

BIO 311C

Spring 2010

Exam 1: in this room at this time on Friday, Feb. 12 (next Friday)

The exam will cover:

- the text reading assignments through the Feb. 10 assignment,**
- the lecture material and web-based PowerPoint through Monday's lecture,**
- the introductory information covered during the discussion periods.**

We will devote the last ~20 minutes of next Wednesday's lecture to a review of the subject matter.

Lecture 8 – Friday 5 Feb. 2010



External Coatings of Cells

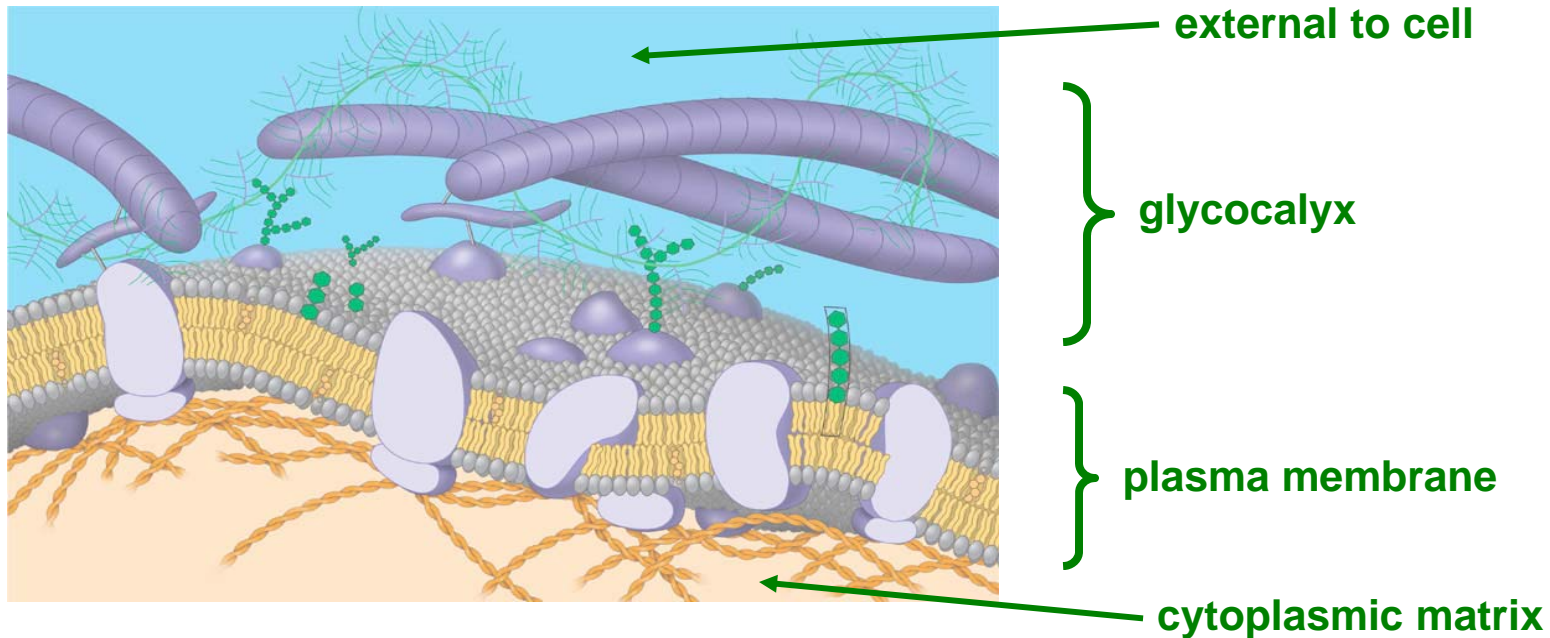
Nearly all kinds of cells (prokaryotic and eukaryotic) have a coating external to the plasma of membrane. Depending on the kind of cell and its location, this coating may be used to:

- shield the cell from physical and/or chemical agents in its environment,
- protect the cell from being eaten by other cells or organisms,
- make the cell stronger and/or more rigid,
- protect the cell from drying out,
- anchor the cell to a surface or to another cell,
- allow the cell to swim and/or float in water,
- serve as an array of sensors, allowing the cell to detect and react to its environment, and/or allowing other cells in the environment to detect and react to it.



Animal cells have a complex array of molecules, especially proteins and carbohydrates, on their external surfaces.

Textbook Fig. 6.30, p. 120.



The glycocalyx is a name for the thin external surface that occurs on most animal cells.

According to definitions provided in this course, flagella of eukaryotic cells should be considered as a component of the protoplasm while bacterial flagella are external to the protoplasm. Can you explain why?



Some Features of Plant Cells that Distinguish them from Animal Cells

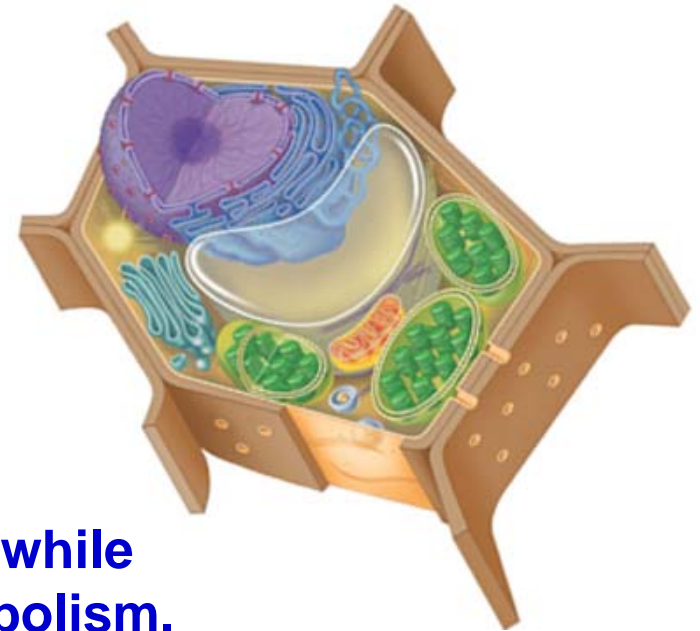
Typical plant cells do not contain:

- lysosomes,
- microtubules that are organized into cilia, flagella or centrioles.

Typical plant cells contain:

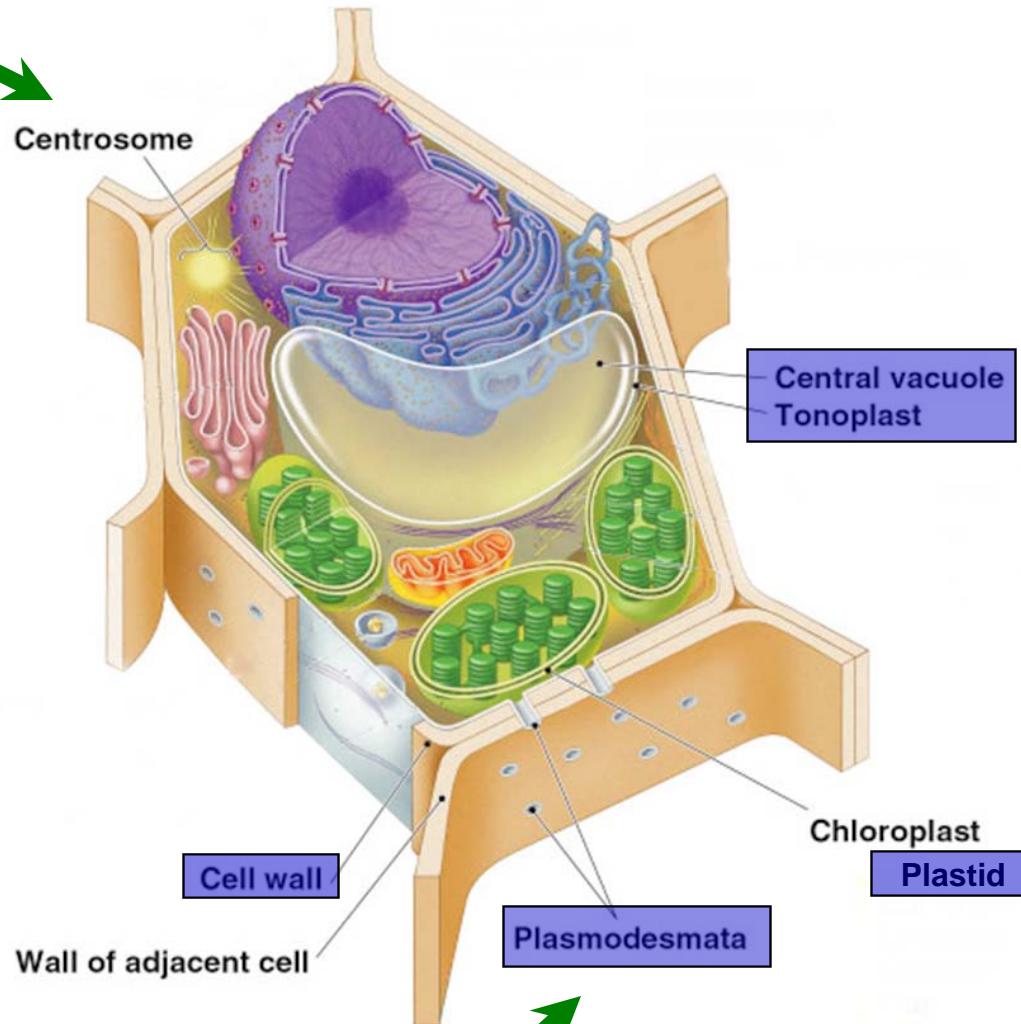
- plasmodesmata,
- a central vacuole,
- a thick cell wall,
- plastids.

Plant cells have a generalized metabolism while animal cells have a more specialized metabolism.



Components of Plant Cells that Differ from Animal Cells

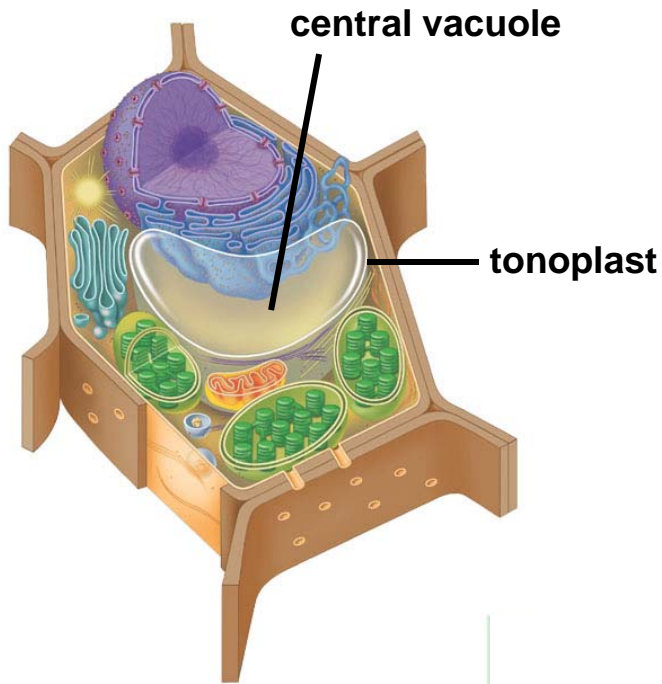
Plant centrosomes do not contain centrioles. The centrosome of a plant cell is often called the Microtubule Organizing Center (MTOC). The plant MTOC is very similar in function to the centrosome of animal cells.



Plasmodesmata provide cytoplasmic connections between adjacent plant cells.



Functions of the Central Vacuole of Plant Cells



It provides osmotic support for turgor pressure.

It is a storage site for food reserves.

It is a repository for metabolic wastes.

It is a site of pigment accumulation, thus producing colored plant tissues.

It is a repository of plant "natural products", some of which have profound effects on animals.

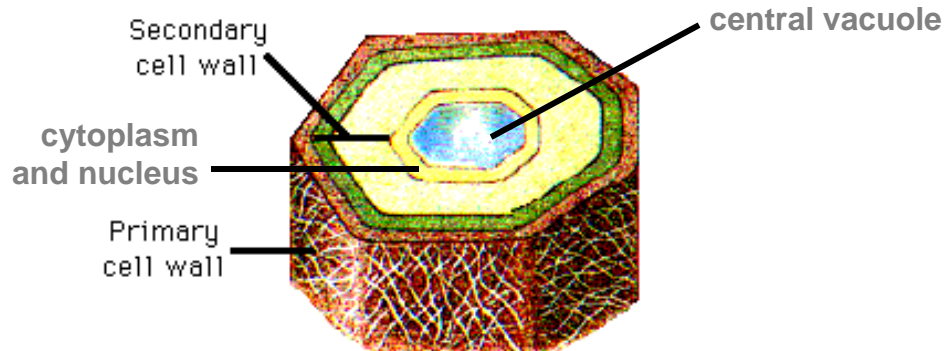
The central vacuole is the largest organelle of most mature plant cells.

The central vacuole does not contain many enzymes.
It is often considered not to be a "living" component of the cell.

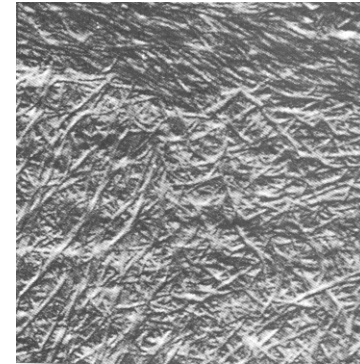
The presence of the plant cell central vacuole helps explain how plant cells can become much larger than animal cells. Can you explain?



The cell wall is thicker than the living portion of many mature plant cells.



**Diagram of a cross-section
of a plant cell**

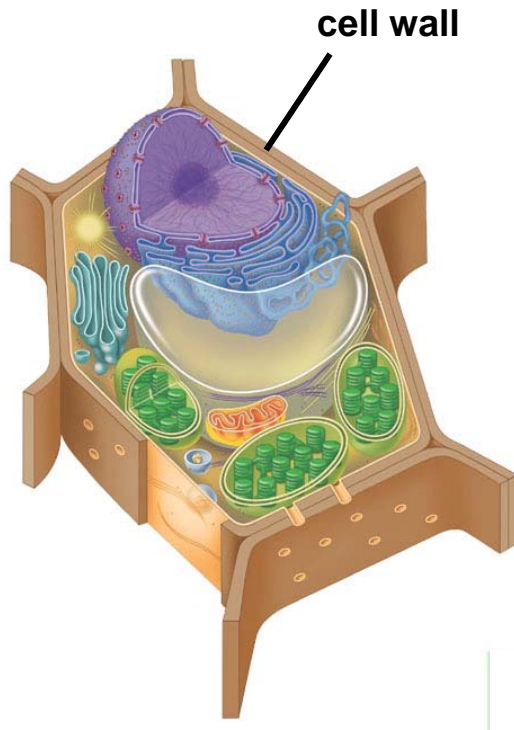


**Electron micrograph of a plant cell
surface, showing the long strands of
cellulose found in plant cell walls**

The plant cell wall and the central vacuole together occupy most of the volume of a mature plant cell.

A major component of the plant cell wall is a chemically inert and physically strong carbohydrate, called cellulose.





Functions of the Plant Cell Wall

It protects the cell from excessive osmotic swelling.

It provides turgidity and mechanical strength.

It protects the cell from infections.

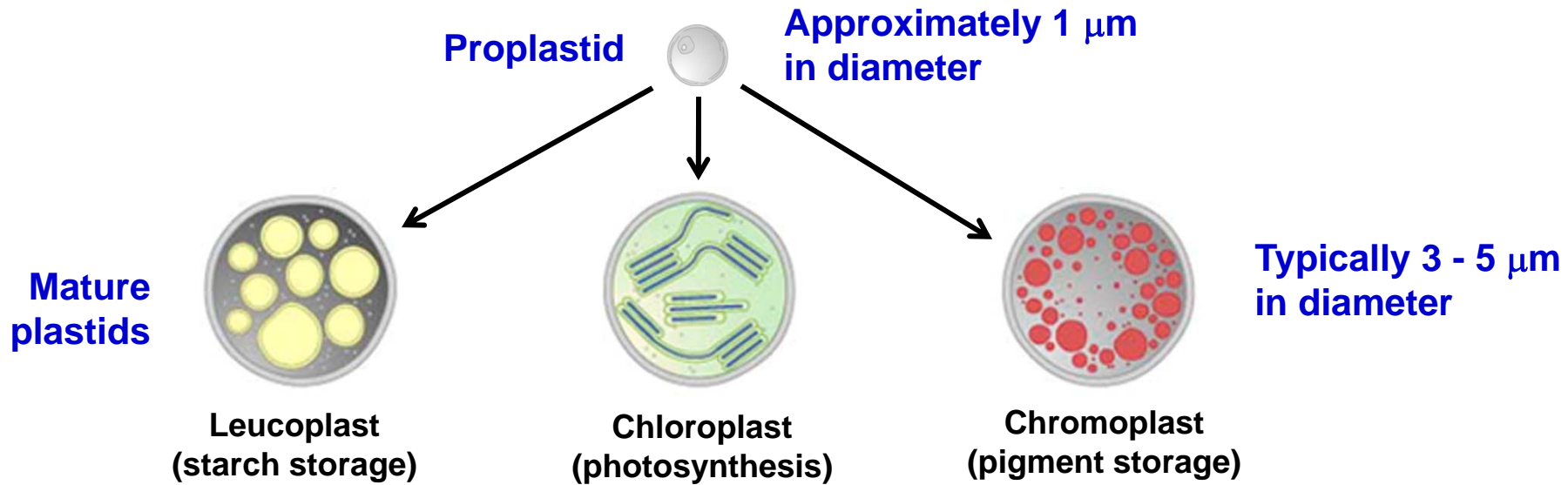
It protects the cell from mechanical abrasion.

Plant cell walls provide strength and rigidity for woody plants.

Plant cell walls and central vacuoles have complementary functions in providing strength and rigidity to herbaceous (non-woody) plants.



Plastids of Plant Cells



From Freeman, Biology,
Prentice-Hall, 2002

All mature plant cells contain plastids derived from proplastids.

All plastids are bounded by an envelope consisting of two membranes that separate an inter-membrane space.



Kinds of Plastids that Occur in Plant Cells

Proplastids

- are immature plastids that occur in young cells.

Leucoplasts

store food/energy reserves (especially starch).

Chromoplasts

impart color (usually yellow, orange or red-orange) to a plant tissue.

Chloroplasts

perform photosynthesis.



Components of plastids include:

DNA (packaged as in prokaryote cells);

All machinery necessary for protein synthesis, including ribosomes (machinery like that found in prokaryote cells);

Metabolic reactions for synthesizing lipids and many other compounds (distinct from similar metabolic reactions that may occur elsewhere in the cell).

These same kinds of components and functions are found in mitochondria.



Chloroplasts are the Sites of Primary Production in Plants

The green color of plants is due to the presence of chlorophyll in chloroplasts.

The primary function of chloroplasts is photosynthesis.

Primary energy production is the use of non-organic sources of energy to produce energy stored as reduced organic compounds.

Primary food production is the use of non-organic sources of food to produce building materials build of organic compounds.

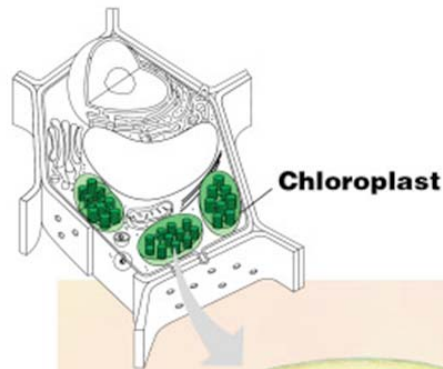
The source of energy for plants is light and the source of food for plants is carbon dioxide.

Overall equation for photosynthesis:

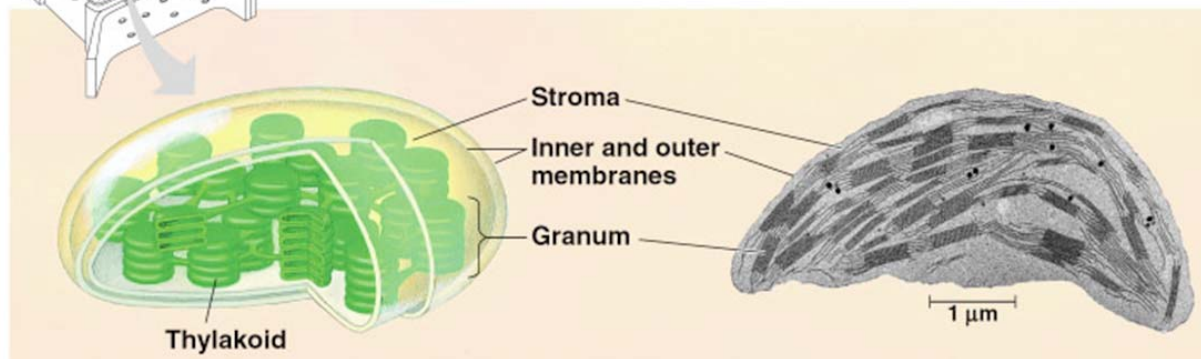


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Structure of a Mature Chloroplast



From textbook Fig. 6.18, p. 111



Most of the chemical machinery required photosynthesis occurs in the stroma and in the thylakoid membranes of chloroplasts.



Generalized metabolism of plant cells:

All of their required components are made from relatively few simple compounds.

Their source of energy is sunlight.

Their source of food is carbon dioxide and inorganic minerals.

Specialized metabolism of animal cells:

They cannot synthesize all required substances and must take in various kinds of organic compounds.

Their source of energy is organic compounds.

Their source of food is organic compounds.

They require specific food supplements such as vitamins, amino acids, lipids, etc.

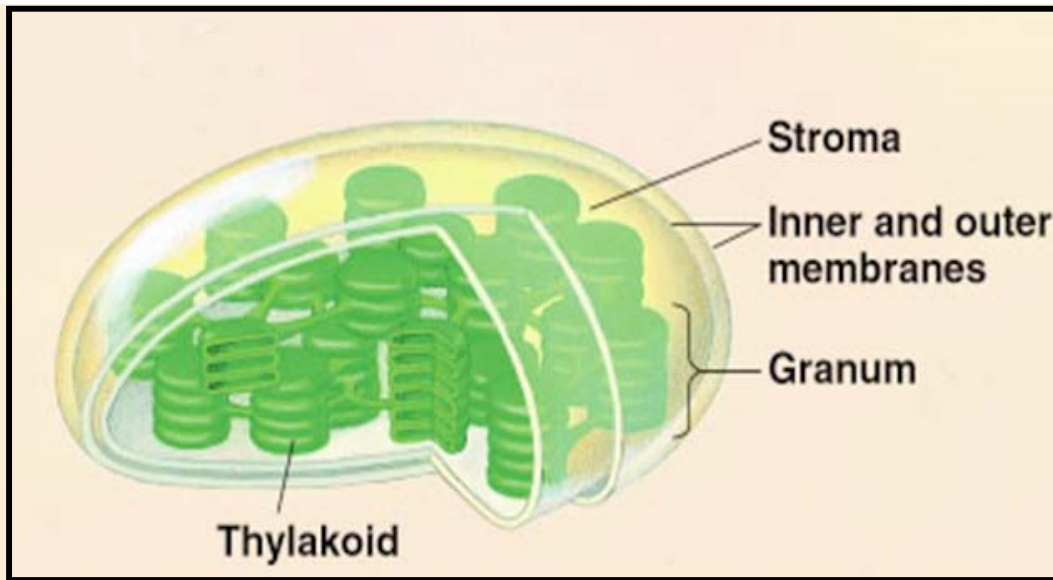
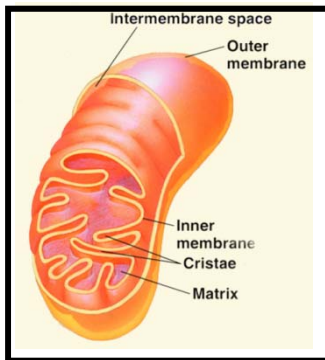
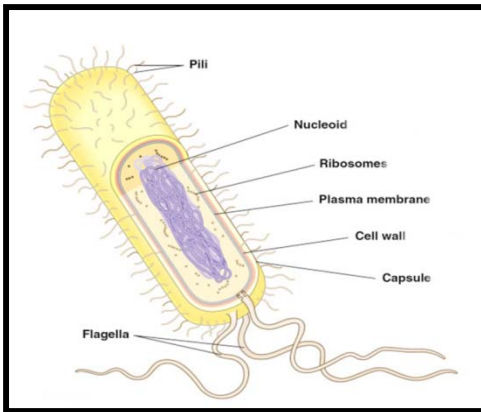


Some Common Features of prokaryotic cells, mitochondria and plastids

They all contain prokaryotic-type "chromosomes" that are not like eukaryotic chromatin.

They all have prokaryote-like protein-synthesizing machinery.

The inner membranes of mitochondrial and chloroplast envelopes are more similar to the plasma membrane of prokaryotic cells than to the membranes of components of the endomembrane system.



Some Evidence for the Endosymbiotic Origin of Mitochondria and Plastids

- Their chromosomes, protein-synthesizing machinery and membrane composition are similar in chemical composition to those of prokaryotes.
- Their genetic information is stored and expressed very similar to the way that prokaryotic genetic information is stored and expressed.
- Some existing eukaryotic cells contain parasitic prokaryotic cells as obligate endosymbionts. These endosymbionts depend on the host cell for many of their food and energy needs.
- A few non-photosynthetic eukaryotes that eat photosynthetic organisms are able to preserve the chloroplasts of ingested organisms in special intracellular compartments, where the chloroplasts continue to do photosynthesis for several weeks.



This animal, a marine sea slug, has eaten green algae but retained their chloroplasts intact. The chloroplasts remain green and continue to do photosynthesis, providing sugar as a source of food and energy for the animal.



A model of the origin of eukaryotes

Textbook Fig. 25.9, p. 517

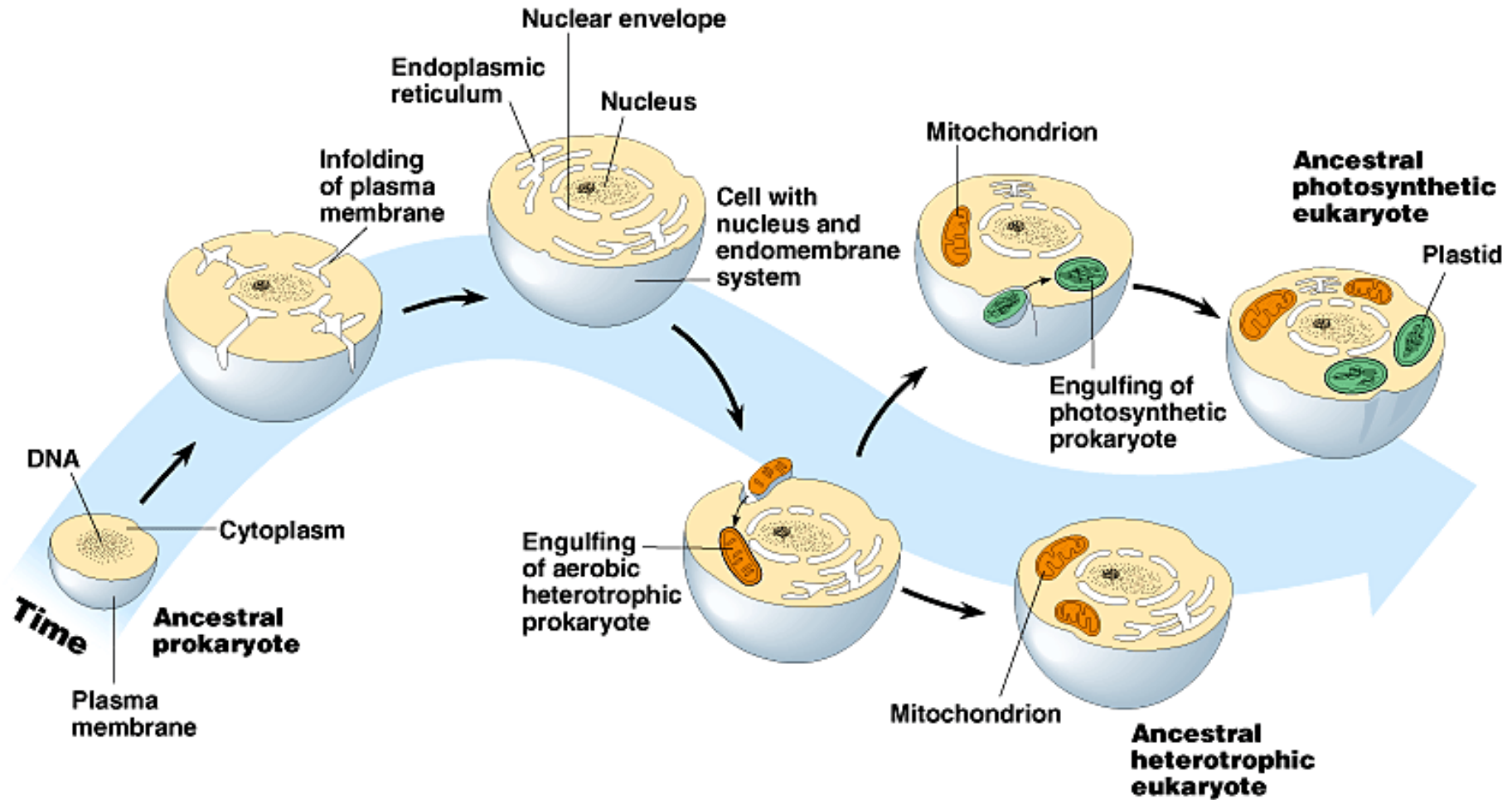


Fig. 28.2, p. 577, shows even more extensive incorporation of one cell into another in a process called secondary endocytosis (not required reading).

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