



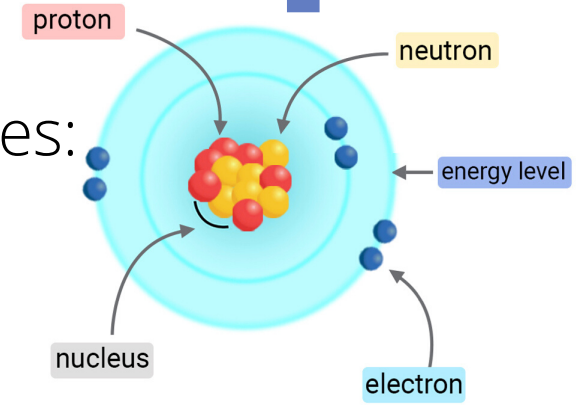
Summary & Practice Sheets

Grade 9 - Biology

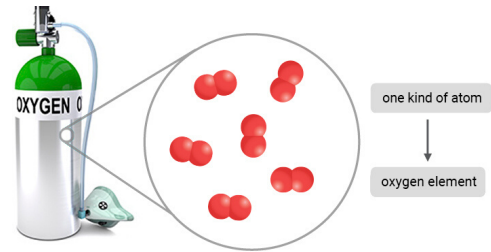
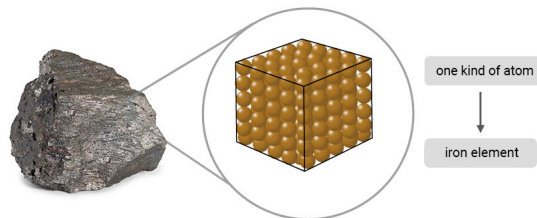
Chemistry in Biology
Cellular Structure and Function
Digestive and Endocrine system

Atoms, Elements, and Compounds

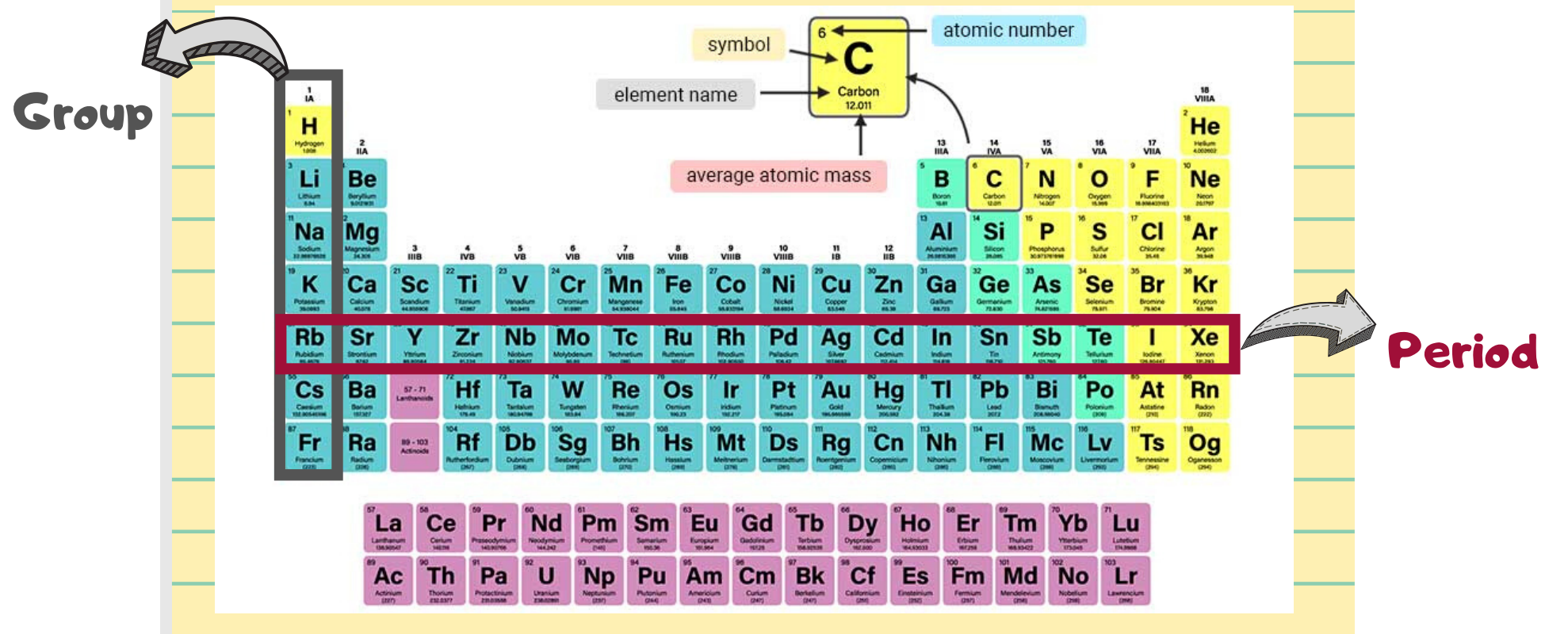
Atoms are composed of three smaller subatomic particles: protons, neutrons and electrons.



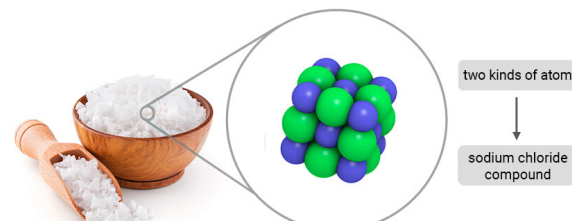
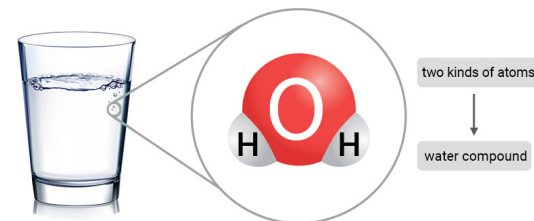
An **element** is a pure substance that is made of **only one type of atom**. It cannot be broken down into other substances by any physical or chemical means.



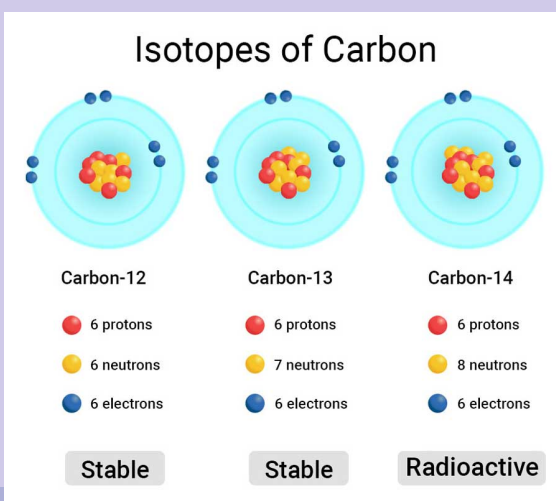
All the known elements found on Earth are arranged in the **periodic table**.



A **compound** is a pure substance that is made of **two or more different types of atoms**. It can be broken down into simpler compounds or elements by chemical means.



Isotopes are atoms of the same element with a different number of neutrons.



Radioactive isotopes have **unstable** nuclei. Their nuclei decay, or breakdown, over time and release energy.

PROPERTIES OF COMPOUNDS

FIXED RATIO

Pure water is always made up of 2 hydrogen atoms and 1 oxygen atom.



The subscript 2 indicates that there are 2 hydrogen atoms.
No subscript indicates that there is 1 oxygen atom.

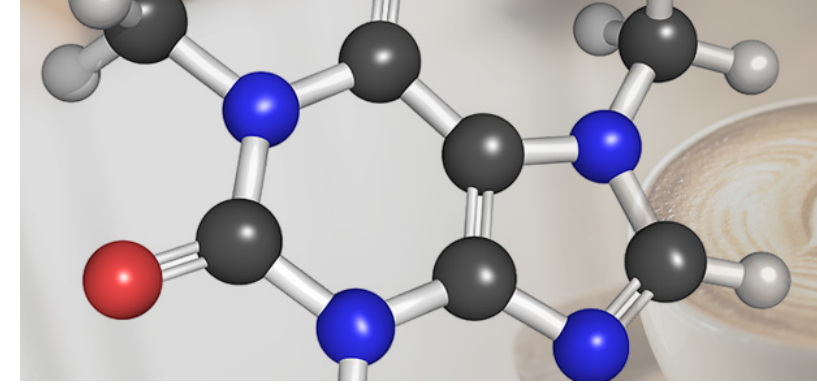
BREAK DOWN

In electrolysis, the passage of an electrical current through water will decompose water into hydrogen and oxygen gases.

UNIQUE PROPERTIES

Hydrogen and oxygen are gases when these elements combine they form water, a liquid.

Chemical Bonds

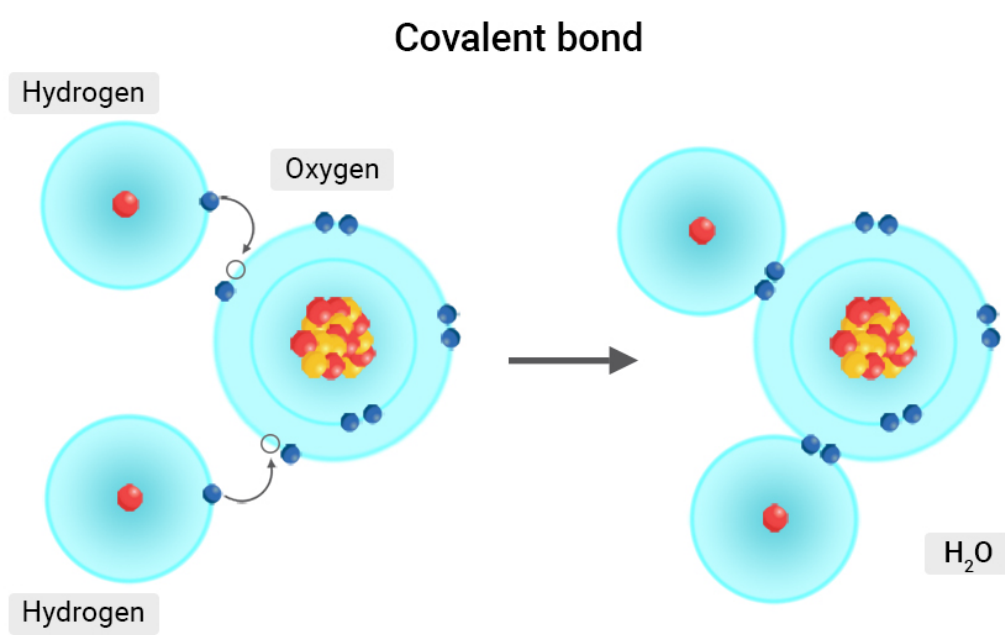


Elements **combine** together to become **chemically stable**. The **electrons** in the **outer** energy level of an atom can **interact** with the electrons in the outer energy level of other atoms. The force that holds the elements together is called **a chemical bond**.

Covalent bonds

a chemical bond formed when **electrons** are **shared** between two atoms.

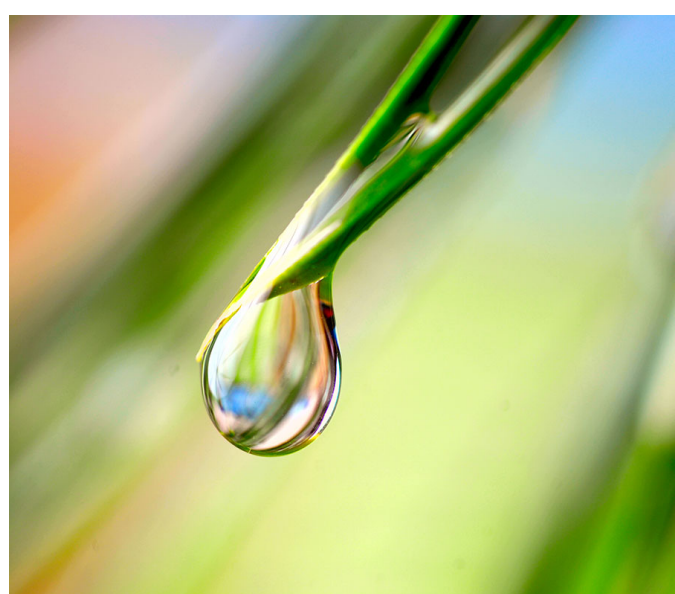
example: water



Nonmetal + **Nonmetal** → Covalent Bonding

Different atoms do not share electrons equally resulting in partially negative and positive regions.

For example, in a water molecule the oxygen atom has a stronger attraction for the electrons resulting in a partially negative charge.

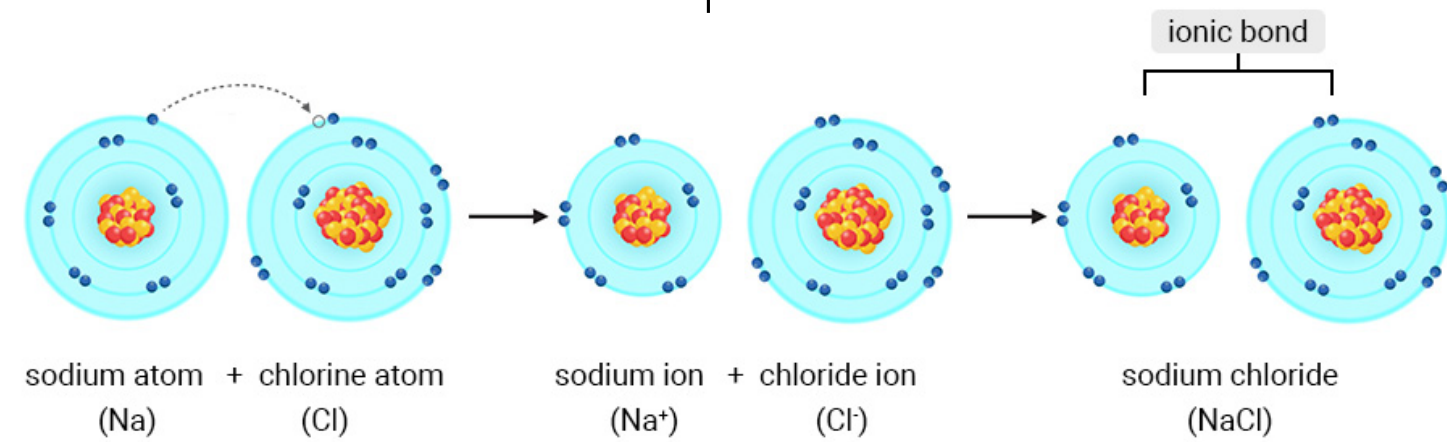


Water droplets form because of the van der Waals forces between the slightly positive and negative charges of a water molecule being attracted to the opposite charge of other nearby water molecules.

Ionic bonds

a chemical bond that holds **positive** and **negative ions** together. In this type of bonding, **electrons** are **not shared**, they are transferred

example: salt



Metal + **Nonmetal** → Ionic Bonding

Common Properties of Ionic Compounds

- most are solid at room temperature
- most dissolve in water
- conduct electricity when dissolved in water
- have high melting and boiling points
- are usually crystalline at room temperature



spiders can climb smooth surfaces because of the van der Waals forces between the atoms in the hairlike structures on their feet and the atoms of the surface they are climbing.

Introducing Chemical Reactions



A **chemical reaction** is the process by which **chemical bonds** between atoms are **broken** and **new ones** are **formed**. In chemical reactions, substances change into different substances.

Two types of changes



Physical change

occurs when matter changes its physical properties but not its chemical composition.



example:
chopping wood

Chemical change

occurs whenever matter changes into an entirely new substance. The new substance has different chemical properties.



example:
burning wood



Chemical Equations: mass is conserved

Reactants \longrightarrow Products



reactants

- starting substance(s) in a chemical reaction
- always written on the left side of the arrow

product

- substance(s) that form during a chemical reaction
- always written on the right side of the arrow

The reaction rate is the rate at which a reactant is used up or a product is formed.

A **catalyst** is a substance that:

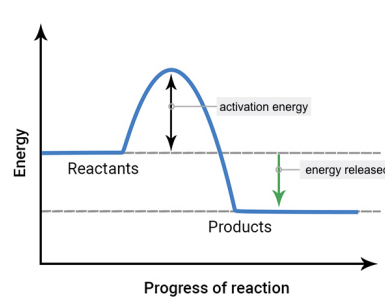
- increases** the rate of a chemical reaction by lowering the activation energy
- is not used up** or changed in a chemical reaction
- does not** change the products of the reaction
- catalysts in living things are called **enzymes**

The **activation energy** is the minimum amount of energy needed to start a chemical reaction and change reactants into products.

Chemical Reaction

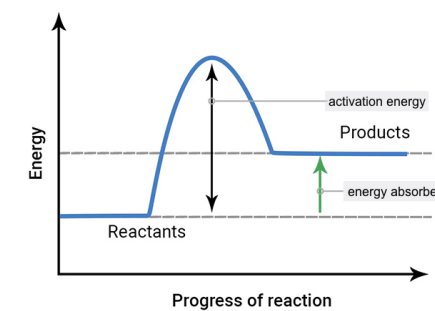
exothermic reaction

a chemical reaction that **releases** thermal energy



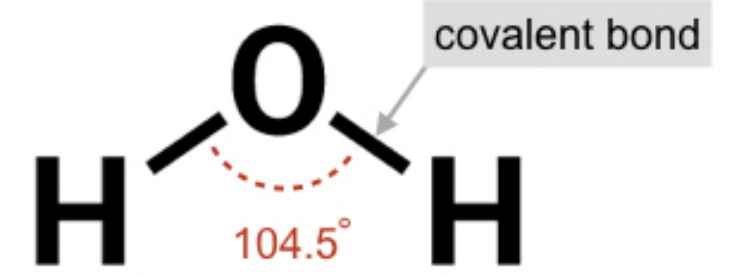
endothermic reaction

a chemical reaction that **absorbs** thermal energy



Exploring the Properties of Water

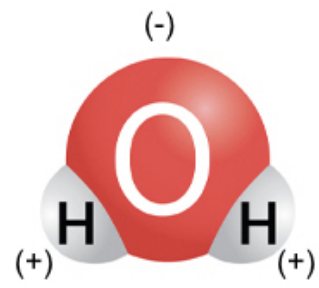
A water molecule is composed of **two hydrogen** atoms and **one oxygen** atom that share electrons in **covalent bonds**.



Exploring the Properties of Water

Polarity of a Water Molecule

Water molecule is slightly negative at the oxygen end and slightly positive at the hydrogen ends



Solubility

Water is called the universal solvent



Cohesion

A water molecule is attracted to other water molecules



Adhesion

A water molecule is attracted to molecules of different substances

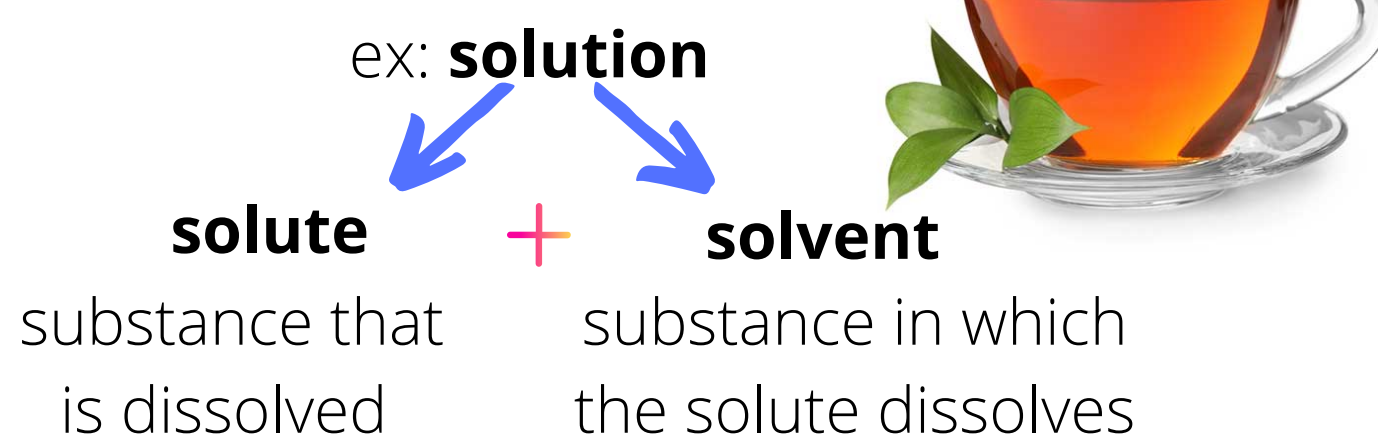


MIXTURES

Mixture is a combination of two or more different substances, elements and/or compounds and can be separated by physical means.

Homogeneous mixtures

a mixture in which the individual substances are **evenly distributed** throughout.



Heterogeneous mixtures

a mixture in which the individual substances are **not evenly distributed** throughout.

ex: **suspension**



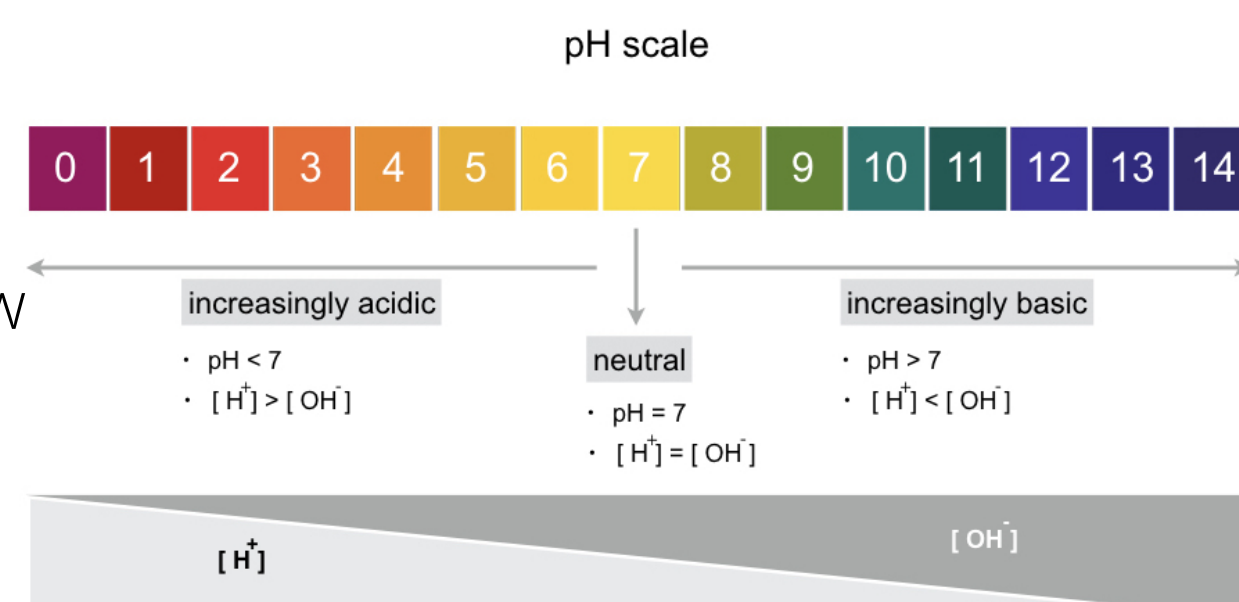
ex: **colloid**



pH Scale

pH is a measure of the concentration of hydrogen ions in a solution. The pH scale is a numeric scale used to determine whether a substance is **acidic** or **basic**, and to measure how strong an acid or base is.

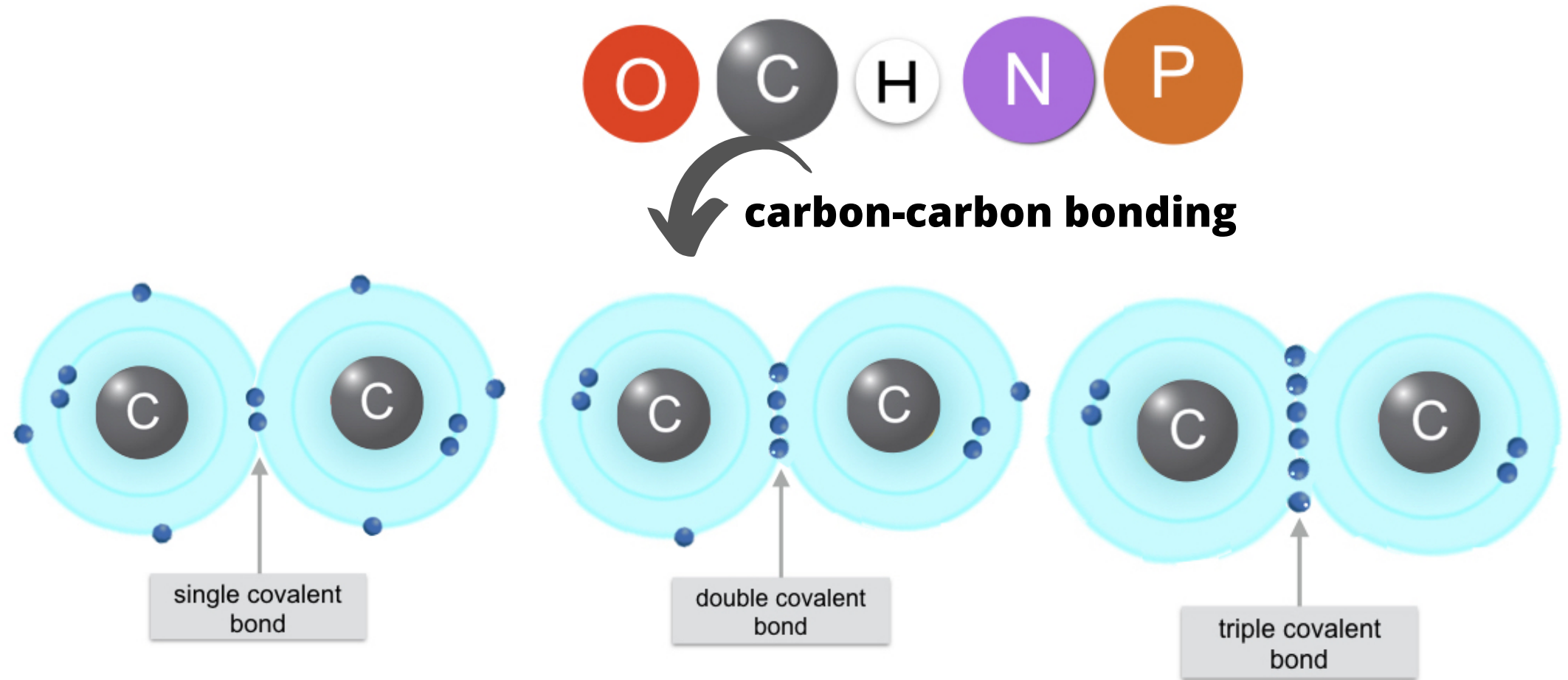
Buffers are mixtures that react with acids and bases to keep the pH levels relatively stable.



Introducing the Major Biological Macromolecules

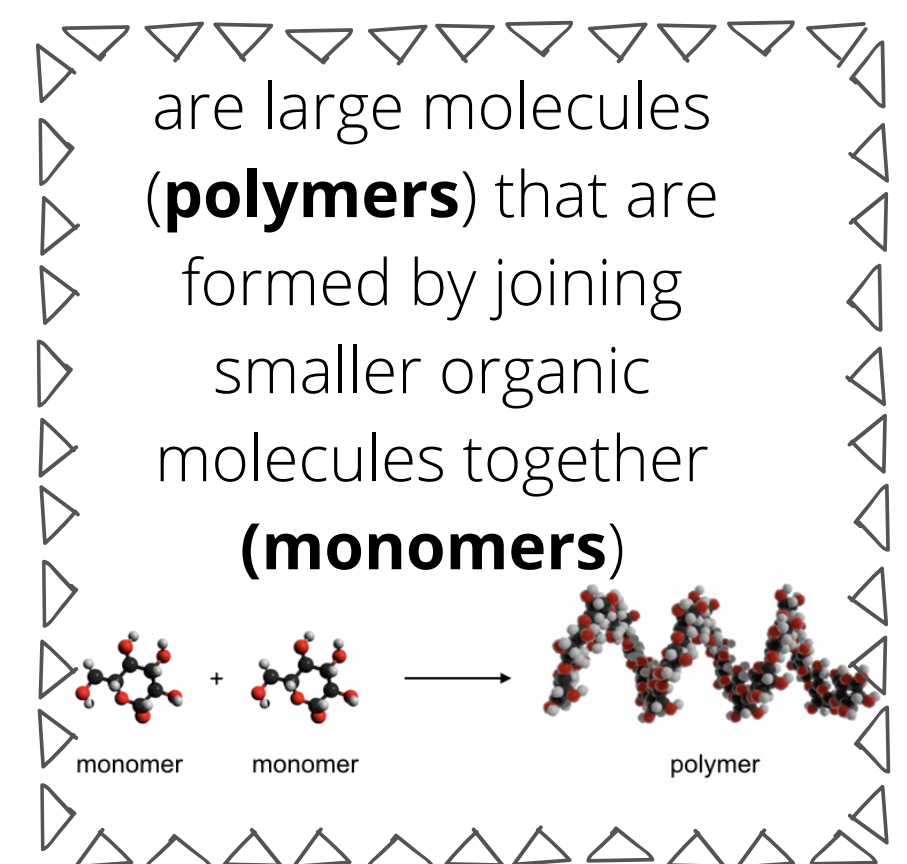
The elements that are found in greater abundance in living things are **oxygen, carbon, hydrogen, nitrogen, and phosphorus**. These elements are organized into larger structures called **molecules**.

A carbon atom has 4 electrons in its outermost energy level. This means carbon can form 4 covalent bonds with other elements.



Carbon atoms make up the backbone of many important molecules in your body like: **carbohydrates, lipids, proteins, and nucleic acids**.

These complex molecules are called **biological macromolecules**.



General formula(CH₂O)_n
made up of carbon, hydrogen, and oxygen atoms combined in a ratio of 1:2:1

Two types:
• DNA
• RNA

Nucleic acids

- contain genetic information

Carbohydrates

- energy storage
- communication
- structural support

Proteins

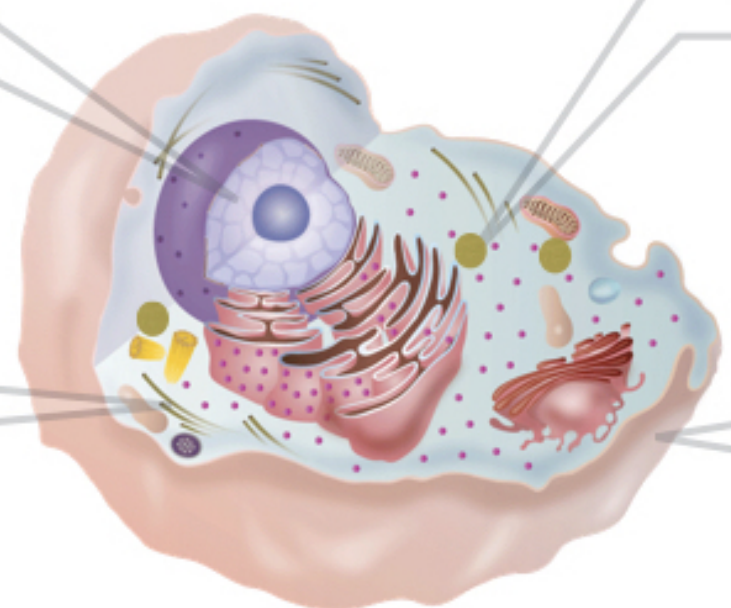
- transport
- communication
- structural support

Lipids

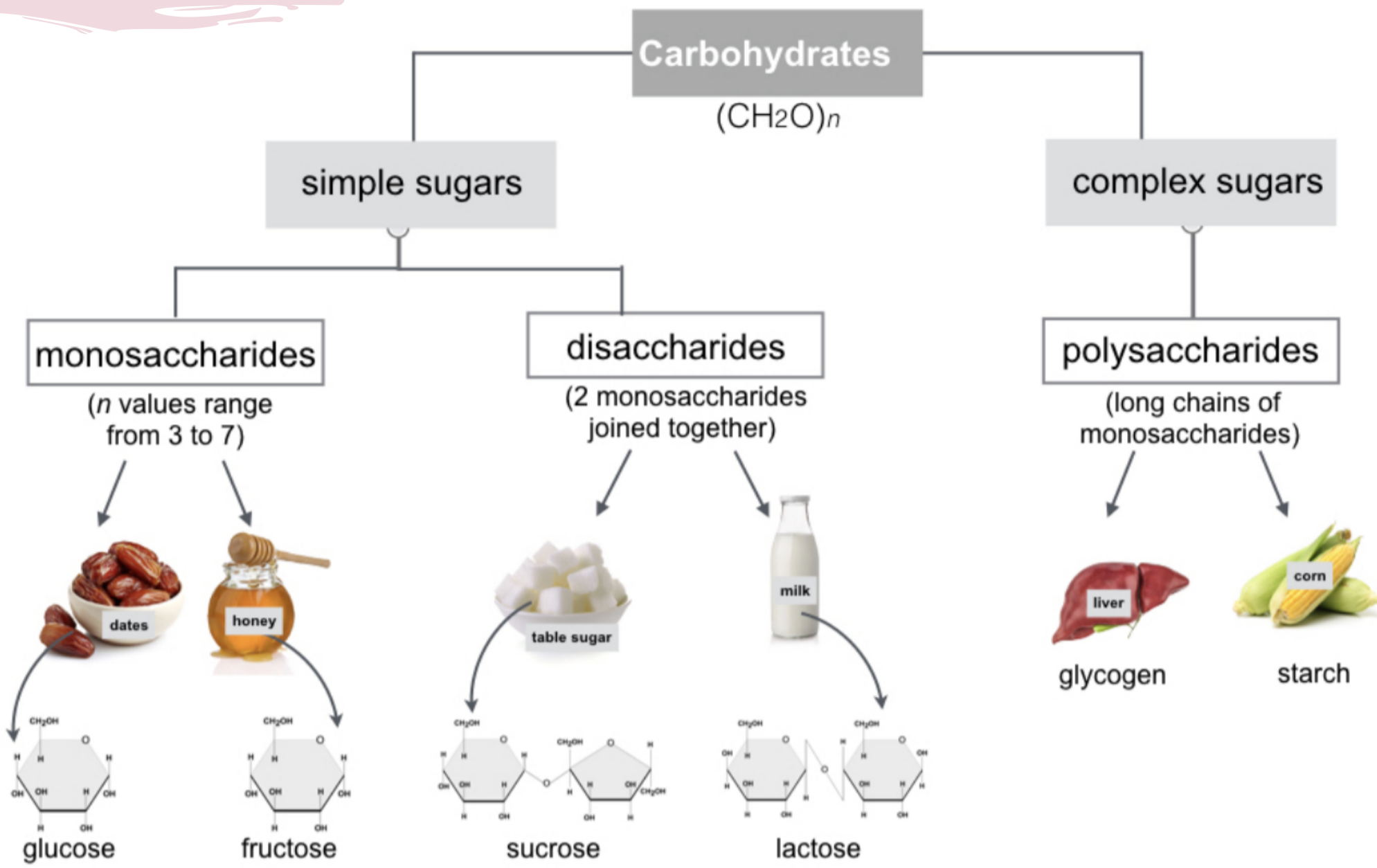
- energy storage
- communication
- protective membranes

A protein's structure, shape, size, and function are determined by the:
number and sequence of amino acids

Fats, oils, and waxes



Carbohydrates



Proteins

Level of protein structure

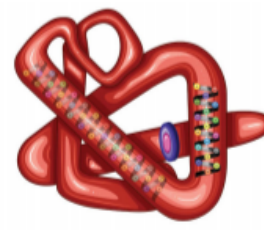
Primary structure



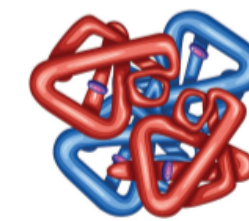
Secondary structure



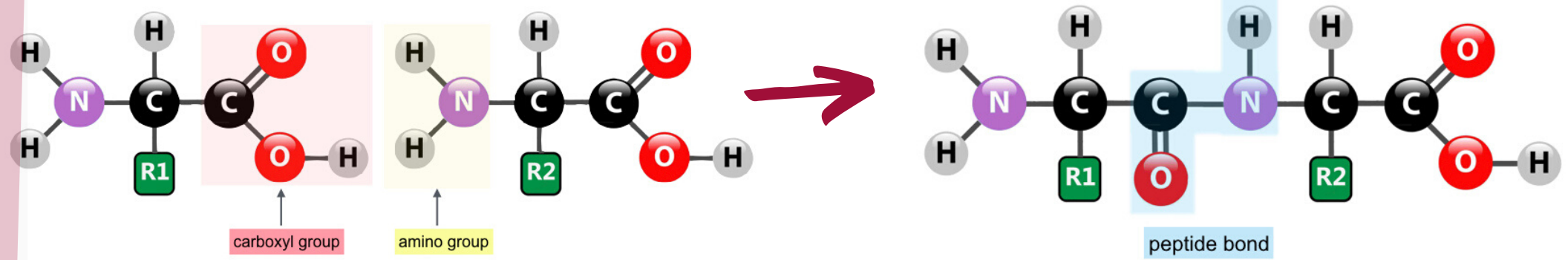
Tertiary structure



Quaternary structure



Each amino acid is attached to another amino acid by a covalent bond, known as a **peptide bond**. A peptide bond forms between the **carboxyl group** of one amino acid and the **amino group** of another amino acid.

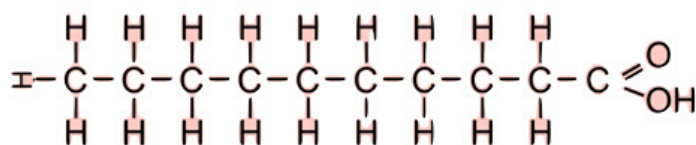


Lipids

Based on the carbon-carbon bonds in their fatty acid tails, lipids can be classified into:

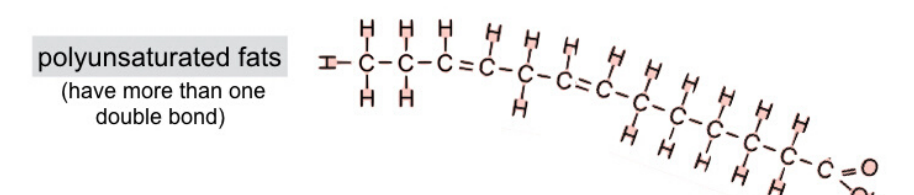
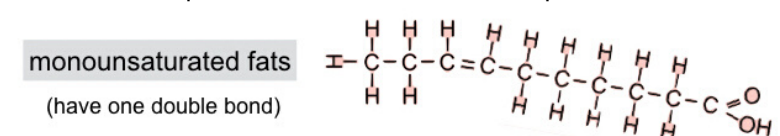
Saturated Fats

- all carbon atoms are bonded together by single covalent bonds
- have straight chains
- are solids at room temperature



Unsaturated Fats

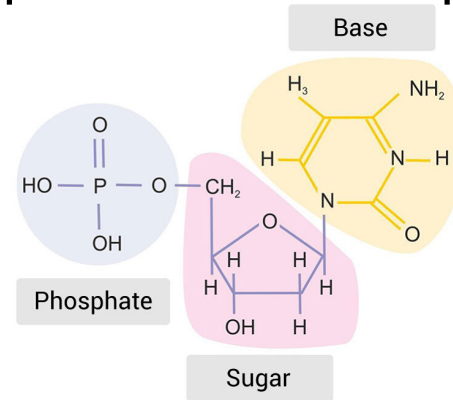
- have at least one carbon-carbon double bond
- have kinks in their chains
- are liquid at room temperature



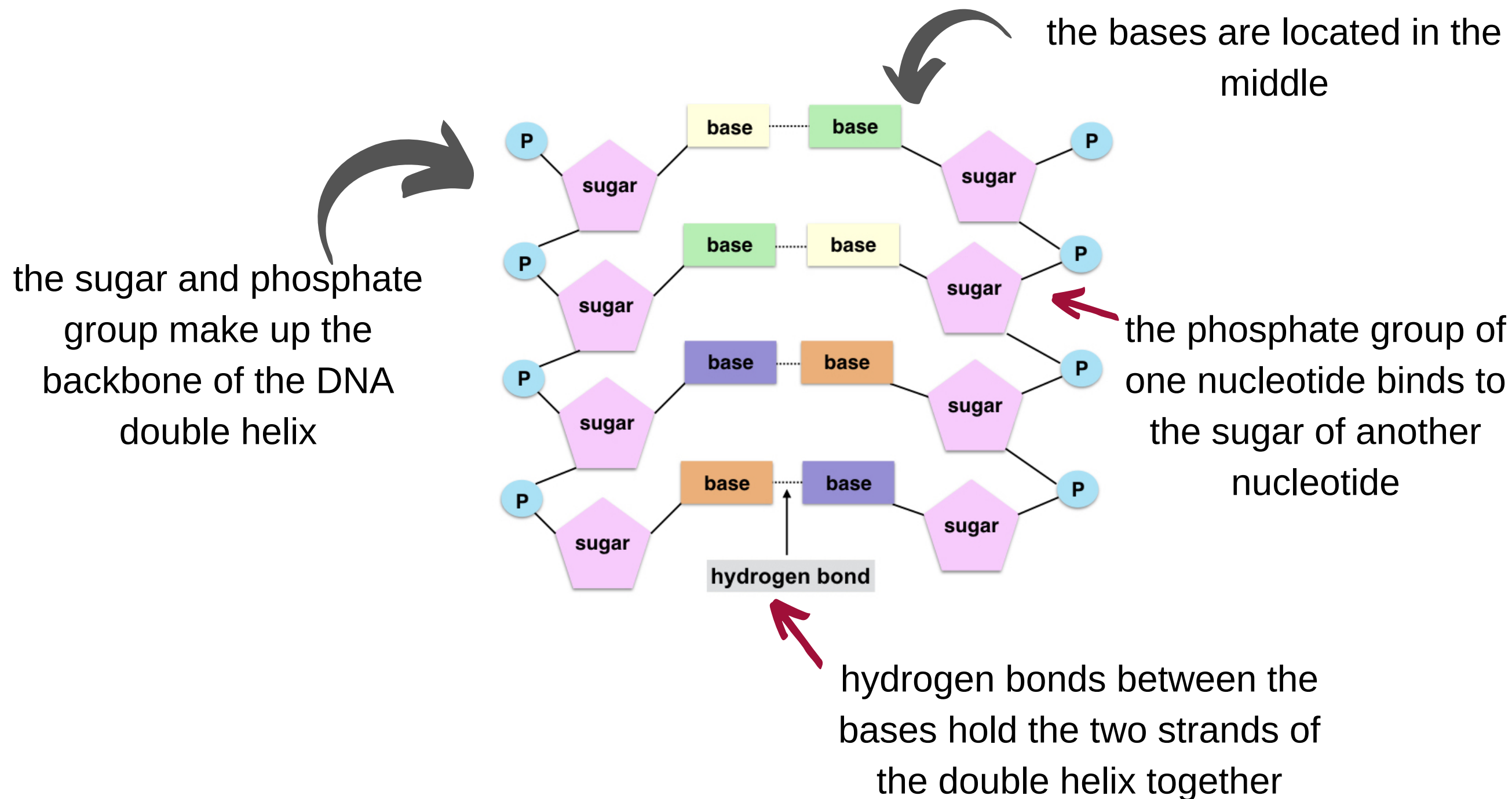
Nucleic Acids

Each nucleotide is made up of three components:

1. a nitrogenous base
2. a sugar
3. a phosphate group



Basic Structure of DNA



Summary

| Macromolecule | Main Elements | Functions | Monomer (building blocks) | Examples |
|----------------------|--|---|--|--|
| Carbohydrates | <ul style="list-style-type: none"> ● carbon ○ hydrogen ● oxygen | <ul style="list-style-type: none"> • main source of energy • provide structural support | <p>simple sugars (monosaccharides)</p> | glucose, lactose, starch, glycogen |
| Lipids | <ul style="list-style-type: none"> ● carbon ○ hydrogen ● oxygen | <ul style="list-style-type: none"> • store energy • make up biological membranes • protect and insulate | <p>glycerol and fatty acids</p> | triglycerides, phospholipids, steroids |
| Proteins | <ul style="list-style-type: none"> ● carbon ○ hydrogen ● oxygen ● nitrogen | <ul style="list-style-type: none"> • control the rate of chemical reactions • transport materials • fight diseases | <p>amino acids</p> | microtubules, skin, muscles, hair, enzymes |
| Nucleic Acids | <ul style="list-style-type: none"> ● carbon ○ hydrogen ● oxygen ● nitrogen ● phosphorus | <ul style="list-style-type: none"> • store and transmit genetic information | <p>nucleotides</p> | DNA, RNA |

PRACTICE

Chapter 1: Chemistry in Biology

Part 1 - Multiple Choice Questions

Identify the choice that best completes the statement or answers the question.

- 1) Neutrons and protons are located at the center of the atom, which is called the _____.
 - a) nucleus
 - b) electron cloud
 - c) isotope
 - d) energy level
- 2) A(n) _____ is a substance that lowers the activation energy needed to start a chemical reaction.
 - a) catalyst
 - b) isotope
 - c) activation energy
 - d) reactant
- 3) _____ is a measure of the concentration of hydrogen ions in a solution.
 - a) pH
 - b) solvent
 - c) solute
 - d) buffer
- 4) Carbohydrates, lipids, proteins, and nucleic acids are _____.
 - a) biological macromolecules
 - b) micromolecules
 - c) monomers
 - d) buffers

Part 2 - Fill in the Blanks

Complete the following sentences using the word bank.

| | | |
|------------------|-----------|---------------|
| Word Bank | acids | amino acids |
| bases | element | peptide bonds |
| products | reactants | |

- 5) A(n) _____ is a pure substance that cannot be broken into other substances by physical or chemical means.
- 6) _____ are substances that release hydrogen ions into solutions.
_____ are substances that release hydroxide ions into solutions.
- 7) A chemical equation shows the _____, the starting substances, on the left side of the arrow. The _____, the substances formed during the reaction, are on the right side of the arrow.

8) Proteins are made from _____ that are joined by _____.

Part 3 - Matching

Match each term to its correct description by writing the letter on the line.

Set A

- | | |
|---------------------|---|
| 9) _____ electrons | a) negatively charged particles that are located outside the nucleus of an atom |
| 10) _____ protons | b) particles that have no charge and are located in the nucleus of an atom |
| 11) _____ neutrons | c) pure substances formed when two or more different elements combine |
| 12) _____ isotopes | d) positively charged particles that are located in the nucleus of an atom |
| 13) _____ elements | e) atoms of the same element that have different numbers of neutrons |
| 14) _____ compounds | f) pure substances that cannot be broken down into other substances by physical or chemical means |

Set B

- | | |
|-----------------------------|---|
| 15) _____ enzyme | a) a substance that binds to an enzyme |
| 16) _____ substrate | b) the specific location where a substrate binds on an enzyme |
| 17) _____ activation energy | c) the energy required to start a reaction |
| 18) _____ active site | d) a protein that speeds up a chemical reaction |

Set C

- | | |
|--------------------------|--|
| 19) _____ solvent | a) a substance in which another substance is dissolved |
| 20) _____ solute | b) a molecule that has an unequal distribution of charges |
| 21) _____ solution | c) a mixture that can react with acids or bases to keep the pH within a particular range |
| 22) _____ polar molecule | d) a weak interaction involving a hydrogen atom and a fluorine, oxygen, or nitrogen atom |
| 23) _____ hydrogen bond | e) the substance that is dissolved in the solvent |
| 24) _____ buffer | f) a mixture that has a uniform composition throughout |

Set D

- | | |
|-------------------------|--|
| 25) _____ carbohydrates | a) are made up of nucleic acids |
| 26) _____ lipids | b) are made up of sugars |
| 27) _____ nucleic acids | c) are made up of fatty acids and glycerol |

Part 4 - Short Answer

Answer each question using the space provided.

28) Relate the structure of water to its ability to its characteristics.

29) Identify and describe factors that can influence enzyme activity.

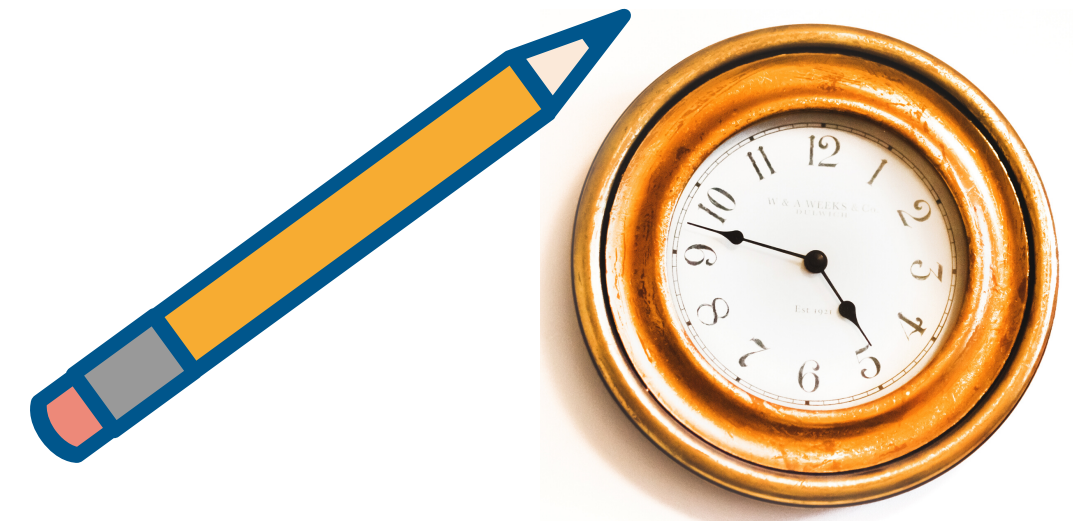
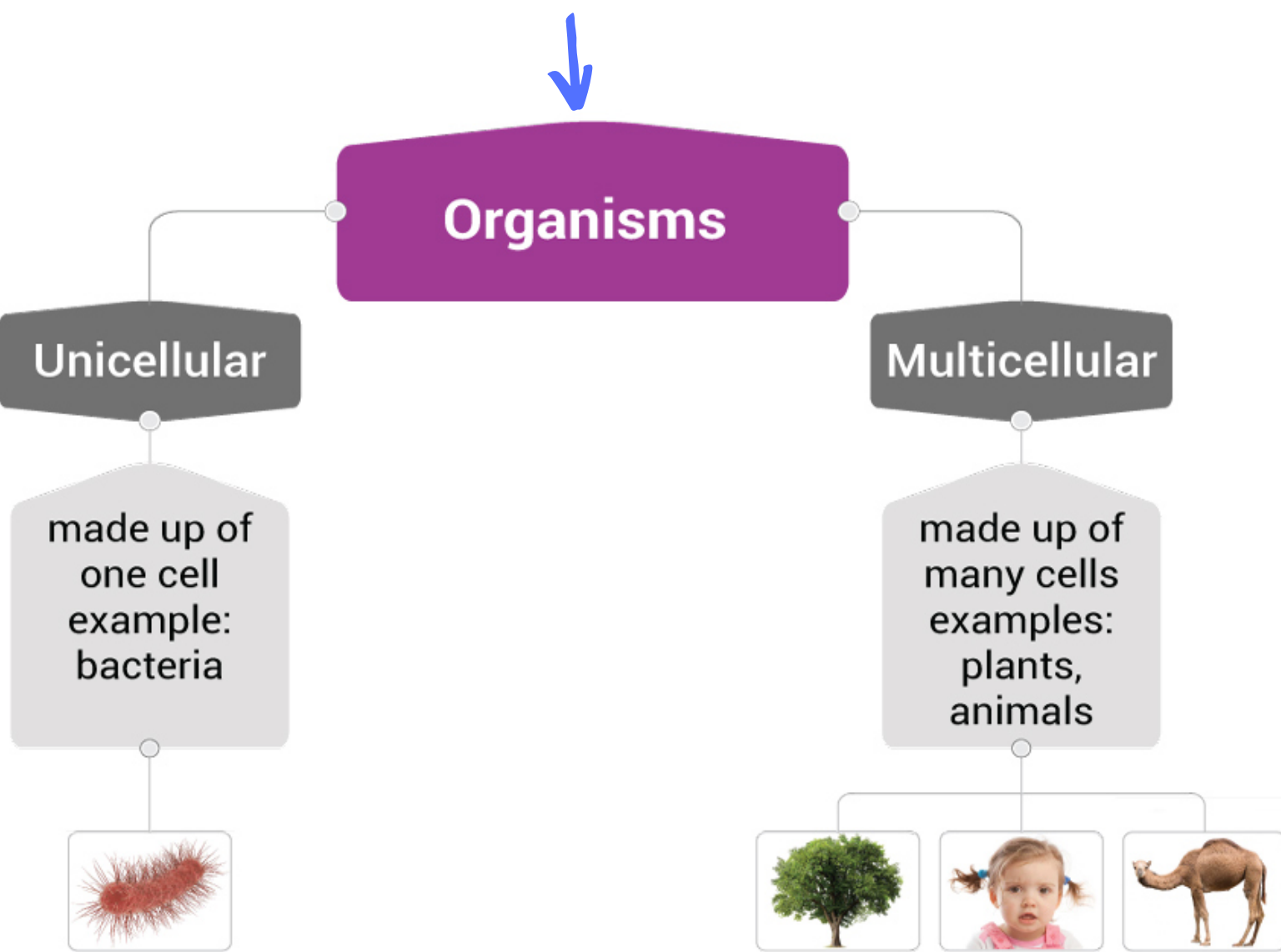
30) What is cellulose? Why humans can't digest it?

31) Compare van der Waals forces, ionic bonds, and covalent bonds.

Introducing Cell Theory

Living

Nonliving



cell
is the basic
structural and
functional unit of
life

cells are tiny and can be seen by microscope



A microscope

is a tool that uses **lenses** to **magnify** or produce an enlarged image of a very small object.

Types

Light Microscope

- 1,000X
- low resolution
- used to view **living** objects

Example:
Compound light microscope

ocular lens

has

objective lens

have different magnifications 4X, 10X, 40X

Electron Microscope

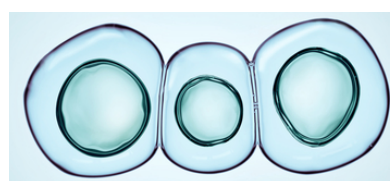
- 500,000X
- high resolution
- used to view **dead** objects

Example:

- scanning electron microscope (SEM)
- transmission electron microscope (TEM)

To calculate the total magnification of compound light you can use this equation:

Magnification of the microscope = magnification of the **ocular lens** x magnification of **objective lens**



Cell Theory

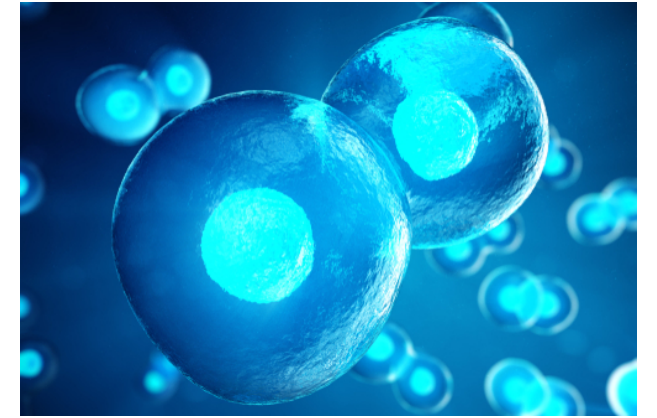
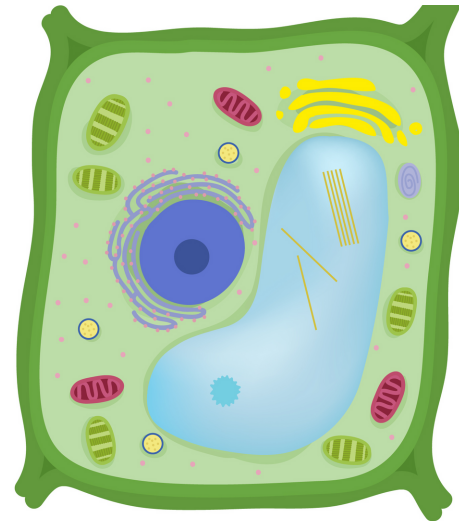
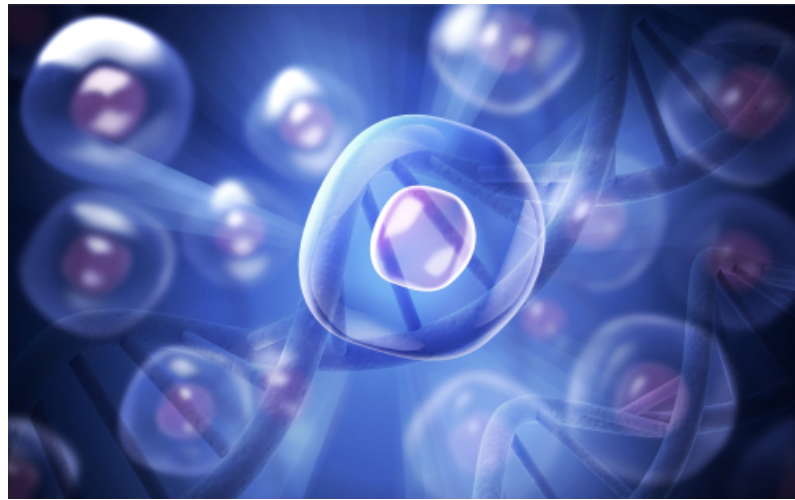
includes 3 main principles to describe cells in living things



All living things are made up of one or more cells.

Cells are the smallest structural and functional units of life.

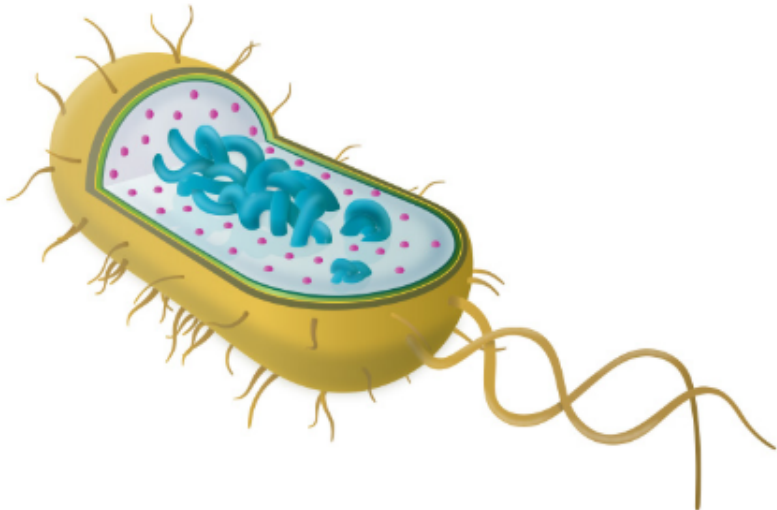
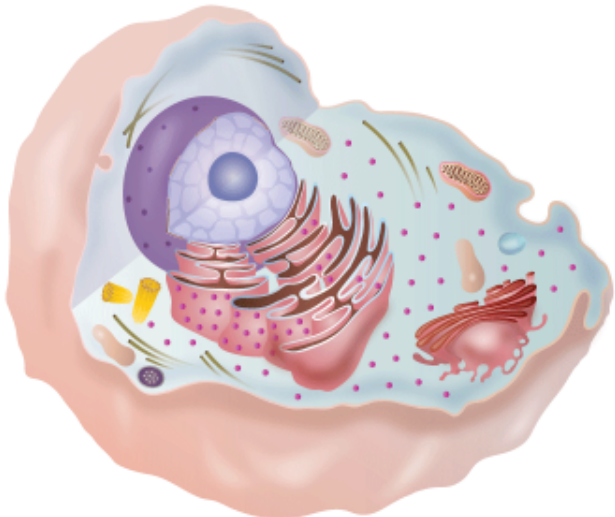
All cells come from preexisting cells.



Basic Cell Types

Prokaryotic means "before the nucleus"

Eukaryotic means "true nucleus"

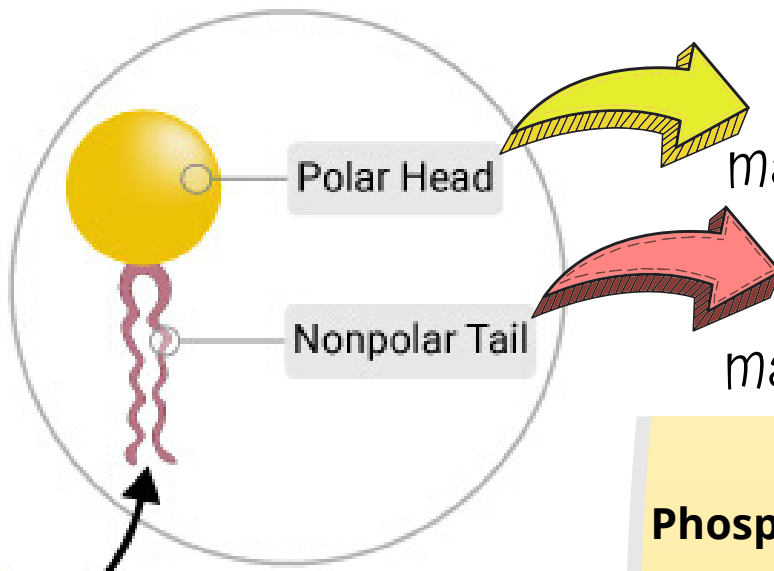
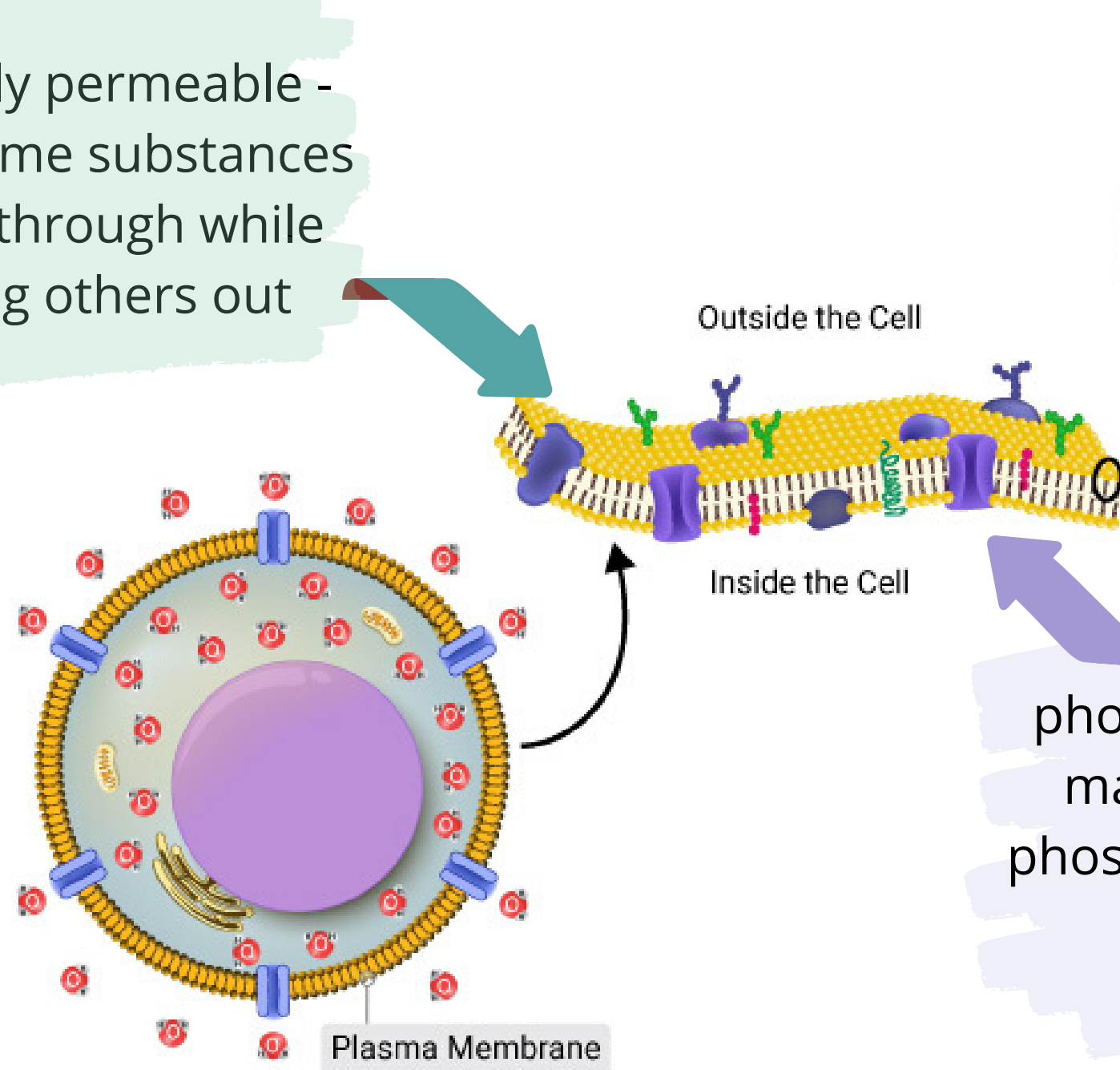
| Prokaryotic Cell | Eukaryotic Cell |
|--|--|
|  |  |
| <ul style="list-style-type: none"> • no nucleus • DNA floats in the cytoplasm • simple structure with no membrane-bound organelles • bacteria have prokaryotic cells | <ul style="list-style-type: none"> • has a nucleus • DNA is contained within the nucleus • complex structures with many membrane-bound organelles • animals, plants, fungi, and protists have eukaryotic cells |

The Plasma Membrane

is a thin, flexible boundary between a cell and its environment that allows nutrients into the cell and allows waste and other products to leave the cell.

Properties of the Plasma Membrane

selectively permeable - allows some substances to pass through while keeping others out



made up of a phosphate group

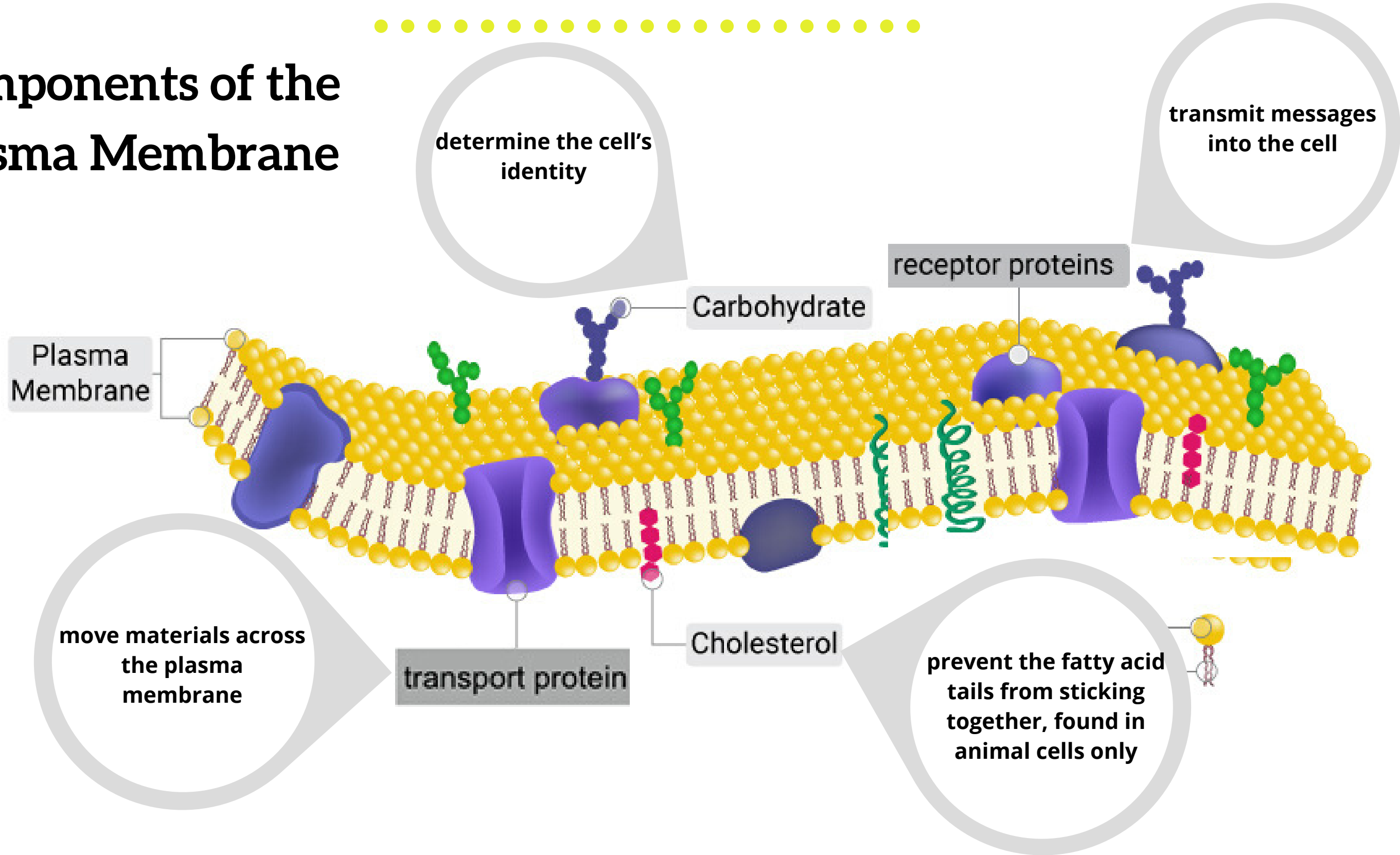
made up of a fatty acid chains

Phospholipids are composed of:

- glycerol,
- phosphate,
- and two fatty acid chains.

phospholipid bilayer - made of 2 layers of phospholipids arranged tail-to-tail

Components of the Plasma Membrane



determine the cell's identity

transmit messages into the cell

move materials across the plasma membrane

prevent the fatty acid tails from sticking together, found in animal cells only

the phospholipids move sideways within the membrane

phospholipids, proteins, cholesterol, and carbohydrates within the membrane create a mosaic of substances

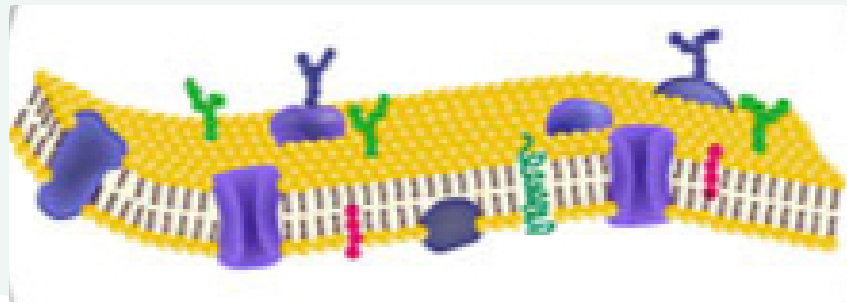
The fluid mosaic model describes the plasma membrane.

Structures and Organelles

Common Structures of all kinds of Cells

Plasma membrane

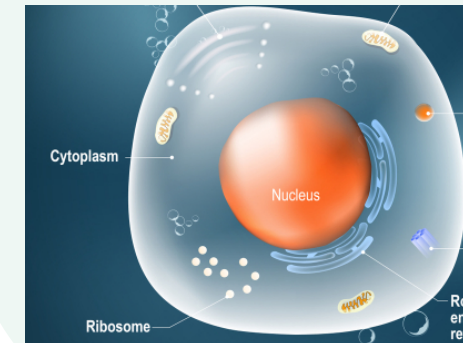
- protects the cell
- separates the inside of the cell from the outside



Cytoplasm

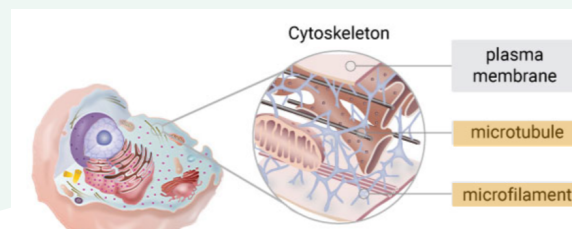
(gel-like material)

- keep the cell shape
- environment for cellular activities
- helps with circulation of nutrients



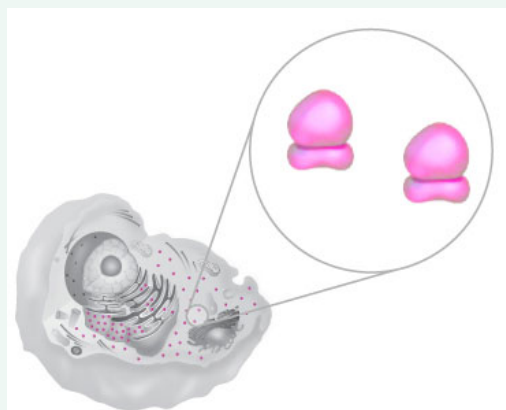
Cytoskeleton

- supports the shape of the cell
- holds cell organelles in place
- can disassemble and reassemble to enable cell movement



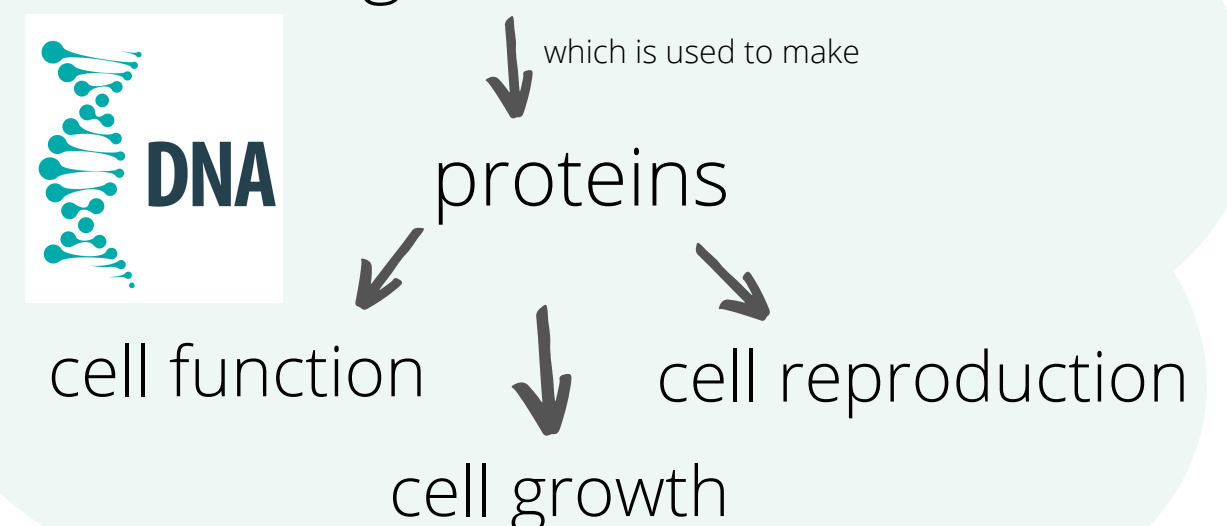
Ribosomes

- made of two subunits: RNA and protein
- site of protein synthesis



DNA

- made of nucleic acids
- stores genetic material

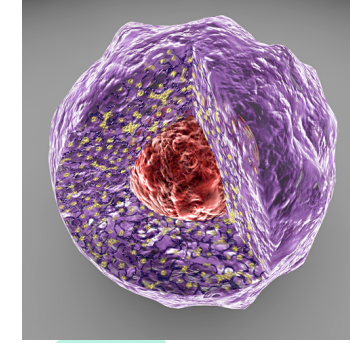


Organelles

are "small organs" inside the eukaryotic cell. Each organelle has a specific structure and function.

Nucleus

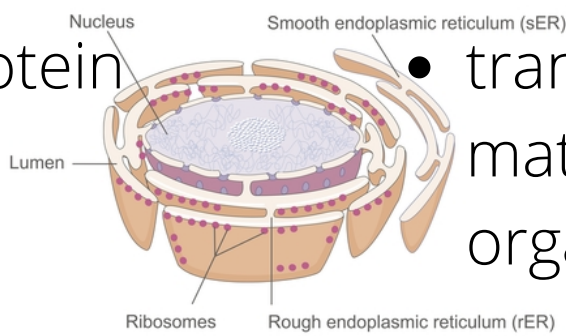
- cell's control center
- contains the cell's DNA
- controls the activities



Endoplasmic Reticulum (ER)

↓
rough endoplasmic reticulum (RER) smooth endoplasmic reticulum (SER)

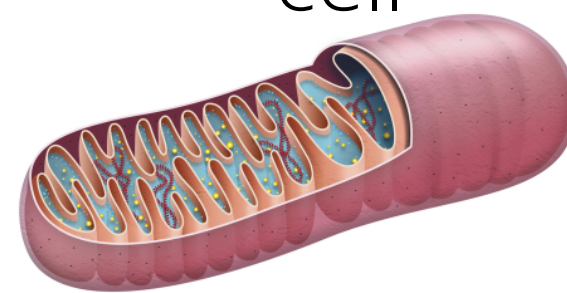
- site for protein and lipid synthesis



- transports materials between organelles

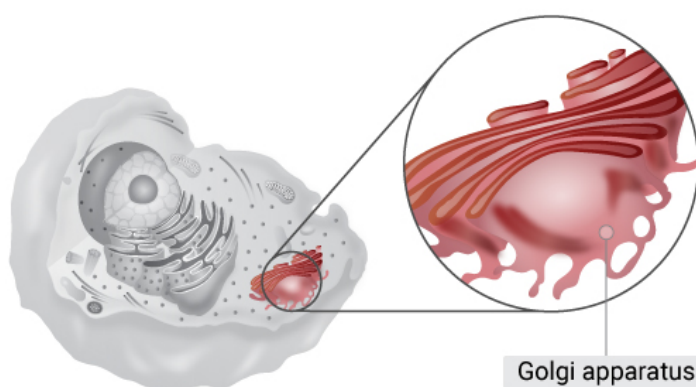
Mitochondria "powerhouse"

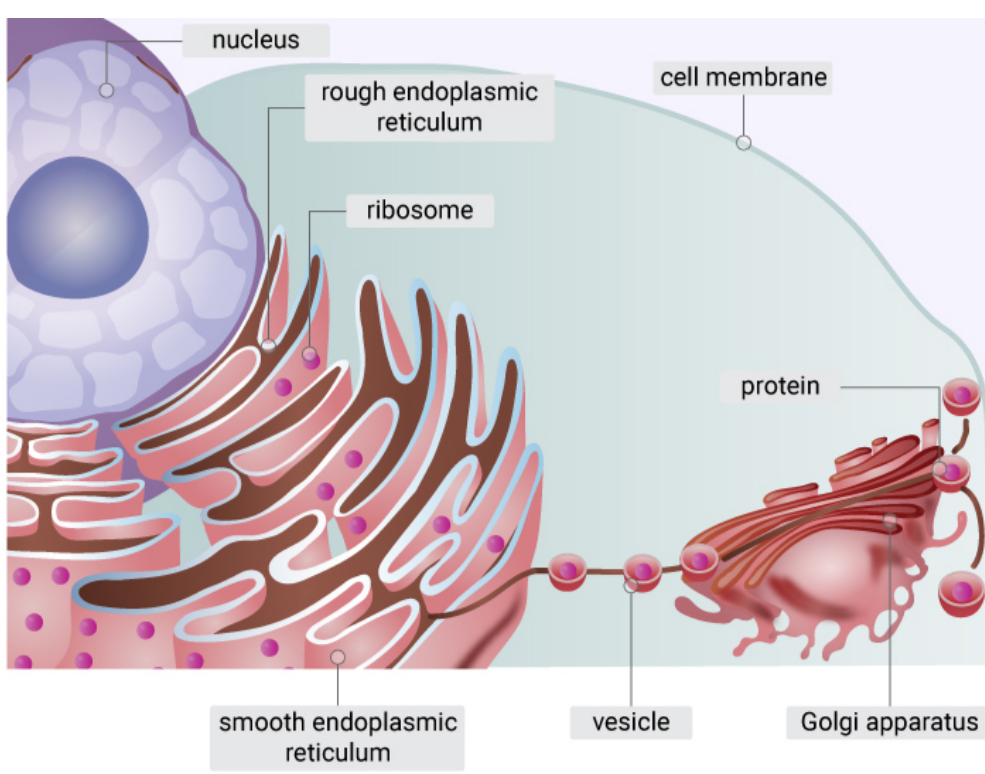
- makes energy available to the cell



Golgi apparatus

- modifies, sorts, and packages proteins



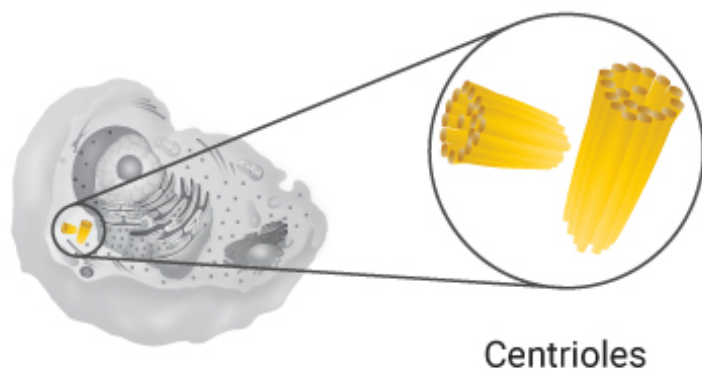


A **vesicle** is a small sac-like structure that stores and moves materials between cell organelles, as well as to and from the cell surface.

Organelles that are found **only** in **Animal Cells**

Centrioles (found near the nucleus)

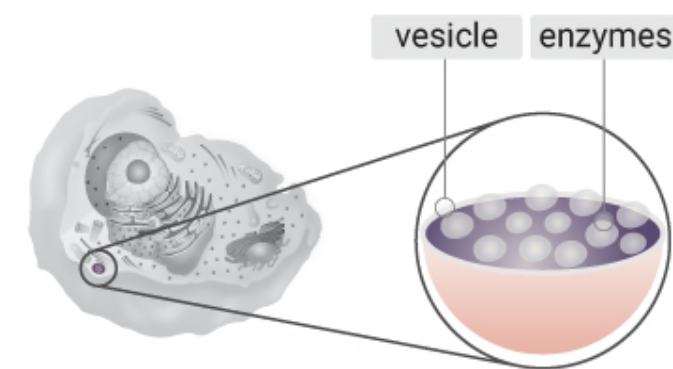
- help organize cell division



Centrioles

Lysosomes (sacs contain digestive enzymes)

- break down food, dead organelles, and invaders, such as viruses and bacteria



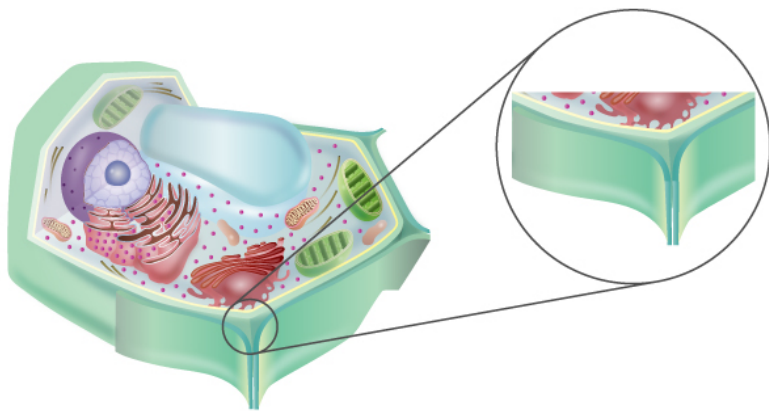
lysosomes are found in animal and most protist cells, but **can also be found in plant cells in rare cases**

Structures that are found **only** in **Plant Cells**

1- Cell Wall

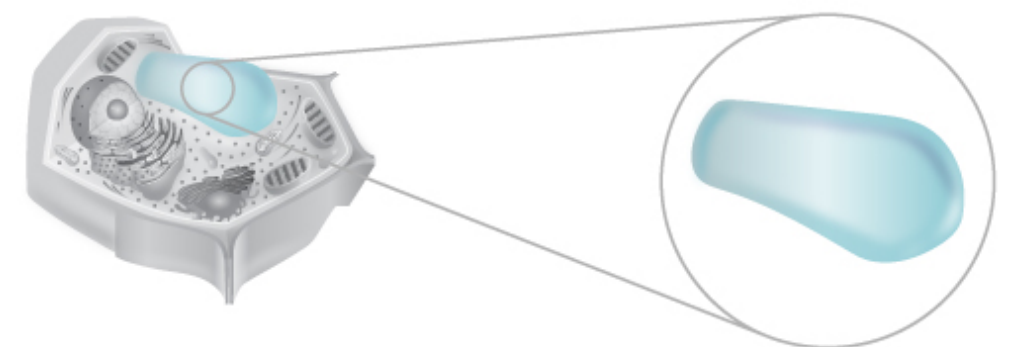
(made of cellulose)

- supports, shapes, and protects the cell
- provides strength for plants to stand against gravity



2- Large Central Vacuole

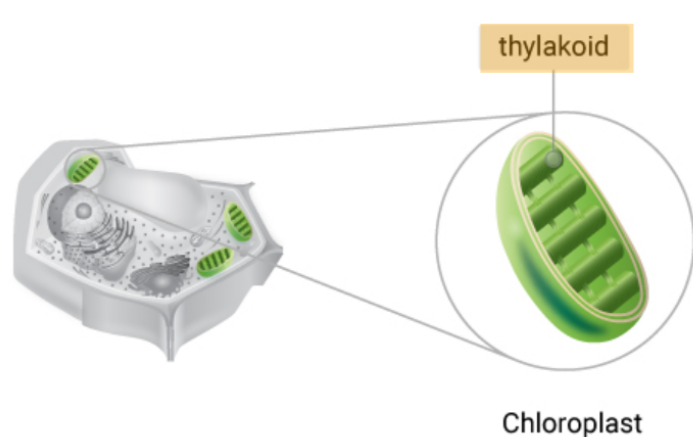
- stores food, water, carbohydrates, enzymes
- stores waste products
- helps plant parts stay rigid and hold their shape



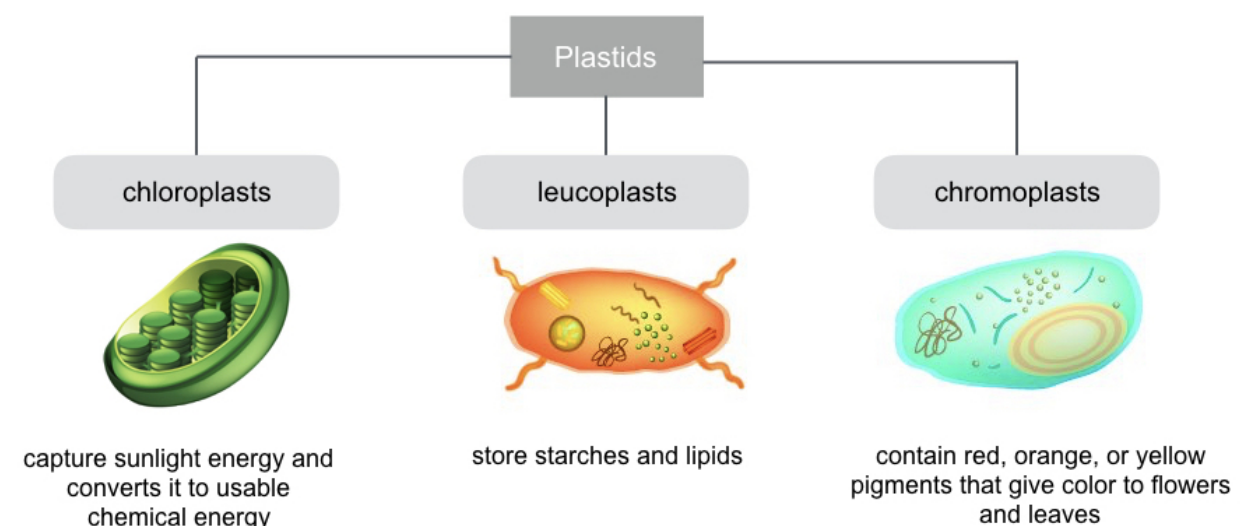
can be found in some animal cells, but they are small in size

3- Chloroplast

- captures sunlight energy and converts it to usable chemical energy (**photosynthesis**)



Chloroplast



Different **extensions** of the plasma membrane

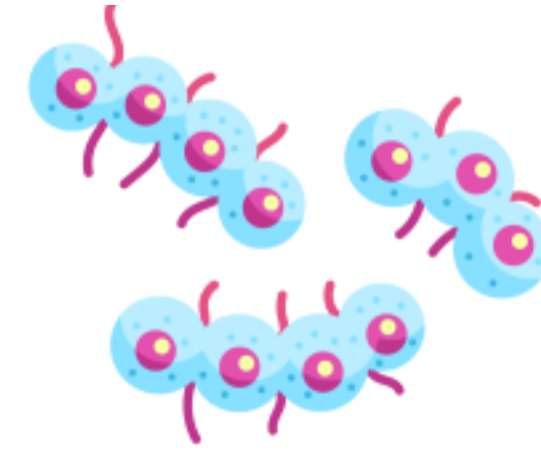
Flagella

long tail-like projections of the plasma membrane
whip-like motion



Cilia

short hairlike projections of the plasma membrane
brush-like motion

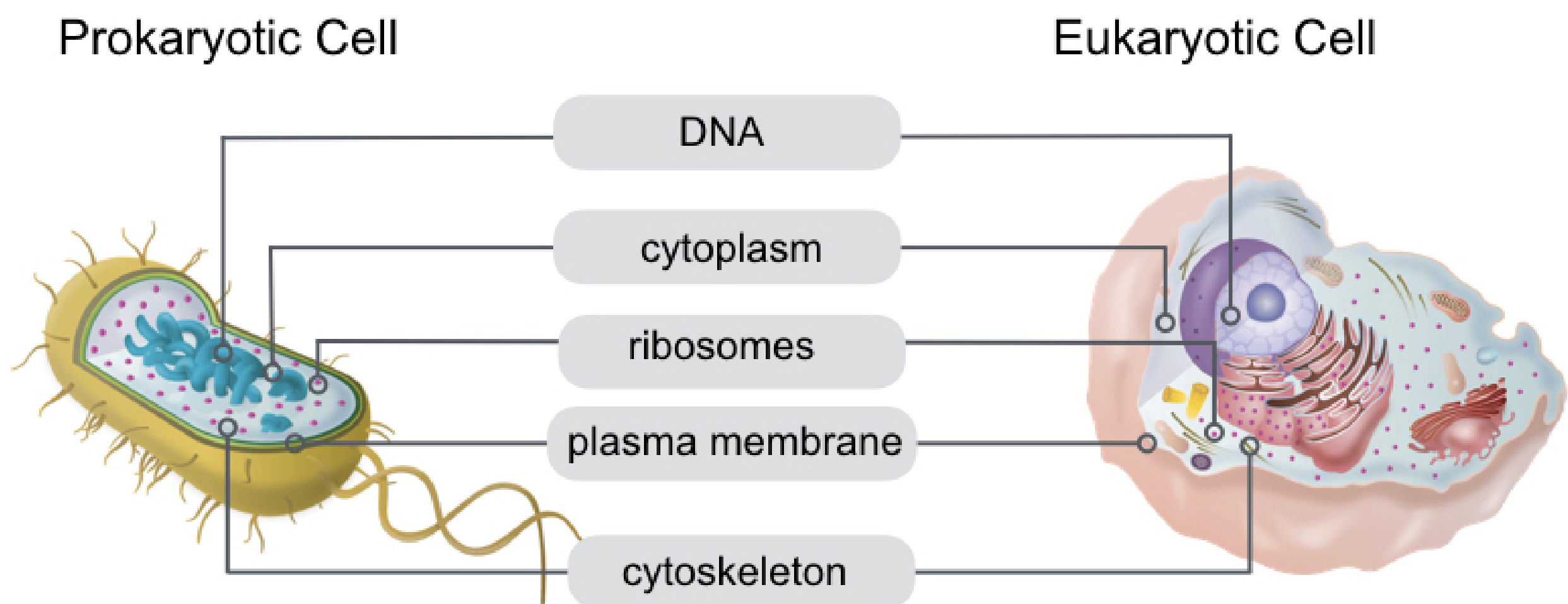


In eukaryotic cells, flagella and cilia are made of microtubules that are arranged in "9 + 2" pattern.

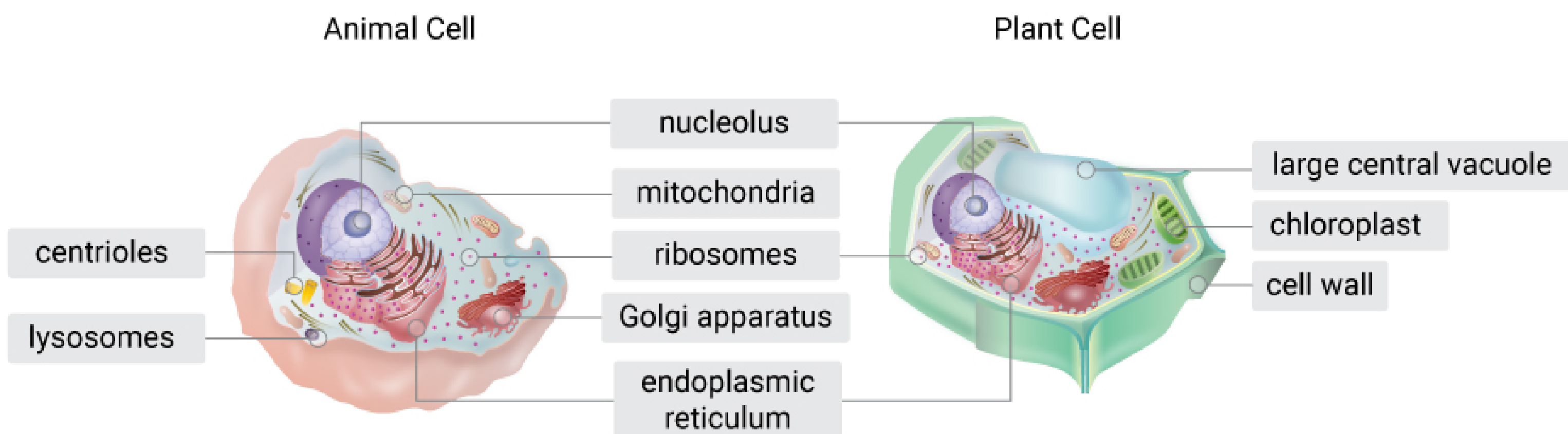
In prokaryotic cells, flagella and cilia contain cytoplasm and are surrounded by the plasma membrane. They are made of complex structures of proteins.

Summary

Common structures that are found in all **Eukaryotic** and **Prokaryotic** Cells



Similarities and **differences** between **Plant** and **Animal** Cells



Cellular Transport

the movement across the plasma membrane occurs through **2** basic processes: passive transport and active transport.

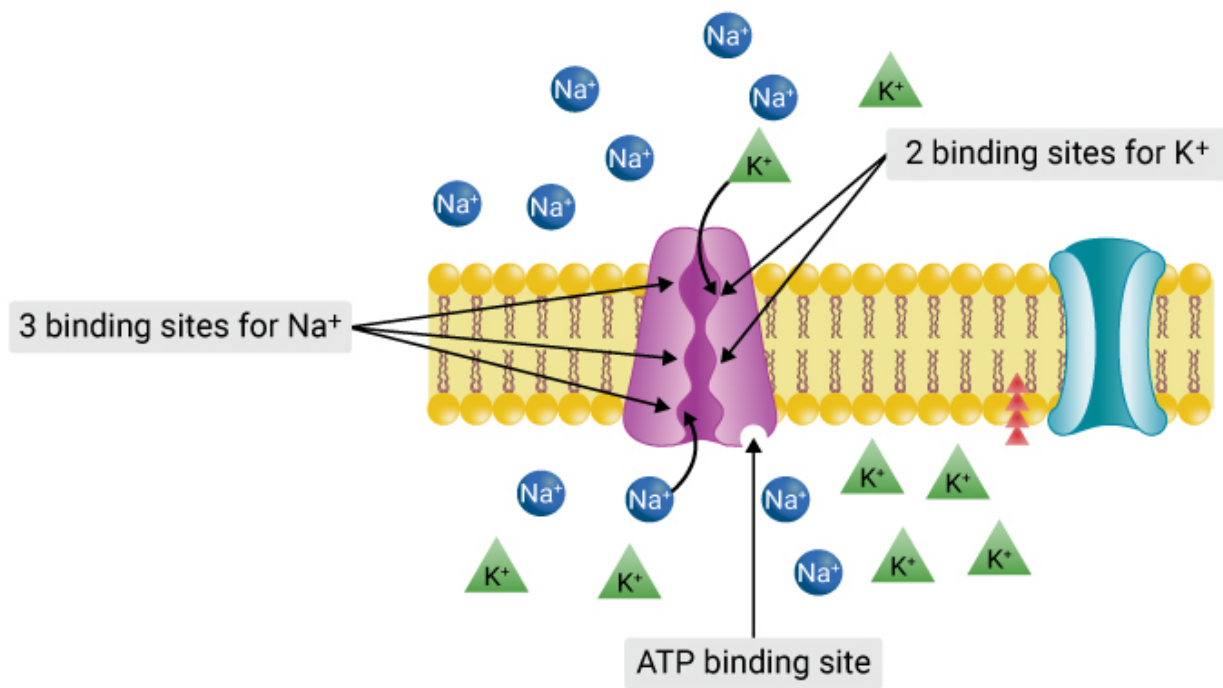
1- Active transport is the movement of materials across the plasma membrane from an area of **lower concentration** to an area of **higher concentration**, with the use of **energy** from the cell.

carrier-assisted transport (pumps)

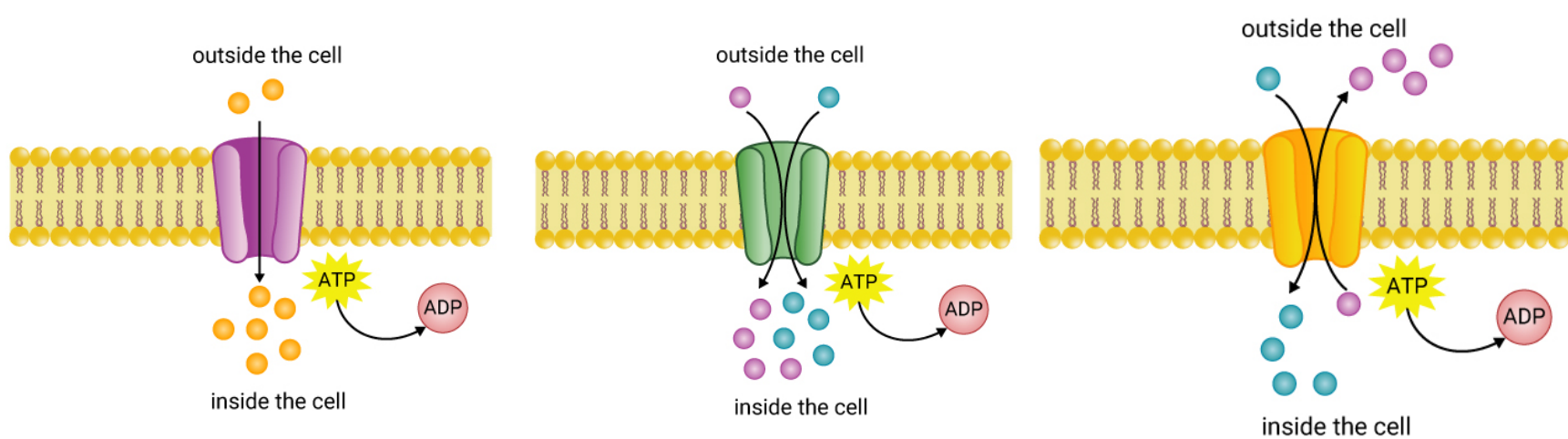
carrier proteins embedded in the plasma membrane move ions

Example: The sodium-potassium ATPase pump
(Na⁺/K⁺ ATPase pump)

Transports **3** Na⁺ out of the cell and **2** K⁺ into the cell



Types of pumps



move one type of molecule in one direction

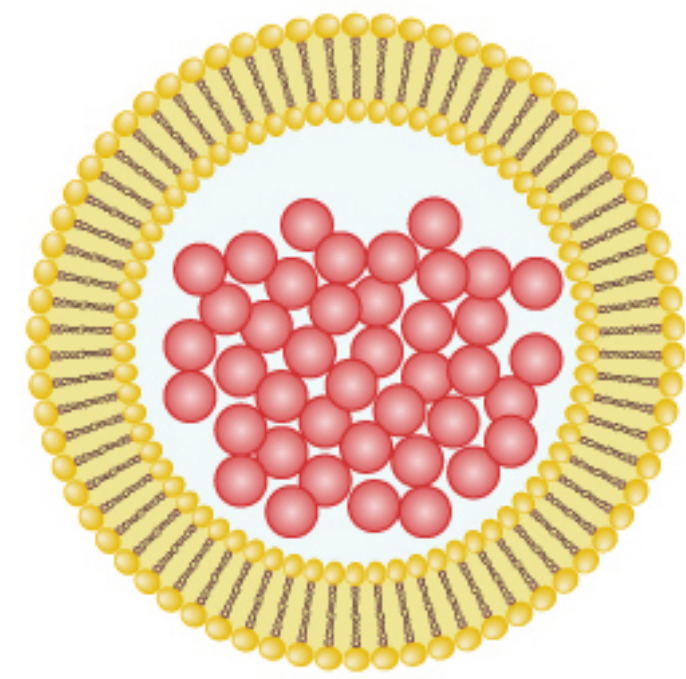
move two different types of molecules, both in the same direction

move two different types of molecules in different directions

vesicle-mediated transport

vesicles that fuse through the cell membrane moves large materials

Example: endocytosis and exocytosis



- a vesicle is a small sac
- enclose large materials and can pull materials into or out of the cell

Endocytosis

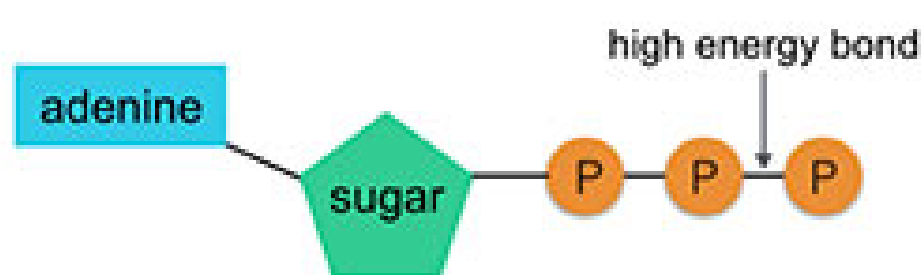
a type of active transport that moves particles **into** a cell

Exocytosis

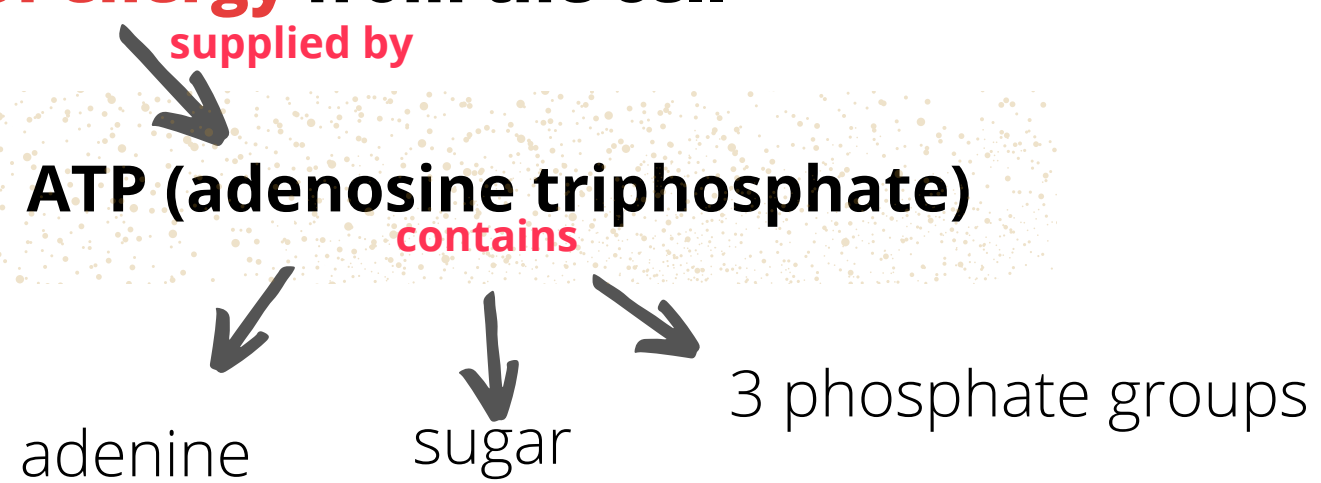
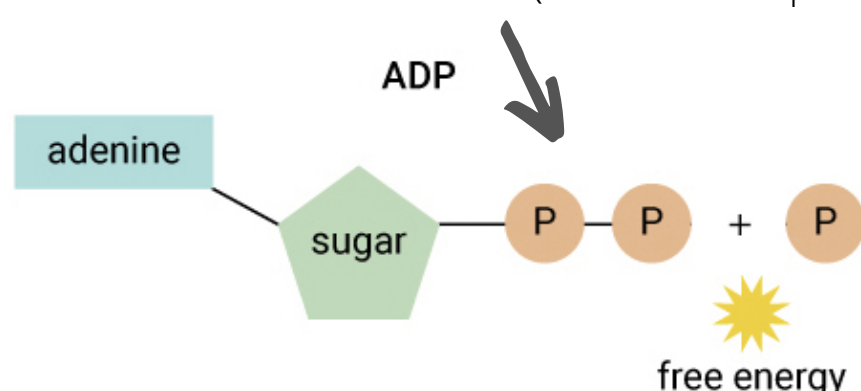
type of active transport that moves particles **outside** a cell

The difference in concentration of molecules across a space is called the **concentration gradient**

Active transport is the movement of materials against a concentration gradient and that it requires the use of energy from the cell



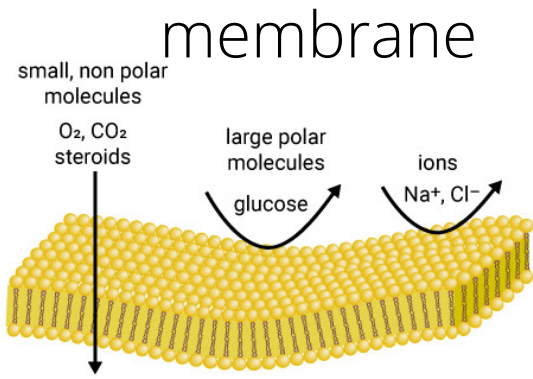
- stores energy in the bonds between the phosphate groups
- releases energy when it breaks down into ADP (adenosine diphosphate)



2- Passive Transport is the movement of materials through the plasma membrane from an area of **higher concentration** to an area of **lower concentration**, that **does not require energy** from the cell.

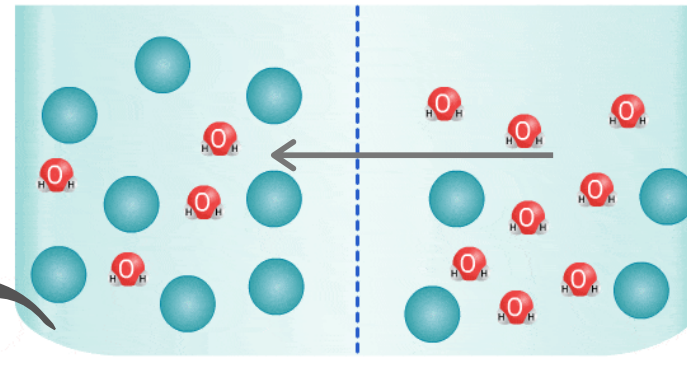
simple diffusion

movement of small or nonpolar molecules such as oxygen and carbon dioxide across the plasma membrane



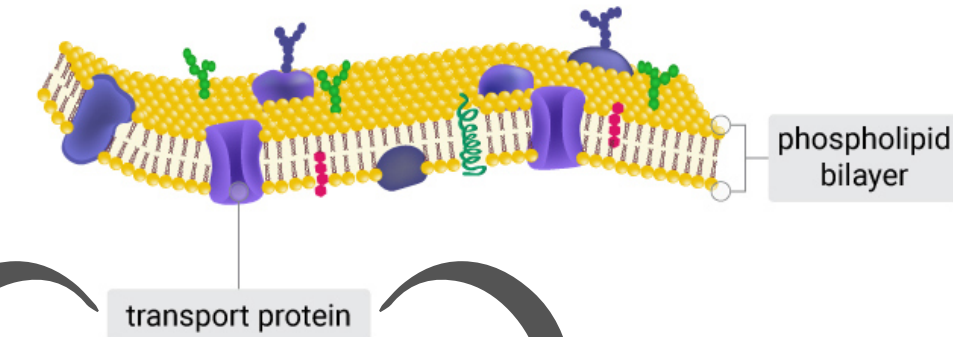
Osmosis

movement of water molecules across the plasma membrane

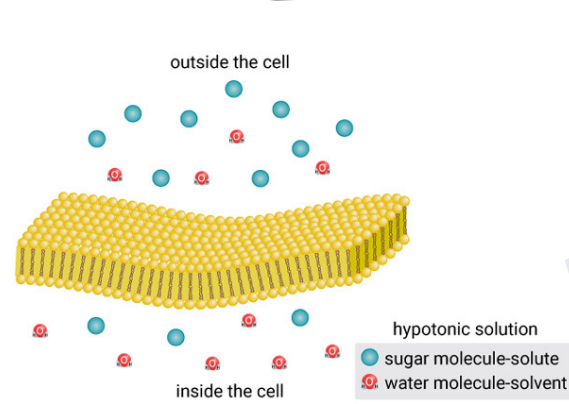
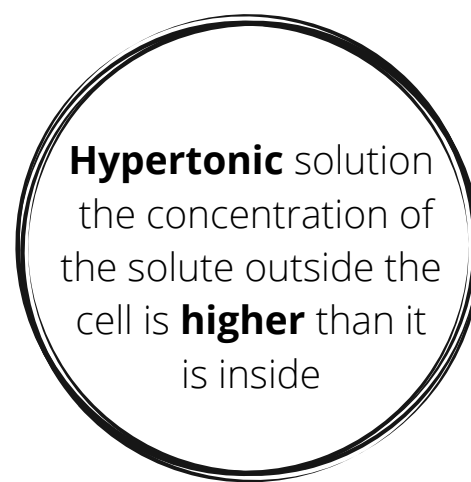
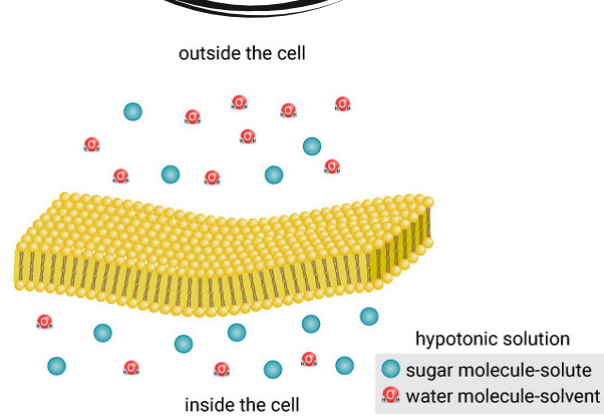
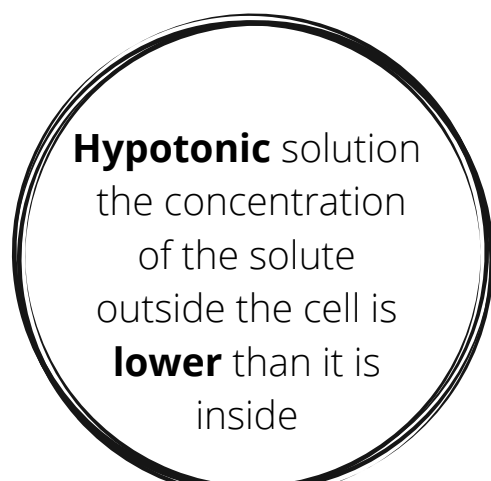
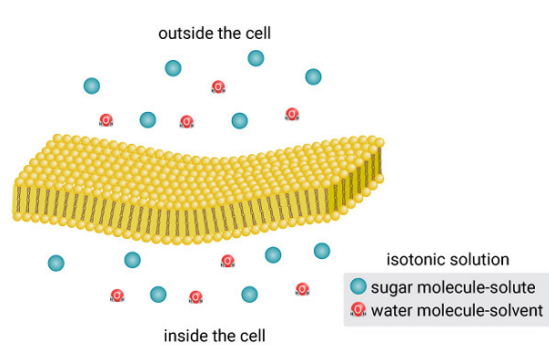
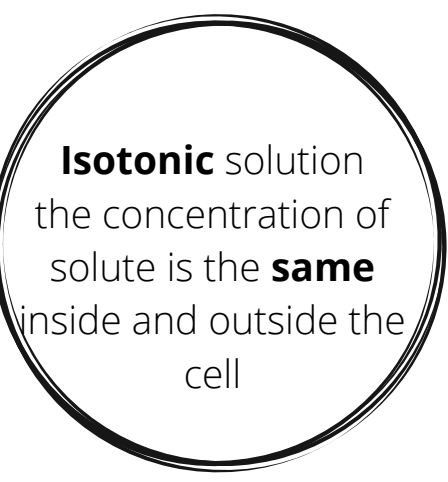


Facilitated diffusion

movement of large or charged molecules, such as proteins and ions, through water-filled transport proteins

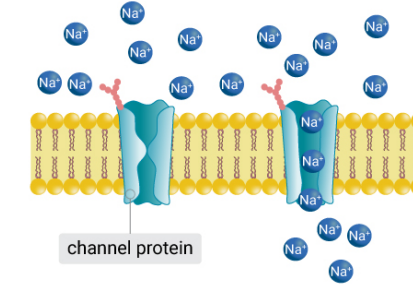


Based on the solute concentration, solutions can be categorized as **isotonic**, **hypotonic**, and **hypertonic** solutions



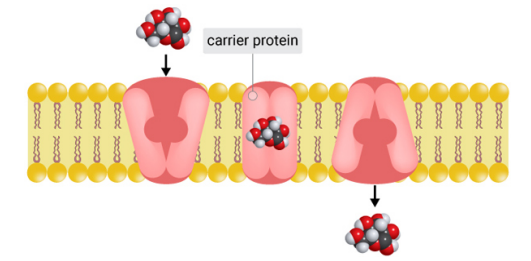
Channel proteins

are like pores that open and close and allow ions to diffuse across the plasma membrane



Carrier proteins

carry large molecules, such as glucose, across the plasma membrane by changing shape after they bind to the molecule



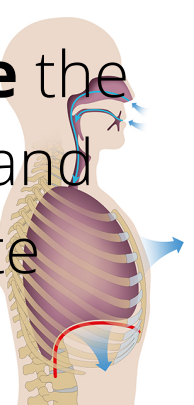
At **dynamic equilibrium**, the concentration of molecules is the same throughout the space. The movement of particles between the two sides still occurs, but the rate of movement is the same

Main **factors** that affect the rate of diffusion

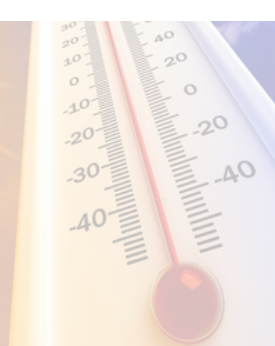
A **higher concentration** can **increase** the number of collisions between the particles, and this increases the diffusion rate



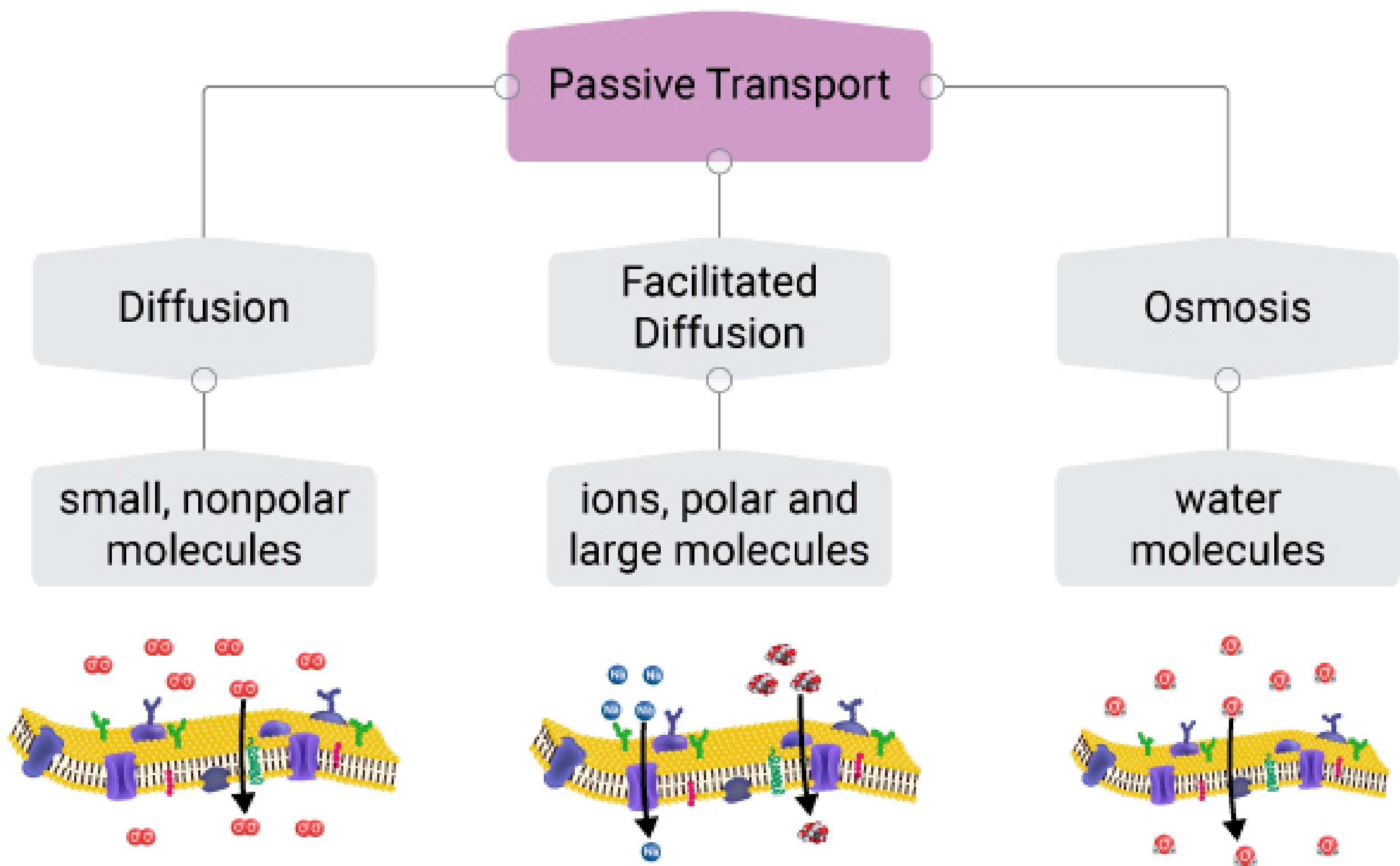
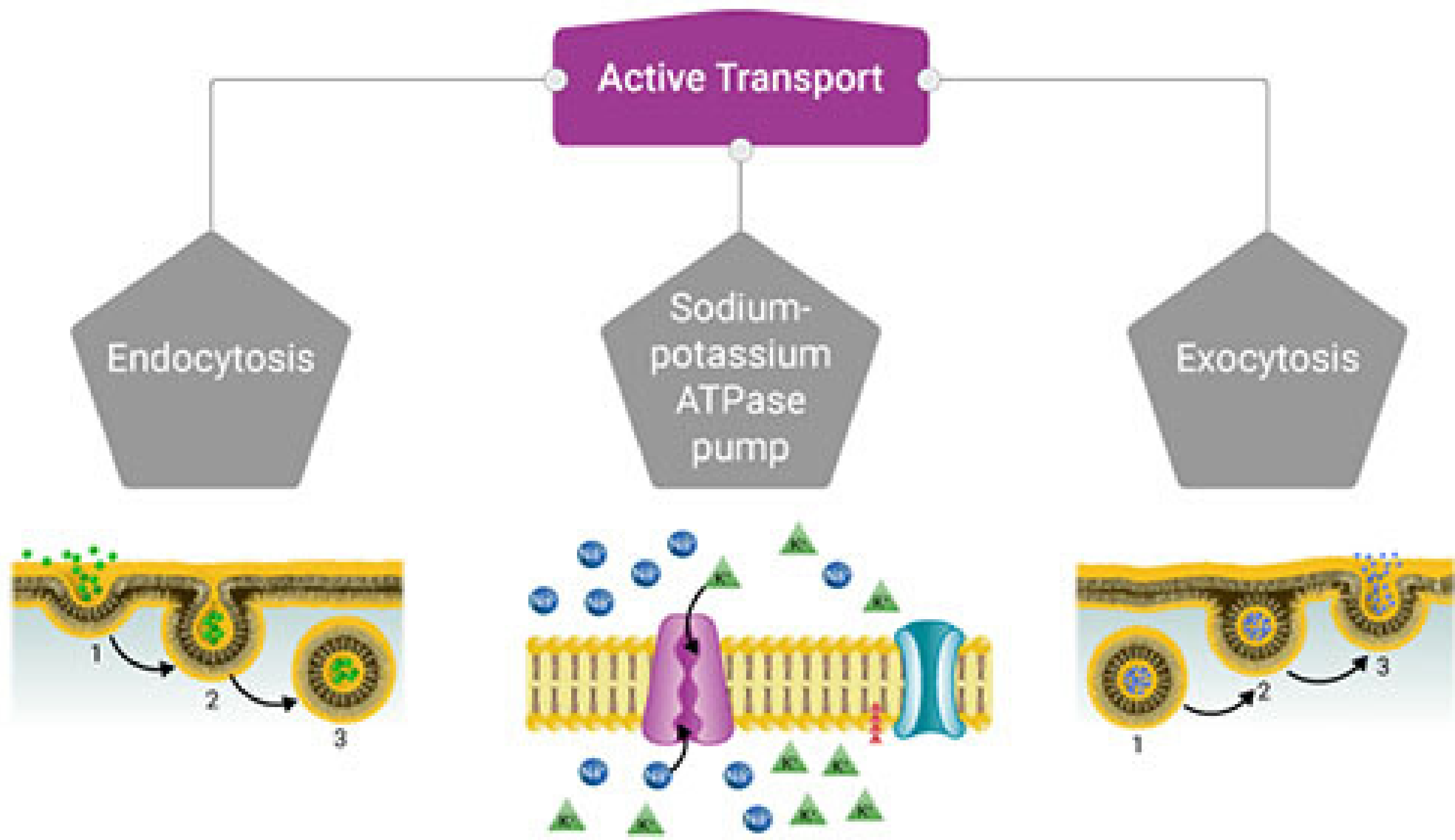
A **higher pressure** can **increase** the collision between the particles, and this increases the diffusion rate



A **higher temperature** can **increase** the speed of collisions between the particles and this increases the diffusion rate



Summary



PRACTICE

Chapter 2: Cellular Structure and Function

Part 1 - Multiple Choice

Identify the choice that best completes the statement or answers the question.

- 1) Which is NOT part of the cell theory?
 - a) The cell is the basic structural and functional unit of living organisms.
 - b) Cells arise from preexisting cells.
 - c) All living things are composed of one or more cells.
 - d) All cells contain nucleus.

- 2) Select the property of the plasma membrane that makes only some substances in and out of a cell.
 - a) selective permeability
 - b) polarity
 - c) viscosity
 - d) fluidity

- 3) Select the site of protein synthesis in the cell.
 - a) plasma membrane
 - b) ribosome
 - c) Golgi apparatus
 - d) chromatin

- 4) All of the following affect the rate of diffusion *except*, _____.
 - a) concentration
 - b) temperature
 - c) pressure
 - d) color

Part 2 - Fill in the Blanks

Complete the sentences below using the word bank.

| | |
|------------------|--------------|
| Word Bank | endocytosis |
| microscope | mitochondria |
| phospholipids | |

- 5) Cells are so small that their existence was unknown before the invention of the _____.
- 6) _____ are the major components of the plasma membrane.
- 7) _____ are the powerhouses of cells.
- 8) Large molecules are moved into the cell using _____.

Part 3 - Matching

Match each term with its correct description by writing the letter on the line.

Set A

- | | |
|------------------------------------|---|
| 9) _____ compound light microscope | a) specialized structure that carries out specific cell functions |
| 10) _____ electron microscope | b) can magnify up to 500,000X |
| 11) _____ organelle | c) cells that contain a nucleus and other organelles that are bound by membranes |
| 12) _____ eukaryotic cells | d) cells without a nucleus or other membrane-bound organelles |
| 13) _____ prokaryotic cells | e) consists of a series of glass lenses and uses visible light to produce a magnified image |

Set B

- | | |
|--------------------------------|--|
| 14) _____ phospholipid bilayer | a) two layers of phospholipids arranged tail-to-tail |
| 15) _____ transport proteins | b) describes the plasma membrane |
| 16) _____ fluid mosaic model | c) move needed substances or waste materials through the plasma membrane |

Set C

- | | |
|---------------------------------|---|
| 17) _____ nucleolus | a) site for protein and lipid synthesis |
| 18) _____ endoplasmic reticulum | b) site of ribosomes production |
| 19) _____ Golgi apparatus | c) vesicle that contains substances that digests excess or worn-out organelles and food particles |
| 20) _____ vacuole | d) sorts and packages proteins into sacs called vesicles |
| 21) _____ lysosome | e) sac used to store food, enzymes, and other materials needed by a cell |

Set D

- | | |
|---------------------------------|--|
| 22) _____ dynamic equilibrium | a) the movement of substances across the plasma membrane against a concentration gradient |
| 23) _____ facilitated diffusion | b) uses transport proteins to move other ions and small molecules across the plasma membrane |
| 24) _____ osmosis | c) the diffusion of water across a selectively permeable membrane |
| 25) _____ active transport | d) a condition of continuous movement but no overall change in the concentration across a membrane |

Part 4 - Short Answer

Answer each question using the space provided.

26) Compare and contrast prokaryotic and eukaryotic cells.

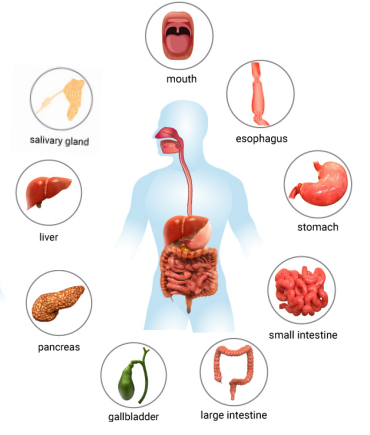
27) Explain how the plasma membrane maintains homeostasis.

28) Compare and contrast structures of plant and animal cells.

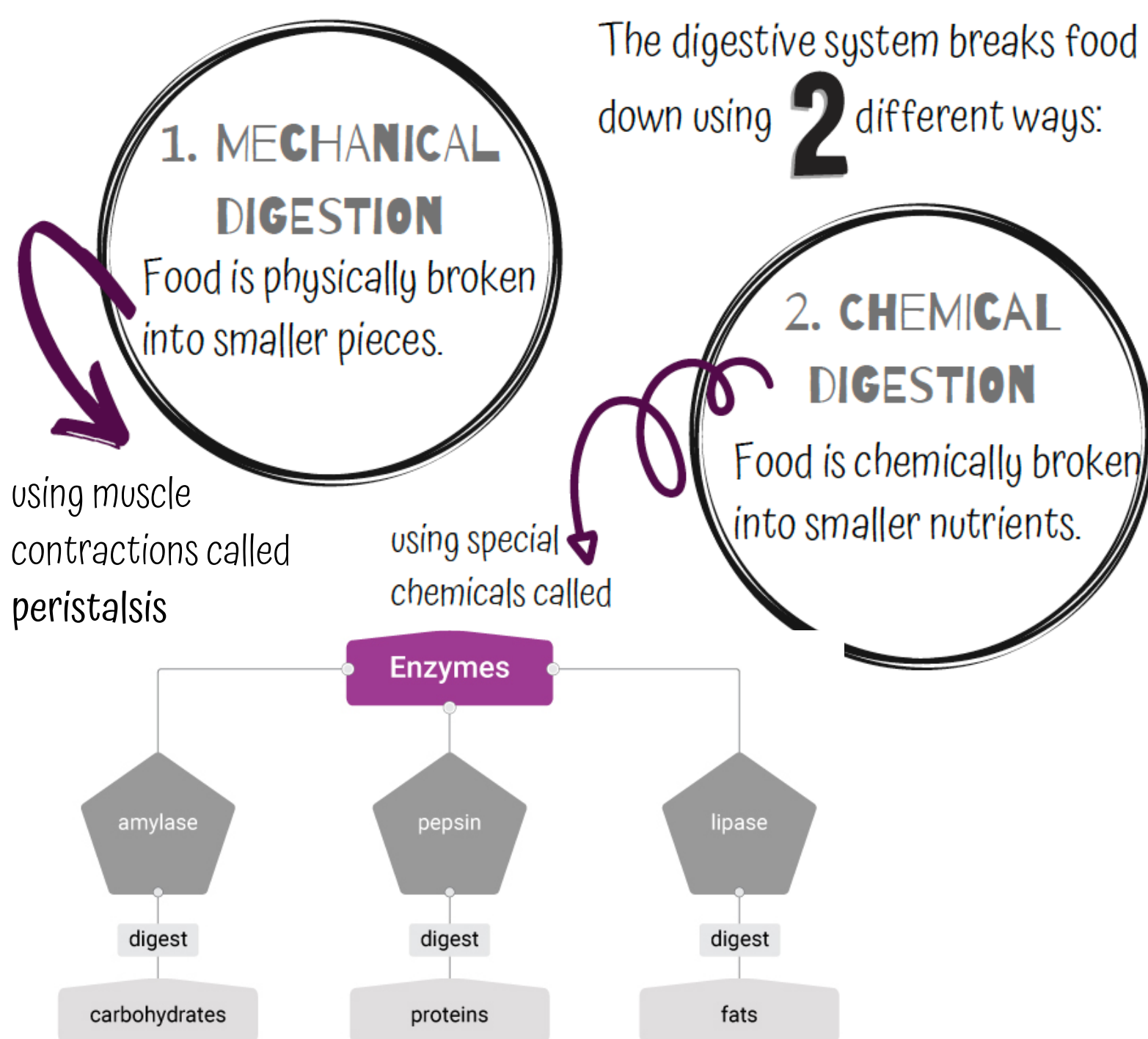
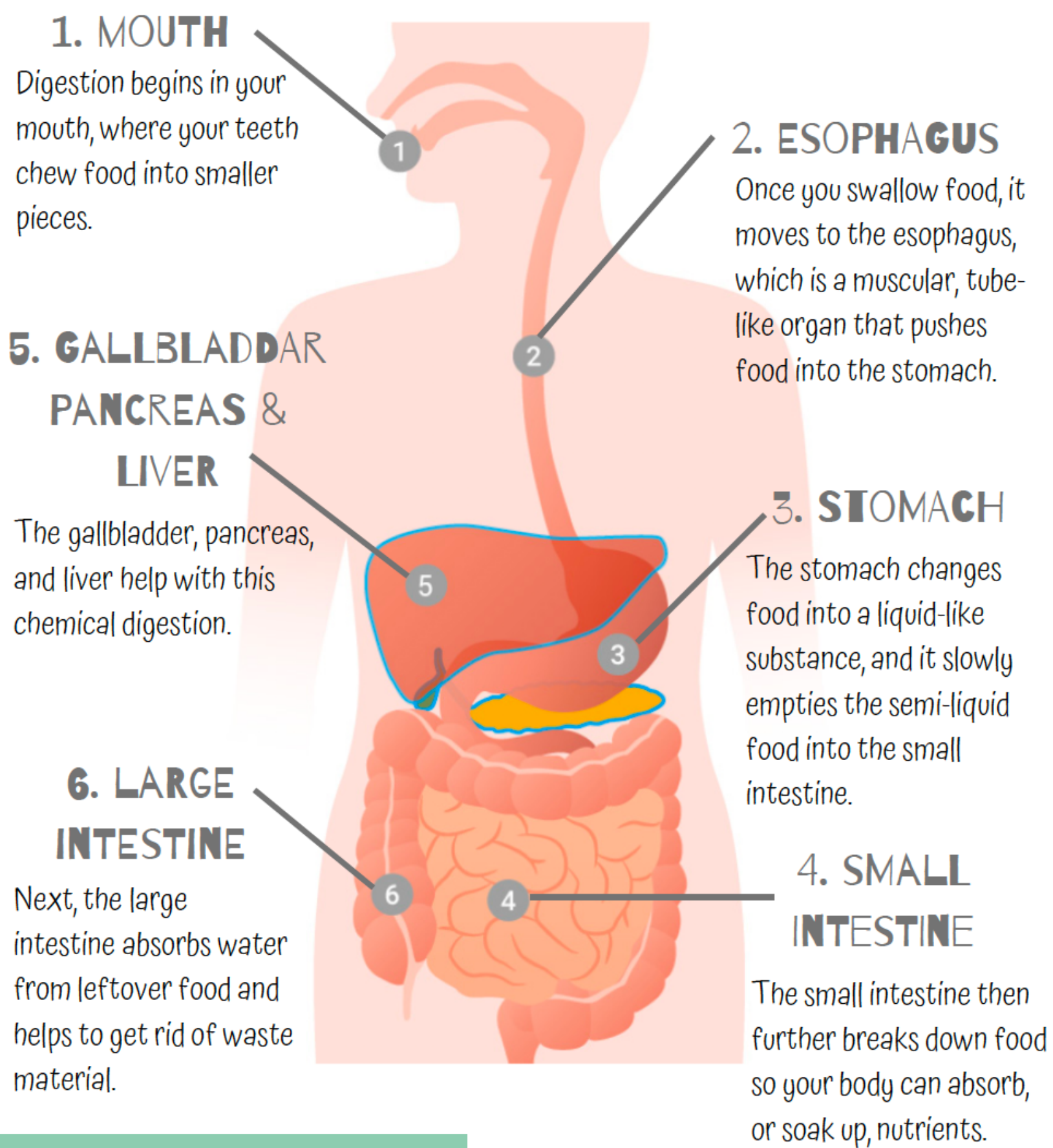
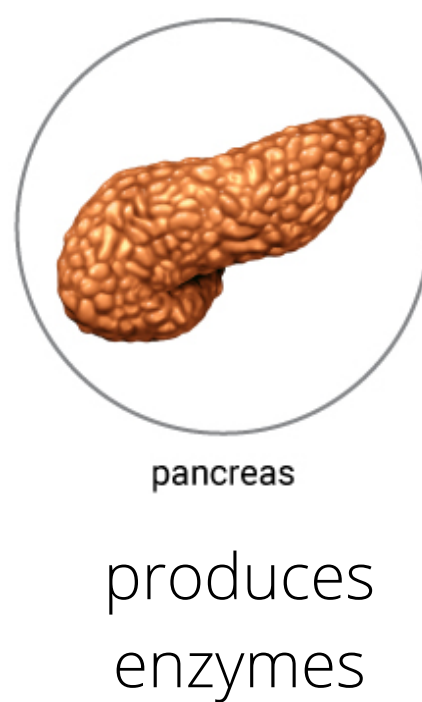
29) Explain what would've happened to a sample of your red blood cells if they were placed in a hypotonic solution, isotonic solution, and hypertonic solution.

The Digestive System

is a group of organs that work together to convert the food into energy and basic nutrients needed to feed the body.



Organs of the Digestive System

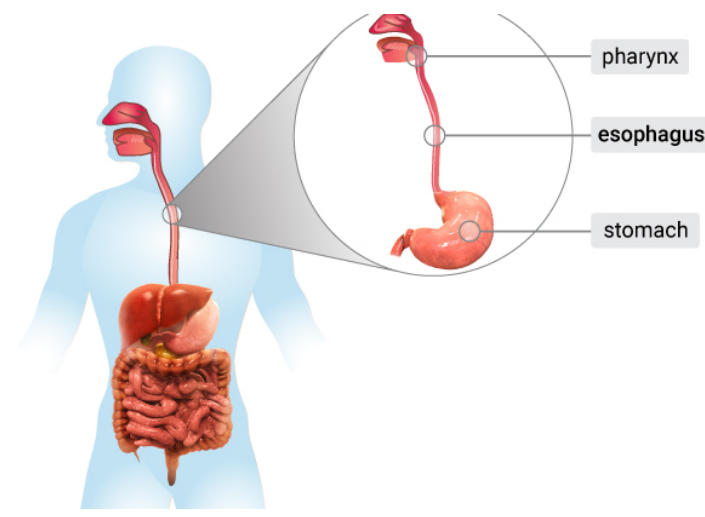


Functions of the Digestive System:

- ingestion of food
- breaking down of food into nutrients that can be absorbed by the body
- elimination of wastes

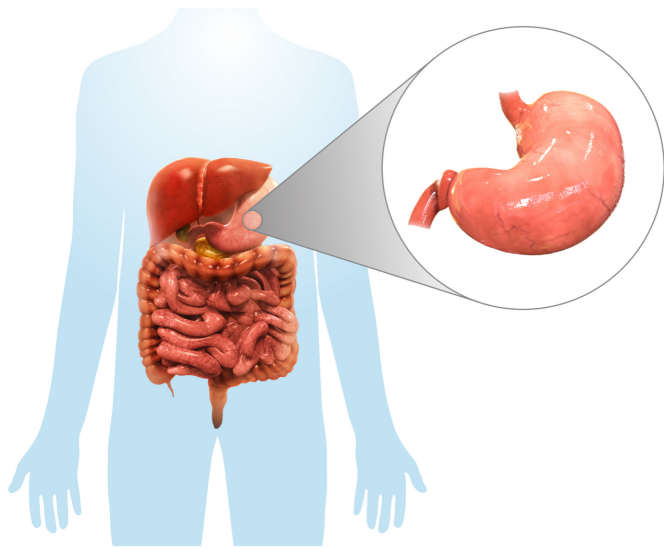
The Digestive Organs

Esophagus



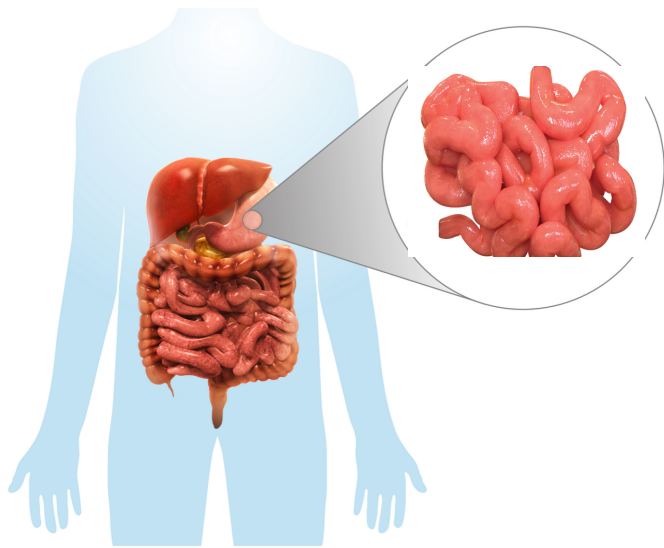
- a hollow, muscular tube that connects the pharynx to the stomach
- has smooth muscles that lines its walls
- 25 cm long
- move the food from mouth to the stomach by *peristalsis*

Stomach



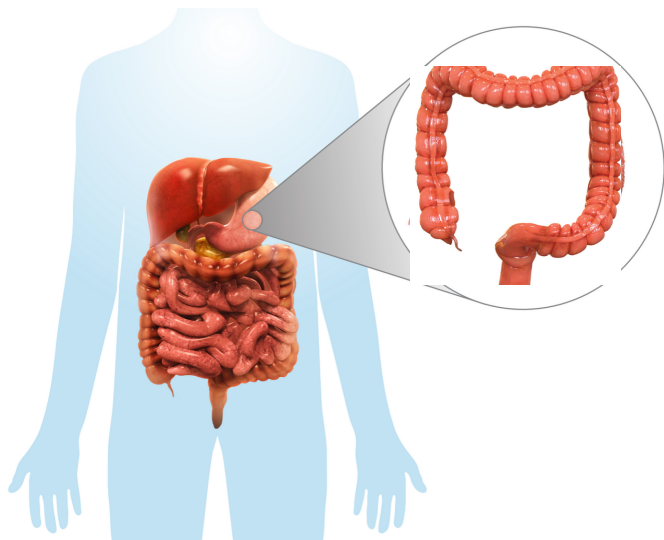
- a hollow, muscular sac that connects the esophagus to the small intestine
- has three overlapping layers of smooth muscles that line its walls
- has capacity of 50 mL when empty and expands to 2 to 4 L when full

Small Intestine



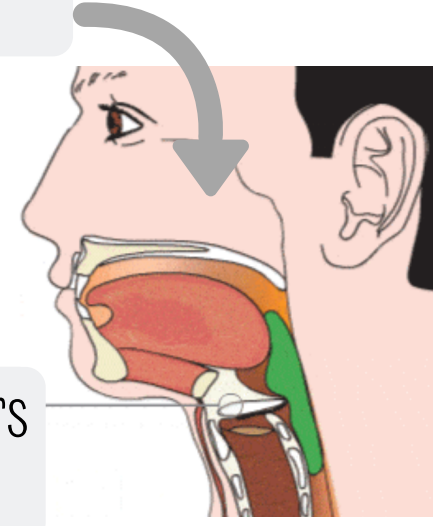
- a long tube that connects the stomach to the large intestine
- the longest part of the digestive tract, about 7 meters long
- has a diameter of 2.5 cm
- has smooth muscles that lines its walls

Large Intestine



- the final section of the digestive tract
- about 1.5 meters long
- has a diameter of 6.5 cm
- includes the colon, the rectum, and the appendix

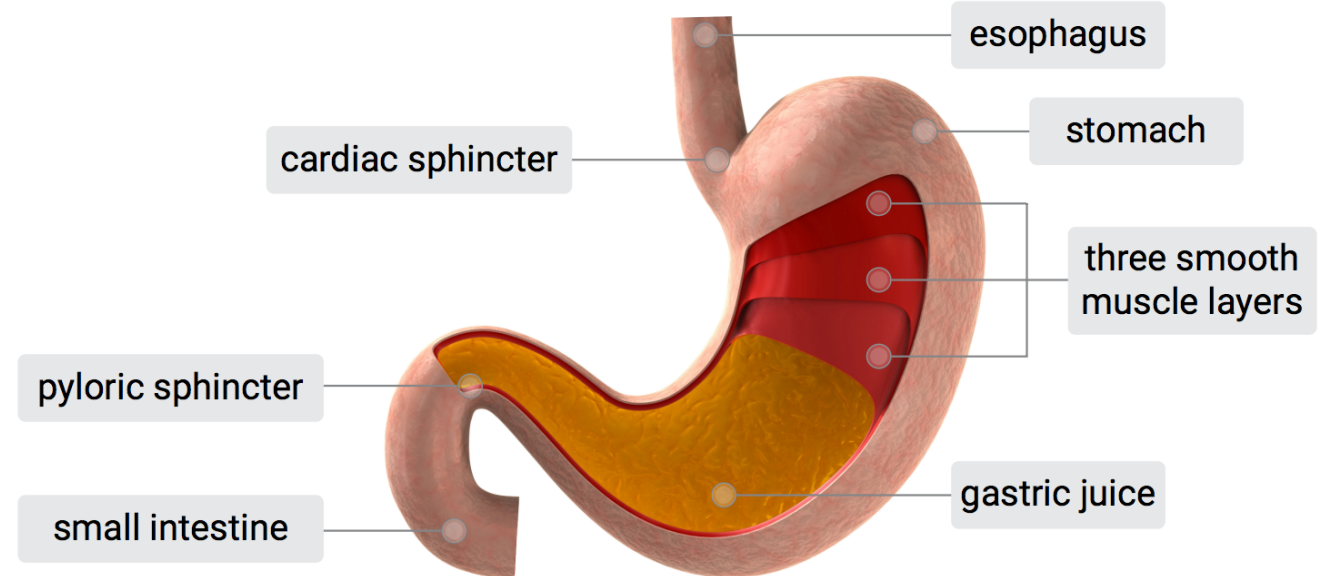
1 you swallow



2 the epiglottis covers your trachea

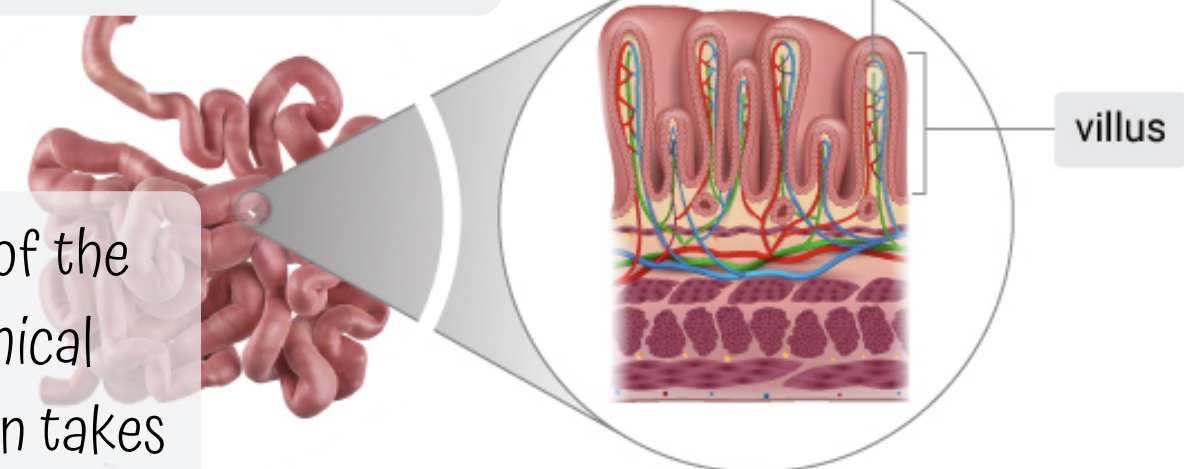
3 the food or drink goes down the esophagus

4 the cardiac sphincter closes after food enters your stomach



5 muscles in the stomach churn food and form chyme

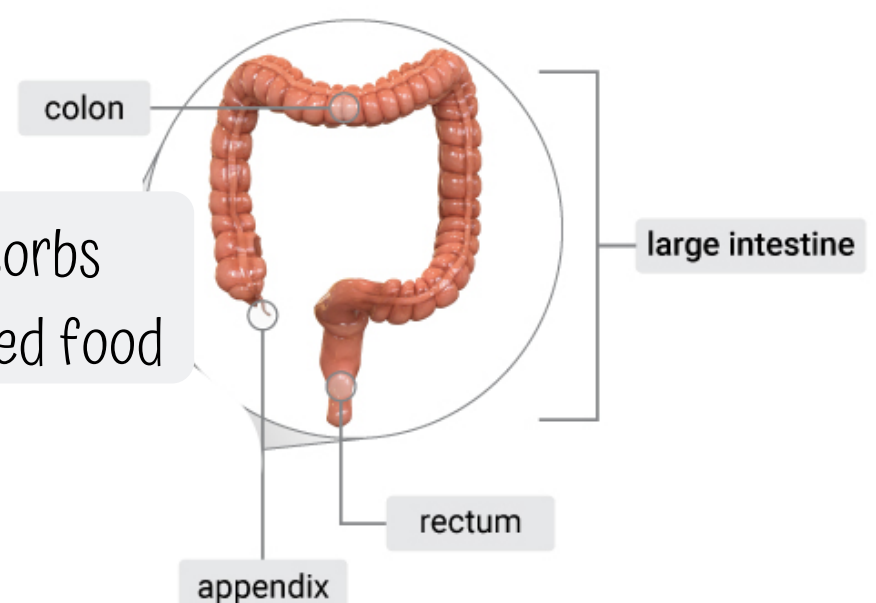
6 chyme leaves your stomach through the pyloric sphincter



7 much of the chemical digestion takes place in the first part of your small intestine

8 the absorption of nutrients occurs villi in the small intestine

9 the large intestine absorbs water from the undigested food



10 solid waste exit the body through the anus

Nutritious EATS!

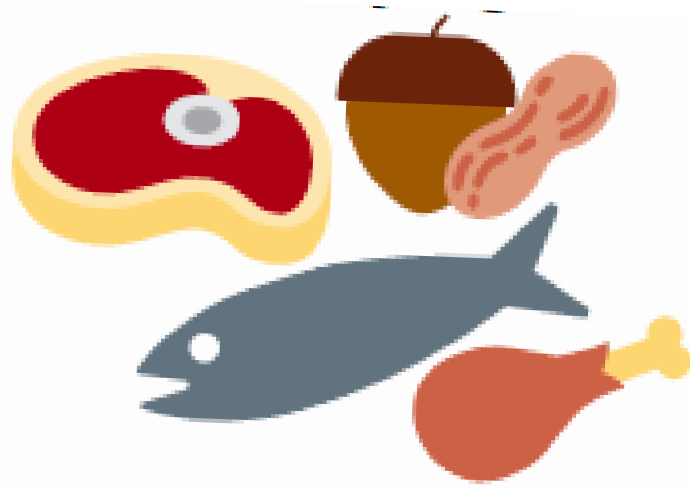
the nutrients you need for cell development, growth, and repair

There are **5** nutrient groups, each with a different function.

proteins

- build and repair cells
- provides structure for bones, skin, nails, and hair

The human body is able to produce 12 out of the 20 amino acids. The other eight are called *essential amino acids* and are obtained from the food you eat.



carbohydrates

the body's major source of energy

Carbohydrates are divided into 2 main classes: simple carbohydrates and complex carbohydrates.



you cannot digest cellulose, but it is important for keeping food moving through the digestive tract

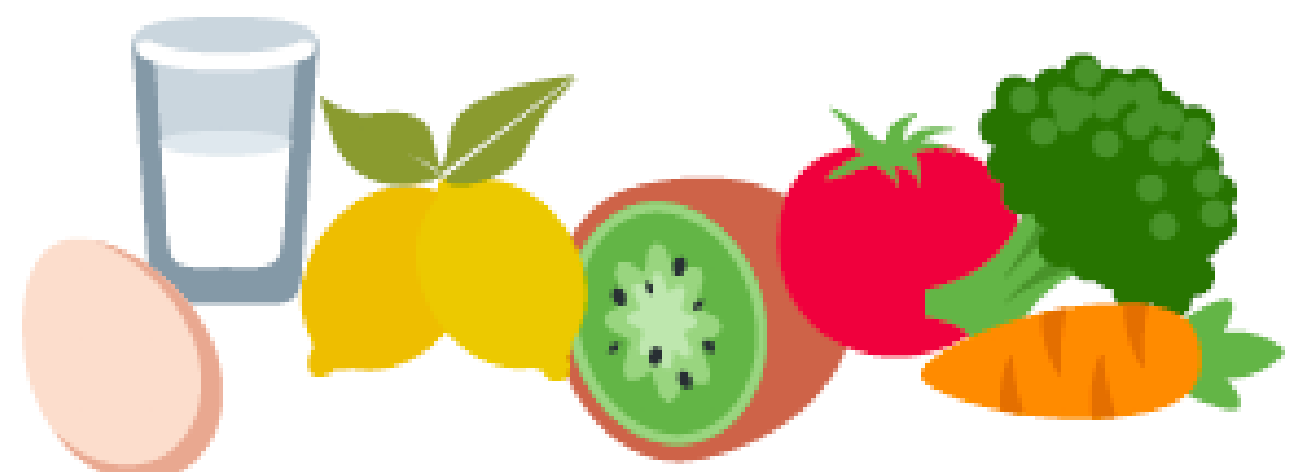
fats

- provides your body with energy and insulation
- help the body absorb vitamins
- are a major part of the cell membrane



vitamins

help regulate body functions and prevent some diseases



minerals

help regulate many chemical reactions



| Mineral | Major Function | Possible Sources |
|-----------------------|---|--------------------------------------|
| Ca (calcium) | • strengthening of teeth and bones • nerve and muscle function | dairy products, salmon |
| P (phosphorus) | • strengthening of teeth and bones | dairy products, meat |
| Mg (magnesium) | • synthesis of proteins | whole grains, green leafy vegetables |
| Fe (iron) | • synthesis of hemoglobin | meat, legumes |
| Cu (copper) | • synthesis of hemoglobin | meat, nuts |
| Zn (zinc) | • healing of wounds | meat, seafood |
| Cl (chlorine) | • balance of water | table salt, processed food |
| I (iodine) | • synthesis of thyroid hormone | fish, milk |
| Na (sodium) | • nerve and muscle function • balance of pH | table salt, processed food |
| K (potassium) | • nerve conduction • contraction of muscles | banana, orange |

| Mineral | Major Function | Possible Sources |
|-----------------------|---|--------------------------------------|
| Ca (calcium) | • strengthening of teeth and bones • nerve and muscle function | dairy products, salmon |
| P (phosphorus) | • strengthening of teeth and bones | dairy products, meat |
| Mg (magnesium) | • synthesis of proteins | whole grains, green leafy vegetables |
| Fe (iron) | • synthesis of hemoglobin | meat, legumes |
| Cu (copper) | • synthesis of hemoglobin | meat, nuts |
| Zn (zinc) | • healing of wounds | meat, seafood |
| Cl (chlorine) | • balance of water | table salt, processed food |
| I (iodine) | • synthesis of thyroid hormone | fish, milk |
| Na (sodium) | • nerve and muscle function • balance of pH | table salt, processed food |
| K (potassium) | • nerve conduction • contraction of muscles | banana, orange |

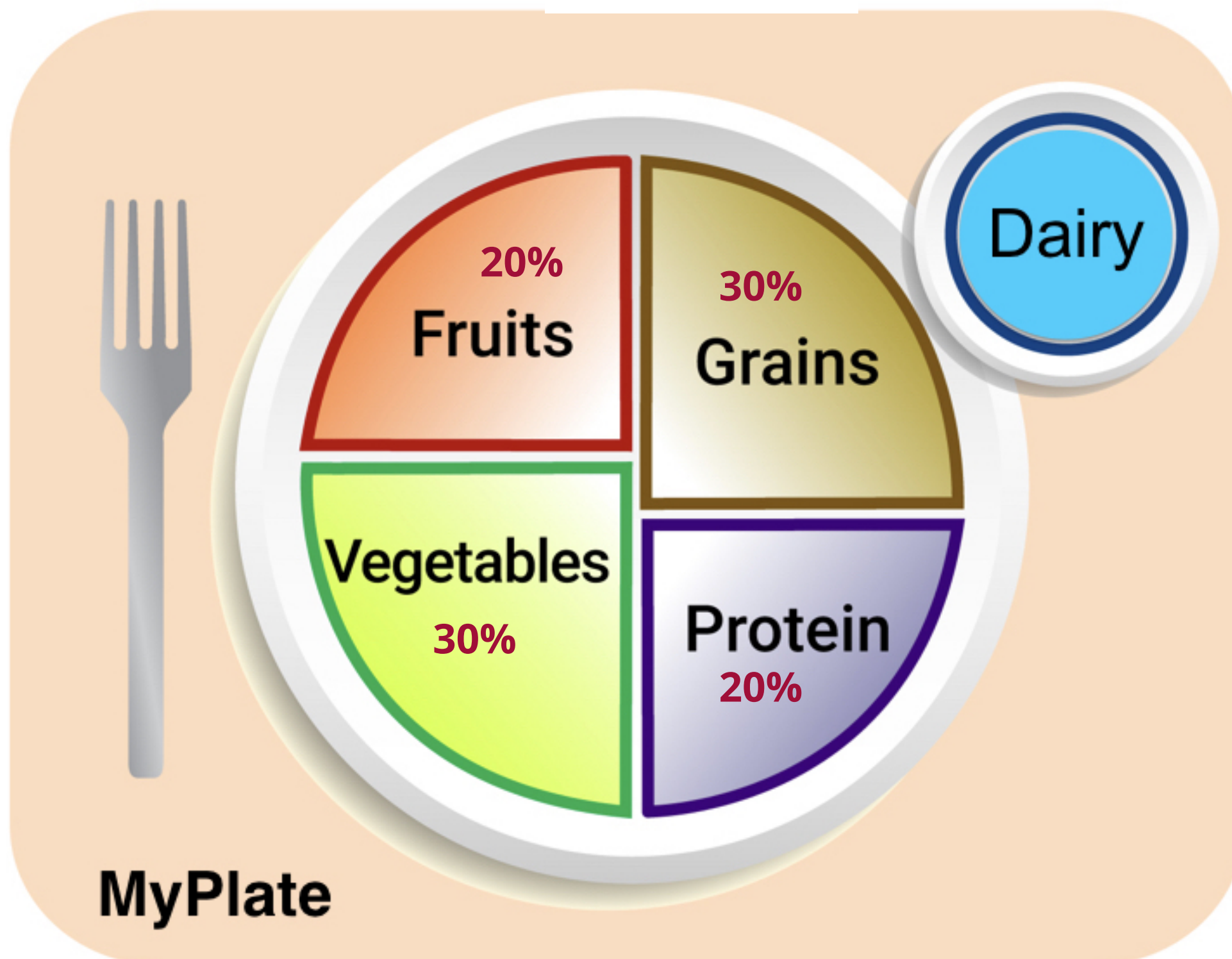
A Balanced Diet

includes ALL 5 nutrient groups



1 provides your body with the nutrients to stay strong and healthy

2 provides your body with the energy it needs to function



amount of energy in a given food or drink → **Calorie**

Not all food have the same energy!

A Calorie is the amount of energy needed to raise the temperature of 1 millileter of water by 1 degree Celsius.

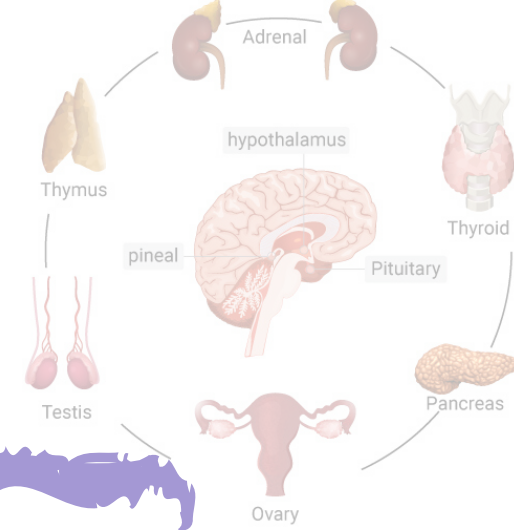
| Nutrient (1 gram) | Number of Calories |
|-------------------|--------------------|
| carbohydrate | 4 |
| protein | 4 |
| fat | 9 |
| vitamin | 0 |
| mineral | 0 |

TIP

Food labels help you keep a balanced diet by telling you what nutrients a food of drink contains!

The Endocrine System

is composed of **glands** that produce and secrete **hormones** and functions as a communication system for the body.



What are endocrine glands?

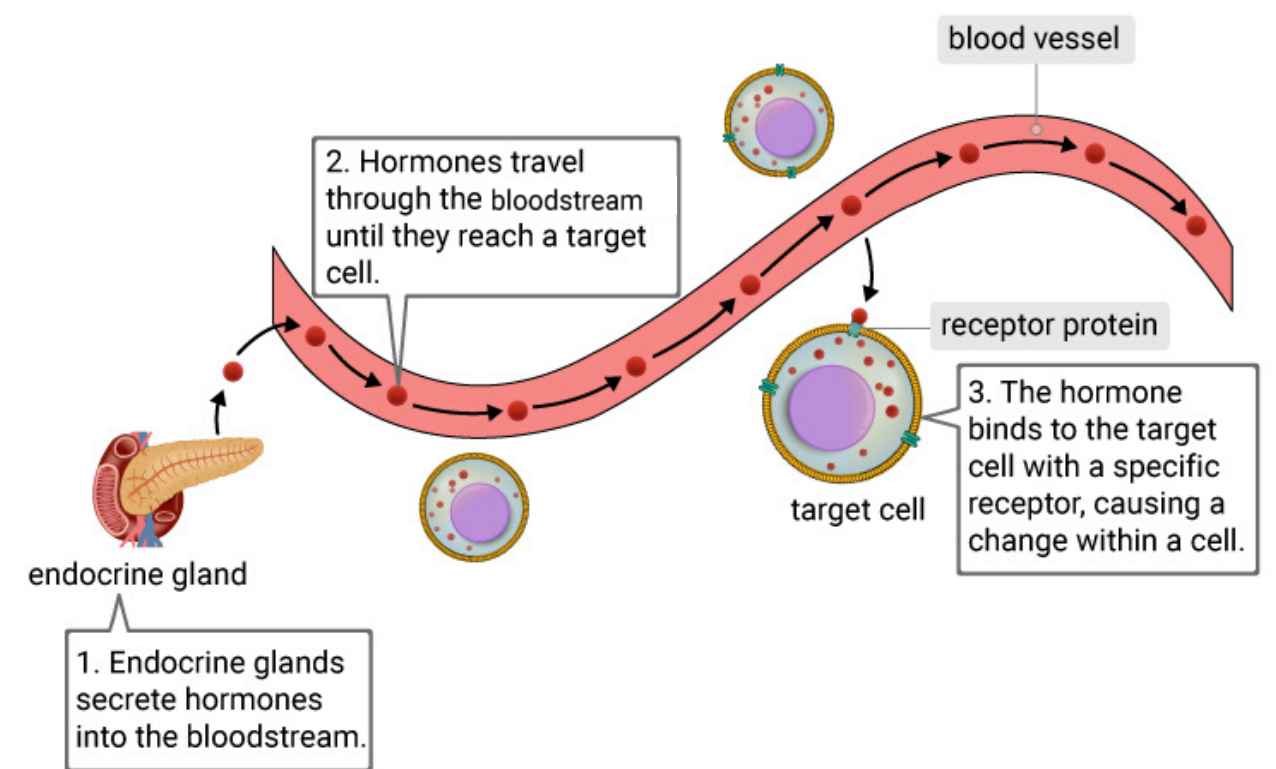
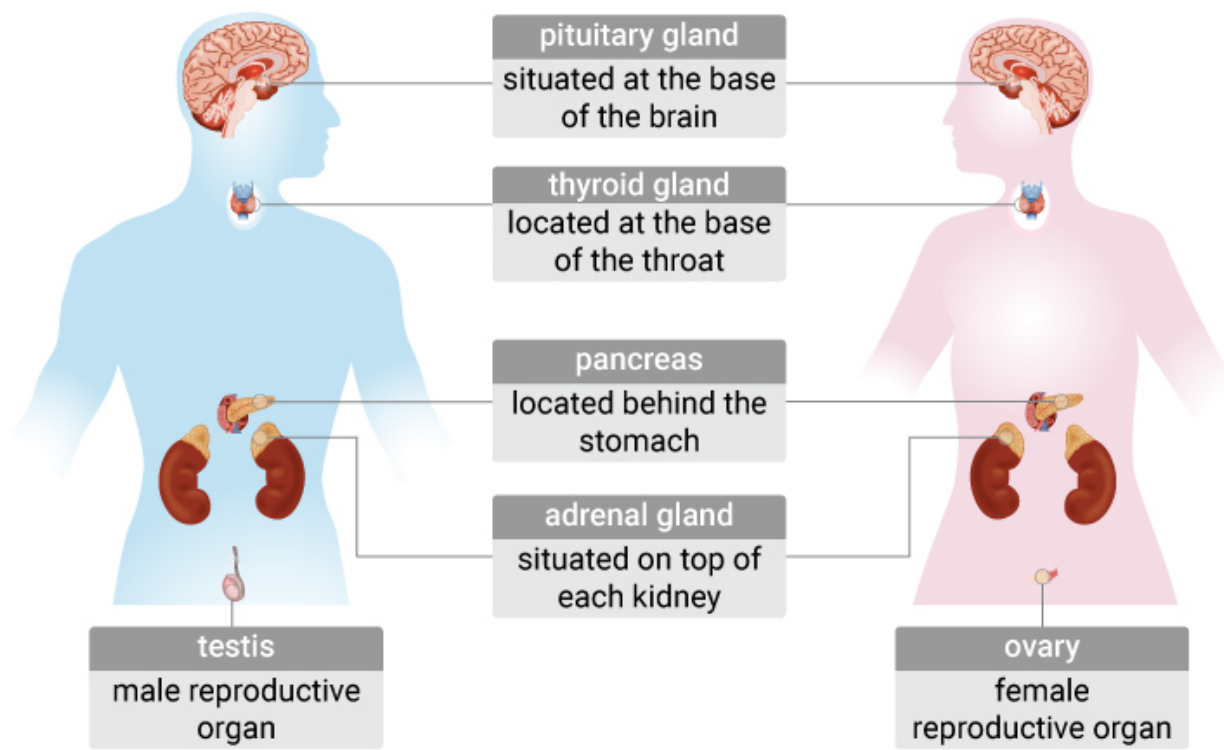
Endocrine glands are glands that release their hormones directly into the bloodstream.

What are hormones?

Hormones are chemical messengers that travel in the bloodstream and act on target cells.

Male Endocrine Glands

Female Endocrine Glands



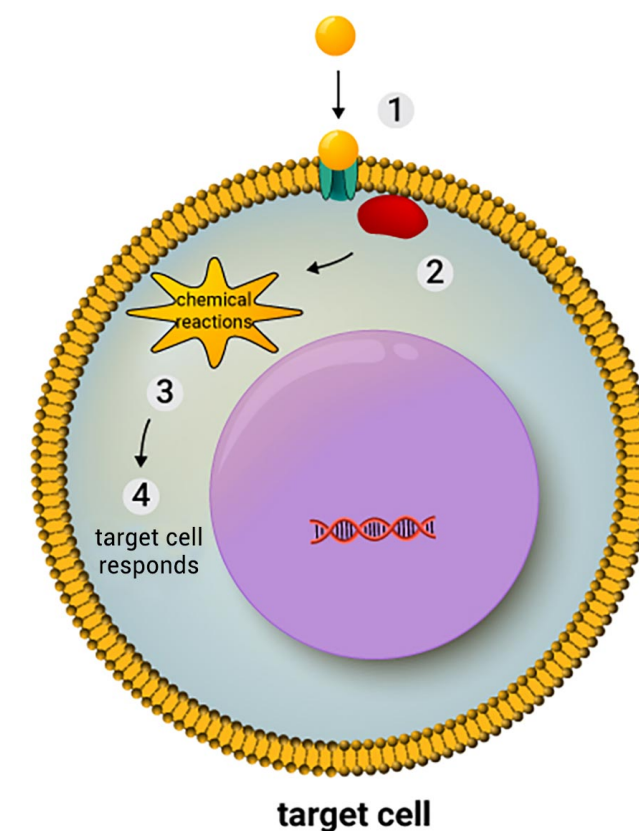
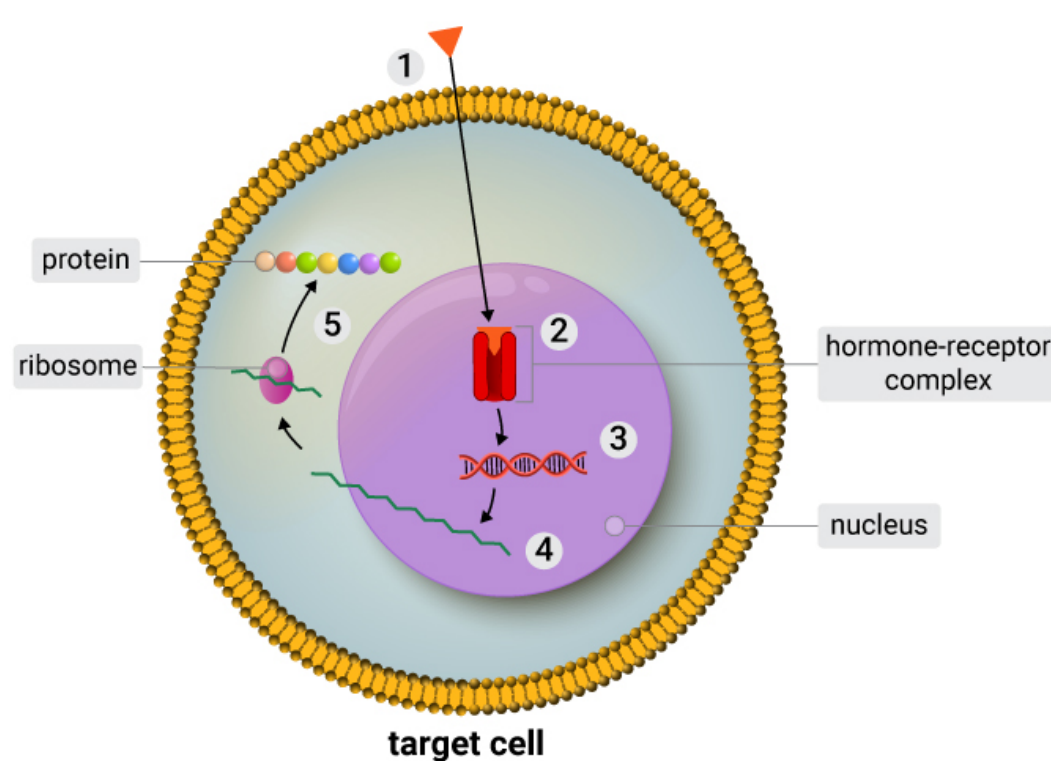
Types of Hormones

Steroid Hormones

- composed of lipids - cholesterol
- can easily pass through the plasma membrane because they are soluble in lipids
- bind to receptors inside the cell
- examples of steroid hormones include: estrogen and progesterone

Amino Acid Hormones

- composed of amino acids
- cannot easily pass through the plasma membrane because they are not soluble in lipids
- bind to receptors on the surface of the cell
- examples of amino acid hormones include: insulin and growth hormones

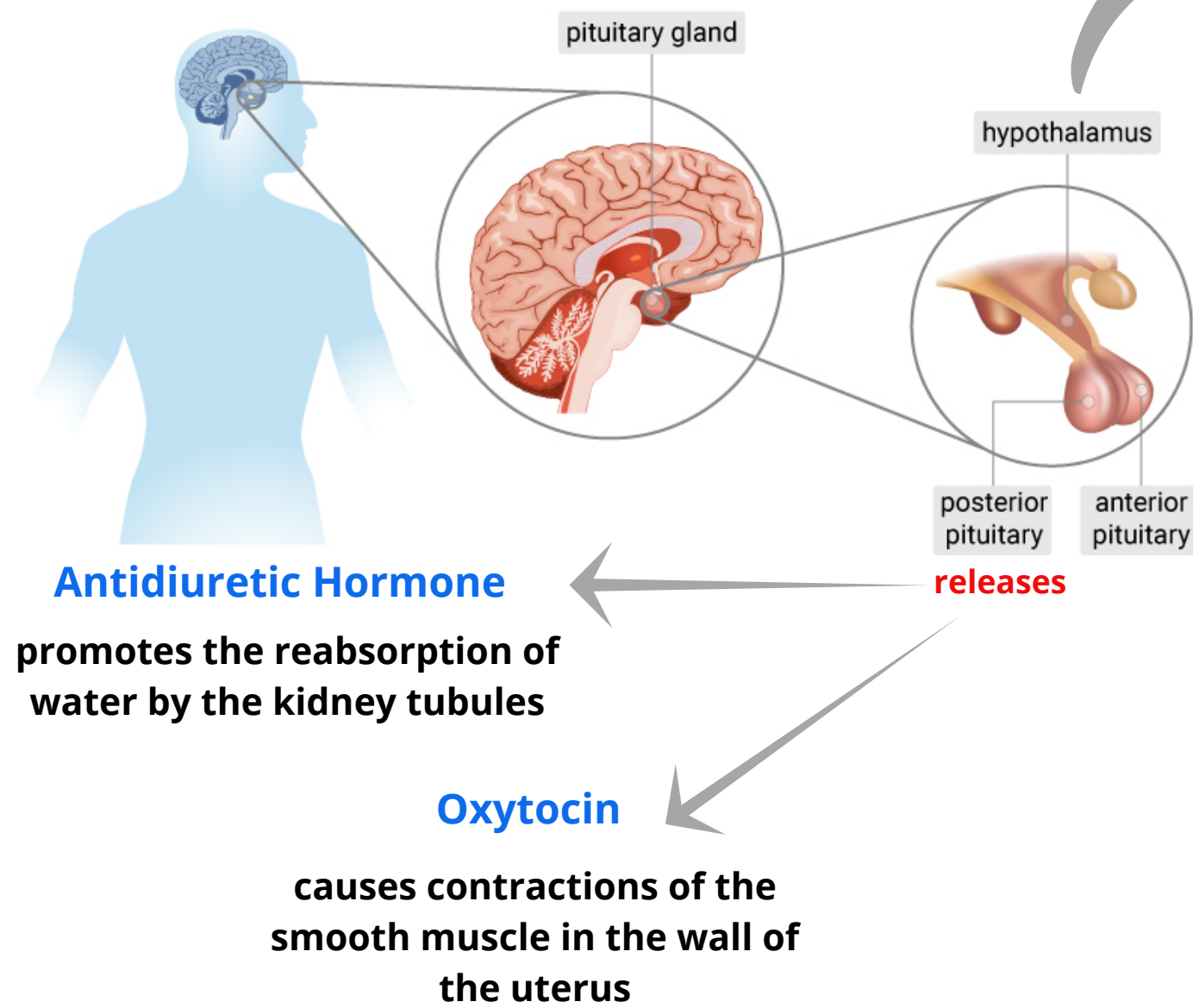


Steroid hormones act by entering the nucleus and activate specific genes.

Amino acid hormones initiate biochemical pathway causing the cell to produce the desired response.

Glands of the Endocrine System

Pituitary Gland

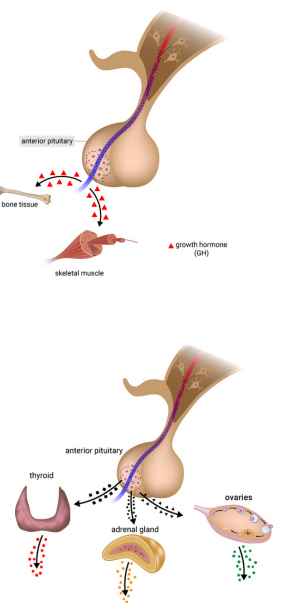


The hypothalamus:

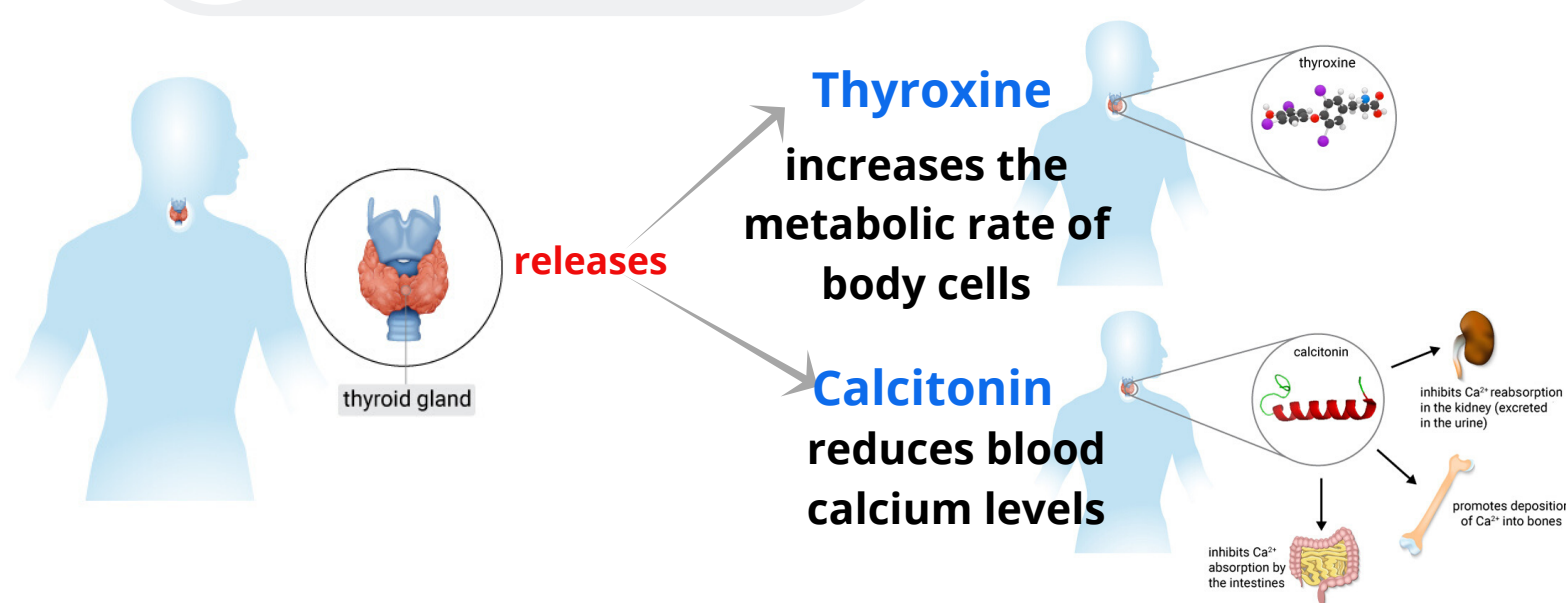
- controls the **anterior pituitary**
- makes hormones that are stored in the **posterior pituitary**

Human Growth Hormone regulates the body's physical growth by stimulating cell division in muscle and bone tissue

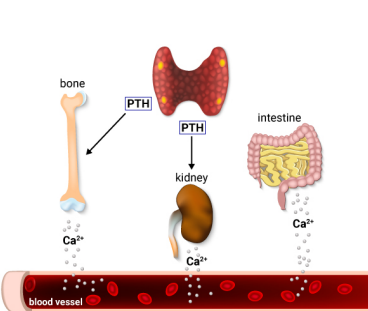
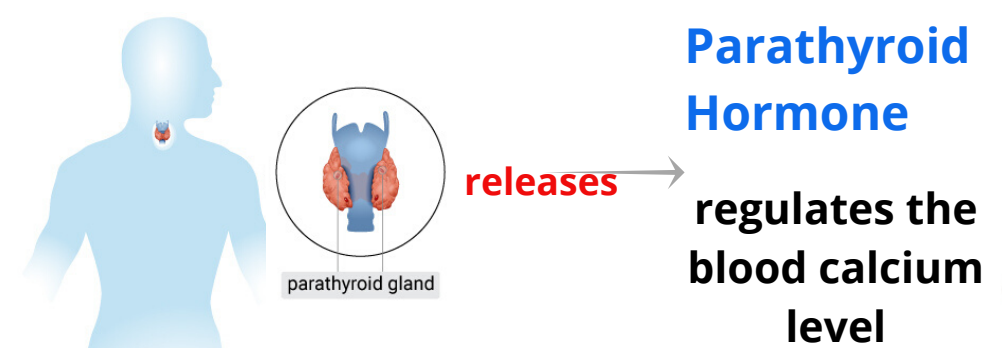
other hormones regulate other endocrine glands



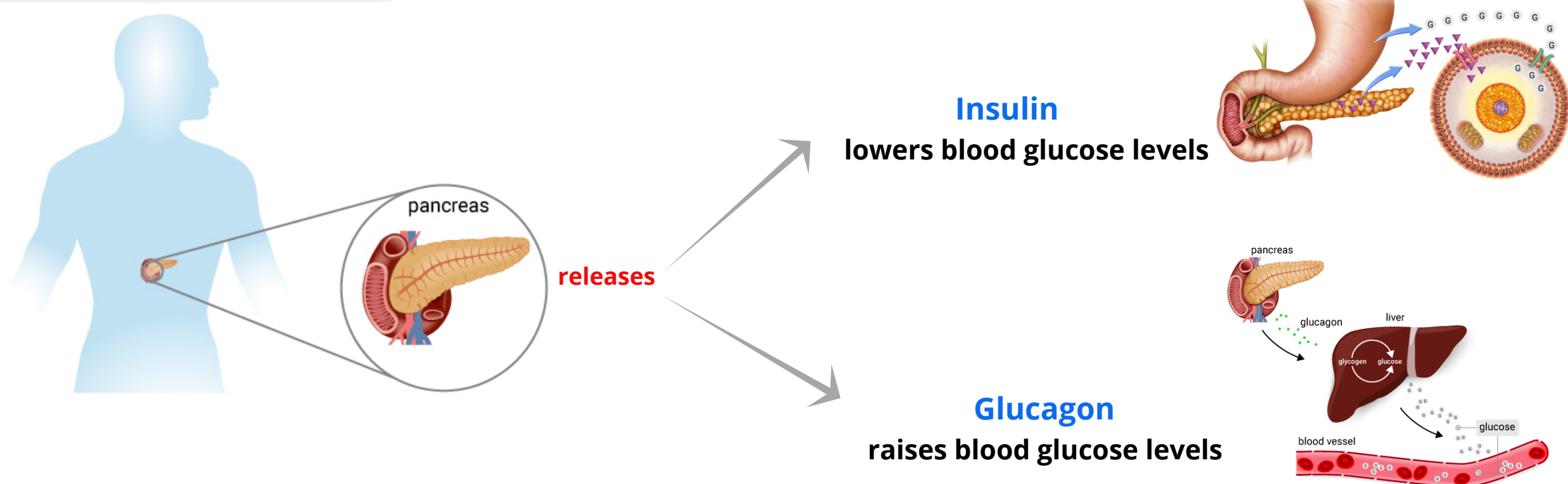
Thyroid Gland



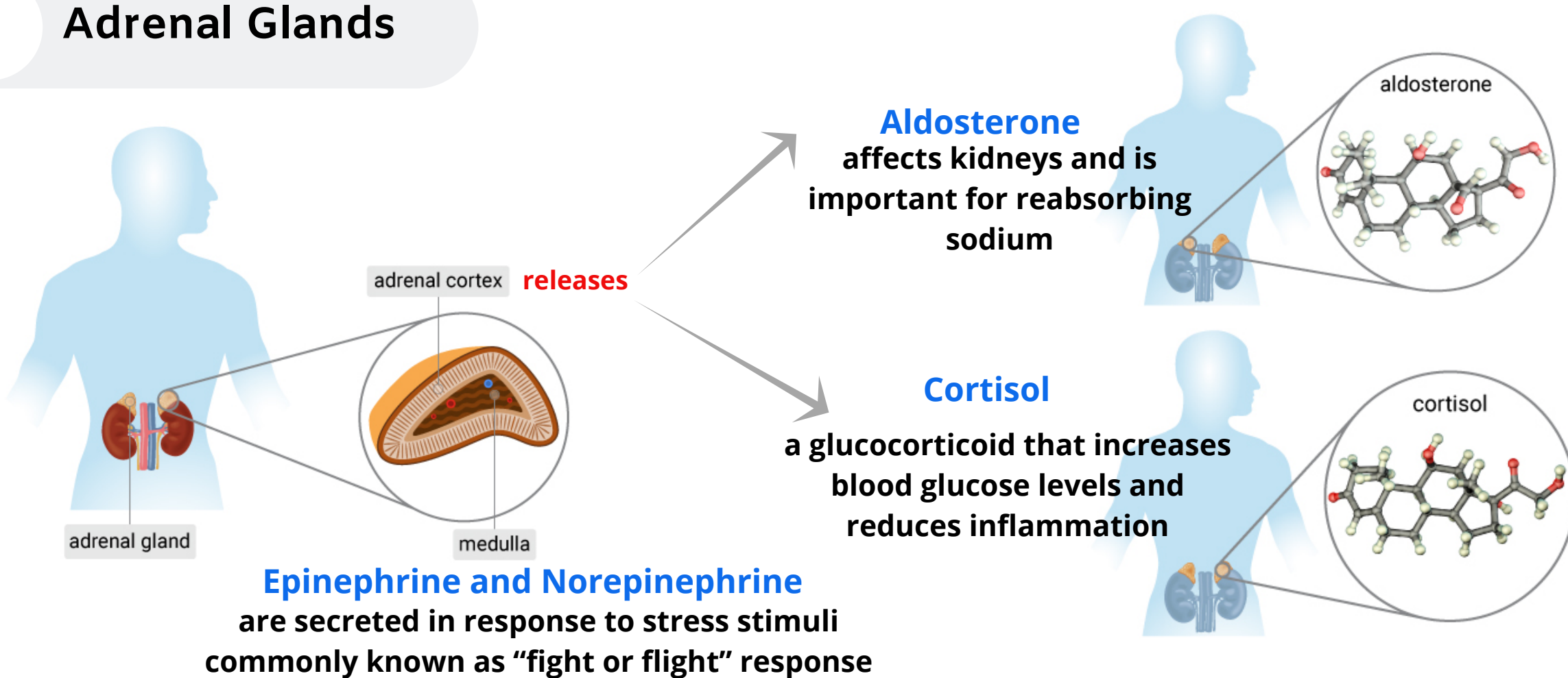
Parathyroid Gland



Pancreas



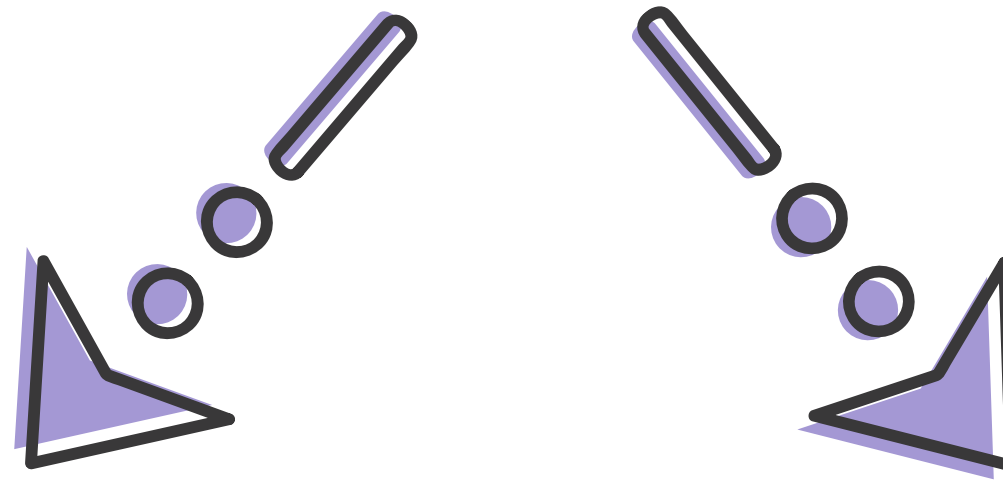
Adrenal Glands



The Endocrine System & Homeostasis

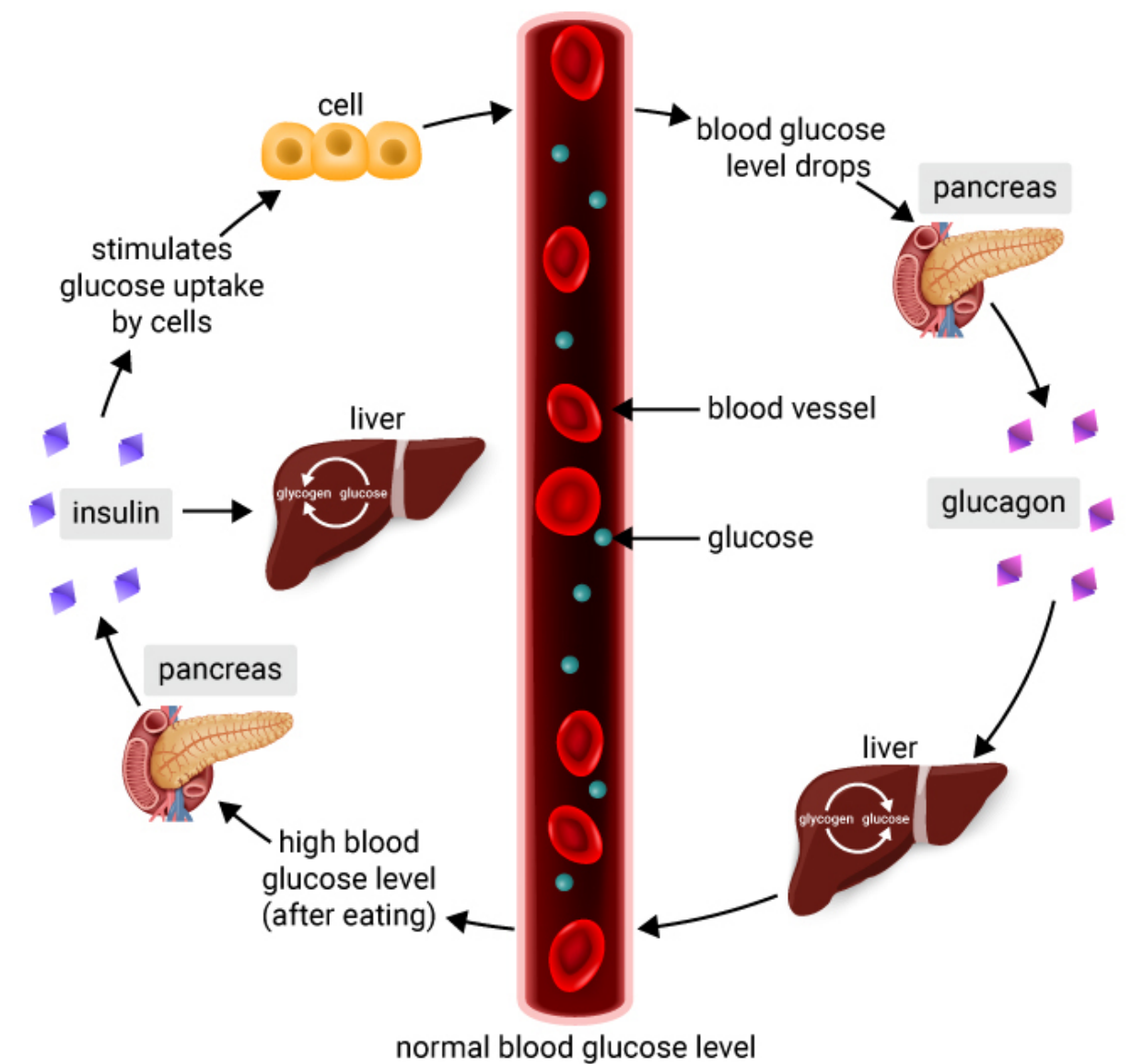
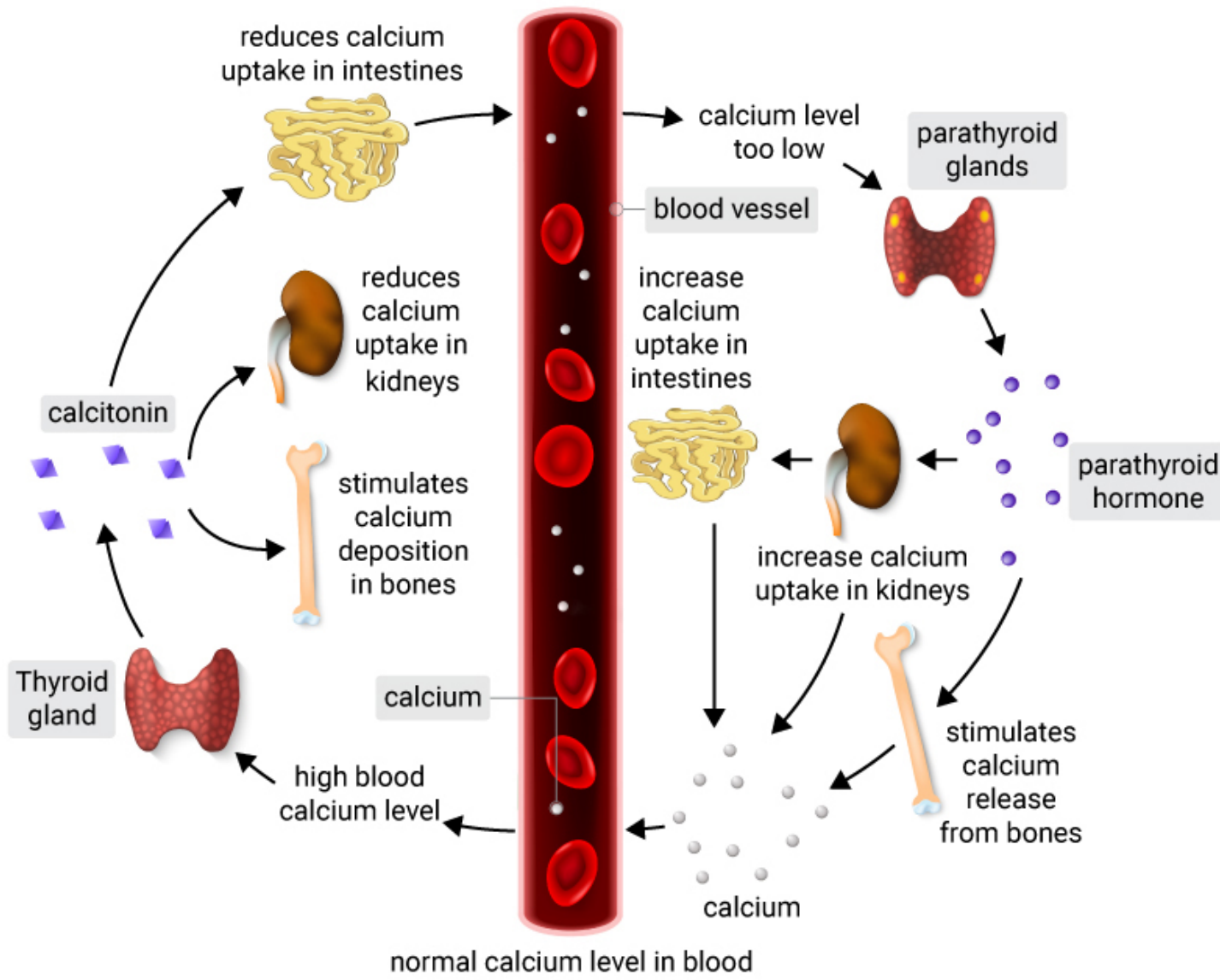
Homeostasis in the body is maintained by internal feedback mechanisms called **negative feedback**.

Negative feedback returns the system to a set point once it deviates from it.



Thyroid and **parathyroid hormones** have opposite actions. They maintain the level of **calcium** in blood by a negative feedback loop.

Insulin and **glucagon** have opposite actions. They maintain the level of **glucose** in blood by a negative feedback loop.



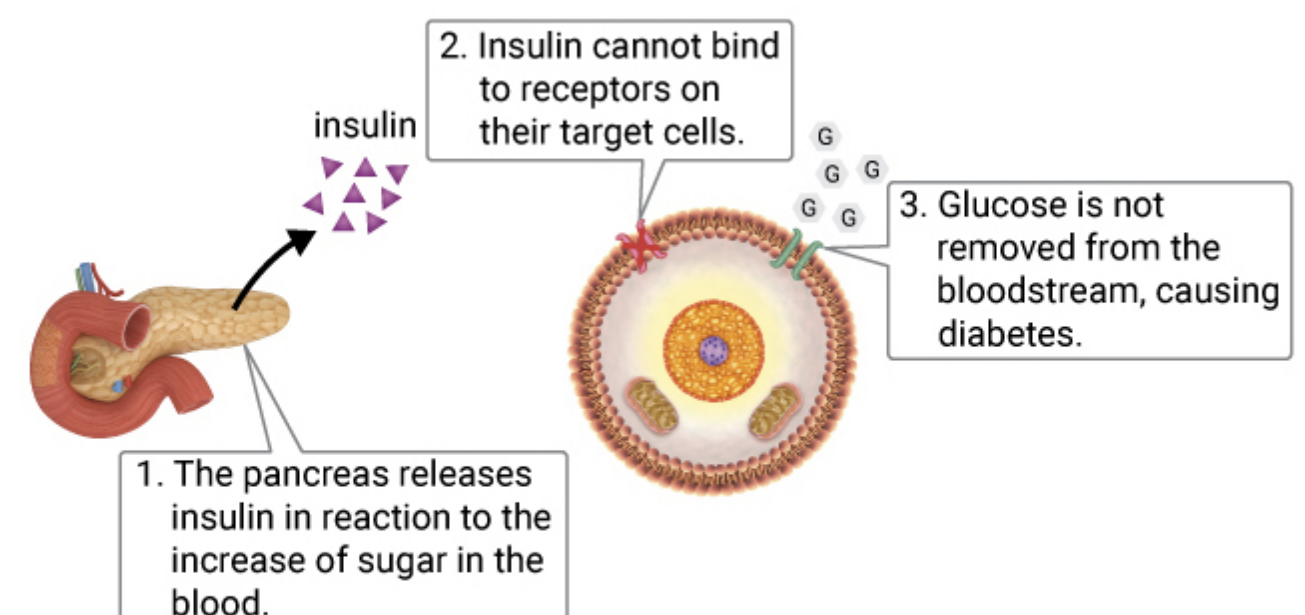
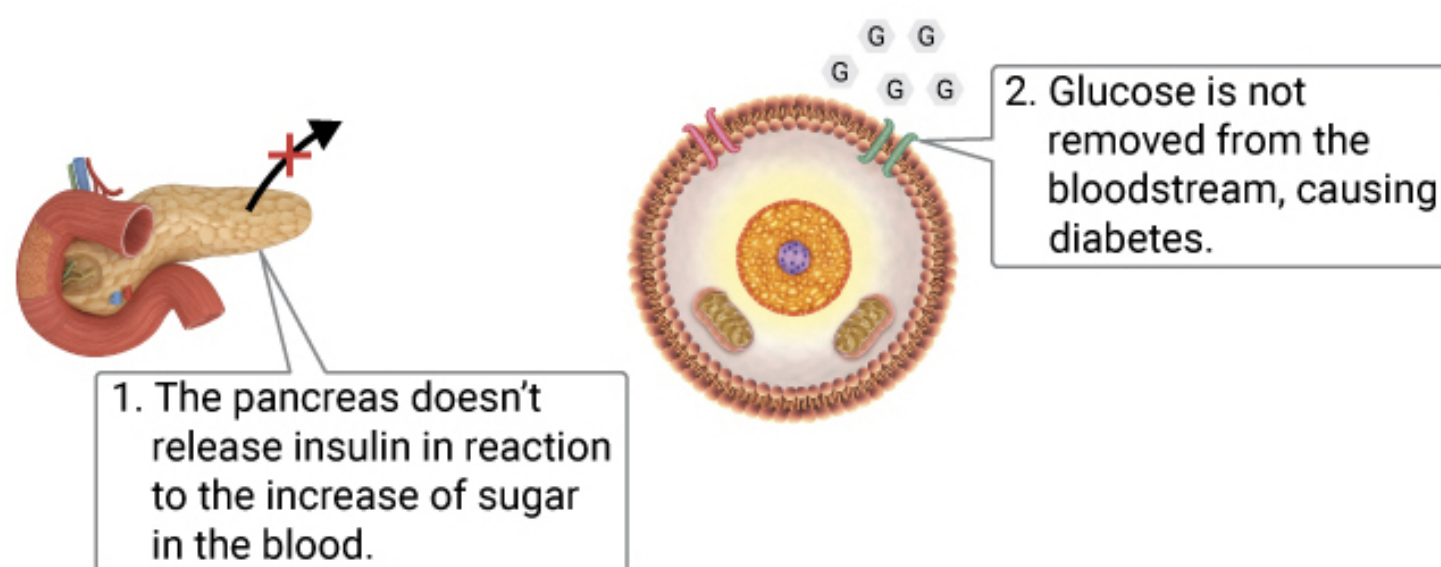
Diabetes

Type 1 Diabetes

- little or no insulin is produced by the pancreas
- appears by the age of 20

Type 2 Diabetes

- the cells of the body do not respond to insulin
- occurs after the age of 40



PRACTICE

Chapter 3: Digestive and Endocrine System

Part 1 - Multiple Choice

Identify the choice that best completes the statement or answers the question.

- 1) A person complaining of digestion problems is not digesting fats well because _____.
 - a) the pyloric sphincter is blocked
 - b) the bile duct is blocked
 - c) the person is secreting excess bile
 - d) the stomach is secreting too much acid

- 2) which pairs of hormones have opposite effects?
 - a) calcitonin and parathyroid hormone
 - b) epinephrine and norepinephrine
 - c) growth hormone and thyroxine
 - d) aldosterone and cortisol

- 3) Which action takes place in the stomach?
 - a) Large fat molecules are digested into smaller molecules.
 - b) Proteins are broken down.
 - c) Amylase breaks down starches into smaller sugar molecules.
 - d) Insulin is secreted for use in the small intestine.

- 4) Select the correct statement.
 - a) Liver produces bile which is secreted into the small intestine.
 - b) Gall bladder produces pepsin which is secreted into the stomach.
 - c) Pancreas produces acid which is secreted into the large intestine.
 - d) Villi produces amylase which is secreted into the mouth.

Part 2 - Fill in the Blanks

Complete the sentences below using the word bank.

| | |
|---------------------|---------------------------|
| Word Bank | Saturated fats |
| A low pH and pepsin | Antidiuretic and oxytocin |
| Cellulose | |

- 5) _____ combination in the stomach break down high-protein foods.
- 6) _____ is not digestible and provides fiber in your diet.
- 7) _____ are derived from animal sources and are solid at room temperature.
- 8) _____ hormones are released from nerve cells rather than from endocrine glands.

Part 3 - Matching

Match each term with its correct description by writing the letter on the line.

Set A

- 9) _____ thyroid gland
 - 10) _____ posterior pituitary gland
 - 11) _____ anterior pituitary gland
- a) secretes human growth hormones
 - b) secretes calcitonin
 - c) secretes oxytocin

Set B

- 12) _____ steroid hormones
 - 13) _____ amino acids hormones
 - 14) _____ hormones
- a) composed of amino acids
 - b) are chemical messengers
 - c) composed of lipids

Set C

- 15) _____ nutrition
 - 16) _____ fats
 - 17) _____ proteins
 - 18) _____ vitamins
- a) organic compounds needed in small amounts
 - b) include enzymes, hormones, and neurotransmitters
 - c) a process by which a person takes in and uses food
 - d) protects some internal organs

Part 4 - Short answer

Answer each question using the space provided.

19) Explain the difference between the terms:
insulin, glucagon

20) For the set of terms below, choose the one term that does not belong and explain why it does not belong.
pepsin, glycogen, glucose

21) Describe what is Calorie?

22) What is Type 1 diabetes?

Answer Key

PRACTICE

Chapter 1: Chemistry in Biology

Part 1 - Multiple Choice Questions

Identify the choice that best completes the statement or answers the question.

- 1) Neutrons and protons are located at the center of the atom, which is called the _____.
a) nucleus
b) electron cloud
c) isotope
d) energy level
- 2) A(n) _____ is a substance that lowers the activation energy needed to start a chemical reaction.
a) catalyst
b) isotope
c) activation energy
d) reactant
- 3) _____ is a measure of the concentration of hydrogen ions in a solution.
a) pH
b) solvent
c) solute
d) buffer
- 4) Carbohydrates, lipids, proteins, and nucleic acids are _____.
a) biological macromolecules
b) micromolecules
c) monomers
d) buffers

Part 2 - Fill in the Blanks

Complete the following sentences using the word bank.

| | | |
|------------------|-----------|---------------|
| Word Bank | acids | amino acids |
| bases | element | peptide bonds |
| products | reactants | |

- 5) A(n) [**element**] is a pure substance that cannot be broken into other substances by physical or chemical means.
- 6) [**acids**] are substances that release hydrogen ions into solutions. [**bases**] are substances that release hydroxide ions into solutions.
- 7) A chemical equation shows the [**reactants**], the starting substances, on the left side of the arrow. The [**products**], the substances formed during the reaction, are on the right side of the arrow.

8) Proteins are made from [**amino acids**] that are joined by [**peptide bonds**].

Part 3 - Matching

Match each term to its correct description by writing the letter on the line.

Set A

- | | |
|-----------------------------------|---|
| 9) <u> a </u> electrons | a) negatively charged particles that are located outside the nucleus of an atom |
| 10) <u> d </u> protons | b) particles that have no charge and are located in the nucleus of an atom |
| 11) <u> b </u> neutrons | c) pure substances formed when two or more different elements combine |
| 12) <u> e </u> isotopes | d) positively charged particles that are located in the nucleus of an atom |
| 13) <u> f </u> elements | e) atoms of the same element that have different numbers of neutrons |
| 14) <u> c </u> compounds | f) pure substances that cannot be broken down into other substances by physical or chemical means |

Set B

- | | |
|---|---|
| 15) <u> d </u> enzyme | a) a substance that binds to an enzyme |
| 16) <u> a </u> substrate | b) the specific location where a substrate binds on an enzyme |
| 17) <u> c </u> activation energy | c) the energy required to start a reaction |
| 18) <u> b </u> active site | d) a protein that speeds up a chemical reaction |

Set C

- | | |
|--|--|
| 19) <u> a </u> solvent | a) a substance in which another substance is dissolved |
| 20) <u> e </u> solute | b) a molecule that has an unequal distribution of charges |
| 21) <u> f </u> solution | c) a mixture that can react with acids or bases to keep the pH within a particular range |
| 22) <u> b </u> polar molecule | d) a weak interaction involving a hydrogen atom and a fluorine, oxygen, or nitrogen atom |
| 23) <u> d </u> hydrogen bond | e) the substance that is dissolved in the solvent |
| 24) <u> c </u> buffer | f) a mixture that has a uniform composition throughout |

Set D

- | | |
|---------------------------------------|--|
| 25) <u> b </u> carbohydrates | a) are made up of nucleic acids |
| 26) <u> c </u> lipids | b) are made up of sugars |
| 27) <u> a </u> nucleic acids | c) are made up of fatty acids and glycerol |

Part 4 - Short Answer

Answer each question using the space provided.

- 28) Relate the structure of water to its ability to its characteristics.
Water molecules are polar, so they form hydrogen bonds. This gives water unique properties, such as a universal solvent, cohesion, adhesion, and density (liquid water becomes more dense as it cools to 4°C).
- 29) Identify and describe factors that can influence enzyme activity.
There are several factors that affect the speed of an enzyme's action, such as the concentration of the enzyme, the concentration of the substrate, temperature, and pH.
- 30) What is cellulose? Why humans can't digest it?
Cellulose is a carbohydrate found in plants that provides structural support in cell walls. Humans are unable to digest cellulose because the appropriate enzymes to break it down are lacking.
- 31) Compare van der Waals forces, ionic bonds, and covalent bonds.
*1) Covalent bond: The bond that is formed by mutual sharing of electrons.
2) Ionic bond: The bond that is formed by the complete transfer of electrons from one atom to another atom.
3) Van der Waal: These are weak interactions between one molecule with other polar or nonpolar molecules to hold to each other.*

PRACTICE

Chapter 2: Cellular Structure and Function

Part 1 - Multiple Choice

Identify the choice that best completes the statement or answers the question.

- 1) Which is NOT part of the cell theory?
 - a) The cell is the basic structural and functional unit of living organisms.
 - b) Cells arise from preexisting cells.
 - c) All living things are composed of one or more cells.
 - d) All cells contain nucleus.**

- 2) Select the property of the plasma membrane that makes only some substances in and out of a cell.
 - a) selective permeability**
 - b) polarity
 - c) viscosity
 - d) fluidity

- 3) Select the site of protein synthesis in the cell.
 - a) plasma membrane
 - b) ribosome**
 - c) Golgi apparatus
 - d) chromatin

- 4) All of the following affect the rate of diffusion *except*, _____.
 - a) concentration
 - b) temperature
 - c) pressure
 - d) color**

Part 2 - Fill in the Blanks

Complete the sentences below using the word bank.

| | |
|------------------|--------------|
| Word Bank | endocytosis |
| microscope | mitochondria |
| phospholipids | |

- 5) Cells are so small that their existence was unknown before the invention of the [**microscope**].
- 6) [**phospholipids**] are the major components of the plasma membrane.

- 7) [**mitochondria**] are the powerhouses of cells.
- 8) Large molecules are moved into the cell using [**endocytosis**].

Part 3 - Matching

Match each term with its correct description by writing the letter on the line.

Set A

- | | |
|---|---|
| 9) <u> e </u> compound light microscope | a) specialized structure that carries out specific cell functions |
| 10) <u> b </u> electron microscope | b) can magnify up to 500,000X |
| 11) <u> a </u> organelle | c) cells that contain a nucleus and other organelles that are bound by membranes |
| 12) <u> c </u> eukaryotic cells | d) cells without a nucleus or other membrane-bound organelles |
| 13) <u> d </u> prokaryotic cells | e) consists of a series of glass lenses and uses visible light to produce a magnified image |

Set B

- | | |
|---------------------------------------|--|
| 14) <u> a </u> phospholipid bilayer | a) two layers of phospholipids arranged tail-to-tail |
| 15) <u> c </u> transport proteins | b) describes the plasma membrane |
| 16) <u> b </u> fluid mosaic model | c) move needed substances or waste materials through the plasma membrane |

Set C

- | | |
|--|---|
| 17) <u> b </u> nucleolus | a) site for protein and lipid synthesis |
| 18) <u> a </u> endoplasmic reticulum | b) site of ribosomes production |
| 19) <u> d </u> Golgi apparatus | c) vesicle that contains substances that digests excess or worn-out organelles and food particles |
| 20) <u> e </u> vacuole | d) sorts and packages proteins into sacs called vesicles |
| 21) <u> c </u> lysosome | e) sac used to store food, enzymes, and other materials needed by a cell |

Set D

- | | |
|--|--|
| 22) <u> d </u> dynamic equilibrium | a) the movement of substances across the plasma membrane against a concentration gradient |
| 23) <u> b </u> facilitated diffusion | b) uses transport proteins to move other ions and small molecules across the plasma membrane |
| 24) <u> c </u> osmosis | c) the diffusion of water across a selectively permeable membrane |
| 25) <u> a </u> active transport | d) a condition of continuous movement but no overall change in the concentration across a membrane |

Part 4 - Short Answer

Answer each question using the space provided.

- 26) Compare and contrast prokaryotic and eukaryotic cells.
Eukaryotic cells contain a nucleus and other membrane-bound organelles, while prokaryotic cells do not.
Prokaryotic cells are simpler than eukaryotic cells.
Both cells have a plasma membrane, DNA, ribosomes, and cytoskeleton.
- 27) Explain how the plasma membrane maintains homeostasis.
The plasma membrane maintains homeostasis within a cell by controlling the substances that enter or leave the cell.
- 28) Compare and contrast structures of plant and animal cells.
Both plant and animal cells are eukaryotic, so they contain membrane-bound organelles like the nucleus and mitochondria.
However, plant cells contain chloroplasts since they need to perform photosynthesis, but animal cells do not. Also, plant cells contain a central large vacuole needed for the temporary storage of materials and cell walls that provide structural support and protect the plant cells.
- 29) Explain what would've happened to a sample of your red blood cells if they were placed in a hypotonic solution, isotonic solution, and hypertonic solution.
A red blood cell will swell and burst when placed in a hypotonic solution. When placed in a hypertonic solution, a red blood cell will lose water and shrivel. In an isotonic solution, the red blood cell will retain its normal shape.

PRACTICE

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| Cellulose | |

- 5) [**A low pH and pepsin**] combination in the stomach break down high-protein foods.
- 6) [**Cellulose**] is not digestible and provides fiber in your diet.
- 7) [**Saturated fats**] are derived from animal sources and are solid at room temperature.
- 8) [**Antidiuretic and oxytocin**] hormones are released from nerve cells rather than from endocrine glands.

Part 3 - Matching

Match each term with its correct description by writing the letter on the line.

