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 cade 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 H2O outside cell	higher concentration of H2O 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	
- Location	in nucleus
- Function	produce ribosomes that are then transported to the cytoplasm
Ribosome	
- Location	attached to rough endoplasmic reticulum (RER) or free-floating in cytoplasm
- Function	Produce proteins
RER (Rough Endoplasmic Reticulum)	
- Location	Cytoplasm
- Characteristic	Membranes with ribosomes attached
- Function	Site of protein synthesis
SER (Smooth Endoplasmic Reticulum)	
- Location	Cytoplasm
- Characteristic	membranes with no ribosomes
- Function	Site of lipid synthesis
Golgi Apparatus	
- Location	Cytoplasm
- Characteristic	Closely, packed stacks of membranes
- Function	Collect, sort, package, and distribute proteins and lipids
Secretory Vesicle	
- Location	Cytoplasm
- Function	Distributes materials out of cell

By **Morghay123**
cheatography.com/morghay123/

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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
- 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
1. Directly through diffusion (passive):	O_2 and CO_2 (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 is?	- Cells framework - Made of proteins
Functions	- Provide support - Hold organelles in place - enable cell to change shape
Types of Cytoskeleton	
Microtubules	- Largest diamete - 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*)

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

Funtions:	- Selective barrier -Encloses cytoplasm
Extracellular	Material outside of cell
Intracellular	Material inside cell membrane
Fluid Mosaic Model	a 2D liquid in which phospoholipids 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)

Counter porter 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 - *transcribe* - RNA - *translate* - 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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