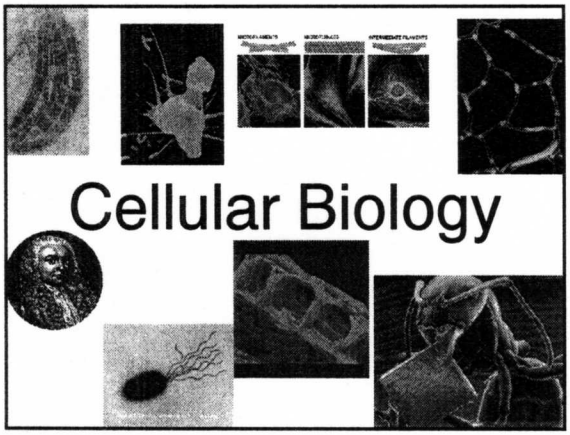
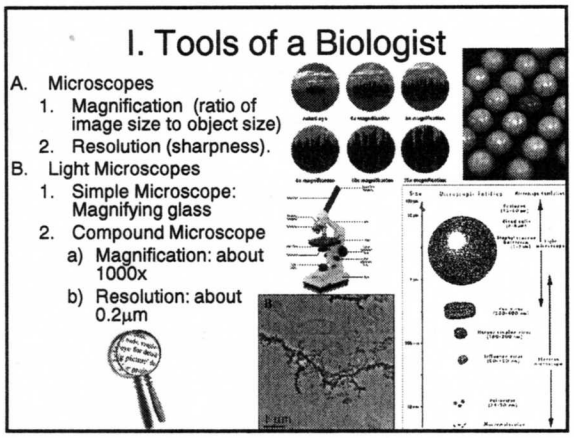


I. Tools of a Biologist

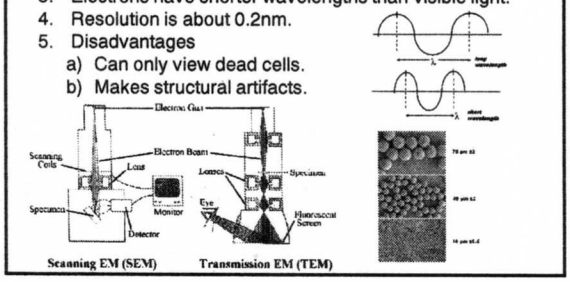
A. Microscopes
   1. Magnification (ratio of image size to object size)
   2. Resolution (sharpness).

B. Light Microscopes
   1. Simple Microscope: Magnifying glass
   2. Compound Microscope
      a) Magnification: about 1000x
      b) Resolution: about 0.2μm



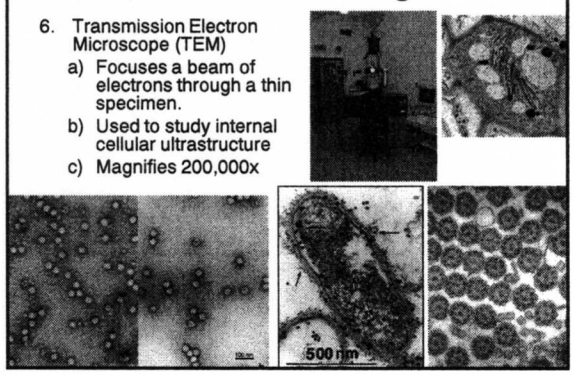
I. Tools of a Biologist

C. Electron Microscopes (1950's)
   1. Uses a beam of electrons focused by magnets.
   2. Resolution is inversely related to wavelength
   3. Electrons have shorter wavelengths than visible light.
   4. Resolution is about 0.2nm.
   5. Disadvantages
      a) Can only view dead cells.
      b) Makes structural artifacts.



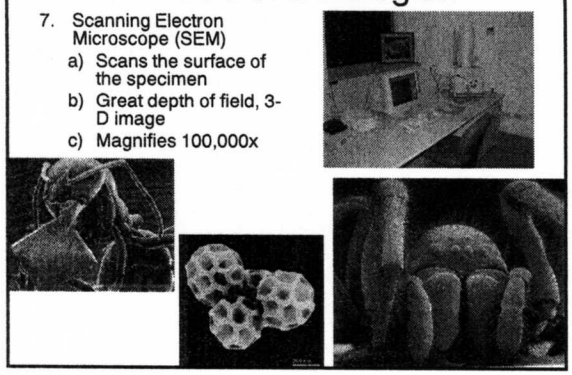
I. Tools of a Biologist

6. Transmission Electron Microscope (TEM)
   a) Focuses a beam of electrons through a thin specimen.
   b) Used to study internal cellular ultrastructure
   c) Magnifies 200,000x



I. Tools of a Biologist

7. Scanning Electron Microscope (SEM)
   a) Scans the surface of the specimen
   b) Great depth of field, 3-D image
   c) Magnifies 100,000x

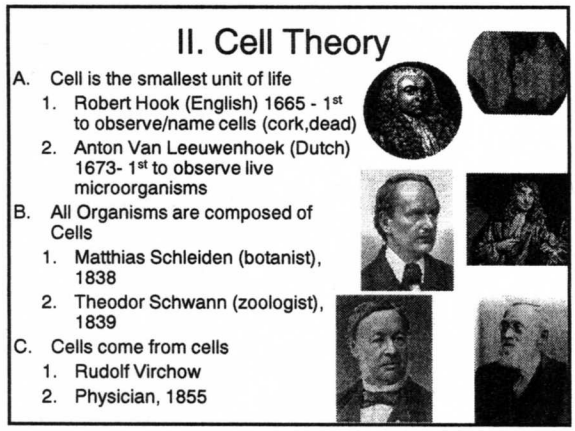


II. Cell Theory

A. Cell is the smallest unit of life
   1. Robert Hook (English) 1665 - 1st to observe/name cells (cork,dead)
   2. Anton Van Leeuwenhoek (Dutch) 1673- 1st to observe live microorganisms

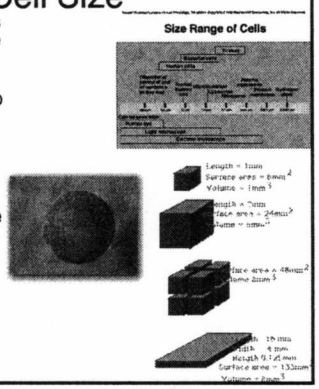
B. All Organisms are composed of Cells
   1. Matthias Schleiden (botanist), 1838
   2. Theodor Schwann (zoologist), 1839

C. Cells come from cells
   1. Rudolf Virchow
   2. Physician, 1855



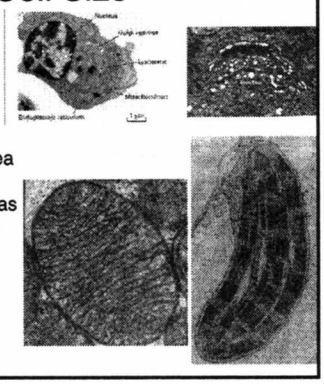
III. Cell Size

A. Range in size from a frog's egg (one millimeter) to one micrometer.
B. Need surface area of membrane large enough to exchange materials.
C. Surface-area-to-volume ratio requires that cells be small.
   1. As cells get larger in volume, relative surface area actually decreases.
   2. Limits how large cells can become.



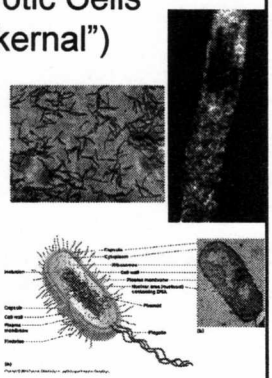
III. Cell Size

D. Cells needing greater surface area use modifications such as folding.
E. Eukaryotic cells compartmentalize
   1. Increases surface area for reactions.
   2. Provide localized areas for specific reactions.
   3. Isolates specific reactions.



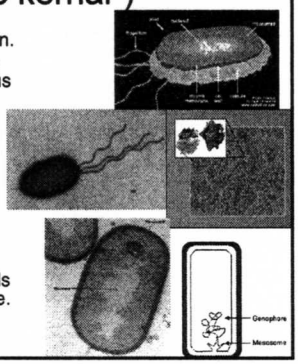
IV. Prokaryotic Cells ("before kernal")

A. Eubacteria and Archaebacteria
B. Most are just visible with light microscopes(1-10μm)
C. Structures:
   1. Nucleoid Region- Large circular DNA molecule (no nucleus).
   2. Plasma membrane- outermost membrane; regulates the entrance and exit of molecules.
   3. Plasmids- small accessory rings of DNA
   4. Cytoplasm- consists of cytosol, a semi-fluid medium.



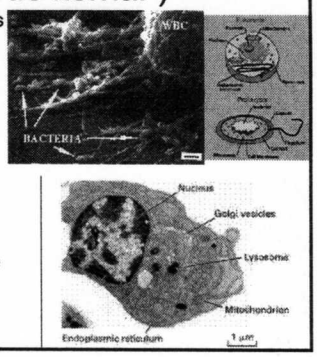
IV. Prokaryotic Cells ("before kernal")

5. Cell wall of peptidoglycan.
6. May be surrounded by a capsule and/or gelatinous sheath (slime layer)
7. Motile bacteria usually have flagella
8. Pili- short appendages that help them attach to an appropriate surface and conjugate.
9. Ribosomes- sites of protein synthesis.
10. Mesosomes- inward folds of the plasma membrane.



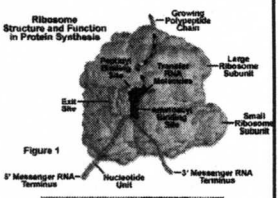
V. Eukaryotic Cells ("true kernal")

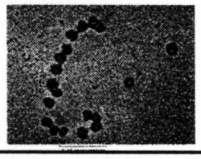
A. Most are ten to 100 times larger than prokaryotic cells.(10-100 μm)
B. Similar to prokaryotic cells- contain plasma membrane, cytosol, ribosomes.
C. Endomembrane System
   1. Series of intracellular membranes
   2. Compartmentalize the cell

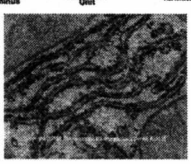


VI. Ribosomes

A. Sites of Protein Synthesis
B. Large numbers in cells with high rates of protein synthesis.
C. Free ribosomes- produce proteins to be used in the cytosol.
D. Bound ribosomes- produce proteins to be used in membranes

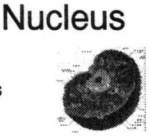
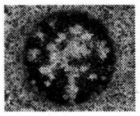
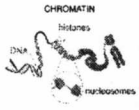






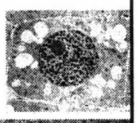
VII. Nucleus

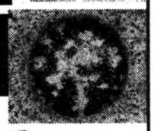
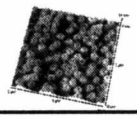
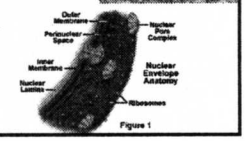
A. Stores genetic information determining structure/function of cells
B. Nucleus has a diameter of about 5 µm.
C. Site where nucleic acids are synthesized
   1. Chromatin: Fine strands of DNA and protein (histones)
   2. Chromosomes: rod-like structures formed during cell division from coiled or folded chromatin.(46 in humans)


VII. Nucleus

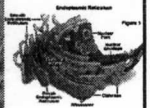
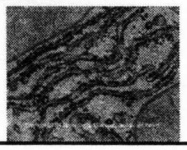
F. Nucleoplasm
   1. Semifluid medium of nucleus
   2. Has a different pH from cytosol
G. Nucleolus: sites where rRNA joins proteins to form ribosomes.
H. Nuclear envelope: a double membrane that separates nucleoplasm from cytoplasm.
I. Nuclear pores (100 nm)- permit passage of certain mRNA and ribosomes

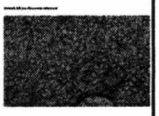
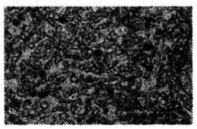
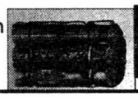
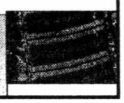
VIII. Endoplasmic Reticulum

A. System of membranous channels and sacs (cisternae)
B. Continuous with outer membrane of the nuclear envelope.
C. Internal space is called cisternal space.
D. Most extensive portion of endomembrane system.
E. Rough ER(studded with ribosomes)
   1. Makes secretory proteins (mainly glycoprotiens)
   2. Packages proteins as transport vesicles.
   3. Makes new membranes.

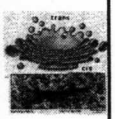
VIII. Endoplasmic Reticulum

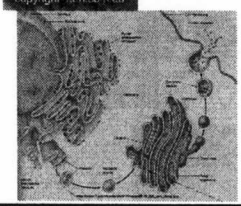
E. Smooth ER (no ribosomes)
   1. Synthesizes lipids, phospholipids, and steroids
   2. In Liver
      a) Converts glycogen to glucose to regulate blood sugar.
      b) Detoxifies drugs and poisons (adds hydroxyl groups making them water soluble).
   3. Stores Ca+ in muscle, calcium is pumped from cytosol into cisternal space.

IX. Golgi Apparatus

A. Golgi apparatus consists of a stack of 3-20 slightly curved sacs (cisternae).
B. Golgi apparatus receives protein-filled vesicles that bud from the ER.
C. Vesicle fuses with inner face membrane of Golgi apparatus (cis face).
D. Proteins are modified and repackaged in vesicles.
E. Vesicles form from membrane of trans face of the Golgi apparatus
F. At plasma membrane, they discharge their contents as secretions.





X. Lysosomes

A. Membrane-bound vesicles produced by Golgi apparatus
B. Contain hydrolytic digestive enzymes.
   1. Enzymes work best at low pH (5)
   2. Membrane pumps in H^+
   3. Isolates digestion.
C. Macromolecules enter a cell by vesicle formation (phagocytosis)
D. Lysosomes fuse with vesicles and digest contents.
E. Macrophages use lysosomes to digest bacteria.