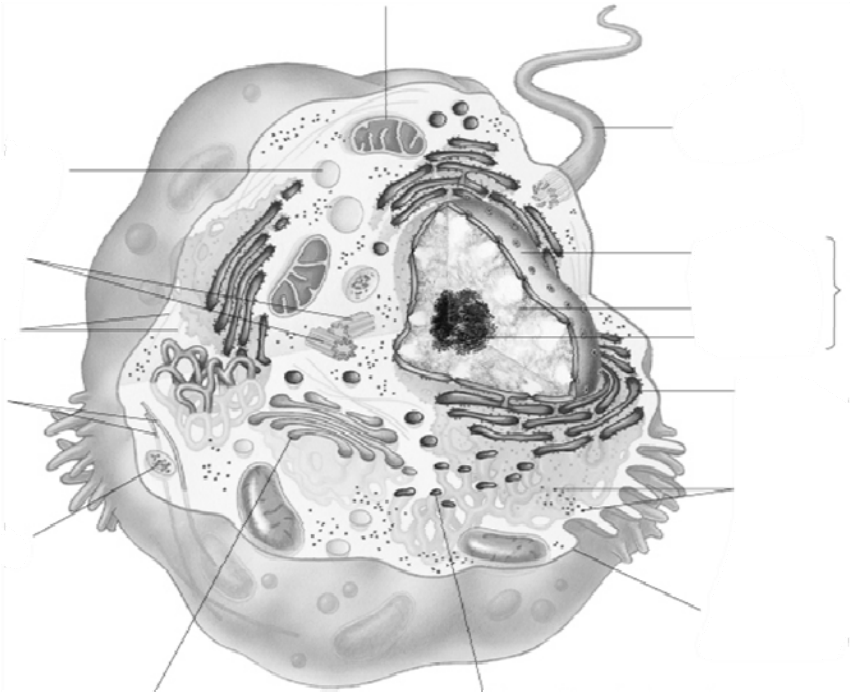
Activity C. Match the following cell components with their characteristic structure and function.

Cell Component	Structural Feature	Function

Rough ER	Made of rRNA and protein	Hydrolysis of macromolecules
Ribosome	Looks like a floppy stack of pancakes	Modification of ER products
Nucleus	Has two separate membranes and a matrix	Membrane synthesis
Cytoskeleton	Comprised of phospholipids and proteins	Synthesis of proteins from mRNA templates
Smooth ER	Made of filaments like microtubules and actin	Protein folding
Golgi apparatus	Network of membranes connected to the rough ER	Provides support and shape
Mitochondria	Enclosed by an perforated envelope (envelope with holes)	Selectively permeable to the extracellular environment
Lysosomes	Studded with ribosomes	The home of the chromosomes
Plasma membrane	Small vesicles filled with digestive enzymes	Cellular respiration

Activity D. Label the cell below.

Use the following terms:
Centrioles
Flagellum
Plasma Membrane
Rough ER
Golgi apparatus
Ribosomes
Nucleus
Chromatin
Nucleolus
Nuclear envelope
Smooth ER
Lysosome
Peroxisome
Microtubules
Microfilaments
Mitochondrion



III. Workshop Activities

Activity A. Jeopardy.

In this section you will be playing Jeopardy. As instructed by the peer leader, sit in a semicircle around the board. The peer leader will write the 4 categories and your names on the board (this is for keeping score). The peer leader will think of a number (e.g., between 1-10) and you will guess the number. The student that comes closest to the peer leader's number gets to select a category first. The peer leader will read one of the "questions" (see below) in that category. The first person to raise their hand can try to "answer the question". In Jeopardy, the "question" is actually a statement and the "answer" is to be phrased as a question. If a wrong "answer" is provided, another student will be given a chance to answer. Once a student has given the correct "answer," 10 pts will be awarded and that student selects the next category.

You are highly encouraged to prepare, outside of workshop, a set of note cards for self-study with the "questions" on one side and the "answers" on the other.

Category 1: What's my name?

$100: This is the chromosome-containing organelle of a eukaryotic cell.

$200: This organelle has two parts; one with membranous tubules and another with flattened sacs that have a bumpy appearance.

$300: This organelle is essentially a membrane-enclosed bag of hydrolytic enzymes.

$400: This is how DNA exists when the cell is not dividing. It is made up of DNA plus proteins.

$500: This organelle is attached directly to the nuclear membrane and is studded with ribosomes.

$600: Ribosomes, DNA, and the nucleolus are all found in this organelle.

$700: This separates the intracellular fluid from the extracellular fluid.

Category 2: Function Injunction

$100: This organelle consists of stacks of flat membranous sacs that modify, store, and route products of the endoplasmic reticulum.

$200: This assembles amino acids into proteins.

$300: This is the site of ribosome synthesis.

$400: This is the major site of ATP synthesis when oxygen is present in the cell.

$500: This organelle produces triglycerides, cholesterol, and steroid hormones.

$600: These tiny sacs carry proteins and lipids to the cell surface for secretion.

$700: This is where synthesis of carbohydrates occurs.

Category 3: On the Move

$100: These are extensions of the cell membrane that help move materials like mucus over the surface of the cell.

$200: This serves as a guide for movement of materials, for separation of chromosomes during cell division, and for maintaining the shape of cells by assuming a compression-resisting role.

$300: Because of its extremely large size, this molecule cannot leave the nucleus through the nuclear pores.

$400: This structure give sperm cells motility.

$500: Proteins and lipids are packed in these to be transported to the outside of the cell.

$600: After amino acids are assembled into a protein they are carried to this organelle for the finishing touches.

$700: mRNA travels from the nucleus to this structure where the mRNA code is translated into amino acid sequence.

Category 4: Probing the Surface

$100: This is made up of a phospholipid bilayer and is the outer boundary of an animal cell.

$200: Receptors, enzymes, channels, motor, and cell adhesion molecules are all examples of this kind of molecule found in the cell membrane.

$300: This model describes proteins floating around in a sea of phospholipids.

$400: This is formed when plasma membranes of neighboring cells in a layer form a barrier that prevents leakage of extracellular fluid across the layer of cells.

$500: This membrane protein is critical for maintaining the concentration of Na^+ and K^+ which are different inside and outside of the cell.

$600: These connections provide cytoplasmic channels between adjacent animal cells.

$700: This membrane protein binds to ligands on the outside of the cell and transmits signals to the inside of the cell.

Activity B: Review of Organelle Structure and Function

Find a partner or partners as instructed by the peer leader and get a piece of newsprint paper and colored markers. Your will be assigned one or more cellular component(s) from the following list for the activity described below.

Nucleus	Golgi Body	Cytoskeleton
Ribosomes	Lysosomes	Plasma membrane
Rough Endoplasmic Reticulum	Mitochondria	
Smooth Endoplasmic Reticulum	Cytoplasm	

1. Draw the cellular component on the paper. Make it large and be as detailed as possible. You may use additional resources to get additional information.
2. Below the drawing describe the functions or special features of the organelle or structure.
3. Decide how you and your partner will present the drawing and information to the rest of the group. When you are called upon to present your drawing and description, take no longer than 2-3 minutes.

Activity C. The Interplay of Organelles

In this activity you will demonstrate the interplay of the organelles as a group. Read the following scenarios and make note of which organelles are involved. Assign roles to each member of the group. Then using the organelles that you created in Activity B as your "setting" act out the scenario. The italicized words are some of the "roles" that you might consider filling.

The cell responds to a hormone signal.

a) Signals that never physically enter the cell can, nevertheless, affect intracellular events. The term signal transduction refers to the series of events that occur between exposure of a cell to a signal and a response from within the cell.

b) An *extracellular signal* (*hormone*) binds to its specific *cell-surface receptor* on the plasma membrane.

c) The cell-surface receptor next undergoes a conformation (shape) change and activates an intracellular protein called a *second messenger*.

d) The second messenger continues the pathway by binding to other target proteins, and activating them. It may activate *membrane transport proteins* which move things like glucose into the cell.

e) It may activate *enzymes* which break down glucose to make ATP for the cell.

f) It may activate *RNA polymerase* to transcribe genes which will eventually give rise to proteins that the cell needs in order to best respond to the original signal.

Synthesis of a secretory protein.

a) *RNA polymerase* copies a gene from DNA to mRNA in the nucleus. The mRNA is transported out of the nucleus through the nuclear pores and then attaches to a *ribosome* on the rough ER.

b) The ribosome translates the mRNA into protein which then ends up on the inside of the *rough ER*.

c) The rough ER membrane buds off creating a *vesicle* containing the newly synthesized protein.

d) The protein-containing vesicle is transported to the *Golgi* and the contents are released into the inside of the Golgi lumen.

e) In the Golgi, the protein is further modified (Golgi folds and adds carbohydrate groups) then sorted into *transport vesicles* that pinch off the Golgi.

f) The transport vesicles carrying secretory proteins are targeted to the plasma membrane.

g) At the plasma membrane, the transport vesicles fuse and empty their contents to the outside of the cell.

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