1. **Pick up** Name Folder

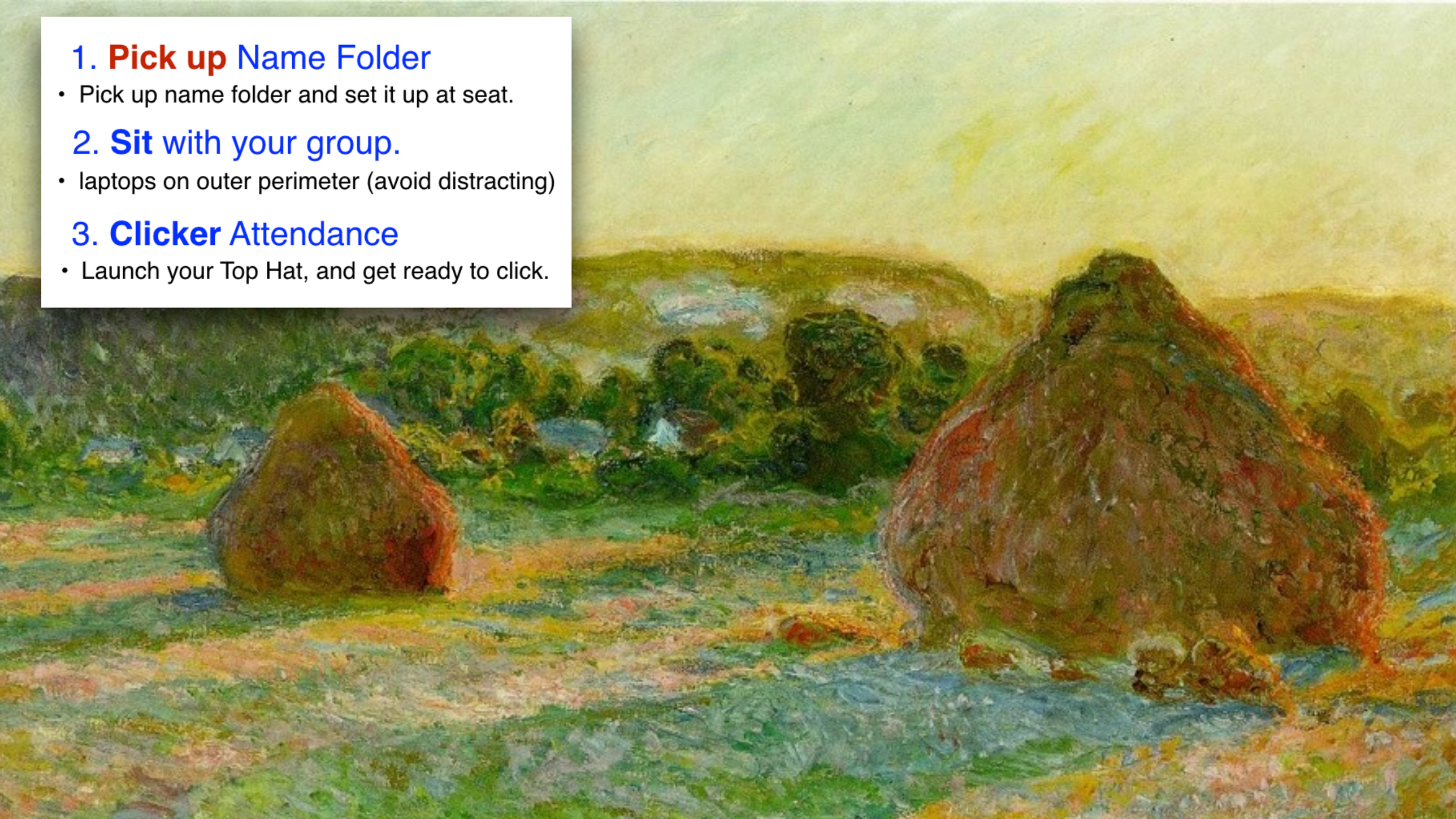
- Pick up name folder and set it up at seat.

2. **Sit** with your group.

- laptops on outer perimeter (avoid distracting)

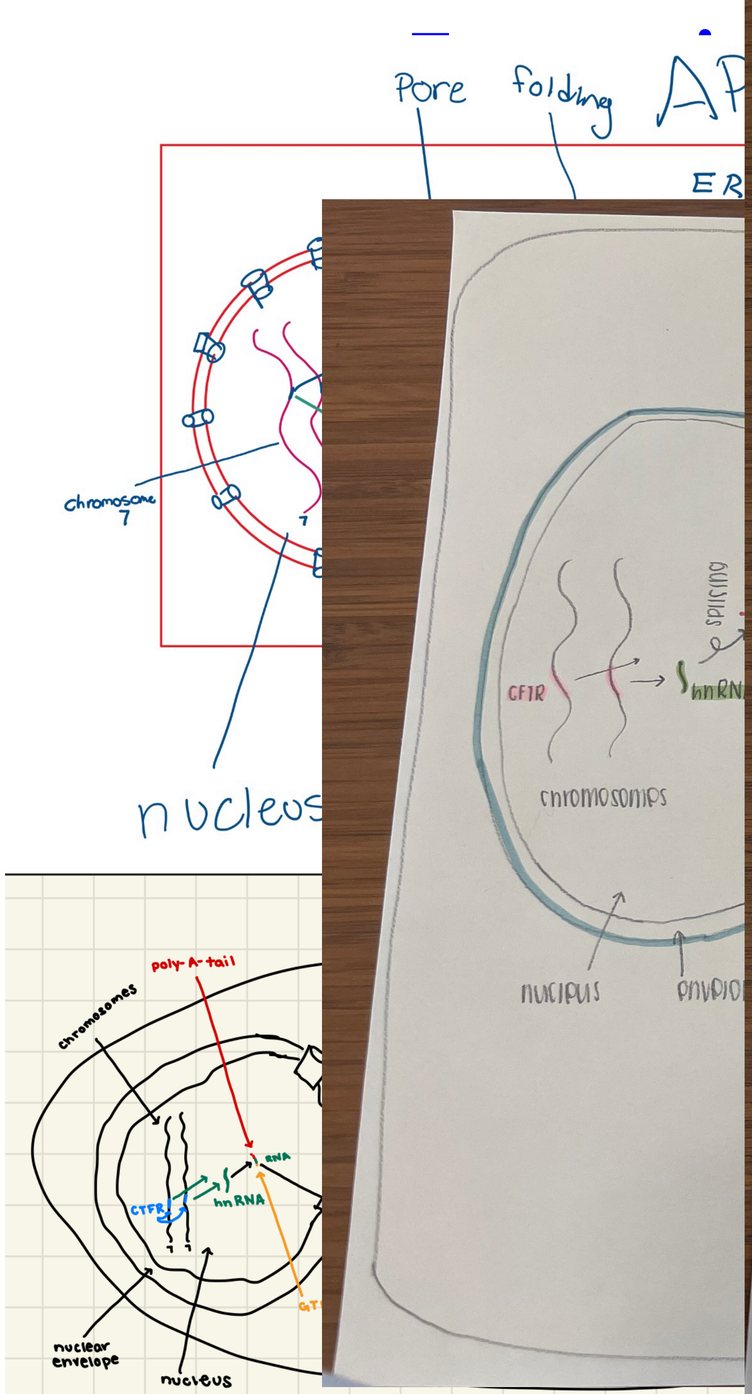
3. **Clicker** Attendance

- Launch your Top Hat, and get ready to click.



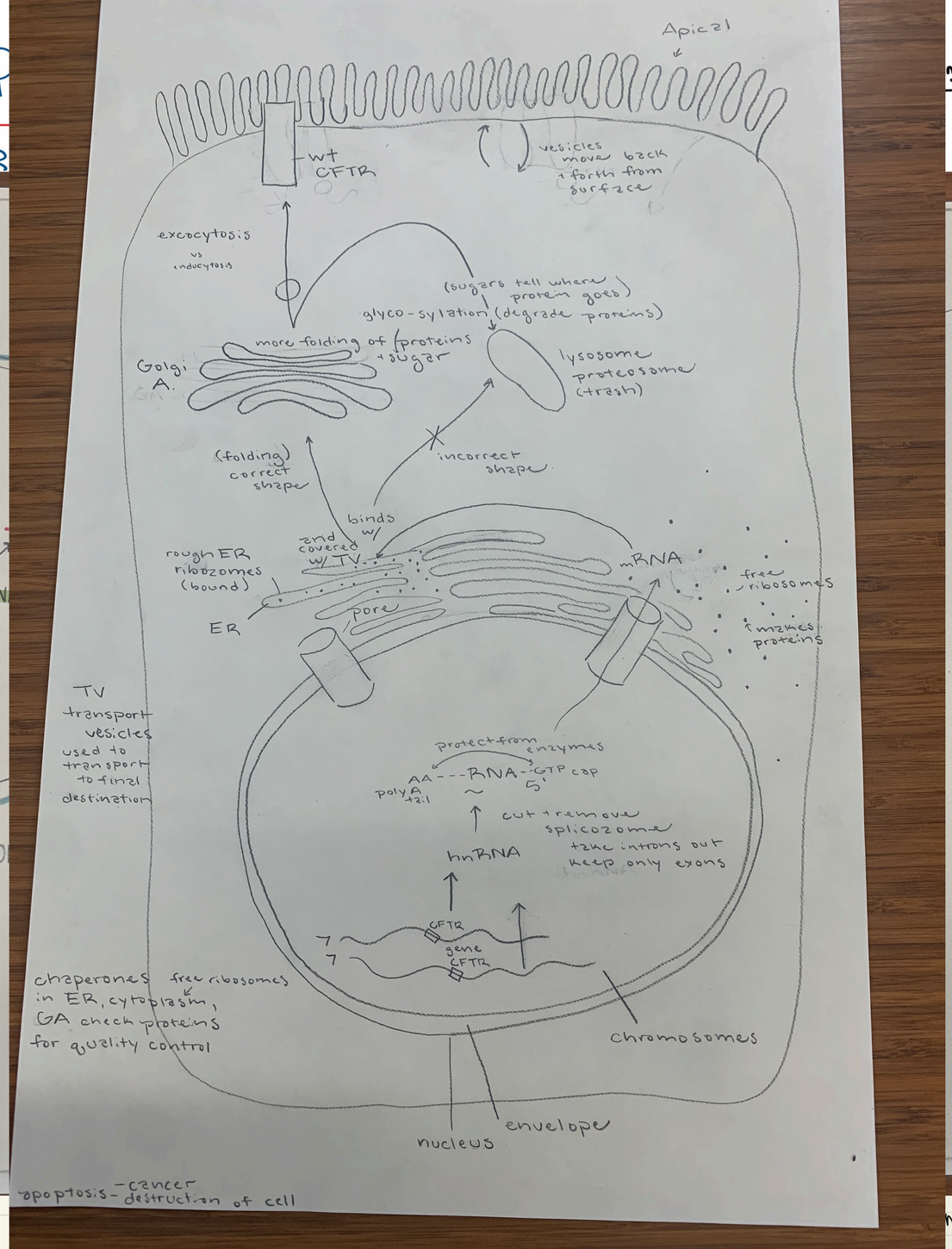
Announcements

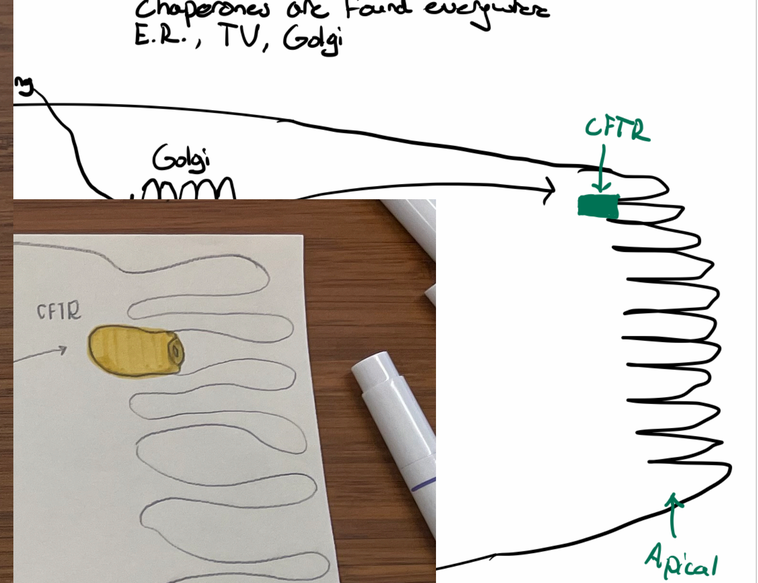
1. **Prof interviews**: Complete before Spring Break, are done outside of lab, make an appointment by emailing **luckie@msu.edu**
2. **Prof interviews**: CANCELLED due to DRAFT2 already DUE
3. Questions about class stuff?

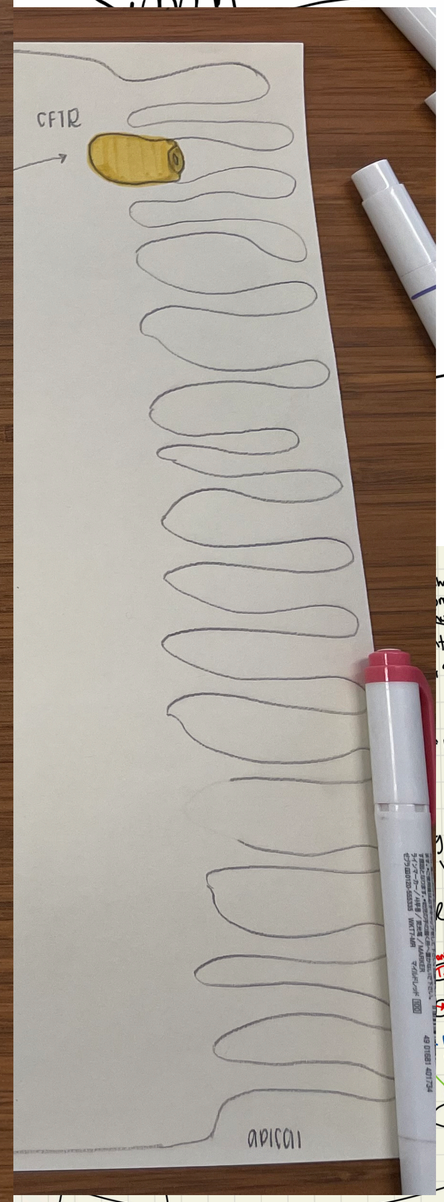

Pore
folding
ER
chromosome 7
nucleus

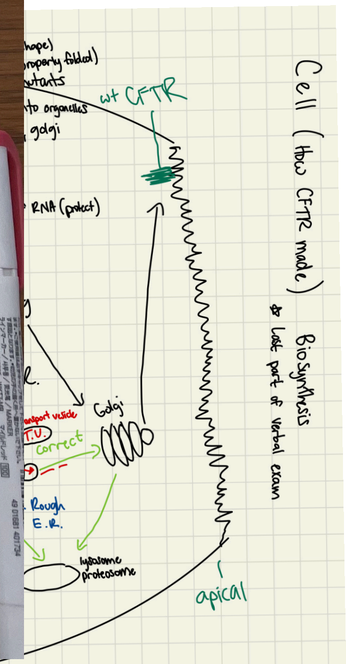
CFTR
hnRNA
splicing
chromosomes
nucleus

poly-A-tail
chromosomes
CTFR
hnRNA
mRNA
nuclear envelope
nucleus


Apical
wt CFTR
vesicles move back + forth from surface
exocytosis vs endocytosis
(sugars tell where protein goes)
glyco-sylation
(degrade proteins)
more folding of proteins + sugar
Golgi A.
lysosome proteosome (trash)
(folding) correct shape
incorrect shape
binds w/
end covered w/ TV.
rough ER ribozomes (bound)
ER
pore
mRNA
free ribosomes
enzymes proteins
TV transport vesicles used to transport to final destination
protect from enzymes
AA---RNA-GTP cap
poly A tail
cut + remove splicozome take introns out keep only exons
hnRNA
CFTR gene CFTR
chaperones in ER, cytoplasm, GA check proteins for quality control
free ribosomes
chromosomes
nucleus
envelope
apoptosis - cancer
destruction of cell


Chaperones are found everywhere
E.R., TV, Golgi
Golgi
CFTR
Apical


CFTR
apical
nucleus
envelope


wt CFTR
to organelles
golgi
RNA (protect)
Golgi
TV
correct
Rough E.R.
lysosome proteasome
apical
Cell (thru CFTR made)
Biosynthesis
& Last part of Verbal exam

Explain the path/steps of the biosynthesis of a wtCFTR protein vs your group's: Starting at the CFTR gene in the nucleus, describe what happens and where, at each step in the creation of a CFTR protein? (hints: include transcription, translation; and describe what happens at each organelle, e.g. inside nucleus, then at ribosome, at ER, at Golgi, and in transport vesicles, etc until finally mature CFTR makes it to the plasma membrane).

The synthesis of the wtCFTR protein starts in the nucleus of the cell, on chromosome 7. The biosynthesis begins with transcription, where the CFTR gene is transcribed into one strand of hnRNA. Splicing then occurs (removes introns and leaves exons) and a poly-A tail and GTP cap are added to both ends of the RNA in order to stabilize it. The mRNA then leaves the nucleus through a pore and travels to the Endoplasmic Reticulum. Once this happens, the mRNA attaches to a ribosome and the ribosome is able to read the nitrogenous base sequence and create an amino acid chain. The proteins that are folded properly move to the Golgi Apparatus. The proteins that are incorrectly folded move to lysosomes (garbage). The Golgi Apparatus takes the correct protein and checks the shape of it. It then does another protein folding in order to move to the plasma membrane. The plasma membrane is where the CFTR channel is located (apical part of cell).
Our group's mutation is the G542X mutation. This is a nonsense mutation and introduces a stop codon into the mRNA, which prevents normal CFTR protein synthesis.

What do you want to do next?

A. Clicker questions: Quiz me and debrief each question
B. Theater: Let's act out what organelles do in the cell
C. Art class: let’s make flash cards
D. Normal class: Biology, announcements, how cells work
E. Medical questions: Quiz groups and debrief the answer

Medical questions *for you*
(Cell biology)

Celiac disease harms the microvilli of cells that line the intestine, that damage would be predicted to cause what potentially?

Medical questions *for you*
(Cell biology)

Cystic Fibrosis patients after digestion have unusually low absorption of nutrients in their intestine, what might cause this?

Medical questions *for you*
(Cell biology)

Your pancreas is known to make and secrete lots of proteins (many enzymes and hormones) needed in the body, if you look through a microscope what organelle might you see far far more of than in other cells? Why.

Medical questions *for you*
(Cell biology)

To function myocytes (muscle cells) need the most energy of any cell in the human body, if you looked through a microscope which organelle do you predict would be super plentiful and thus seen everywhere in myocytes? Why.

Medical questions *for you*
(Cell biology)

Intravenous drug users take lots of drugs, how would you immediately know anyone was a drug users by looking through a microscope? Why.

What do you want to do next?

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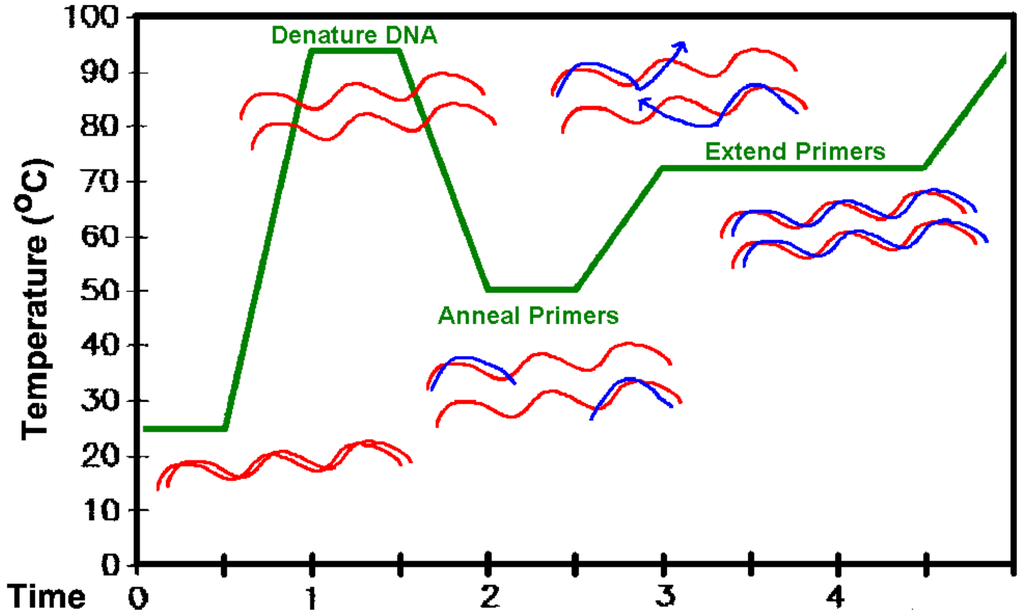
E. Medical questions: Quiz groups and debrief the answer



If primer #1 is calculated to anneal at 50°C and primer #2 at 60°C what's a good temp to try for your annealing temperature in the first PCR experiment you do?

a. 45°C

b. 50°C

c. 55°C

d. 60°C

e. 65°C

How many functional CFTR channels are on the surface of a cell of a CF patient?? (normal=100)

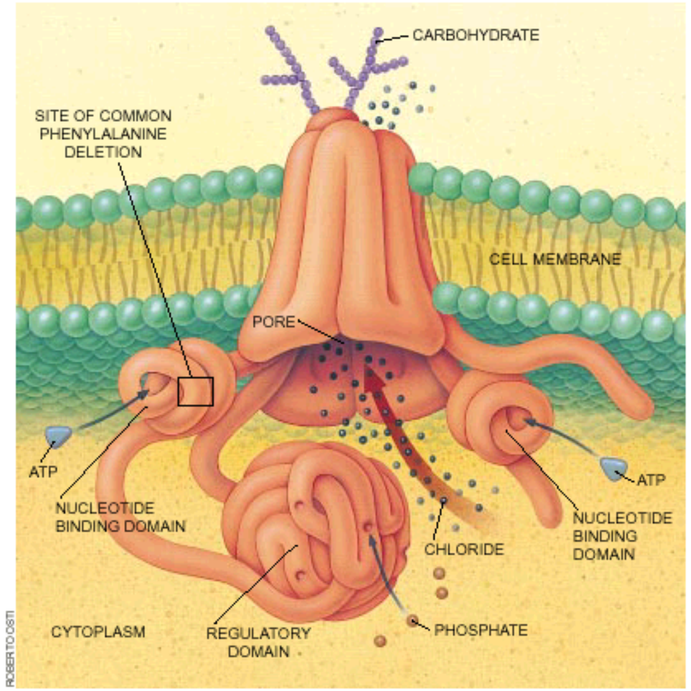
A. 50

B. 25

C. 10

D. 5

E. 0



How many functional CFTR channels are on the surface of a cell of a **CF carrier**?? (normal=100)

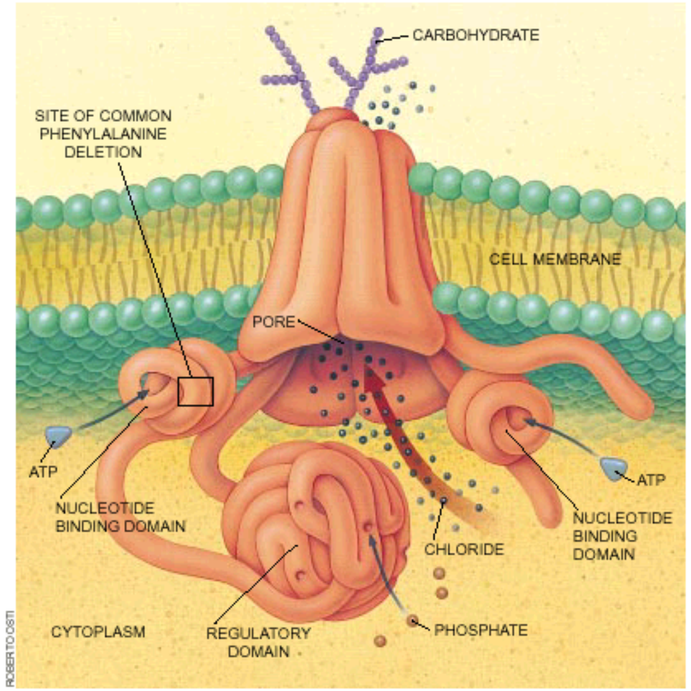
A. 50

B. 25

C. 10

D. 5

E. None of the above are correct.



Where are the CFTR channels found normally [in a healthy person]?

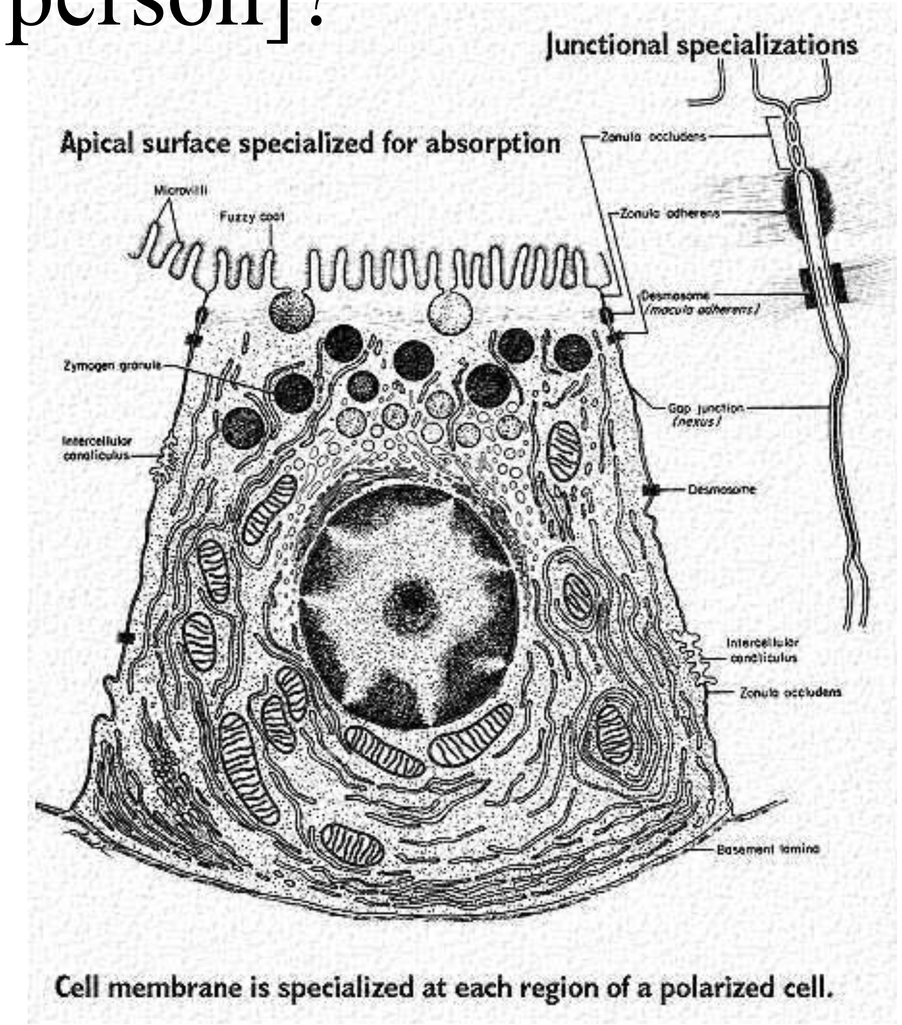
A. the apical surface ->

B. inside the ER

C. the lateral surface ->

D. in the lysosome

E. the basal surface ->



Predict

If you have a cell that produces **100 mRNAs** from its CFTR gene, ***how many*** CFTR proteins will that cell make?

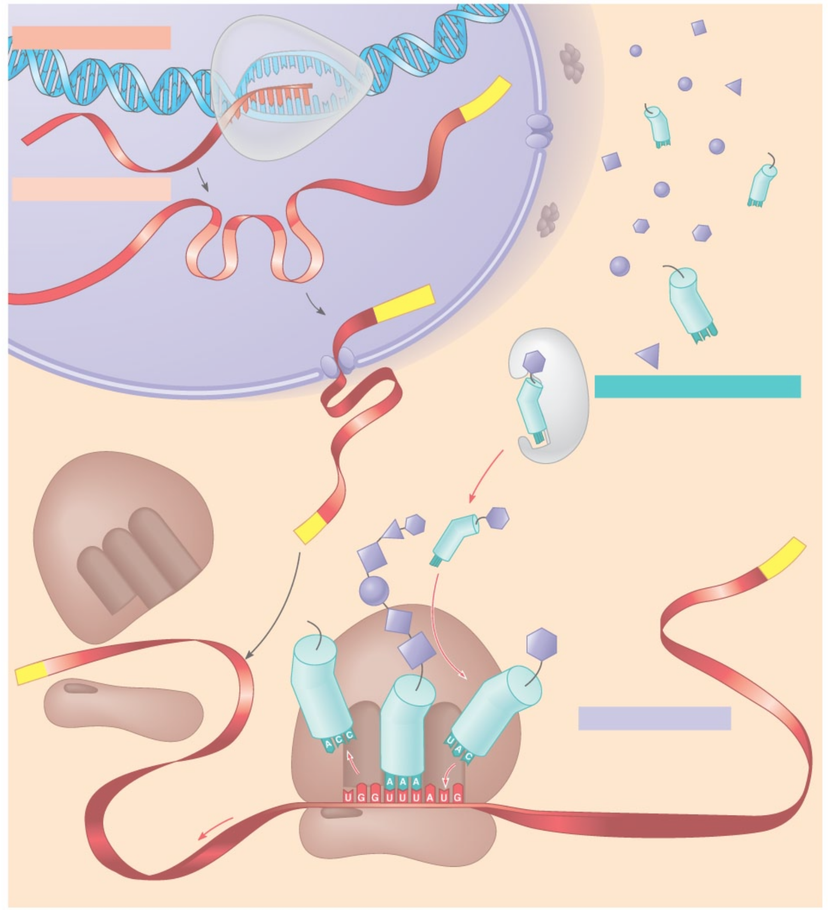
A. 500

B. 250

C. 100

D. 50

E. Impossible to predict



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D. Normal class: Biology, announcements, how cells work
E. Medical questions: Quiz groups and debrief the answer

Back to Biology...

Budgeting homework time (60 min): The Chapter **Cell Structure (OSB)** section 4.3 is 3060 words in length with a number of art figures (no data figures for trifectas). Reading at 200 words per minute would mean the section might take 15 minutes to read. But the video is 14 minutes and when done properly, when you pause to review figures and take careful notes, this assignment should take you more like 60 minutes.

1. _____ **For Thursday's lecture,** read section 4.2 "Prokaryotic Cells" and 4.3 "Eukaryotic Cells" in chapter **Cell Structure (OSB)**. For section 4.3 (3060 words) take handwritten notes in your notebook.

2. _____ Compare and contrast the anatomy of a Prokaryote versus Eukaryote. Then also a plant cells versus an animal cell. Which seems most advanced, why?

3. _____ (flipped classroom) Watch the **14min lecture by Mr. Andersen** provided where he gives you a tour of the cell. Add to your notes any interesting points he makes that helped you better understand the parts of the cell and what they do.

4. _____ While reading, focus mostly and take notes regarding **Figures 2 & 3, and 4 & 5,** and note the building block of cell walls/wood in **Figure 9.** We will discuss these in class. Generally, you need to learn the names and functions of each organelle. It's best to create hand-made flash cards with the name on one side and the function on the other. Also add interesting facts, like a drug user would be expected to have more of which organelle? Use these to study prior to class and then prior to the exam too.

5. _____ **Advanced**: Take a sneak peek at section 4.4, in particular study Figure 1.

4.2 Prokaryotic Cells

Cell Structure (OSB)

Quiz Me 4.2 > Prokaryotic Cells

Use Flash Cards as Student

Summary: By the end of this section, you will be able to:

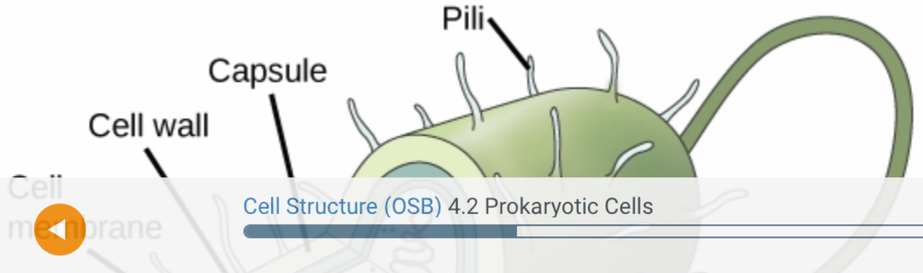
- Name examples of prokaryotic and eukaryotic organisms
- Compare and contrast prokaryotic cells and eukaryotic cells
- Describe the relative sizes of different kinds of cells
- Explain why cells must be small

Cells fall into one of two broad categories: prokaryotic and eukaryotic. Only the predominantly single-celled organisms of the domains Bacteria and Archaea are classified as prokaryotes (pro- = “before”; -kary- = “nucleus”). Cells of animals, plants, fungi, and protists are all eukaryotes (ceu- = “true”) and are made up of eukaryotic cells.

Components of Prokaryotic Cells

All cells share four common components: 1) a plasma membrane, an outer covering that separates the cell’s interior from its surrounding environment; 2) cytoplasm, consisting of a jelly-like cytosol within the cell in which other cellular components are found; 3) DNA, the genetic material of the cell; and 4) ribosomes, which synthesize proteins. However, prokaryotes differ from eukaryotic cells in several ways.

A **prokaryote** is a simple, mostly single-celled (unicellular) organism that lacks a nucleus, or any other membrane-bound organelle. We will shortly come to see that this is significantly different in eukaryotes. Prokaryotic DNA is found in a central part of the cell: the **nucleoid** (**Figure 1**).



Sections 4.2 + 4.3 2-21-23 Cell Structure Week 7

4.2 Prokaryotic cells

L.O.s . name examples of prokaryotic + eukaryotic organisms
· compare + contrast prok vs euk / draw them
· describe sizes + why cells must be small.

Proks: mostly single-celled organisms in Bacteria + Archaea

Euks: ("true" nucleus) animals, plants, fungi, protists.

Common aspects – PM, Cyt, DNA, ribosomes

Proks lack – nucleus, mem-bound organelles (instead "nucleoid")
they have cell wall made of: peptides/proteins + sugars glycans · "peptido glycan"
some also have slimy shiny capsule made of: "polysaccharides" long sugars = starch

Bigger cells – have less surface area on PM / volume inside thus harder to get enough stuff (like O_2) through, AND diffusion is slow so long distance is trouble.

Quiz Me page 1

4.3 Eukaryotic cells

L.O.s · describe structure of eukaryotic cells
· compare to animal + plant cells
· state the role of the PM
· summarize the functions of major cell organelles

Form follows function (Structure–Function)
nucleus = "true" nucleus = "eukaryote" organelles = little organs - specialized functions like your body

Mr Andersen–Tour of the Cell "lecture" (14 minutes)

• The plasma membrane (PM) – a phospholipid bilayer w/embbed proteins that serves as a barrier (outside vs inside) – fingers like micro-villi

Q: Celiac disease → harms microvilli of intestine . pred. of impact?
C.F. has low absorption of nutrients why think so?

2-21-23 (cont)

4.3 Eukaryotic cells (cont). (at Figure 3) membranes + villi.

The Cytoplasm – liquid aqueous "cytosol" + cytoskeleton + lot of stuff (thus gel/solid like) ribosomes

The Nucleus – (pl. nuclei) home to most cell's DNA makes/assembles
- has "chromatin" = DNA wrapped around proteins (histones)
- has darker section = "nucleolus" – ribosome-assembly area (like car plant) NI
- has liquid like cytosol called "nucleoplasm"
- barrier is nuclear "envelope" two membranes
- pores allow import/export – nuclear lamina = skeleton

The Nuclear envelope
- double membrane - outer most portion of nucleus (barrier/shield)
- pores control passage of ions, molecules, RNA ⟷ cytoplasm

Chromatin + Chromosomes
Chromosomes = DNA linear structures (prokaryotes often circular)
= humans have 46 (23 pairs) chromosomes
= condense + become visible ONLY during DIVISION
= usually not condensed + usually wrapped around histones
genes that are turned ON, hence expressed, unwind lots

The nucleolus
→ place where rRNA + r proteins assembled together (like car plant.)
(→ mRNA for ribosome proteins, leaves nucleus, at existing ribosomes made into proteins, they return to nucleus + get assembled together w/ other rRNA => make new ribosomes which then leave nucleus to live in cytosol near R.E.R.

Ribosomes
- cellular organelles that make proteins. often clustered together or floating free in cytoplasm. Can be found attached to either PM or outer R.E.R. / nuclear membrane. mRNA provides info for ribosomes to build new proteins from single amino acids.

Q: Since Pancreas makes + secretes tons of proteins what organelles do its cells have lots of?

2-21-23

4.3 (cont)

Mitochondria – alien life-form that lives inside our cells. (symbiosis)
- contain own DNA + own ribosomes
- power house – energy factory – make ATP
- cellular Respiration (CPHS backwards) turns food/glu into pH gradient
- oval shaped double membrane. Anatomy – vocab. → waste is CO_2 + H_2O

Q: Since muscle cells need lots of energy what organelle do they have lots more of?

Peroxisomes –
- round small organelles w/ 1 mem. Oxidation rxns break down fatty acids + aa's.
- also detox poisons, + alcohol (in liver cells)
- smooth ER in liver cells also detoxify drugs

Q: take lots of drugs how can tell through microscope?

Vesicles + vacuoles – similar but different sizes
Central Vacuole in plants – water reservoir like in CA.

Q: low water = wilting plant
Wilting plants means what organelle in trouble?

Lysosomes
Stomach of cell – pH acidic break down macromolecules

Cell Wall
rigid covering outside of PM. – Peptido-glycan in ~~animals~~ proks
Wood = multiple sugar molecules connected by 1-4 linkages ← Cellulose in plants (wood)

Chloroplasts
See PHS – contain own DNA + own ribosomes

Endosymbiosis (mentioned)

Sections 4.2 + 4.3 2-21-23 Cell Structure Week 7

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Quiz Me page

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2-21-23 (cont)

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2-21-23

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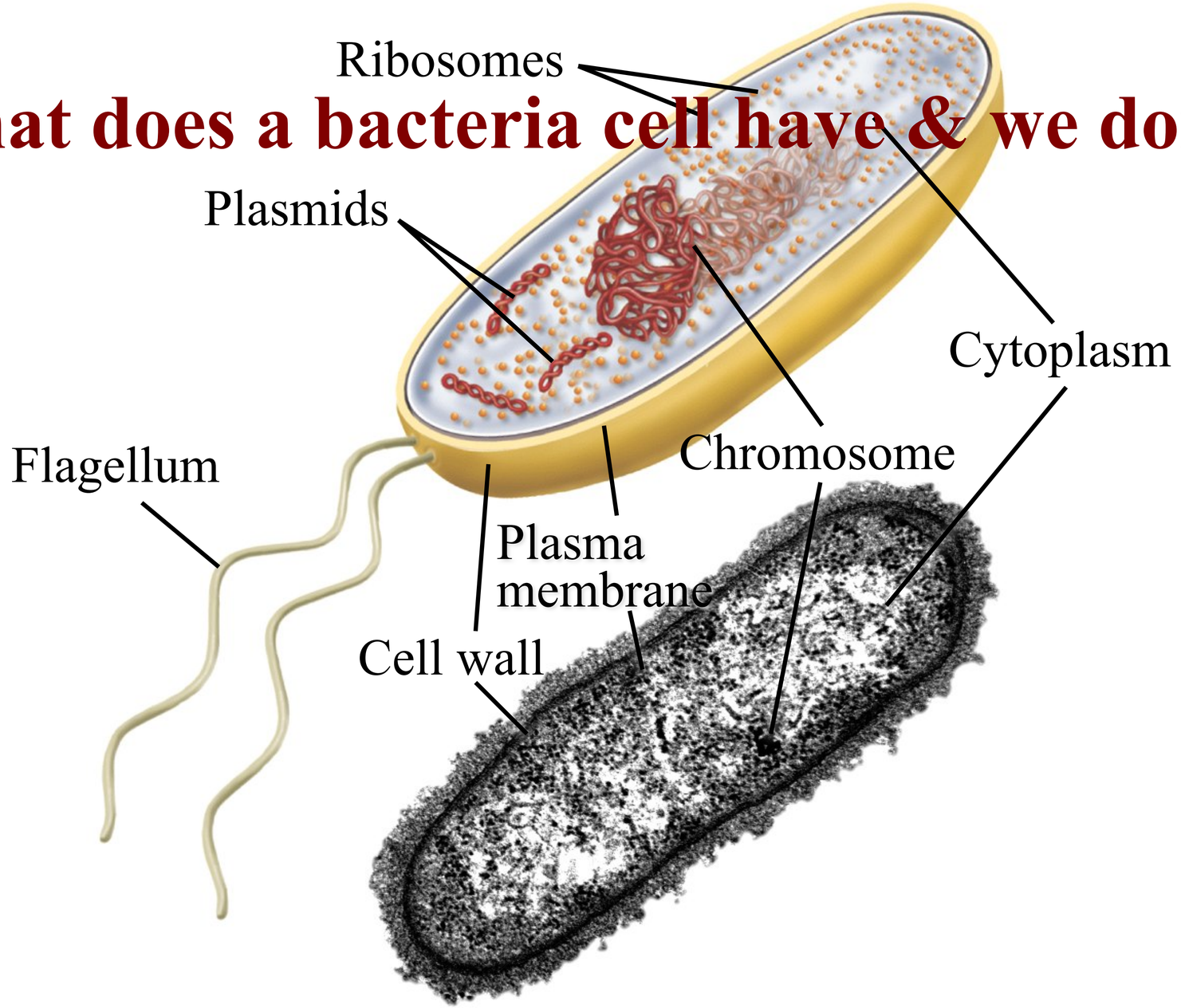
Endosymbiosis (mentioned)

So what does a bacteria cell have & we don't?



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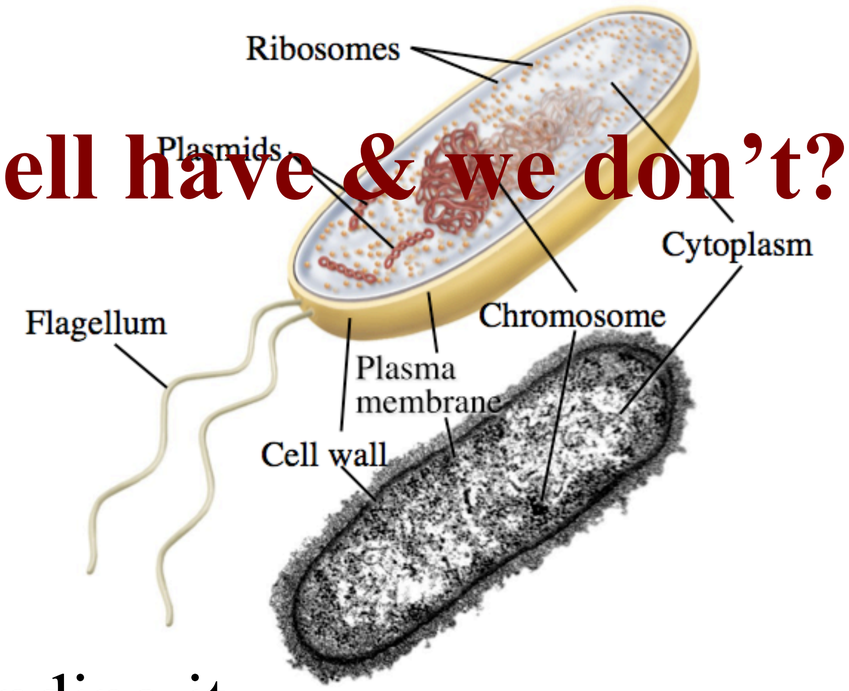


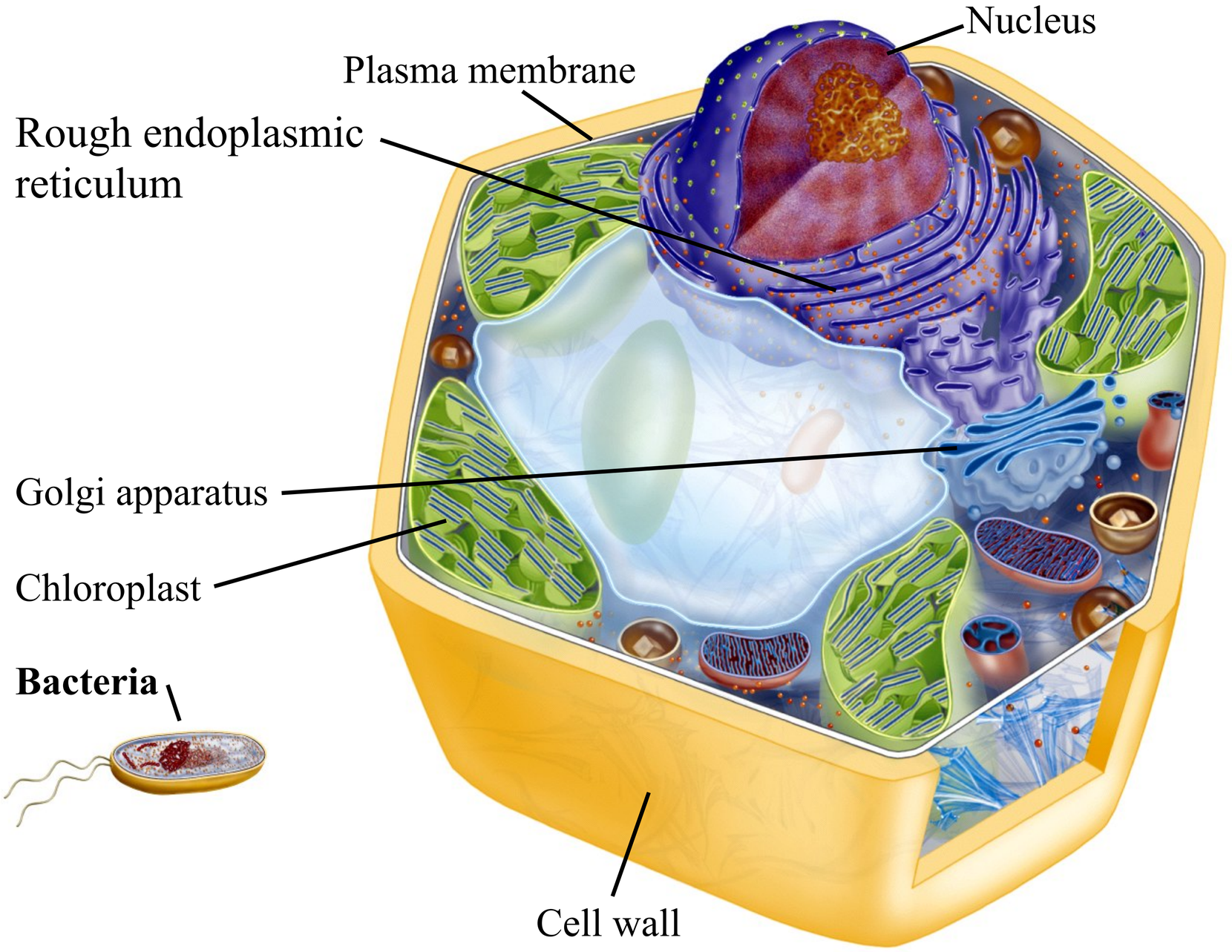
A. The plasma membrane surrounding it

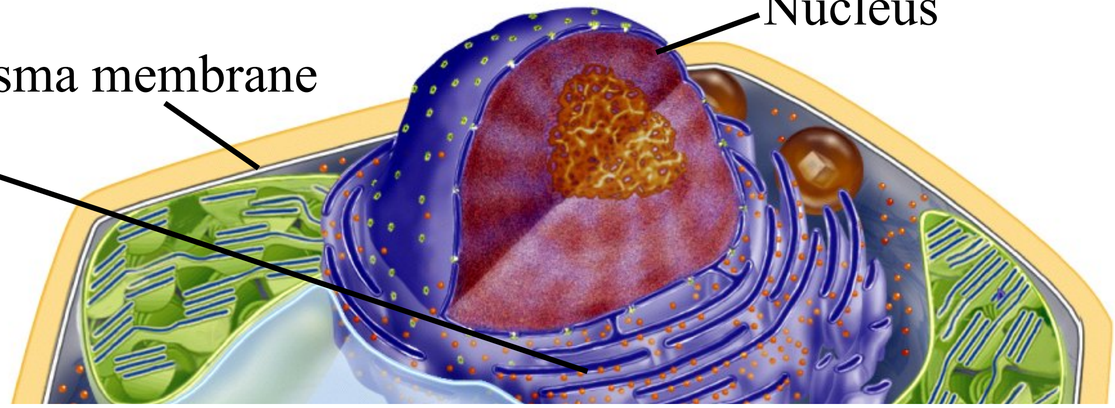
B. Chromosomes with DNA to make RNA

C. Ribosomes making proteins

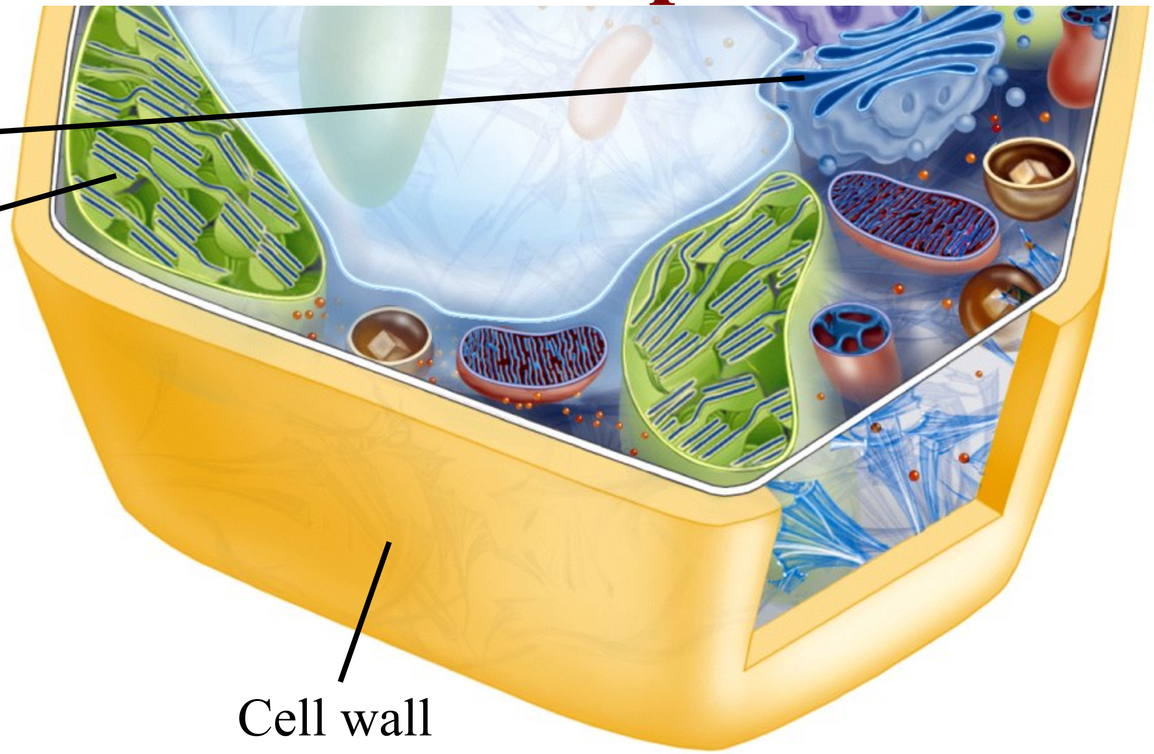
D. The cell wall surrounding it

E. None of the above

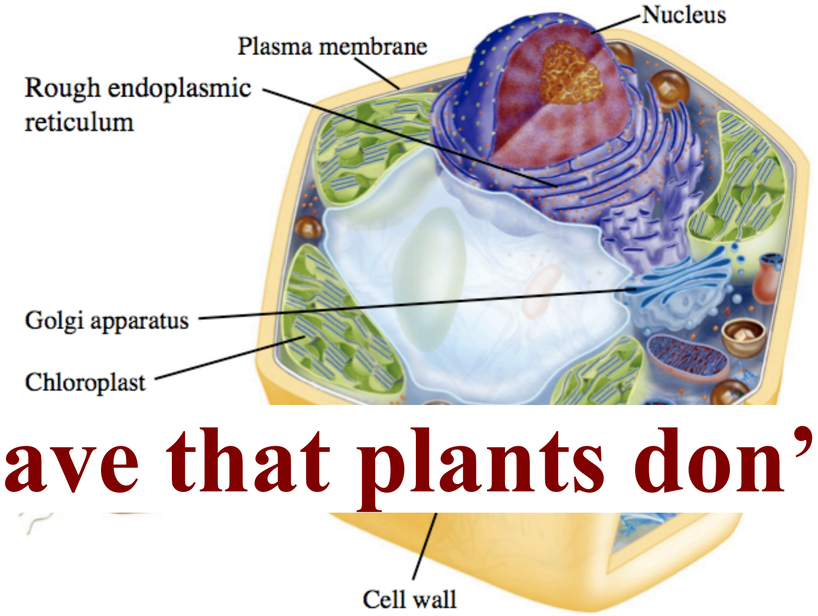

Nucleus
Plasma membrane
Rough endoplasmic reticulum
Golgi apparatus
Chloroplast
Bacteria
Cell wall



What does animal cell have that plants don’t?



Bacteria



What does animal cell have that plants don’t?

A. A single plasma membrane surrounding it

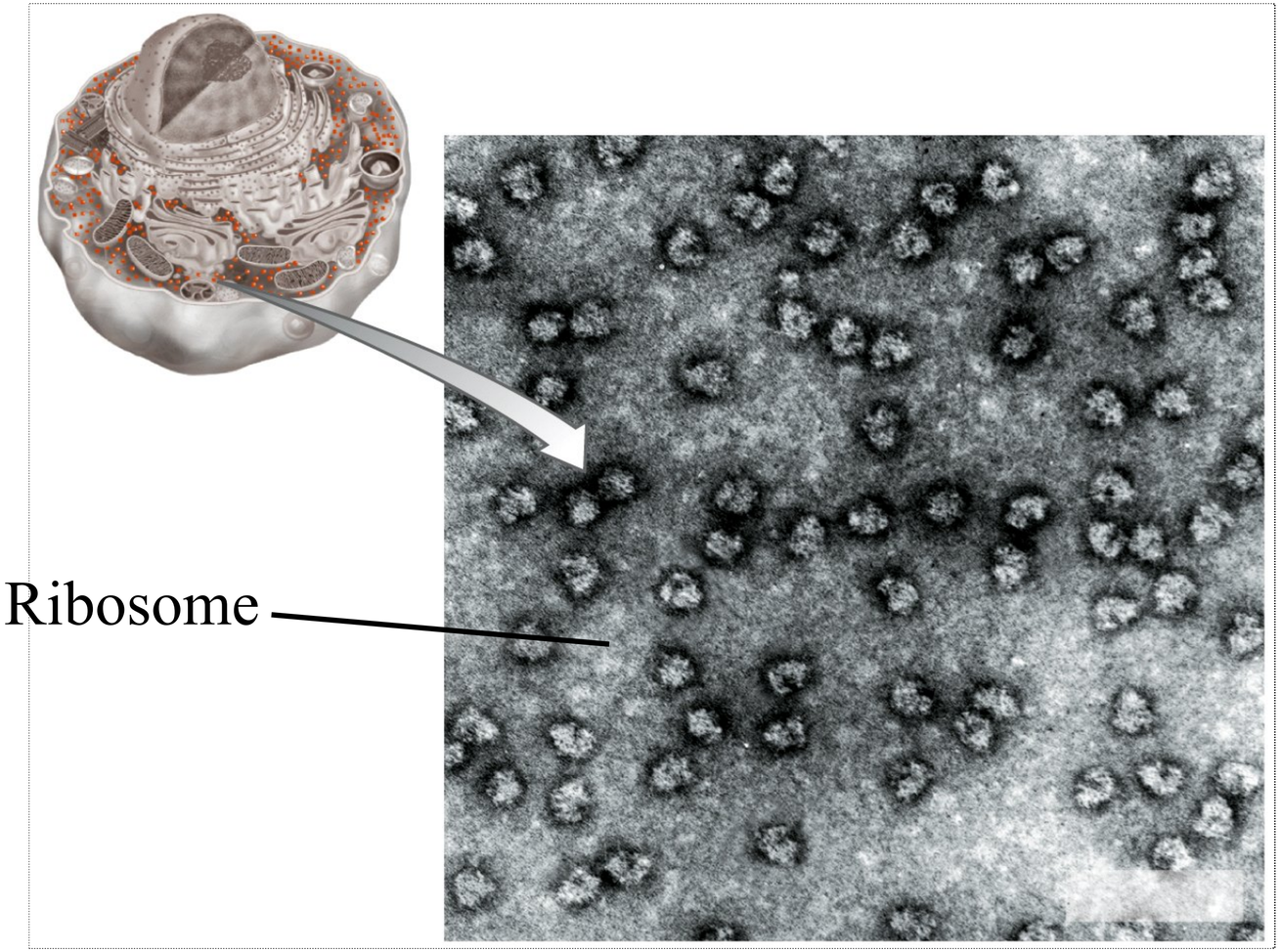
B. Mitochondria

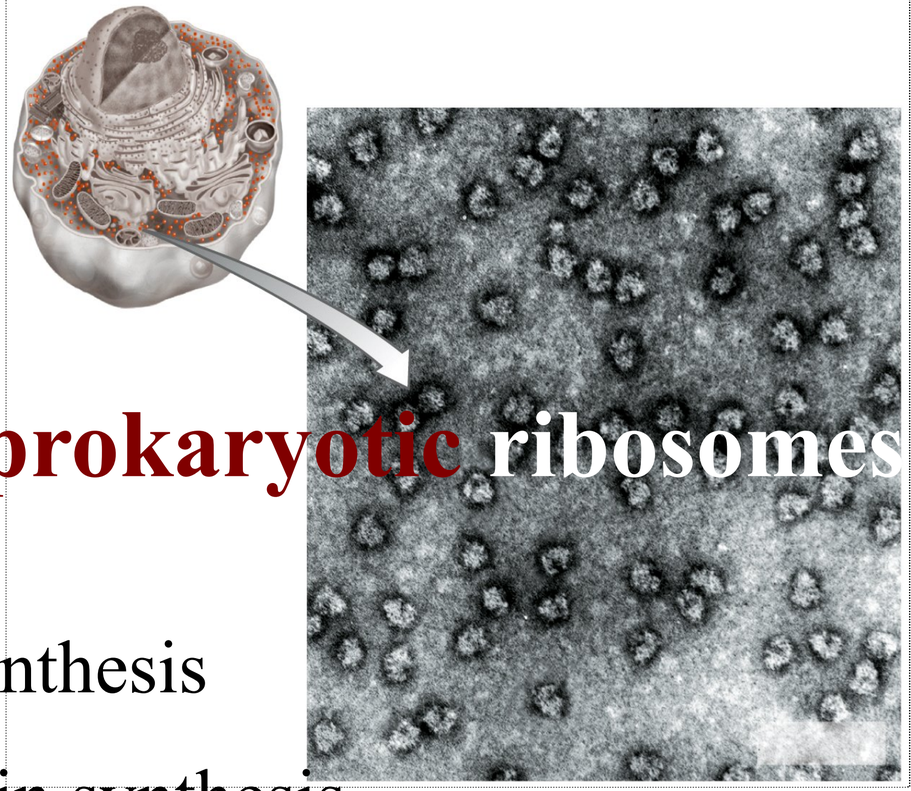
C. A true Nucleus

D. The cell wall surrounding it

E. None of the above

Antibiotics that inhibit prokaryotic ribosomes





Antibiotics that inhibit prokaryotic ribosomes

A. Will stop bacterial protein synthesis

B. Will stop mitochondria protein synthesis

C. Will stop nucleus from making proteins

D. None of the above

E. More than one of the above

4.3 Eukaryotic Cells

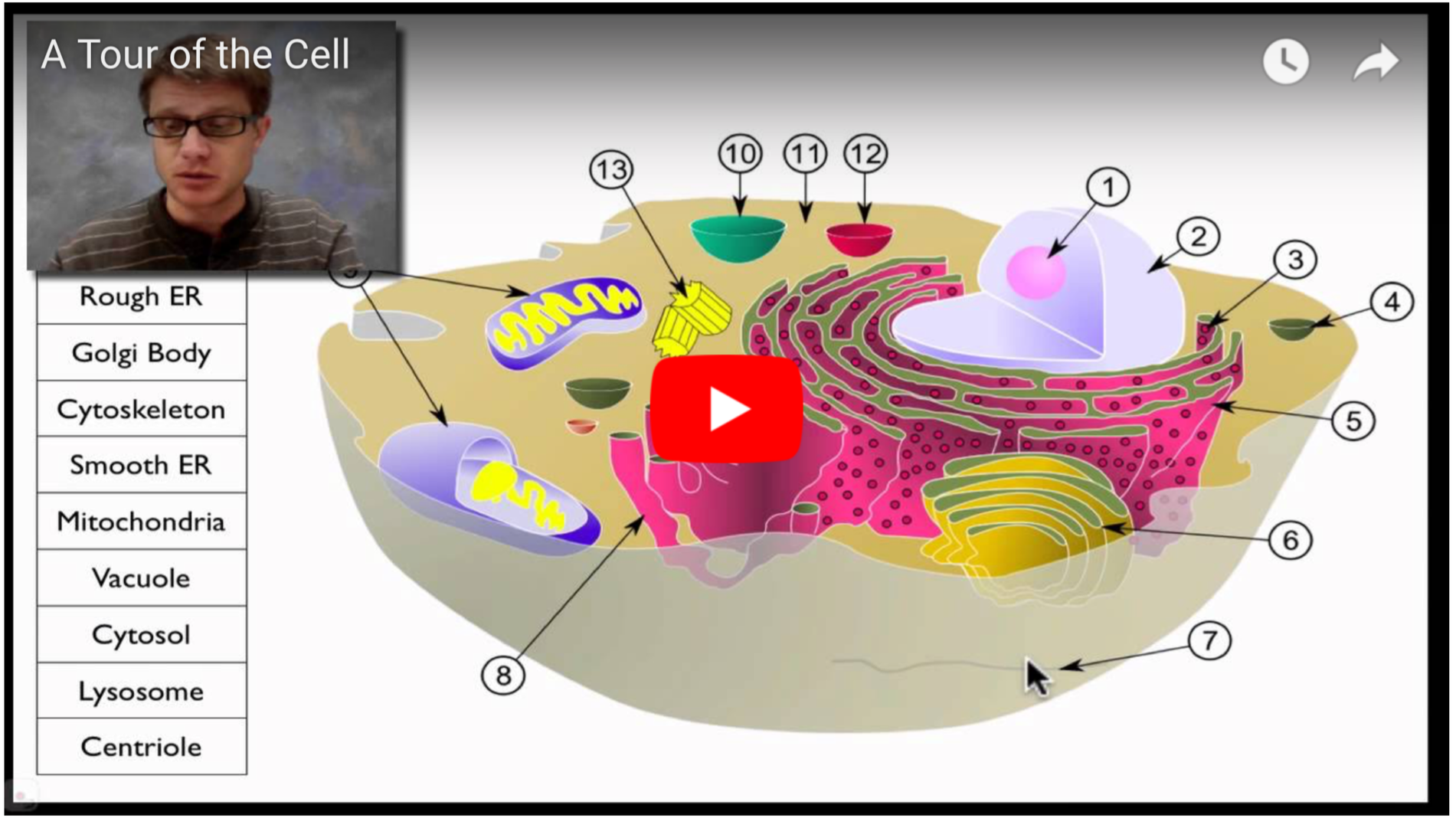
Summary: By the end of this section, you will be able to:

- Describe the structure of eukaryotic cells
- Compare animal cells with plant cells
- State the role of the plasma membrane
- Summarize the functions of the major cell organelles

Have you ever heard the phrase “form follows function?” It’s a philosophy practiced in many industries. In architecture, this means that buildings should be constructed to support the activities that will be carried out inside them. For example, a skyscraper should be built with several elevator banks; a hospital should be built so that its emergency room is easily accessible.

Our natural world also utilizes the principle of form following function, especially in cell biology, and this will become clear as we explore eukaryotic cells (**Figure 1**). Unlike prokaryotic cells, **eukaryotic cell**s have: 1) a membrane-bound nucleus; 2) numerous membrane-bound **organelles** such as the endoplasmic reticulum, Golgi apparatus, chloroplasts, mitochondria, and others; and 3) several, rod-shaped chromosomes. Because a eukaryotic cell’s nucleus is surrounded by a membrane, it is often said to have a “true nucleus.” The word “organelle” means “little organ,” and, as already mentioned, organelles have specialized cellular functions, just as the organs of your body have specialized functions.

At this point, it should be clear to you that eukaryotic cells have a more complex structure than prokaryotic cells. Organelles allow different functions to be compartmentalized in different areas of the cell. Before turning to organelles, let’s first examine two important components of the cell: the plasma membrane and the cytoplasm.



Take a tour of the cell.

What do you want to do next?

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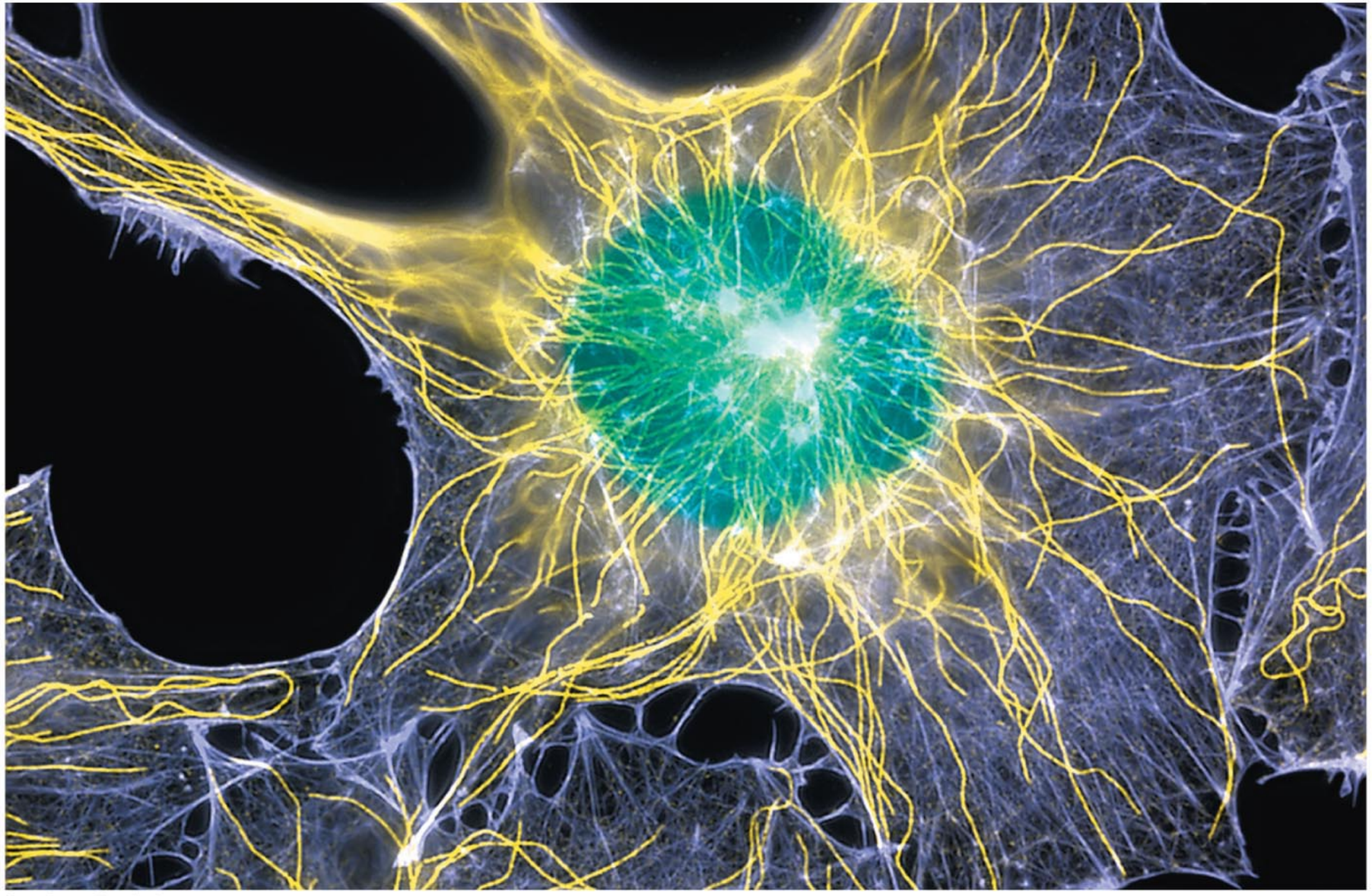
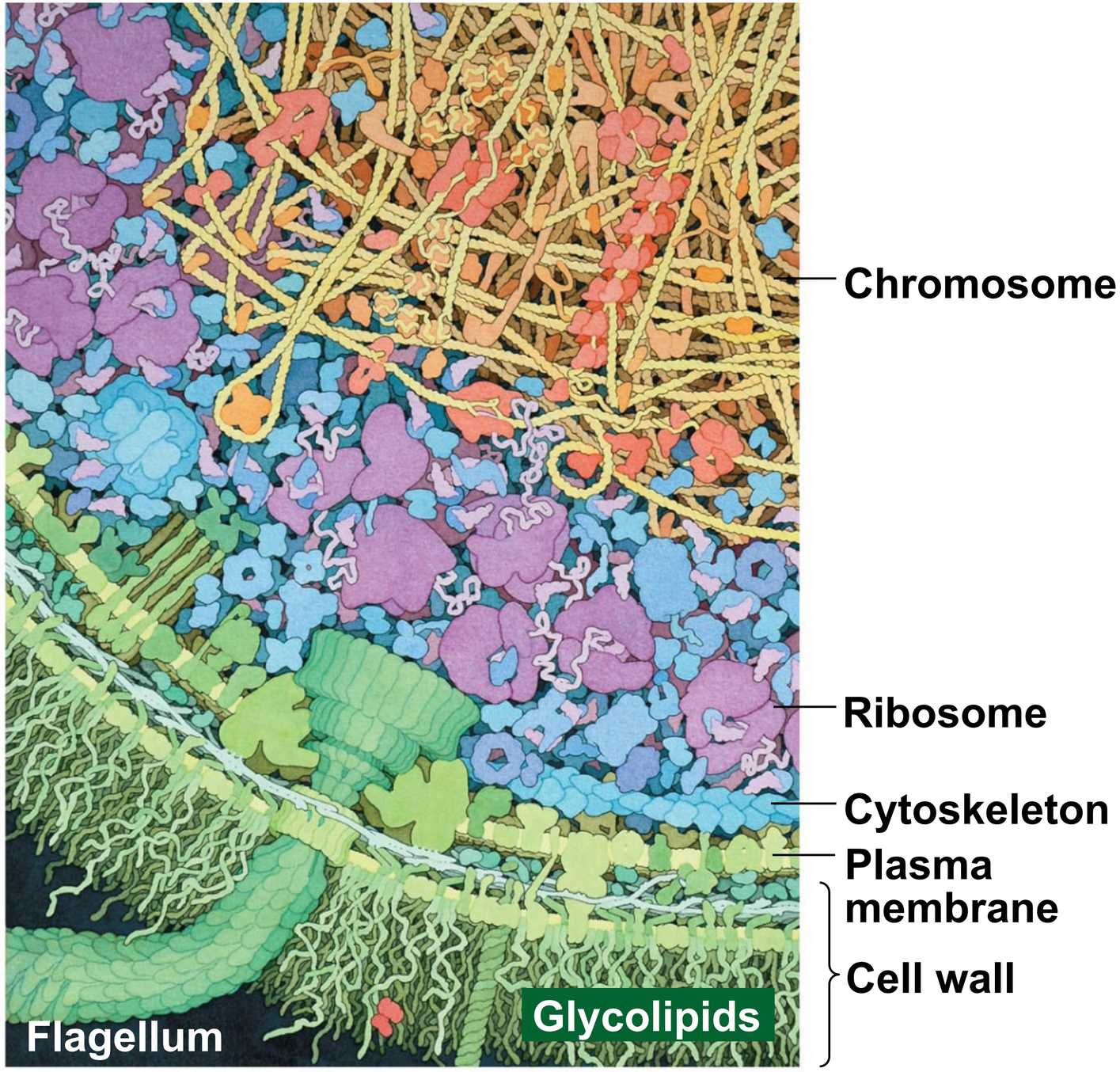




If you were a prokaryotic cell, you would be lacking _____.

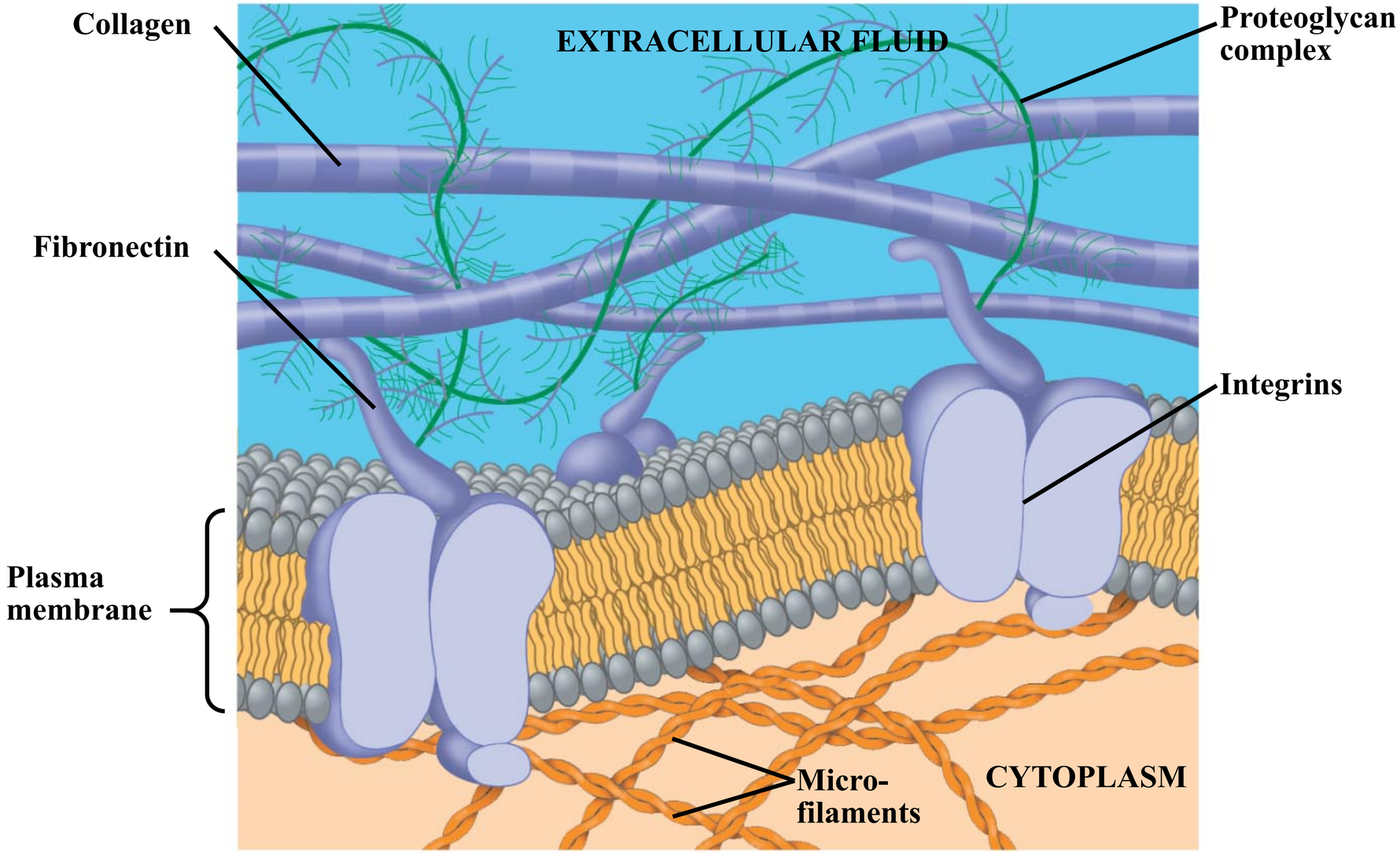
a. a plasma membrane composed of phospholipids and proteins
b. chromosomes that contain genetic information
c. ribosomes to synthesize proteins
d. mitochondria to generate ATP

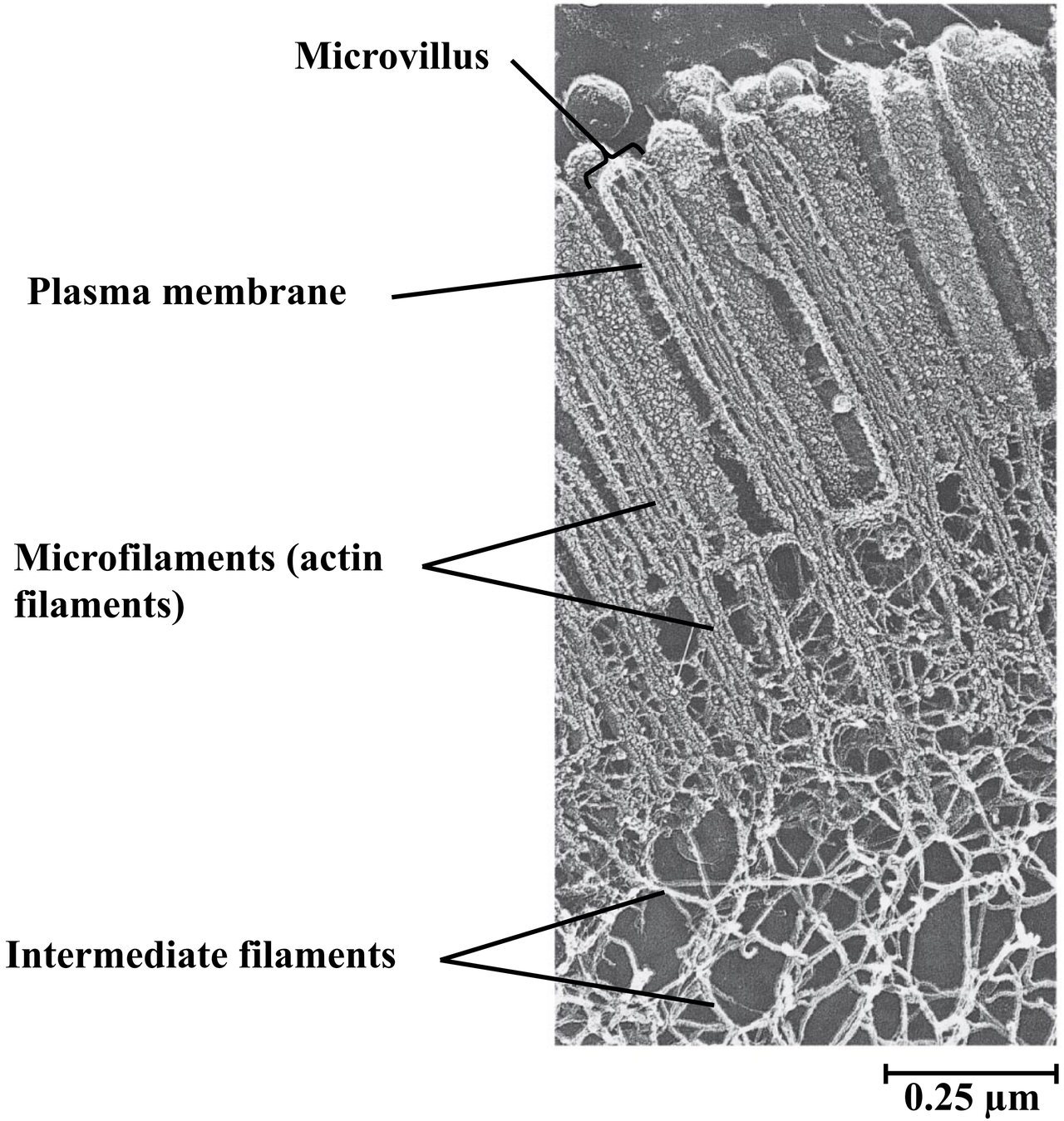
Which of the following is NOT considered a benefit of compartmentalization in eukaryotes?

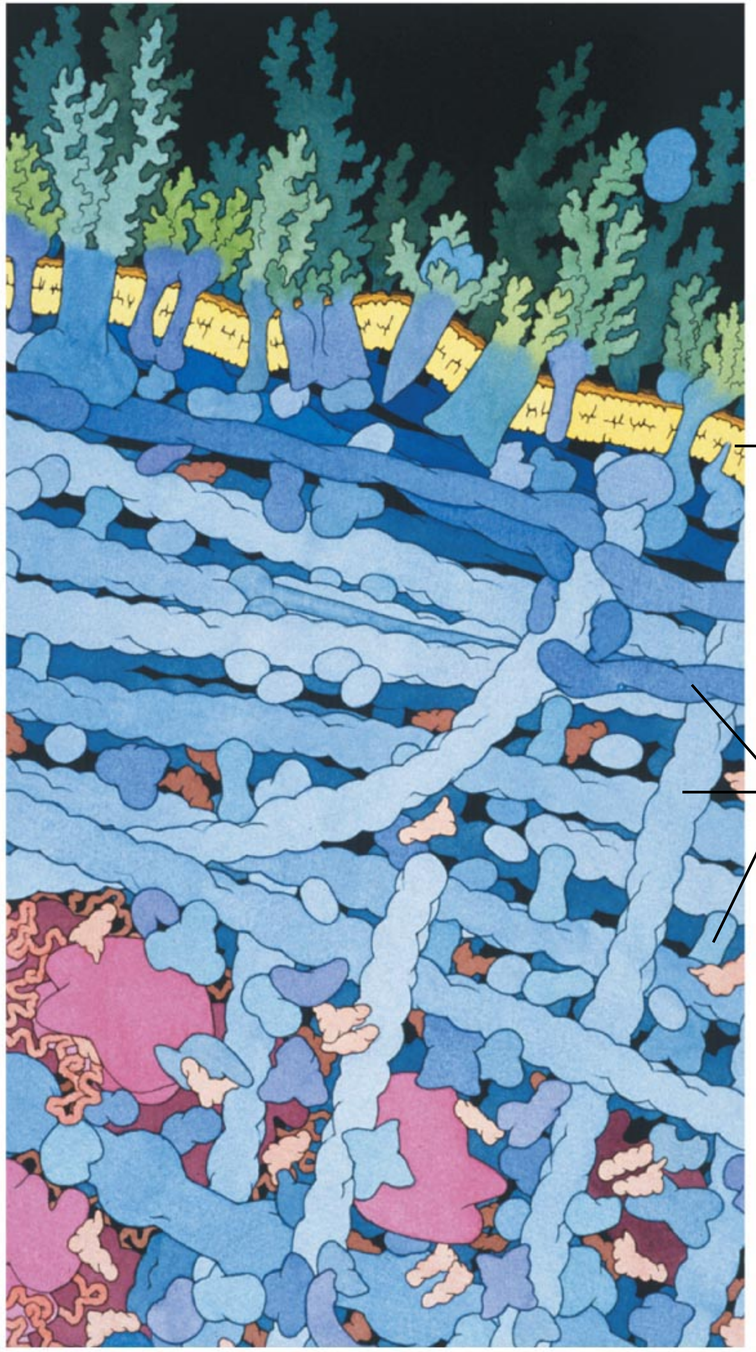
a. Chemical reactions are more efficient because substrates are more easily maintained at high concentrations within organelles.
b. Chemical reactions that are incompatible can be segregated in different organelles.
c. DNA is transcribed and translated at significantly higher rates because all of the machinery is inside a single, membrane-bound nucleus.
d. When the product of one reaction is the substrate for a second reaction, the enzymes that work together can be clustered together on internal membranes and result in greater speed and efficiency.

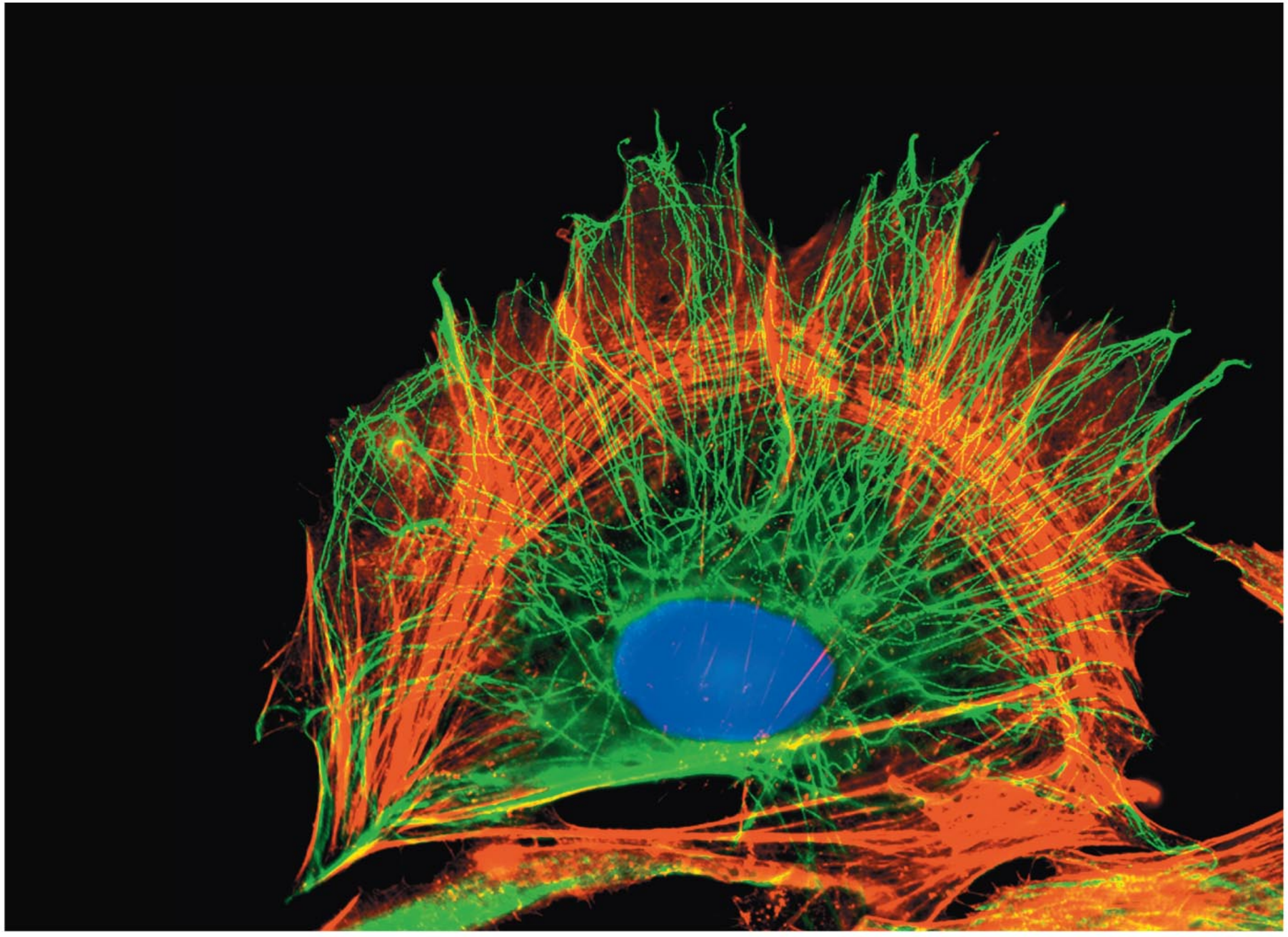
Why is the smooth endoplasmic reticulum unable to synthesize proteins?

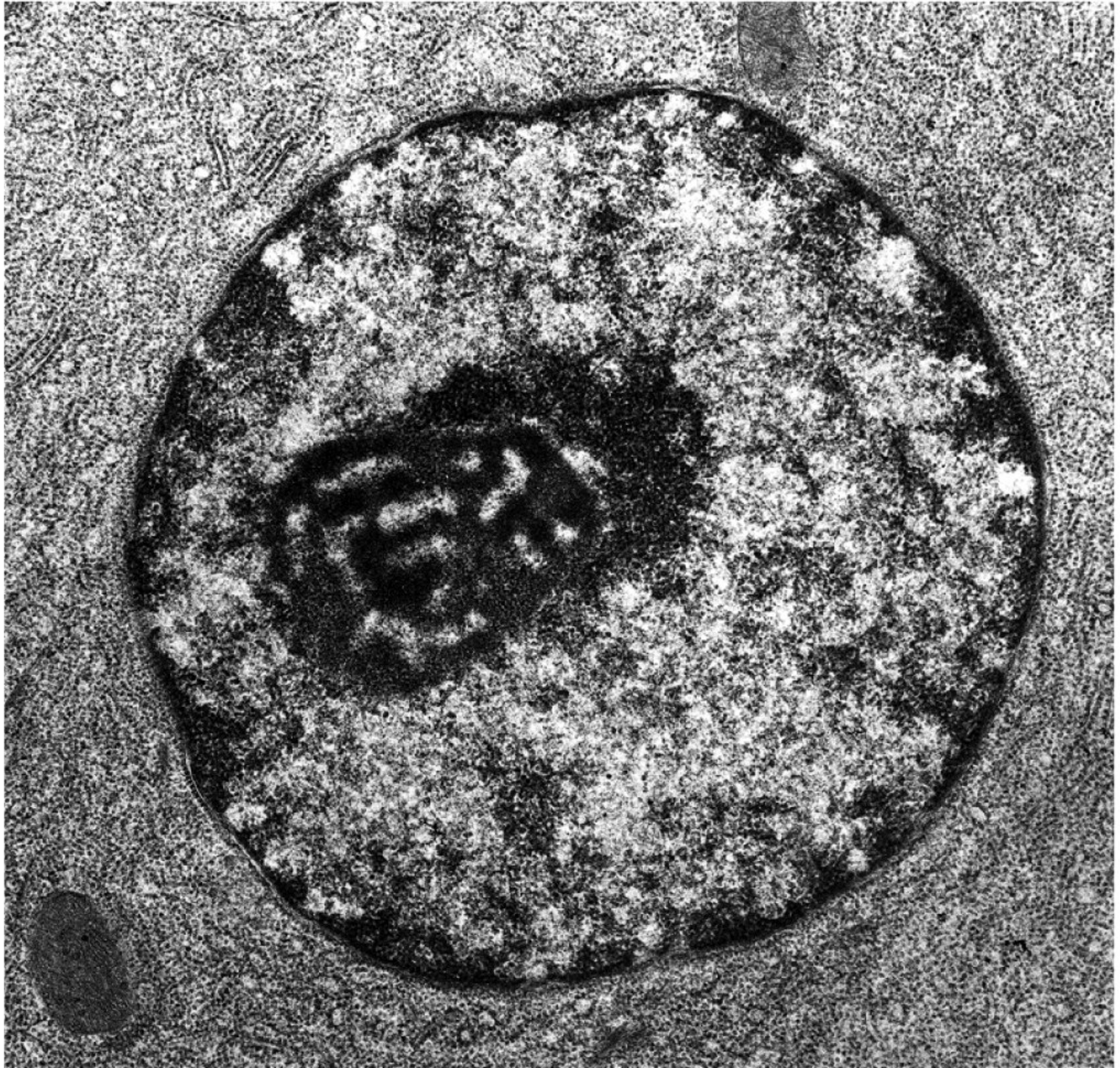
a. It has no ribosomes.
b. There is no supply of free amino acids that it can easily access.
c. It stores calcium, which is known to inhibit protein synthesis.
d. It has no DNA to direct the synthesis of proteins.

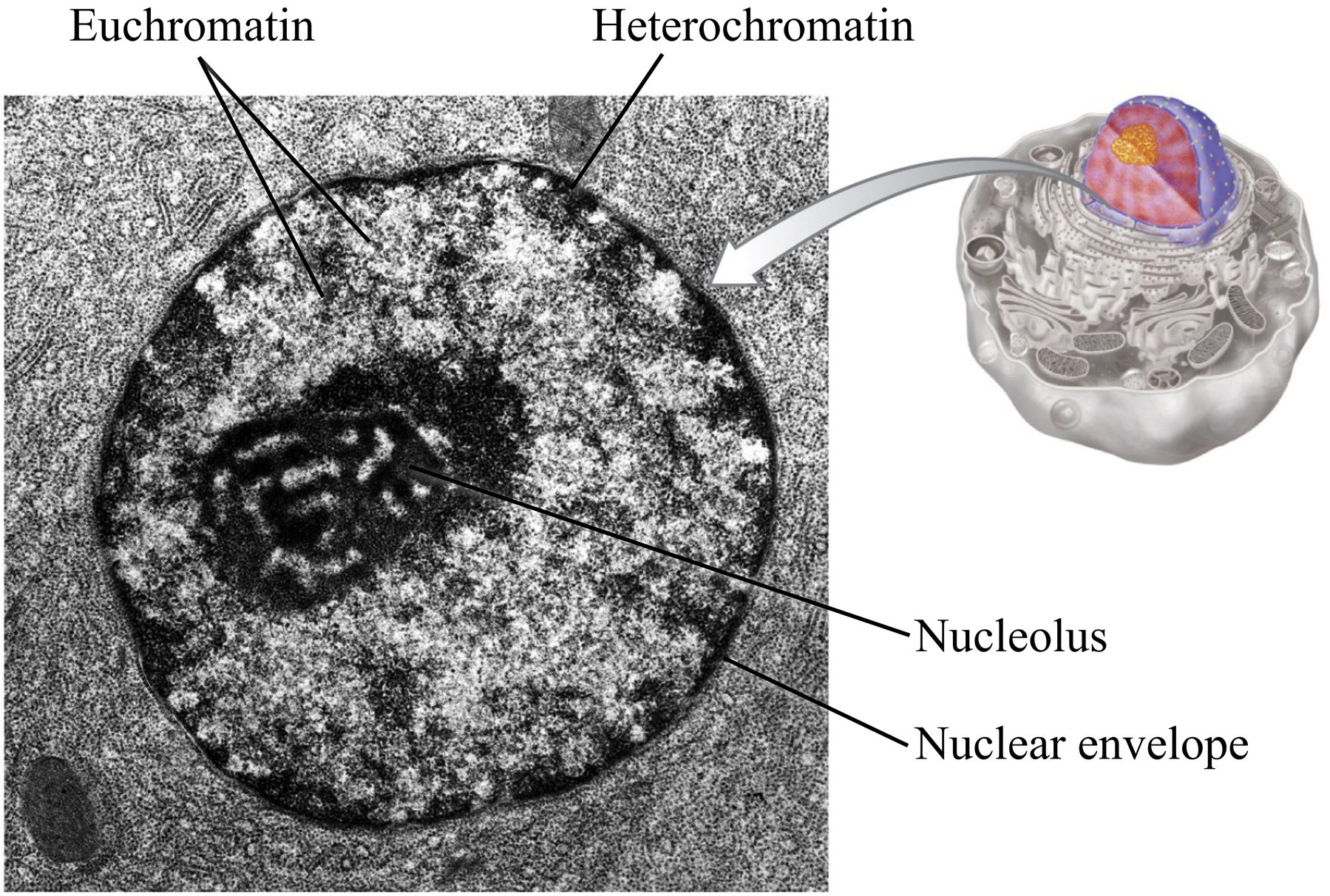


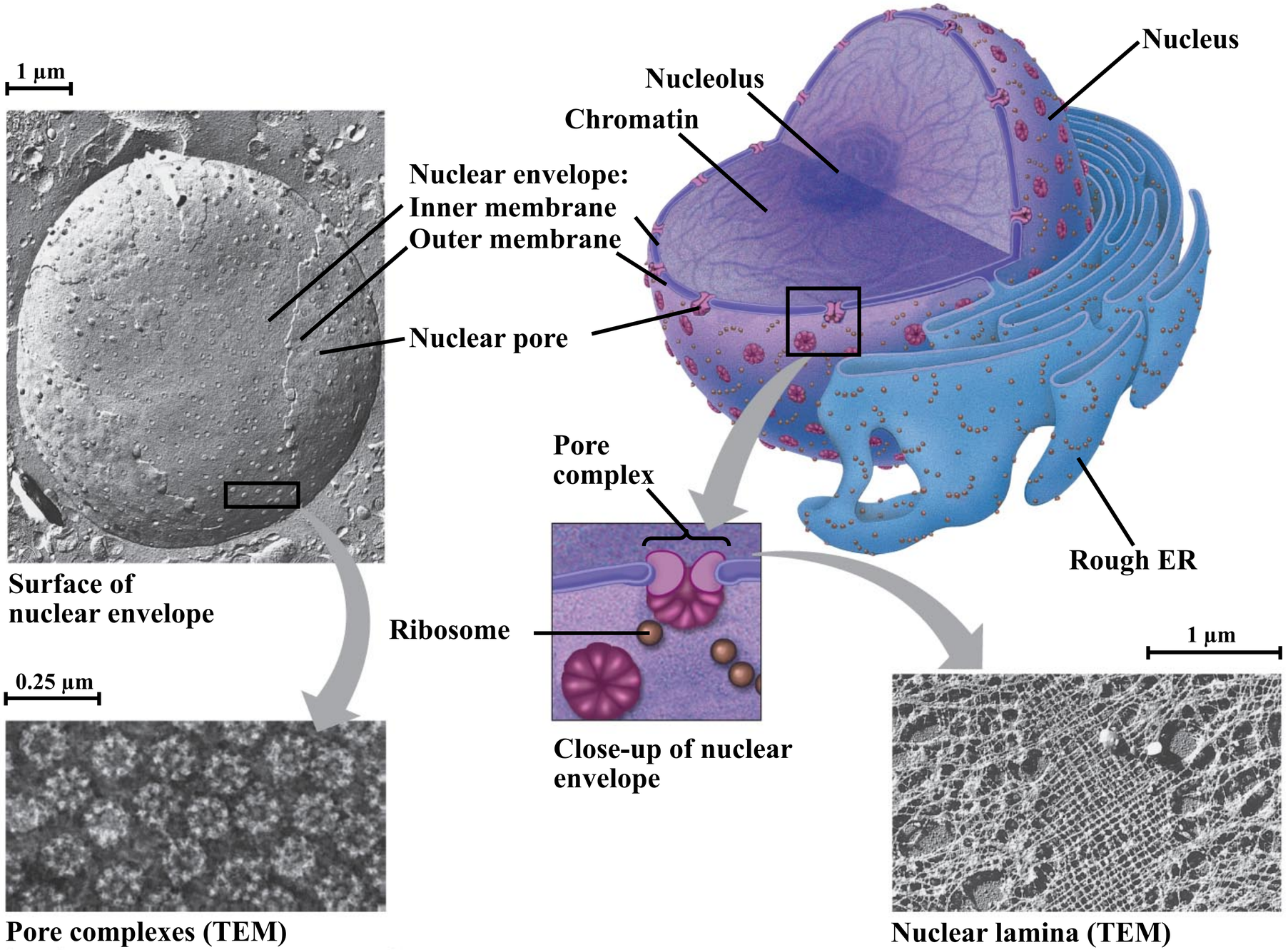


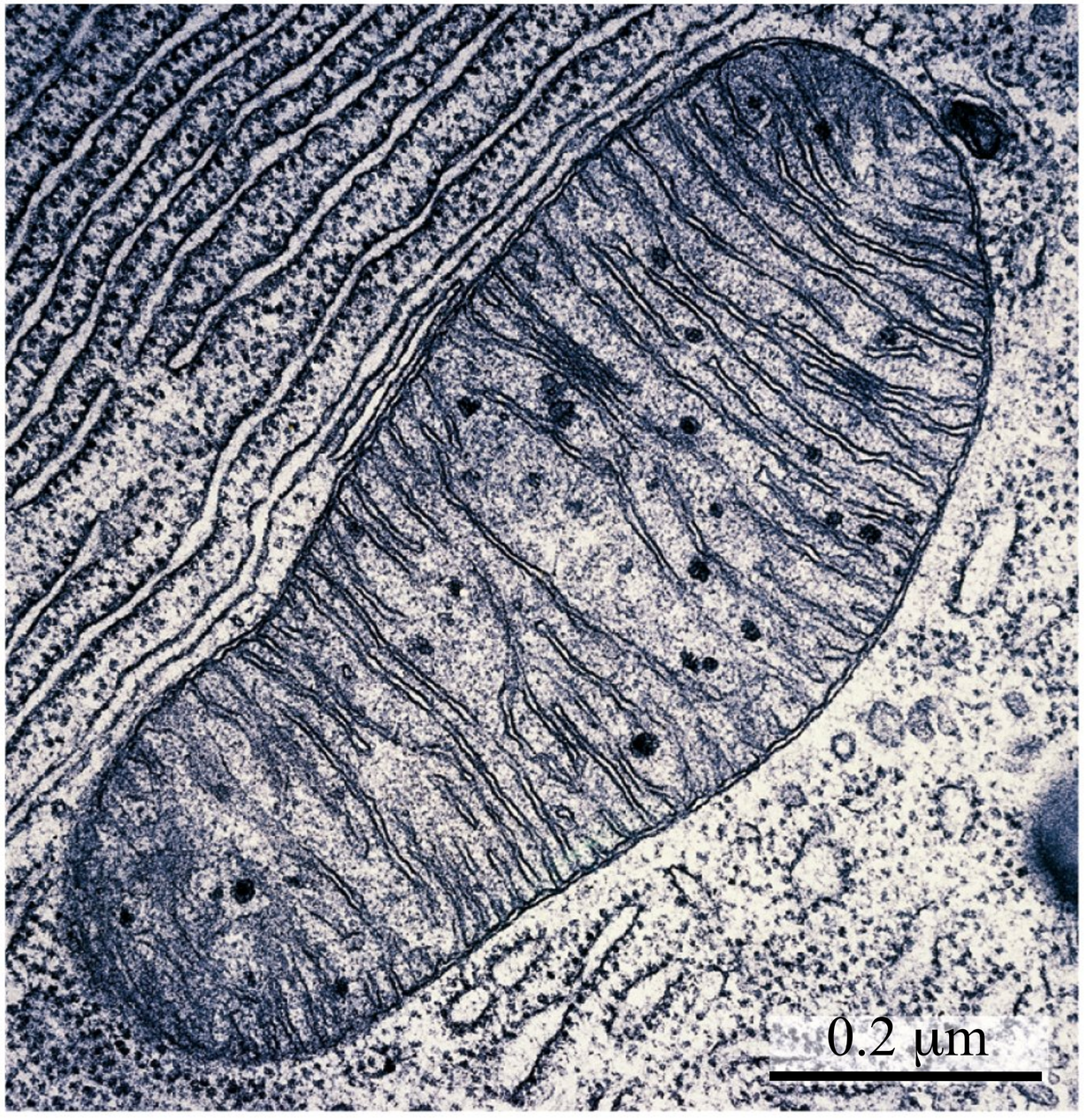







Euchromatin
Heterochromatin
Nucleolus
Nuclear envelope

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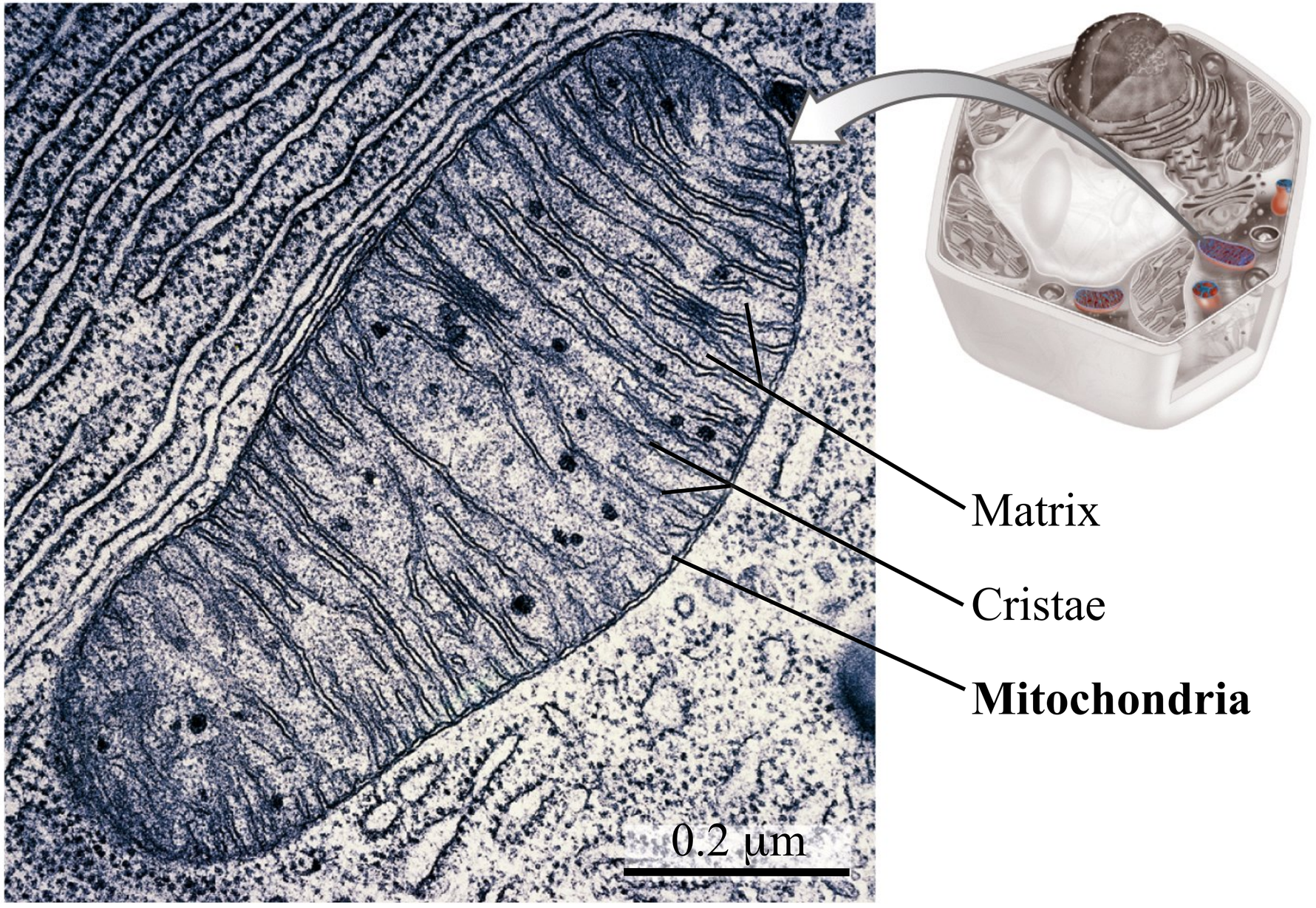
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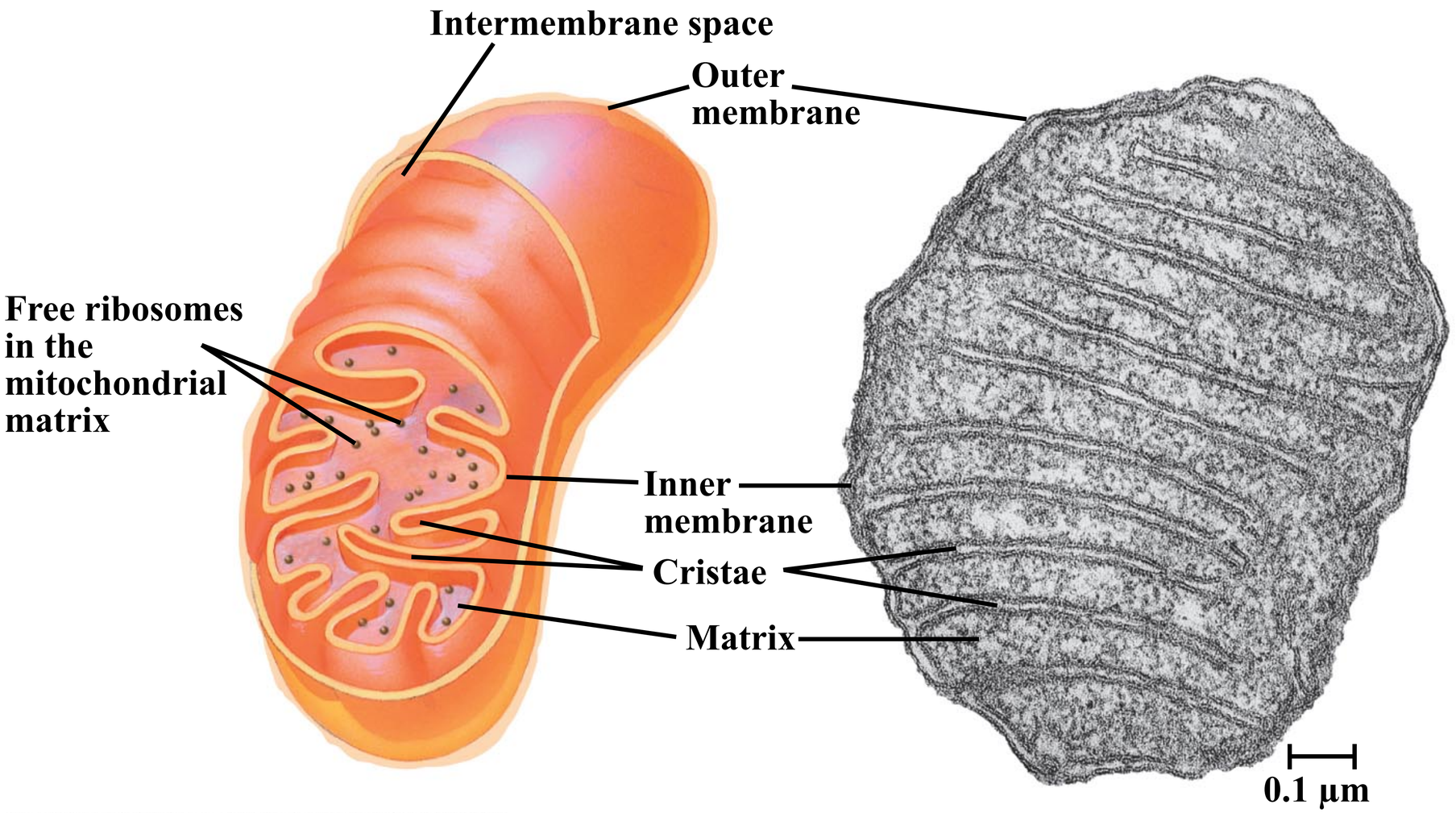
Cristae
Mitochondria
0.2 μm



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