Chemical Reactions

SBI4U

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Biochemical Reactions

There are four main types of biochemical reactions that occur between biological molecules.

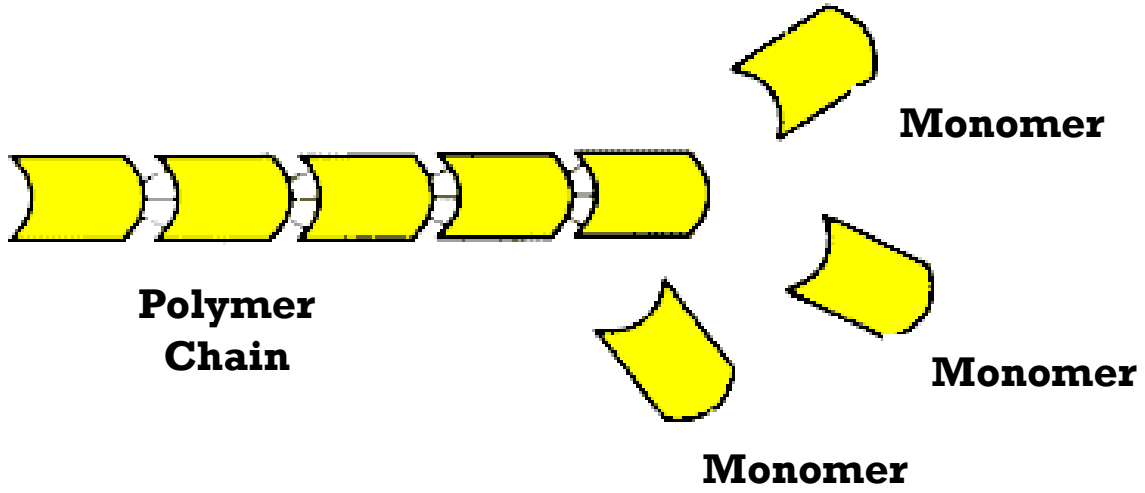
1. ***Condensation:***
2. ***Hydrolysis:***
3. ***Neutralization:***
4. ***Oxidation – Reduction:***

Macromolecules

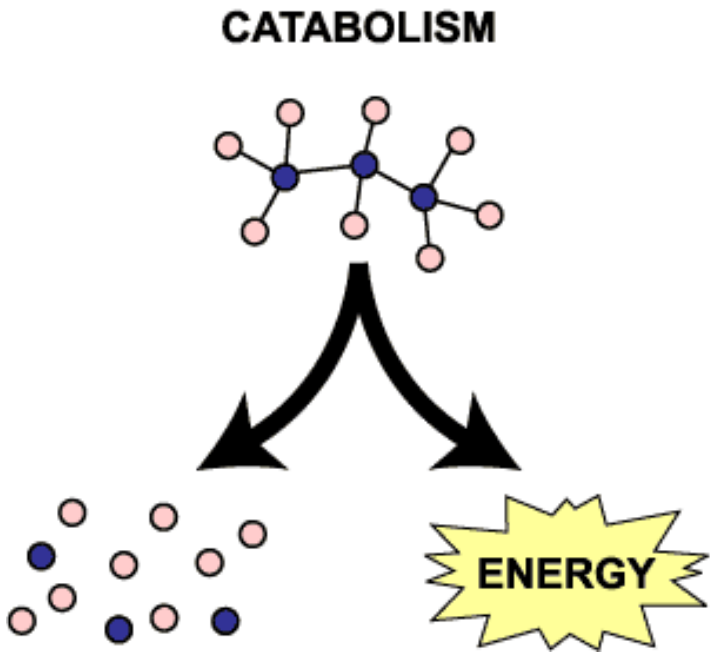
- Macromolecules are large complex molecules that are composed of repeating smaller subunits that are covalently linked.

- The smaller repeating subunits are referred to as ***'monomers'*** and the large macromolecules are known as ***'polymers'.***

Macromolecules can be broken or formed through hydrolysis and condensation reactions respectively.

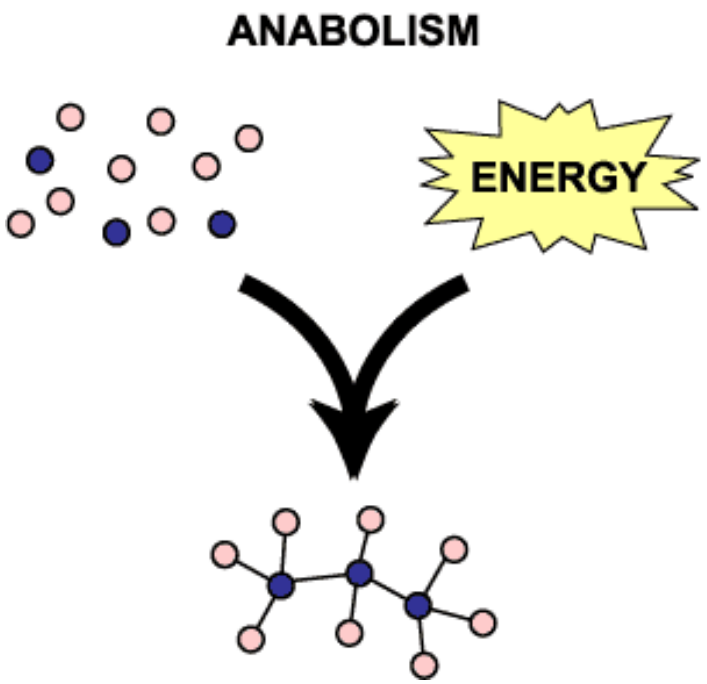


Biochemical Reactions and Macromolecules



Reactions that break macromolecules into individual monomer subunits.

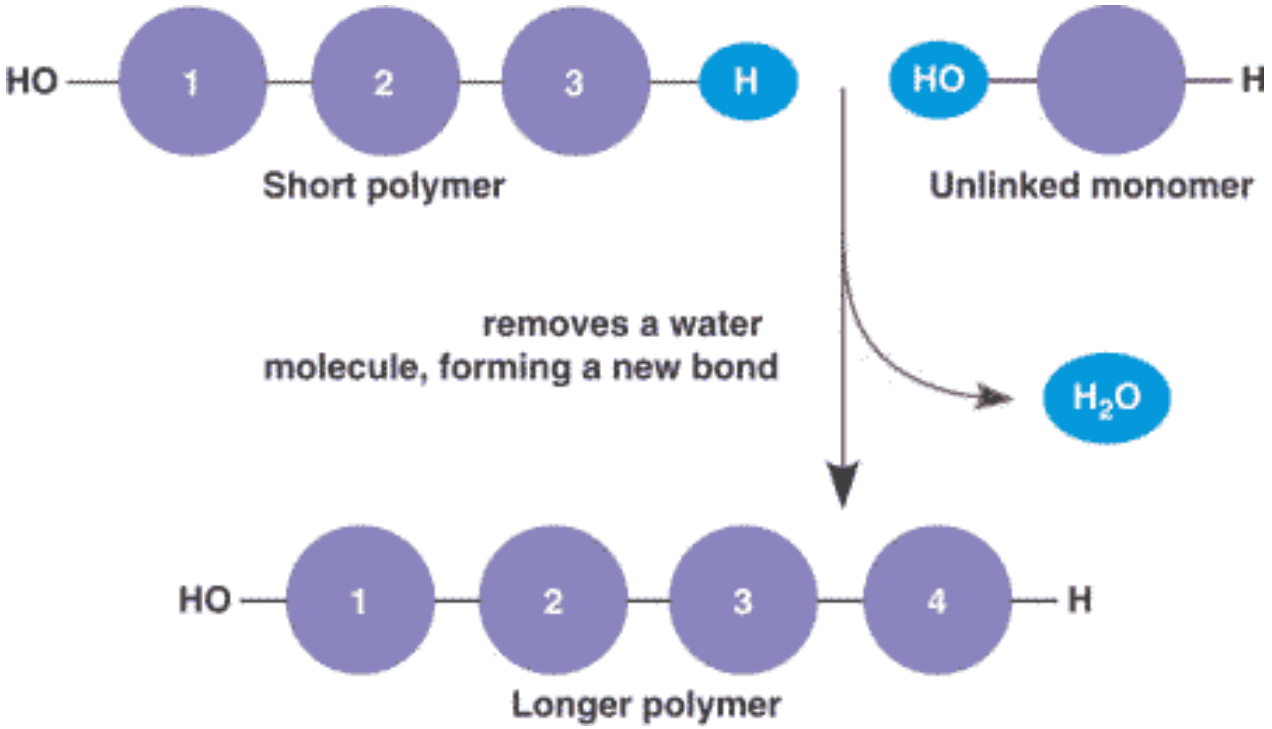
HYDROLYSIS REACTION



Reactions that produce large molecules from smaller subunits.

CONDENSATION REACTION

1. Condensation Reaction



Water is removed to form a covalent bond between the monomer subunits. This creates a longer polymer chain.

(Anabolic Reaction)

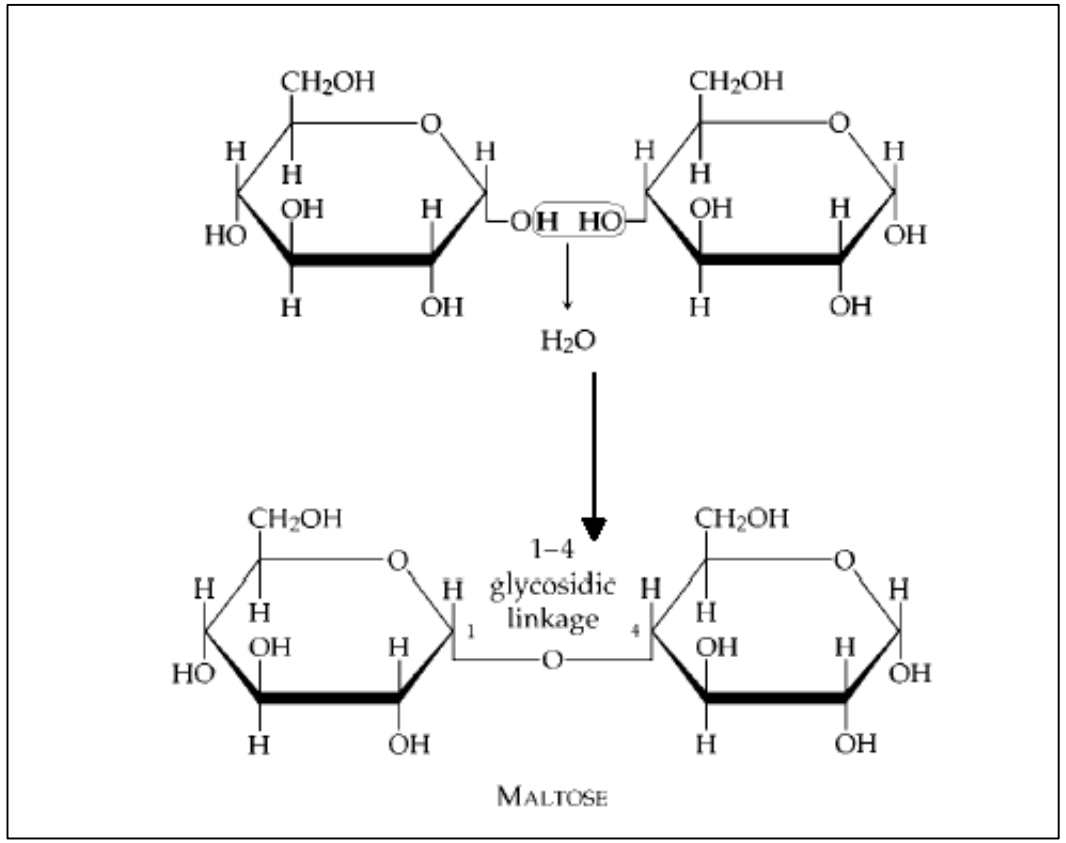
1. Condensation Reaction

GLYCOSIDIC LINKAGE

Molecules with projecting ***–H atoms*** are linked to other molecules with projecting ***–OH groups***, producing H_2O.

Glycosidic bonds are commonly found in carbohydrates.

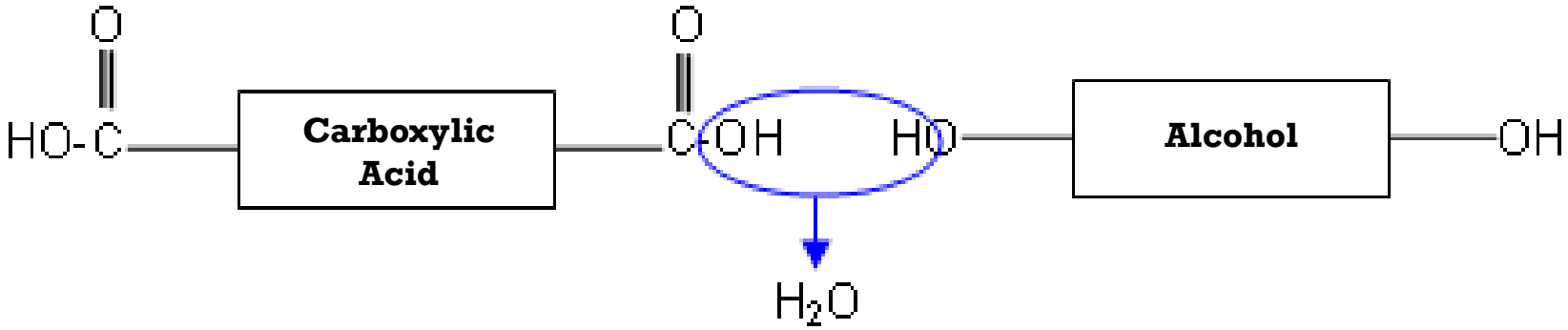
The ***monosaccharide*** subunits are joined through glycosidic bonds.



1. Condensation Reaction

ESTER LINKAGE

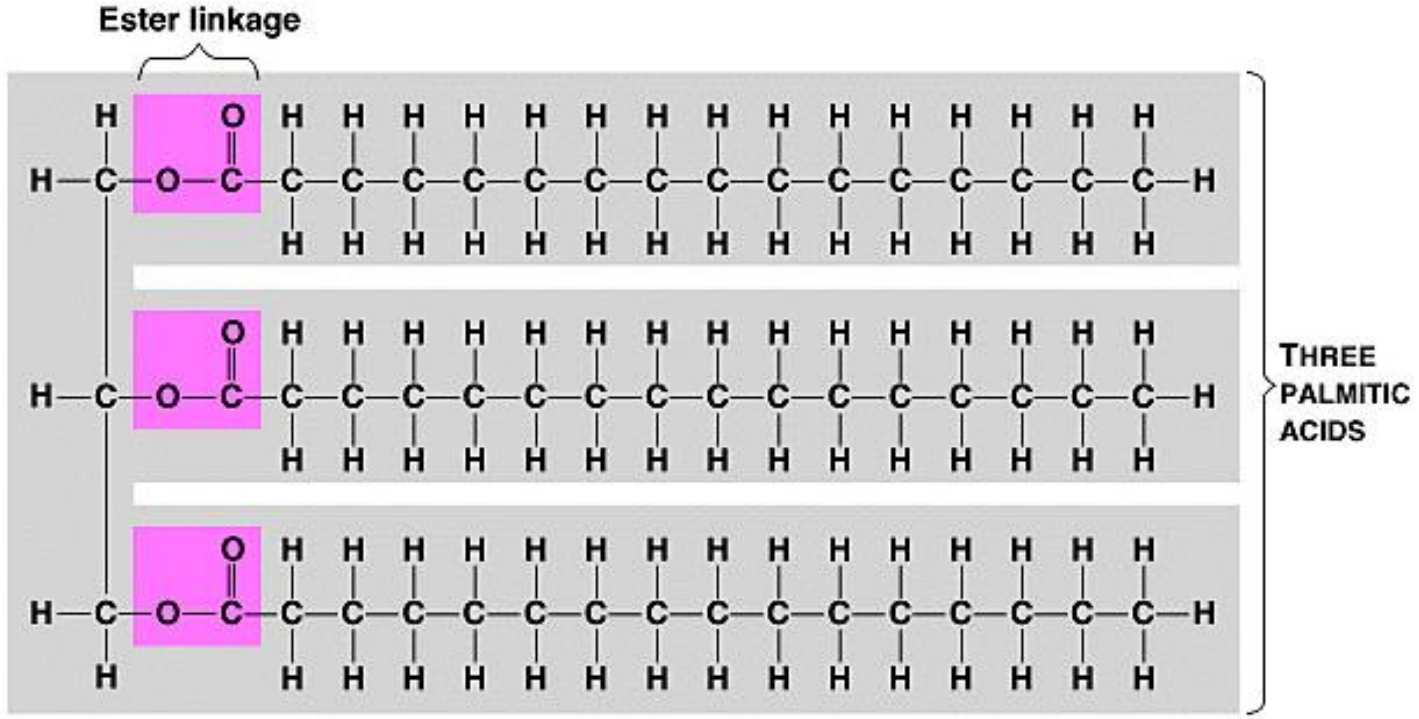
The hydroxyl group (-OH) of the carboxylic acid combines with the hydrogen atom (-H) of the alcohol.



1. Condensation Reaction

Example of an ESTER LINKAGE

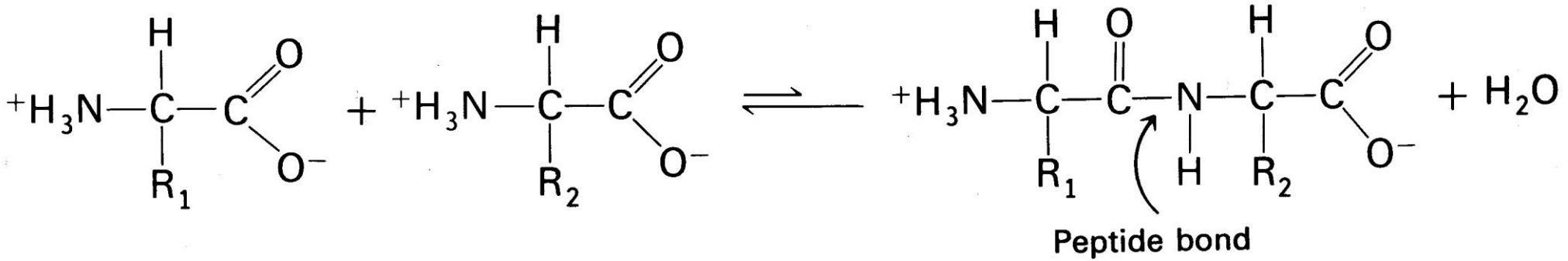
Ester bonds are commonly found in lipids.



1. Condensation Reaction

PEPTIDE BOND

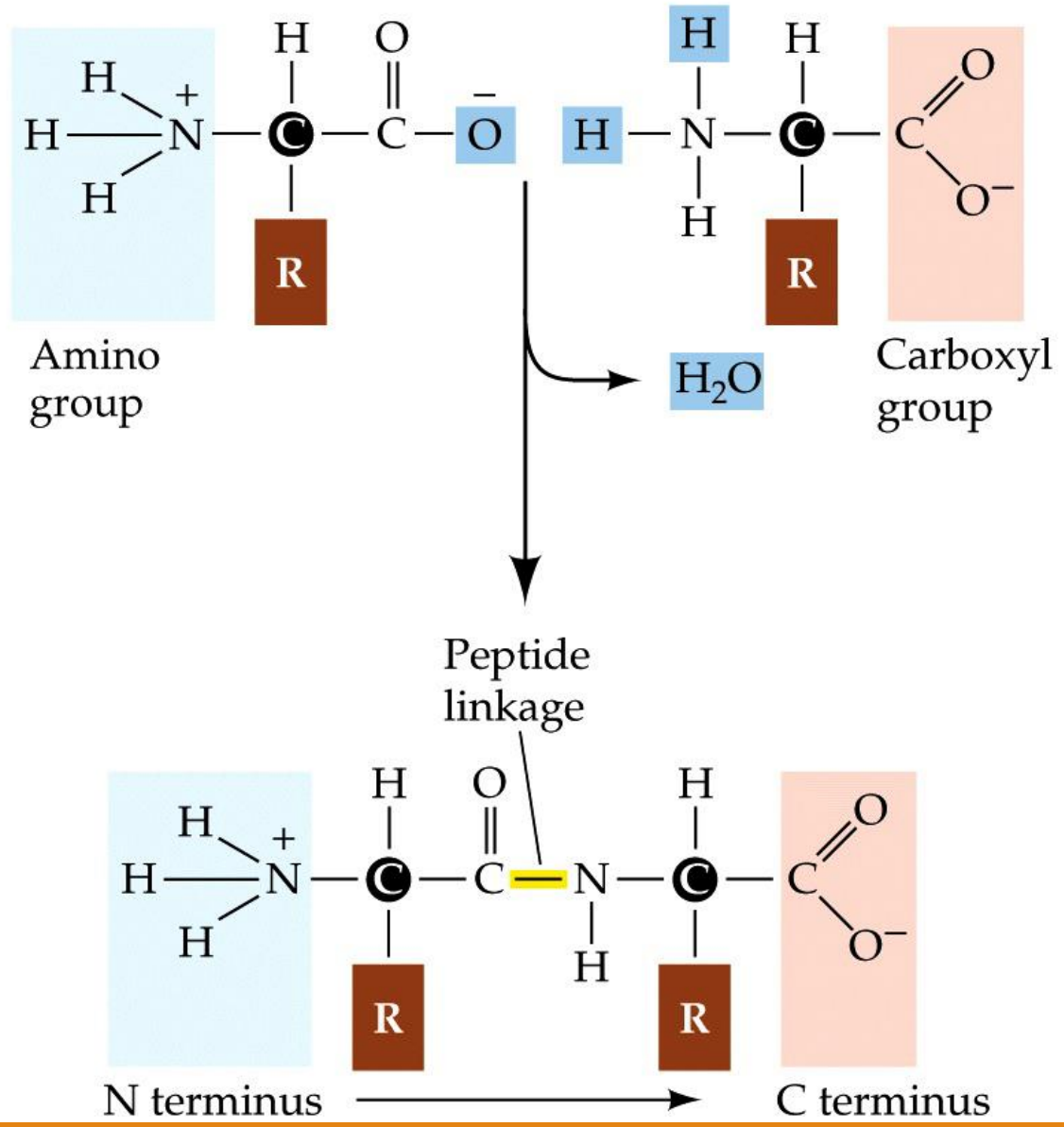
Amide linkage that holds amino acids together in polypeptides.



1. Condensation Reaction

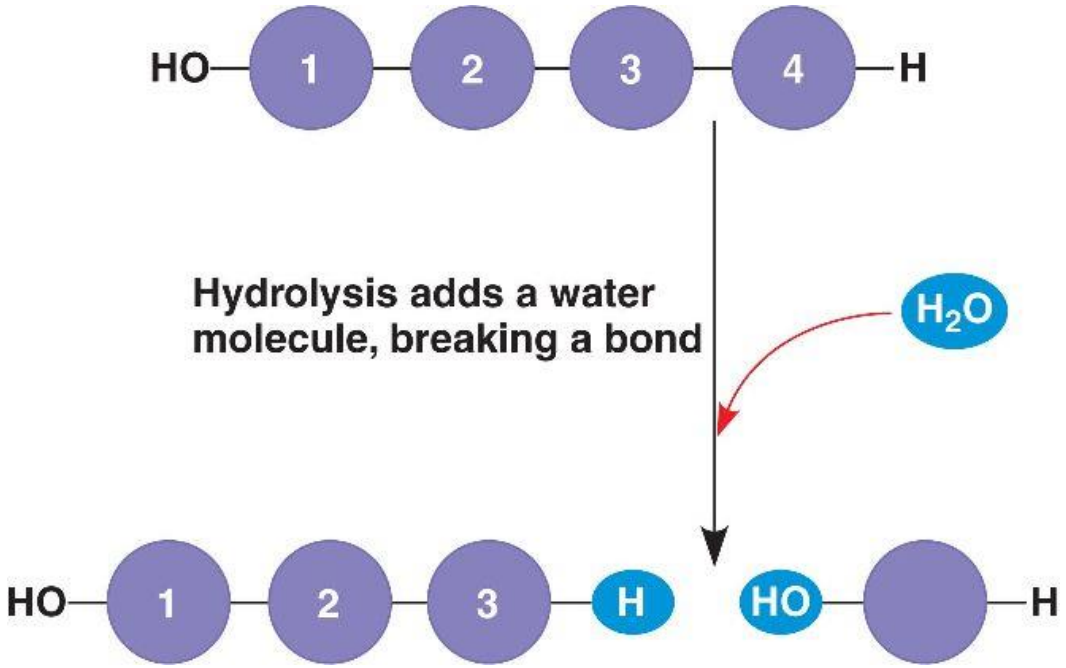
PEPTIDE BOND

Peptide bonds form between amino acids during the formation of a polypeptide chain.



2. Hydrolysis Reaction

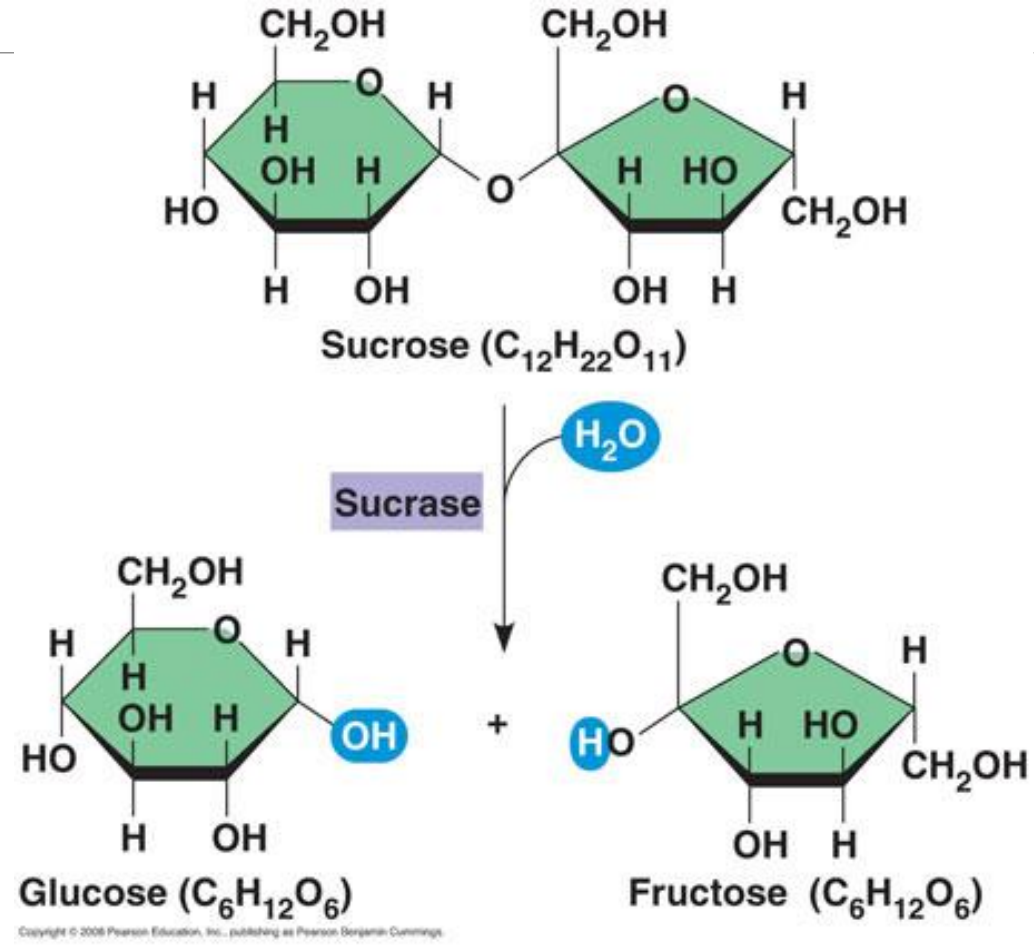
Hydrolysis reactions are catabolic reactions whereby ***<u>water is added</u>*** to break the covalent bonds between monomer subunits.



2. Hydrolysis Reaction

A large molecule is split into smaller subunits by breaking the covalent bond.

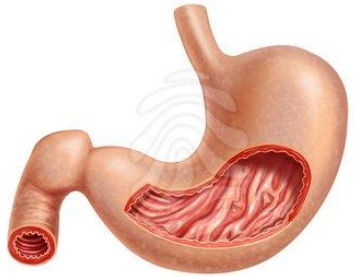
A hydrogen atom (-H) is added to one subunit while a hydroxyl group (-OH) is added to the other subunit.

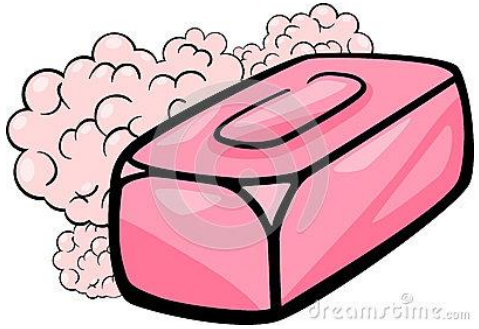


Acids & Bases

Characteristic of an Acid:

- Sour taste
- Ability to conduct electricity
- Turns blue litmus paper red.



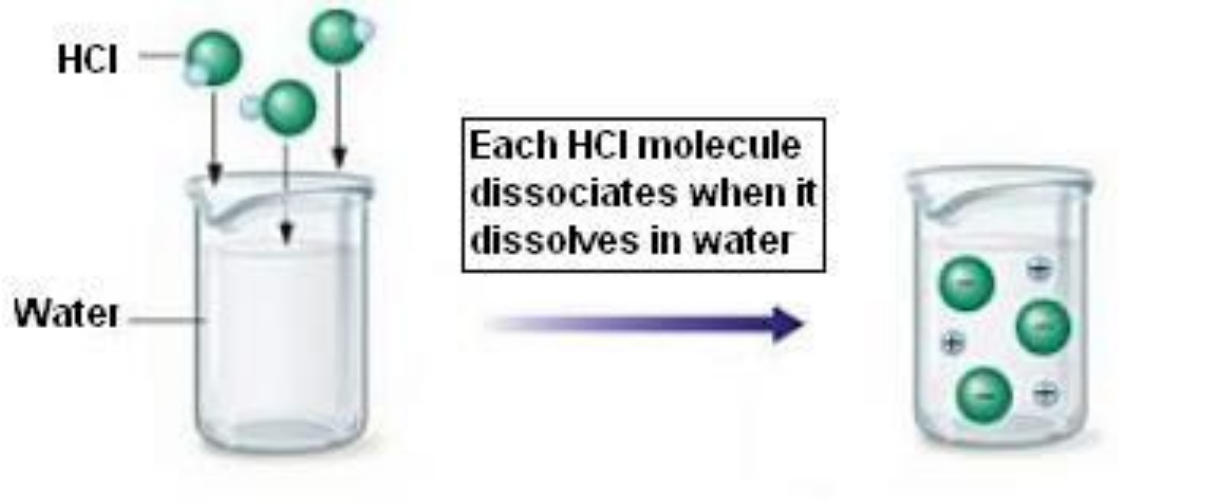


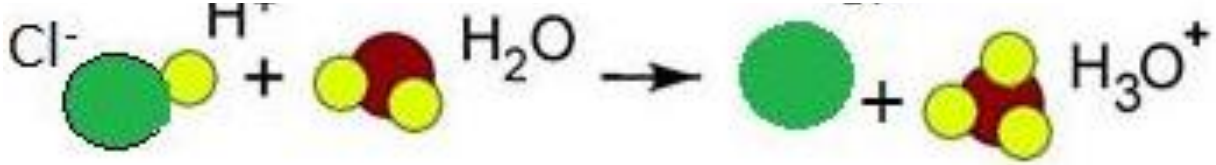
Characteristic of a Base:

- Bitter turns red litmus paper blue
- Slippery

Acids & Bases

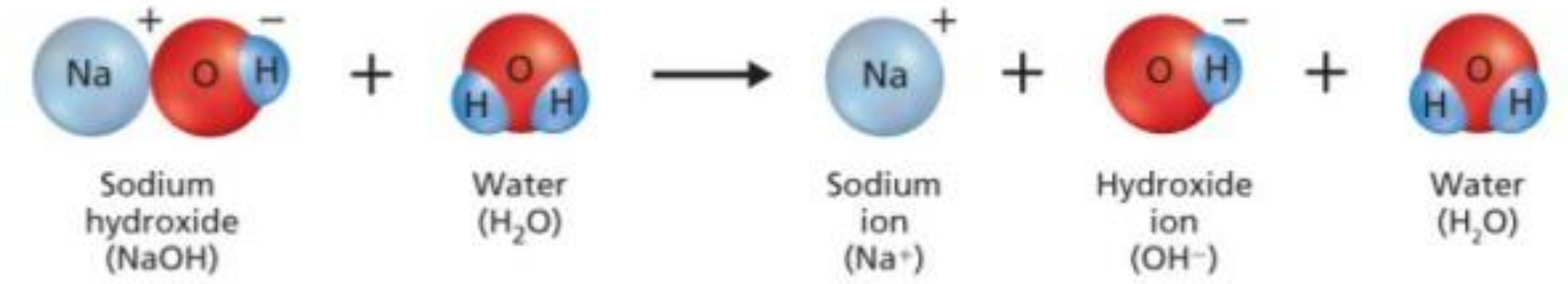
Acid: a substance that releases hydrogen ions (protons) H+ when dissolved in water.





Acids & Bases

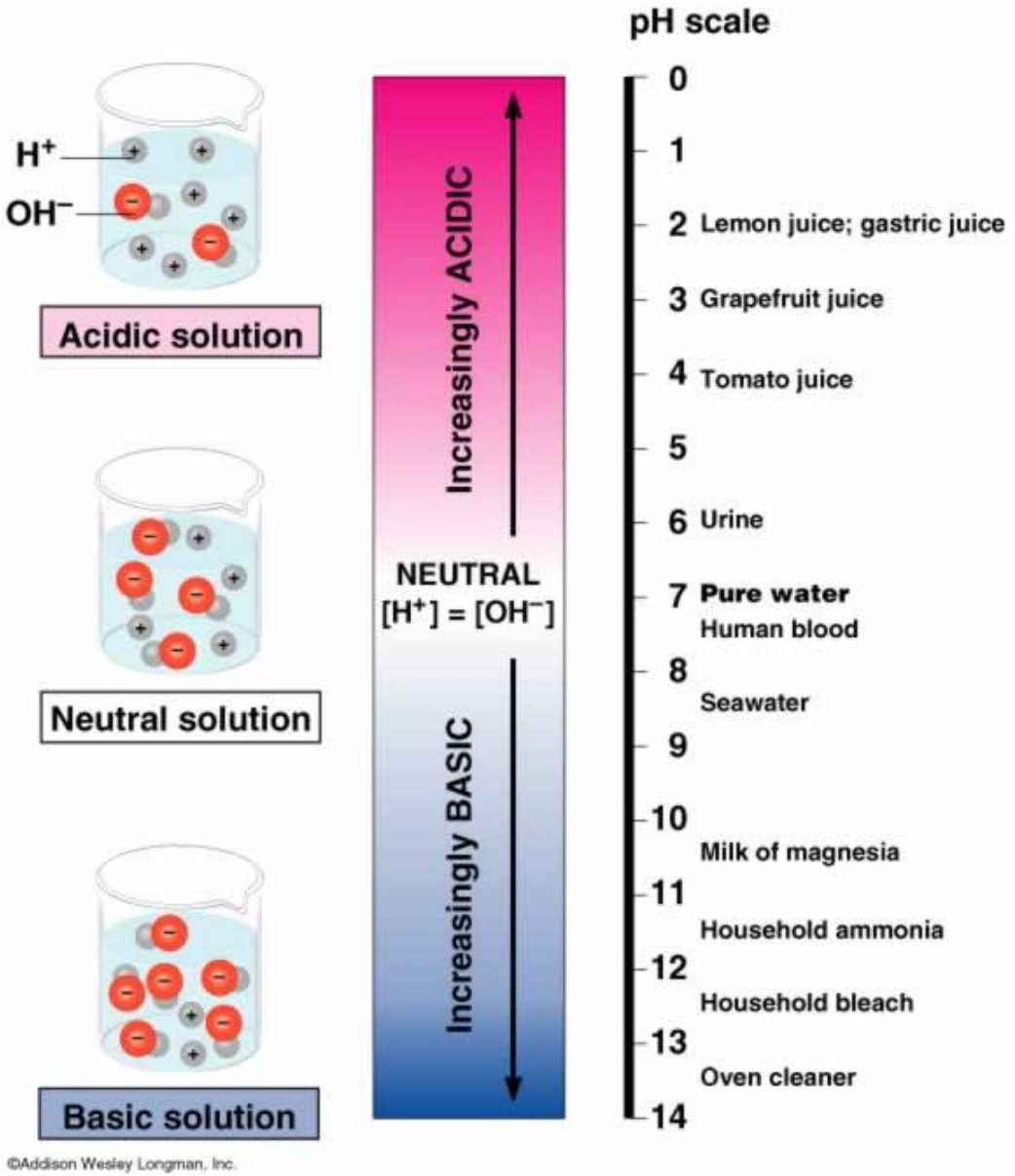
Base: a substance that releases a hydroxide (OH-) ion or accepts a proton (H+)



Acids & Bases

pH scale: *a numerical scale that is used to classify solutions as either acidic, basic or neutral.*

The ***pH scale*** *measures the concentration of protons in a solution.*

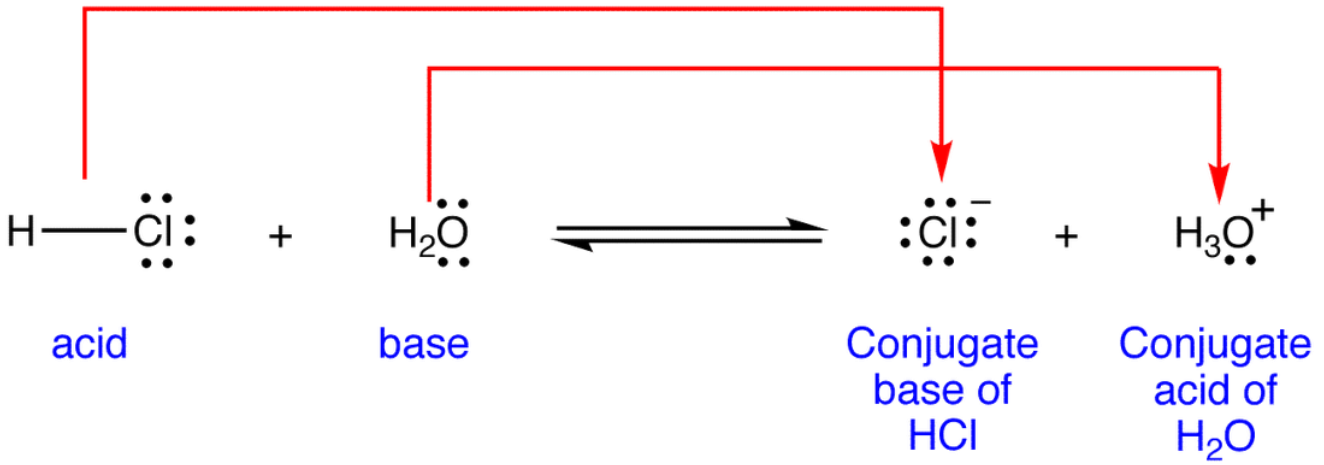


Acid – Base Reactions

When acids and bases react, they tend to form conjugate pairs. Conjugate pairs are based on the gain/loss of protons between the two compounds in the reaction.

Conjugate acids: *acids that gain a proton during the reaction.*

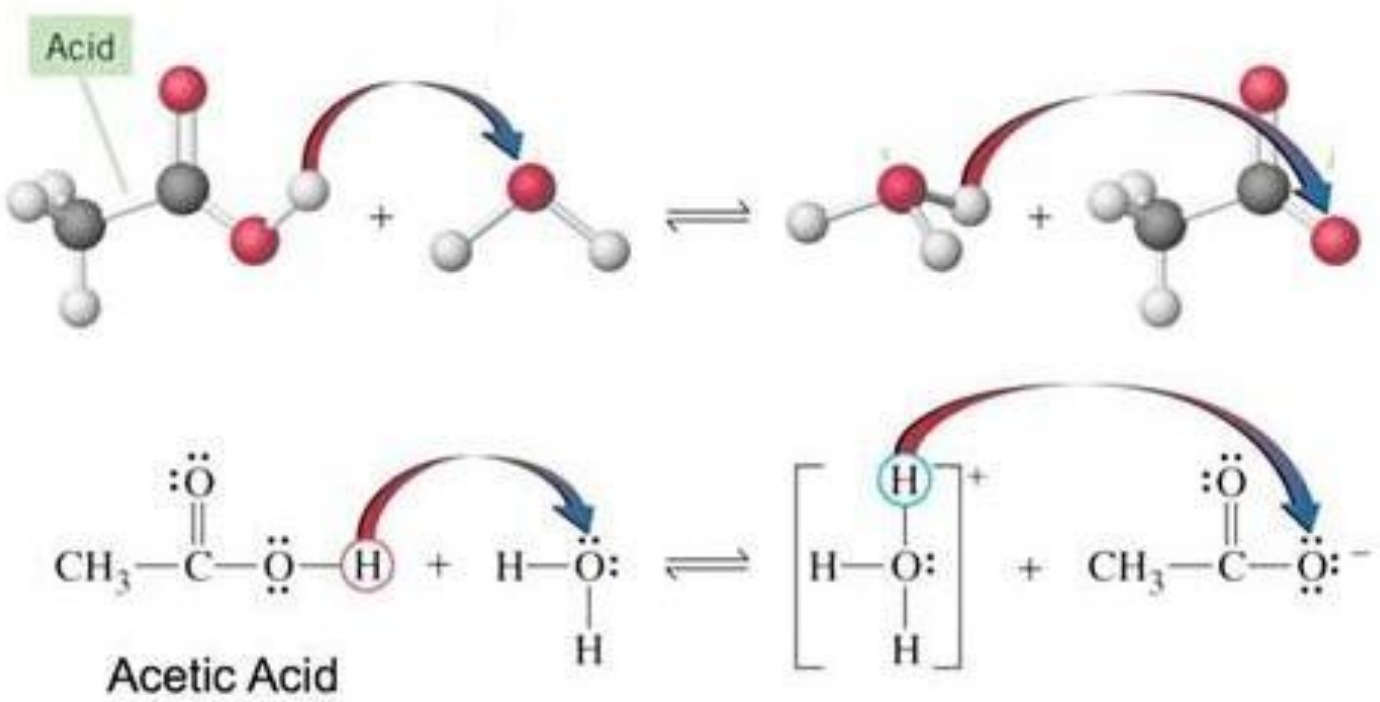
Conjugate bases*: bases that lose protons during the reaction.*



Acid + Base → Conjugate Base + Conjugate Acid

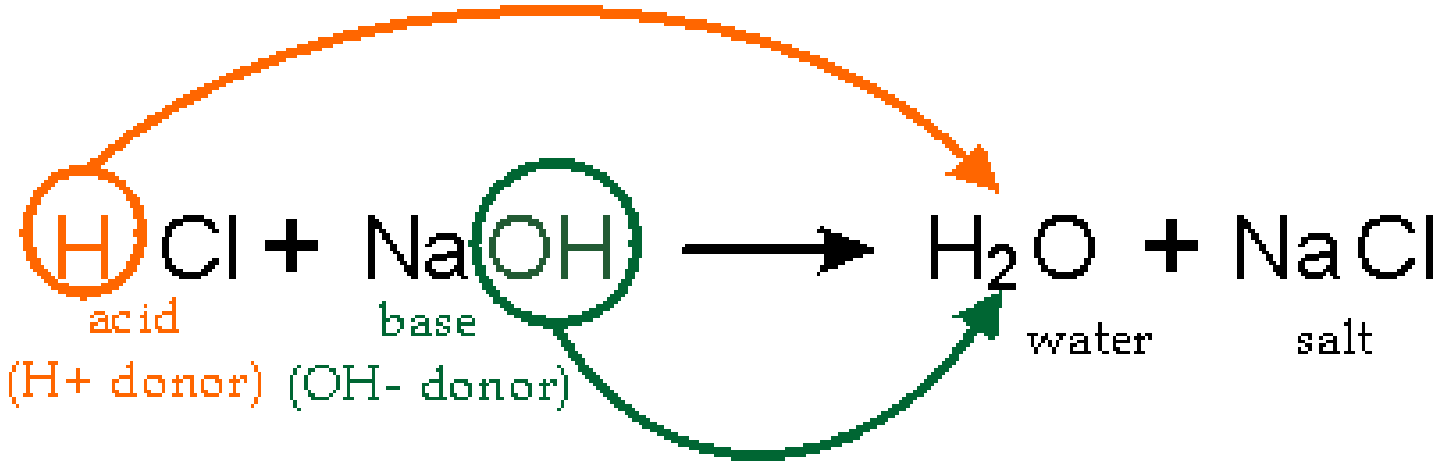
Acid – Base Reactions

These acid-base reactions are reversible.



3. Neutralization Reactions

When an acid is mixed with a base the solution is neutralized due to the water that is formed.



Acid/Base Buffers

Applications of pH:

- In the human body, different organs will contain a narrow pH rage.

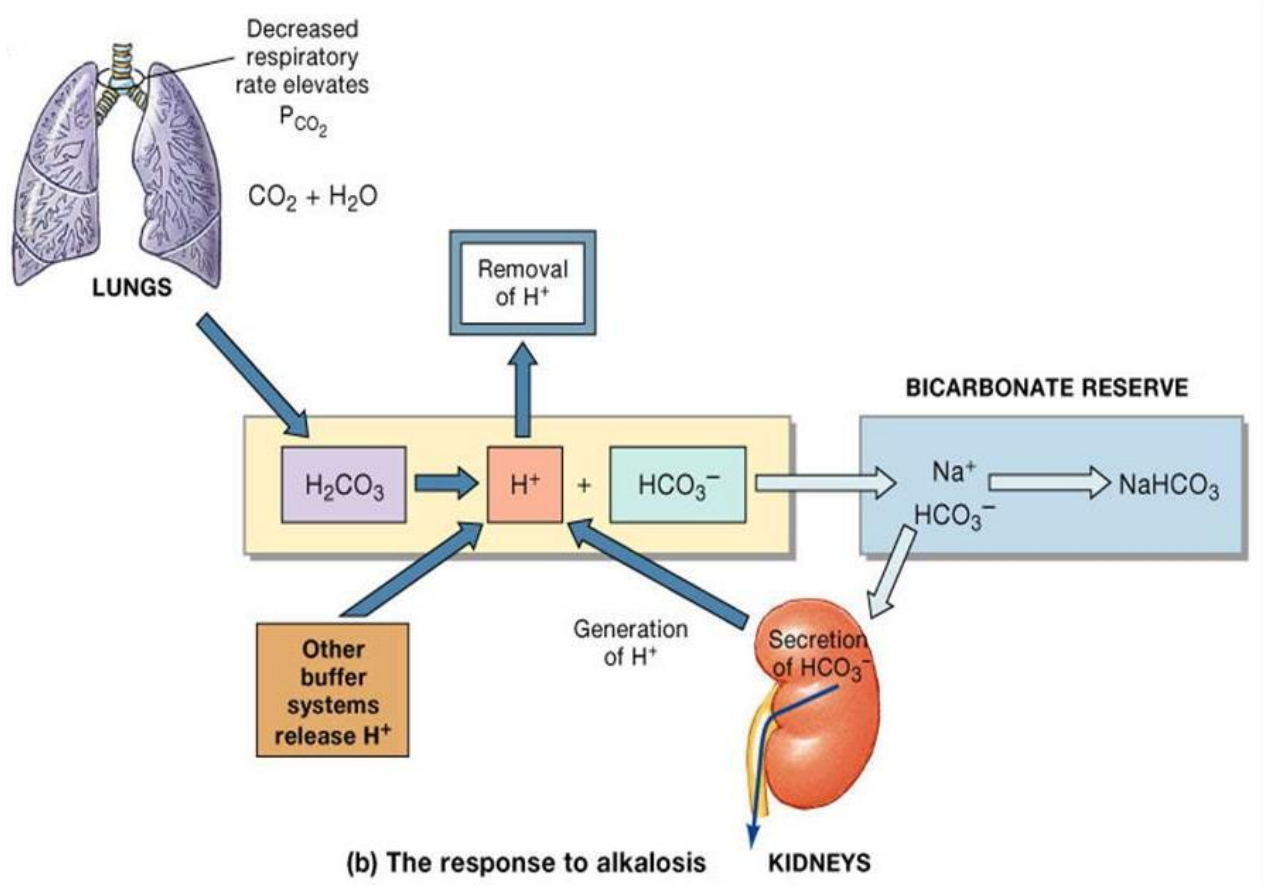
Stomach **Intestine** **Saliva**

- If the pH range within these organs deviates from its average range health issues may arise.

Acid/Base Buffers

If the blood pH increases a person may feel dizzy or agitated.
(Alkalosis)

If the blood pH decreases a person may feel disoriented, vomit, brain damage and kidney disease.
(Acidosis)



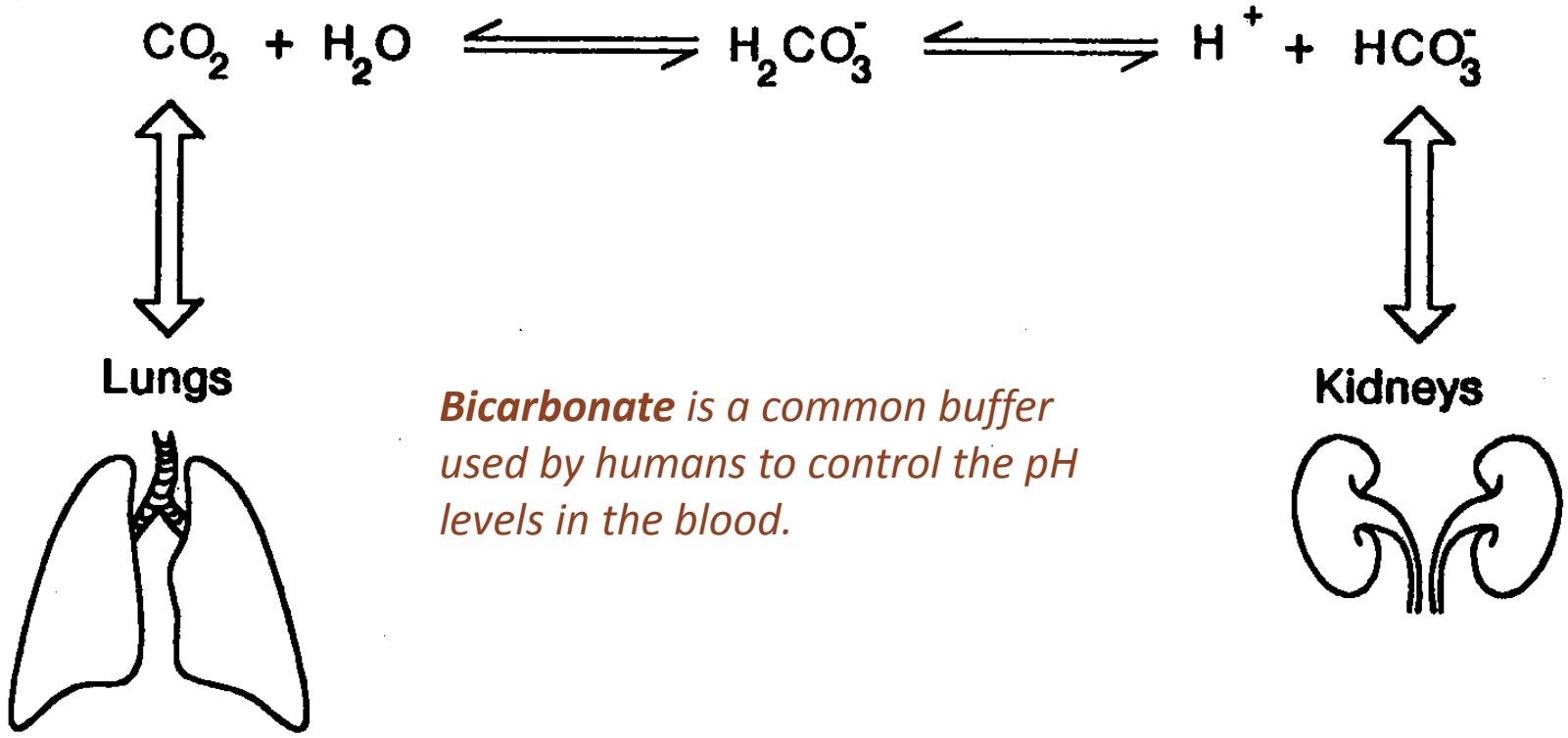
Acid/Base Buffers

- To prevent the body's pH levels from deviating from its norm, there are many buffers present that help maintain an optimal pH level.

- **Buffer**: a substance that minimizes changes in pH by donating or accepting H+ as needed.

What can the body do in order to bring the pH back to optimum level?

Acid/Base Buffers



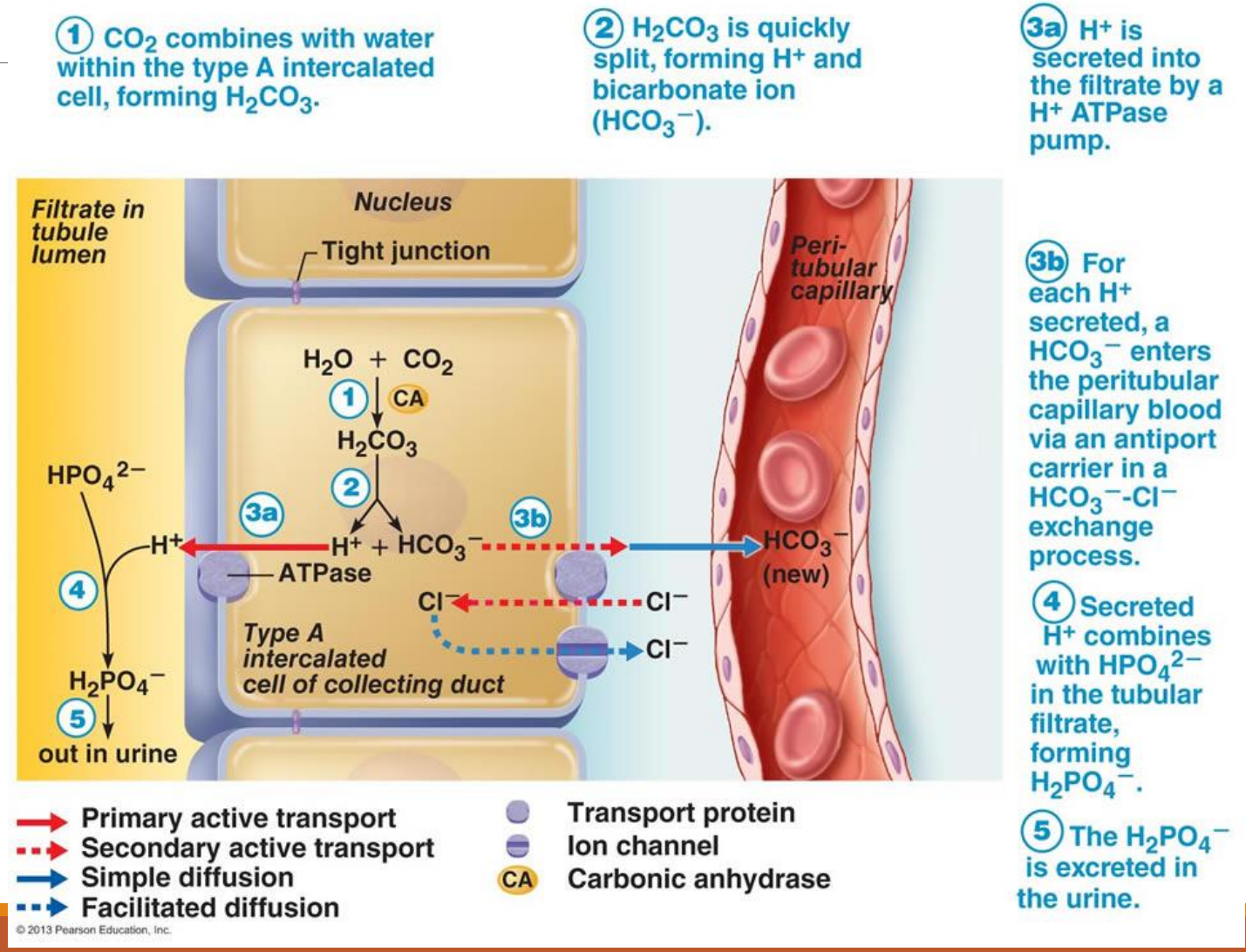
Bicarbonate *is a common buffer used by humans to control the pH levels in the blood.*

Acid/Base Buffers

Due to cellular respiration, CO_2 is released as a byproduct and it diffuses down its concentration gradient into the blood.

CO_2, may combine with water to form H_2CO_3.

H_2CO_3 is one of the primary buffers used to maintain pH levels in the blood.

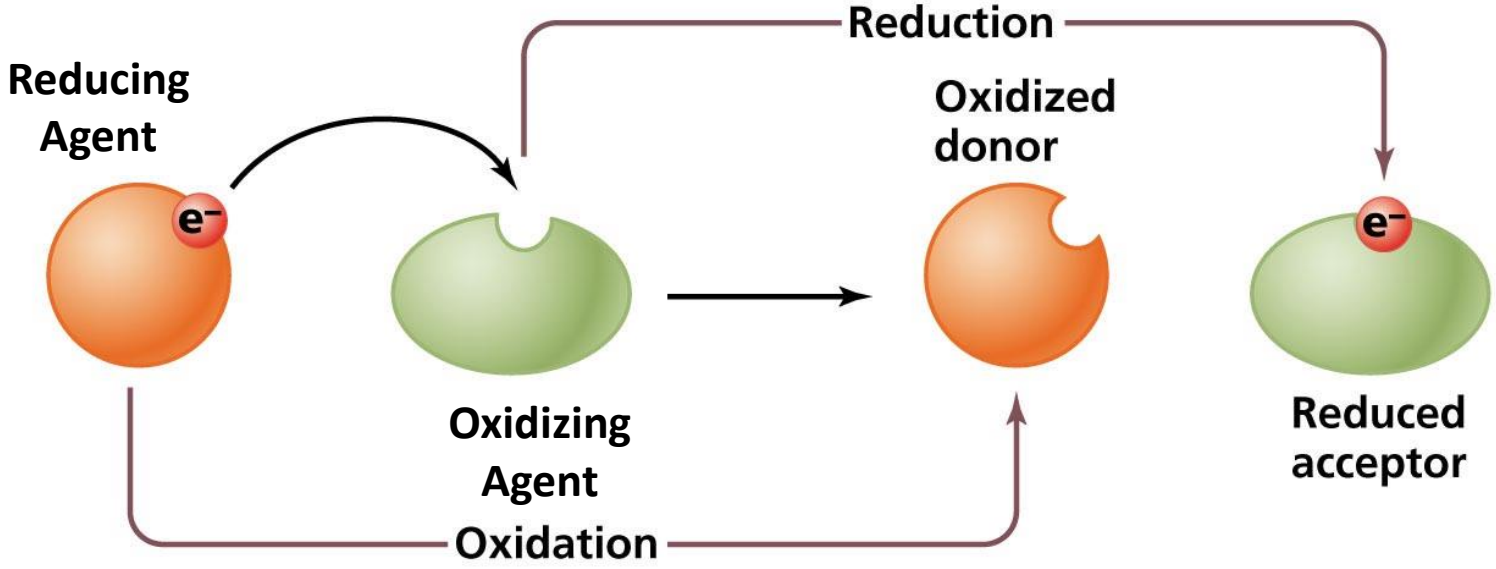


4. Oxidation – Reduction (REDOX) Reactions

Many of the chemical reactions involved in cellular respiration and photosynthesis involve the transfer of electrons.

Oxidation: *process involving the loss of electrons*

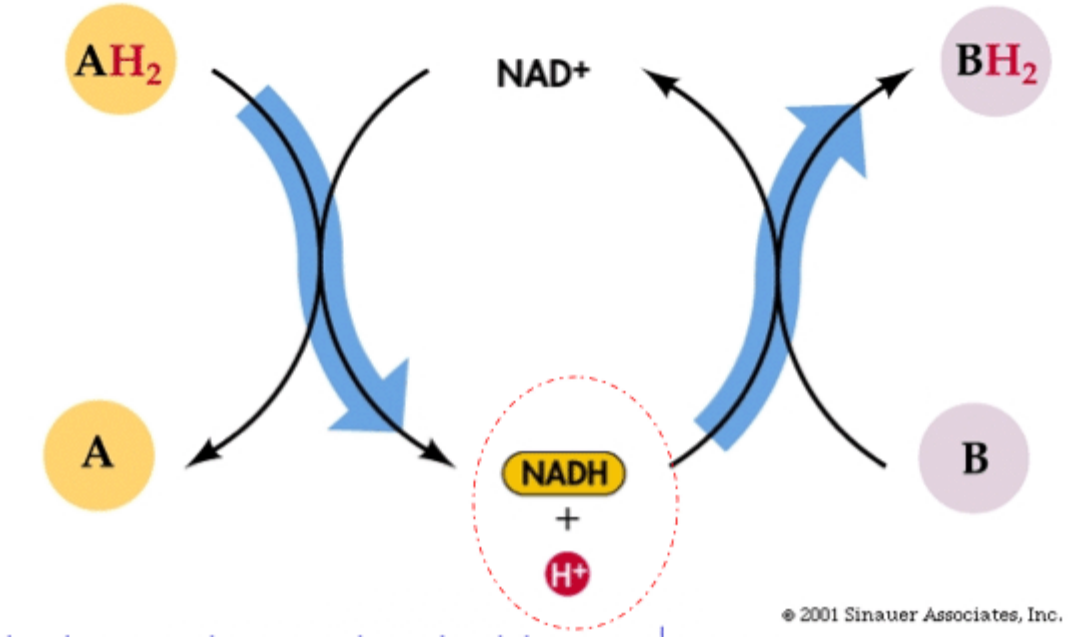
Reduction: *process involving the gain of electrons.*



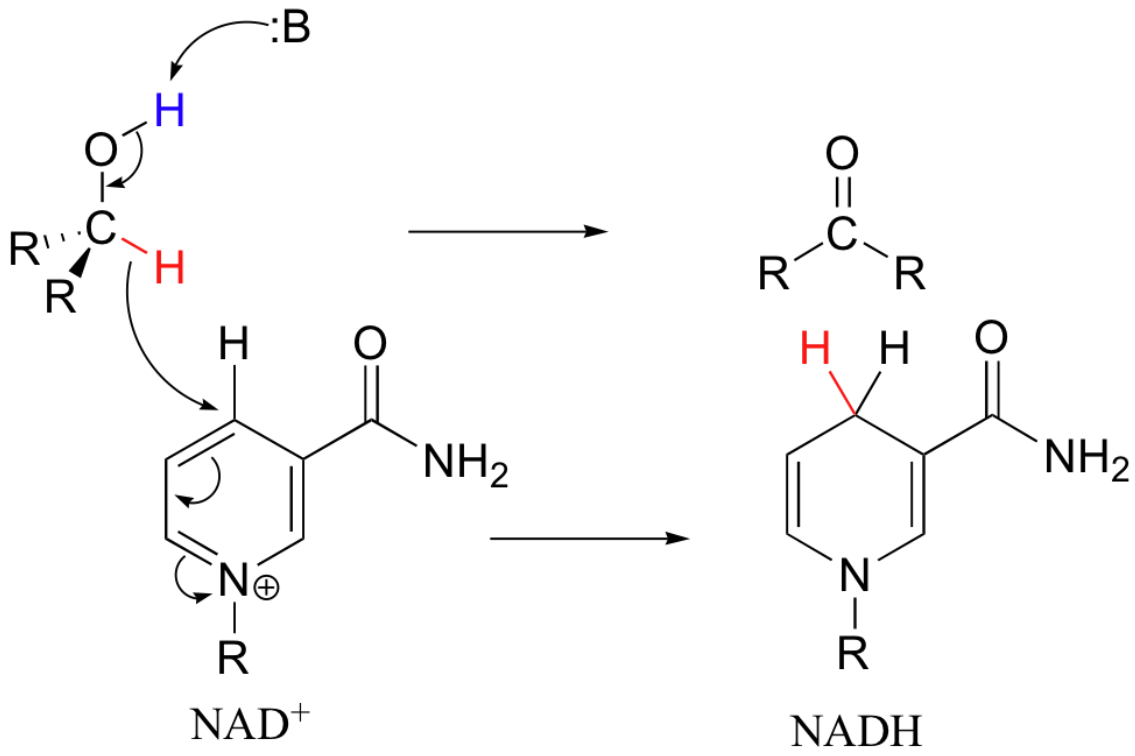
4. REDOX Reactions

A series of redox reaction occurs when the product of one redox reaction becomes the reactant in the other.

This is usually seen in reactions that want to transport electrons . The next oxidizing agent must be stronger than the previous one.



4. REDOX Reactions - NAD^+ (Electron donor and acceptor)



Nicotinamide adenine dinucleotide

NADH is a coenzyme that is used in cellular respiration to transport electrons in a series of redox reactions.

NADH is the reduced form that carries the electrons to another oxidizing agent. Once oxidized, it becomes NAD+ and is ready to accept electrons from a reducing agent.

Homework

Textbook: pg. 42 # 1 & 4-6