

Functions of Cells

- Basic unit of life
- Cell metabolism and energy release
- Synthesis of molecules
- Communication
- Reproduction and inheritance

Whole Cell Activity

- A cells characteristics are determined by the type of proteins it produces
- Proteins' function is determined by genetics
- Information in DNA provides the cell with a code for its cellular processes

Osmosis

- What is it? Diffusion of water across a cell membrane
- Osmotic Pressure the force required to prevent movement of water across cell membrane

A measure of the tendency of water to move by osmosis across a selectively permeable membrane

Osmotic Solutions

Hypotonic Solutions	Hypertonic Solutions	Isotonic Solutions
- lower concentration of solutes outside cell	higher concentration of solutes outside cell	Equal concentrations of solutes
Higher concentration of H ₂ O outside cell	higher concentration of H ₂ O inside cell	Water doesn't move

Osmotic Solutions (cont)

- H₂O moves into cell H₂O moves out Cell remains intact
- LYSIS (burst) Crenation (shrinks)

Cell Structures

Cytoplasm

- Location Inside cell
- Characteristic Jelly-like fluid
- Function Give cell shape and hold organelles in place

Nucleus (not part of the cytoplasm)

- Location Center of cell
- Characteristics All cells contain nucleus at some point
- Function Houses DNA

Nuclear Envelope

- Location: edge of nucleus

Nuclear Pores

- Location Surface of nucleus
- Function Where materials pass in and out of nucleus

Chromosome

- Location Inside nucleus
- Characteristic Made of DNA and proteins
- Function Part of genetic makeup

Chromatin

- Location Inside nucleus
- Characteristic Loosely coiled chromosomes

Cell Structures (cont)

Nucleolus

- in nucleus
- Location
- produce ribosomes that are then transported to the cytoplasm
- Function

Ribosome

- attached to rough endoplasmic reticulum (RER) or free-floating in cytoplasm
- Location
- Produce proteins
- Function

RER (Rough Endoplasmic Reticulum)

- Cytoplasm
- Location
- Membranes with ribosomes attached
- Characteristic
- Site of protein synthesis
- Function

SER (Smooth Endoplasmic Reticulum)

- Cytoplasm
- Location
- membranes with no ribosomes
- Characteristic
- Site of lipid synthesis
- Function

Golgi Apparatus

- Cytoplasm
- Location
- Closely, packed stacks of membranes
- Characteristic
- Collect, sort, package, and distribute proteins and lipids
- Function

Secretory Vesicle

- Cytoplasm
- Location
- Distributes materials out of cell
- Function



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Cell Structures (cont)

Lysosome

- Location	Cytoplasm
- Function	Enzymes that digest foreign material

Mitochondria

- Location	Cytoplasm
- Characteristics	Contains folds (cristae)
- Function	Produces ATP

Main Components of a cell

Plasma or cell membrane

Organelles

Cytoplasm

Jobs of the Cell Membrane

1. Separate the inside from the outside of the cell
2. Enable the immune system to recognize the cell as self or non-self --> marker glycoproteins or glycolipids
3. Attach cells together or to the extracellular matrix --> adhesion proteins
4. Receive signals from outside the cell and transmit the signals to inside the cell --> receptor proteins
5. Selectively transport substances from inside to outside the cell, or outside to inside the cell via transport mechanisms

Movement through the Cell Membrane

- Cell membrane selectively determines what can pass in and out of the cell	- Enzymes, glycogen, and potassium are found in higher concentrations INSIDE the cell
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- Sodium, calcium, and chloride are found in higher concentrations OUTSIDE the cell	- Nutrients must be able to enter the cell and waste products must be able to exit the cell
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1. **Directly through diffusion (passive):** O₂ and CO₂ (small molecules)

2. **Facilitated diffusion (passive) through membrane channels:**

- proteins that extend from one side of the cell membrane to other
- Size, shape and charge (+/-) determine what can go through
- Ex. Na⁺ passes through Na⁺ channels

3. **Carrier molecules:**

- bind to molecules, transport them across, and drop them off

4. **Vesicles:**

- Can transport a variety of materials
- Fuse with cell membrane

Endocytosis

What is it? Process that brings materials into cell using vesicles

1. Phagocytosis
Cell eating (solid particles)
2. Pinocytosis
Cell drinking (liquid particles)
3. Receptor mediated endocytosis

Cytoskeleton

What is it?	- Cells framework - Made of proteins
Functions	- Provide support - Hold organelles in place - enable cell to change shape

Types of Cytoskeleton

Microtubules	- Largest diameter - Provide structural support - Form cilia and flagella
Intermediate filaments	- Medium diameter - maintain cell shape
Microfilaments	- Smallest diameter - Involved in cell movement

Cell Division

- Formation of 2 daughter cells from a single parent cell
- Uses mitosis and meiosis
- each cell (except sperm and egg) contains 46 chromosomes (*diploid*)



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Cell Division (cont)

- Sperm and egg contain 23 chromosomes (*haploid*)

Mitosis

- Cell division that occurs in all cells except sex cells

- Forms 2 daughter cells

1. *Interphase*: 46 chromosomes

2. *Prophase*: Chromosomes doubled to 92

3. *Prometaphase*: Nucleus dissolves and microtubules attach to centromeres

4. *Metaphase*: Chromosomes align at middle of cell

5. *Anaphase*: Separated chromosomes pulled apart

6. *Telophase*: Microtubules disappear cell division begins

7. *Cytokinesis*: Two daughter cells formed each with 46 chromosomes

Cell Membrane

Functions: - Selective barrier
- Encloses cytoplasm

Extracellular Material outside of cell

Intracellular Material inside cell membrane

Fluid Mosaic Model a 2D liquid in which phospholipids and proteins diffuse easily

Made of phospholipids and proteins phospholipids form a double layer or bilayer

Polar Region - "heads"
- hydrophilic
- exposed to H₂O

Cell Membrane (cont)

Nonpolar Regions - "tails"
- hydrophobic
- away from H₂O

cell membrane consists of phospholipids, cholesterol (for strength and flexibility), and proteins

Diffusion

What is it? movement of molecules from areas of high to low concentration

Solution solid, liquid, or gas that contains one or more solutes

Solute Substance added to solvent that dissolves

Solvent Substance such as H₂O that solute is being added to

Is energy required? no

Mediated Transport Mechanisms

Facilitated diffusion - diffusion with aid of a carrier molecule
- requires no ATP
- passive transport

Active transport - moves substance from low to high concentration
- required ATP
Ex. Sodium-potassium pump

Cotransport - a diffusing substance moves in same direction as a transported substance

Mediated Transport Mechanisms (cont)

Counterporter protein - a diffusing substance moves in direction opposite to that of transported substance

Microtubules of the Cytoskeleton

Centriole - Composed of 9 microtubules

Centrosome - 2 centrioles oriented perpendicular to one another. Plays a role in mitosis

Flagella

- Location Cell surface

- Characteristic 1 per cell

- Function move cell, Eg. Sperm

Cilia

- Location Cell Surface

- Characteristic Many per cell

- Function Move materials across cell's surface

Microvilli

- Location Cell Surface

- Characteristic Shorter than cilia

- Function Increase surface area

DNA

Double helix

Deoxyribose-phosphate backbone

Nucleotide base pairs

Backbone = sugar (ribose-phosphate)



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DNA (cont)

Gene Expression

- information in DNA directs protein synthesis
- *nucleotide sequence of a gene determines amino acid sequence of specific protein*
- Enzymes regulate chemical reactions
- Uses transcription and translation

Flow of Genetic Information

Central Dogma	DNA -
	<i>transcribe</i> -
	RNA - <i>translate</i>
	- Protein

Transcription

- | | |
|--------------------------------|-------------------------|
| - Process by which DNA is read | - Occurs in the nucleus |
| - Produces mRNA | - mRNA contains codons |

- Codons: set of 3 nucleotide bases that code for a particular amino acid

Translation

- | | |
|--|---------------------|
| - Process by mRNA is converted into amino acids (polypeptides) | - Produces proteins |
|--|---------------------|
- Codons pair with anticodons
 - anticodons: 3 nucleotide bases carried by tRNA



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