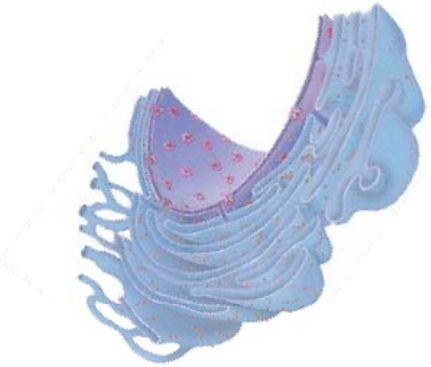
BIO 311C
Spring 2010

Lecture 6 – Monday 1 Feb. 2010

Summary of Different Functions of the Endoplasmic Reticulum and Golgi Bodies

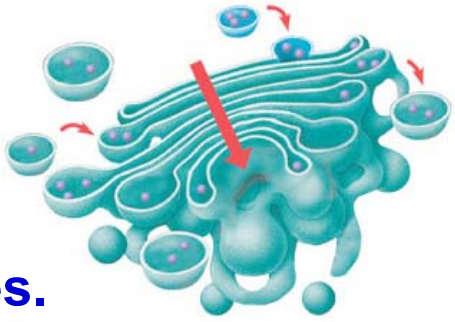
The endoplasmic reticulum is responsible for:

- **targeting protein synthesis at the e.r. membrane;**
- **synthesis of lipids and oligosaccharides;**
- **processing molecules so they become functional;**
- **assembly of new membrane.**



Golgi bodies are responsible for:

- **sorting membrane and lumen contents of golgi cisternae into different regions;**
- **targeting incipient vesicles to different specific sites.**



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Review

Functions of Lysosomes

Intracellular digestion

Destruction of bacteria, other pathogens and toxins

Recycling of worn-out organelles and occlusions

Tissue development in complex multicellular organisms

Autolysis (breakdown of cellular components) after the cell dies

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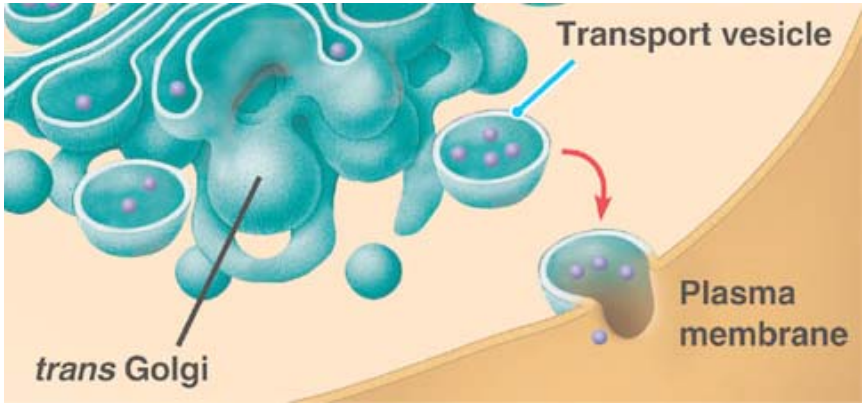
Transport vesicles from the golgi that fuse with the plasma membrane are capable of:

a. expanding the plasma membrane, allowing the cell to become larger;
b. confirring functions to the plasma membrane;
c. exporting substances from the cell without releasing any contents of the cytoplasmic matrix.



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Functions of the Plasma Membrane

It keeps the cytoplasmic contents of the cell separated physically and chemically from the environment.

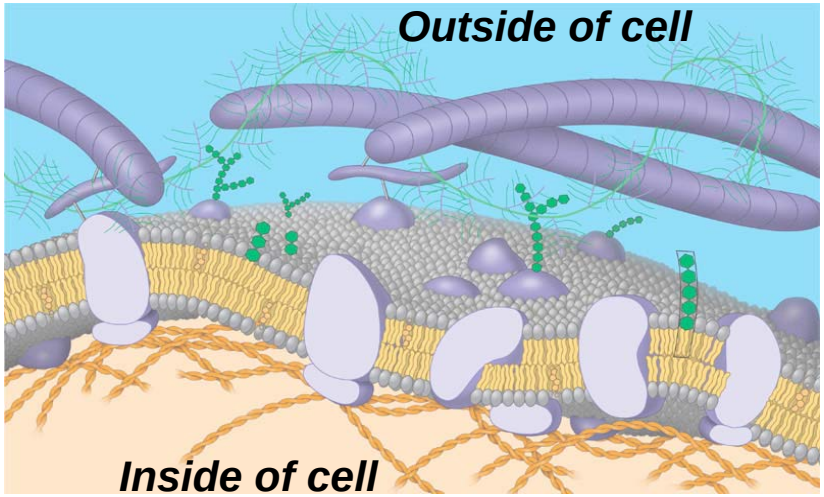
It regulates the movement of substances into and out of the cell.

It provides specific surface receptors for communication with other cells, viruses and chemical substances in the surrounding environment.

It provides specific attachment sites for intracellular and extracellular components of the cell.

Model of the plasma membrane of an animal cell.

Textbook Fig. 7.7, p. 128



plasma membrane

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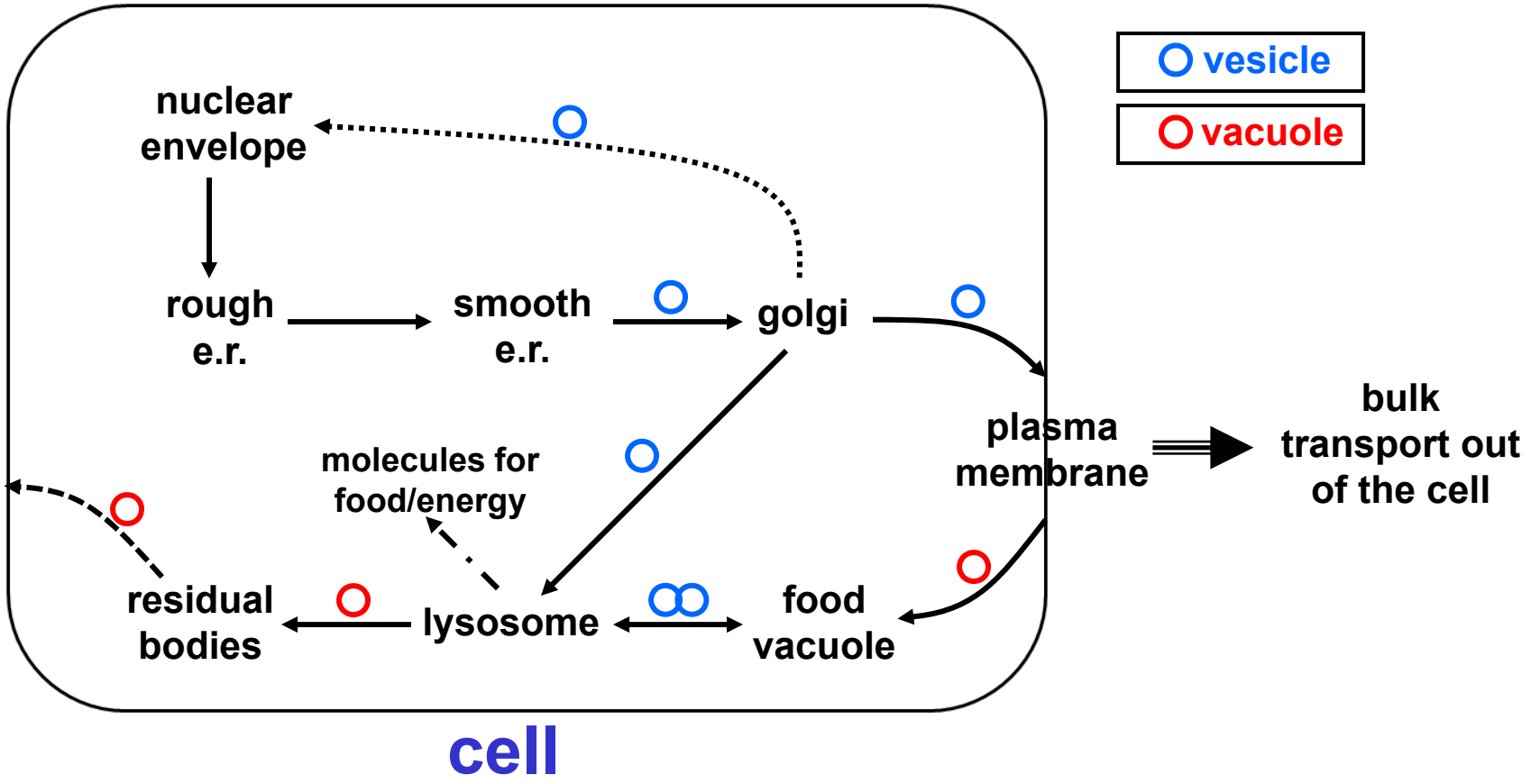
Relationship Among Various Organelles of the Endomembrane System of Eukaryotic Cells



Substances leave the lumen spaces of the endomembrane system into the cytoplasmic matrix one molecule at a time through lysosomes. Substances are transported into the extracellular space in bulk through the plasma membrane.

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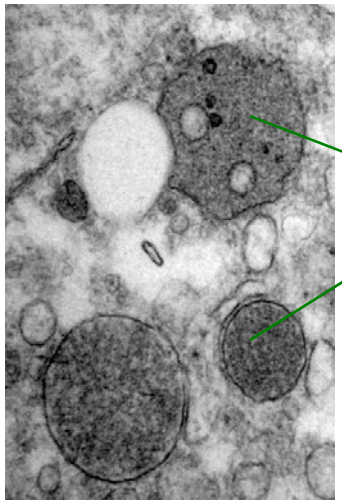
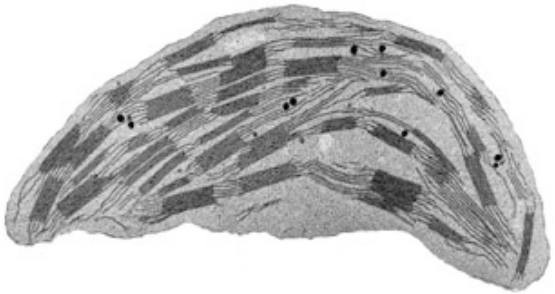
Membrane-bounded Organelles that are <u>not</u> a part of the Endomembrane System



peroxysomes

mitochondrion

1 µm



chloroplast

These organelles divide by fission rather like prokaryotic cell division.

Their membranes are constructed of molecules that are assembled from the cytoplasmic matrix or that are synthesized within the organelle.

The contents of their luminal spaces are not mixed with luminal contents of endomembrane organelles.

Also see textbook Figs. 6.17, 6.18. 6,19 p. 110 - 111.

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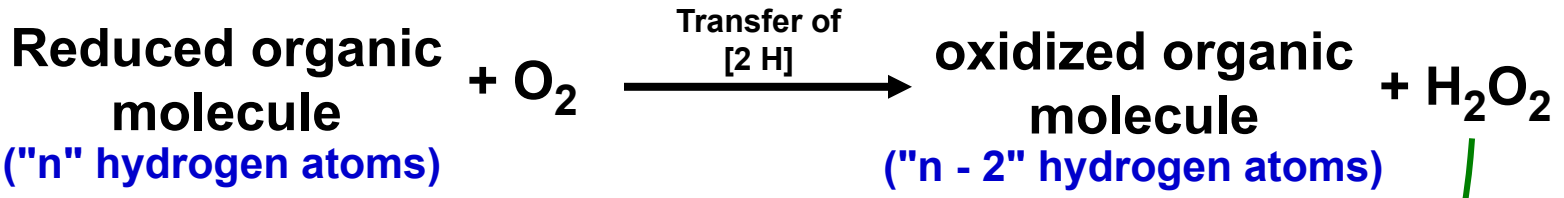
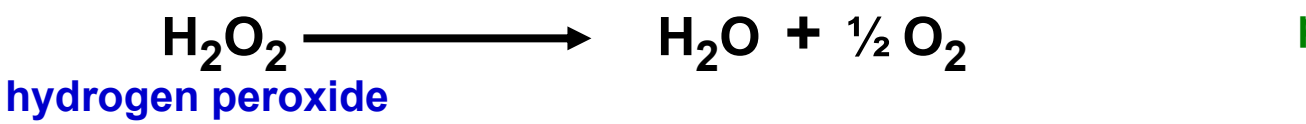
A primary function of peroxysomes is destruction of hydrogen peroxide.

Consider the following two-stage process:

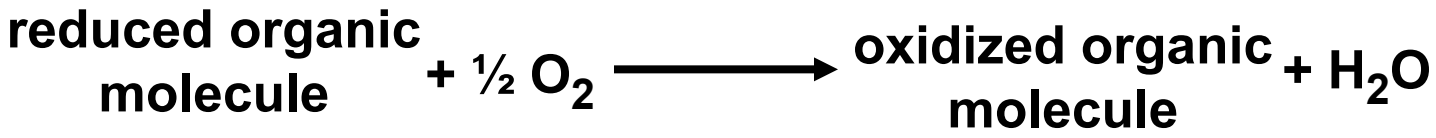
(1) In an organelle such as a mitochondrion adjacent to a peroxysome, or in the peroxysome itself :



(2) In the peroxysome:



Sum of reactions (1) and (2):



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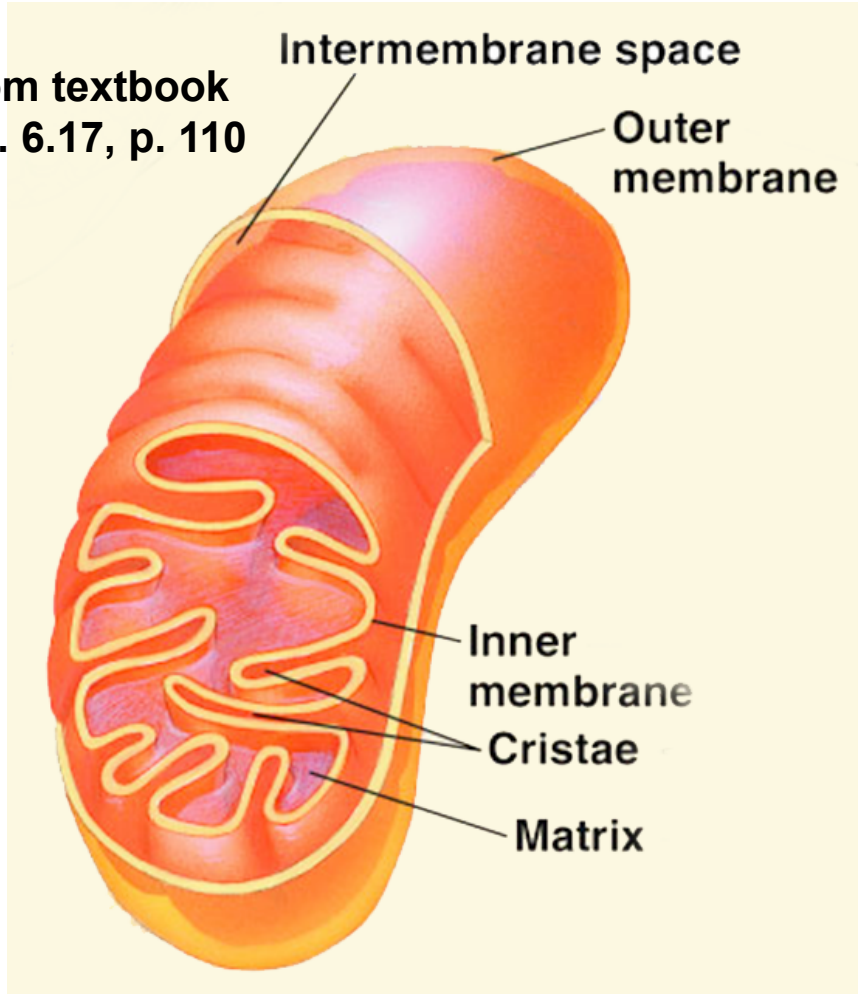
The mitochondrion is the primary site of energy production in most eukaryotic cells.

From textbook
Fig. 6.17, p. 110



The mitochondrial envelope consists of two membranes, an inner and an outer membrane.

The mitochondrial inner membrane separates two compartments, the matrix and an intermembrane space.

Most metabolic activity of the mitochondrion occurs in the matrix and at the inner membrane.

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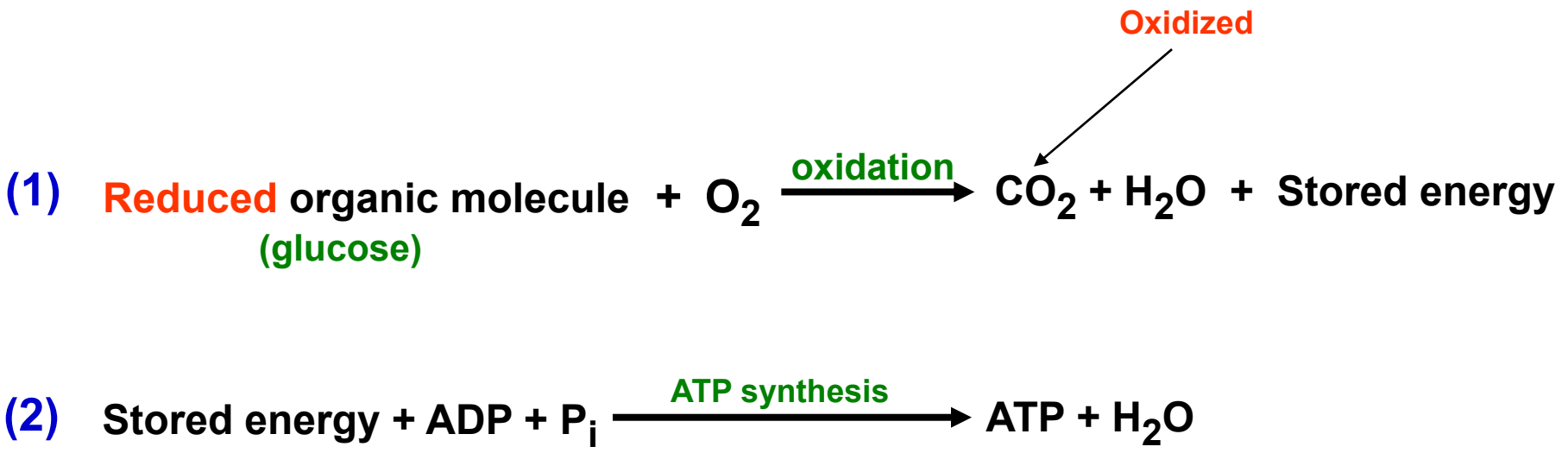
The primary function of mitochondria is respiration.



Each of these numbered events is a process involving a set of chemical reactions, not just a single reaction.

The names of the processes are written above the arrows.

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Other components of mitochondria include:

DNA (packaged much like the DNA in prokaryote chromosomes).

All machinery necessary for protein synthesis, including ribosomes. The protein-synthesis machinery is similar to the protein-synthesis machinery of prokaryotic cells.

Enzymes that facilitate synthesis of lipids and various other organic compounds. Some of these compounds are used in mitochondria, and some are exported for use elsewhere in the cell.

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Components of the Cytoskeleton

The cytoskeleton of eukaryotic cells consists of:

1. rod-like structures constructed of proteins;
2. proteins that are associated with these structures.

Rod-like structures of the cytoskeleton include:

a. microtubules,

b. microfilaments,

c. intermediate filaments.

The associated proteins are utilized to:

a. attach various rod-like components of the cytoskeleton together;

b. attach components of the cytoskeleton to other cellular structures such as membrane-bounded organelles,;

c. allow movement of components of the cytoskeleton with respect to each other or with respect to other components of the cell. These "movement“ proteins are called "motor" molecules.

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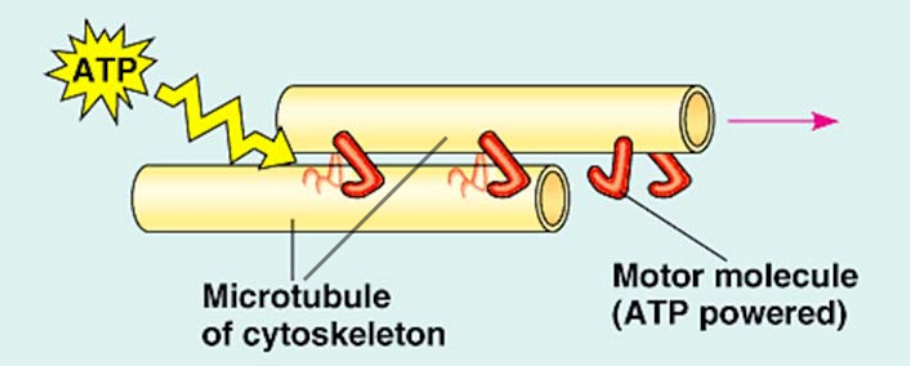
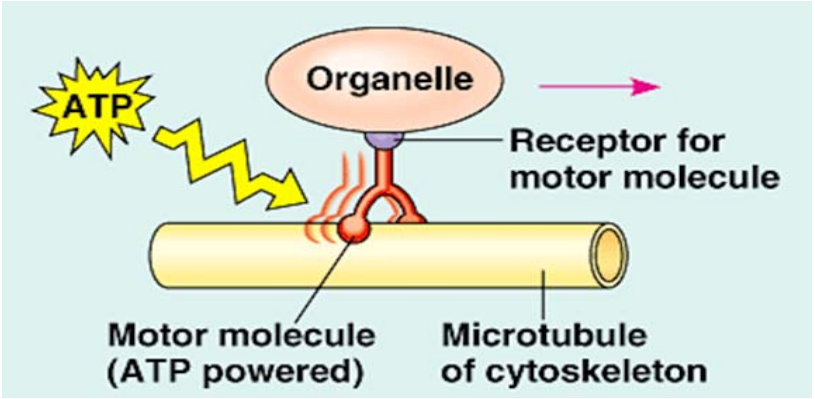
Motor Molecules of the Cytoskeleton

See also textbook Figs. 6.21



Some motor molecules cause microtubules or microfilaments to slide past each other in order to facilitate movement.



Other motor molecules cause cellular structures which are not a part of the cytoskeleton to slide along microtubules or microfilaments in order to translocate the structure.

In cell biology, translocation refers to the movement of a structure from one location to another within the cell.

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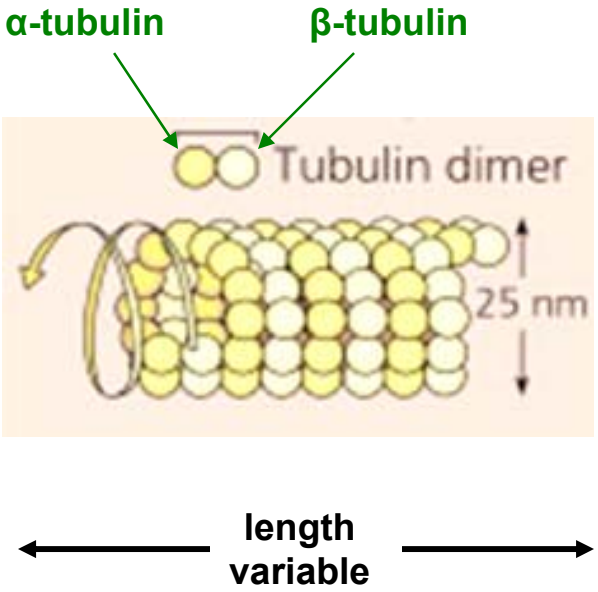
Microtubules form a framework of tubular structures within the cytoplasm of eukaryotic cells.



Microtubules vary in length, and may be several μm long. They are always 25 nm in diameter.

Microtubules are dynamic structures, dis-assembled into tubulin dimers when no longer needed, then re-assembled from the dimers into new microtubules as needed elsewhere.

Tubulin is a kind of protein.

A dimer is a molecule that consists of two (often identical or very similar) molecules chemically bonded together.

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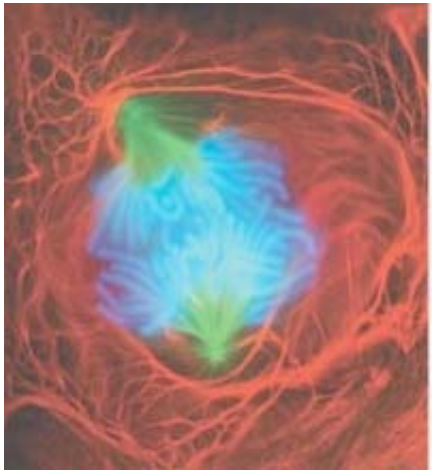
Microtubules, along with their motor molecules and other MAPs* guide the movements of chromosomes during mitosis.



MIcroscopic view of a stained cell during mitosis, showing the moving chromosomes (blue), microtubules (green) and intermediate filaments (red) of the cell.

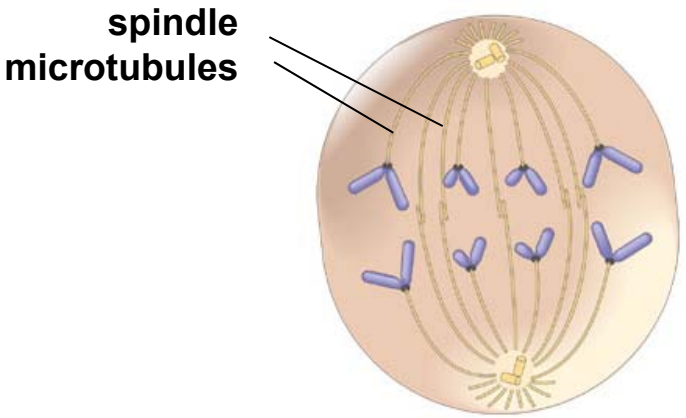


Diagram showing chromosomes (blue) moving to two opposite ends of a cell during mitosis, guided and pulled by a framework of microtubules called a spindle.

*MAP = microtubule-associated protein

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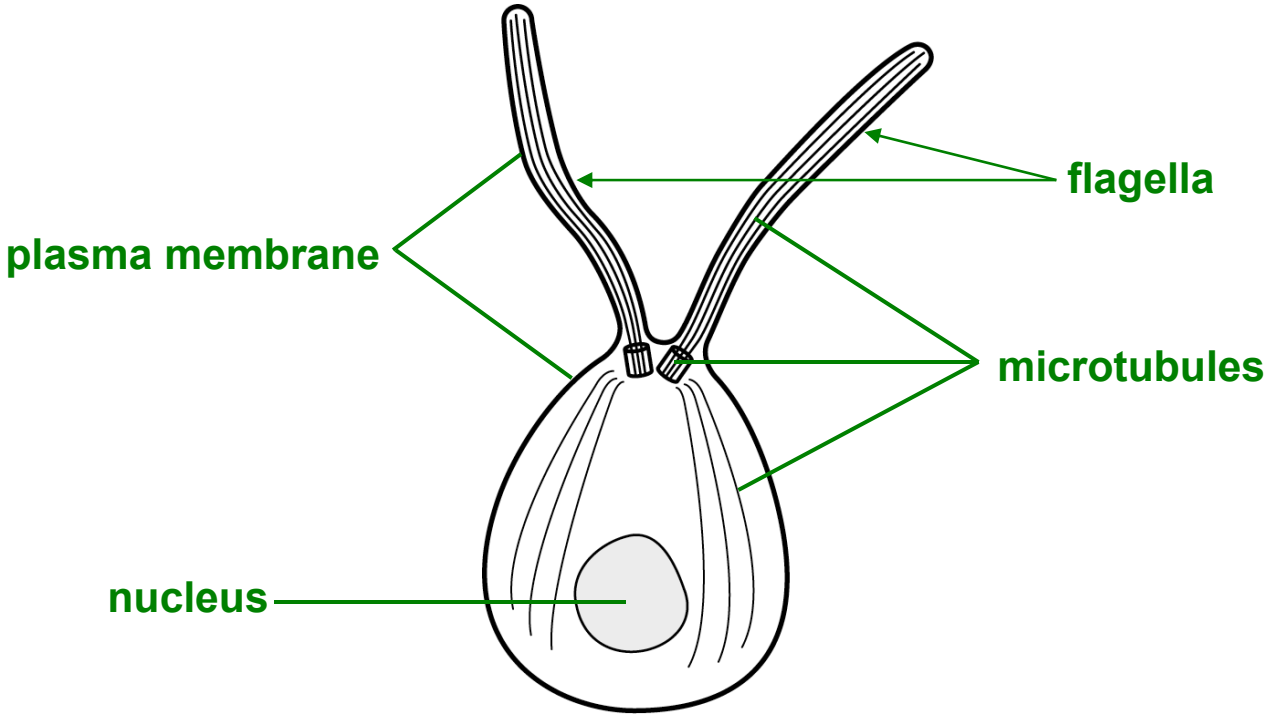
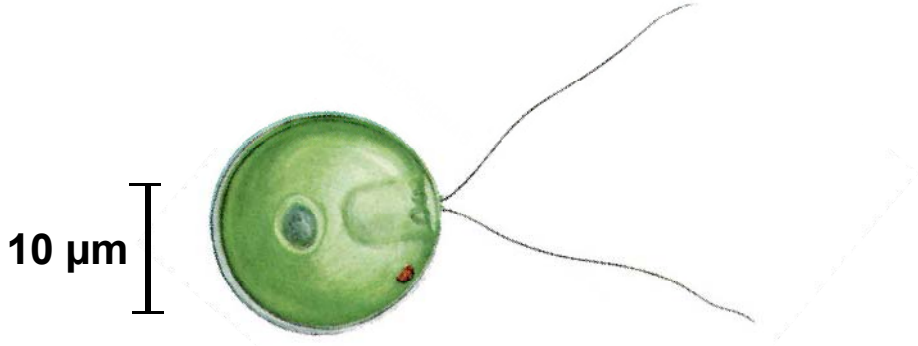
Diagram of Some Features of a Typical Single-celled Eukaryotic Organism that Contains Flagella



- Flagella or cilia are components of many kinds of eukaryotic cells.
- They are rod-like structures projecting from the cell and surrounded by the plasma membrane.
- A parallel array of microtubules runs longitudinally along them. *

External Appearance of Flagella

- Cells that contain flagella generally have only one or a very few flagella.
- Flagella are typically very long, sometimes much longer than the length of the cell.
- Flagella generally move with a whip-like motion to propel the cell through water or to move water past the cell.



A single-celled (unicellular) eukaryotic organism that contains two anterior flagella.

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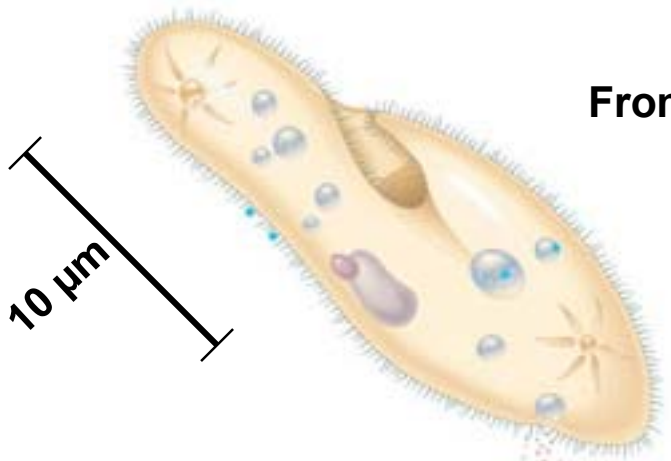
External Appearance of Cilia

- Cells that contain cilia often have many cilia.
- Cilia are typically much shorter than the length of the cell.
- Cilia generally move in synchrony with a beating motion to propel the cell through water or to move water past the cell. The synchronous beating is rather like the coordinated rowing of a boat by a racing crew.



From textbook Fig. 28.11, p. 584.

A single-celled (unicellular) organism that is covered with cilia.

Most kinds of human cells contain a single cilium projecting from the cell. In typical human cells it does not beat, and its function in is only now becoming well understood.

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Many kinds of eukaryotes contain cells with flagella or cilia. No kind of cell contains both. Plant cells do not contain flagella or cilia.

unicellular organism that contains two flagella

unicellular organism that contains many cilia

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