

Chapter 16

CELL STRUCTURE AND FUNCTION

OVERVIEW: Cells as basic units of life; control of cellular metabolism-- from inside and outside; cellular membranes as *boundary*, *compartments*, and *channels*; membrane structure and how substances move in and out of cells

RECAPING: With this assignment, we enter the final part of our study, namely "Cell Biology." We have already made major inroads into this area through our study of mitosis, meiosis, DNA, and chromosomes. Indeed, we will have many opportunities to review as you are exposed to some "flashbacks" to previous topics. This will aid greatly as you prepare for the Final Exam which will be one-half *comprehensive* and the other half focusing on "Cell Biology." It may also be encouraging to know that the volume of reading will be much less, the total being less than eighty (80) pages for the rest of the quarter.

STRATEGY: Your reading/study assignment in Chapter 16, pages 367-391, introduces "Cell Biology." This chapter provides an overview of cellular organelles which we will reinforce as we move into our final topics in Chapter 17. Your experiences this week in laboratory will give you valuable visual experiences of the "Cells and Organelles."

BOARDS, NAILS:

cellular metabolism	<u>membrane parts:</u>	<u>processes:</u>
cytoplasm	proteins	diffusion
plasma membrane	phospholipids	osmosis
organelles		turgor
cell wall	<u>membrane properties:</u>	plasmolysis
chloroplasts	hydrophobic, hydrophilic	passive transport
mitochondria	differential permeability	active transport
endoplasmic reticulum	irreducible complexity	endocytosis
		exocytosis
		apoptosis

LEARNING GOALS:

1. You should be able to draw a "generalized cell" at least 3 cm in diameter and include cell membrane, cell wall, cytoplasm, nucleus, nucleolus, vacuole, and chloroplasts. Label each structure.
2. List four functional roles of membranes in cells and illustrate each by referring to a cellular structure.
3. Define *metabolism* (review Assignment #4) and explain how cellular metabolism is controlled from outside the cell and from within the cell. Illustrate each type of control by reference to a specific example.
4. Explain the molecular structure of biological membranes; namely, what types of large molecules are present, how are they arranged in the membrane, and how does water influence their arrangement?
5. Define *diffusion*, *osmosis*, *passive transport*, and *active transport*. How are they different?
6. Use your experiences from the "Cells and Organelles" Lab to discuss cell structure, diffusion, and osmosis.
7. Explain how apoptosis aids in embryonic development and in halting the spread of cancerous cells.
8. Explain how *lateral gene transfer* and the bacterial flagella demonstrate complexity in prokaryotic cells.

STUDY OUTLINE: CELL STRUCTURE AND FUNCTION

I. INTRODUCTION – RECAP OF PARTS I, II and III:

A. PARTS I and II — “ENVIRONMENTAL BIOLOGY”

B. PART III — “ORGANISMIC BIOLOGY”

C. NOW WE BEGIN PART IV — “CELL BIOLOGY”

PRINCIPLE: Since living matter is made of cells, ultimately all basic life processes involve what occurs in cells – i.e. cellular metabolism.

Cellular Metabolism = total of all the chem/physical processes that occur in cells

THEREFORE: To understand life processes, need to understand cellular metabolism

II CELL STRUCTURE – Review from “Cells and Organelles Laboratory”

A. EXERCISE – DRAW A CELL on paper -- c.m. + nucleus + E.R.

RESULT: ALL LINES represent M_____

B. **PRINCIPLE:** If cells are complex networks of membranes and if all living matter is composed of cells then the substance of living matter is...

C. MEMBRANE FUNCTIONS – Fig. 16-2, 16-3

1. TO REGULATE MOVEMENT – cell membrane regulates traffic in and out of the cell

Evidence from lab: _____

2. TO COMPARTMENTALIZE – organelles separate conflicting metabolic reactions

Examples: Chloroplasts (photosyn, autotrophs), mitochondria (site of respiration)

3. TO TRANSPORT – Golgi bodies act as intracellular “taxi services”

4. AS REACTIVE SURFACES -- hold enzymes, ribosomes

D. CASE IN POINT -- Unicellular organisms – e.g. *Paramecium*, *Amoeba*

> One cell “does it all” – performs all “Basic Life Functions”

E. QUESTION: How is cellular metabolism controlled in multicellular organisms?

F. TWO ASPECTS OF CONTROL:

1. From INSIDE the cell – via nucleus (DNA as genetic code → metabolic control system)
2. From OUTSIDE the cell – for example:
 - a. NEURONS –
 - b. HORMONES –
 - c. APOPTOSIS (programmed cell death) – proteins from outside bind to membrane and cell unleashes enzymes of cellular degradation inside
3. QUESTION: What controls the environment of each cell?

III. AS THE SPIRIT OF GOD MOVED OVER THE SURFACE OF THE WATERS, WHAT SUBSTANCE WOULD HE CREATE TO SERVE AS A MATRIX FOR LIFE ??

A. WATER HAS MARVELOUS PROPERTIES -- Section 16-E

PROPERTIES: _____

1. SALTS OR SUGARS –
2. SILICON (OF SAND) –
3. LIPIDS -- carbon-hydrogen chains
4. PHOSPHOLIPIDS = COMPROMISE (HEADS + TAILS) Figure 16-5
> Artificial membrane – hydrophobic and hydrophilic interactions

B. BIOLOGICAL MEMBRANES

1. STRUCTURE -- Evidence in FREEZE-FRACTURE technique
 2. PROPERTIES -- SELECTIVELY PERMEABLE
 - a. WATER -- moves READILY across
 - b. SALT IONS -- MOVE SLOWLY (CHARGED)
 - c. LARGE MOLECULES -- OBVIOUSLY IMPOSSIBLE (e.g. protein)
- >> SOLUTION: ENDOCYTOSIS –

III. WATER AND MEMBRANES -- THREE PROCESSES

A. DIFFUSION – defined as _____

B. OSMOSIS – defined as _____

NOTE: Here you should apply the experiences and visualizations of the “Cells and Organelles” Lab

C. PASSIVE TRANSPORT – particles move through membrane channels
down a concentration _____

D. ACTIVE TRANSPORT – movement of substances against a _____

E. ENDOCYTOSIS / EXOCYTOSIS – macromolecules move across membrane when
the membrane engulfs or expels substances.

IV. THE CELL DIFFERENTIATION DILEMMA -- Introduction to Gene Expression

A. THE QUESTION: If all cells of a multicellular organism originate from the zygote by mitosis and cytoplasmic division, how can they become so different in form and function? That is, what allows for differentiation?

B. THE ANSWER (Theory):