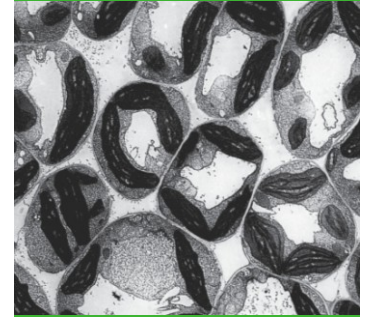


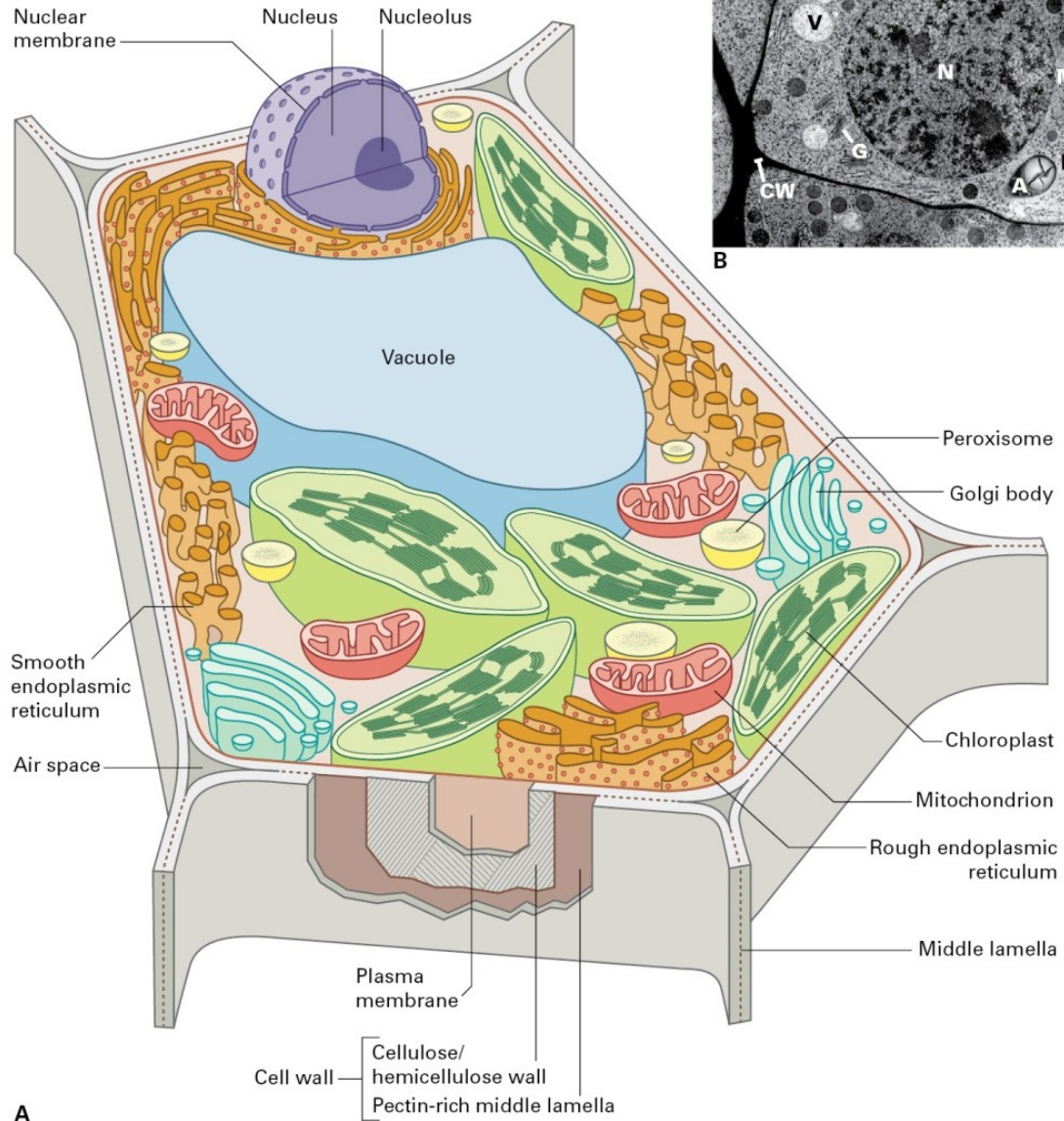


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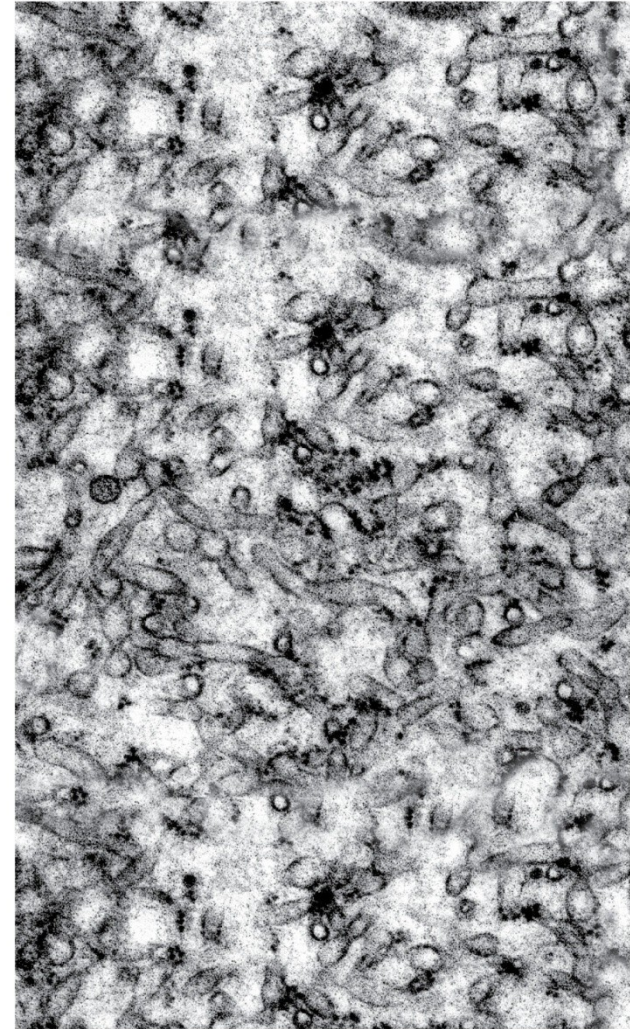
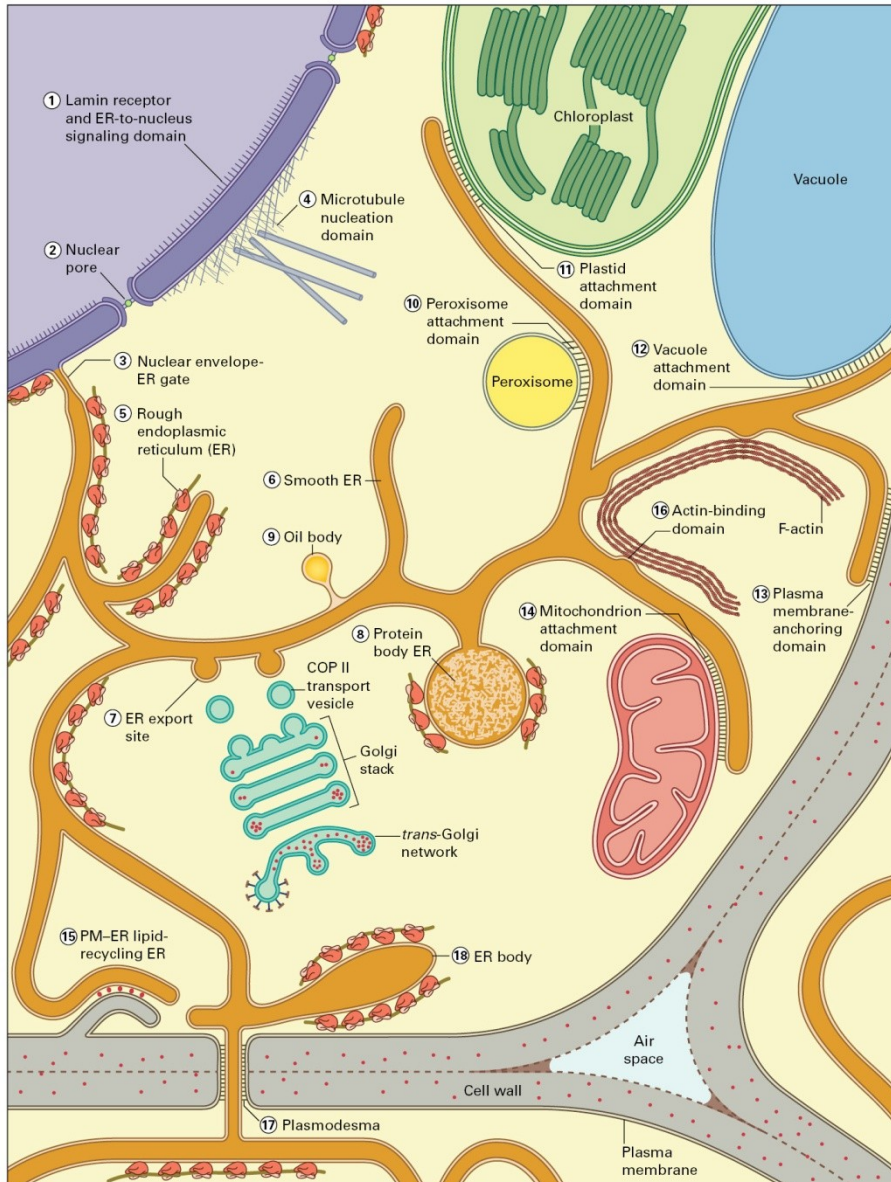


Plant cell



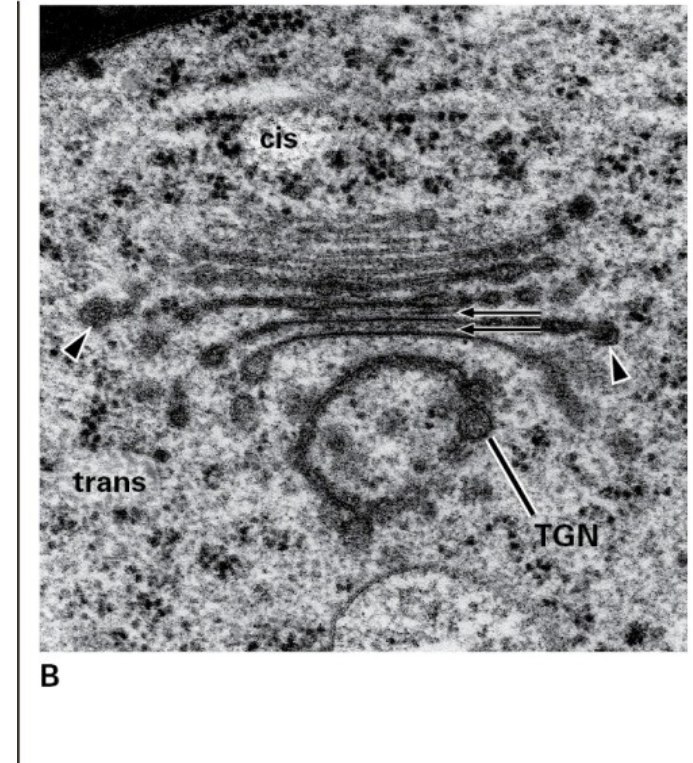
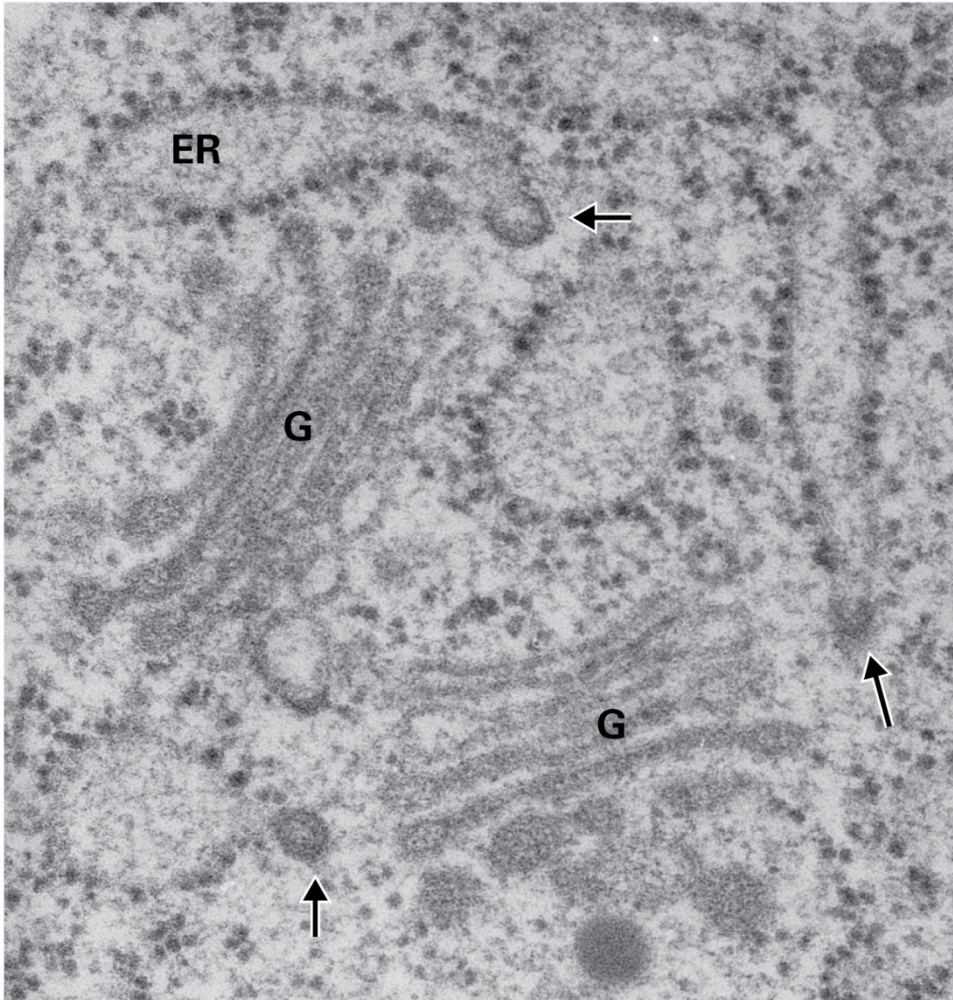


Endoplasmic reticulum

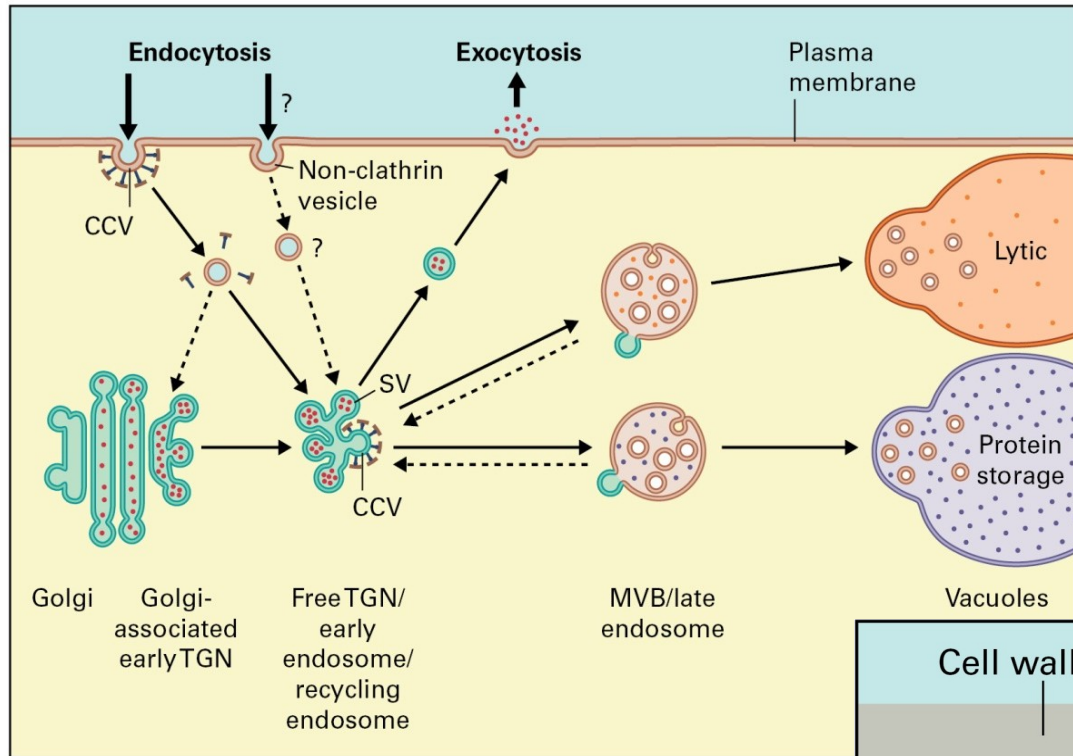


ER tubules

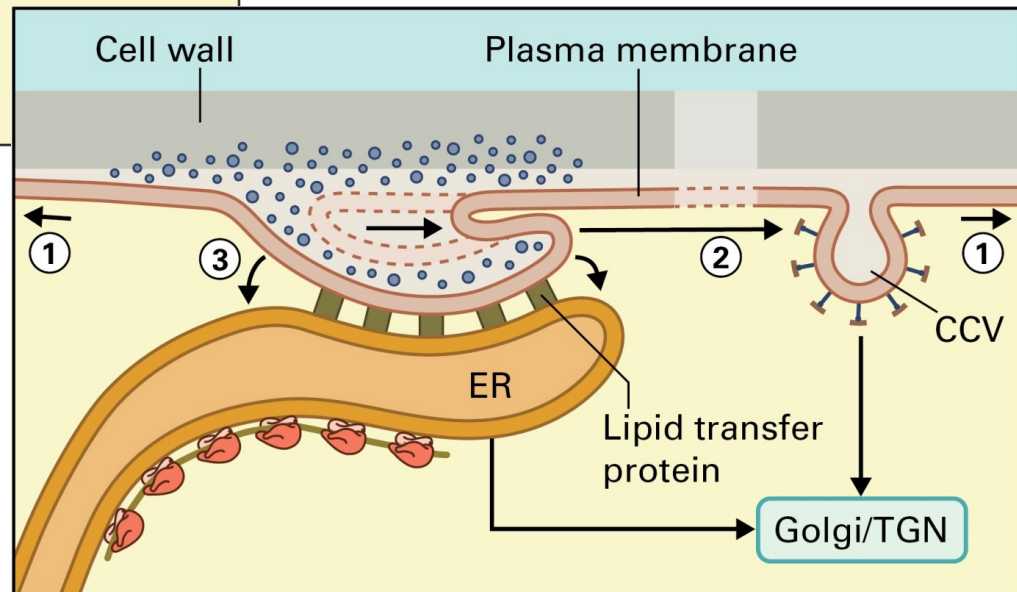
Golgi apparatus



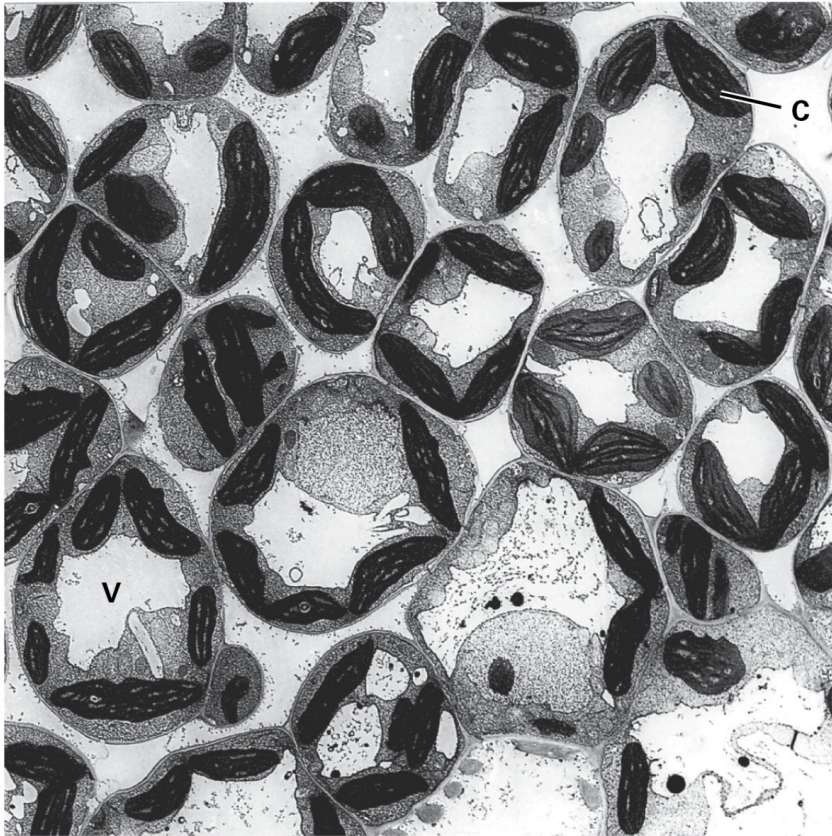
Exocytosis and endocytosis



The mechanisms for removing the excess membrane from the plasma membrane



Vacuoles

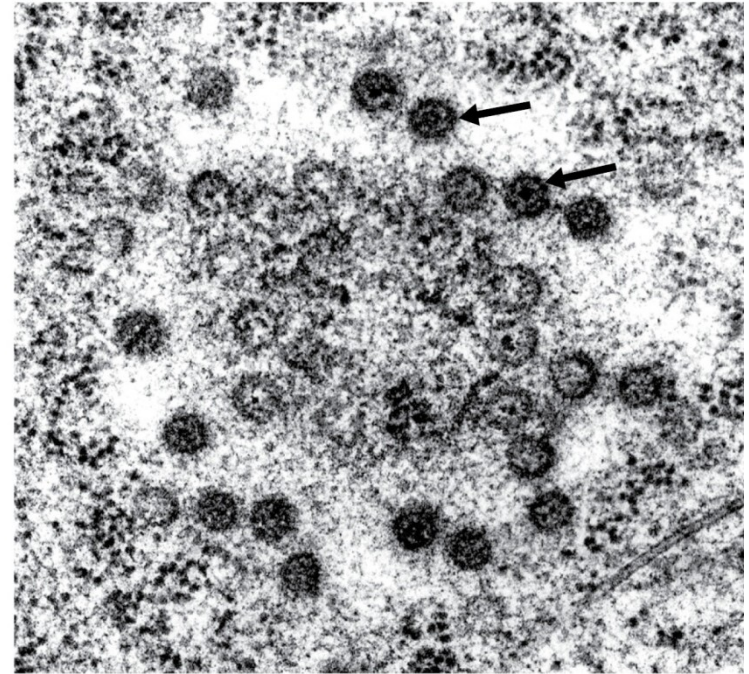
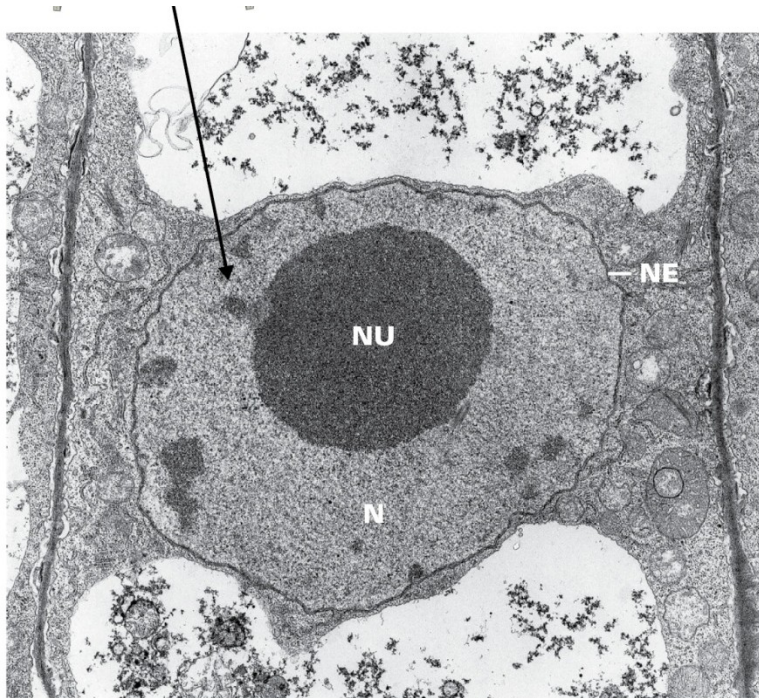


Metabolic roles of vacuoles:

- Growth
- Storage
- Digestion
- pH and ionic homeostasis
- Defense against microbial pathogens and herbivores
- Sequestration of toxic compounds
- Pigmentation

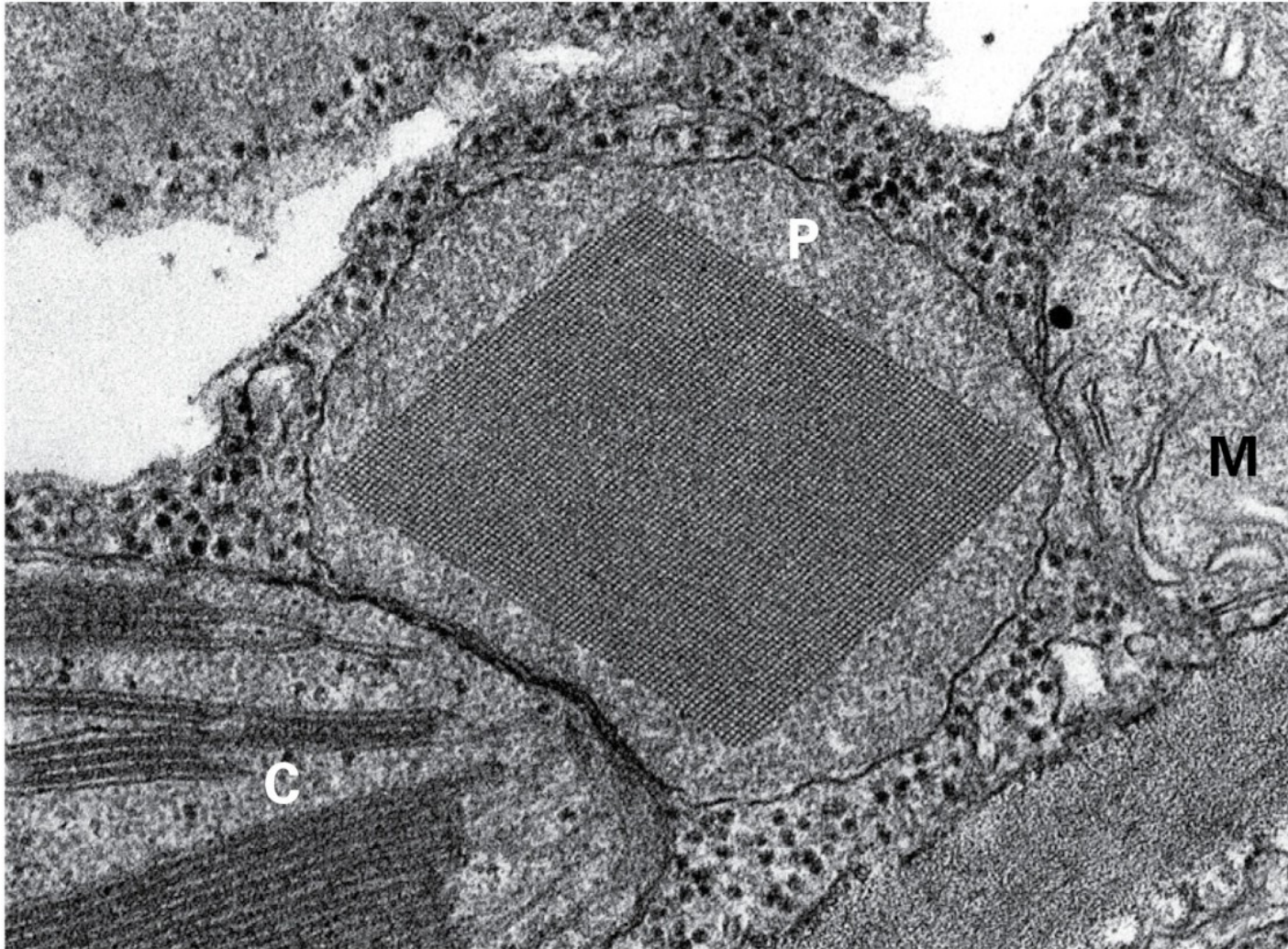
The nucleus

N, nucleus
NE, nuclear envelope
NU, nucleolus



Nuclear pores

Peroxisomes

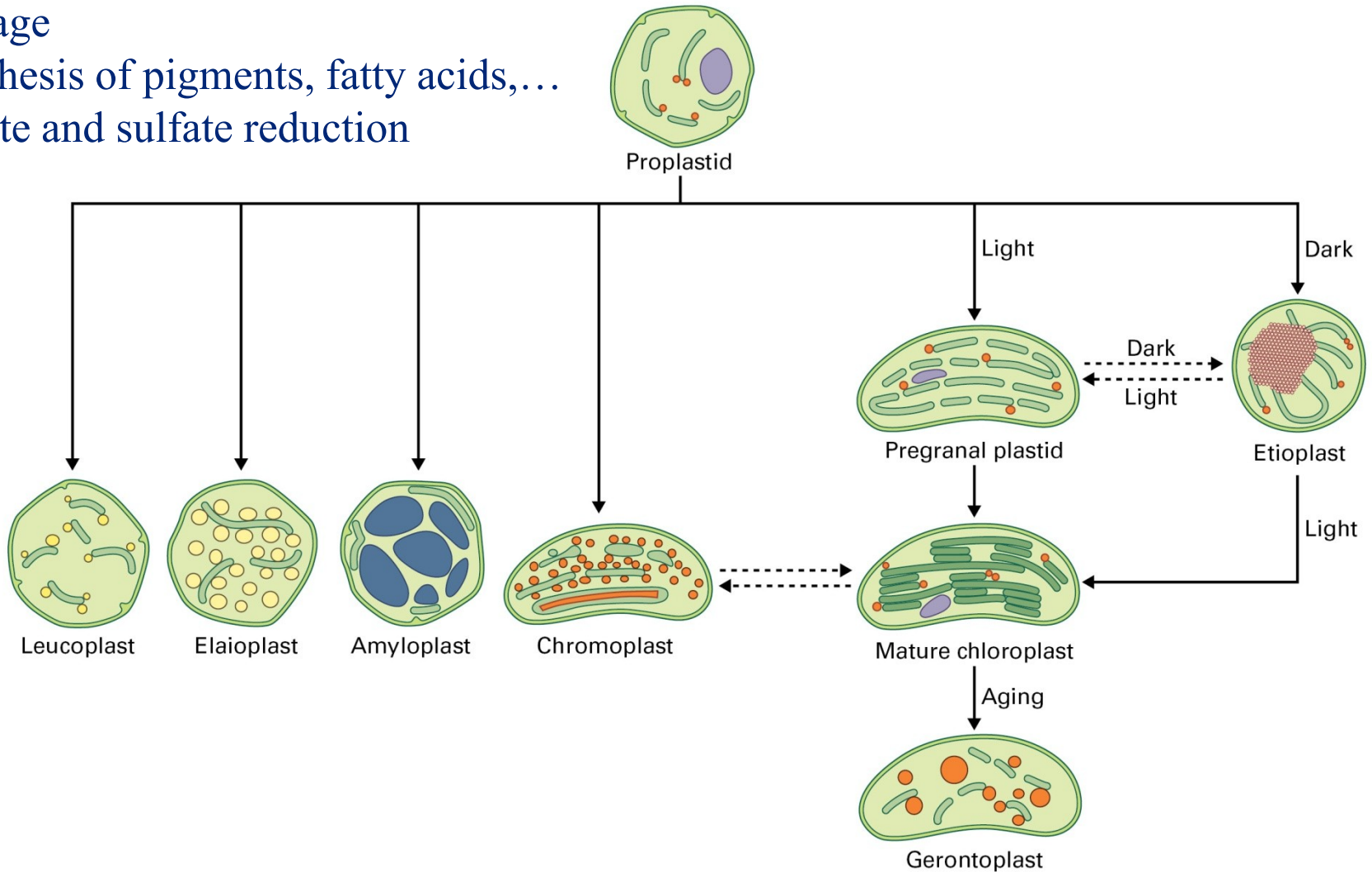


C, chloroplast
P, peroxisome
M, mitochondrion

Plastids

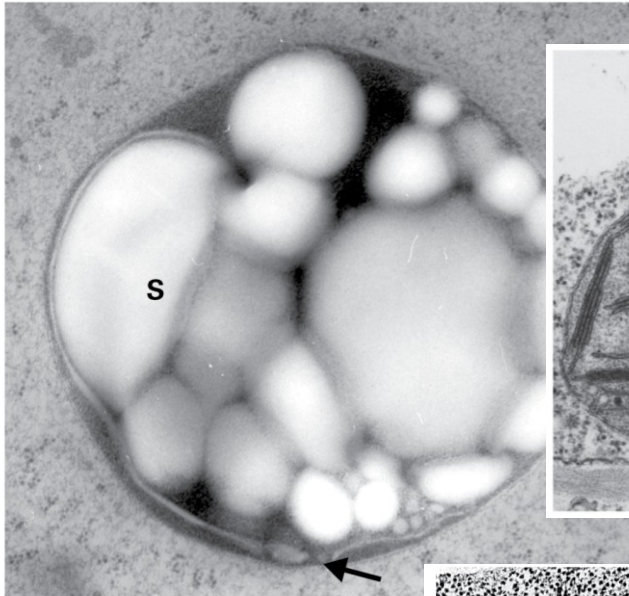
Metabolic roles of plastids:

- Photosynthesis
- Storage
- Synthesis of pigments, fatty acids,...
- Nitrite and sulfate reduction

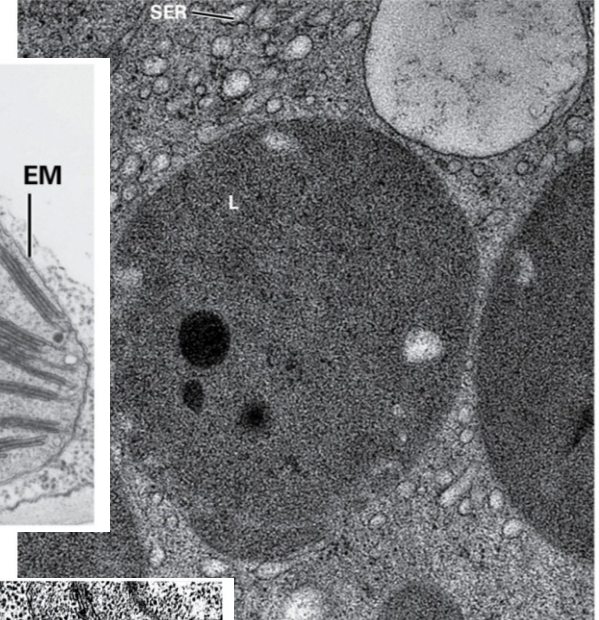
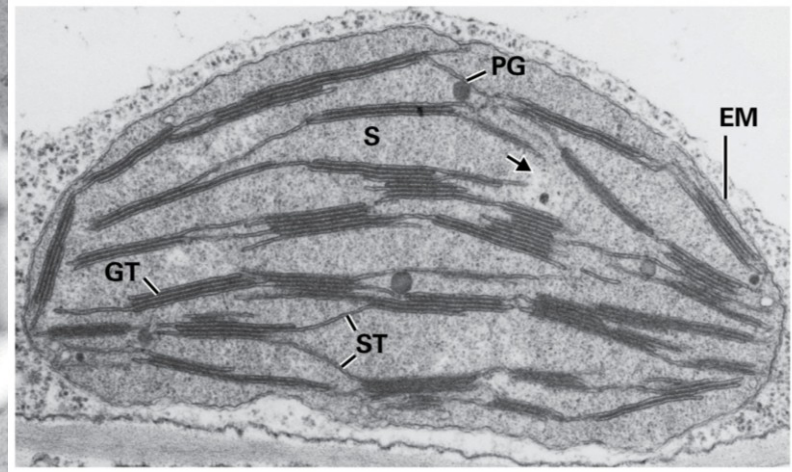


Plastids

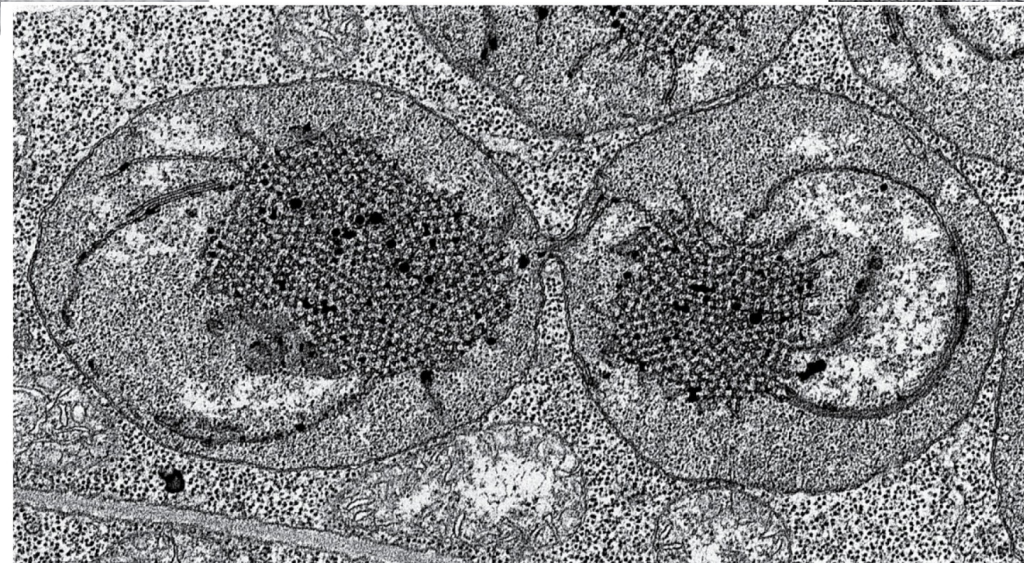
Chloroplast



Amyloplast

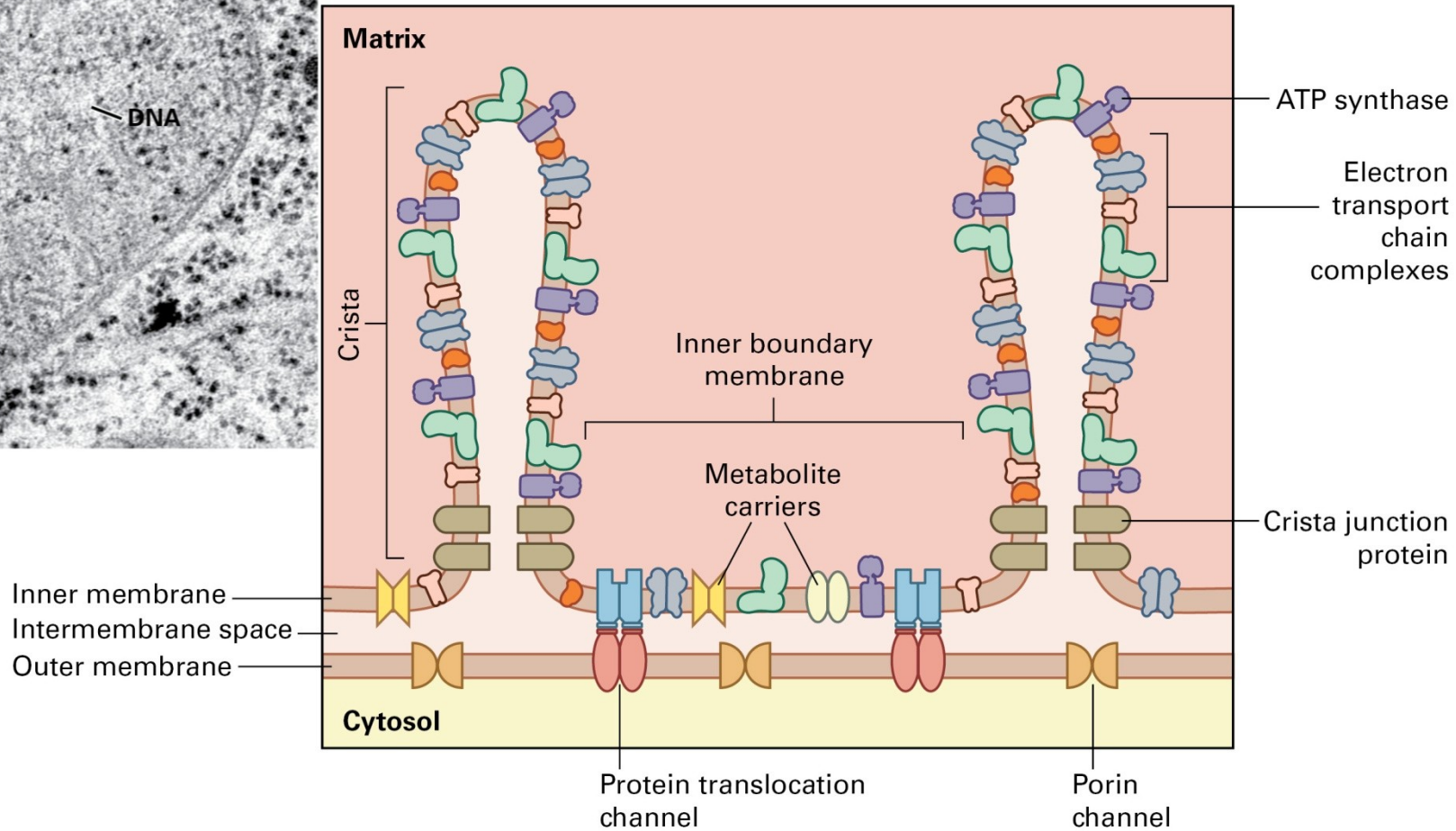
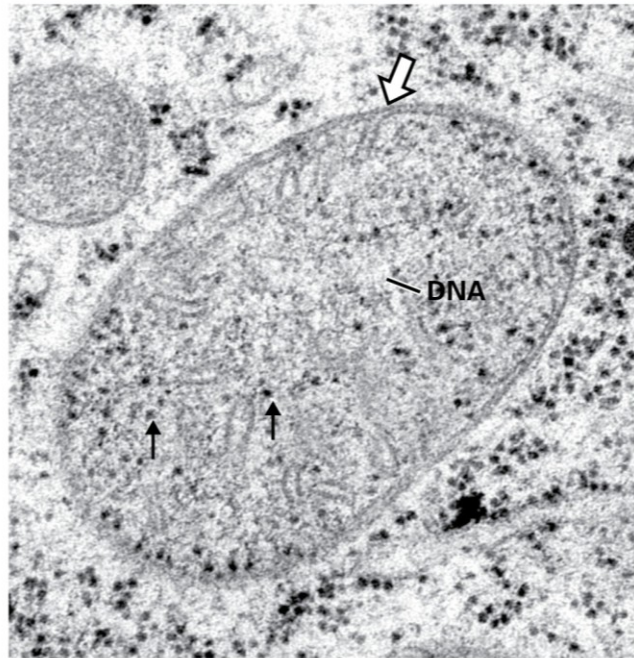


Leucoplast

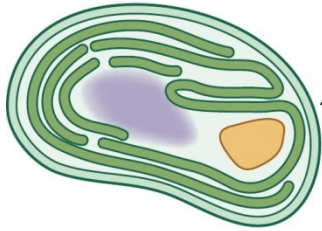


Etioplasts

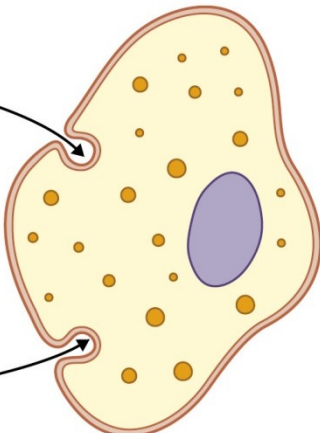
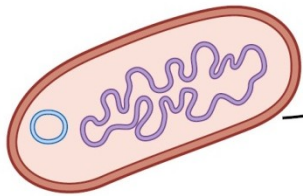
Mitochondria



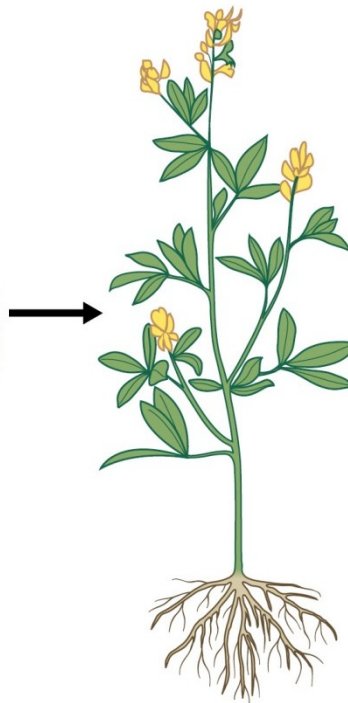
Common ancestor of
plastid and modern
cyanobacteria



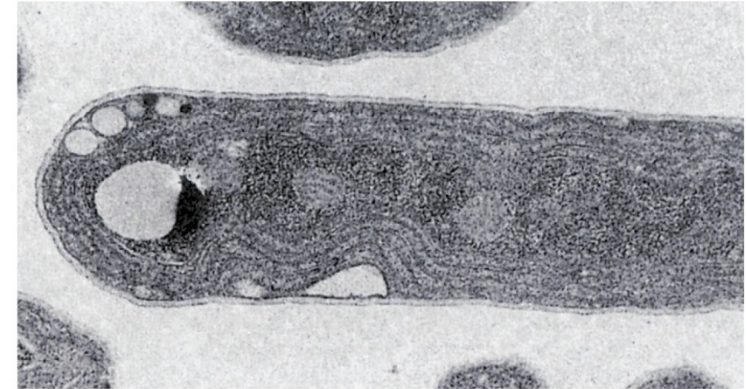
Common ancestor of
mitochondrion and
 α -group of modern
proteobacteria



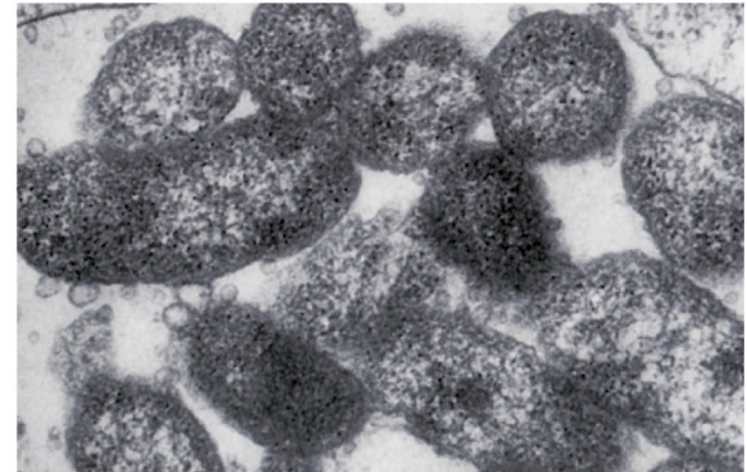
Protoeukaryotic cell



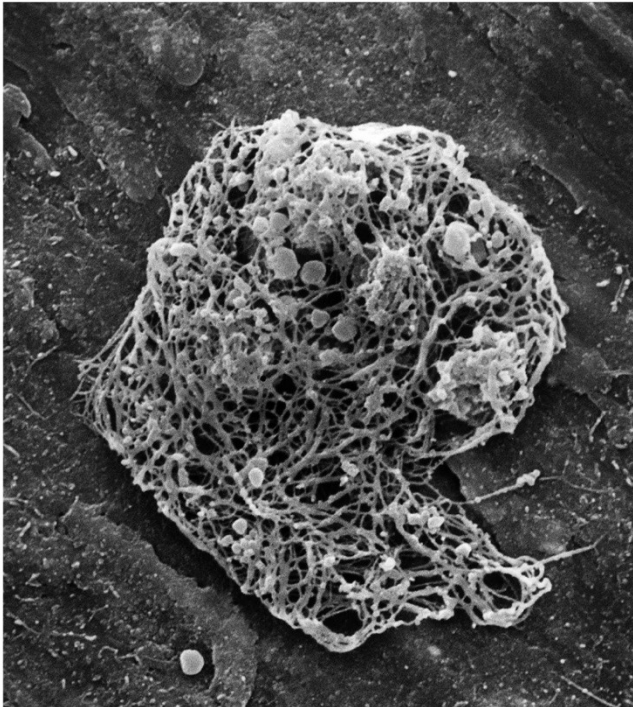
Synechococcus lividus



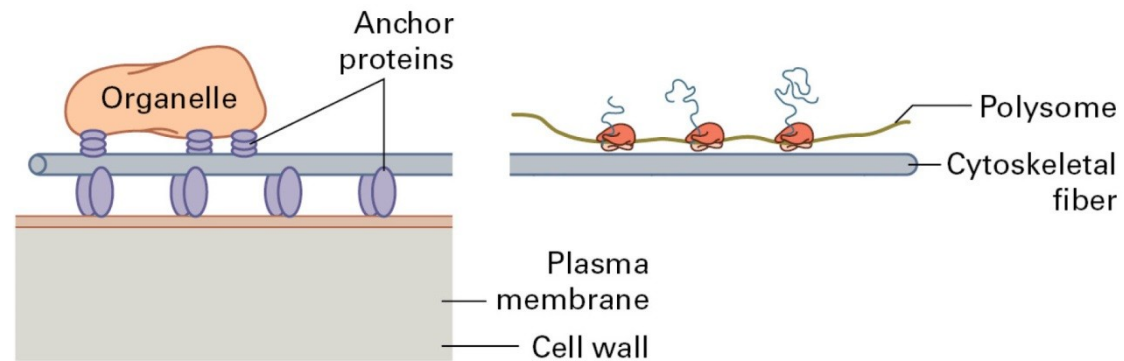
Rickettsiella popilliae



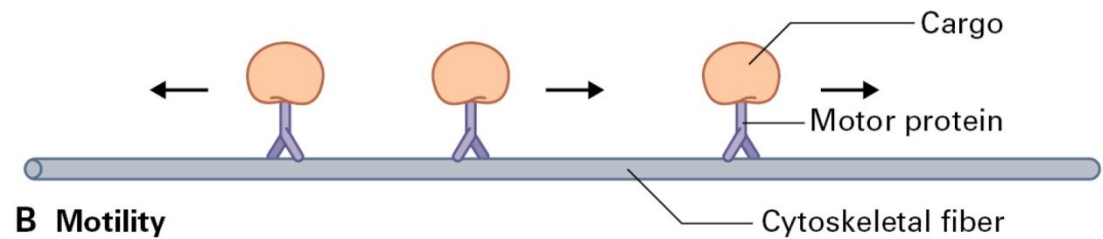
The cytoskeleton



Electron micrograph of a cytoskeletal meshwork from a carrot cell

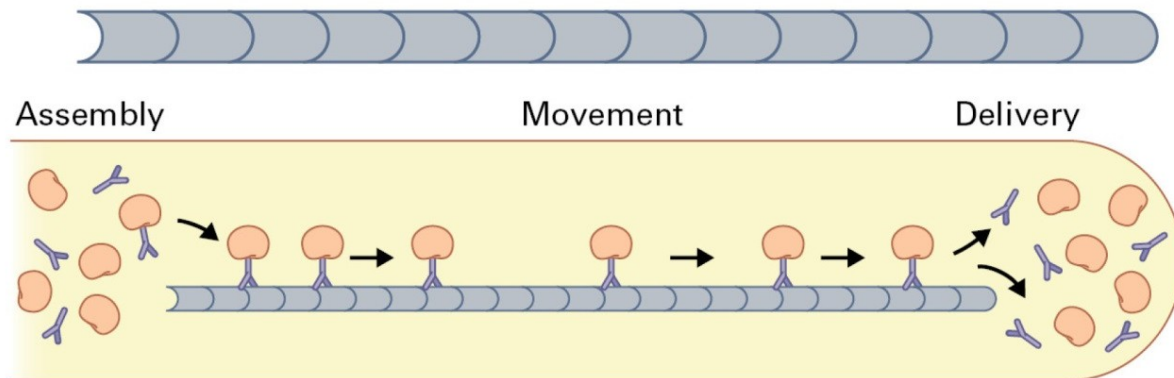
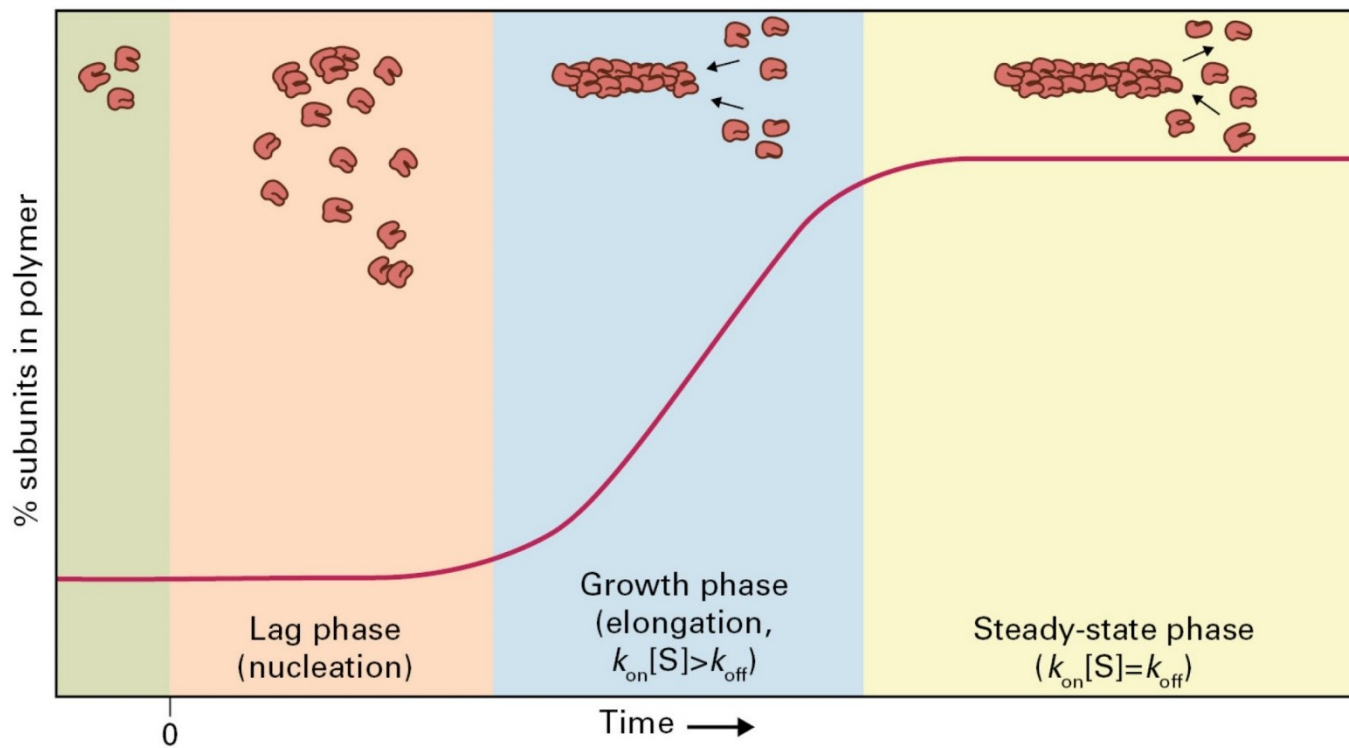


A Anchorage



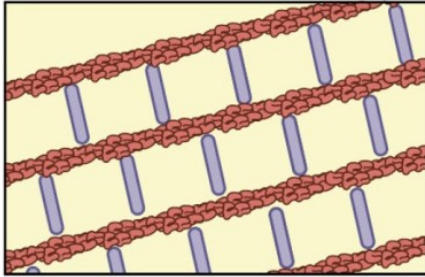
B Motility

The cytoskeleton

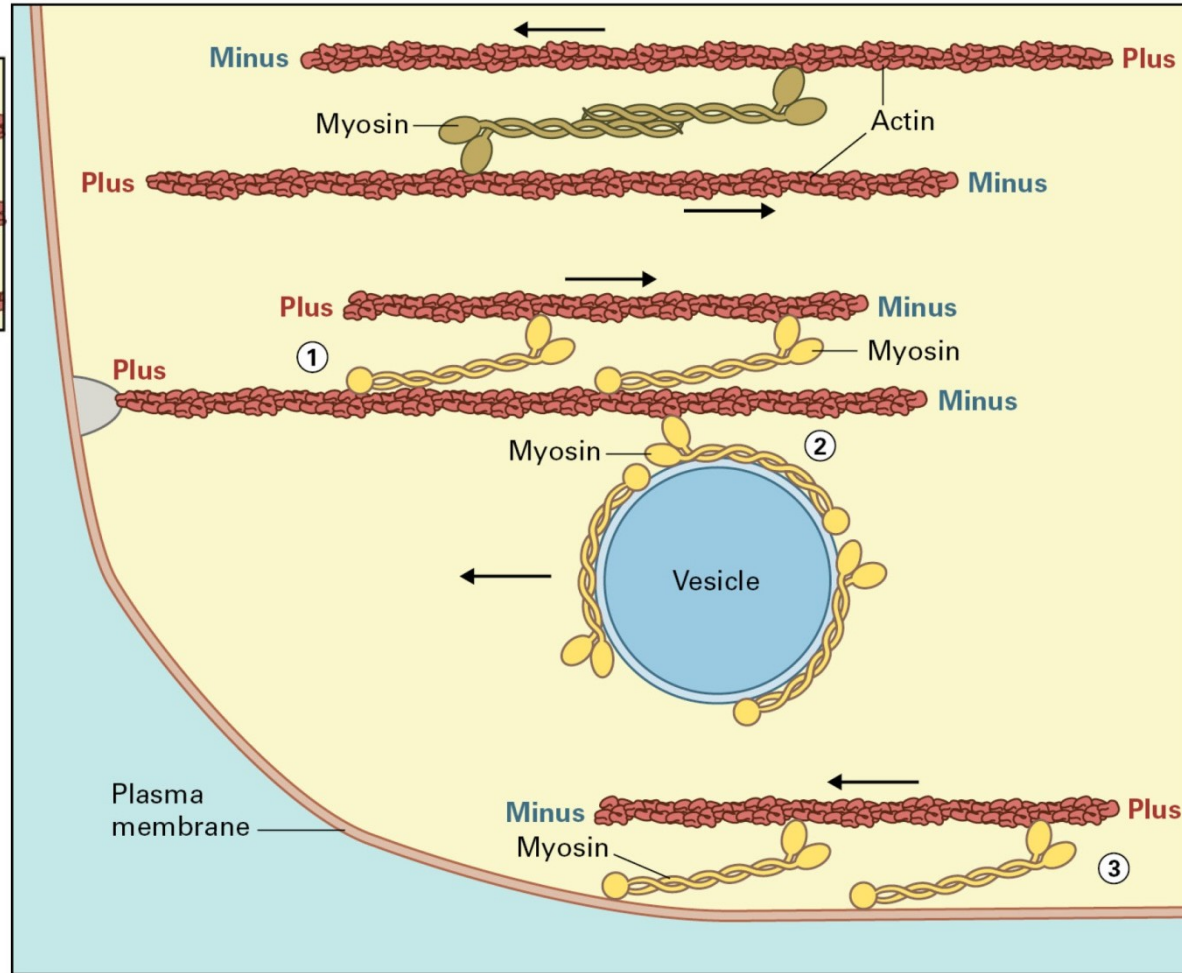
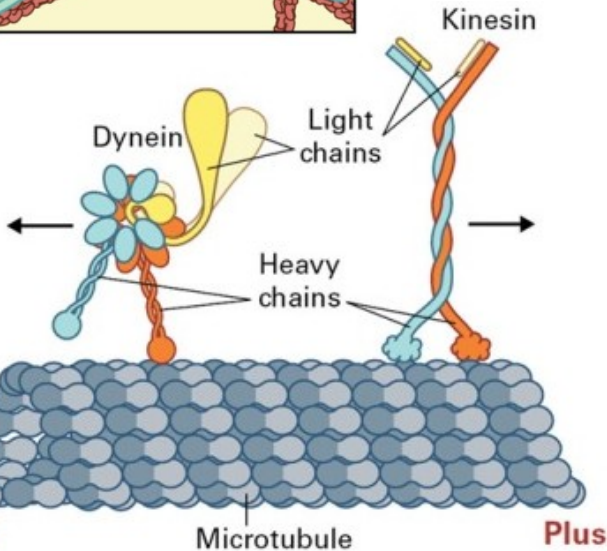
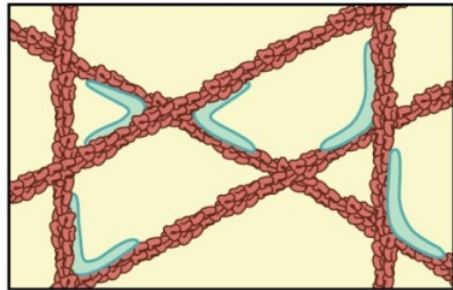


The cytoskeleton

Cross-linking (bundle-forming)

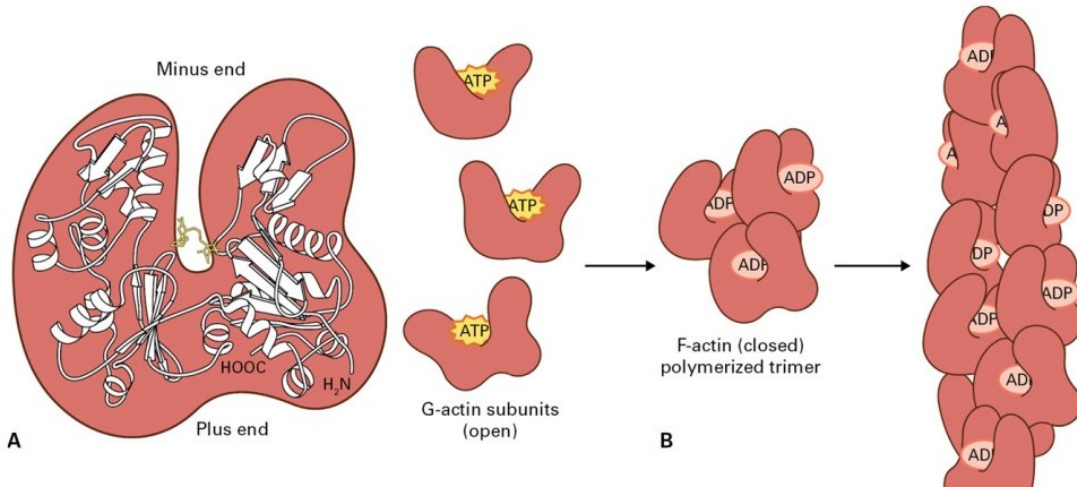


Cross-linking (mesh-forming)

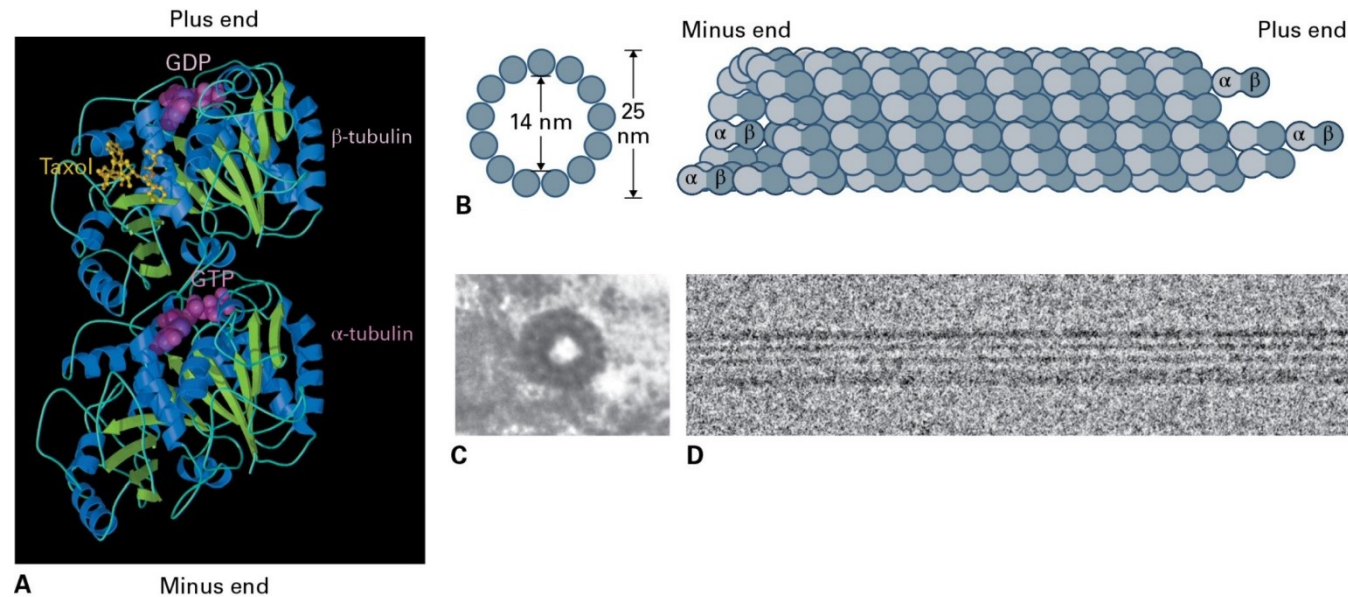


The cytoskeleton

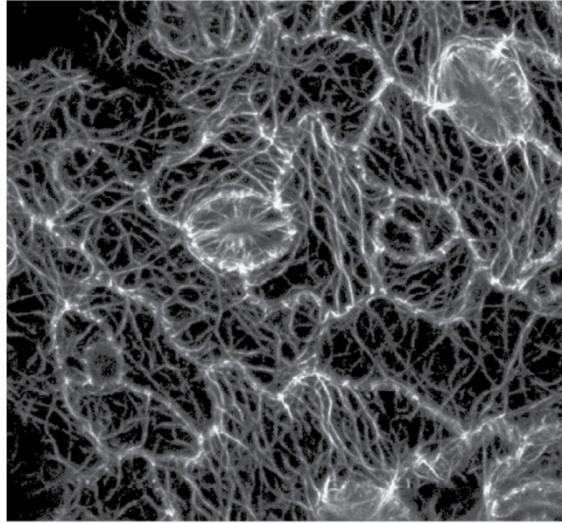
The structure of actin and actin filaments



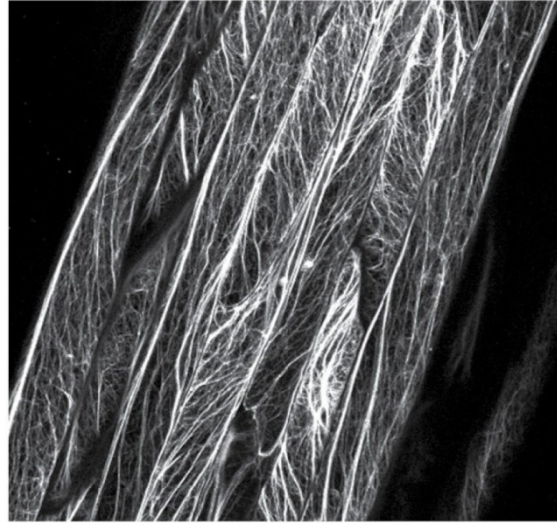
The structure of tubulin and microtubules



The cytoskeleton



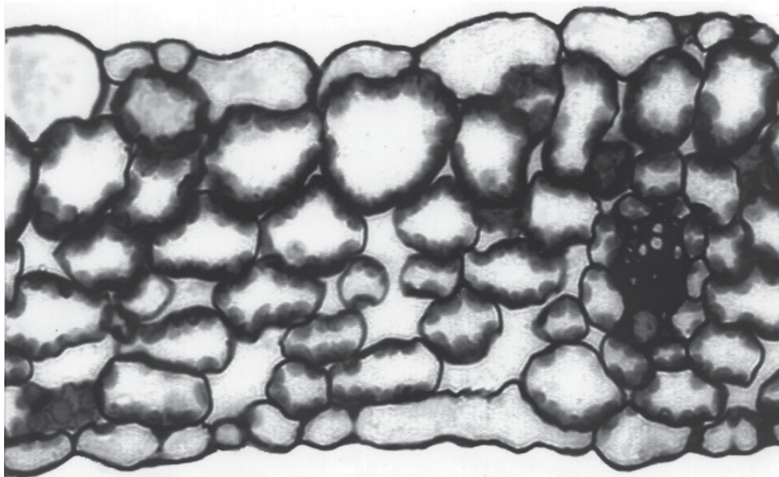
A



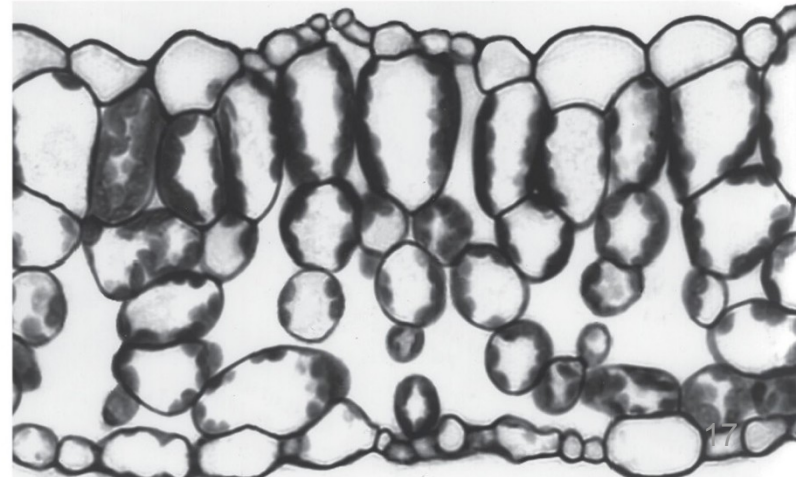
B

Actin filaments in plant epidermis (A) and leaf veins (B).

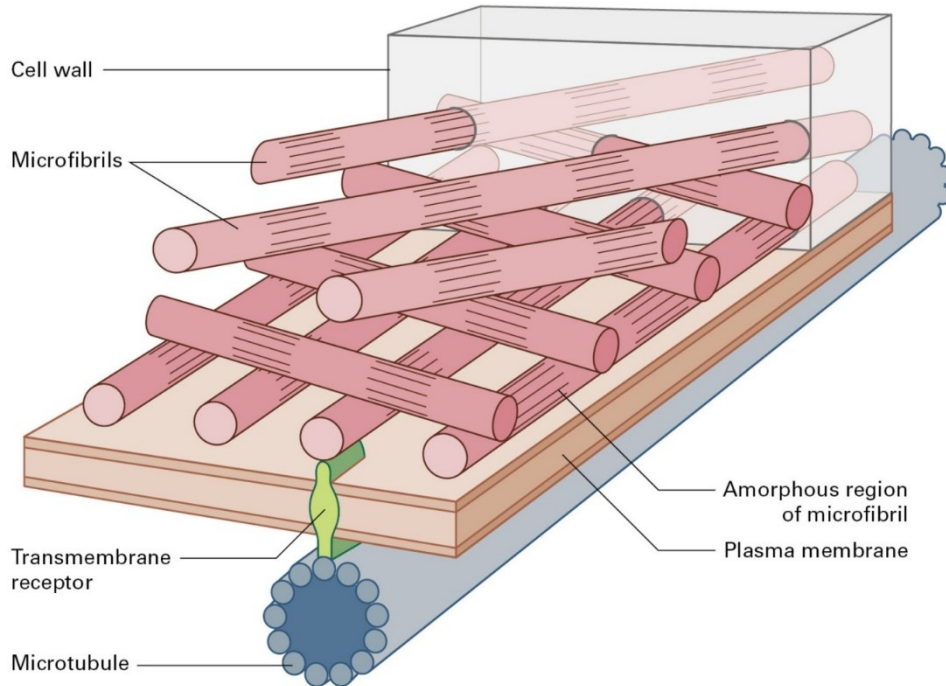
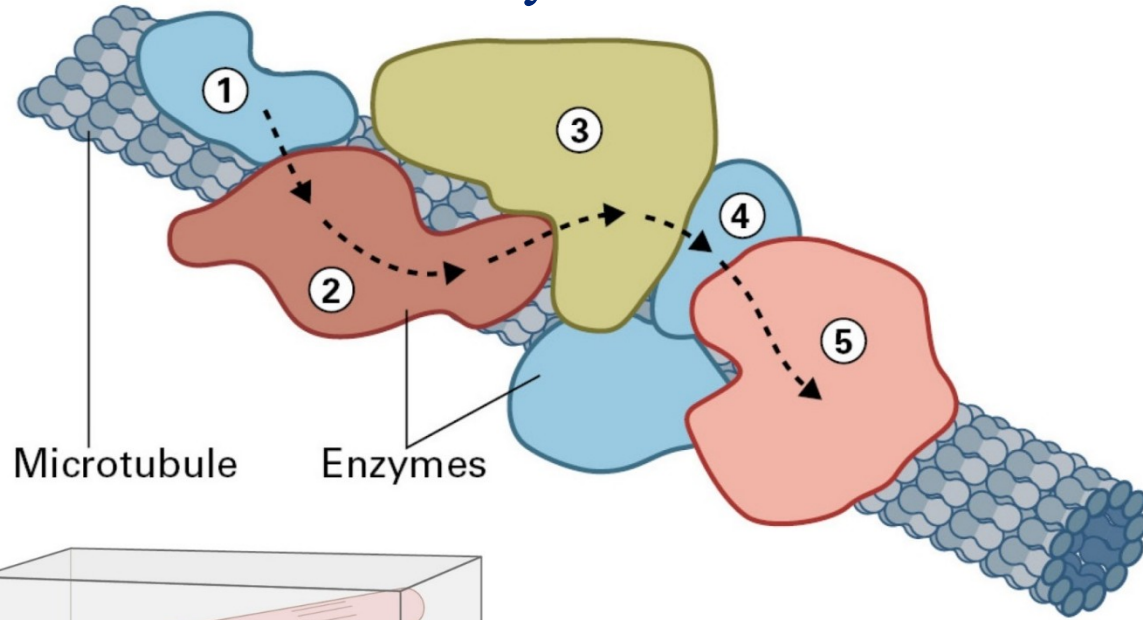
Dim light



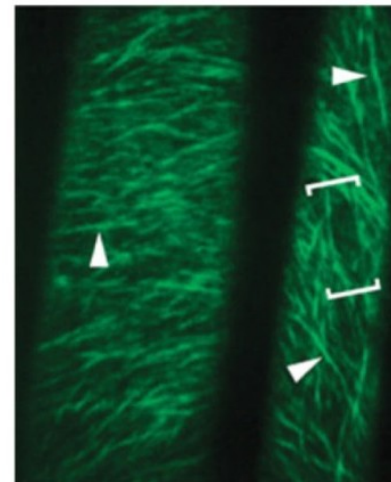
Bright light



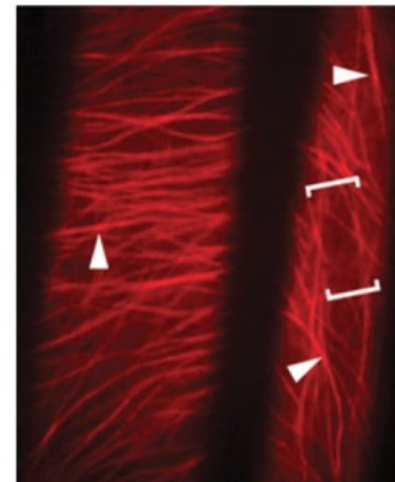
The cytoskeleton



Trajectories of motion of cellulose synthase

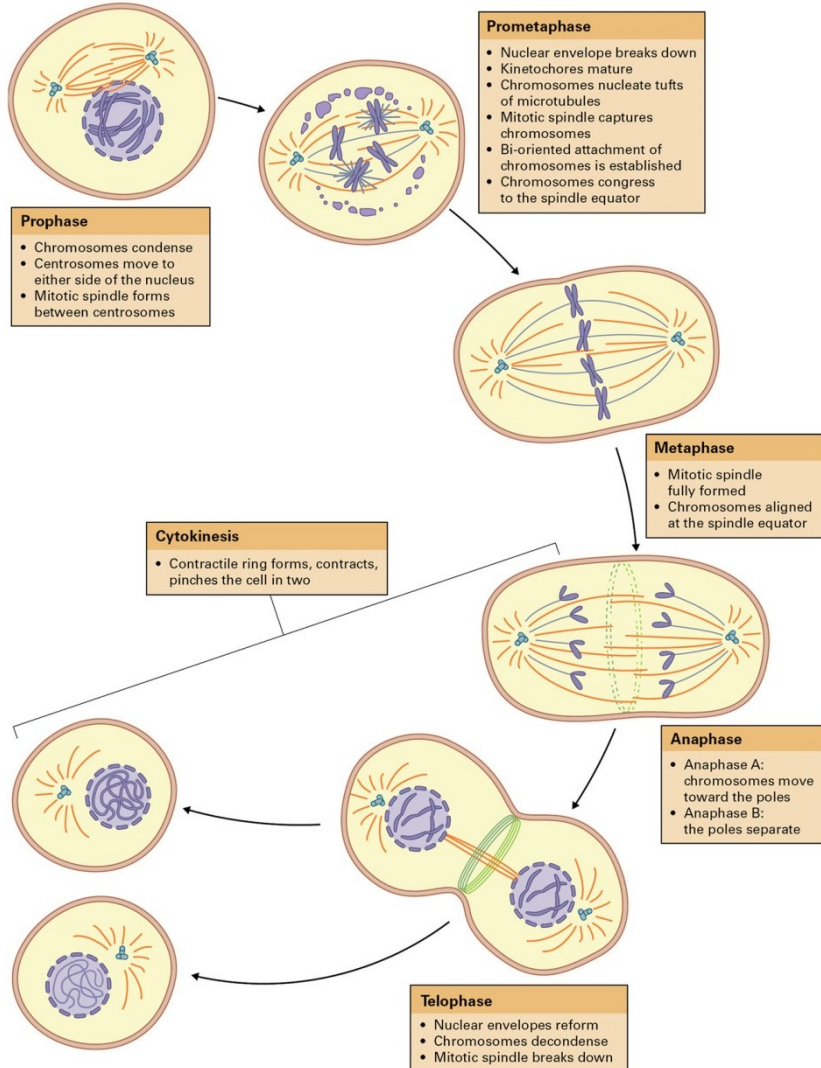


Cortical microtubules

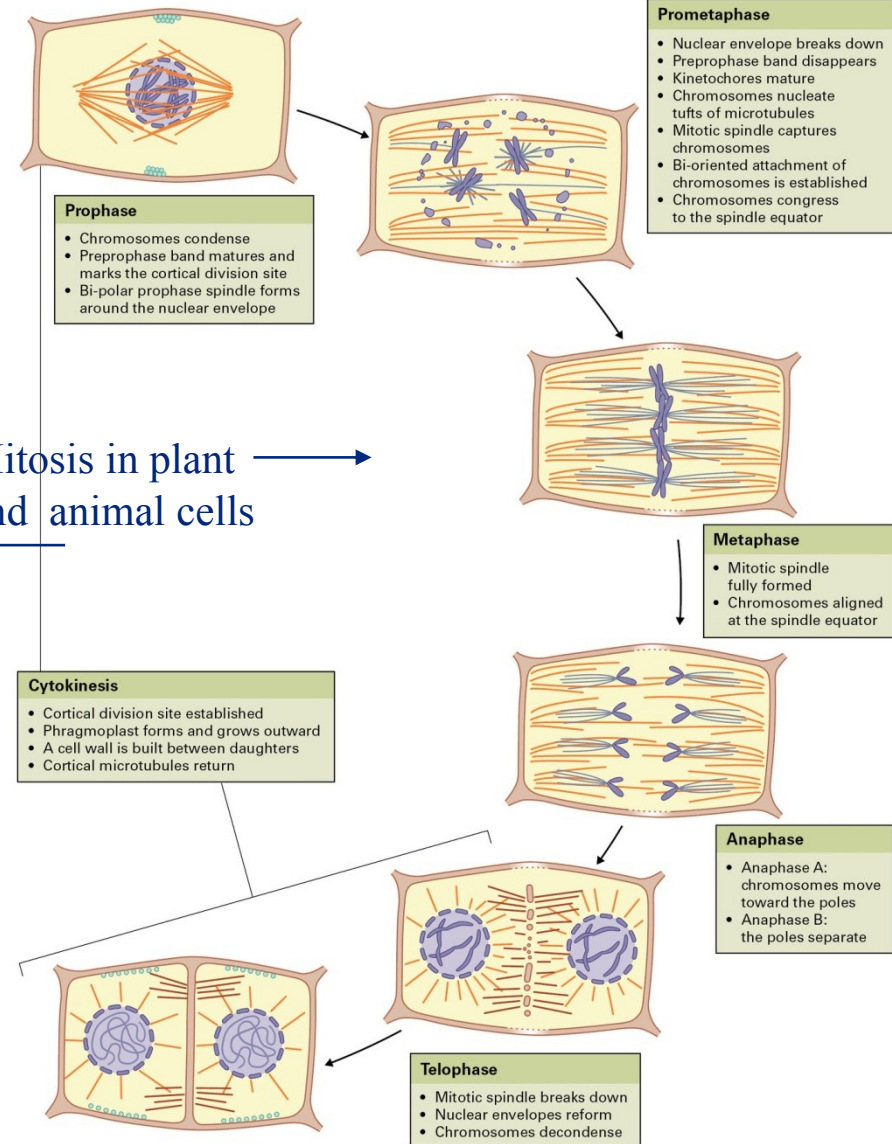


Plant cell division

Animal cell



Plant cell



Mitosis in plant and animal cells