Membrane organelles: endoplasmic reticulum, Golgi complex, lysosomes. Secretion, phagocytosis, pinocytosis. Mitochondria. Chloroplasts

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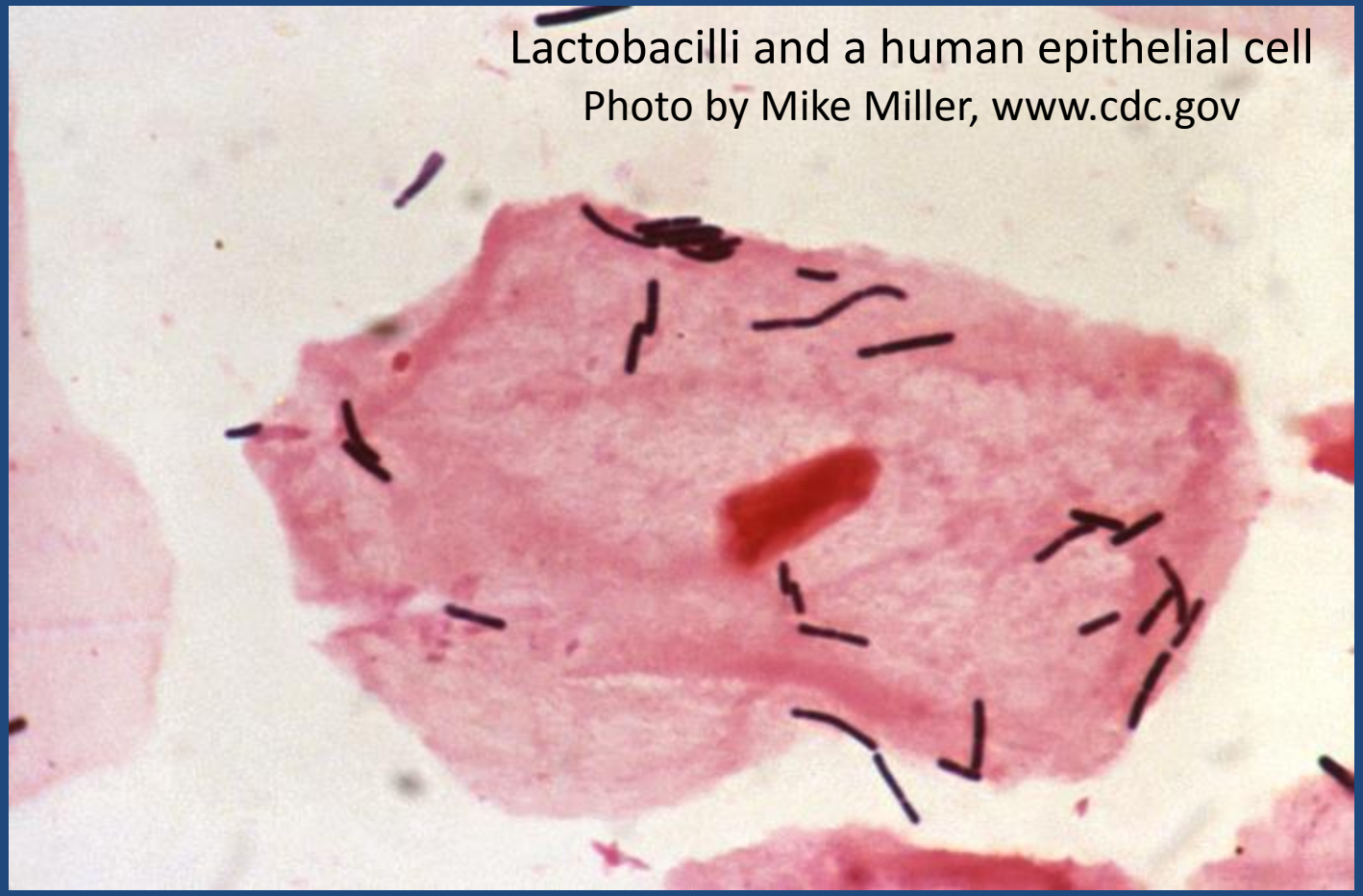
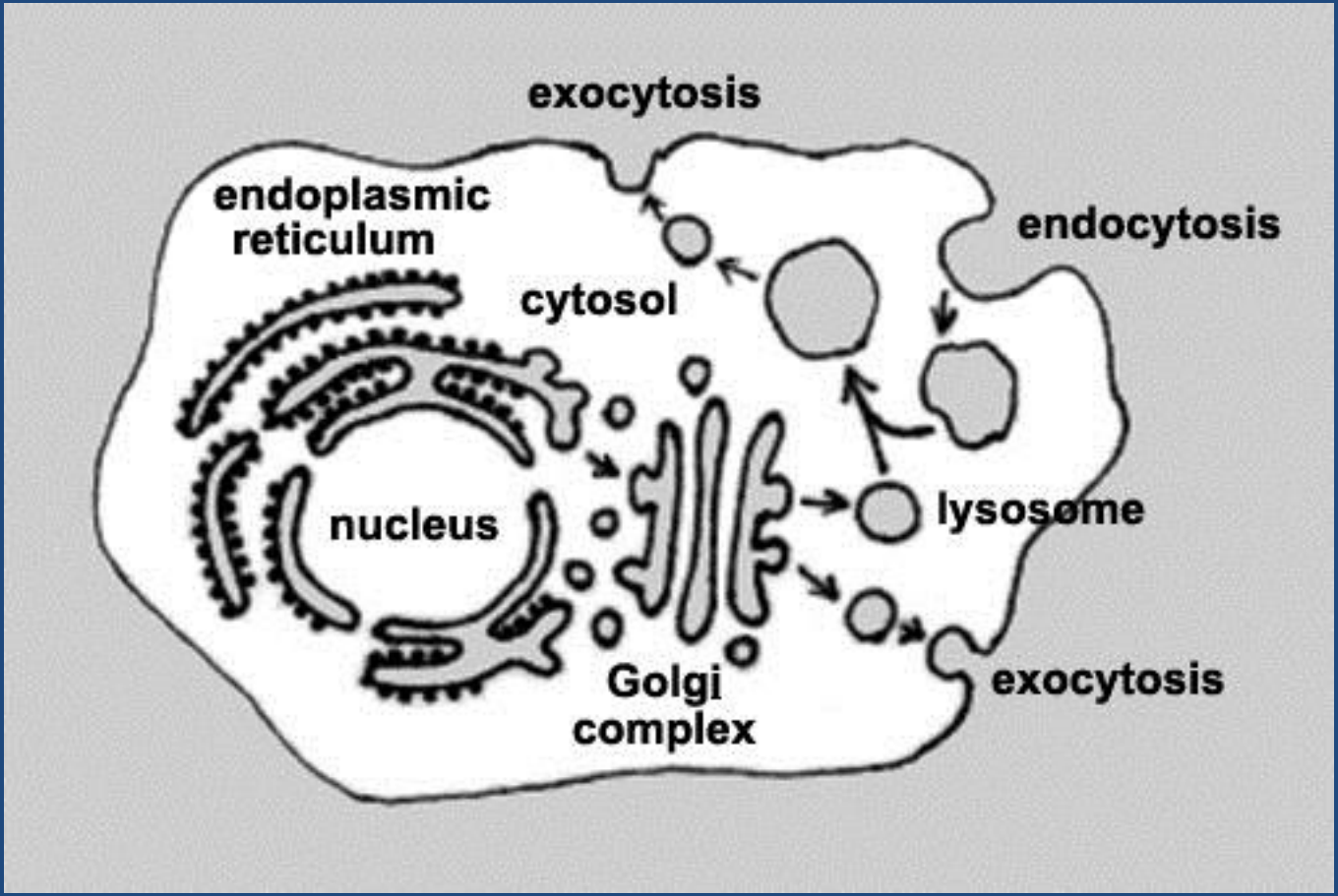
Eukaryotic cells are much larger than prokaryotic cells



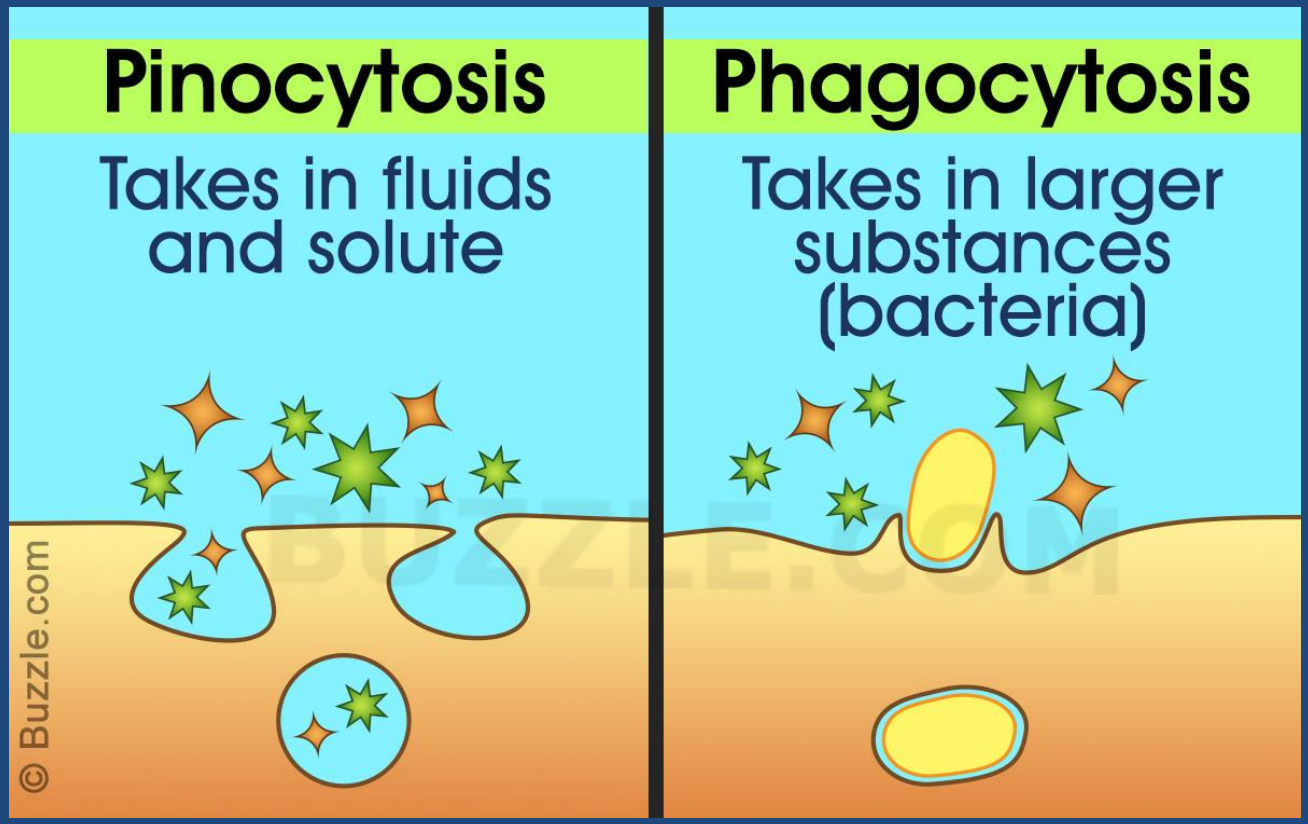
Lactobacilli and a human epithelial cell
Photo by Mike Miller, www.cdc.gov

With its size, the eukaryotic cell needs compartmentation. It is based on endomembranes

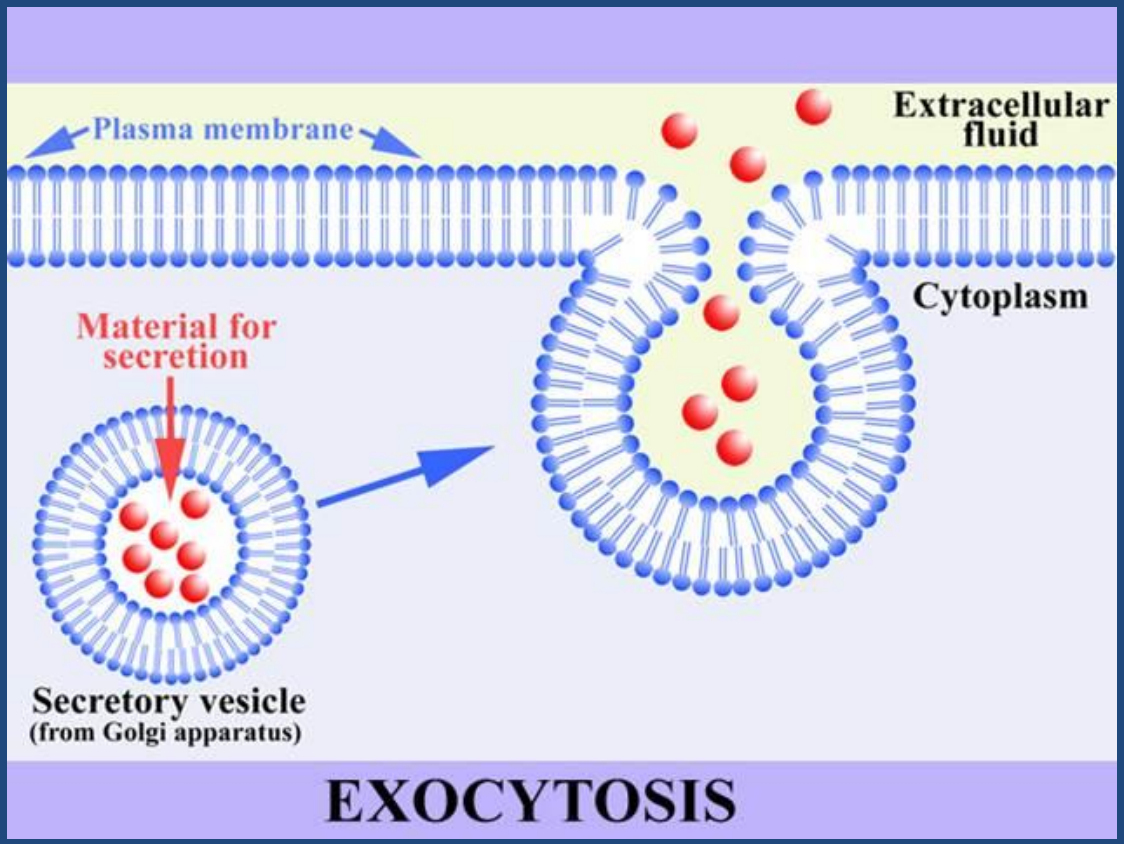


Drawing based on Alberts et al. *Molecular Biology of the Cell*

The engulfment of extracellular material in a vesicle is called endocytosis.
It can be phagocytosis or pinocytosis

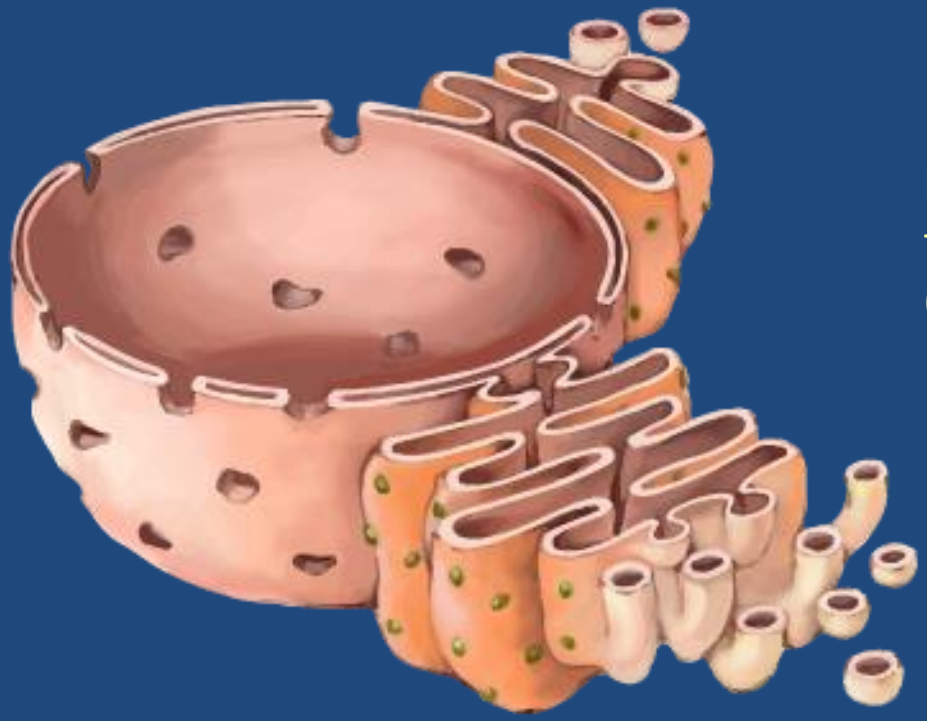


Exocytosis is the opposite process:
release of material outside the cell by fusion of a vesicle with the cell membrane



lmwhitebiology

The endoplasmic reticulum is a network of membrane tubules and flattened sacs called cisternae



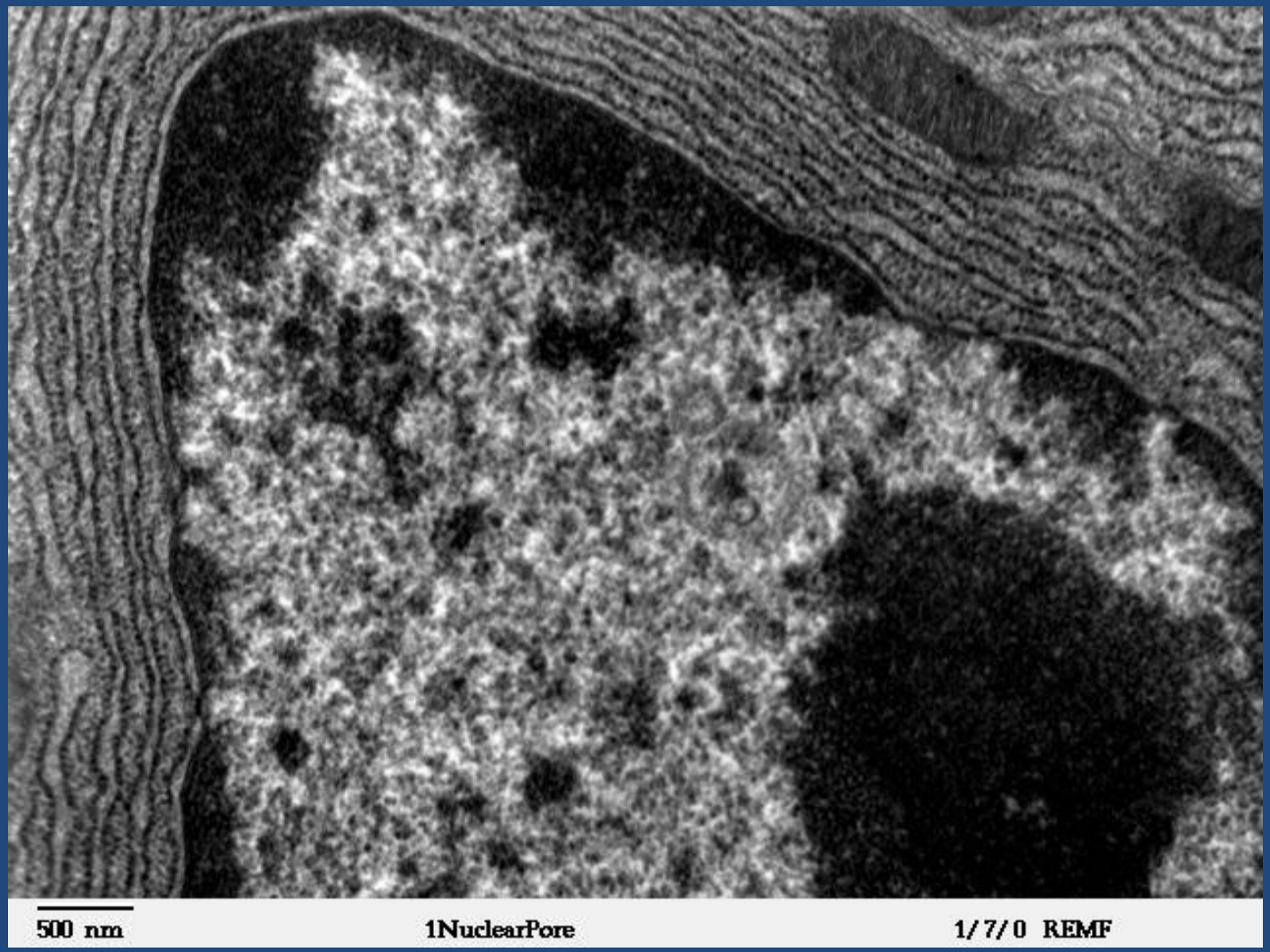
DataBase Center for Life Science (DBCLS)

It is subdivided into rough and smooth.

Rough endoplasmic reticulum carries ribosomes and participates in synthesis of proteins for export.

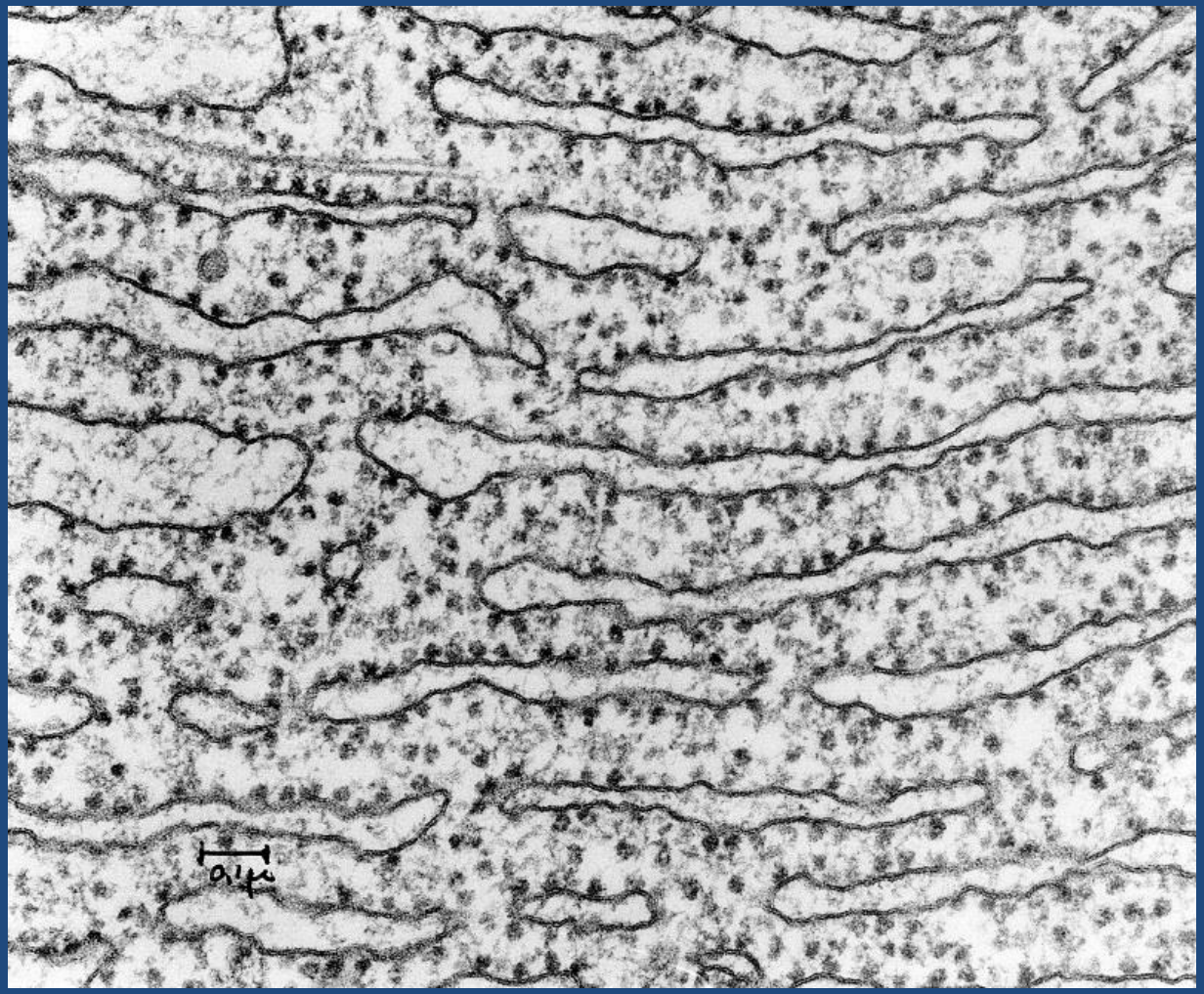
Smooth endoplasmic reticulum participates in phospholipid, fat, and steroid synthesis and metabolism in in Ca^{2+} storage.

Rough endoplasmic reticulum in a pancreatic cell



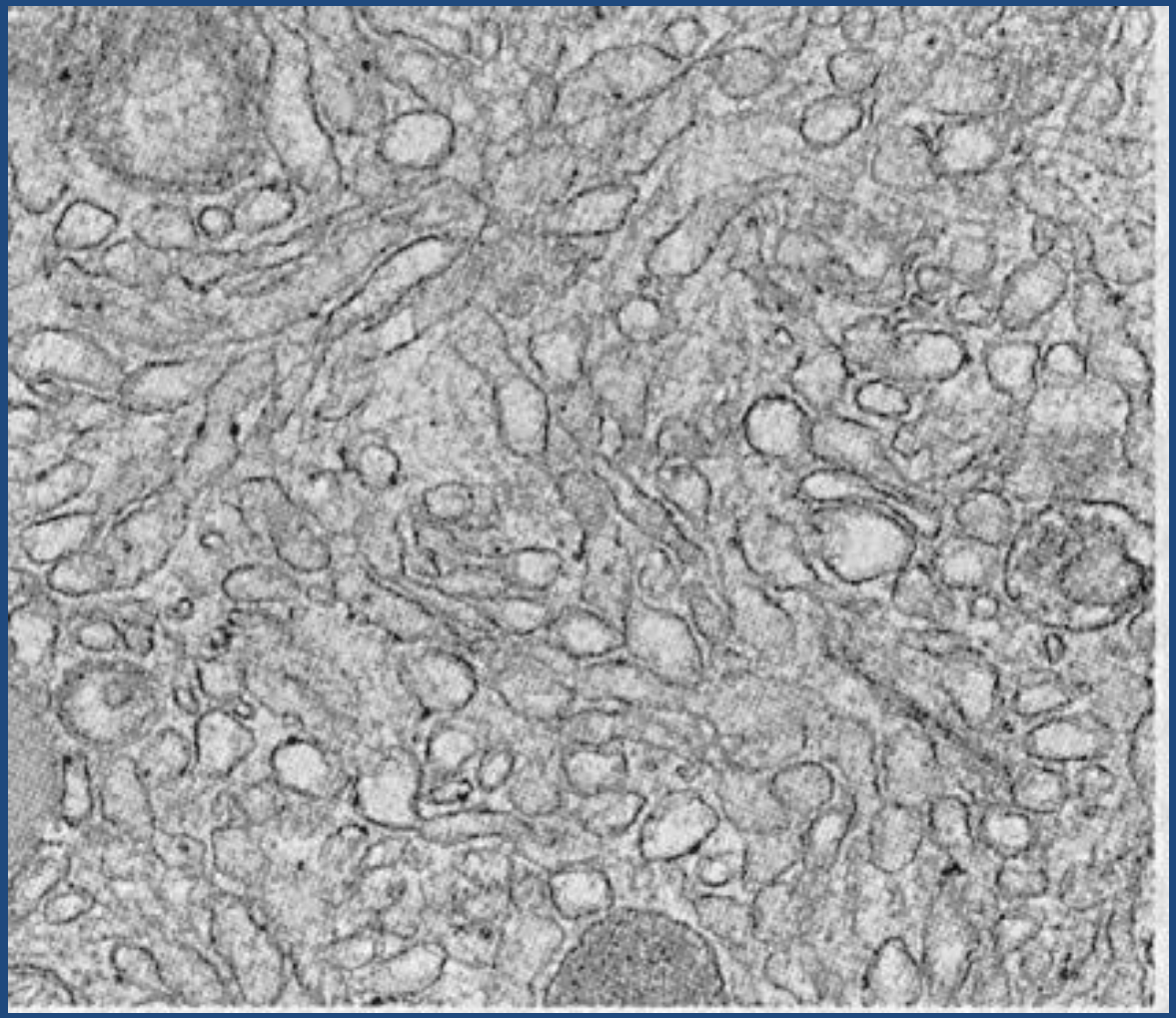
Louisa Howard, http://remf.dartmouth.edu/imagesindex.html

At a high magnification, attached ribosomes are seen



socratic.org

Smooth endoplasmic reticulum lacks ribosomes



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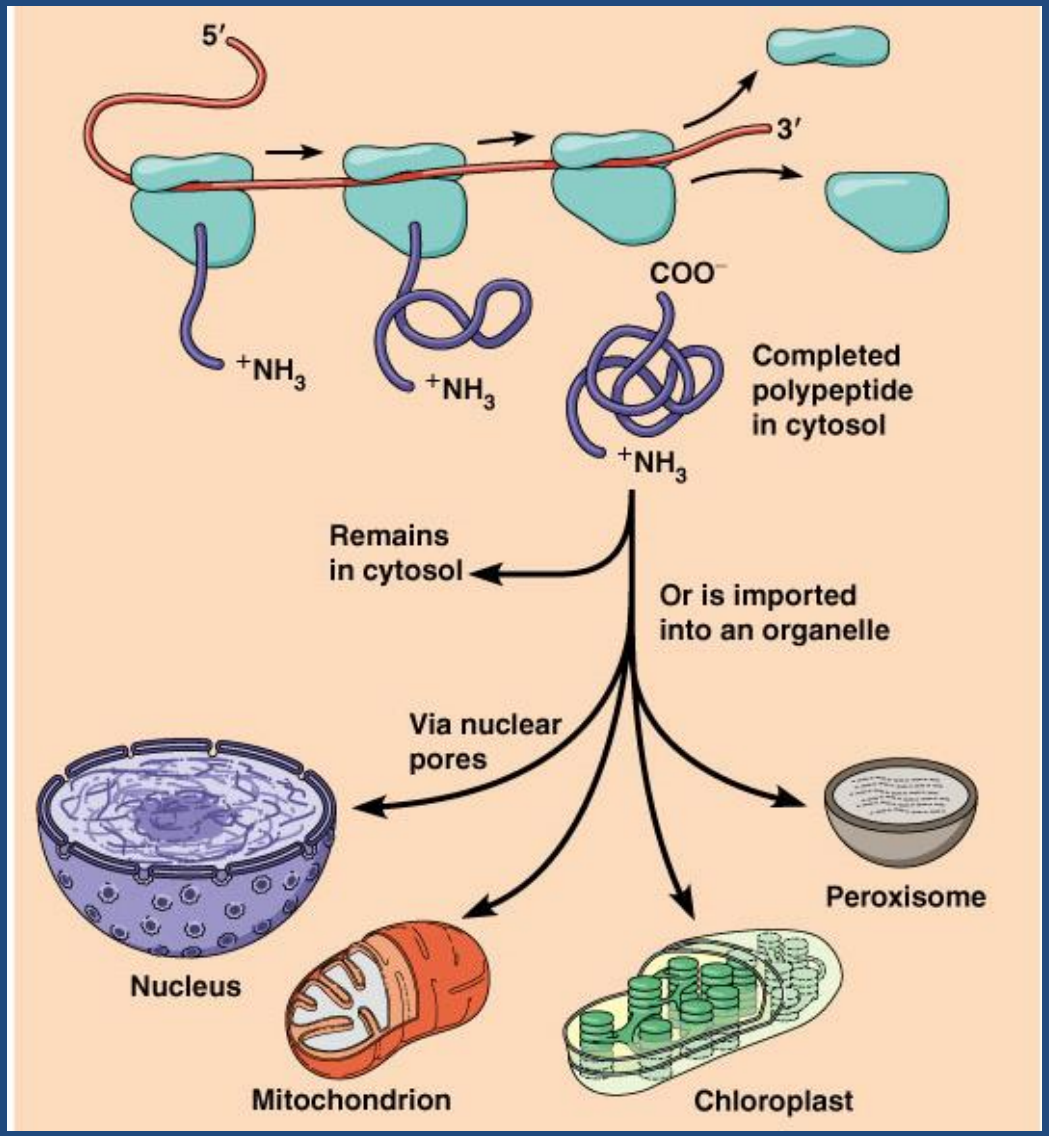
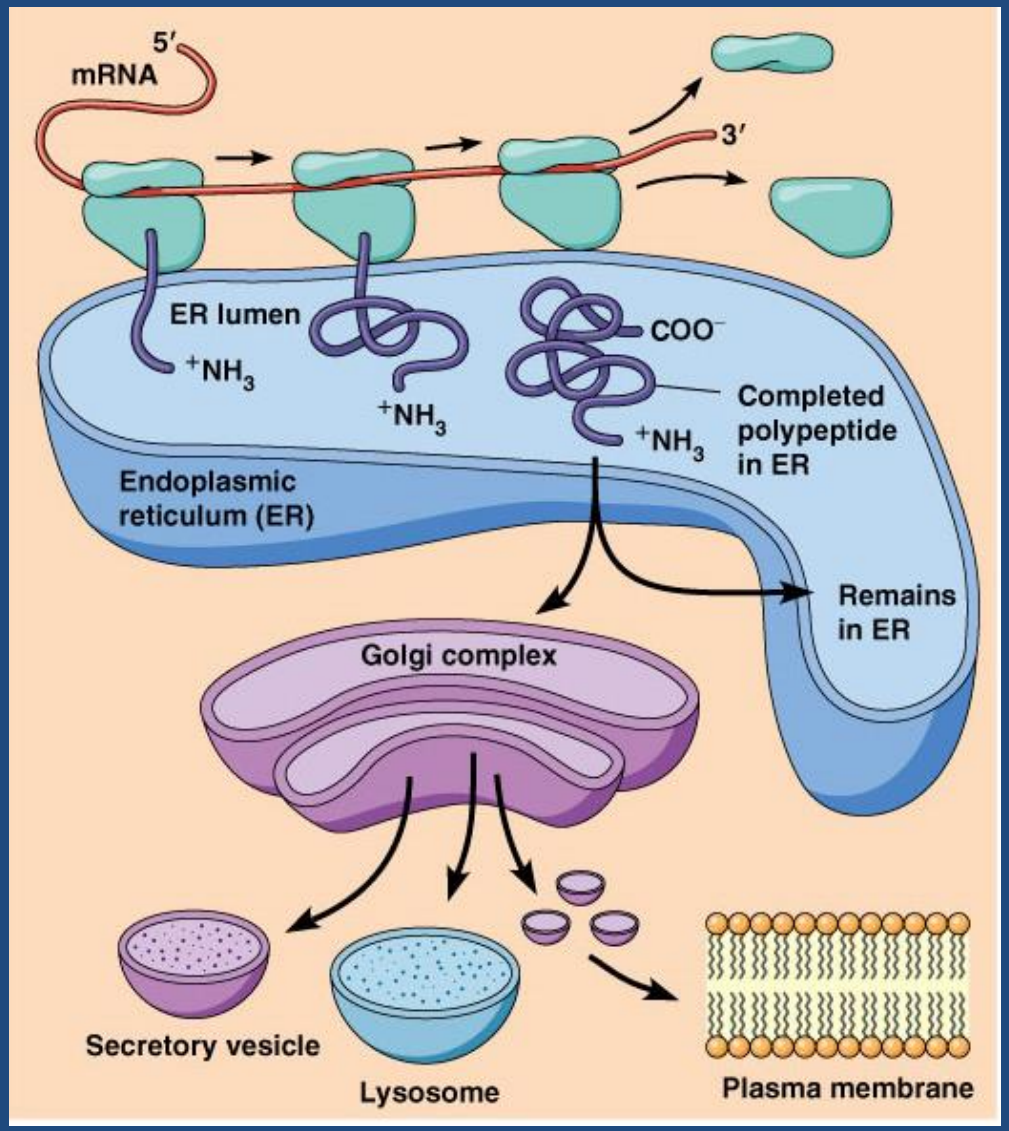
Proteins to be used inside the cell are synthesized by free ribosomes in the cytosol



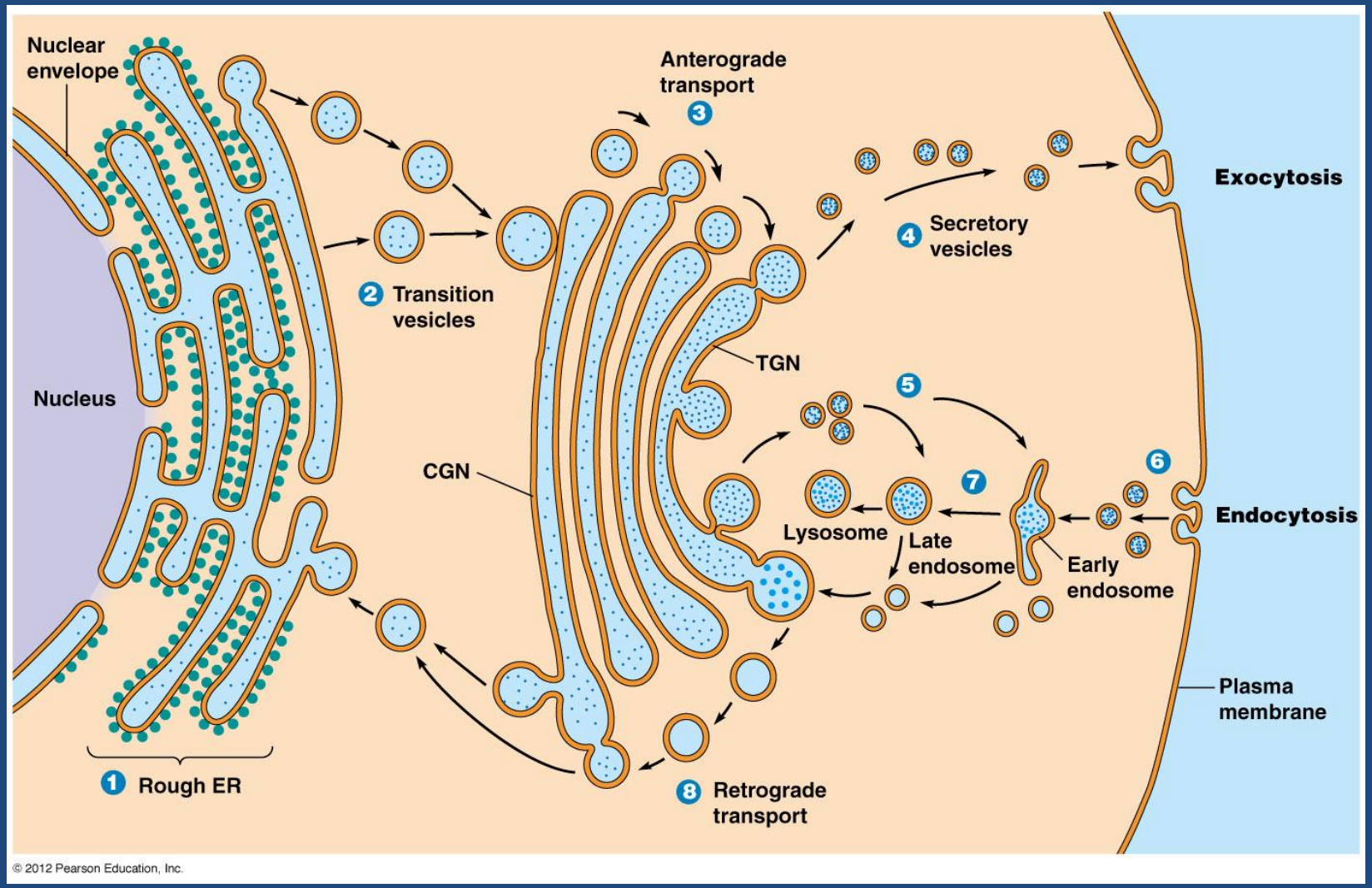
Pearson Education

Proteins to be secreted are synthesized by ribosomes bound to rough endoplasmic reticulum



Pearson Education

From the endoplasmic reticulum, substances for export are transported to the Golgi complex (Golgi apparatus) in vesicles



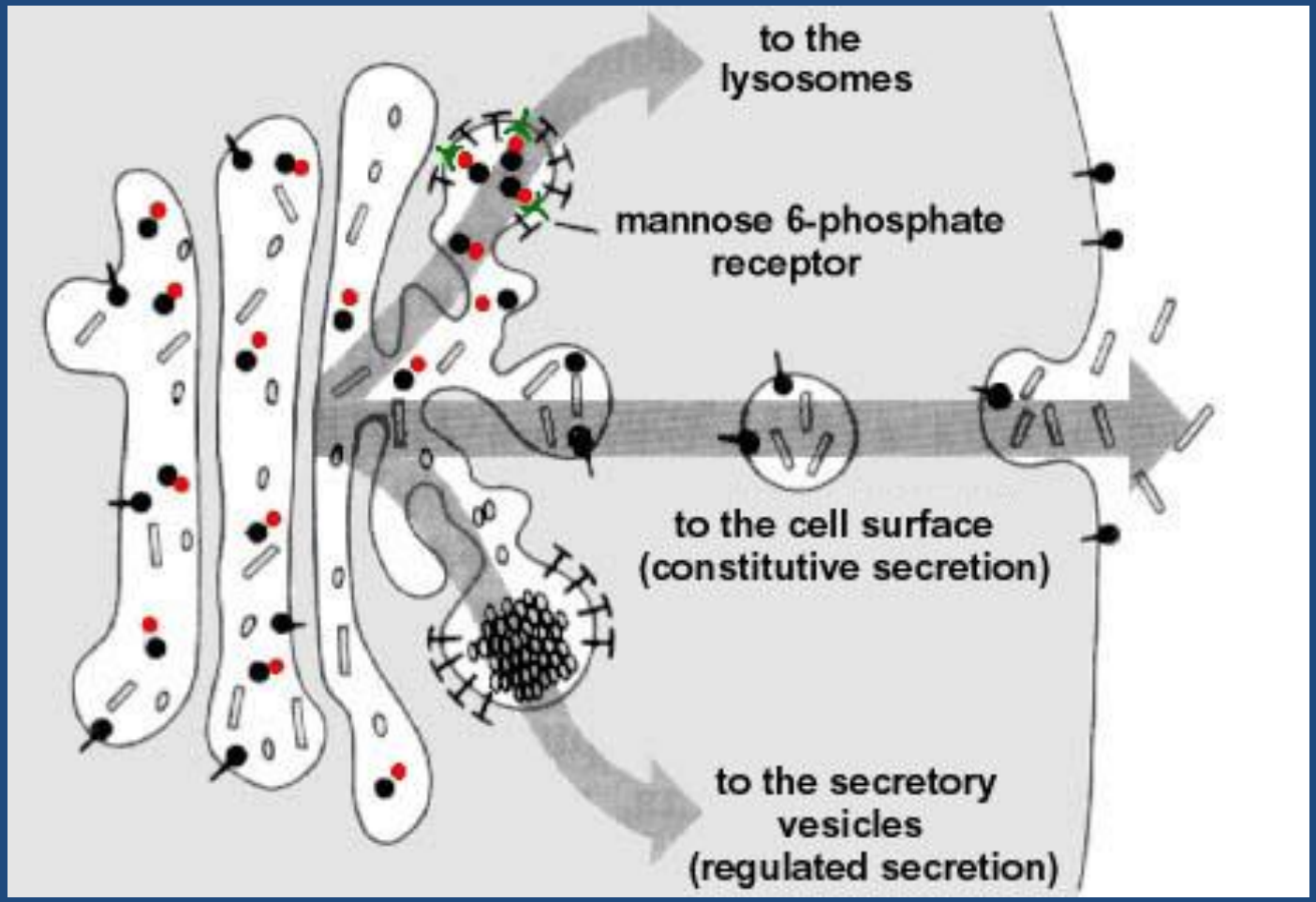
http://www.mun.ca

The Golgi complex is a stack of cisternae and vesicles. It processes, sorts and ships cell products

Biophoto Associates

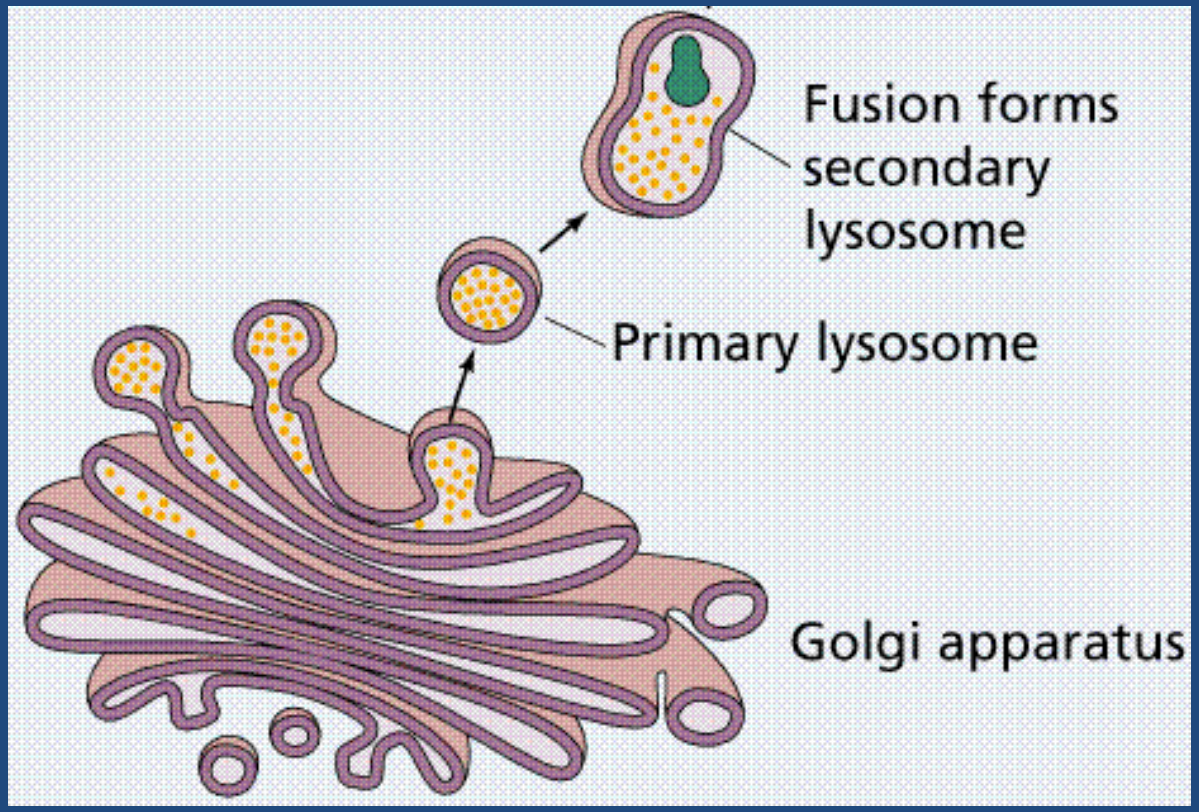
There is more than one way out of Golgi

Vesicles with secretions fuse with the cell membrane and discharge their content, a process called secretion.
Lysosomes remain inside the cell.



From Alberts et al., Molecular Biology of the Cell

Lysosomes are vesicles full of hydrolytic enzymes (hydrolases)



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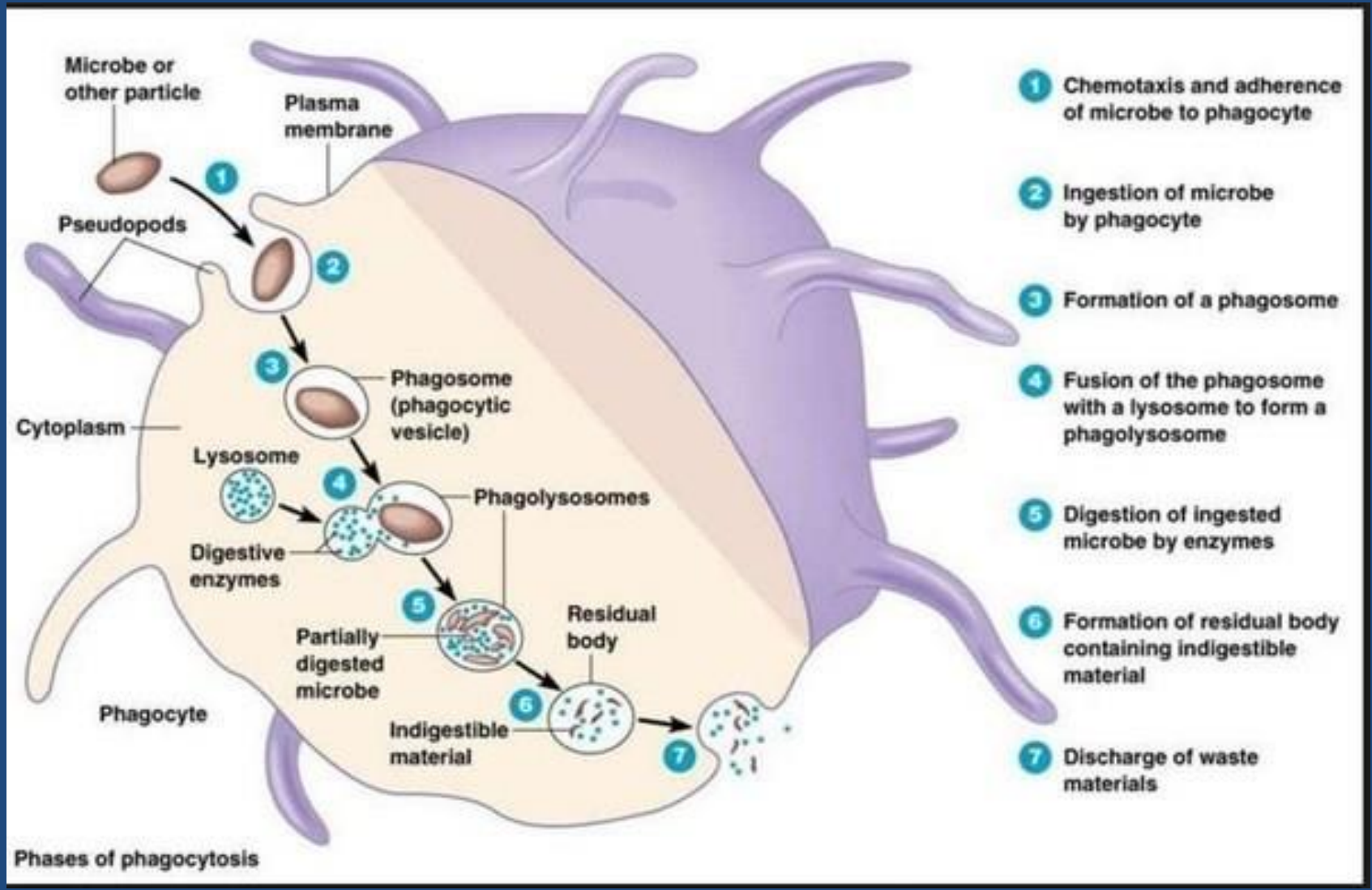
They fuse with a vesicle containing object(s) to be digested and are used in phagocytosis and cell renewal.

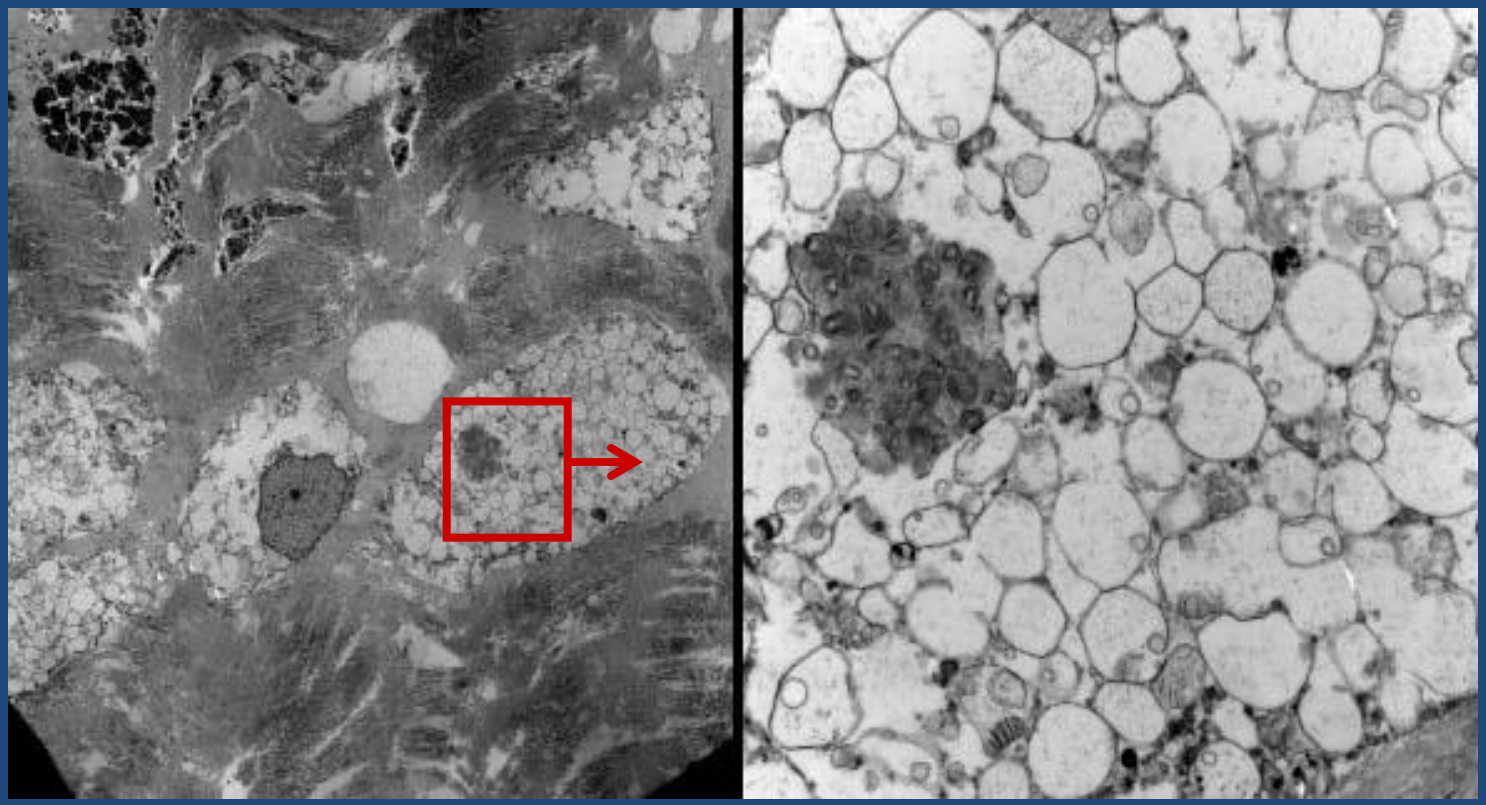
Phagocytosis



Benjamin Cummings

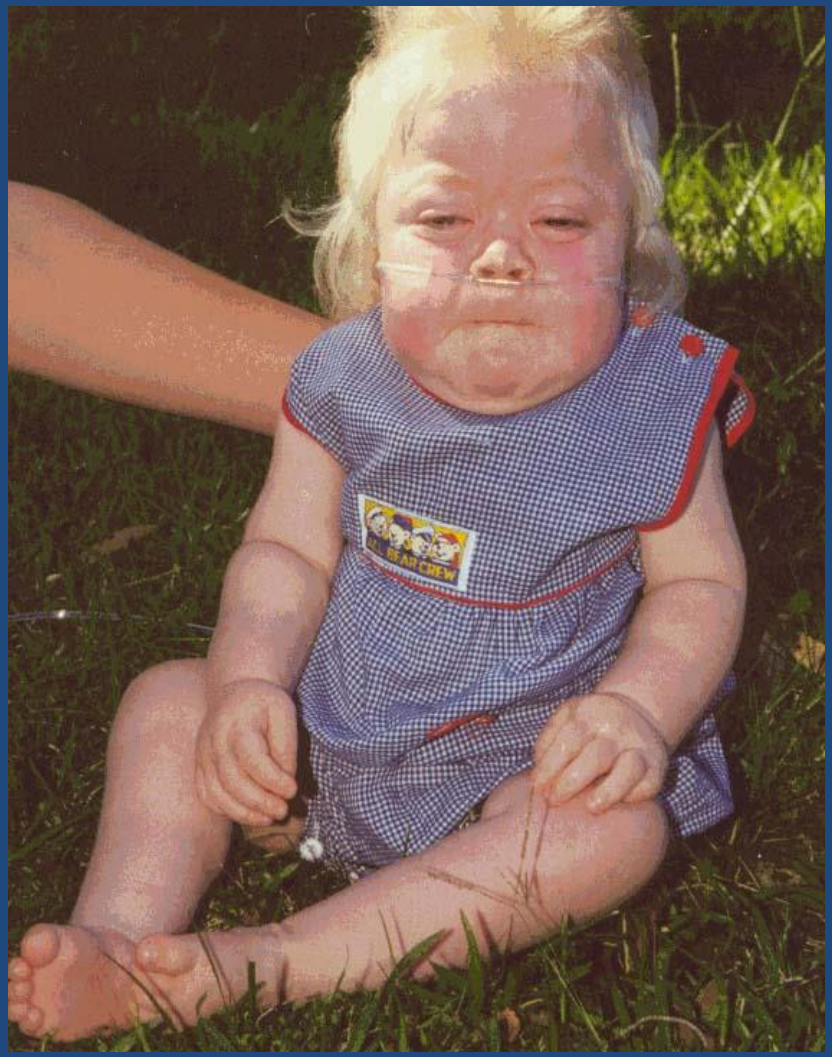
When sorting to lysosomes fails

If mannose-6-phosphate cannot be synthesized due to a gene mutation, lysosomal enzymes cannot be sent where they belong. They will be exocytosed by constitutive secretion, and everything that must be digested by lysosomes will instead fill the cell, forming abnormal, harmful inclusions as shown in this micrograph.



Inclusions in a cardiac valve (from http://webhome.idirect.com)

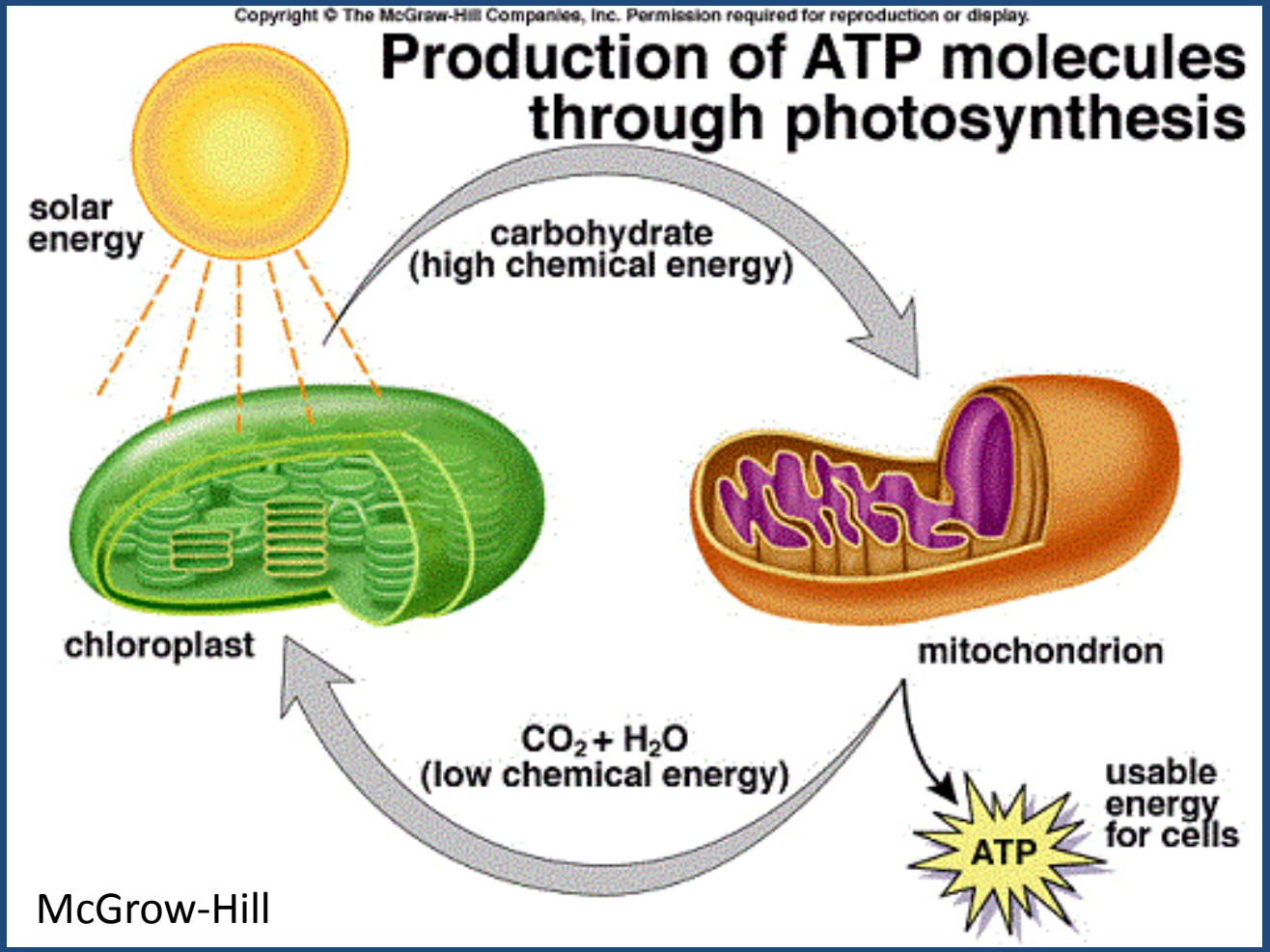
I-cell disease (mucolipidosis II)



From http://www.mpssociety.org

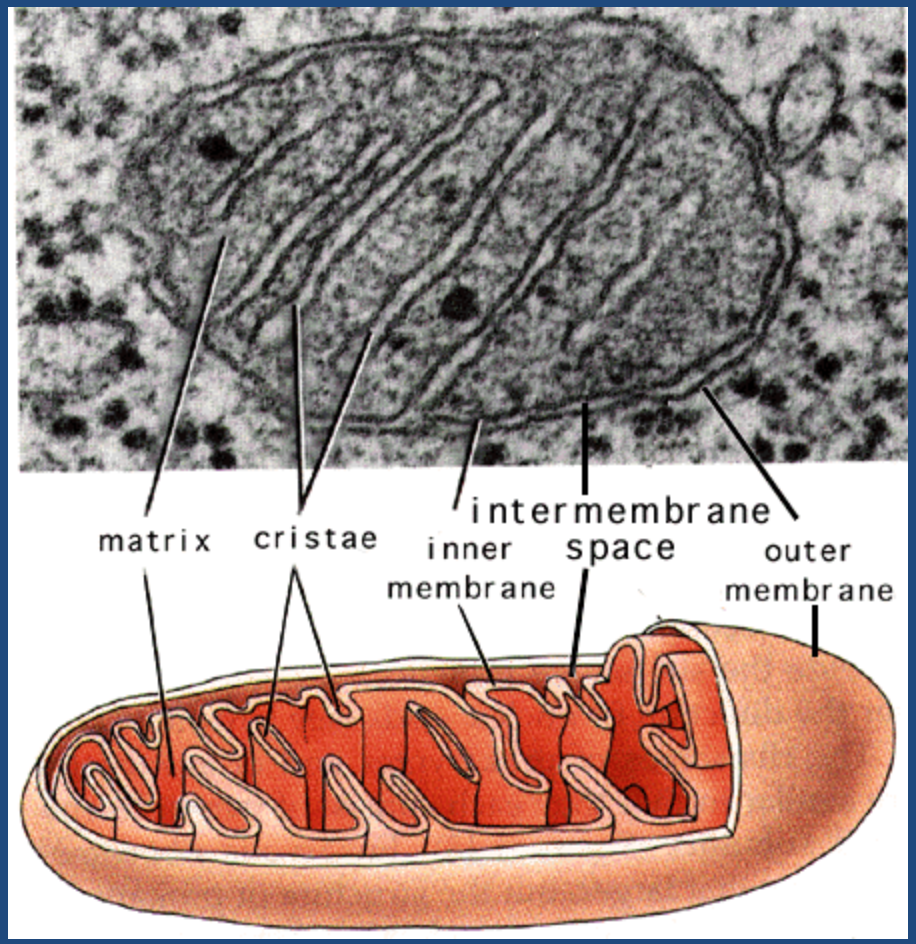
At organism level, this molecular defect is manifested as a severe autosomal recessive disorder called mucolipidosis II or I-cell disease (I is for “inclusions”). Like many other inborn errors of metabolism, the I-cell disease is progressive and ultimately lethal. Children have short-trunk dwarfism and other skeletal abnormalities, retarded psycho-motor development, coarse facial features and restricted joint movement. Most of them die before age 7 of heart failure or respiratory tract infections.

Double-membrane organelles



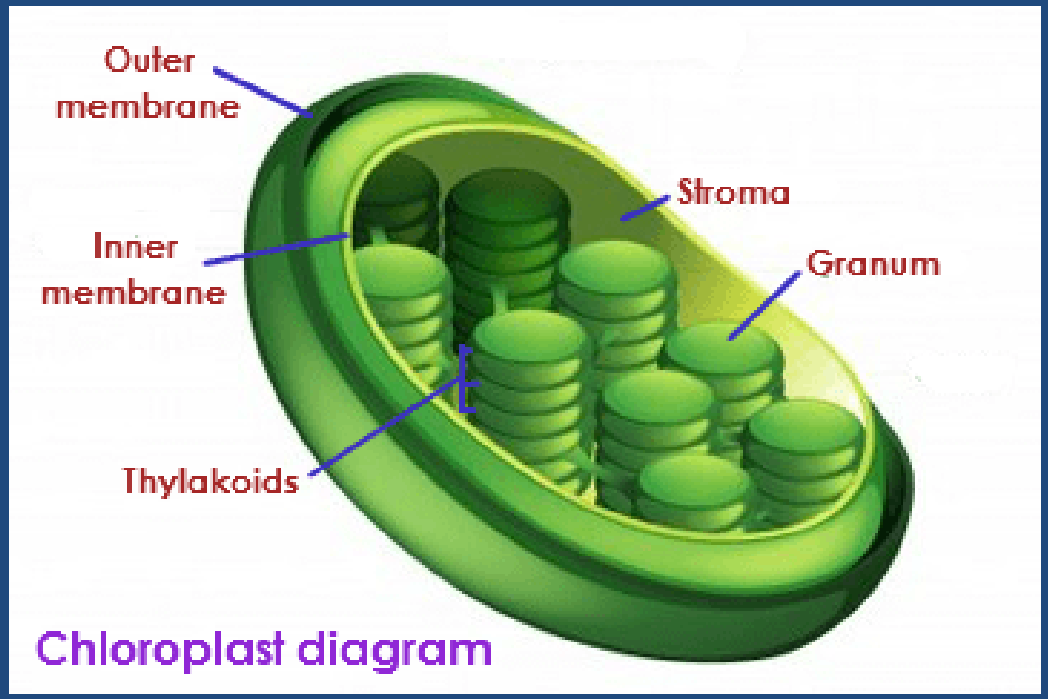
Mitochondria and chloroplasts have a double membrane. Their main function is to transform energy.

Structure of mitochondria



http://academic.brooklyn.cuny.edu/biology/bio4fv/page/mito.htm

Structure of chloroplasts



https://biology.tutorvista.com/animal-and-plant-cells/chloroplasts.html