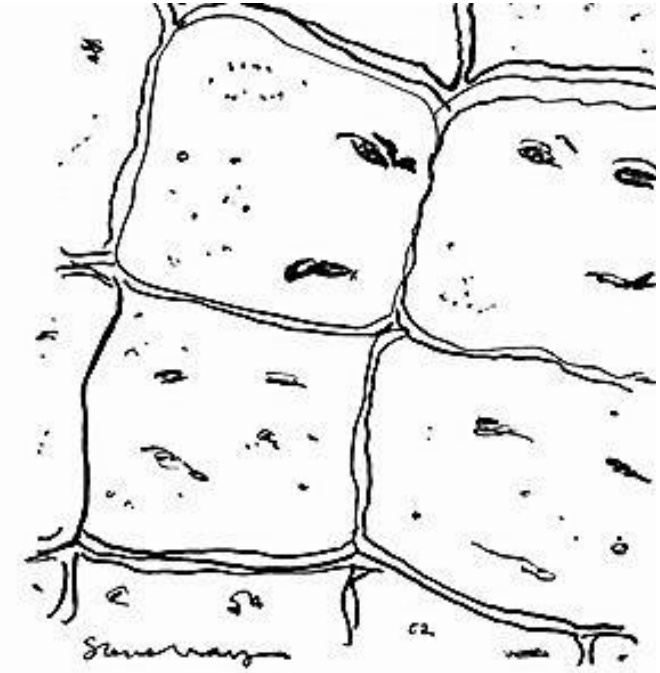
THE CELL

Cell theory

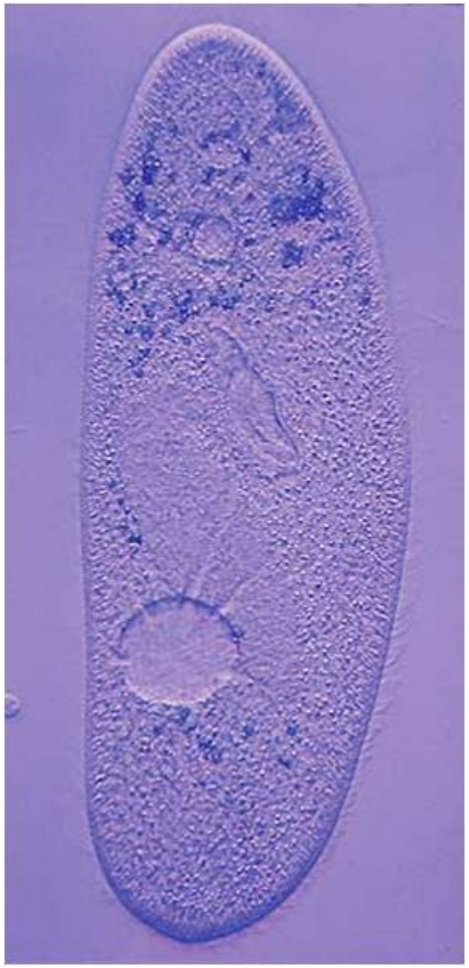
- Principles
  - Cell is basic unit of life
  - All organisms are made of cells
    - Unicellular
    - Multicellular
  - All cells come from cells



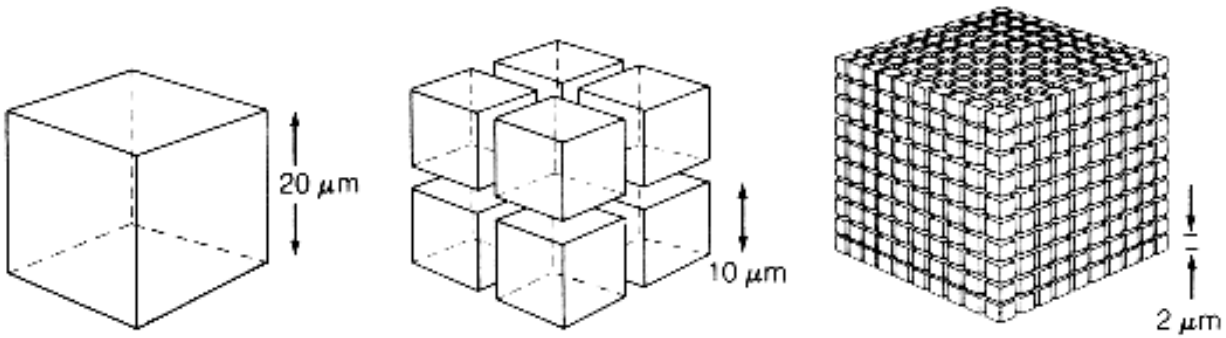
"I tell you, I remember when all this was protoplasm."

Cell basics

- Cell membrane
- Organelles
  - Discrete structures inside
- Cytoplasm
  - Fluid inside cell



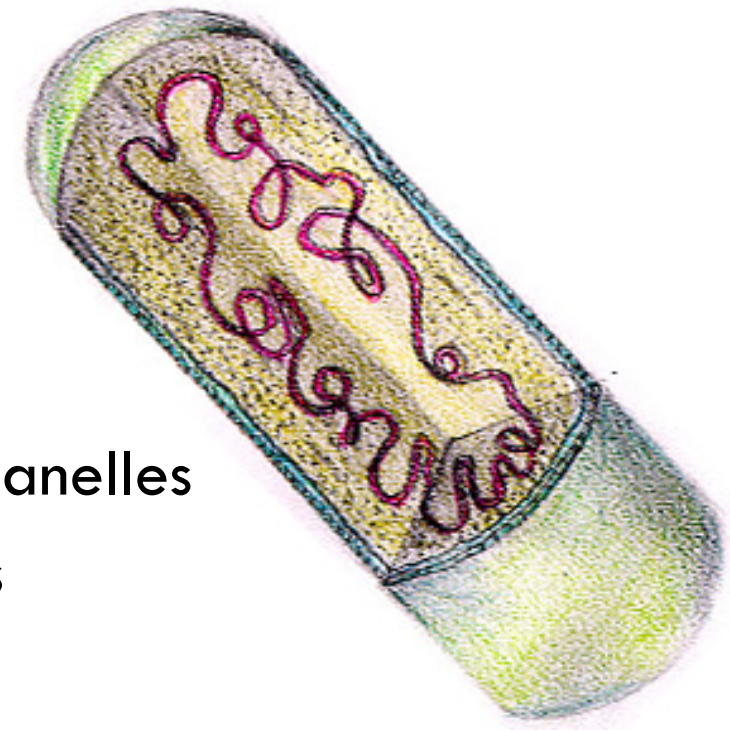
Why are cells so small?



Length of one side	20 μm	10 μm	2 μm
Total surface area (height × width × number of sides × number of cubes)	2400 μm^2	4800 μm^2	24,000 μm^2
Total volume (length × width × height × number of cubes)	8000 μm^3	8000 μm^3	8000 μm^3
Surface area to volume ratio (surface area ÷ volume)	0.3	0.6	3.0

Types of cells

- Prokaryotic
  - aka Bacteria
  - No nucleus
  - DNA throughout cell
    - circular
  - No membrane-bound organelles
  - Ribosomes: make proteins

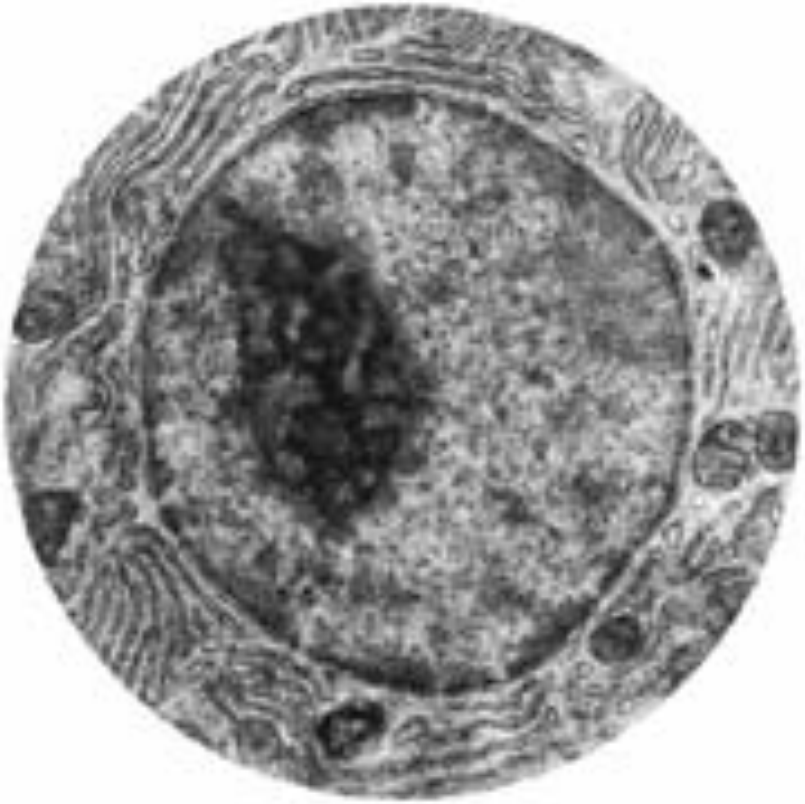


Types of cells

- Eukaryotic
  - Plants, animals, fungi, protists
  - Complex
  - Have nucleus
    - DNA is linear
  - Many membrane-bound organelles
  - Uni- or multicellular

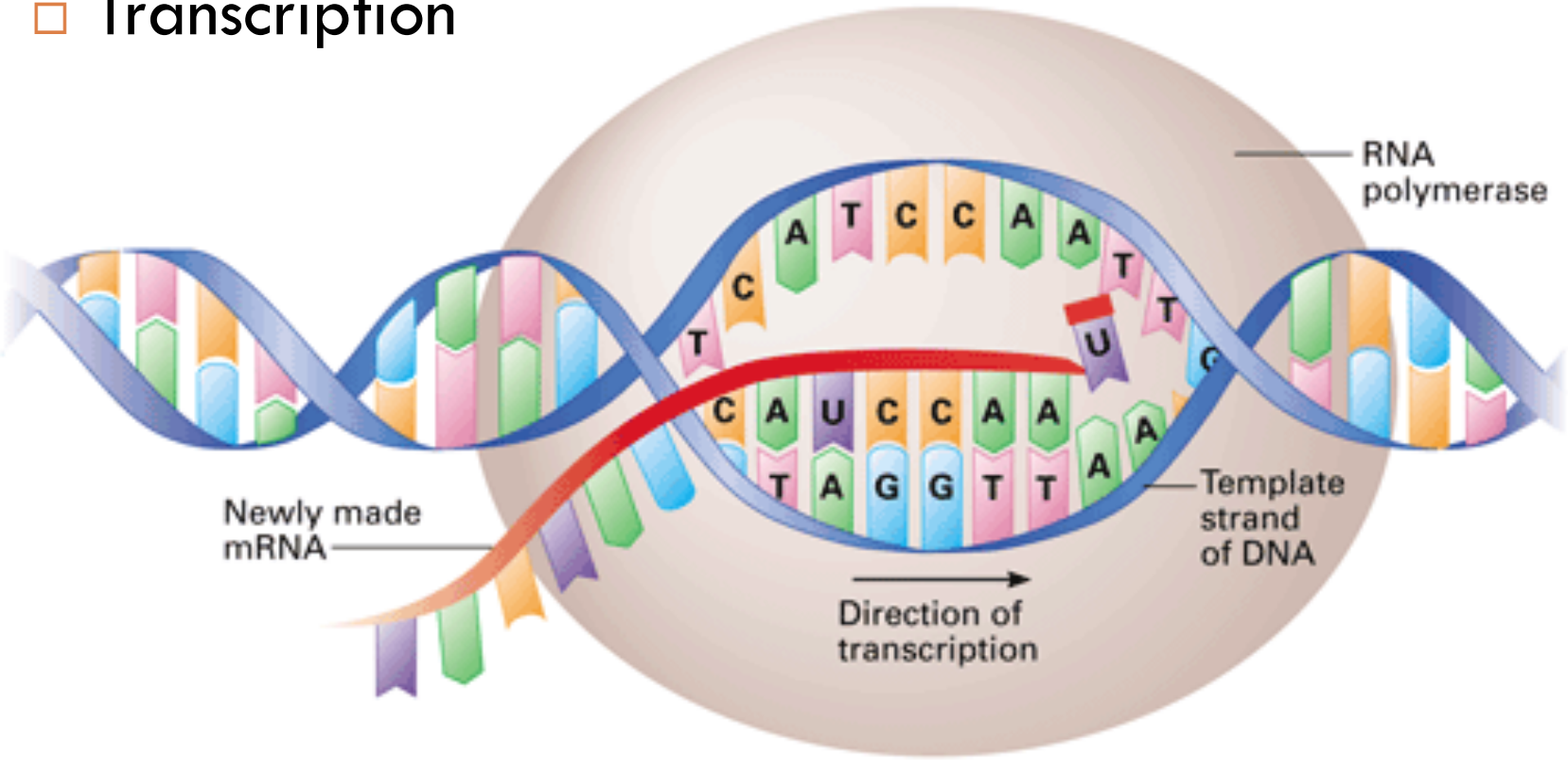
The nucleus

- Nuclear envelope
  - Membrane bound
  - Nuclear pores
    - gatekeepers
- Chromatin
  - Middle
  - Contains chromosomes
- Nucleolus
  - Dark core
  - Produces ribosomes



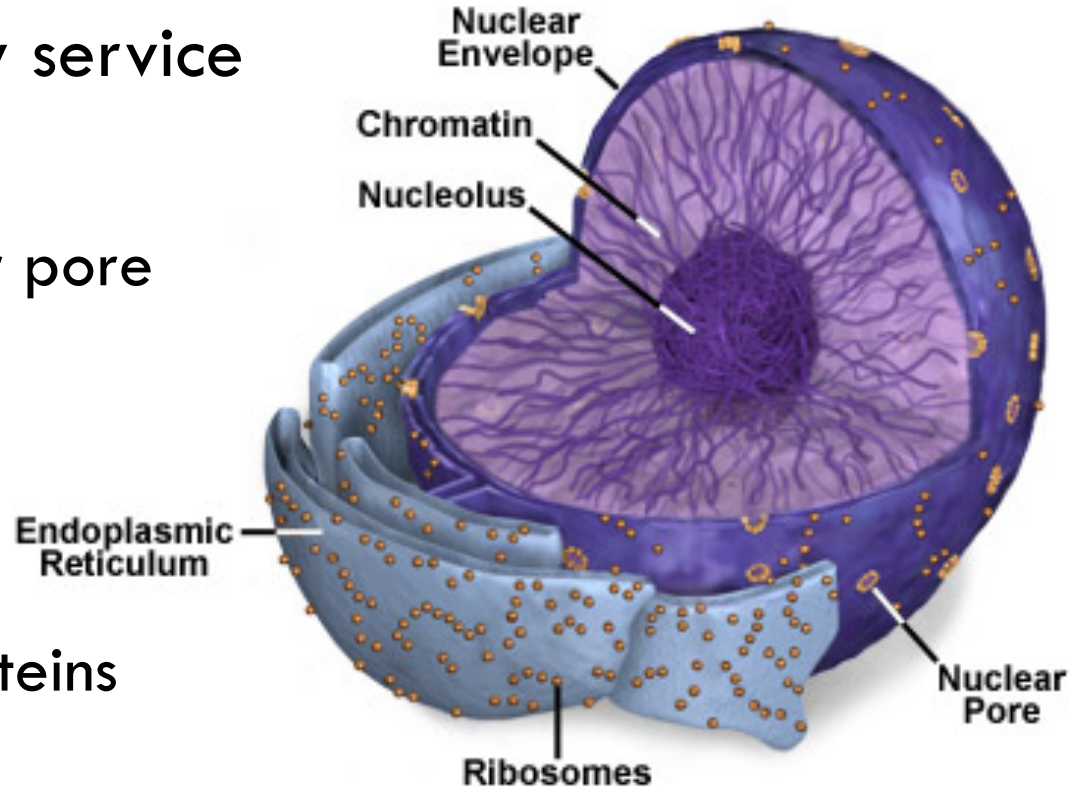
Genes

- Code for distinct bits of mRNA
- Transcription



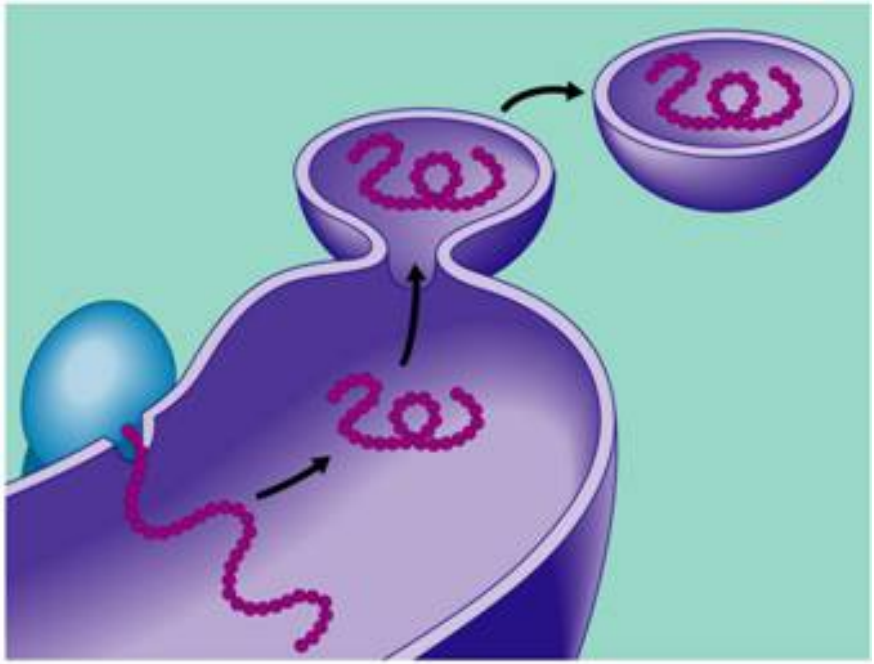
Endoplasmic Reticulum

- Internal delivery service
- mRNA travels
  - Outside nuclear pore
  - Through ER
  - To Ribosome
- Ribosome
  - Synthesizes proteins
  - Translation



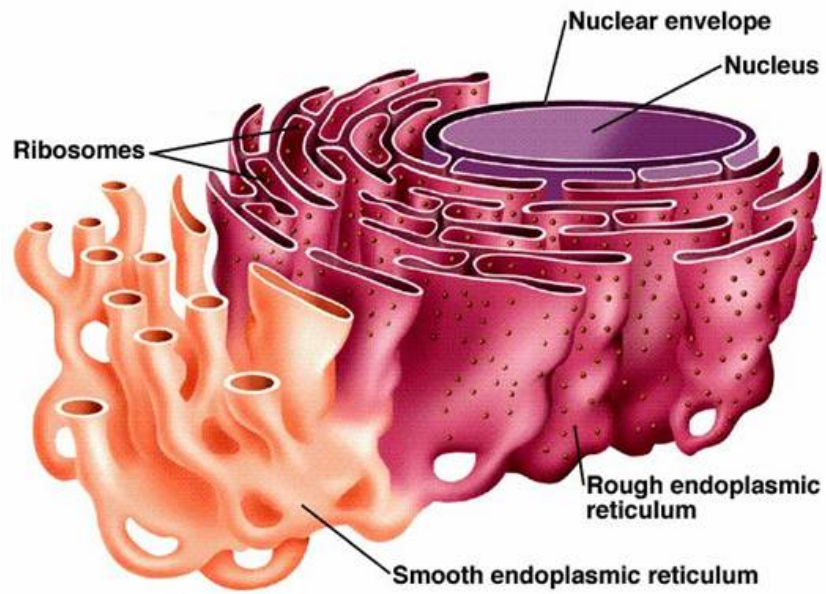
Endoplasmic Reticulum

- Rough ER
  - Has ribosomes
  - Functions
    - Protein synthesis
      - Ribosomes
    - Protein shipping
      - Transport vesicles
    - Membrane synthesis
      - Lipids + proteins



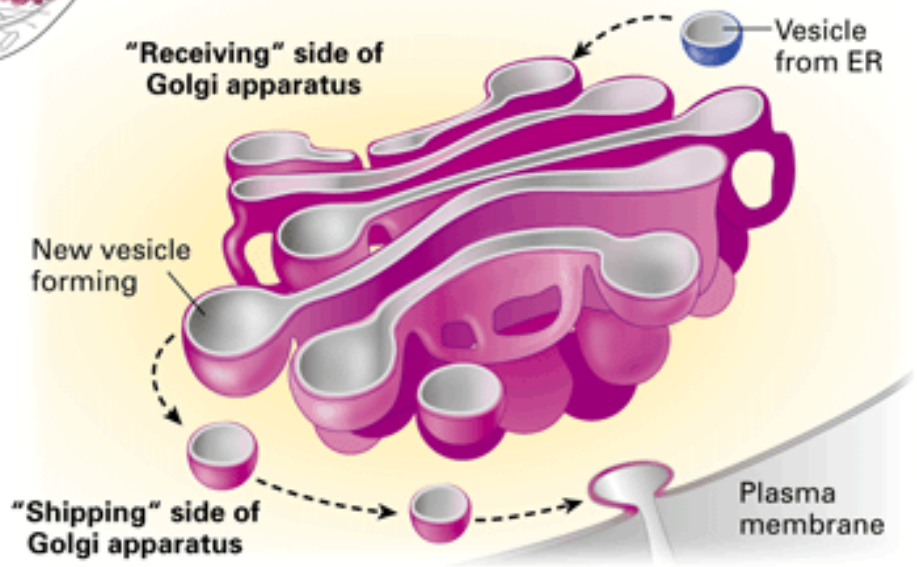
Endoplasmic Reticulum

Endoplasmic Reticulum



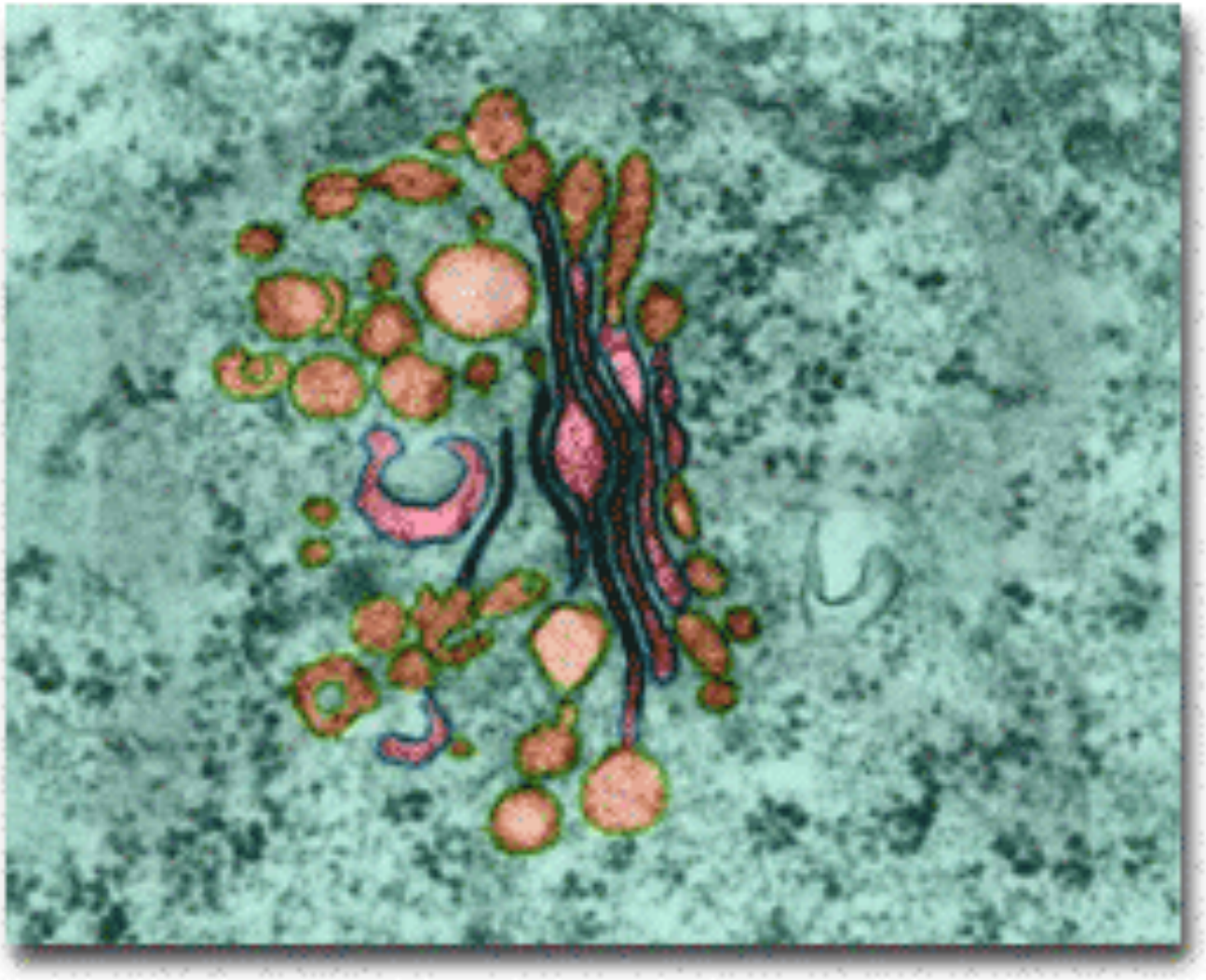
- Smooth ER
  - No Ribosomes
  - Functions
    - Creation of lipids
      - Hormones
      - For membranes
    - Breaks down carbohydrates
      - Liver cells
    - Detoxifies drugs/poisons
      - Liver cells

Golgi Apparatus



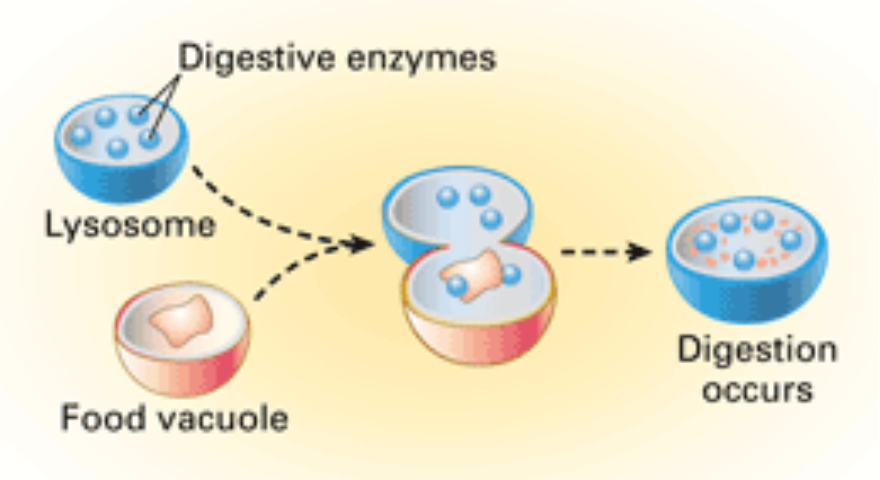
- Functions
  - Products of ER are:
    - Modified
    - Stored
    - Shipped
      - ID tags
- Polarity
  - "cis" – receiving
  - "trans" – shipping

Golgi Apparatus

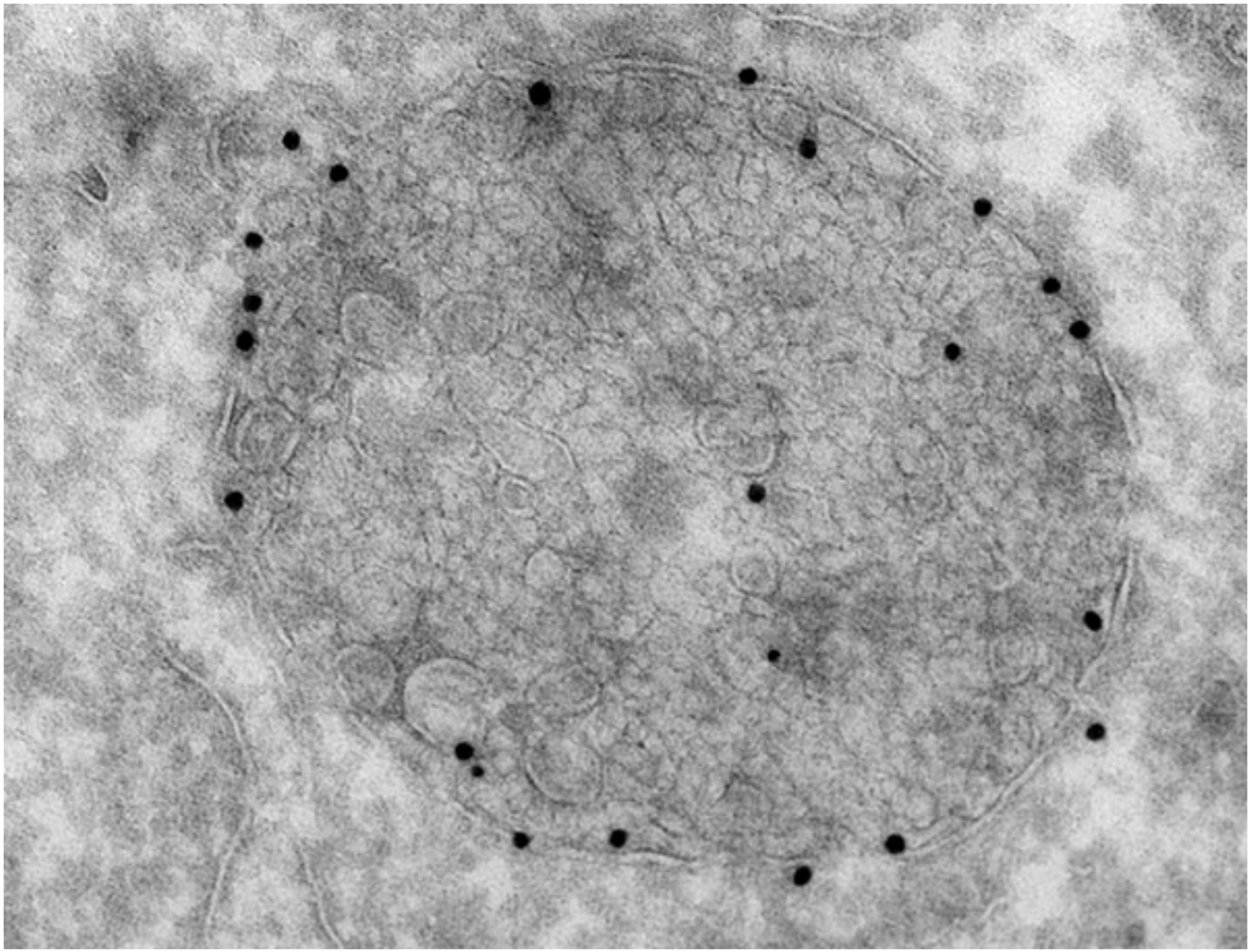


Lysosome

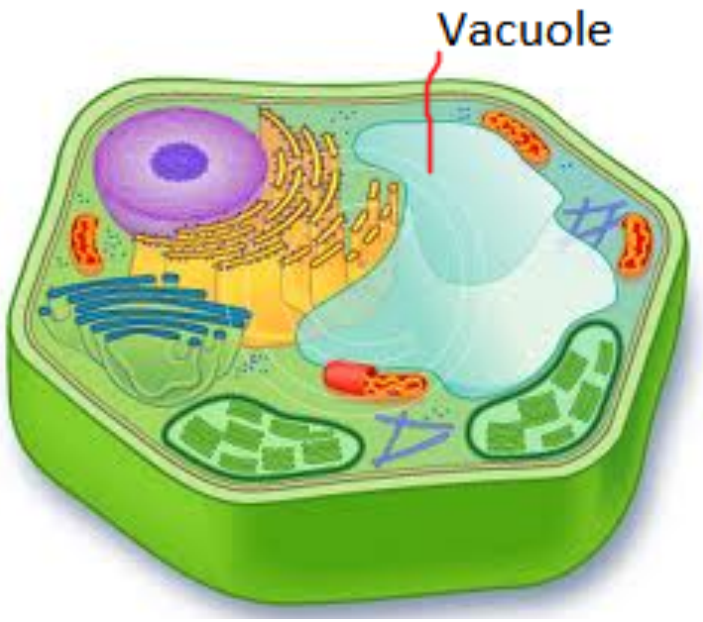
- Membrane bound
- Functions
  - Digestion of “food”
    - Phagocytosis
  - Recycle cell materials
    - Autophagy
  - Programmed cell death



Lysosome



Vacuole

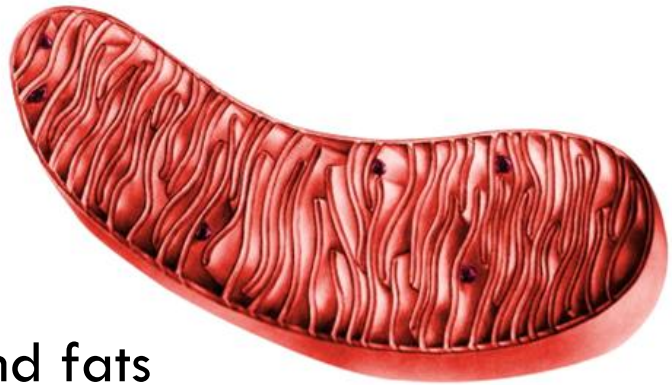


- Large sac
- Derived from ER/Golgi
- Functions
  - Plants
    - Storage
      - (i.e. proteins in seeds)
    - Disposal site of harmful molecules
    - Colors
  - Protists
    - Expel excess water
    - Contractile vacuoles

Vacuole

Mitochodrion

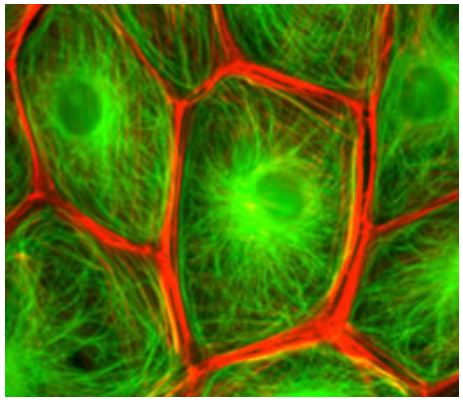
- Structure
  - Double membrane
  - Contain own DNA
    - Make own ribosomes
    - Make some proteins
- Functions
  - Site of cellular respiration
  - Energy transformer
    - Generates ATP from sugars and fats



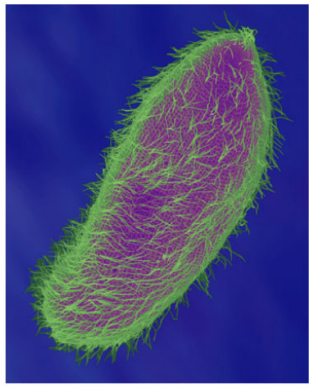
Mitochondrion

Cytoskeleton

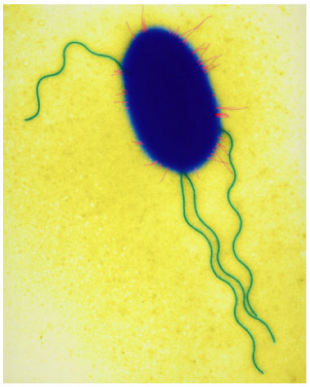
- Structure
  - Interconnected microtubules
- Function
  - Structural support
  - Change cell shape
  - Cell movement
    - Whole cell



Cytoskeleton



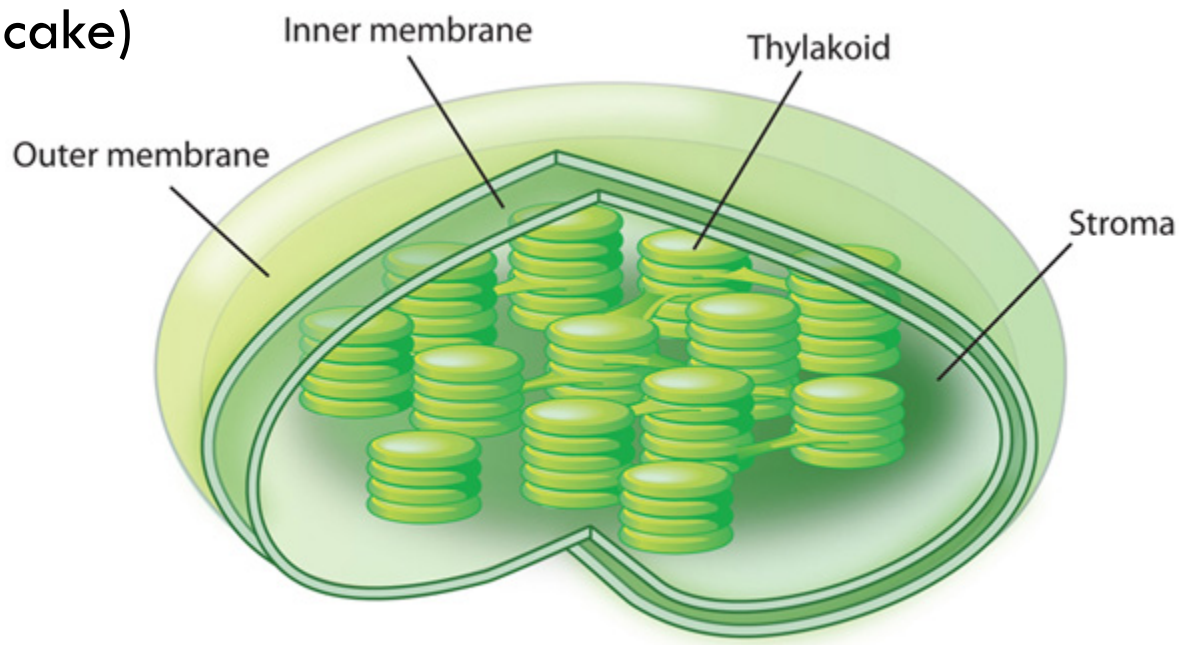
Cilia



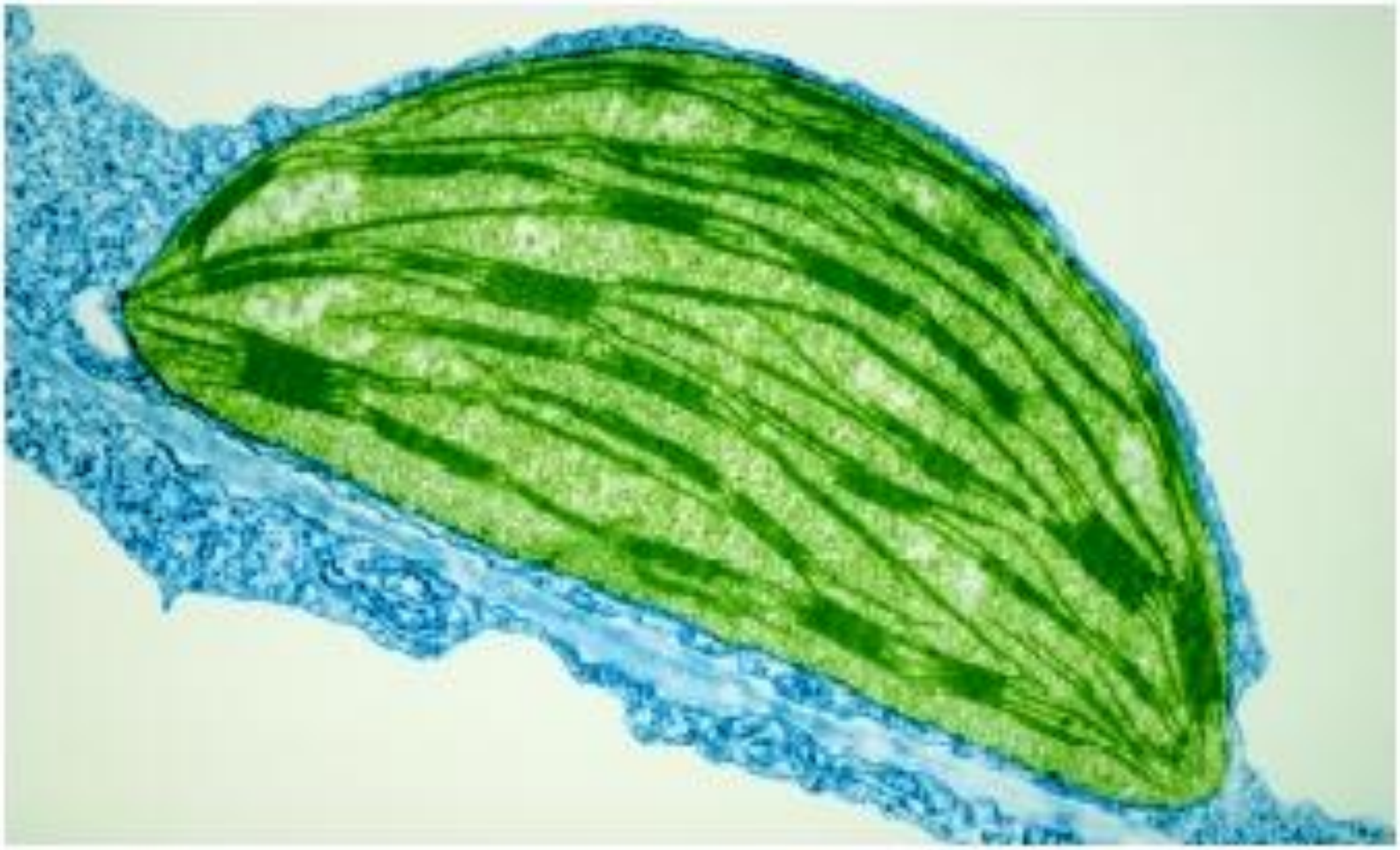
Flagella

Chloroplast

- Structure
  - Double membrane
  - Stroma
  - Grana (short stack)
    - Thylakoid (pancake)
    - Chlorophyll
- Functions
  - Site of photosynthesis
    - Light energy to chemical energy

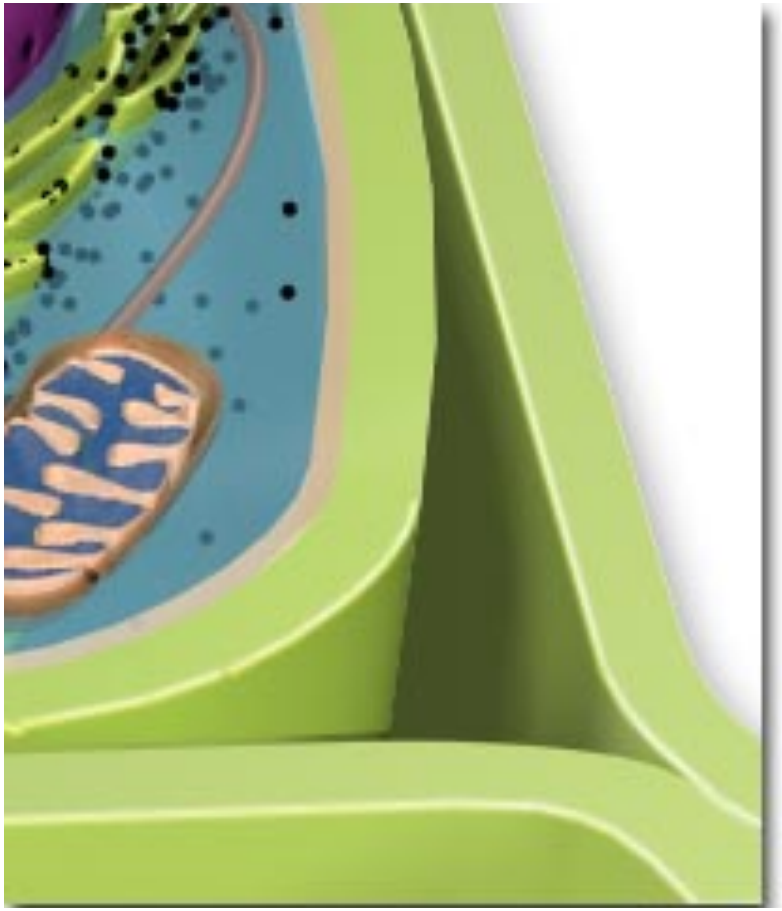


Chloroplast



Cell wall

- Unique to plants
- Structural support
- Made of cellulose
  - i.e. wood



Cell wall