The Fundamental Unit Of Life

Prokaryotes

Eukaryotes

Specialized Structures of the Cell

How Plant and Animal Cells differ

Homeostasis

Cell membranes

Membrane Transport

Osmosis
THE FUNDAMENTAL UNIT OF LIFE

- **Cells** - the fundamental unit of living systems
- Cells make up everything we do
  - Allow us to talk and read
  - Make our bodies what they are
  - Digest our food and make up our organs
HOW WAS THE CELL DISCOVERED?

▸ 1590’s- Zacharias Janes, a spectacle maker, experimented with the lenses in his shop. By putting them into a tube he found that objects seemed larger. This was the first invention of the compound microscope.

▸ 1632ish- Anton van Leeuwenhoek by grinding and polishing 550 lenses to make a new “lens tube.” This allowed him to view 270x

▸ 1655- Robert Hooke in was the first to illustrate in great detail his observations under the microscope. Most famous for his observations on a cork where he described lots of little pores as “cells” (he just discovered plant cells)
All cells share certain features

- bounded by a selective barrier (plasma membrane)
- inside there is a jelly-like substance (cytosol)
- Contain genes from DNA (chromosomes)
- tiny complexes that make proteins (ribosomes)

What separates one cell from another?

- Prokaryotic Cells
- Eukaryotic Cells
PROKARYOTES

- **Prokaryotic Cells** - “before nucleus” in Greek,

- DNA is concentrated in a region that is not membrane-enclosed called a **Nucleoid**

- Organelle are absent

- Bacterial cells

- THEY DO NOT HAVE A NUCLEUS!
PROKARYOTIC CELL STRUCTURES

- Cell wall
- Cell membrane
- Ribosomes
- Genetic Material
- Cytoplasm
- Flagella and or Cilla
MORE ABOUT PROKARYOTIC CELLS

- Reproduce through **Binary Fission**

- **Asexual Reproduction** is a type of reproduction by which an offspring raises from a single organism and has the genetics only of that parent.

- the fully grown parent cell splits into two halves producing two new cells, the cells then mature and repeat the process.

- Gain energy from:
  - Photosynthesis
  - Chemosynthesis
  - Digestion of other organisms
EUKARYOTES

- **Eukaryotic Cells**: DNA is found in an organelle called the nucleus
- Greek for True nucleus
- Contain cytoplasm in the space between the nucleus and the cell membrane
- Organelle are suspended in the cytoplasm
- Much larger than prokaryotic cells
- Animal and Plant cells
- Think these are the cells you and me are made of
EUKARYOTIC CELLS STRUCTURES

- May Have:
  - Chloroplast
  - Golgi apparatus
  - Lysosomes
  - Mitochondrion
  - Plastids
  - Rough and Smooth Endoplasmic Reticulum
  - Vacuoles
  - Vesicles
MORE ON EUKARYOTIC CELLS

» Reproduce:
  » Mitosis
  » Meiosis

» Get energy:
  » Photosynthesis
  » Digestion of other organisms

» Plants, Fungi, or Animal cells
PROKARYOTIC OR EUKARYOTIC?
PROKARYOTIC OR EUKARYOTIC?
PROKARYOTIC OR EUKARYOTIC?
ANIMAL VS. PLANT

Animal

- Selectively Permeable Membrane
- Small Vacuoles

Plant

- Chloroplast & Chlorophyll
- Large Central Vacuole
- Cell Wall
SPECIALIZED STRUCTURES OF THE CELL

Why do cells have specialized structures?

- It allows them to do certain task efficiently

Think of a City (There are a lot of people that do specialized tasks)

- Trash Collectors dispose of our trash or waste
- Power plants allow us to have power at our homes
- Doctors take care of sick people and deliver babies

If one person took on all the jobs that make this city run it would not run very efficiently or effectively
CELL WALL

- Type of cell:
  - Found in both Prokaryotes and Eukaryotes
  - In plant cells with Eukaryotes

- Description:
  - Rigid outer layer of the cell outside the cell membrane

- Function:
  - Support & protection
  - Helps maintain the cells shape
**CELL/PLASMA MEMBRANE**

- **Type of cell:**
  - Eukaryotes and Prokaryotes
  - Plants and Animals
- **Description:**
  - Outer covering made of a lipid bilayer (phospholipid)
- **Function:**
  - Barrier between the cell and its environment
  - Controls the substances that enter and leave the cell
  - Provides support and protections
RIBOSOMES

- Type of cell:
  - Eukaryotic and Prokaryotic cells
  - Plant and Animal cells

- Description:
  - Make protein & Ribosomal RNA
  - Very Small
  - Spherical

- Function:
  - High rate of protein synthesis (make proteins)
CYTOPLASM

- **Type of cell:**
  - Eukaryotic and Prokaryotic
  - Plant and Animal

- **Description:**
  - Jelly like substance also known as cytosol

- **Function:**
  - suspend organelle
  - Contains materials the organelle need
  - Allows organelle to travel through it
FLAGELLA

- Type of cell:
  - Prokaryotic and Eukaryotic
  - Animal not Plant

- Description:
  - Long thread like extension of the cell
  - Tail

- Function:
  - Helps the cell move
CILIA

- Type of cell:
  - Prokaryotic and Eukaryotic
  - Animal not Plant

- Description:
  - Short hairlike projection on the surface of the cell

- Function:
  - Help the cell move in fluid
  - Push or Pull stuff away or to the cell
NUCLEUS

- **Type of cell:**
  - Eukaryotes only
  - Plants and Animal

- **Description:**
  - Core of the cell

- **Function:**
  - Contains genetic information (DNA)
  - Directs and regulates the cell activities
  - Cell brain
NUCLEAR MEMBRANE/NUCLEAR ENVELOPE

- Type of cell:
  - Eukaryotes
  - Plants and Animals

- Description:
  - Double layered membrane that surrounds the nucleus

- Function:
  - Separates it from the cytoplasm
NUCLEOLUS

- Type of cell:
  - Eukaryotes
  - Animal and Plants

- Description:
  - Dense darkly colored structure in the nucleus
  - made of protein and ribosomal RNA

- Function:
  - Makes Ribosomes
CHLOROPLAST

- **Type of cell:**
  - Eukaryotes
  - Plants only

- **Description:**
  - Oval shaped with a green color (chlorophyll)

- **Function:**
  - Photosynthesis to make sugar
CHLOROPLAST CONTINUED

- **Thylakoids** - interconnected sacs that contain chlorophyll
- **Granum** - in each thylakoid they are stacked like poker chips
- **Stroma** - the fluid outside the thylakoid
GOLGI APPARATUS

- Type of cell:
  - Eukaryotes only
  - Plants and Animals

- Description:
  - Made up of many flatten sacks called Cistern

- Function:
  - Modifies and packages materials created in the cell for transport
  - Postoffice
LYSOSOMES

- Type of cell:
  - Eukaryotes
  - Plants and Animals

- Description:
  - Small sacks of hydrolytic enzymes

- Function:
  - Digest/break down old and worn out organelle
  - Break down viruses or bacteria
  - Digest food particles
HOW DO LYSOSOMES WORK?

- In order to digest anything they first have to get to object into them they do this through Phagocytosis or by attaching and releasing their digestive enzymes.

- **Phagocytosis** - ingest or engulf other cells or particles.
MITOCHONDRIUM

- Type of cell:
  - Eukaryotes
  - Plants and Animals

- Description:
  - Rod shaped with inner and outer membranes

- Function:
  - Converts sugar to ATP (adenosine triphosphate aka Energy) for the cell.
  - Powerhouse for the cell
PLASTID

- Type of cell:
  - Eukaryotes only
  - Plants

- Description:
  - Double membrane bound organelle

- Function:
  - food storage
  - function depends of which pigments are present
ROUGH ENDOPLASMIC RETICULUM/ROUGH ER

- **Type of cell:**
  - Eukaryotes
  - Plants and Animals

- **Description:**
  - System of membranous tubes and sacs covered with ribosomes (nerd rope)

- **Function:**
  - Helps make and transports new proteins to the golgi apparatus or outside the cell
SMOOTH ER

- Type of cell:
  - Eukaryotes
  - Plants and Animals

- Description:
  - System of membranous tubes and sacs

- Function:
  - Makes lipids
  - Creates and Stores Steroids
  - Stores ions act the cells might need
  - Metabolizes carbohydrates
Metabolism - refers to all of the chemical reactions that take place inside of organisms to allow life to occur.

Catabolism - the breaking down in living organisms of more complex substances into simpler ones.

Anabolism - the chemical reactions that synthesize molecules in metabolism (build up).
VACUOLE

- Type of cell:
  - Eukaryotes
  - Plants and Animals

- Description:
  - Sacs (plants have large ones)

- Function:
  - Stores water, nutrients, waste products, etc.
VESICLE

- Type of cell:
  - Eukaryotes
  - Plants and Animals

- Description:
  - Small Sacs

- Function:
  - Store transport and digest material in the cell
CELL MEMBRANES

- The Membrane separates the living cell from its environment
- A Plasma membrane controls the traffic into and out of the cell
- **Selective permeability** - allows some substances to cross more easily than others
- Think of membranes as a gateway into and out of the cell
- Made up of mostly lipids and proteins
  - Phospholipid bi layer with proteins stacked in it
  - Phospholipids are **amphipathic**, meaning they have a hydrophobic and hydrophilic end
HOW PROTEINS ARE ARRANGED IN THE MEMBRANE

- **Fluid mosaic model** - various proteins embedded or attached to the phospholipid bilayer

- Proteins act as the gatekeepers; they allow stuff in and out of the cell.
MEMBRANE PROTEINS FUNCTIONS

▸ Transport (AKA Channel Proteins)

▸ Allows particles across the membrane no questions asked (left)

▸ Attaching to the protein then temporally changing its shape so that ATP (Energy) pumps it across the membrane (right)
MEMBRANE PROTEIN FUNCTIONS

- **Enzyme activity**

  - 1 or more proteins that are enzymes and have an active site that can act on one another

- **Single Transduction**

  - Act as receptors with a specific binding site once activated it will change shape and start sending a signal that the cell will react to
MEMBRANE PROTEINS FUNCTIONS

- Cell to Cell recognition
  - Act as tags so that other cells can recognize it as not foreign
- Intercellular joining
  - Aids in the joining together of multiple cells
Attachment to the cytoskeleton and Extracellular Matrix

- helps maintain the cell shape and stabilizes the location of certain membrane proteins
HOMEOSTASIS

- **Homeostasis** - the tendency toward a relatively stable equilibrium between interdependent elements

- Without an equilibrium our body systems would burn out

- Types of homeostasis in the body
  - Temperature regulation
  - pH regulation
  - Ion regulation
  - Waste regulation
VOCABULARY

- **Diffusion** - the movement of molecules of any substance across a membrane

- **Concentration Gradient** - the region along which the density of a chemical substance increases or decreases

- **Permeable** - allowing liquids or gases to pass through it
MAINTAINING HOMEOSTASIS

Figure 7.13

(a) Diffusion of one solute

(b) Diffusion of two solutes
OSMOSIS

- **Osmosis** - the diffusion of free water across a selectively permeable membrane

- **Osmoregulation** - the adaptation to control the solute and water concentration in and outside of a cell

- **Tonicity** - the ability of a surrounding solution to cause a cell to gain or lose water

- Remember we want to be in equilibrium!

- When we are not in equilibrium there is a tendency for bad things to happen.
**ISOTONIC CELLS**

- **Isotonic**: there is no net movement across the plasma membrane.

- It is at equilibrium there is the same inside and outside the membrane.
HYPERTONIC SOLUTION

- **Hypertonic** - the concentration of solutes is greater inside the cell than outside of it (more solutes are going to flow out of the cell than are replaced).

- This throws the cell out of equilibrium causing the cell to shrivel up.
HYPOTONIC SOLUTION

- **Hypotonic** - less solute and more water than another solution (water is going to rush into the cell faster than it can leave the cell)

- This is a disrupted equilibrium that causes the cell to rupture or lyse
MEMBRANE TRANSPORT

- **Passive Transport** - is the diffusion of a substance across a biological membrane
  - Does not exert energy
  - The concentration gradient itself drives the permeability
  - Cells want to maintain homeostasis!
MEMBRANE TRANSPORT

- **Facilitated diffusion** - is the process of spontaneous passive transport of molecules or ions across a cell's membrane.

- The most common substance transmitted across a membrane is ion (charged particles).
What happens when we need to move particles against the concentration gradient?

In order to move against the gradient you need to use/exert energy (ATP)

**Active transport** - the movement of molecules across a cell membrane from a region of their lower concentration to a region of their higher concentration

This helps where there are small amounts of solute that differ from the concentration of its environment

The most famous form of active transport is the sodium potassium pump
SODIUM POTASSIUM PUMP

Function:

- help maintain a resting potential
- effects transport
- Regulate cellular volume
- aids in signal transduction
- 1/5 of the cells energy expenditure (2/3 in neurons)
SODIUM POTASSIUM PUMP

Mechanism:

1. The pump binds to ATP and 3 Na⁺ ions
2. ATP is hydrolyzed, phosphorylation of the pump, releases ADP
3. Conformational change in the pump exposes the Na⁺ ions to the outside and releases them
4. 2 K⁺ ions bind do the outside of the this causes the pump to release the phosphorous (dephosphorylation) changing the pump to the same form as in step 1
5. Allows the K⁺ to go through the membrane
6. Now process starts over
The figure illustrates the process of active transport involving sodium (Na+) and potassium (K+) ions. Here is a description of the steps depicted in the figure:

1. **Extracellular Fluid**
   - Sodium (Na+) ions are high, and potassium (K+) ions are low.

2. **Cytoplasm**
   - Sodium (Na+) ions are low, and potassium (K+) ions are high.

3. **Active Transport**
   - The active transport process is catalyzed by ATP, which hydrolyzes to ADP and inorganic phosphate (Pi).

4. **K+ Transport**
   - Potassium (K+) ions are transported into the cytoplasm.

5. **Restoration**
   - The cell restores its ionic balance, with sodium (Na+) ions in the extracellular fluid and potassium (K+) ions in the cytoplasm.
**Exocytosis** - a process by which the contents of a cell vacuole are released to the exterior through fusion of the vacuole membrane with the cell membrane.
Endocytosis - the taking in of matter by a living cell by invagination of its membrane to form a vacuole.
CAN'T TELL IF BIOLOGY
OR FOREIGN LANGUAGE