Slide 1

Structure and Functions of Cells

Lecture 9

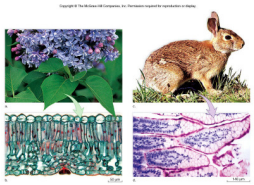
Slide 2

Learning Outcomes

- Cell Theory
- Size of cells
- The structure of cells
- The function of cell organelles

Slide 3

Cell Theory



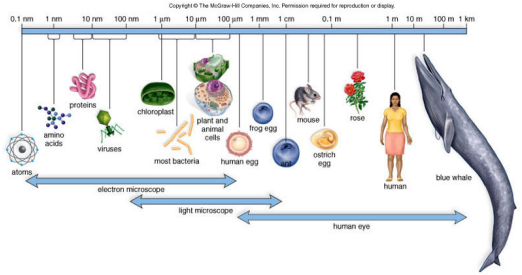
- First observed by Robert Hooke 1665
- Schleiden, Schwann, 1839 (1 and 2)
- Virchow (3) 1858

1. All living things are made of cells.
2. Cells are the basic units of structure and function in all living things.
3. All cells come from the reproduction of existing cells.

- Viruses NOT composed of cells
- Therefore not alive

Slide 4

Cell Sizes



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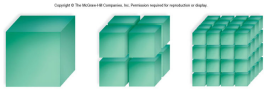
Size and Cell Function



One 4-cm cube | Eight 2-cm cubes | Sixty-four 1-cm cubes

Total surface area (height × width × number of sides × number of cubes)	96 cm^2	192 cm^2	384 cm^2
Total volume (height × width × length × number of cubes)	64 cm^3	64 cm^3	64 cm^3
Surface area: Volume per cube (surface area ÷ volume)	1.5:1	3:1	6:1

- Small size:
  - increases surface area:volume ratio
- Increases rate of diffusion of molecules
  - into cells
  - out of cells
- Larger cells slower diffusion
  - Less efficient

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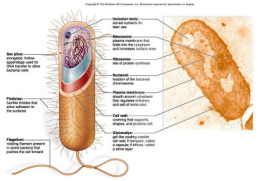
Prokaryotic Cells



- Bacteria and Archaea
- First cells 3.3 billion years ago
- One circular chromosome
- Cells with no nucleus
  - Pro = before karyon = nucleus
- Small size
  - 1-2um
- Complex cell wall of peptidoglycan
- Sensitive to penicillin
- Selective toxicity
- Our cells lack peptidoglycan cell wall
- 70s ribosomes

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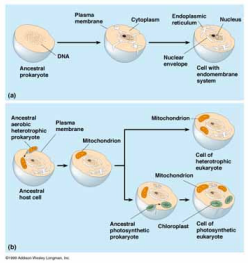
Evolution of Eukayoticic Cells

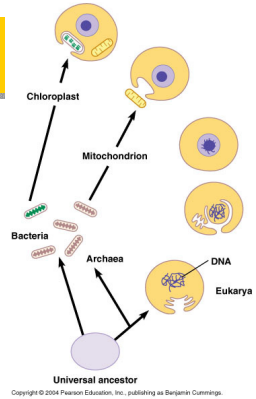


- Eukaryotes formed from Prokaryotes
- Nuclear membrane
- Endoplasmic Reticulum
- Formed from infoldings of plasma membrane
- 2.5 billion years ago
- Ancestor of eukaryotes
  - archaea
- Loss of bacterial cell wall

Slide 8

Endosymbiosis

- Engulfed aerobic bacterium internal symbiont
  - MITOCHONDRIA
- Engulf photosynthetic bacterium internal symbiont
  - CHLOROPLAST
- Both have double membranes
- 70s ribosomes
- Own DNA



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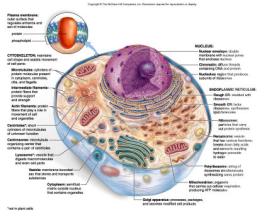
Eukaryotic Cells



- Fungi, Protists, Plants and Animals
- Possess a true nucleus
- Organelles
- Cytoskeleton
- Multiple linear chromosomes

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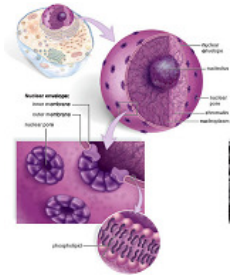
Nucleus Functions



- Nuclear envelope
- House and protect cell genetic information
- Chromosomes
- Composed of DNA and proteins
- Chromatin

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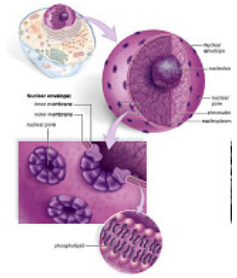
The Nucleolus



- Active in the synthesis of ribosomes
- 65% rRNA
- 35% proteins

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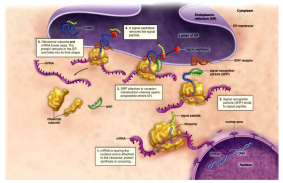
Ribosome Structure and Function



- Site of Protein synthesis
- Large subunit
- Small subunit
- Eukaryotic 80_s v Prokaryotic 70_s
- Basis for action of some antibiotics
- streptomycin
- mRNA
- Transfers polypeptide to Endoplasmic Reticulum

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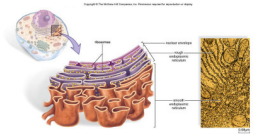
Rough Endoplasmic Reticulum



- Folded internal membranes
- Increase surface area for reactions
- Rough- studded with ribosomes
- Protein synthesis and processing

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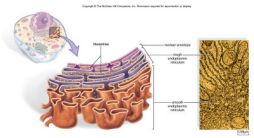
Smooth Endoplasmic Reticulum



- Smooth – no ribosomes
- Lipid synthesis
- Phospholipids
- Steroids
- Testosterone
- Detoxify toxins
- Alcohol tolerance

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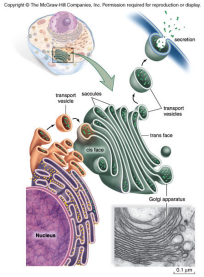
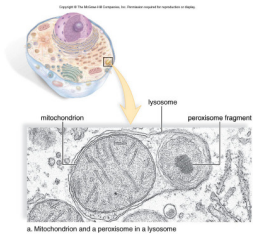
Golgi Apparatus



- 3-20 membrane-bound sacs
  - Pancake stack
- Shipping and Handling Center
- Incoming vesicles from ER
  - Proteins
  - lipids
- Outgoing vesicles
  - Secretion
  - Cell membrane

Lysosomes



a. Mitochondrion and a peroxisome in a lysosome

- Membrane bound vesicles produced by the Golgi apparatus
- Contain digestive enzymes
- Breakdown
- Macromolecules
- Old organelles
- Pathogens
- White Blood Cells
- Apoptosis

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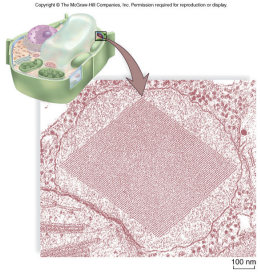
Peroxisomes



- Membrane bound vesicles that contain enzymes
- Oxidize molecules
- By-product Hydrogen Peroxide H_2O_2
- Catalase
- $H_2O_2 \rightarrow H_2O + O_2$

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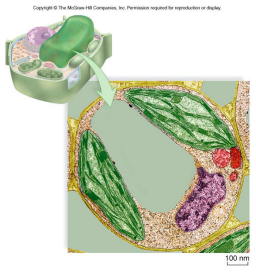
Plant Cell Central Vacuole



- May occupy up to 90% cell volume
- Maintains turgor pressure
- Storage
- Nutrients
- Waste products

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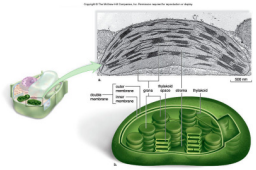
Chloroplasts



- Bounded by a double membrane
- Contain chlorophyll
- Site of photosynthesis in plant/algal cells
- Stroma
  - Fluid filled space
- Thylakoid
  - Single membrane bound sac
- Grana
  - Stack of thylakoids

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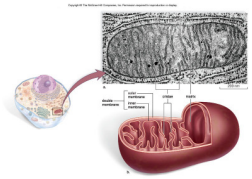
Mitochondria



- Double membrane
- inner membrane folded into Cristae
- Matrix
  - Enclosed by inner membrane
  - Enzymes that break down sugars
  - mtDNA and ribosomes
- Site of cellular respiration
  - ATP synthesis

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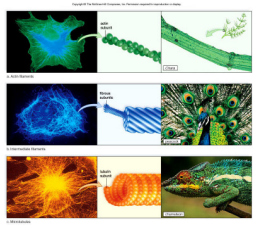
Cytoskeleton



- Provide internal structure
- Maintain cell shape
- Anchor organelles
- Movement of organelles
- Movement of cell

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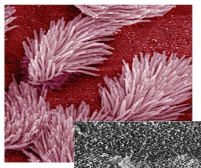
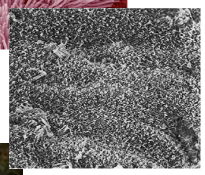
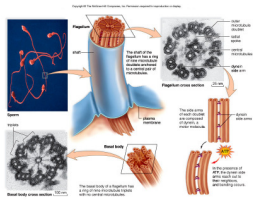




Cilia

- Function
- To move objects past the cell
- Brush border of respitory system
- Why your nose runs on cold days

Flagella



- Structure
- Ring of 9 pairs of microtubules around central pair
- Function
- Whip-like motion moves cell
- Sperm cells