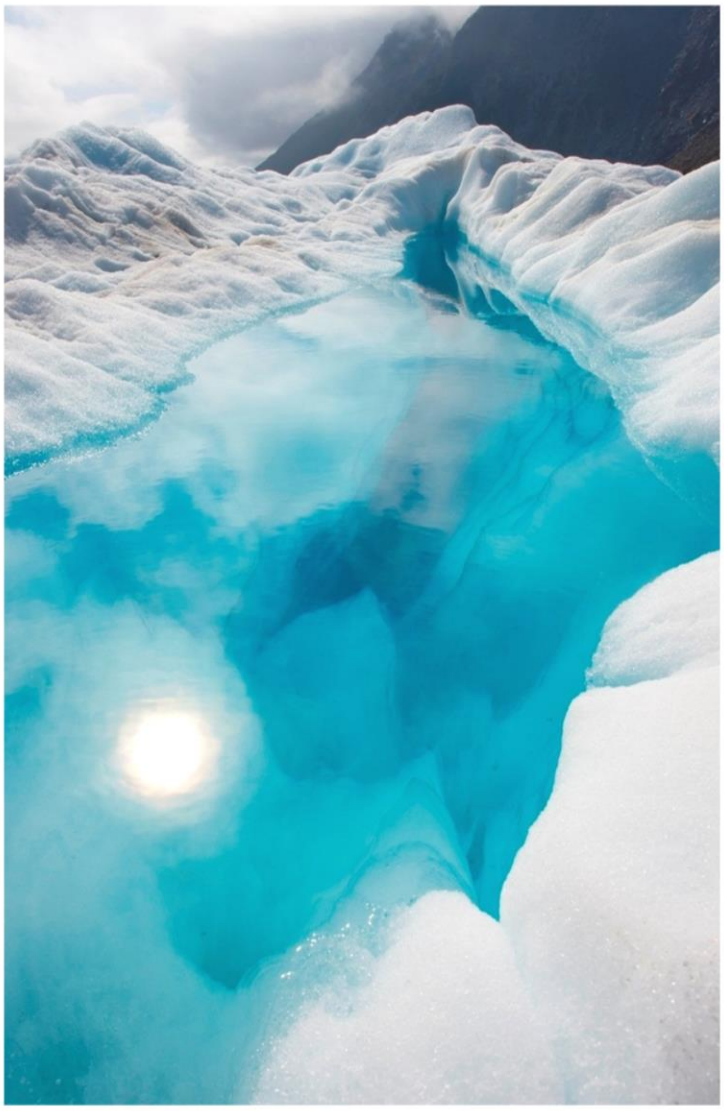


Introduction to cell biology

CHAPTER (1)
PART (1)

Done by: Abdelhadi Okasha
1st Sheet

Important information are Highlighted in the sheet, if you don't have time, just study them

1.0 | Introduction (not important)

→ All living organisms and their organs are made of cell.
→That's why :We study the origin of cells to know the origin of life.
→Some cells are used as medicines

1.1 | The discovery of cells

→Cells are the topic of intense study.
→The study of cells requires creative instruments and techniques.
→Cell biology is *reductionist*, based on the premise that studying the parts of the whole can explain the character of the whole.

→Some Information about microscopes:
1. They Were used to discover cells (as cells are very small to be seen)
2. Robert Hooke invented the first microscope, it had double lens
3.Then the microscope was refined (تم تحسينه) by Anton Leewenhoek, it had single lens
4. Cells were named like that (by Robert hooke) because they reminded him of the cells inhabited by monks living in a monastery.
ذكروه بالغرف اللي كان يسكنها الرهبان في الصوامع
5. Leeuwenhoek was the first to examine a drop of pond water under the microscope and observe the teeming microscopic "animalcules"(الاسم اللي سمى فيه الخلايا) that darted back and forth.

Leewenhoek: single lens microscope

Hooke: double lens microscope

→Now we'll speak about very important theory (cell theory):
The cell theory was articulated in the mid-1800s by Matthias Schleiden, Theodor Schwann and Rudolf Virchow.

Very important

1) All organisms are composed or one or more cells.
2) The cell is the structural and functional unit of life.
3) Cells arise only by division from a pre-existing cell.

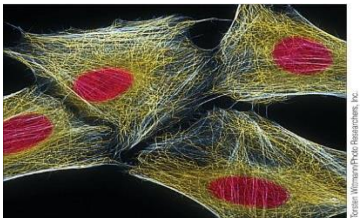
1.2 | Basic Properties of Cells

→Life and death are the most basic properties of cells.

→To study properties of cells in easy way, we need to isolate them in **vitro**, as cells can grow and reproduce in culture for extended periods. (So isolation and culturing are important to study cells)

→ The first human cells that had been isolated in extended cultures are called HeLa cells (very important information)

→**HeLa cells** are cultured tumor cells isolated from a cancer patient (Henrietta –'p Lacks) by George and Martha Gey in 1951, they're still alive until today.



→Now we'll mention all basic properties of cells, then we'll explain each point in details:

1. Cells are highly complex and organized
2. Cells Possess a Genetic Program and the Means to Use It
3. Cells Are Capable of Producing More of Themselves
4. Cells Acquire and Utilize Energy
5. Cells Carry Out a Variety of Chemical Reactions
6. Cells Engage in Mechanical Activities
7. Cells Are Able to Respond to Stimuli
8. Cells Are Capable of Self-Regulation
9. Cells evolve (*)

ملاحظة: شبه أكيد في الامتحان سيأتي سؤال:
Which of the following is not a basic property of cells?
فاحفظ النّقاط التسعة كاملين
لسماع النقاط التسعة لأجل الحفظ اضغط هنا

let's explain each point in details:

1. Cells are highly complex and organized

→Cellular processes are highly regulated.

→ Cells from different species share similar structure, composition and metabolic features that have been conserved.

→Structure is related to function.

أي مجموعة من أي إشي قبل سهم هي عنصر واحد من اللي بعده
Atoms → Molecules → polymers → complexes → organelles → cells
e.g. Group of molecules form a polymer

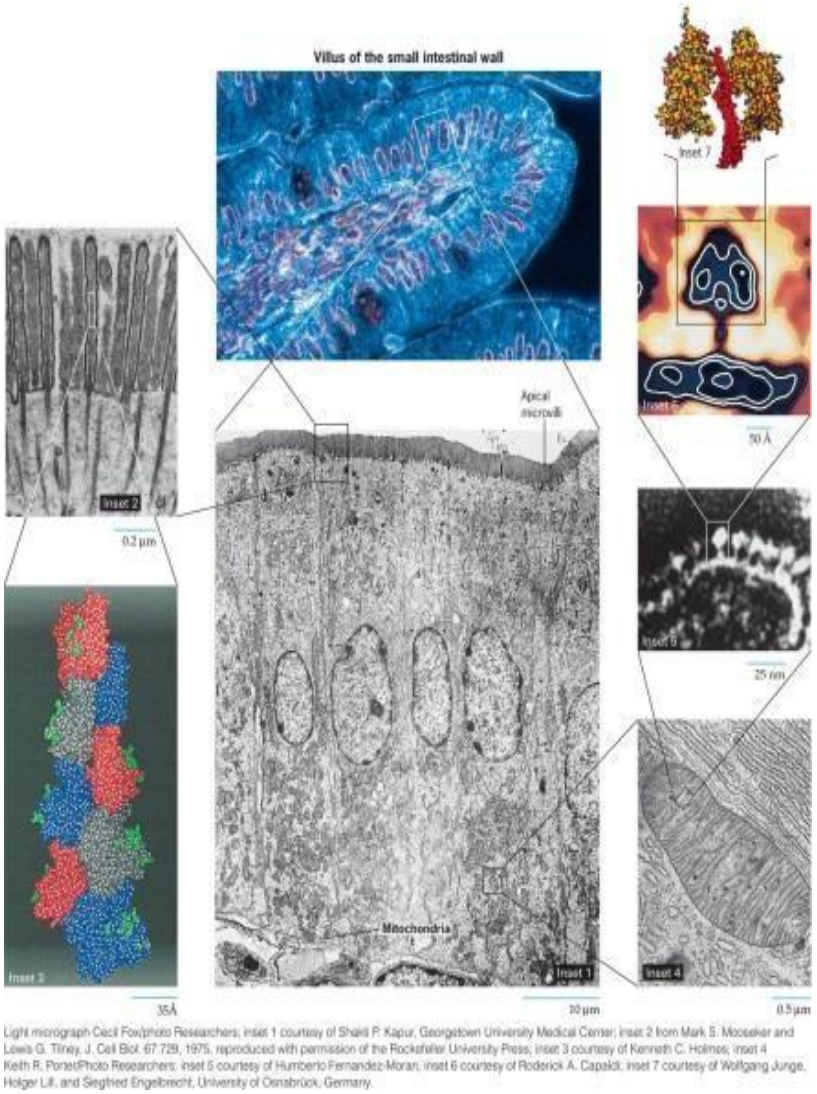
→ Let's speak about two examples on the golden rule (structure is related to function)

a)

The epithelial cells that line the intestine are tightly connected to each other like bricks in a wall (Figure 1.3 inset 1). The apical ends of these cells, which face the intestinal channel, have long processes (*microvilli*) that facilitate absorption of nutrients (inset 2). The microvilli are able to project outward from the apical cell surface because they contain an internal skeleton made of filaments, which in turn are composed of protein (*actin*) monomers polymerized in a characteristic array (inset 3)

b)

At their basal ends, intestinal cells have large numbers of mitochondria (inset 4) that provide the energy required to fuel various membrane transport processes. Each mitochondrion is composed of a defined pattern of internal membranes, which in turn are composed of a consistent array of proteins, including an electrically powered ATP-synthesizing machine that projects from the inner membrane like a ball on a stick (insets 5–7).



Light micrograph Cecil Fox/photo Researchers; inset 1 courtesy of Shakil P. Kapur, Georgetown University Medical Center; inset 2 from Mark S. Mooseker and Lewis G. Tilney, J. Cell Biol. 67:729, 1975, reproduced with permission of the Rockefeller University Press; inset 3 courtesy of Kenneth C. Holmes; inset 4 Keith R. Porter/Photo Researchers; inset 5 courtesy of Humberto Fernandez-Moran; inset 6 courtesy of Roderick A. Capaldi; inset 7 courtesy of Wolfgang Junge, Holger Lill, and Siegfried Engelbrecht, University of Osnabrück, Germany.

2. Cells Possess a Genetic Program and the Means to Use It
→Organisms are built according to information encoded in a collection of genes.
→This information is packaged into a set of chromosomes that occupies the space of a cell nucleus in eukaryotic cells.
→In prokaryotic cells, this information is represented in a circular DNA.
→ Genes (function:) store information and constitute the blueprints (why:) a) for constructing cellular structures, b)the directions for running cellular activities, and c) the program for making more of themselves. (How all of this occurs?)
DNA is transcribed to mRNA, that is translated to polypeptides, these polypeptides will form functional active native proteins that do all of the previous points in addition to most of the cell functions
→The molecular structure of genes allows for changes in genetic information (mutations) that lead to variation among individuals, which forms the basis of biological evolution(*).

3. Cells Are Capable of Producing More of Themselves

→ Cells reproduce by division, a process in which the contents of a "mother" cell are distributed into two "daughter" cells.

→Prior to division, the genetic material is faithfully duplicated, and each daughter cell receives a complete and equal share of genetic information.

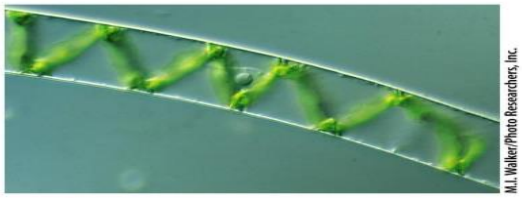
Mammalian oocyte after unequal cell division to produce polar body (arrow)

4. Cells Acquire and Utilize Energy

→ Photosynthesis provides fuel for all living organisms.

→ Animal cells derive energy from the products of photosynthesis, mainly in the form of glucose.

→Cells can convert glucose into ATP—a substance with readily available energy.



Spirogyra: alga with ribbon-like chloroplast for photosynthesis

5. Cells Carry Out a Variety of Chemical Reactions

→ Cells function like miniaturized chemical plants, A bacterial cell for example is capable of hundreds of chemical reactions.

→Virtually all chemical changes that take place in cells require enzymes to increase the rate at which a chemical reaction occurs.

→Enzymes: substances that catalyze reactions without being consumed

→ Cell's metabolism: The sum of the chemical reactions in a cell.

6. Cells Engage in Mechanical Activities

→Examples on mechanical activities:

a) transport materials

b) assemble and disassemble structures

c) move itself from one site to another.

→These mechanical activities are based on dynamic, mechanical changes in cells

→ Many types of molecular "machines" are used for mechanical activities. (e.g. motor proteins : used for initial of some mechanical activities by changing their shape)

7. Cells Are Able to Respond to Stimuli

→ What are substances that cause stimuli?

1)Hormones, 2)growth factors, 3)extracellular materials, and 4)substances on the surfaces of other cells

→How do these substances (stimulators) work?

Cells in plants or animals are covered with receptors, these receptors interact with substances in the environment.

→How can cells respond to stimuli?

by 1)altering their metabolism, or 2)moving from one place to another, or 3)even committing suicide.

E.g. on stimulation: A single-celled protest can move away from an object in its path or toward nutrients.

8. Cells Are Capable of Self-Regulation

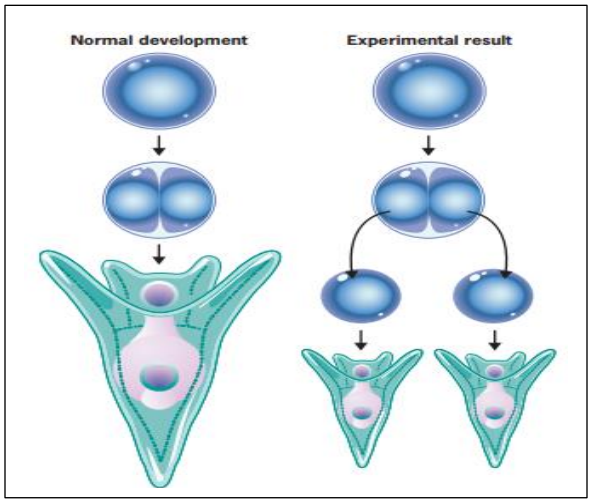
→Cells are robust (strong) and are protected from dangerous fluctuations(Changes) in composition and behavior.

→How that happens?

by Feedback circuits that serve to return the cell to the appropriate state.

→Maintaining a complex, ordered state requires (what?) constant regulation.

e.g. when we separate 2 or 4 urchin embryo cells, each of these separated cells will form an isolated embryo.



قال ابن القيم رحمه الله: «فالمؤمن المخلص لله من أطيب الناس عيشًا، وأنعمهم بالاً، وأشرحهم صدرًا، وأسرّهم قلبًا، وهذه جنةٌ عاجلةٌ قبل الجنة الآجلة».

الداء والدواء [٢٧٩]