CELL STRUCTURE AND FUNCTION

Textbook Connection McDougal Littell “Biology” 1.1, 3.1-3.2, 18.5

Revised 2012-2013
Objectives:

1. Differentiate between prokaryotic and eukaryotic cells.
2. Describe the internal structure of eukaryotic cells.
3. Summarize functions of organelles in plant and animal cells.
4. Differentiae between unicellular and multicellular organisms.
Prokaryotic Cells (Bacteria)

- **Prokaryotic Cells**
  - primitive, ‘before kernal’
    - NO NUCLEUS
  - Lack internal membranes (no “membrane-bound” organelles)
  - Genetic material: single, circular DNA molecule suspended in the cytoplasm
    - Ex. Bacteria (such as Anthrax or E. coli)
  - Microscopic, single-celled organisms
Prokaryotic Cells (Bacteria)

- **Prokaryotic Cells**
  - Cell structures:
    - Cell Wall
    - DNA
    - Cell Membrane
    - Ribosomes
    - Cytoplasm
Bacteria live on or in just about every material and environment on Earth from soil to water to air, and from your house to arctic ice to volcanic vents.

- Each square centimeter of your skin averages about 100,000 bacteria.
- A single teaspoon of topsoil contains more than a billion (1,000,000,000) bacteria.
- A shovel full has as many bacteria as there are people on Earth.

http://www.microbe.org/microbes/bacterium1.asp
Prokaryotic Cells (Bacteria)

This is Streptococcus pyogenes which is the organism responsible for Strep Throat, Rheumatic Fever and Impetigo (also known as FLESH EATING BACTERIA!).

- It has been with us for centuries and looks like it will continue to be, but it is not a major concern for the entire human race as some of the tabloids might have you believe.

- A gram of the toxin from this organism is a lethal dose for 200,000 mice.
- A cup of this toxin in pure form would be capable of depopulating the entire Earth.

Ready to move on??

- The toxin, called botulin, works like nerve gas causing respiratory failure, paralysis and death in as little as 4 hours.
- It can be found in improperly prepared canned foods.

Information from http://www.dmacc.cc.ia.us/instructors/scottie.htm
Beneficial Bacteria

Not all bacteria are bad.

Humans and Other Animals:

More bacterial cells in us and on us than there are human cells.

In the gut:

- Provide nutrients: break down food, make vitamins.
- Keep away harmful microbes by filling niches that would be filled by disease-causing bacteria.

Help chemically break down dairy products to yogurt and cheese, cucumbers to pickles, to make soy sauce and vinegar.
Beneficial Bacteria

Ecosystems:
- Produce oxygen, recycle carbon, nitrogen, hydrogen and sulfur.
- Helps make minerals in the soil for plant growth.
- Bioremediation: break down pollutants (ex. Oil)
- Recycling and composting: biodegradable often means it can be broken down by bacteria.
Eukaryotic Cells (*you-carry-ee-AHT-ihk*),

- ‘true kernal’ contains a “TRUE NUCLEUS”
  - Membrane bound (enclosed) organelles
  - Genetic material: located in the nucleus.
- Multi-cellular and single-cellular organisms
What do YOU think?

- What characteristics are shared by most cells?

- In what ways are cells similar to atoms?
Prokaryotic vs Eukaryotic Cells

VISUAL VOCAB

Prokaryotic cells do not have a nucleus or other membrane-bound organelles.

Eukaryotic cells have a nucleus and other membrane-bound organelles.
A Generalized Eukaryotic Cell Diagram

• although cells come in many shapes and sizes…
Human cell size and shape comparison:
Types of Eukaryotic Cells:

- Animal Cells
- Plant Cells

• Both types have many of the same internal parts but there are also a few parts unique to either just plants or just animals.

• Lets start with the parts common to both types…
<table>
<thead>
<tr>
<th>Major Parts of the Eukaryotic Cell:</th>
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<tbody>
<tr>
<td>Cell Membrane</td>
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Cell Membrane: “Security Gate”

- Surrounds the cell
- Controls movement of materials into and out of cell
Cytoplasm: “cyto” = something belonging to a cell.

- Fills space between cell membrane and nucleus.
  - Maintains cell structure
  - Where many chemical reactions take place.

**Made up of 2 parts**

1) **Cytosol:** the fluid environment
   - Mostly water
2) Cytoskeleton:

Network of protein fibers crisscrossing the cytoplasm that constantly change to meet the needs of the cell.

- Give shape of the cell
- Anchors its organelles and serves as a “track” for them to move on.
- Enable cells to move and divide.
- Help muscle cells contract and relax.
Organelles: subcellular structures

- Structures specialized to perform distinct processes.
- Most are surrounded by membranes.
Organelles involved in making proteins

- Nucleus
- Ribosomes
- Endoplasmic Reticulum
- Vesicles
- Golgi Apparatus
Nucleus: “Brain”

- Controls the functions of the cell
  - Stores and protects genetic info (DNA)
  - DNA contains genes which are the instructions for making proteins.

- Includes the following:
  - **Nuclear Envelope (Membrane):** Double membrane folded upon itself to create a space in between. It controls movement into and out of the nucleus
  - **Nuclear Pore:** holes which allow movement between nucleus and cytoplasm.
Nucleus:

- **Nucleolus**: Dense region inside nucleus, where and ribosomes are assembled.
- **Chromatin**: Genetic Material (DNA) which is organized into structures called chromosomes during cell division.
Endoplasmic Reticulum (ER): “Highway”

- Interconnected network of channels...aids in movement of molecules inside the cell.
- Rough ER:
  - Ribosomes found on surface.
  - Proteins leave ribosome and enter into ER where they are modified.
- Smooth ER:
  - No ribosomes on surface.
  - Make lipids (fats).
  - Break down drugs and alcohol.
Vesicles: “Semi-Trucks”

- Small membrane-enclosed sacs
- Transport molecules from place to place (ex. ER to Golgi Apparatus.)
Ribosome: “Factory”

- Makes proteins and found in the cytosol (used for cell membrane or secreted) or on the ER (used in chemical reactions in cell).
- NOT Organelles
Golgi Apparatus (Complex): “packaging and distributing center”

- Stack of membrane-enclosed spaces.
- Process/Sorts/Packages protein/lipids for distribution within the cell and export out of the cell.
- Proteins/lipids come from endoplasmic reticulum.
What do YOU think?

- What is distinctive about the nuclear membrane? Why is it described as an envelope?

- Suppose a certain poison kills human cells by blocking pores in the nuclear membrane. Explain why it would or would not kill bacteria.

- Medicine, alcohol and many drugs are detoxified in liver cells. Why do you think the liver cells of some people who abuse alcohol and drugs have an increased amount of smooth ER?
Putting it all together...

Identify each of the following:
A:
B:
C:
D:
E:
F:
Part IV: Other organelles:

- Mitochondria
- Vacuole
- Lysosomes
- Centrosomes
- Cell wall
- Chloroplasts
- Central Water Vacuole
Mitochondria: “Powerplant”

- Provides energy for cell.
  - Converts food to usable energy for cell.
- Have their own ribosomes and DNA.
**Vacuole: “Storage Tanks”**

- Fluid filled sack.
- Stores water, food molecules, ions and enzymes.
- Animal cells contain many small vacuoles.
- Plant cells contain a large central vacuole...we will be talking about this more later...
Lysosomes: “Suicide Sacs/Recycling Centers”

- Carry enzymes to destroy cellular waste.
  - Break down damaged/worn out cell parts.
- Engulf/digest targeted molecules
  - Defend cell from invading bacteria/viruses
- Once thought to be only in animal cells, but exist minimally in plant cells.
- Membrane protects cell from enzymes.
What do YOU think?

How do vesicles and vacuoles compare?
Animal Cells contain all of the previous organelles plus:

Centrioles: 2 cylindrical organelles (together called a centrosome)
- Formed by hollow protein fibers called microtubules (part of the cytoskeleton)
- Produce microtubules that aid in moving chromosomes during cell division.
- Found in animals and algae only but not in all animal cells.

Video tour of cell
Plant Cells:
contain all of the previous organelles (except centrioles) as well as:

Cell Wall:
- Gives cells shape and support and provides protection.
- Found in algae, fungi and most bacteria too.
Plant Cells:
contain all of the previous organelles (except centrioles) as well as:

Chloroplast: (green)
- Changes sun’s energy as well as CO2 and H2O into food.
- Also in green algae.
Plant Cells:
contain all of the previous organelles (except centrioles) as well as:

Central Water Vacuole:

- Single, large water filled vacuole in the middle of the cell.
- Strengthen cells and provide support for plant.
- Contains toxins to harm plant predators, waste products and pigment for color (petals).
Plant Cells: contain all of the previous organelles (except centrioles) as well as:

Central Water Vacuole:
What do YOU think?

Would it be accurate to say that a chloroplast makes energy for a plant cell? Explain.

What are the similarities and differences between plant and animal cells?

How do the parts of a cell make it function as a system?
Animal Cell

ENDOPLASMIC RETICULUM (ER)

Chromatin
Nucleolus
Nuclear envelope

NUCLEUS

Flagellum

Rough ER
Smooth ER

Centrosome

Peroxisome

Microvilli

Microfilaments
Intermediate filaments
Microtubules

Lysosome

Ribosomes
Golgi apparatus
Plasma membrane
Mitochondrion

Not in animal cells:
Chloroplasts
Central vacuole and tonoplast
Cell wall
Plasmodesmata

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Plant Cell

Diagram of a plant cell showing the nucleus, nucleolus, nuclear envelope, centrosome, rough endoplasmic reticulum, smooth endoplasmic reticulum, ribosomes, Golgi apparatus, central vacuole, tonoplast, microfilaments, intermediate filaments, microtubules, mitochondrion, peroxisome, plasma membrane, chloroplast, cell wall, wall of adjacent cell, plasmodesmata, and not in plant cells: lysosomes, centrioles, flagella (in some plant sperm).
Unicellular (one) vs. Multicellular (many)

Unicellular: Single-Celled
- Most common forms of life on Earth.
- Carry out all functions of Life.
  - Bacteria
  - Amoeba
  - Paramecium
Unicellular (one) vs. Multicellular (many)

Multicellular
- Larger organisms.
- Different cells have specialized functions together making a complete organism.
  - Human
  - Spider
  - Jellyfish
- Visit a “Tour of the Cell” at:
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