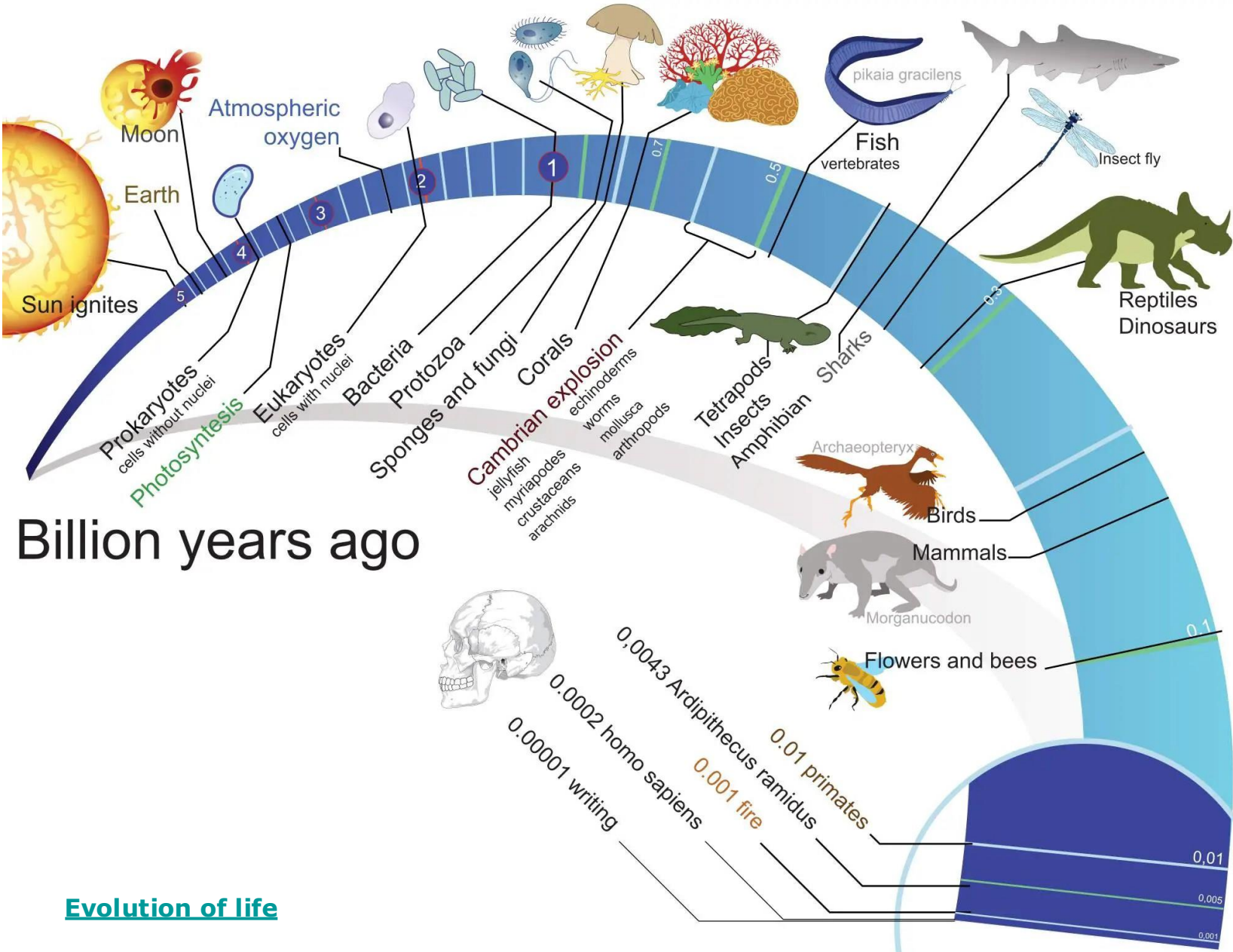


Lodish • Berk • Kaiser • Krieger • Bretscher •  
Ploegh • Amon • Martin

# **Molecular Cell Biology**

**EIGHTH EDITION**

# Evolution of life



Billion years ago

# All living organisms descended from a common ancestral cell.

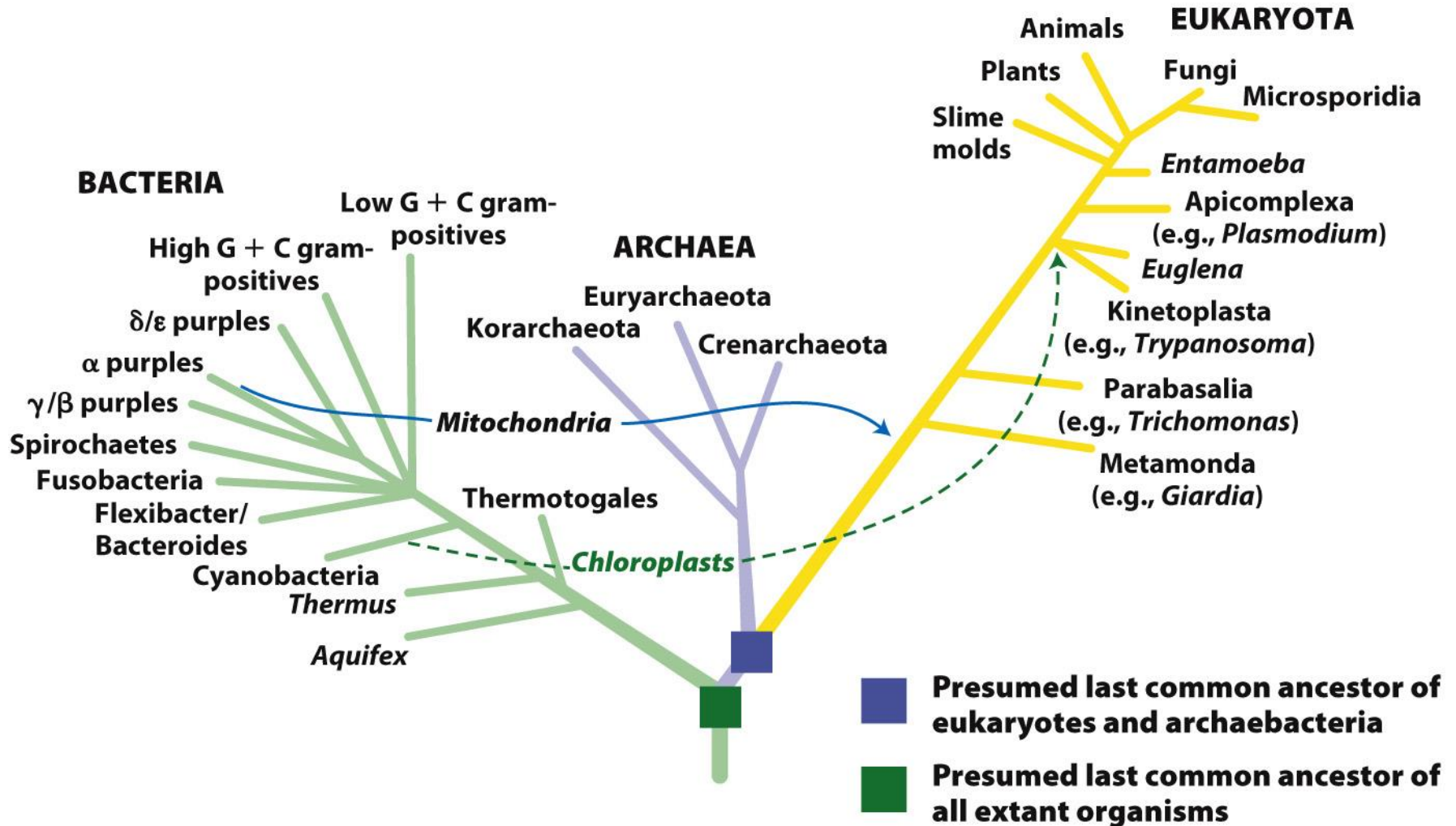
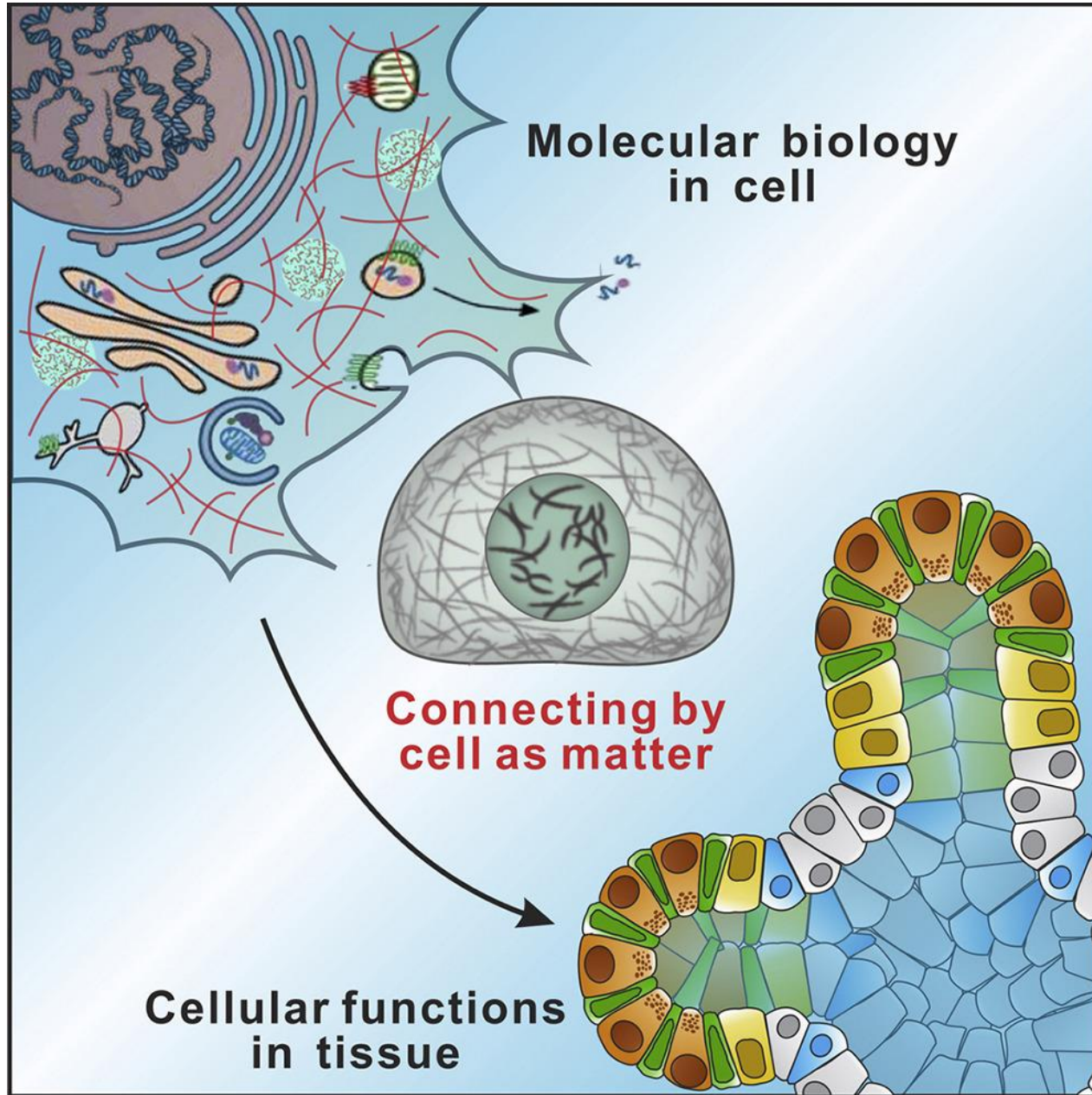
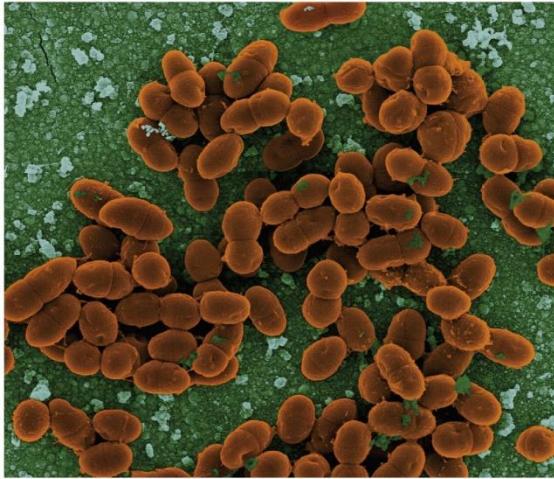


Figure 1-1  
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# Molecular cell biology: in perspective



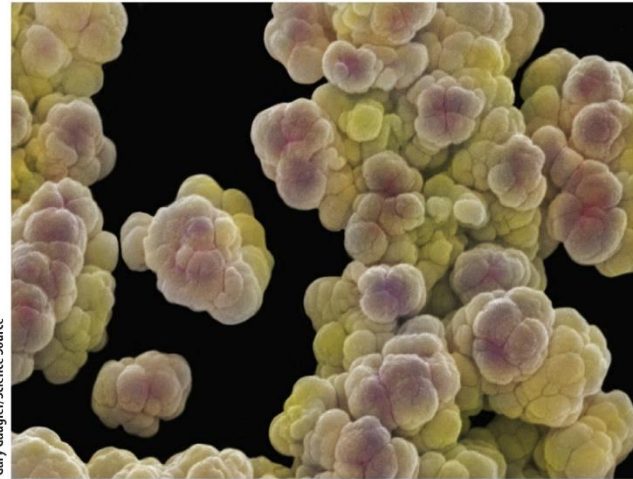
# Morphological variety of cells



Gary Gaugler/Science Source

Eubacteria 1 μm

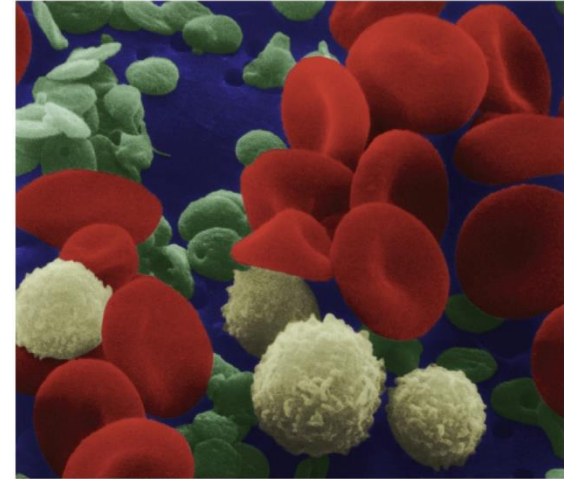
Figure 1-3a  
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Power and Syred/Science Source

Archaeobacteria 1 μm

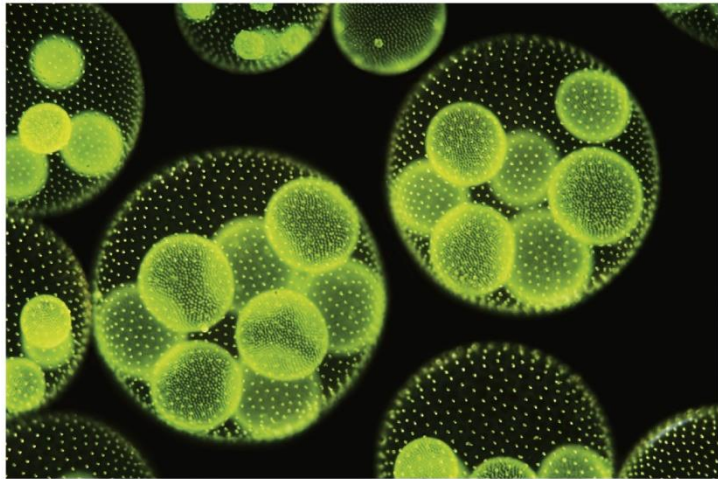
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Science Source

Blood cells 10 μm

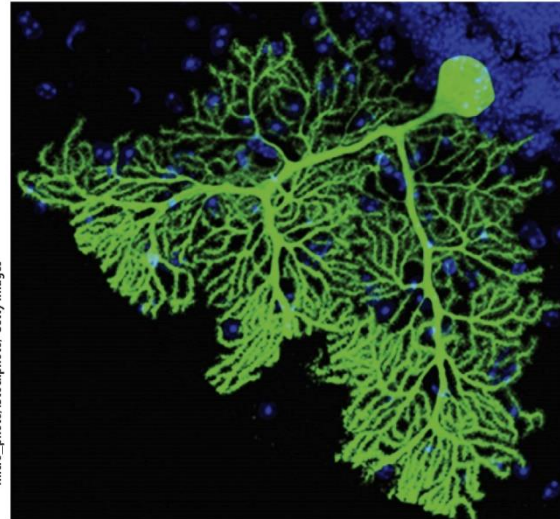
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micro\_photo/(Stockphoto/ Getty Images)

Alga colony 100 μm

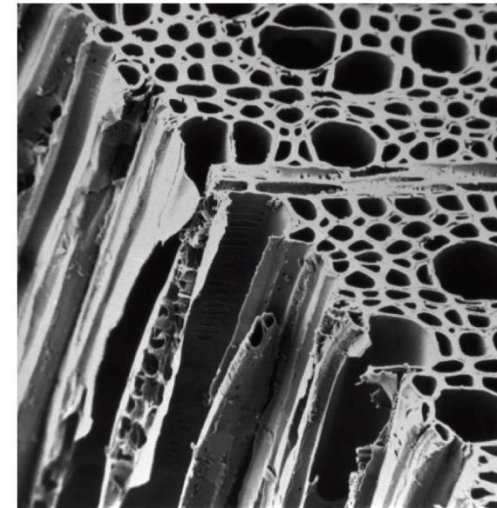
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Courtesy of Dr. Helen M. Blau (Stanford University School of Medicine) and Dr. Clas B. Johansson (Karolinska Institutet)

Neuron 20 μm

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Biophoto Associates/Science Source

Plant cells 20 μm

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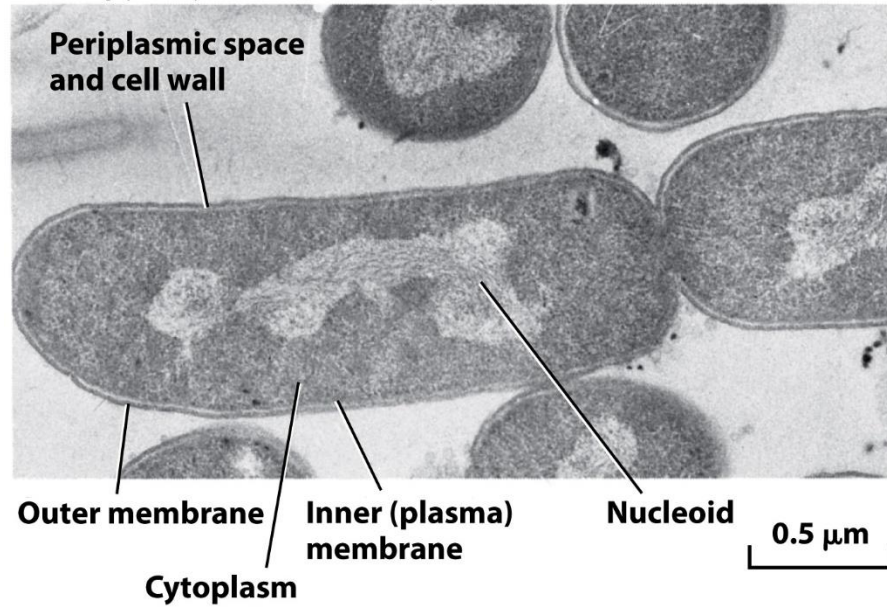


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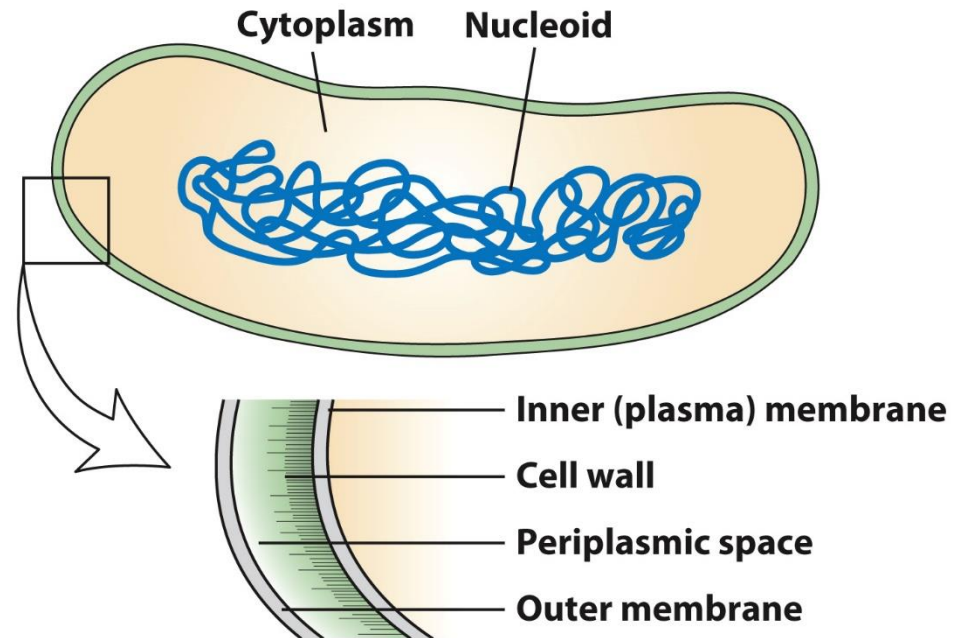


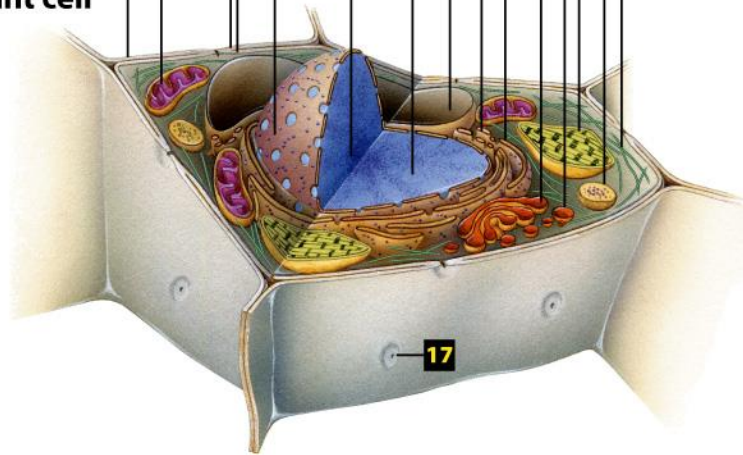
Figure 1-11 part 2  
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## Animal cell



1 2 3 14 4 5 6 15 7 8 9 16 12 10 11 13

## Plant cell



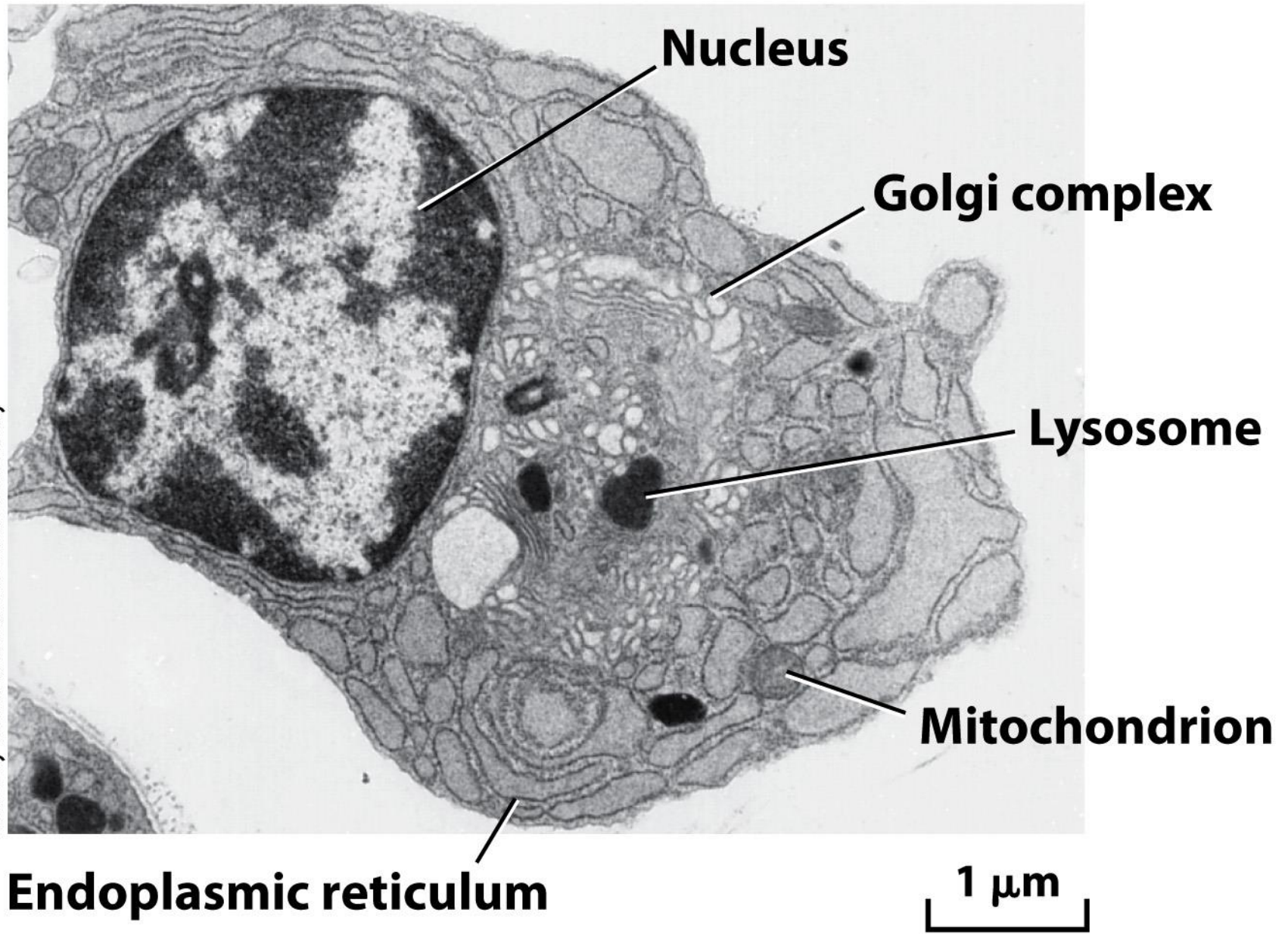
17

- 1** Plasma membrane controls movement of molecules in and out of the cell and functions in cell-cell signaling and cell adhesion.
- 2** Mitochondria, which are surrounded by a double membrane, generate ATP by oxidation of glucose and fatty acids.
- 3** Lysosomes, which have an acidic lumen, degrade material internalized by the cell and worn-out cellular membranes and organelles.
- 4** Nuclear envelope, a double membrane, encloses the contents of the nucleus; the outer nuclear membrane is continuous with the rough ER.
- 5** Nucleolus is a nuclear subcompartment where most of the cell's rRNA is synthesized.
- 6** Nucleus is filled with chromatin composed of DNA and proteins; site of mRNA and tRNA synthesis.
- 7** Smooth endoplasmic reticulum (ER) contains enzymes that synthesize lipids and detoxify certain hydrophobic molecules.
- 8** Rough endoplasmic reticulum (ER) functions in the synthesis, processing, and sorting of secreted proteins, lysosomal proteins, and certain membrane proteins.
- 9** Golgi complex processes and sorts secreted proteins, lysosomal proteins, and membrane proteins synthesized on the rough ER.
- 10** Secretory vesicles store secreted proteins and fuse with the plasma membrane to release their contents.
- 11** Peroxisomes contain enzymes that break down fatty acids into smaller molecules used for biosynthesis and also detoxify certain molecules.
- 12** Cytoskeletal fibers form networks and bundles that support cellular membranes, help organize organelles, and participate in cell movement.
- 13** Microvilli increase surface area for absorption of nutrients from surrounding medium.
- 14** Cell wall, composed largely of cellulose, helps maintain the cell's shape and provides protection against mechanical stress.
- 15** Vacuole stores water, ions, and nutrients, degrades macromolecules, and functions in cell elongation during growth.
- 16** Chloroplasts, which carry out photosynthesis, are surrounded by a double membrane and contain a network of internal membrane-bounded sacs.
- 17** Plasmodesmata are tubelike cell junctions that span the cell wall and connect the cytoplasms of adjacent plant cells.

Figure 1-12a

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Courtesy of I. D. J. Burdett and R. G. E. Murray



**Figure 1-12b**  
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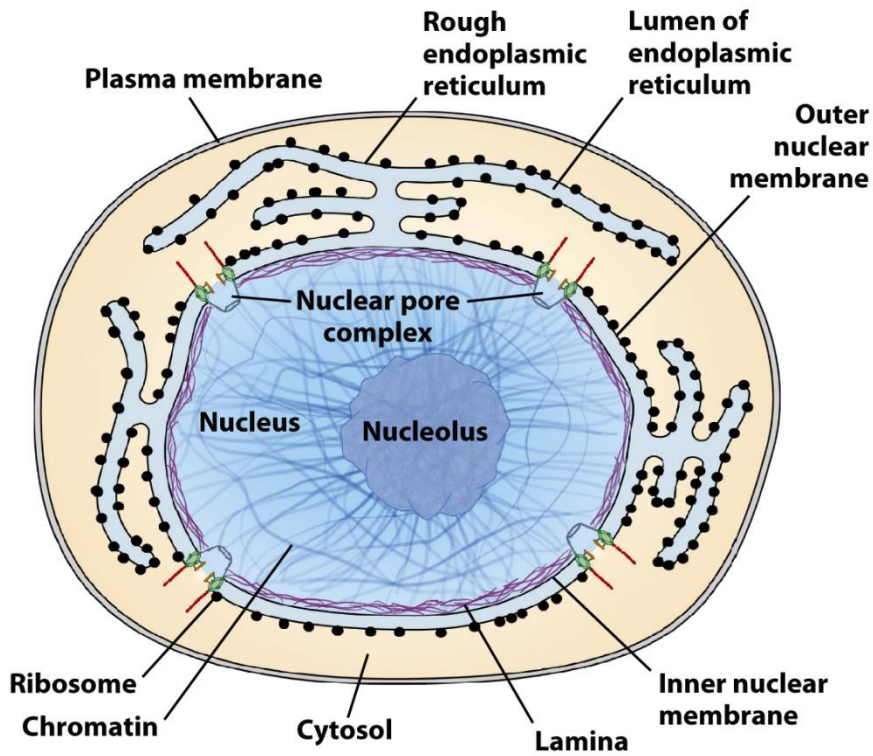
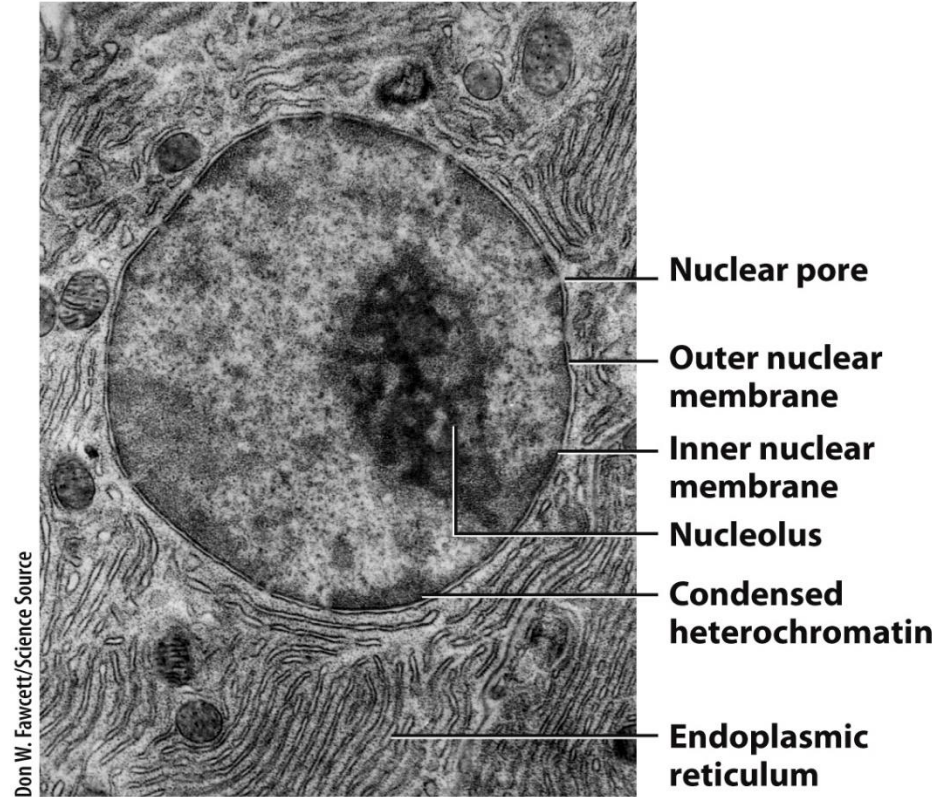
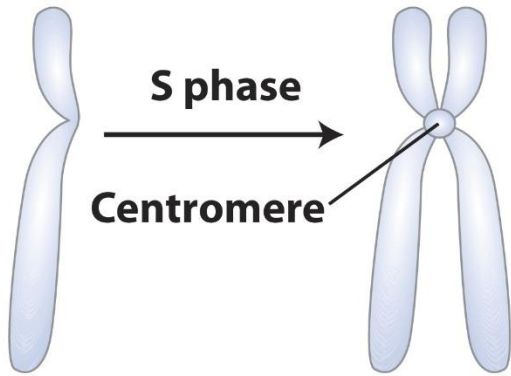


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Don W. Fawcett/Science Source

Figure 1-15b  
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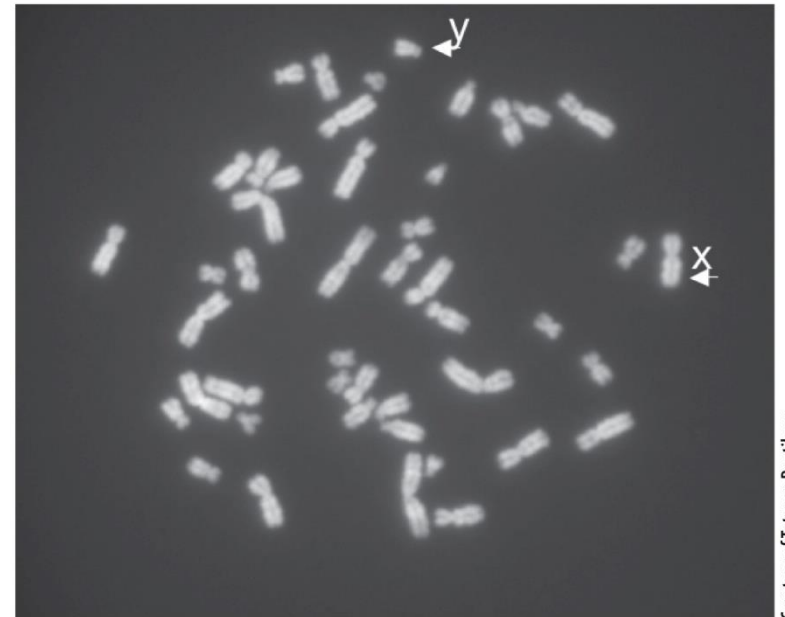
**Chromosome**      **Sister chromatid pair**

**Figure 1-16a**  
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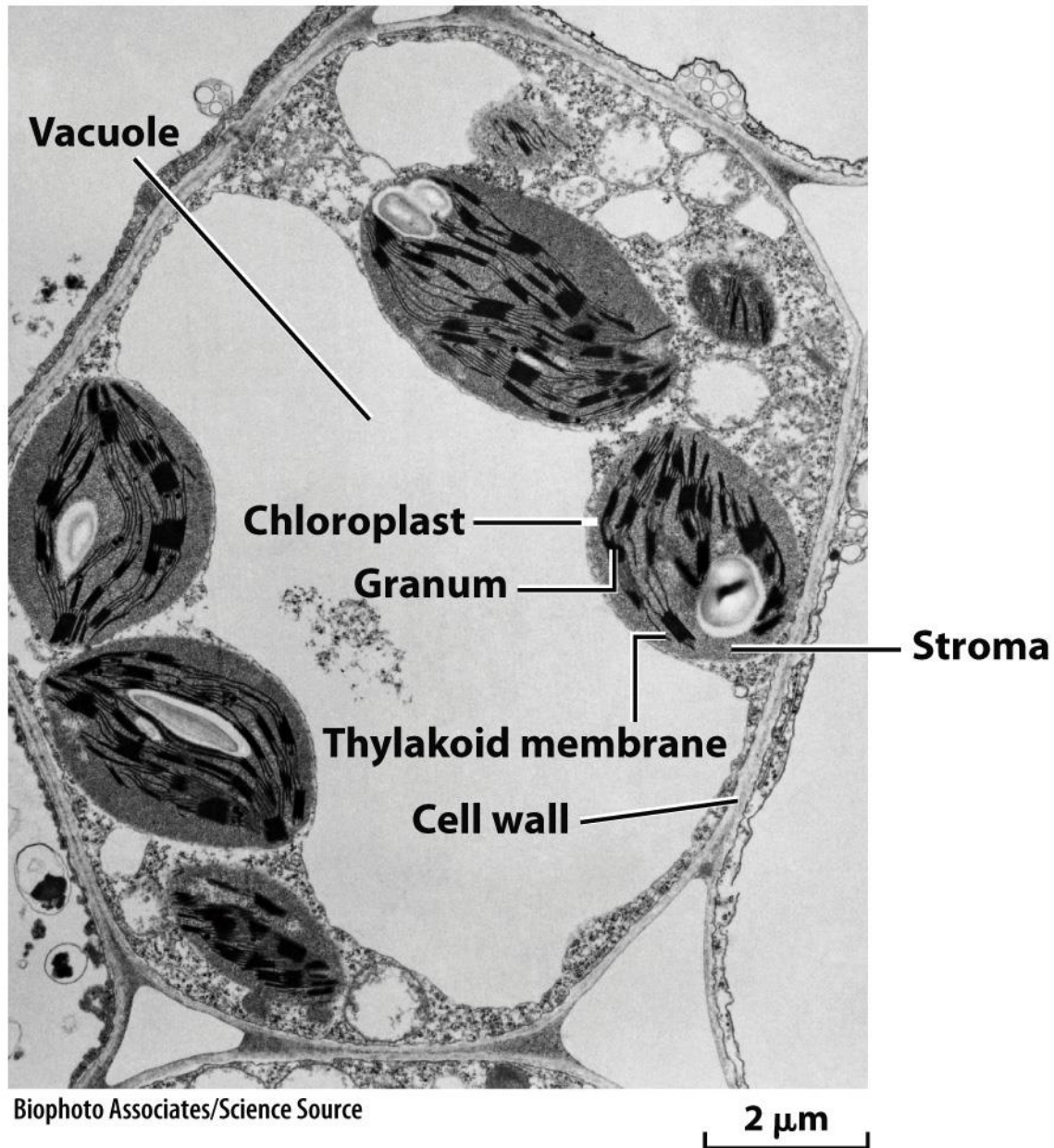
**Figure 1-16b**  
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Medical RF/The Medical File/Peter Arnold Inc.



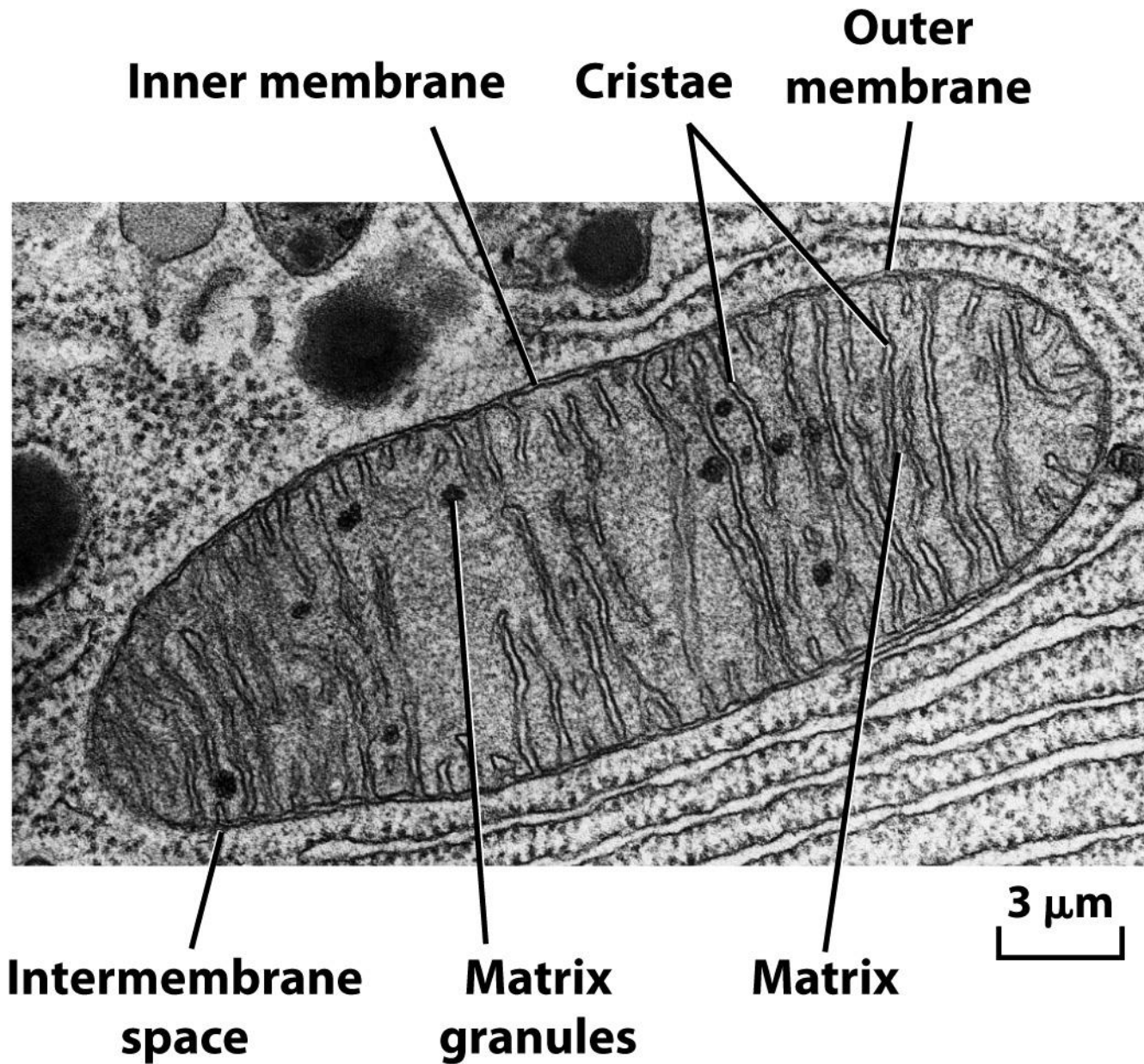
**Figure 1-16c**  
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Courtesy of Tatyana Pyntikova



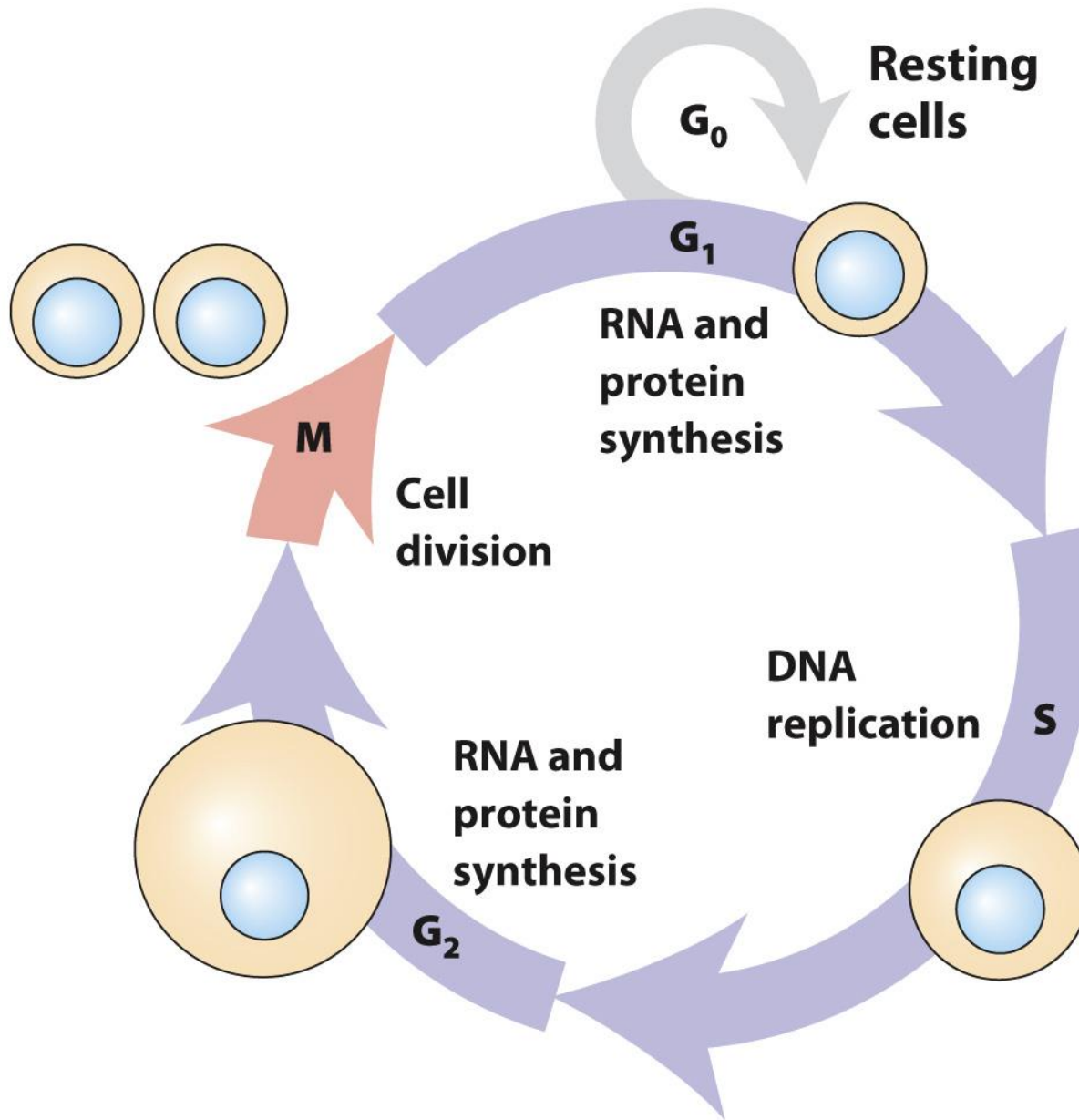
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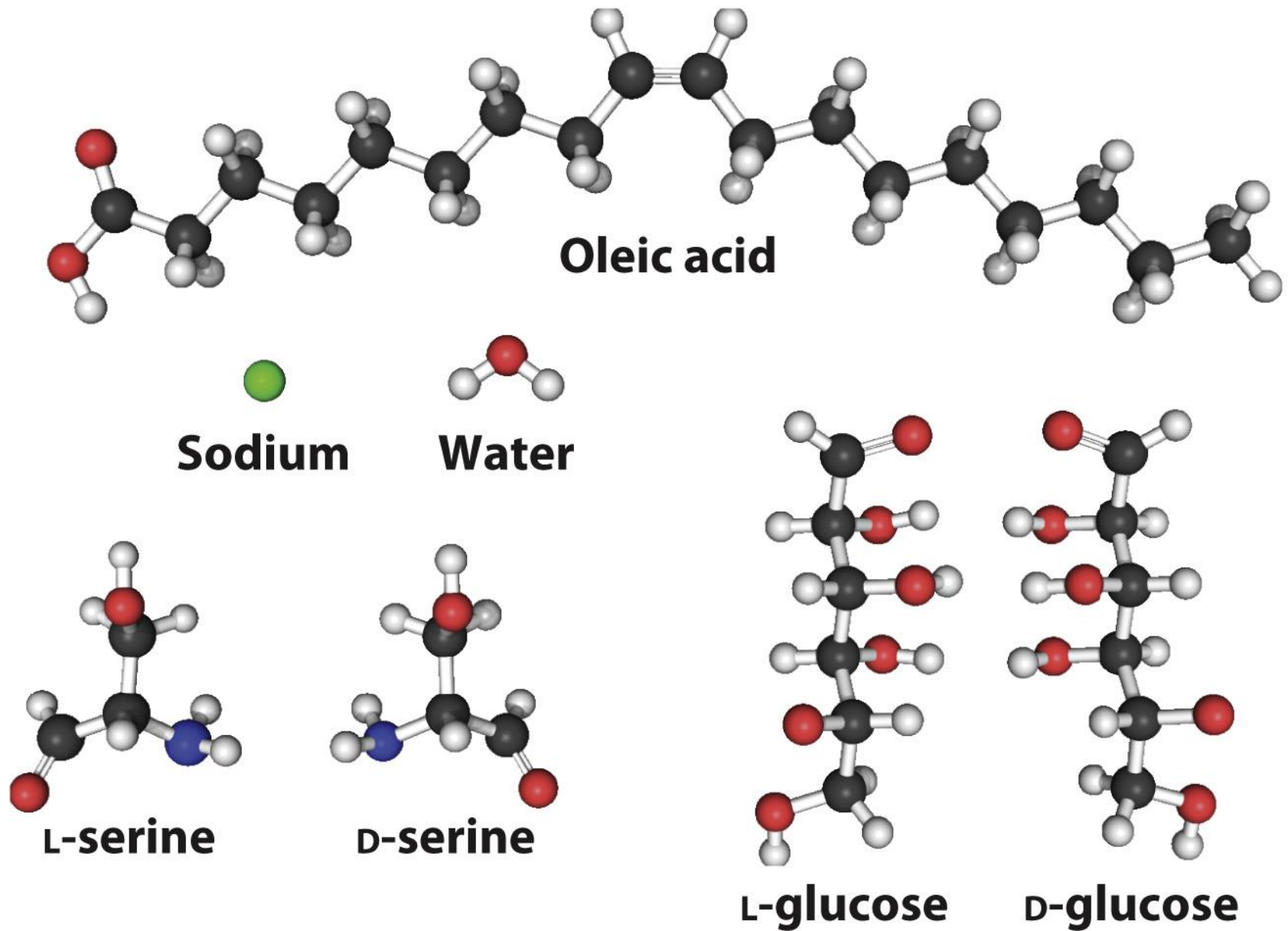


Keith R. Porter/Science Source

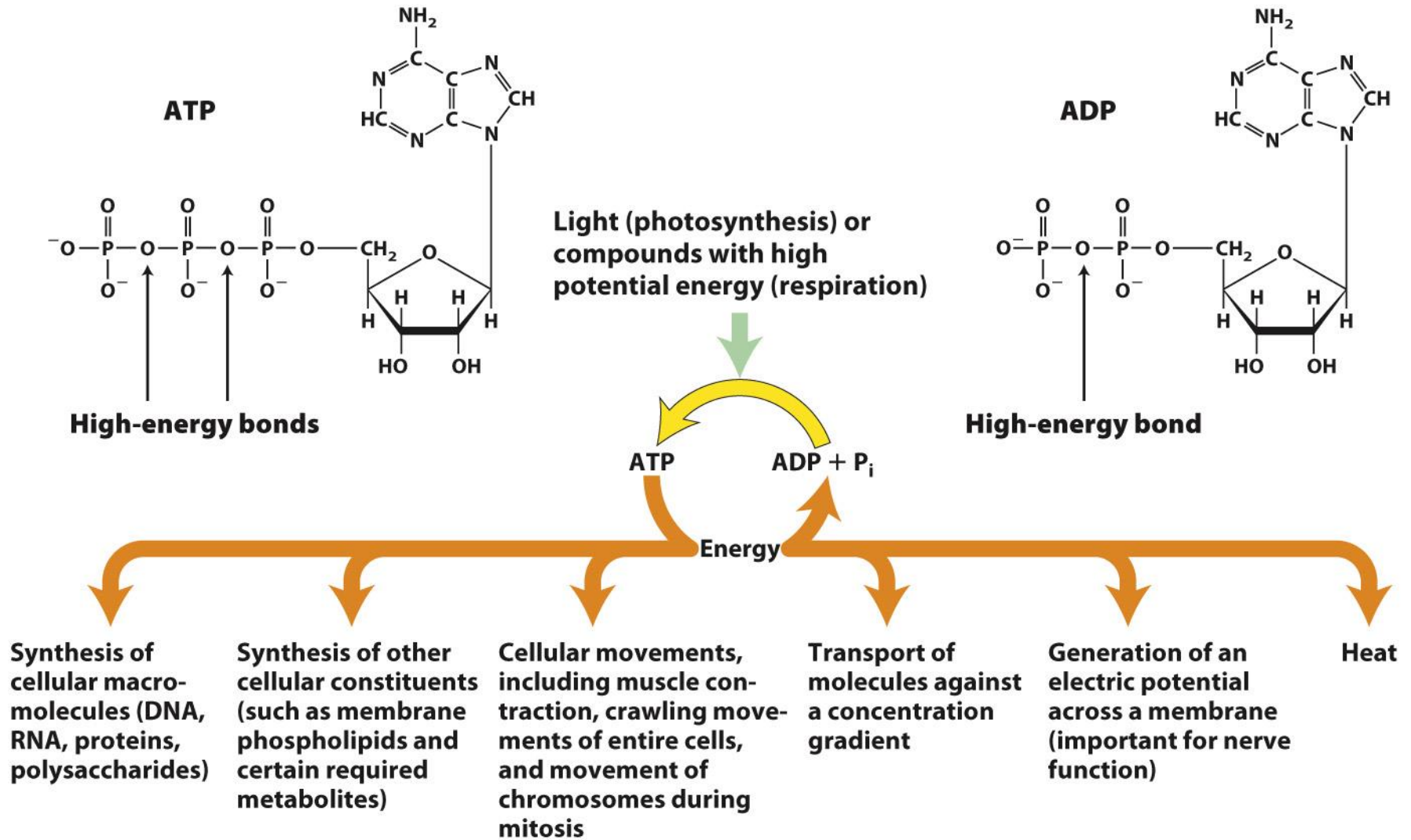
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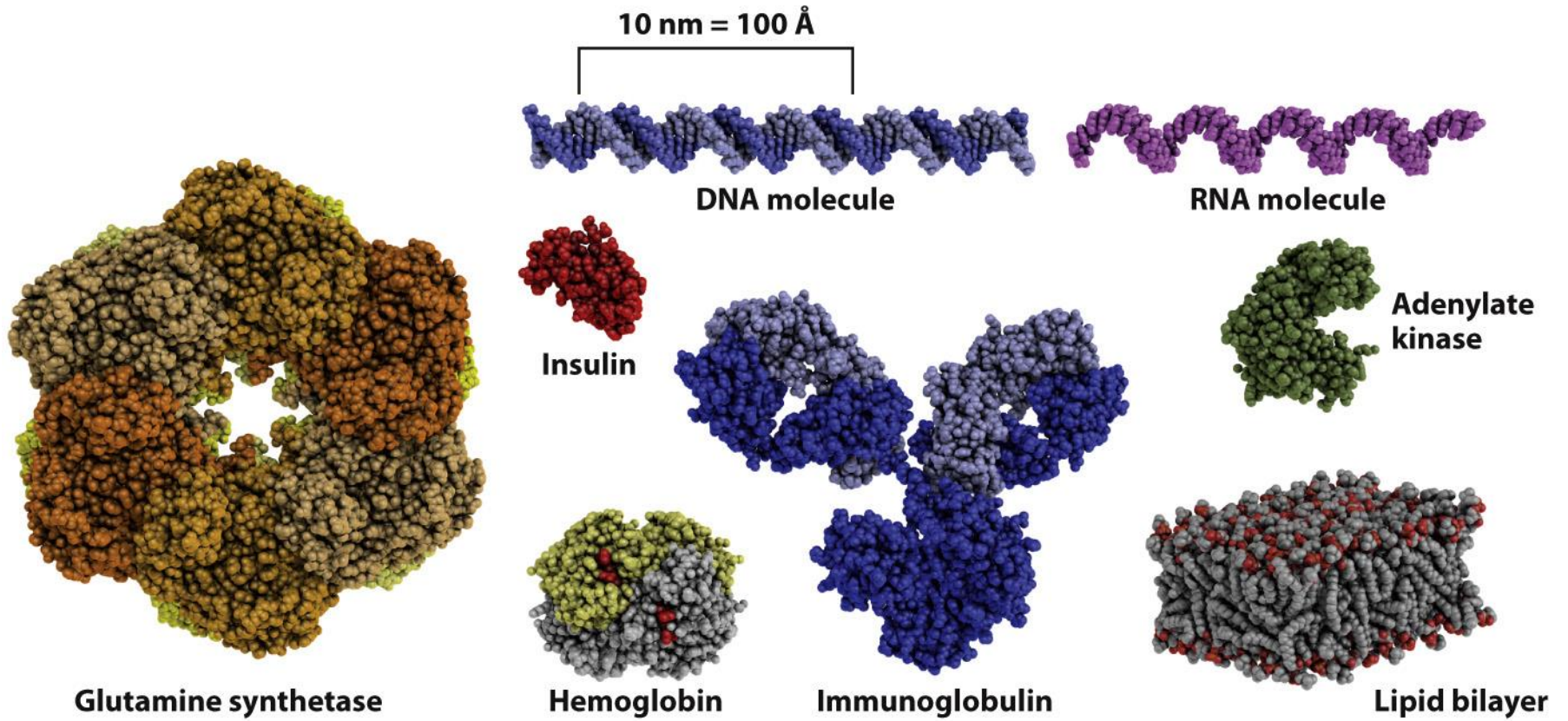
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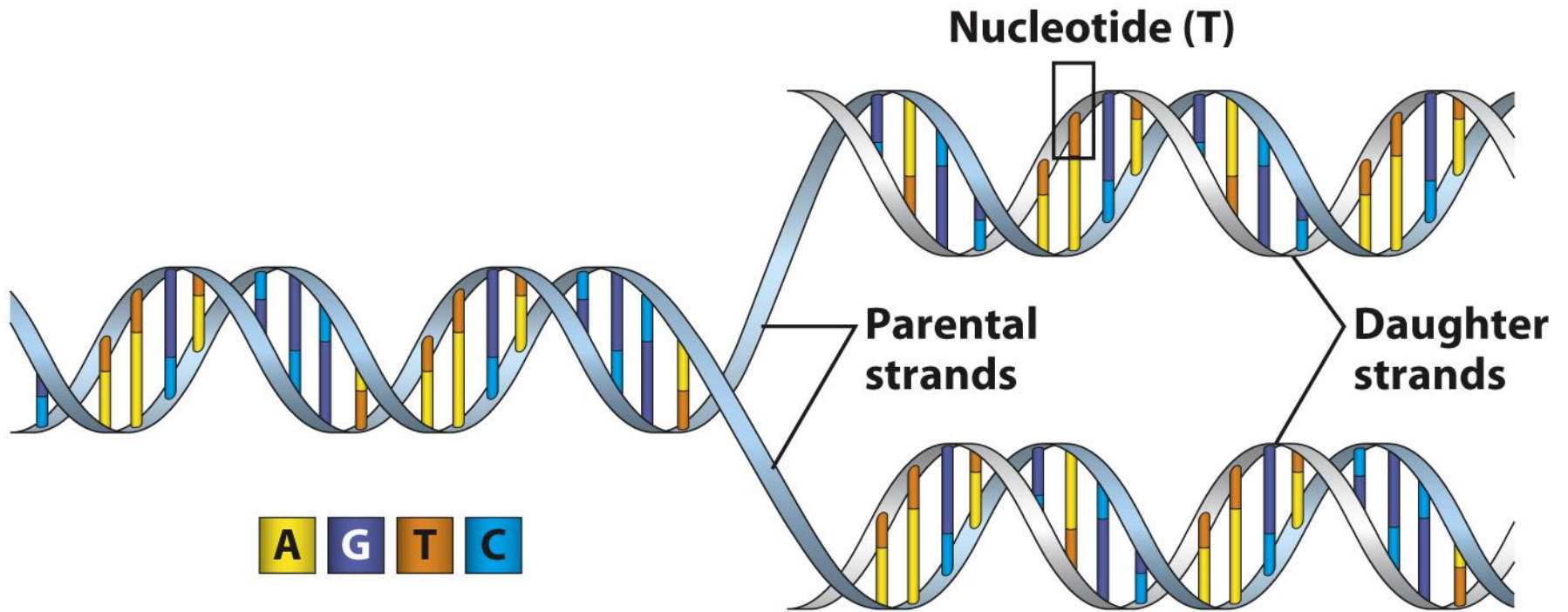


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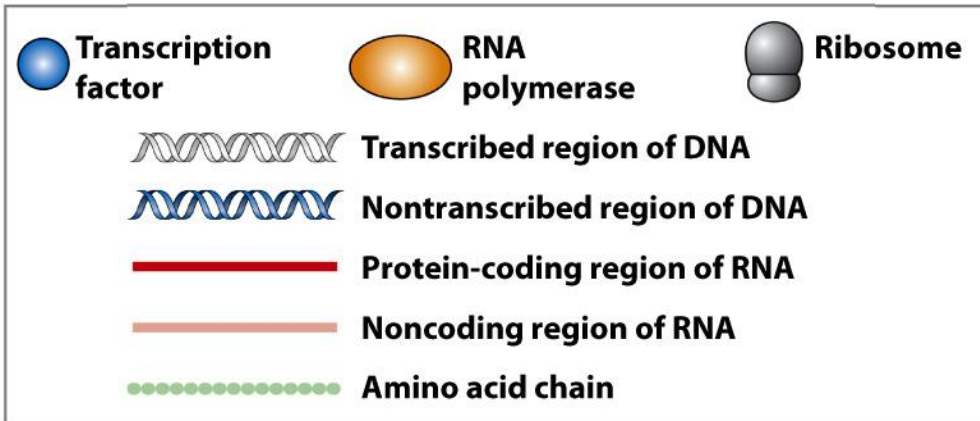
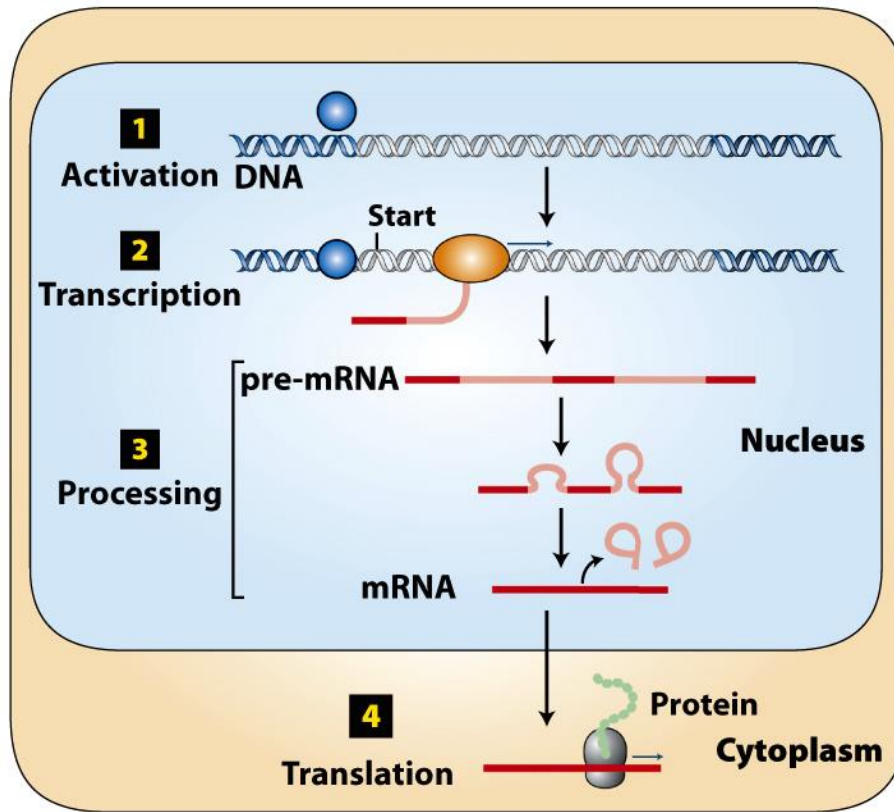


**Figure 1-7**  
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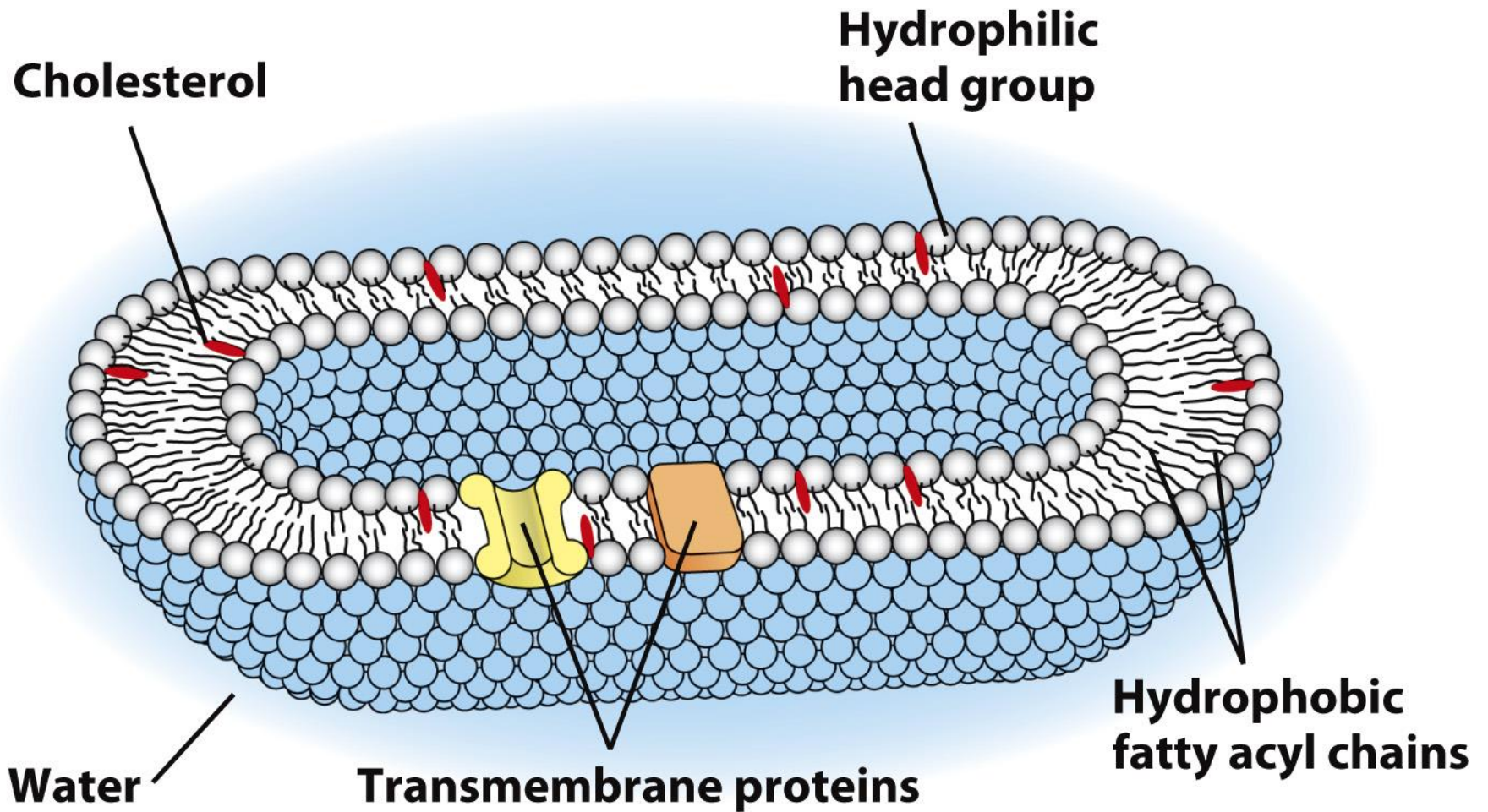




**Figure 1-8**  
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**Figure 1-9**  
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**Figure 1-10**  
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A glowing, multi-colored, irregularly shaped object resembling a cell or a biological structure. The object is primarily dark blue and black, with bright magenta and cyan highlights along its edges and internal contours, giving it a 3D, translucent appearance. The background is solid black.

Emerging view of a cell

# Bacterial cell

Electron micrograph courtesy of I. D. J. Burdett and R. G. E. Murray

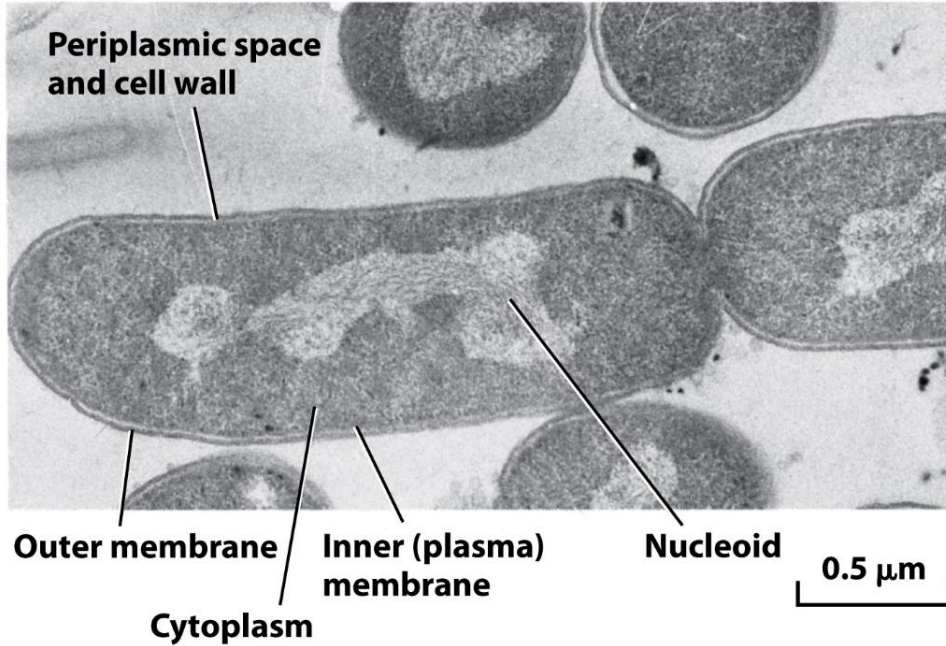
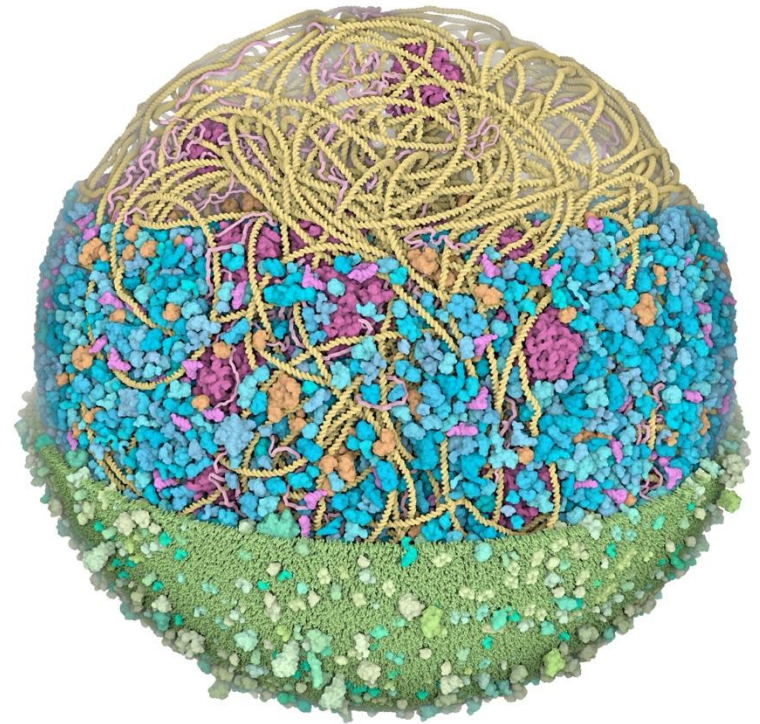


Figure 1-11 part 1  
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*Mycoplasma mycoides* illustration by David Goodsell

# Inside a bacterial cell

## Mycoplasma mycoides illustration by David Goodsell

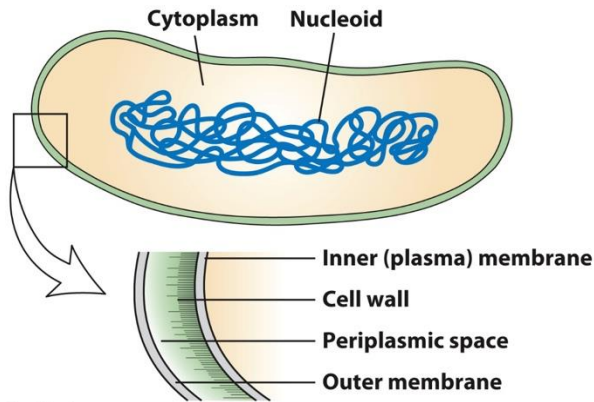
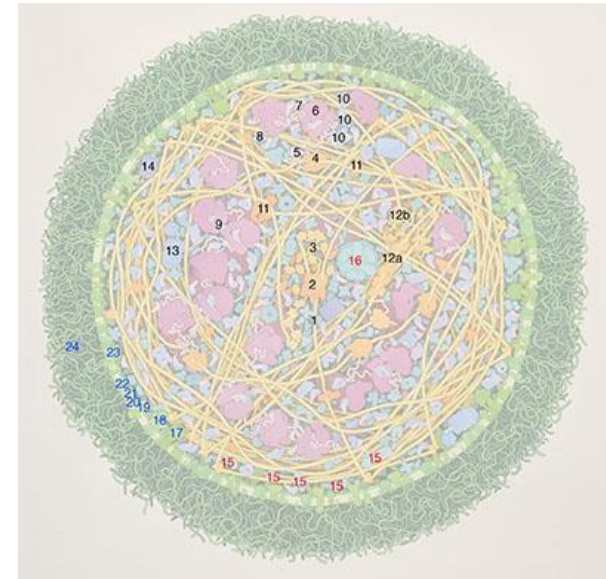
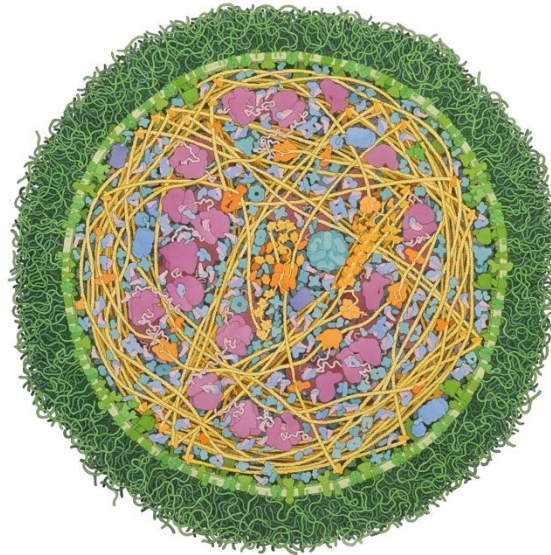


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Key for "Mycoplasma mycoides"

Protein synthesis (labels in black)

1. [DNA](#)
2. [DNA polymerase](#)
3. [single-stranded-DNA binding protein](#) (protects single-stranded portions during replication)
4. [RNA polymerase](#)
5. messenger RNA
6. [ribosome](#)
7. [transfer RNA](#) (in pink) and [elongation factor Tu](#) (in blue)
8. [elongation factor Tu and Ts](#)
9. [elongation factor G](#)
10. [aminoacyl-tRNA synthetases](#)
11. [topoisomerases](#)
12. [Rec system for DNA repair](#): a) RecA, b) RecBC
13. [chaperonin GroEL](#) (helps folding of new proteins)
14. ClpA (destroys old proteins)

Enzymes for energy production (labels in red) [glycolytic enzymes](#)

1. [pyruvate dehydrogenase complex](#)

2.

Membrane proteins (labels in blue) [ATP synthase](#)

3. secretory proteins

4. [sodium pump](#)

5. zinc transporter

6. magnesium transporter

7. ABC transporter (different ABC transporters transport different types of molecules-ABC is short for "ATP-binding cassette")

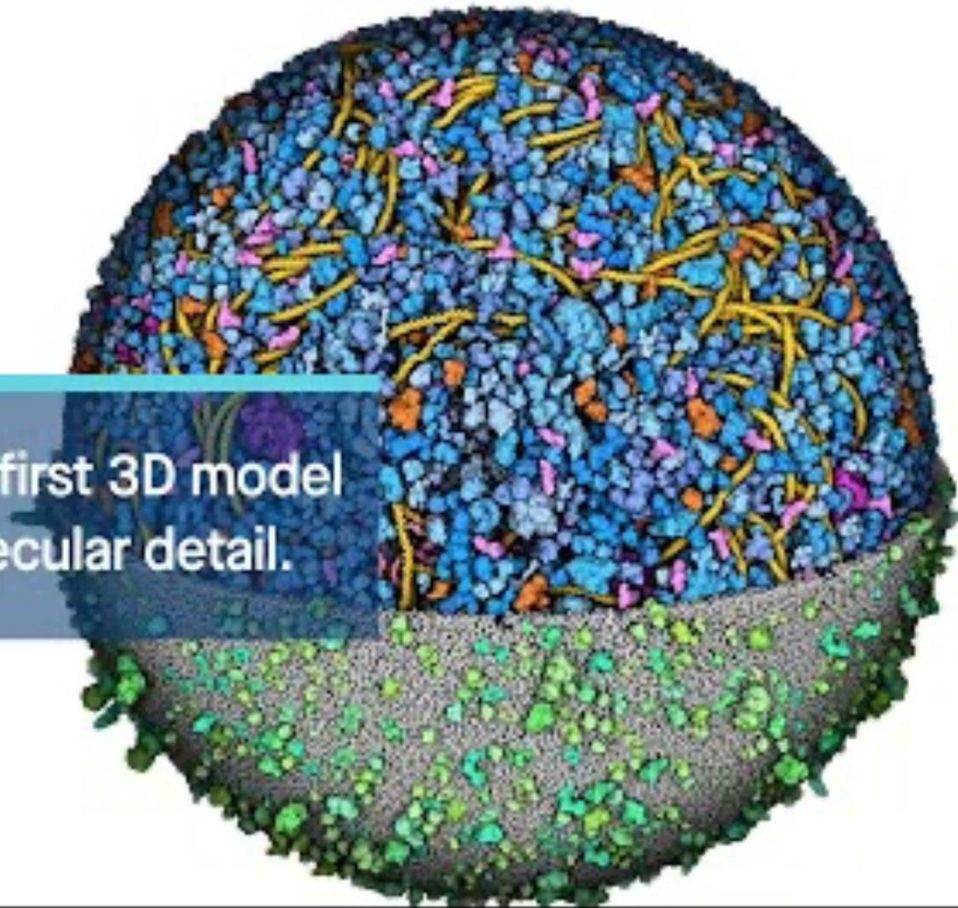
8. magnesium transporter

9. lipoglycan (long carbohydrate chains connected to lipid in the membrane)

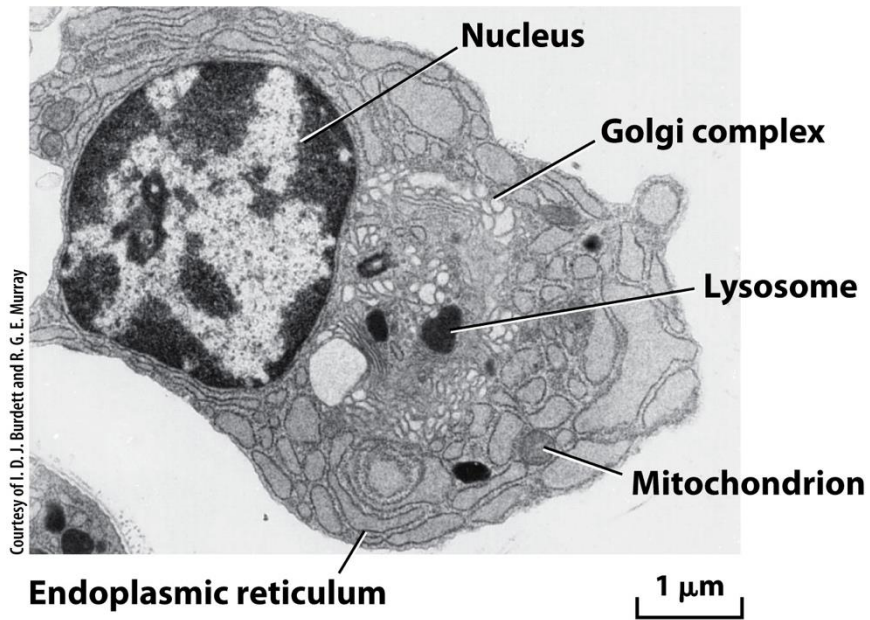
# 3D model of a bacterial cell

---

Researchers create first 3D model of entire cell at molecular detail.



# Eukaryotic cell



Courtesy of I. D. J. Burdett and R. G. E. Murray

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# Clicker Question 1-1

All of the following are macromolecules EXCEPT:

- A. polysaccharides.
- B. proteins.
- C. nucleic acids.
- D. sugars.
- E. All of the above are macromolecules.

# Clicker Question 1-1

All of the following are macromolecules EXCEPT:

- A. polysaccharides.
- B. proteins.
- C. nucleic acids.
- D. sugars.
- E. All of the above are macromolecules.

Sugars are the monomers used to form polysaccharides.

## Clicker Question 1-2

DNA is converted into RNA in a process called:

- A. transcription.
- B. translation.
- C. complementary base pairing (G=C, A=T).
- D. genetic coding.
- E. catalyzation

# Clicker Question 1-2

DNA is converted into RNA in a process called:

- A. transcription.
- B. translation.
- C. complementary base pairing (G=C, A=
- D. genetic coding.
- E. catalyzation

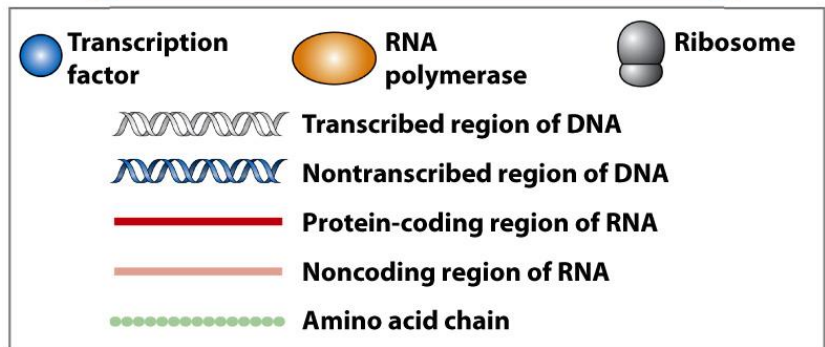
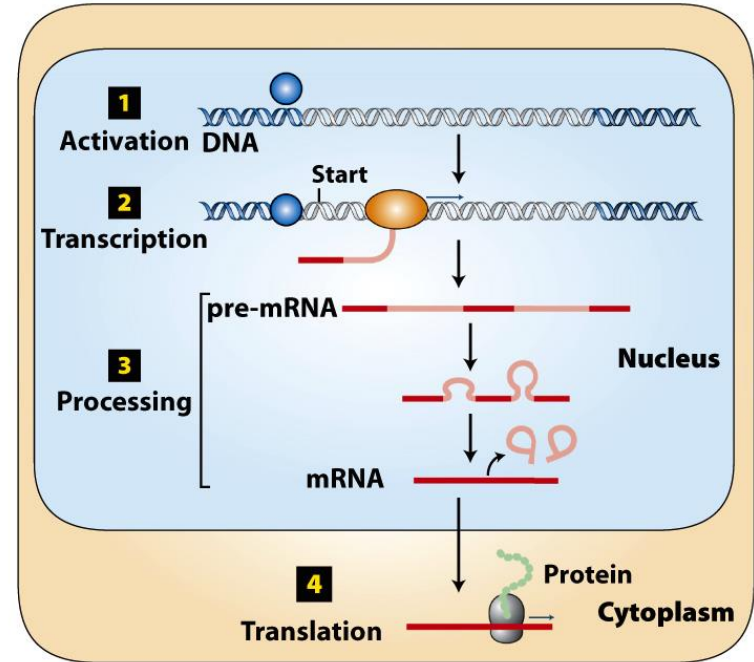


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# Clicker Question 1-3

Phospholipid bilayers contain:

- A. cholesterol.
- B. transmembrane proteins.
- C. hydrophobic fatty acyl chains.
- D. hydrophilic head groups.
- E. All of the above

# Clicker Question 1-3

Phospholipid bilayers contain:

- A. cholesterol.
- B. transmembrane proteins.
- C. hydrophobic fatty acyl chains.
- D. hydrophilic head groups.
- E. All of the above

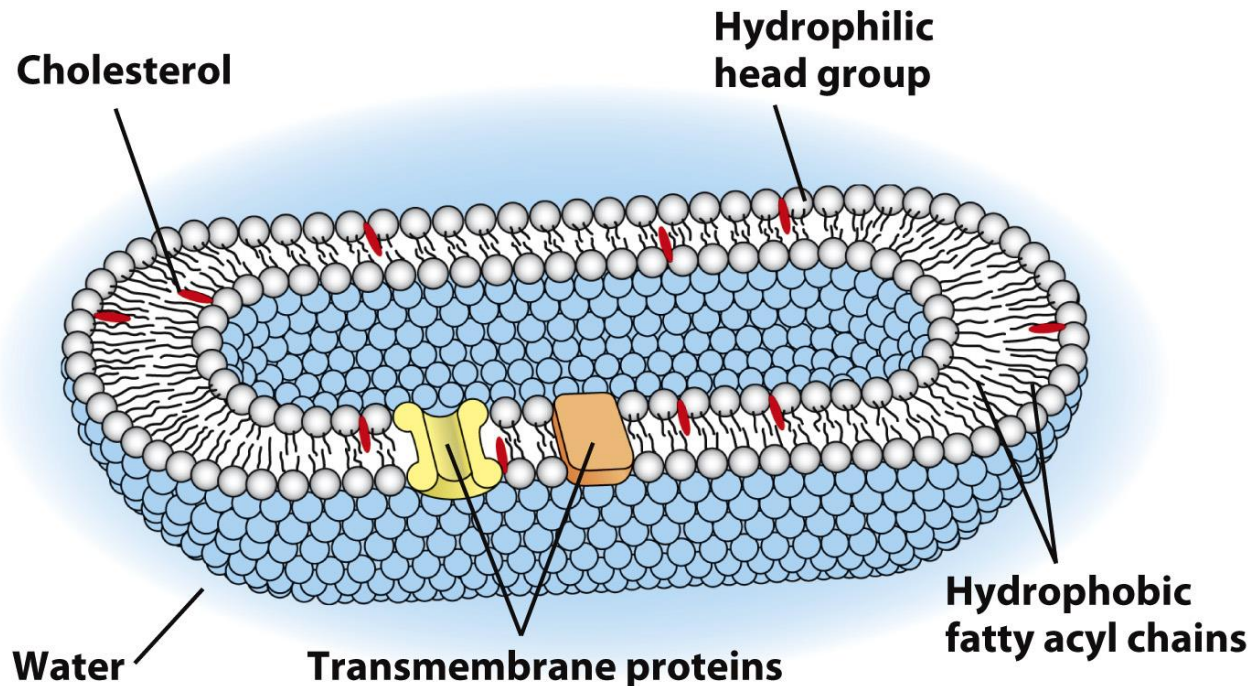


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## Clicker Question 1-4

\_\_\_\_\_ is the most common molecule used by cells to capture, store, and transfer energy.

- A. ATP
- B. ADP
- C. L-glucose
- D. D-glucose
- E. Water

# Clicker Question 1-4

\_\_\_\_\_ is the most common molecule used by cells to capture, store, and transfer energy.

- A. ATP
- B. ADP
- C. L-glucose
- D. D-glucose
- E. Water

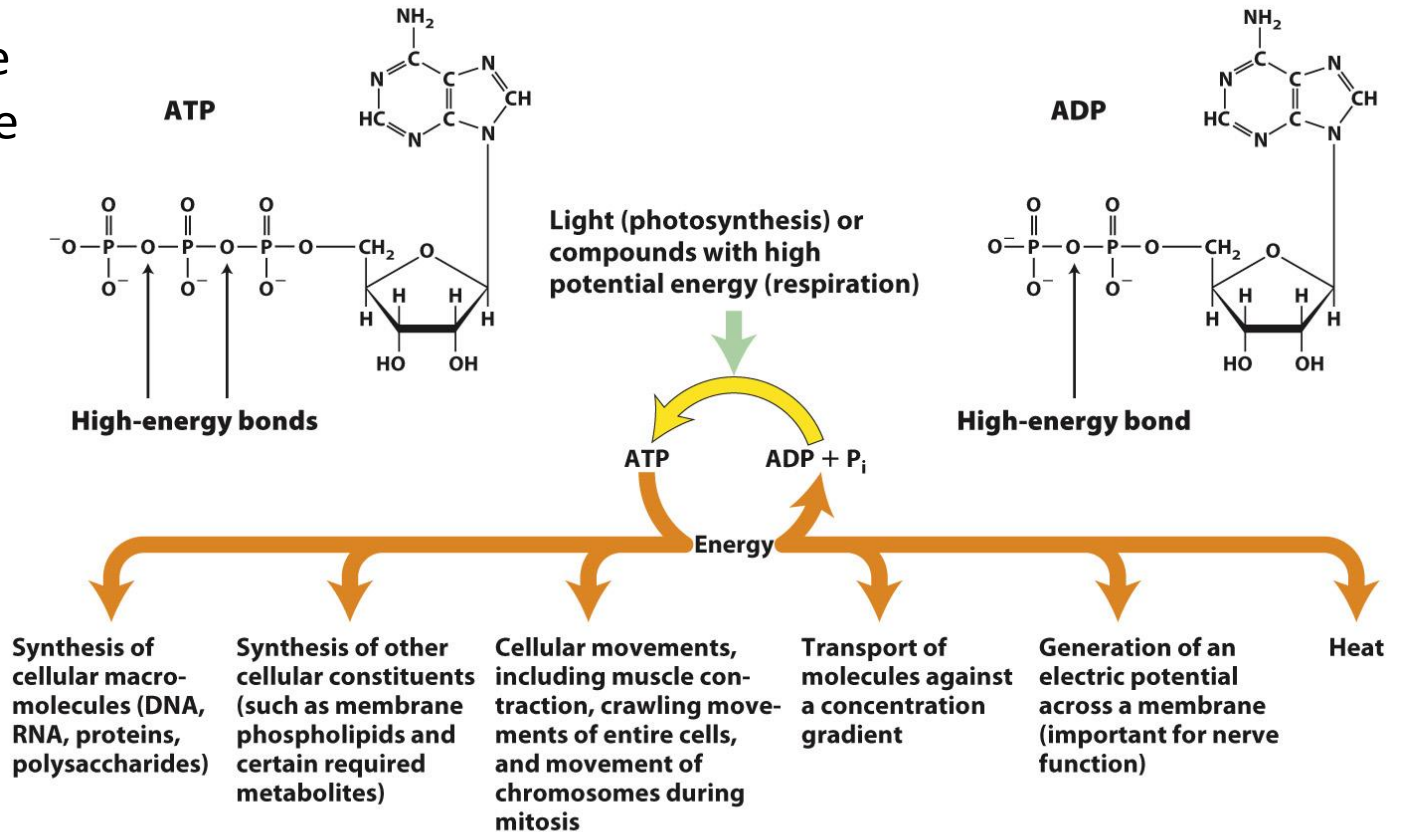


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# Clicker Question 1-5

The DNA double helix is stabilized by weak hydrogen bonds between:

- A. G and C bases only.
- B. A and T bases only.
- C. A and U bases only.
- D. A and T bases and between G and C bases.
- E. A and U bases and between G and C bases.

# Clicker Question 1-5

The DNA double helix is stabilized by weak hydrogen bonds between:

- A. G and C bases only.
- B. A and T bases only.
- C. A and U bases only.
- D. A and T bases and between G and C bases.
- E. A and U bases and between G and C bases.

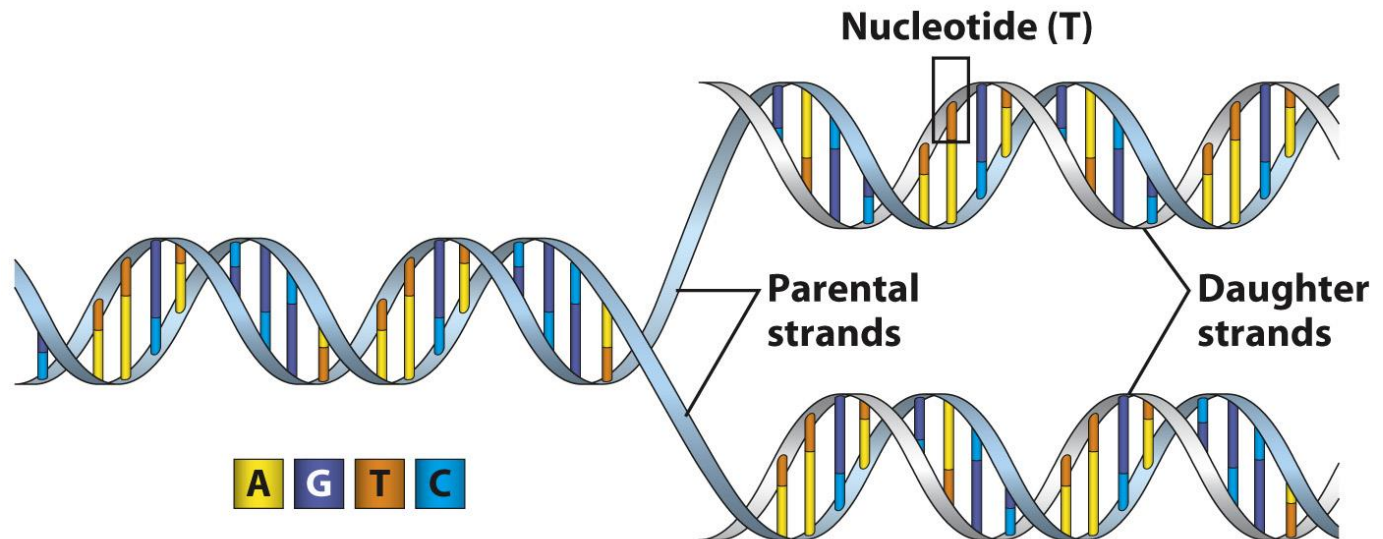


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## Clicker Question 1-6

TRUE or FALSE: Water is a component of the phospholipid bilayer.

- A. True
- B. False

# Clicker Question 1-6

TRUE or FALSE: Water is a component of the phospholipid bilayer.

- A. True
- B. False

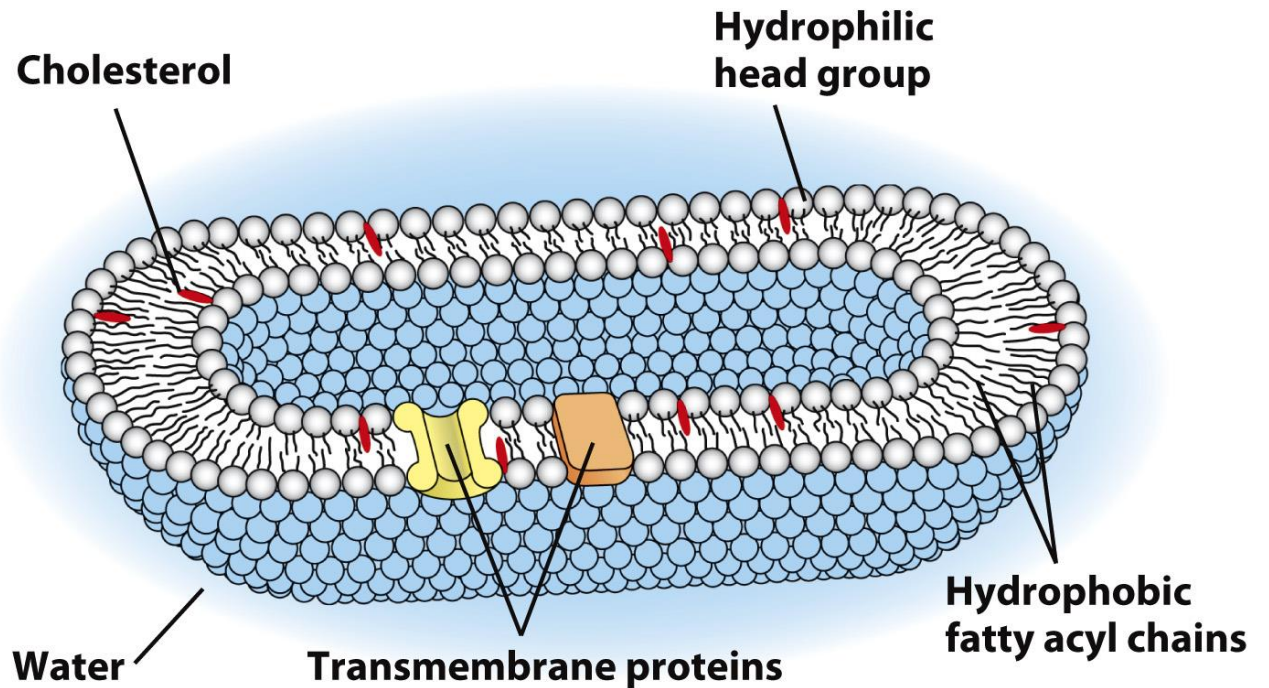
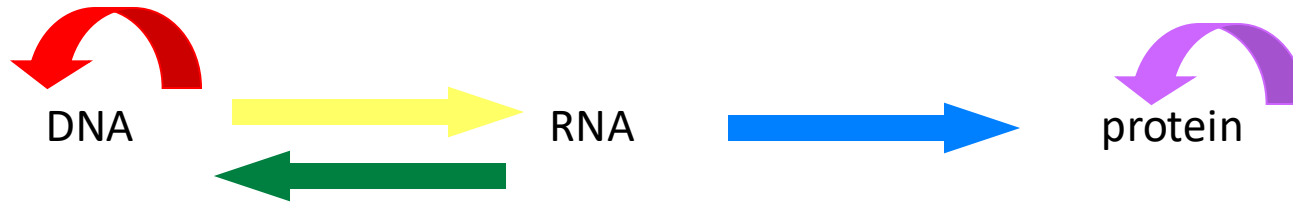


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## Clicker Question 1-2

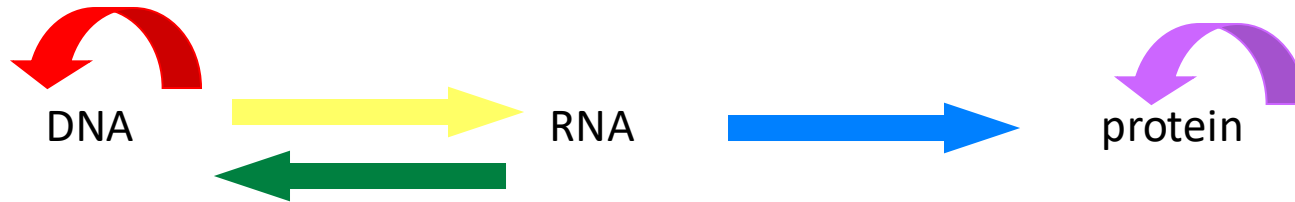
In the diagram below, which arrow indicates the process of *translation*?



- A. red
- B. yellow
- C. green
- D. blue
- E. purple

## Clicker Question 1-2

In the diagram below, which arrow indicates the process of *translation*?



- A. red
- B. yellow
- C. green
- D. blue**
- E. purple