

تركيب الخلية Cell structure

نظرية الخلية Cell theory:

- خلية واحدة أو أكثر قد يتكون مخلوق كل
1. Each organism consist of one or more cells.
 2. A cell is the smallest unit of life.
 3. Each new cell arises from another preexisting cell.
 4. Cell passes hereditary material (DNA) to its offspring.
 5. Cell is structural and functional unit of organisms.

الخلايا مكونات Components of all cells:

- ماء خليط مثل جلي مادة سائلة سيمتوبلازم
1. **Cytoplasm:** semifluid substance jelly like mixture (water - sugars - ions proteins).
موقع التمثيل الغذائي الخلوي هو موقع
- site of cells metabolism.
 2. **Plasma membrane:** الغشاء البلازمي
داخل وخارج تتحرك المواد نفاذية اختيارية
- (selectively permeable) substances move in and out.
طبقة دهنية ثنائية يتكون من
- consist of lipid bilayer.
 3. **Organ Elle:** carries out specialized metabolic function
الخلية داخل
inside cell.
لنسبة إلى الحجم تنبأ الخلايا جميع
All cells start out volume ratio:
مع يزداد الملائن حجم التي يربط العلاقة
- relationship in which volume of an object increase with
مربع مع تزداد المناطق السطحية لكن تظهر مكعب
cube of diameter. But surface areas increase with square
القطر
of diameter.
على تسلسلها يؤثر و حجم الخلية يحدد
- limits cell size and influences cell shape.

ميكروسكوبات الخلايا نرى كيف
How do we see cells: (microscopes)

تركيبه الغشاء الخلوي
Cell membrane: structure

دهون حفسفرة

- Phospholipids.

نموذج فسيفساء السوائل

- Fluid mosaic model.

ولها أيضا الغشاء معظم تنفذ بروتينات الغشاء
Membrane proteins: carry out most membrane functions.

البروتين الالتصاق

1. Adhesion protein.

بروتين المستقبلات

2. Receptor protein.

بروتين التعرف

3. Recognition protein.

بروتين النقل

4. Transport protein.

بدائيات النواة

Prokaryotes:

بدائيات بكتيريا مجالاتها

- domains (bacteria - archaea).

أصغر وأيضية و صغيرة

- Smallest and metabolically diverse life.

المحيط الجبوي المناطق كل تعيش في

- Inhabit all regions of biosphere.

جسم بدائيات النواة

Prokaryote body plan:

سيتوبلازم

1. Cytoplasm:

تخليق البروتين الريبوسومات

- Ribosomes (protein synthesis).

بلازميد جينات تحوي

- Contain genes as (plasmids).

تحوي

- Contain DNA.

جدار خلوي

2. Cell wall:

منفذ لكن شبه مبد

- Semirigid but permeable.

من يتكون

- Consist of :

بكتريا عديد المتسكر و ببتيد
 a) Peptide and polysaccharides (bacteria).
 بروتينات

b) Proteins (archaeas)

جدار الخلية تحاطب عديد المتسكر من كسولة عصبوية
 - Stick capsule of polysaccharids surrounds cell wall.

3. Pili: protein filaments used for (help cells move
 في التحرك نقل البلازميد أو عبر السطوح
 across surfaces or for plasmid transfer).

4. Flagella: for mobility.
 للحركة السوط

الخلايا حقيقية النواة

Eukaryotic cells:

حركة يتحكم يغلف غير واضح مسامات نواة

1) Nucleus: pores in unclear envelope control movement of
 النواة خارج و داخل الجزيئات
 molecules into and out of nucleus.

2) Endomembrane system:
 نظام الأغشية الداخلية

شبكة داخلية اندوبلازمية ناعمة و خشنة
 - (Rough and smooth endoplasmic reticulum)

أحسام جولجي والحويصلات
 - (vesicles: Golgi bodies)

العشاء و النواة بين عضيات تتفاعل
 - Interacting organelles between nucleus and plasma

البلازما
 membrane.

البروتينات و الدهون تُعدل و تصنع
 - Make and modifies (lipids and proteins)

أجزاء الخلايا الميتة الجزيئات إعادة تدوير
 - Recycles molecules such as worn-out cell parts.

السموم تعطيل
 - Inactivates toxins.

إنتاج البروتين الشبكة الاندوبلازمية
 rough ER: protein production.
 الخشنة

لا تملك ريبوسومات الشبكة الاندوبلازمية الناعمة
 - Smooth ER: has no ribosomes.

حلوته من يقلل تنقل تخزين الحويصلات
 vesicle: stores – transports – degrades its contents.

المواد السامة أو فضلات أو تعزل فجوة
 vacuole: isolates or disposes of wastes or toxic materials.

هضم داخل الخلايا ليسوسوم

lysosome: intra cellular digestion.

السامة و الأحماض دهنية الأحماض أمينية تحطيم

peroxisome: breaks down amino acids fatty acid and toxic

المواد materials.

جسم جولجي

Golgi body:

الدهون و عديد الببتيد يعدل

- modifies polypeptide and lipid.

نقل في المنتجات يعلب و يخزن

- Sort and packages products into transport

حويصلات vesicles.

تنتج ميتوكوندريا

mitochondria: produces ATP.

البناء الضوئي كلوروبلاست

chloroplast: photosynthesis.

الهيكل الخلوي

cytoskeleton:

الخيوط البروتينية من نظام ديناميكي

- Dynamic system of protein filaments.

البروتينات المحركة البروتينات التبعية مع يتفاعل

- Interacts with accessory proteins (motor proteins).

عناصر الهيكل الخلوي

Cytoskeletal Elements:

1) Microtubules:

الخلايا تحرك

- Movement of cells.

الأهداب و الأسواط تحرك

- Movement flagella and cilia.

حركة

2) Microfilament: movement of pseudopods.

الأسنجة و الخلايا دعم

3) Intermediate filament: support cells and tissues.-

مع في التفاعل البروتين يستخدم الطاقة البروتينات المحركة

Motor proteins: energy: using protein that interact with

ليحرك أجزاء الخلية عناصر الهيكل الخلوي

cytoskeletal elements to move cells parts.

السوائل ضرب تنسق أهداب

cilia: coordinated beating stirs fluid.

تركيب حركي الأسواط
flagella: motile structure.

غرف و في الحركة خلايا حقيقية النواة بعض تسامد
pseudopods: helps some eukaryotic cells move and engulf
الفريسة
prey.

الأميبا مثال
example: amoebas

المادة الخلوية الخارجية
extra cellular matrix (ECM):

الأنسجة و الملايا تدعم
Supports cells and tissues.
خلايا إرسال الإشارات
- Signaling cell.

cuticle:

من نوع
- Type of (ECM).
غطاء للحماية المفصليات و النباتات موجودة في
- Found in plants and arthropods (protective covering).

أو الأخرى إلى الخلية تفضل تقاطعات الخلايا
Cell junctions: connect a cell to another or to ECM:

- تقاطع ضيق
1) Tight junction.
تقاطع الالتحام
2) Adhering junction.
تقاطع فجوي
3) Gap junction.

عن طريق
Cell junctions in plants: by plasmodesmata .

إشارات مغذيات ماء للمواد تسمح القنوات جعل
- Make channels allow material (H₂O – nutrients) signaling
تتدفق خلايا إلى الجزيئات
molecules to flow through.

تختص للمخلوقات الحية الحياة طبيعة
Nature of life: (living things only):

- تتكون من خلية واحدة أو أكثر
1) Consist of one or more cells.

للحياة الجزيئات العضوية تستخدم وتصنع

2) Make and use organic molecules of life.

الأيض العمليات البيولوجية الذاتية

3) Self-sustain biological processes (metabolism).

عمر ناضج بتغير الوقت حياتها مدى تتغير

ب إعادة إنتاجها

5) Reproduce by DNA.

يمكن أن تتغير عبر الأجيال يكتسب

6) Can change over generation.

بكتريا

bacteria:

الغلاف الحيوي اجزاء كل بي توجده

- found in all parts of biosphere.

مفيدة أمعاء جسم الإنسان في توجد

- Found in human body (intestine) beneficial.

الغذاء الملوث أمراض تسبب

- Causes disease (contamination food).

مثال

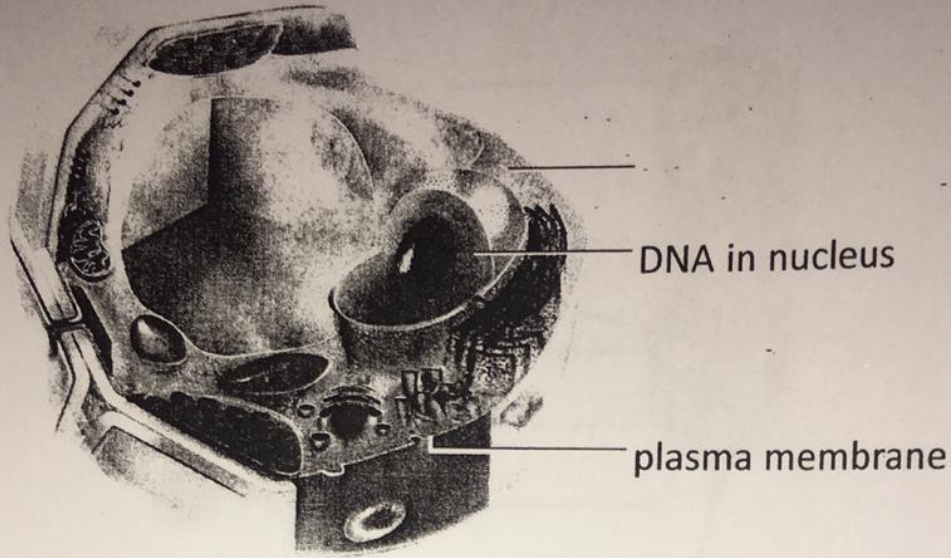
example: E-Coli

تتقيم الطعام الحماية من البكتريا

protecting from bacteria: sterilizing food.

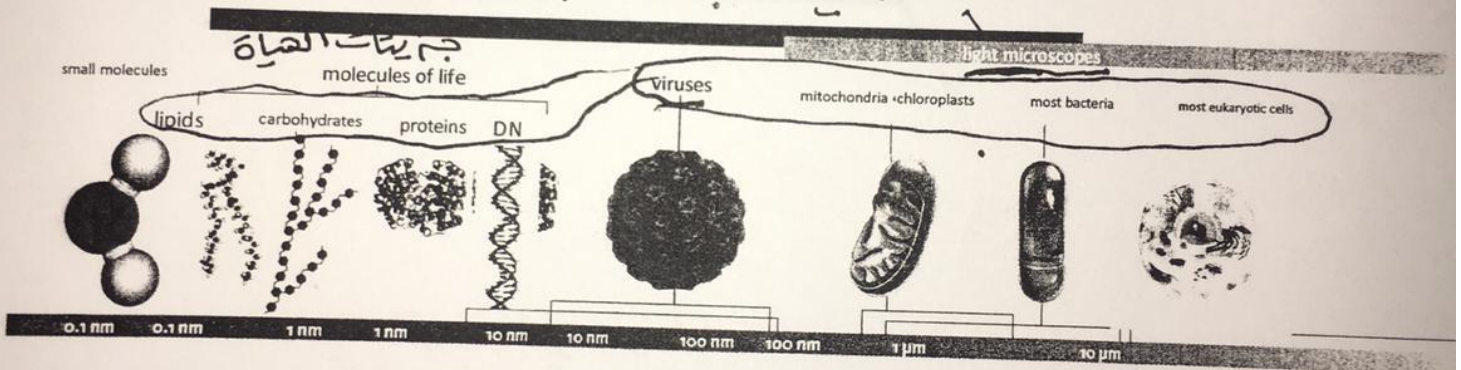
لا توجد في الحيوان لكن فحوة مركزية كبيرة تحتوي على نباتات

Plants: contain a large central vacuole but not animals.



حزرا اما بالميكر وسكون

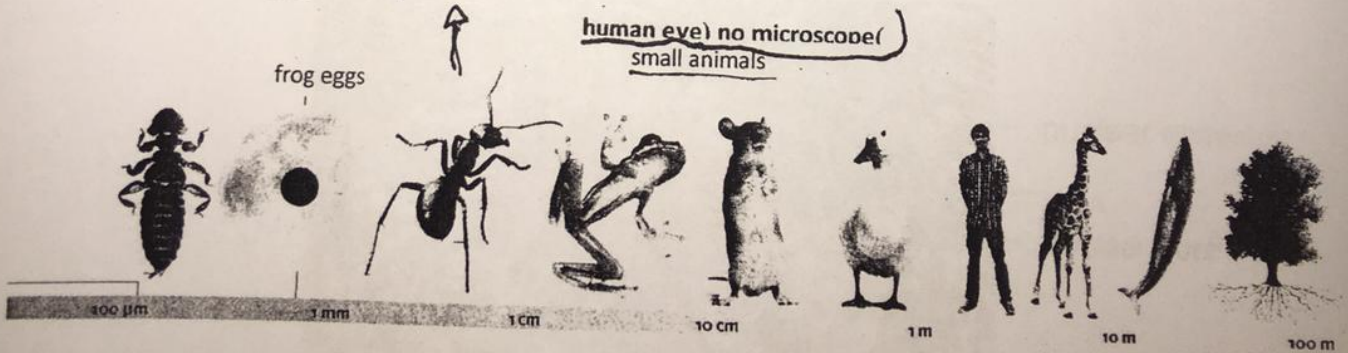
حزرا في



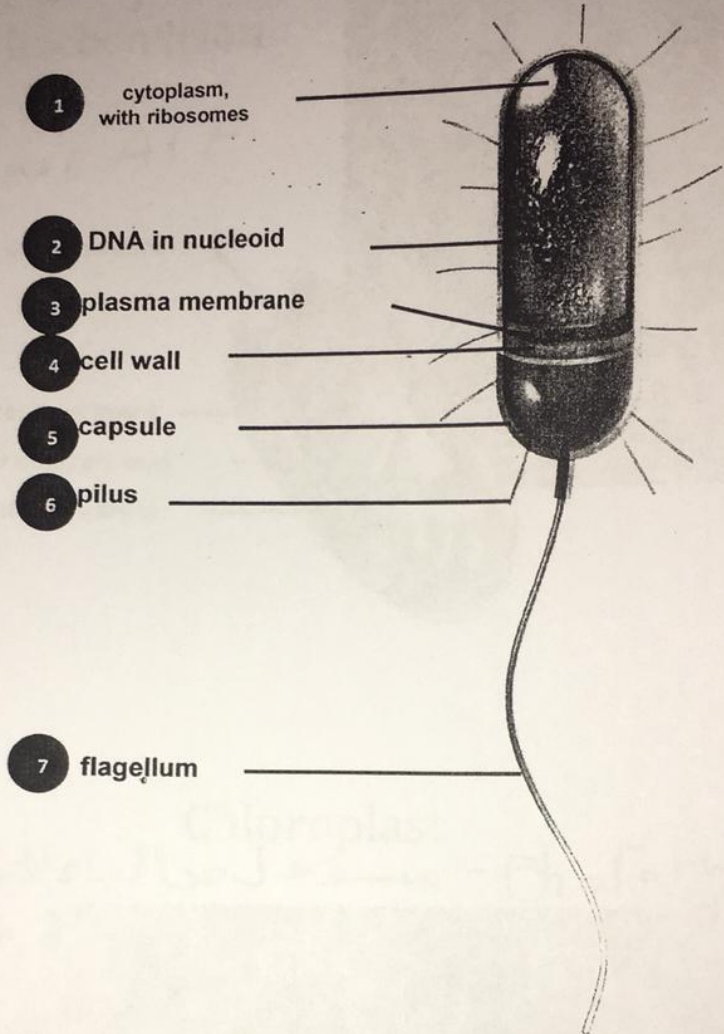
حزرا اما بالعين

human eye) no microscope(

small animals



جسمه بدائيات النواة
Prokaryote Body Plan



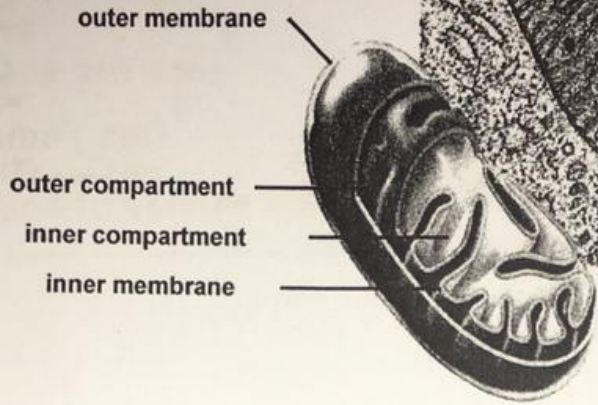
النواة في الخلية
Nucleus of a Cell



- nuclear envelope
- DNA
- nuclear pore

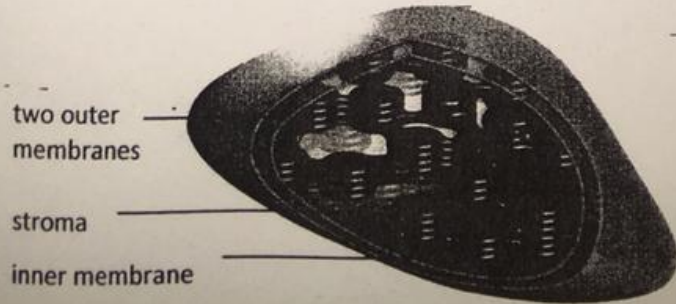
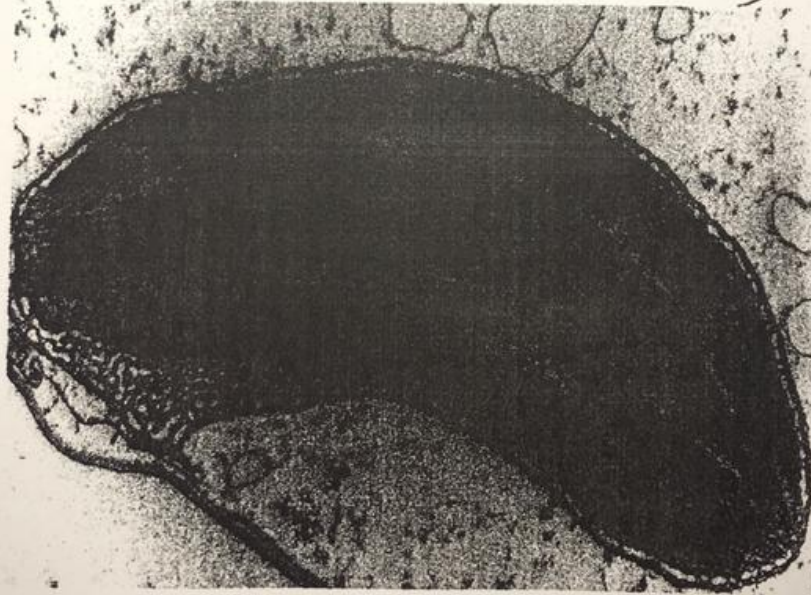
تنتج الـ ATP
Mitochondrion

Produce ATP



0.5 μm

Chloroplast
Photosynthesis - مسؤولة عن البناء الضوئي



محددات حجم الخلية

Constraints on Cell Size

قطر

قطر الخلية

	2	3	6
Diameter (cm)	2	3	6
Surface are (cm) ²	12.6	28.2	113
Volume (cm) ³	4.2	14.1	113
Surface-to-volume ratio	3:1	2:1	1:1

حجم الخلية

نسبة مساحة السطح إلى الحجم

Summary



Section 3.1 Bacteria are found in all parts of the biosphere, including the human body. Huge numbers inhabit our intestines, but most of these are beneficial. A few can cause disease. Contamination of food with disease-causing bacteria can result in food poisoning that is sometimes fatal.

Section 3.2 Cells differ in size, shape, and function, but all start out life with a **plasma membrane**, **cytoplasm**, and a region of DNA. Most cells have additional components.

In eukaryotic cells, DNA is contained within a **nucleus**, which is a membrane-enclosed **organelle**. All cell membranes, including the plasma membrane and organelle membranes, are selectively permeable and consist mainly of phospholipids organized as a lipid bilayer. The **surface-to-volume ratio** limits cell size.



By the **cell theory**, all organisms consist of one or more cells; the cell is the smallest unit of life; each new cell arises from another, preexisting cell; and a cell passes hereditary material to its offspring.



Section 3.3 A cell membrane can be described as a **fluid mosaic**, which means it behaves like a two-dimensional liquid of mixed composition—lipids (mainly phospholipids) and proteins. The lipids are organized as a double layer in which the nonpolar fatty acid tails of both layers are sandwiched between the polar heads.

All cell membranes may have enzymes and **transport proteins**. Plasma membranes can also incorporate **receptor proteins**, **adhesion proteins**, and **recognition proteins**.

Section 3.4 Bacteria and archaea, informally grouped as “prokaryotes,” are the most diverse forms of life. These single-celled organisms have no nucleus, but all have DNA and **ribosomes**. Many have a permeable but protective **cell wall** and a sticky capsule, as well as motile structures (**flagella**) and other projections (**pili**). Bacteria and other microbial organisms often share living arrangements in **biofilms**.



Section 3.5 All eukaryotic cells start out life with a nucleus and other organelles. The nucleus protects and controls access to the cell's DNA. Membrane proteins form pores in the **nuclear envelope** that control the movement of molecules into and out of the nucleus.

Endoplasmic reticulum (ER) is a continuous system of sacs and tubes extending from the nuclear envelope. Ribosome-studded rough ER makes proteins; smooth ER makes lipids and breaks down carbohydrates, fatty acids, and some toxins. **Golgi bodies** modify proteins and lipids before sorting them into vesicles. Different types of **vesicles** store, degrade, or transport substances through the cell. Enzymes in **peroxisomes** break down substances such as amino acids, fatty acids, and toxins. **Lysosomes** contain enzymes that break down wastes and cellular debris for

recycling. Fluid-filled **vacuoles** have various functions, including storage and disposal of wastes and toxins. A large central vacuole keeps plant cells plump.

Other eukaryotic organelles include **mitochondria** (which produce ATP by aerobic respiration) and **chloroplasts** (which specialize in photosynthesis).



A **cytoskeleton** organizes a eukaryotic cell's interior, reinforces its shape, and helps move its parts. Interactions between ATP-driven **motor proteins** and hollow, dynamically assembled **microtubules** bring about movement of cells and cell parts such as eukaryotic flagella and cilia. A **microfilament** mesh reinforces plasma membranes. Elongating microfilaments help bring about movement of **pseudopods**. **Intermediate filaments** support cells and tissues.

Section 3.6 Many cells secrete an **extracellular matrix (ECM)** that has different functions depending on the cell type. In animals, a secreted basement membrane supports and organizes cells in tissues. Plant cells, fungi, and many protists secrete a wall around the plasma membrane. A **cuticle** is an ECM secreted by cells at a body surface.



Cell junctions connect cells to one another and to their environment. Plasmodesmata connect the cytoplasm of adjacent plant cells. In animals, gap junctions form open channels between adjacent cells; adhering junctions anchor cells to one another and to basement membrane; and tight junctions form a waterproof seal between cells in some tissues.



Section 3.7 All living things make and use the molecules of life; consist of one or more cells that engage in self-sustaining biological processes; change over their lifetime; and pass their DNA to offspring that can change over generations.

Self-Quiz

Answers in Appendix I

- Despite the diversity of cell type and function, all cells have these three things in common:
 - cytoplasm, DNA, and organelles with membranes
 - a plasma membrane, DNA, and a nuclear envelope
 - cytoplasm, DNA, and a plasma membrane
 - a cell wall, cytoplasm, and DNA
- Every cell is descended from another cell. This idea is part of _____.
 - evolution
 - the theory of heredity
 - the cell theory
 - cell biology
- The surface-to-volume ratio _____.
 - does not apply to prokaryotic cells
 - is part of the cell theory
 - constrains cell size
 - b and c
- True or false? Some protists start out life with no nucleus.
- Unlike eukaryotic cells, prokaryotic cells _____.
 - have no plasma membrane
 - have RNA but not DNA
 - have no nucleus
 - a and c
- Cell membranes consist mainly of _____ and _____.
 - lipids; carbohydrates
 - phospholipids; proteins
 - lipids; carbohydrates
 - phospholipids; ECM

7. Most membrane functions are carried out by _____.
- a. proteins
 - b. phospholipids
 - c. nucleic acids
 - d. hormones
8. Which of the following statements is correct?
- a. Ribosomes are only found in bacteria and archaea.
 - b. Some animal cells are prokaryotic.
 - c. Only eukaryotic cells have mitochondria.
 - d. The plasma membrane is the outermost boundary of all cells.
9. In a lipid bilayer, the _____ of all the lipid molecules are sandwiched between all of the _____.
- a. hydrophilic tails; hydrophobic heads
 - b. hydrophilic heads; hydrophilic tails
 - c. hydrophobic tails; hydrophilic heads
 - d. hydrophobic heads; hydrophilic tails
10. The main function of the endomembrane system is _____.
- a. building and modifying proteins and lipids
 - b. isolating DNA from toxic substances
 - c. secreting extracellular matrix onto the cell surface
 - d. producing ATP by aerobic respiration
11. Enzymes contained in _____ break down worn-out organelles, bacteria, and other particles.
- a. lysosomes
 - b. mitochondria
 - c. endoplasmic reticulum
 - d. peroxisomes
12. Put the following structures in order according to the pathway of a secreted protein:
- a. plasma membrane
 - b. Golgi bodies
 - c. endoplasmic reticulum
 - d. post-Golgi vesicles
13. No animal cell has a _____.
- a. plasma membrane
 - b. flagellum
 - c. lysosome
 - d. cell wall
14. _____ connect the cytoplasm of plant cells.
- a. Plasmodesmata
 - b. Adhering junctions
 - c. Tight junctions
 - d. Adhesion proteins
15. Match each cell part with its main function.
- | | |
|------------------------|-----------------------------------|
| <u>6</u> mitochondrion | a. connects cells |
| <u>9</u> chloroplast | b. protective covering |
| <u>e</u> ribosome | c. ATP production |
| <u>d</u> nucleus | d. protects DNA |
| <u>H</u> cell junction | e. protein synthesis |
| <u>F</u> flagellum | f. maintains internal environment |
| <u>A</u> cell membrane | g. photosynthesis |
| <u>b</u> cuticle | h. movement |

Digging Into Data

Organelles and Cystic Fibrosis

CFTR is a transport protein in the plasma membrane of cells lining cavities and ducts of the lungs, liver, pancreas, intestines, and reproductive system. The transporter moves chloride ions out of the cells. Water that follows the ions creates a thin film that allows mucus to slide easily through these structures.

People with cystic fibrosis (CF) have too few copies of the CFTR protein in the plasma membranes of their cells. Not enough chloride ions leave the cells, and so not enough water leaves them either. The result is thick, dry mucus that clogs the airways to the lungs and other passages. Symptoms include difficulty breathing and chronic lung infections.

In most people with CF, one amino acid of the CFTR protein is missing. A protein with this change is made correctly, and it can transport ions correctly, but it never reaches the plasma membrane to do its job. In 2000, researchers investigated the cellular location of the defective protein (Figure 3.17).

- Which organelle contains the least amount of CFTR protein in normal cells? In cells with the deletion?
- In which organelle is the amount of CFTR protein most similar in both types of cells?
- Where is the CFTR protein with the deletion getting held up?

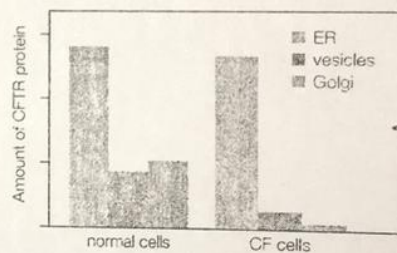


FIGURE 3.17 Amounts of CFTR protein associated with endoplasmic reticulum, vesicles traveling from ER to Golgi, and Golgi bodies in CF cells and normal cells. © Cengage Learning.

Critical Thinking

- In a classic episode of *Star Trek*, a gigantic amoeba engulfs an entire starship. Spock blows the cell to bits before it has a chance to reproduce. Think of at least one problem a biologist would have with this particular scenario.
- In plants, the cell wall forms as a young plant cell secretes polysaccharides onto the outer surface of its plasma membrane. Being thin and pliable, this primary wall allows the cell to enlarge and change shape. At maturity, cells in some plant tissues deposit material onto the primary wall's inner surface. Why doesn't this secondary wall form on the outer surface of the primary wall?



P.L. Walne and J.H. Armit, *Paramecium*, 77:325-354, 1967.

- A student is examining different samples with a microscope. She discovers the single-celled organism above swimming in water from a freshwater pond. What kind of microscope is she using? light
- Which structures can you identify in the organism above? microscope
Is it a prokaryotic or eukaryotic cell? chloroplast = eukaryotic