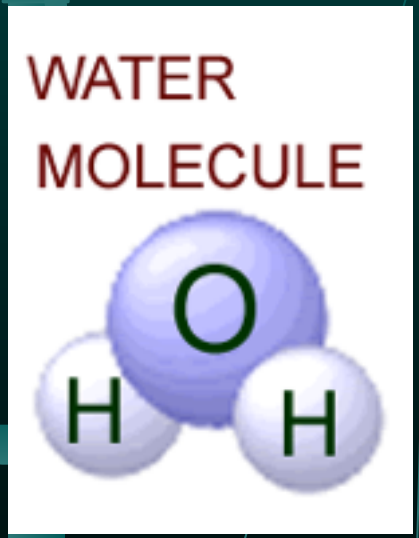
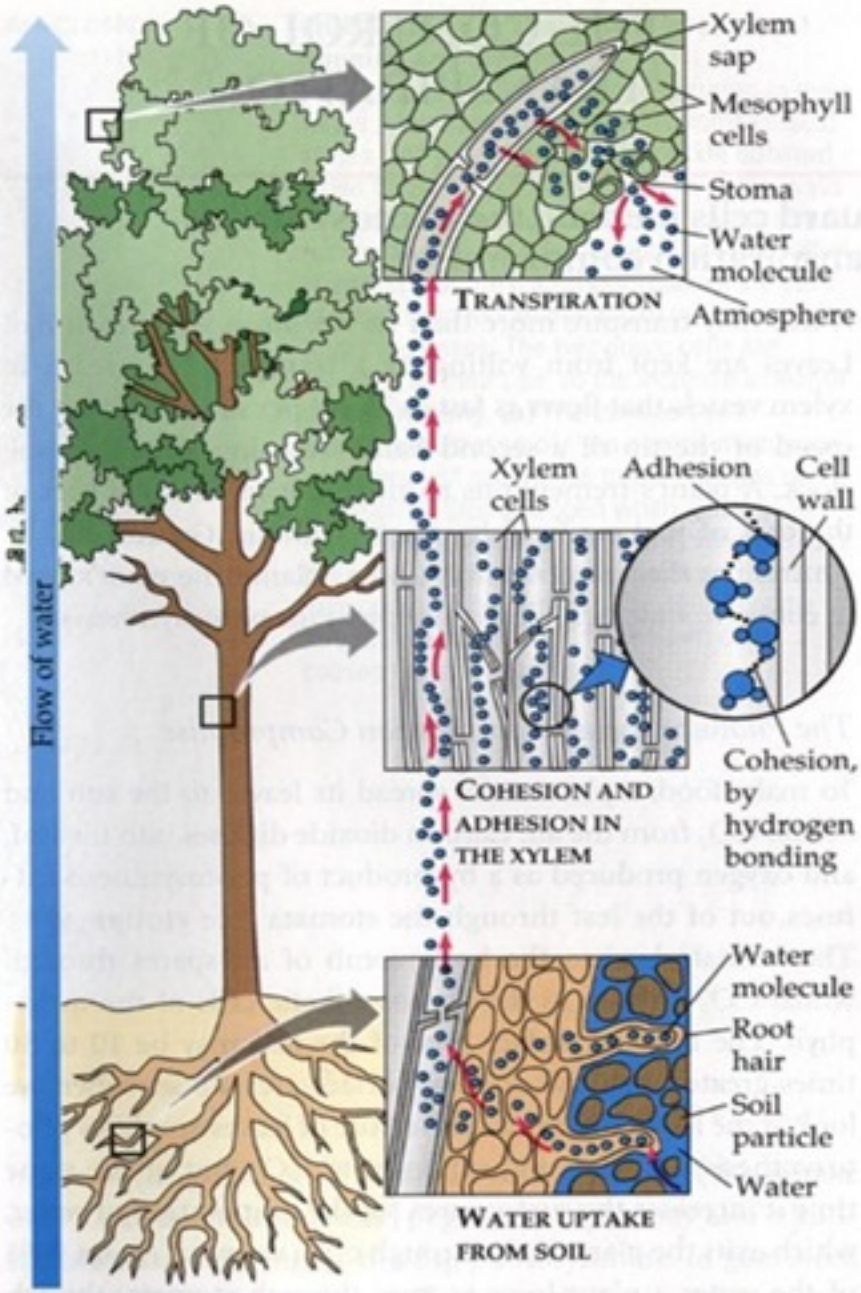
2-2 Properties of Water

A. The Water Molecule

- Water is polar
- Hydrogen bonds form between water molecules
- Properties of Water:
  - cohesion
  - adhesion
  - capillary action
  - high specific heat
  - ice floats
  - good solvent





Pulling It All Together

3. Transpiration – the movement of water out of the leaf, "pulls" water upward by osmosis

2. Capillary action – the tendency of water to rise in a thin tube

cohesion – attraction between like molecules

adhesion – attraction between different molecules

1. Root pressure and active transport cause water to move from the soil into the root

What causes a plant to wilt?

B. Solutions & Suspensions

- water is is often found as part of a mixture **Solutions:**
  - all parts are evenly distributed (ex: salt-water)
  - the solute (salt) is dissolved by the solvent (water)
  - water is the “Universal Solvent”-most substances will dissolve in water

Suspensions:

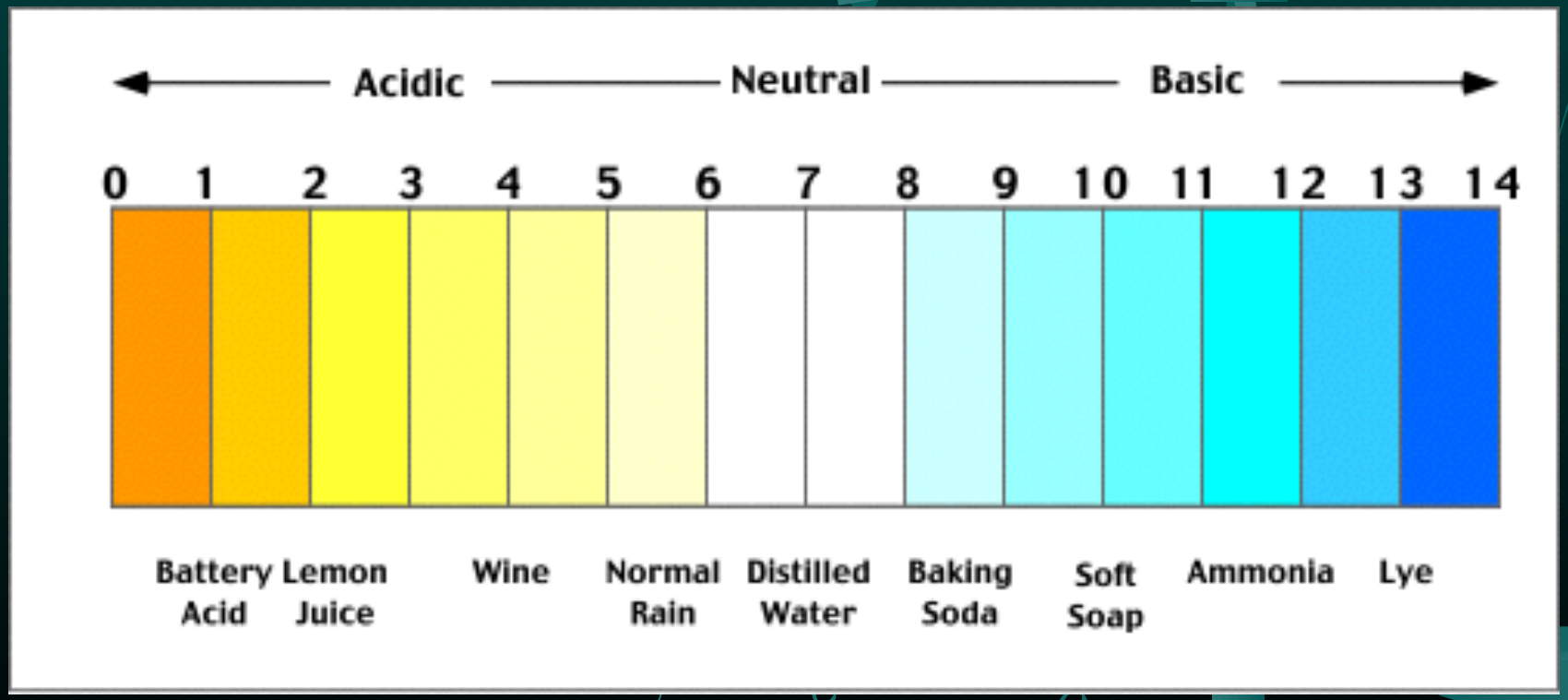
- some materials do not dissolve in water but separate into small pieces that do not settle out

Blood:

- mostly water containing many dissolved compounds (oxygen, glucose, carbon dioxide, etc.)
- contains many undissolved proteins that remain in suspension as blood moves through the body

C. Acids/Bases/pH Scale

The pH Scale:
Indicates the concentration of H^+ ions in solution



Acids

- contain higher concentrations of H+ than pure water and have pH values **less than 7**

Bases

- contain lower concentrations of H+ than pure water and have pH values **greater than 7**

Buffers

- Important for maintaining pH levels within most cells (between 6.5 and 7.5 for most cells)
- Weak acids or bases that can react with strong acids or bases to prevent sharp changes in pH.

2-3 Carbon Compounds

A. The Chemistry of Carbon

- Organic Compounds (contain both **C & H**); Organic Chemistry
- Bonds with many atoms, including other carbon atoms, can form **chains** that are almost unlimited in length
- carbon can form millions of different complex structures

B. Macromolecules

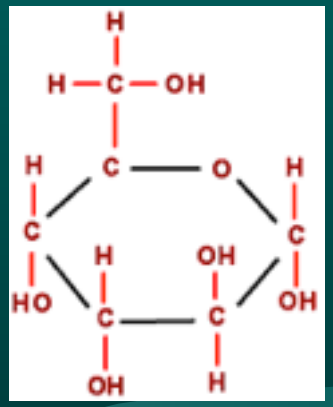
- Giant molecules made from thousands of smaller molecules through the process of polymerization

- Monomers (small units) join together to form polymer (larger molecules)

Four Groups of Organic Compounds

- Carbohydrates
- Lipids
- Nucleic Acids
- Proteins

C. Carbohydrates



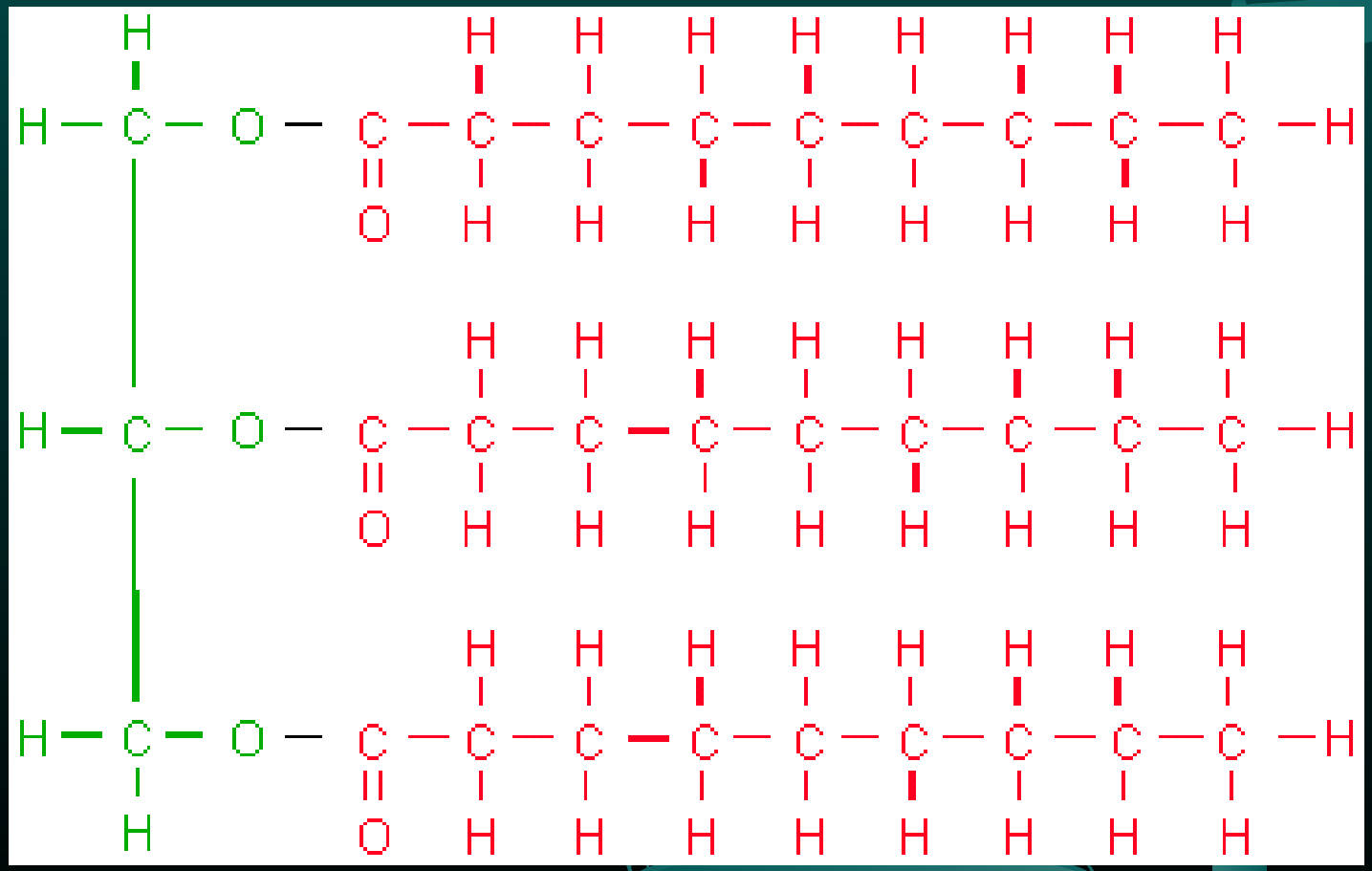
- C H O
- Usually a 1:2:1 ratio; ring like structure
- used as a main source of energy and for structural purposes in plants
- living things store extra sugar as starch
- Starches form when sugars join together in a long chain
- single sugars (monosaccharides) are glucose, fructose, and galactose
- double sugars (disaccharides) include lactose, sucrose and maltose
- polysaccharides (starches) include glycogen, plant starch and cellulose
- usually end ins -ose (ex: glucose, sucrose, lactose)

D. Lipids

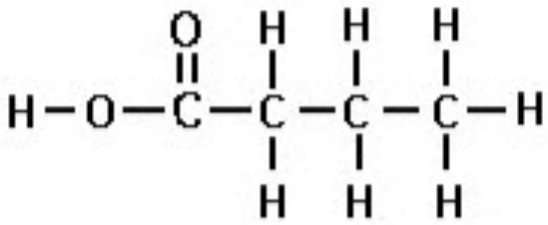
- C, H, O
- Not soluble in **water**
- include fats, oils, waxes, and steroids
- Used to store energy
- important parts of biological membranes & waterproof coverings
- many lipids form when a glycerol molecule combines with fatty acids

Lipid Molecule

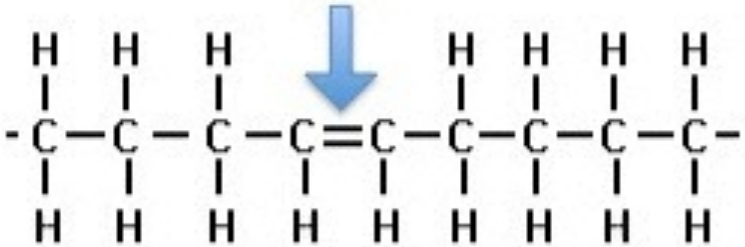
Glycerol 3 Fatty Acids



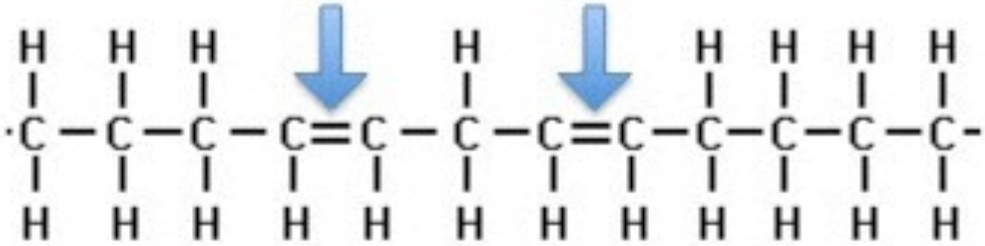
Saturated Fat



Monounsaturated Fat

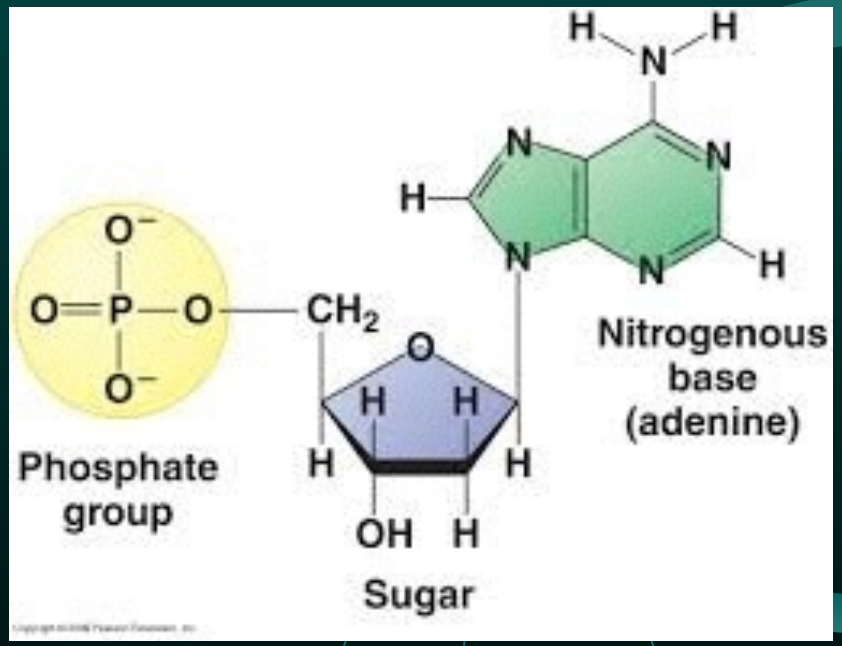


Polyunsaturated Fat



E. Nucleic Acids

- C, N, P, H, O
- Polymers formed from monomers called **<u>nucleotides</u>**



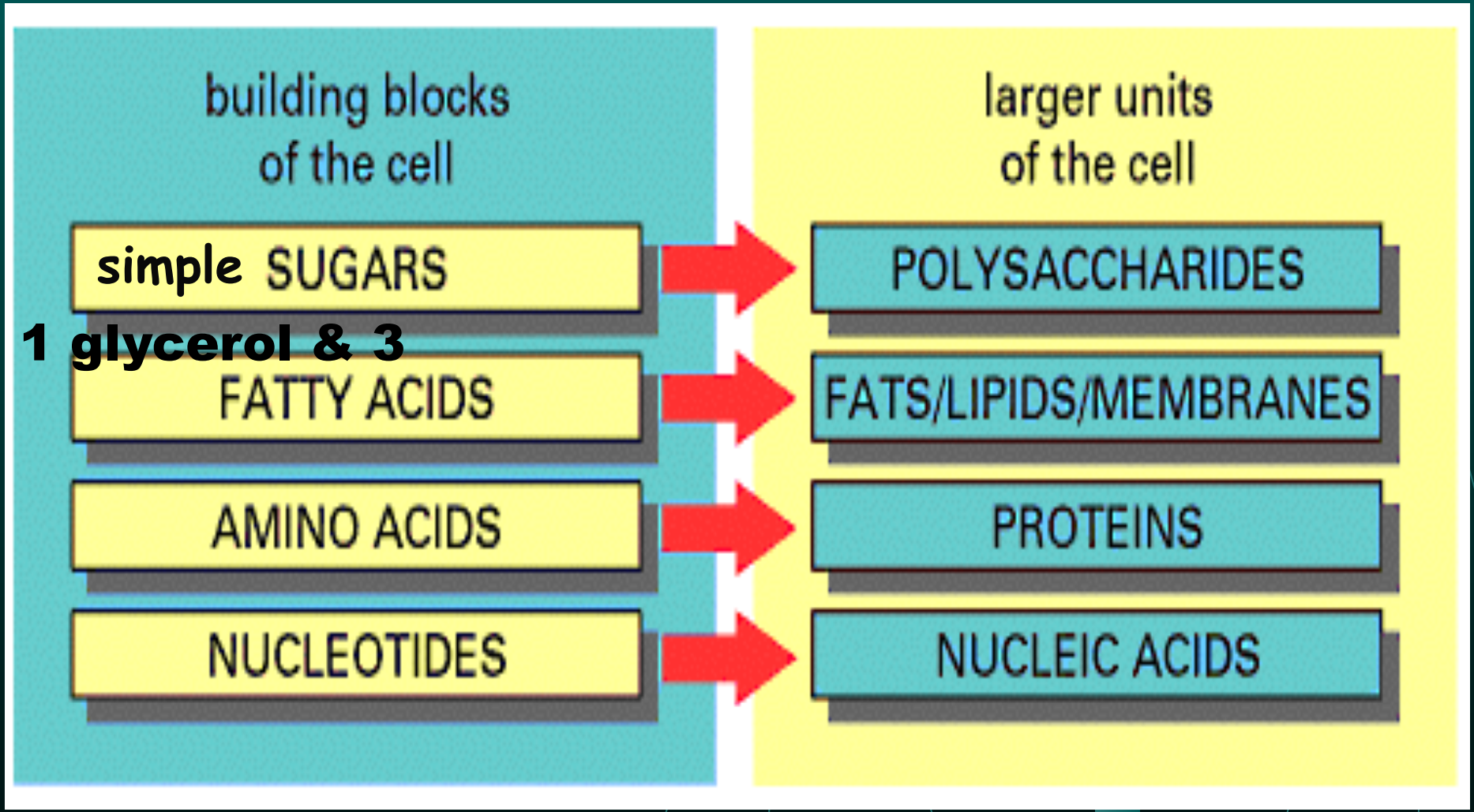
- Store & transmit hereditary or genetic info.
- Two kinds: DNA and RNA

F. Proteins

- C, H, O, N
- Polymers formed from monomers called amino acids
- more than **20** different amino acids found in nature
- any amino acid can be joined to any other amino acid forming a wide range of proteins
- DNA contains instructions for building proteins
- amino acids usually end in -ine (ex: glycine, glutamine)

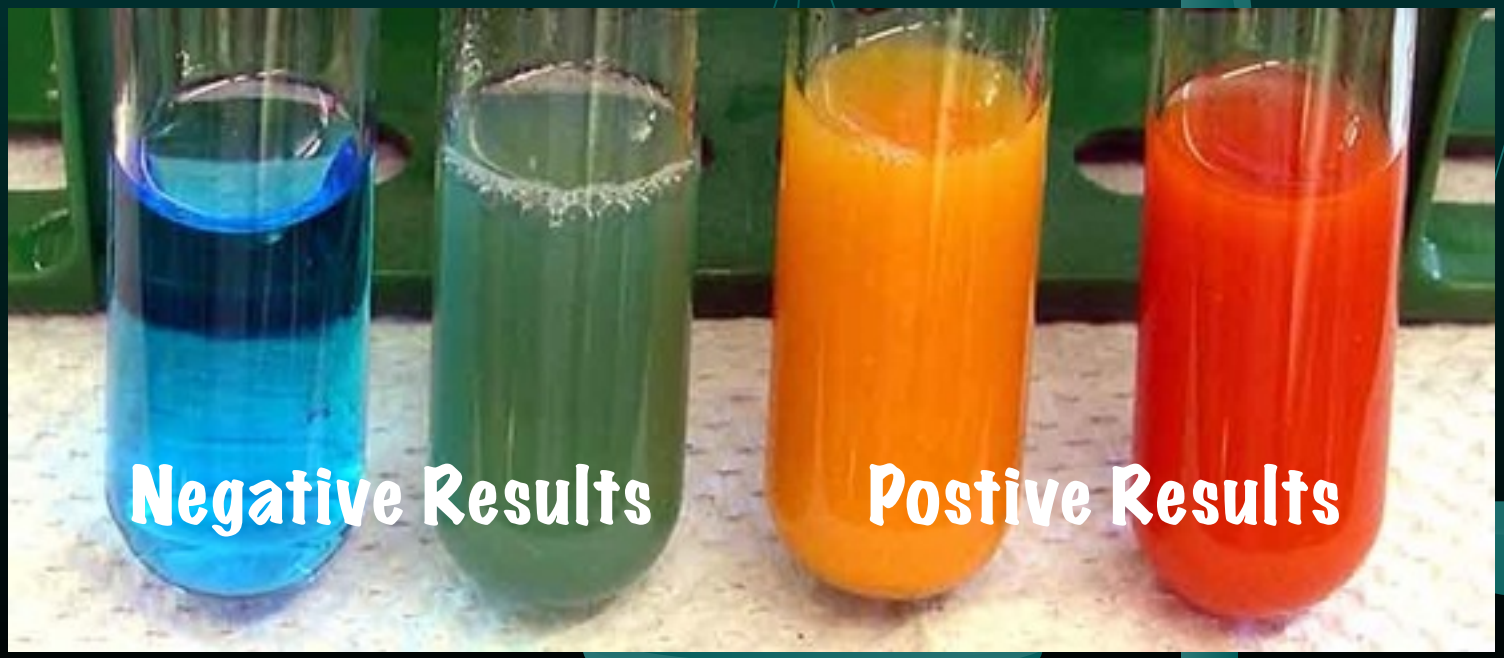
Functions of Proteins:

- Regulate cell processes
- Control the rate of chemical reactions
- Used to form bones and muscles
- Transport substances into and out of cells
- Fight disease


building blocks of the cell
larger units of the cell
simple SUGARS
POLYSACCHARIDES
1 glycerol & 3
FATTY ACIDS
FATS/LIPIDS/MEMBRANES
AMINO ACIDS
PROTEINS
NUCLEOTIDES
NUCLEIC ACIDS

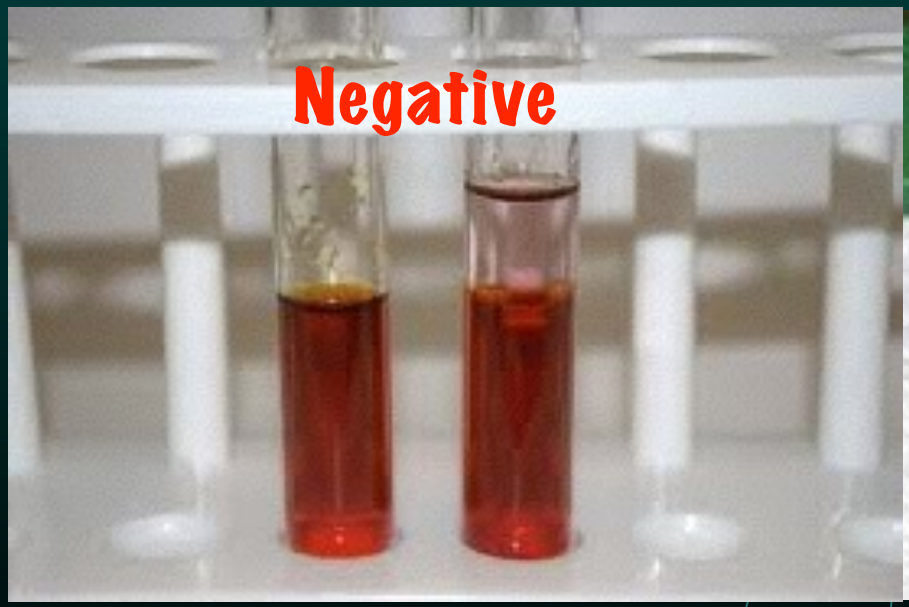
Identifying Nutrients

- **Benedict's Solution:** used to test for monosaccharides (ex: glucose)
- Color changes from blue to yellow or orange/red when it is heated



- **<u>Biuret</u>**: used to test for protein
- Color changes from blue to purple in the presence of protein

- **<u>Lugol's Iodine:</u>** used to test for starch (polysaccharide)
- Color changes from amber to a dark purple/black in the presence of starch



- **<u>Sudan Red:</u>** use to test for the presence of lipids
- it is a fat soluble dye that stains lipids red

2-4 Chemical Reactions and Enzymes

A. Chemical Reactions

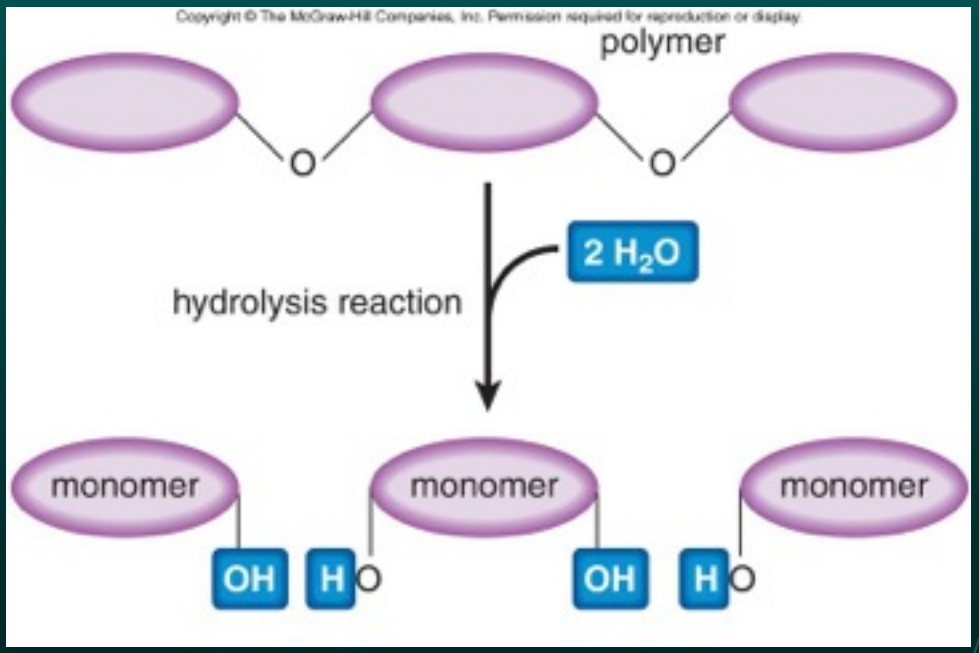
Reactants: enter into a reaction (left of the arrow)

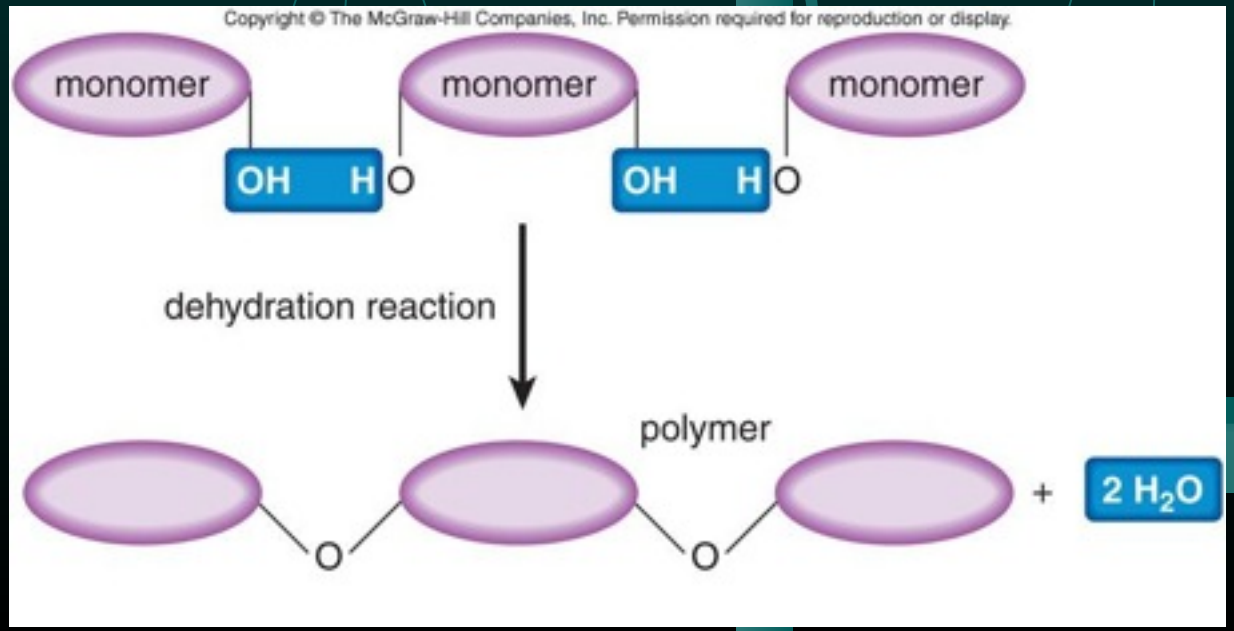
Products: produced by a chemical reaction (right of the arrow)

$$\text{carbon dioxide} + \text{water} \xrightarrow{\text{sunlight}} \text{glucose} + \text{oxygen}$$

Bonds are broken in reactants and new bonds are formed in products

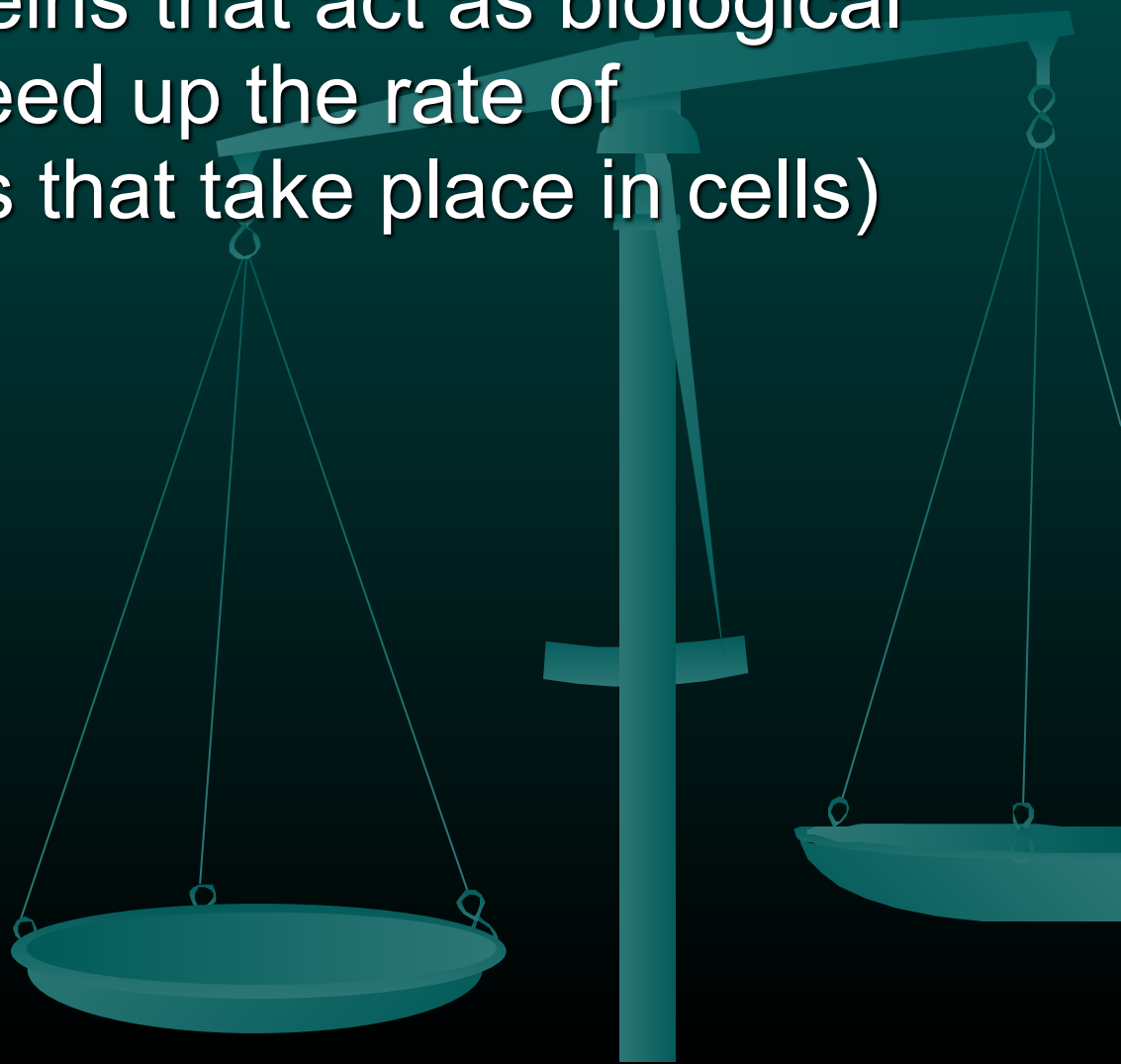
Biochemical Reactions

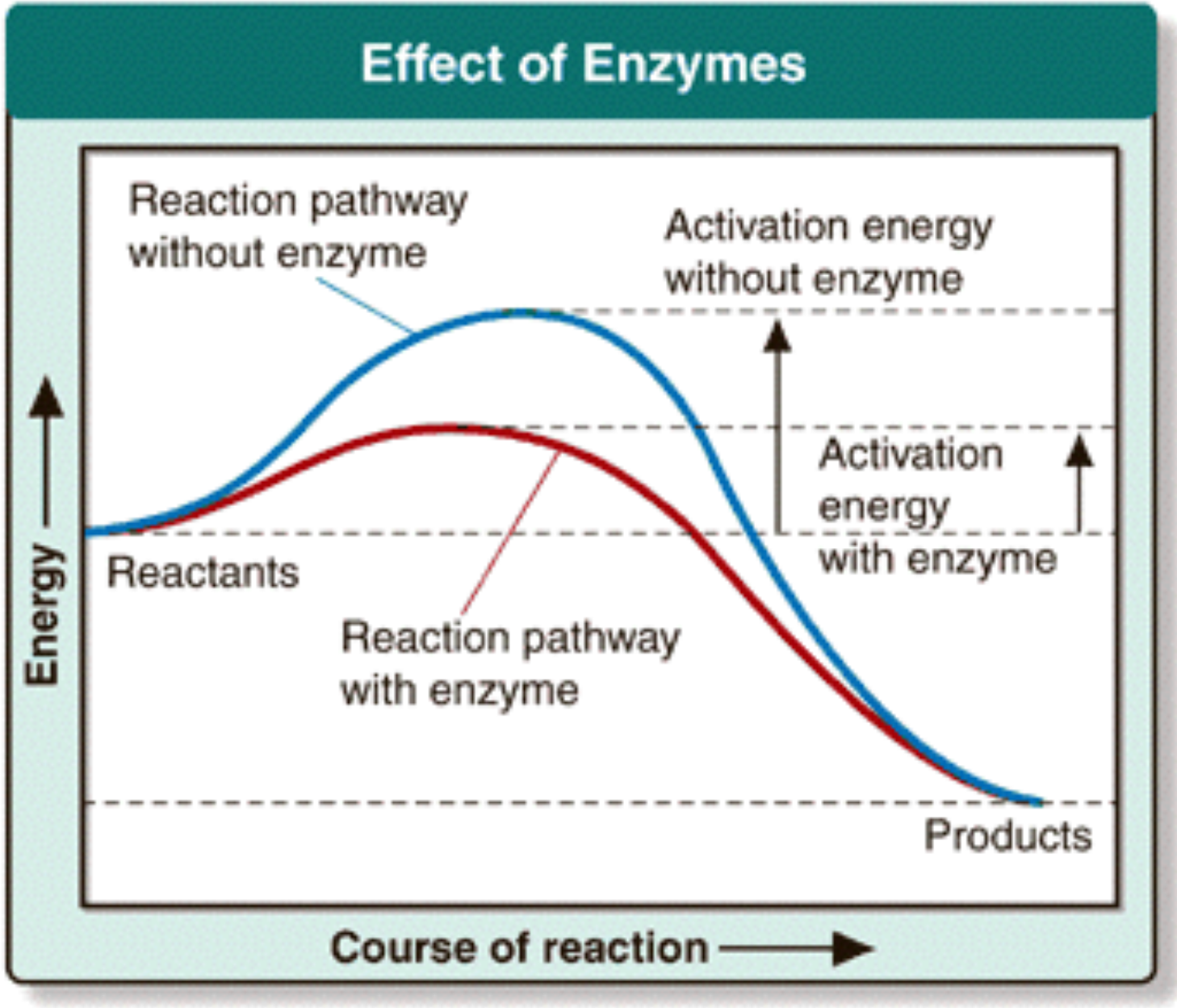




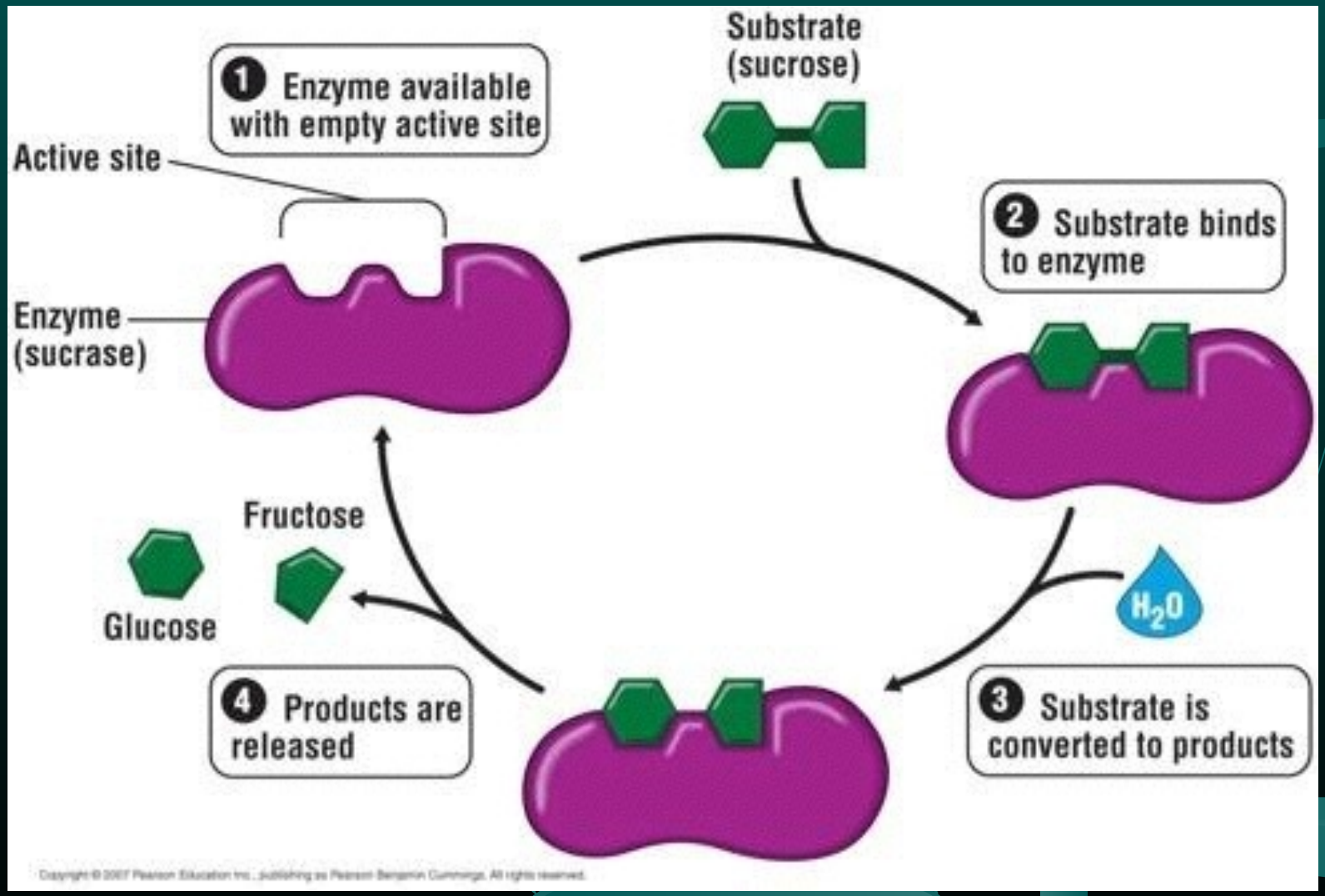
B. Enzymes

- Cells make catalysts
- Enzymes are proteins that act as biological catalysts (they speed up the rate of chemical reactions that take place in cells)




Effect of Enzymes
Reaction pathway without enzyme
Activation energy without enzyme
Activation energy with enzyme
Reactants
Reaction pathway with enzyme
Products
Energy
Course of reaction

C. Enzyme Action



Enzyme Characteristics

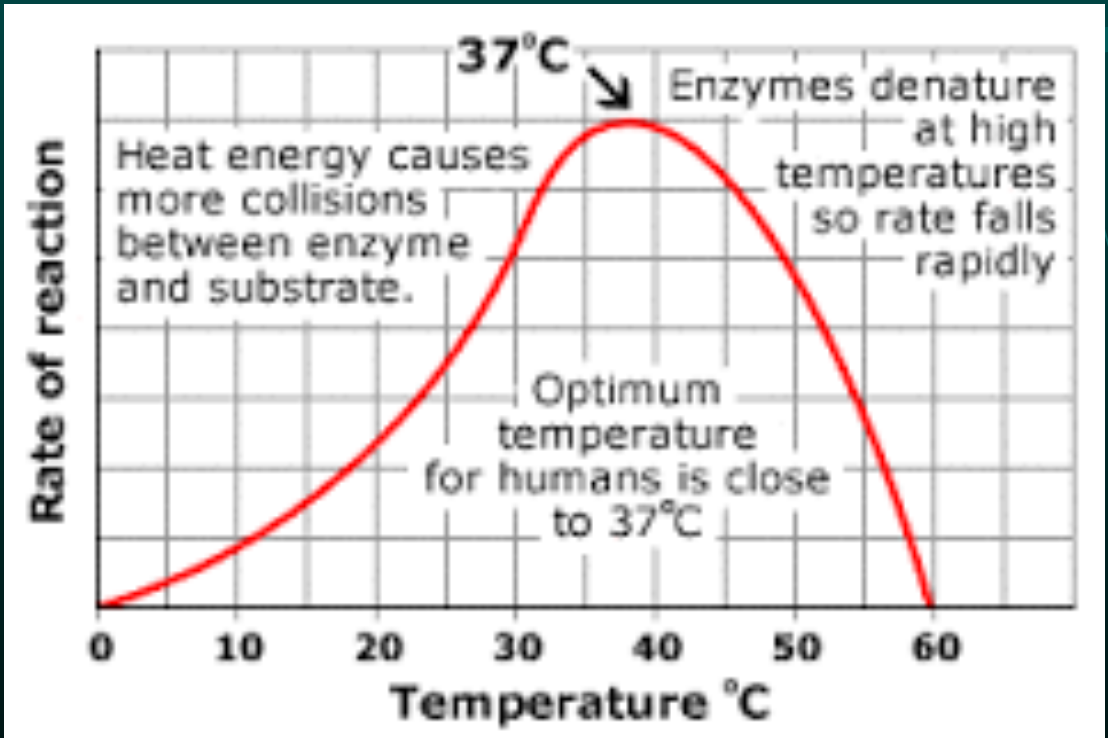
- have a specific shape and can only catalyze one type of reaction
- remain unchanged throughout the reaction and can be used over and over again
- names usually end in –ase

For example: lactase, catalase, amylase

Regulation of Enzyme Activity

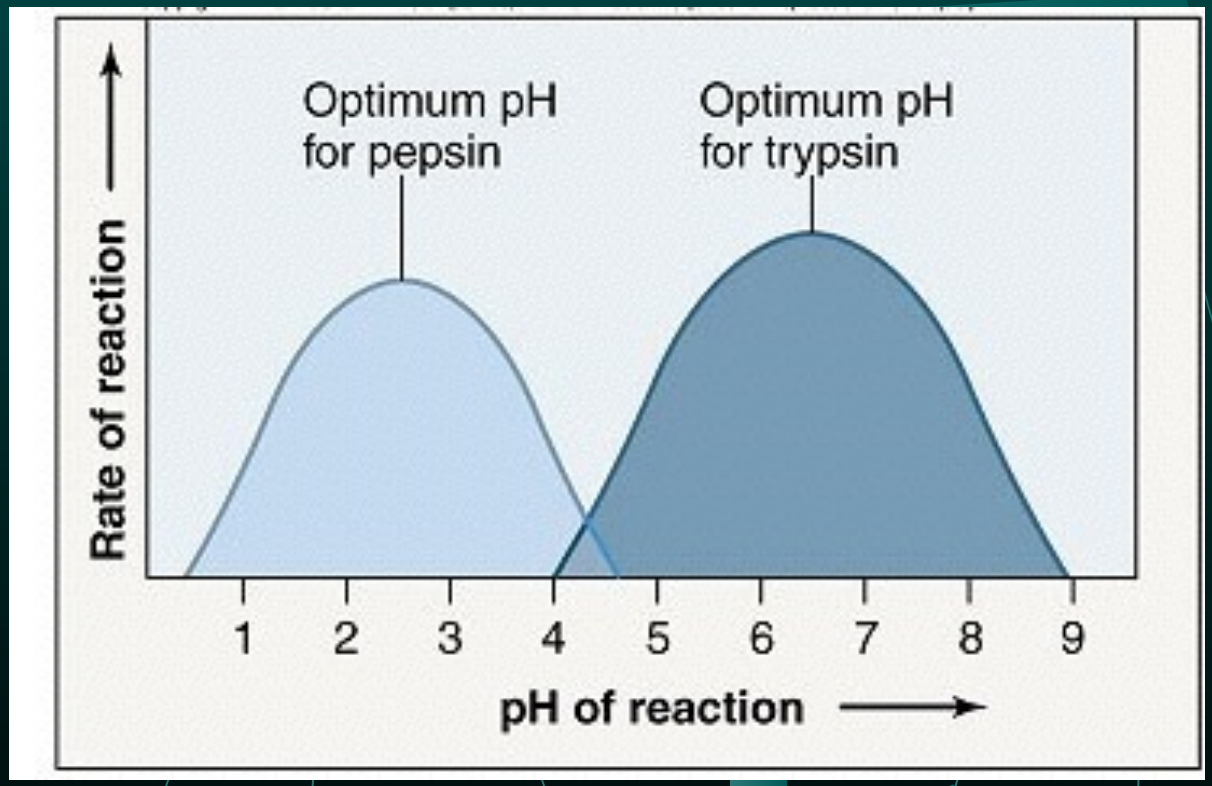
Temperature

Denature: the shape of the enzyme (protein) is permanently altered preventing it from performing its function



pH

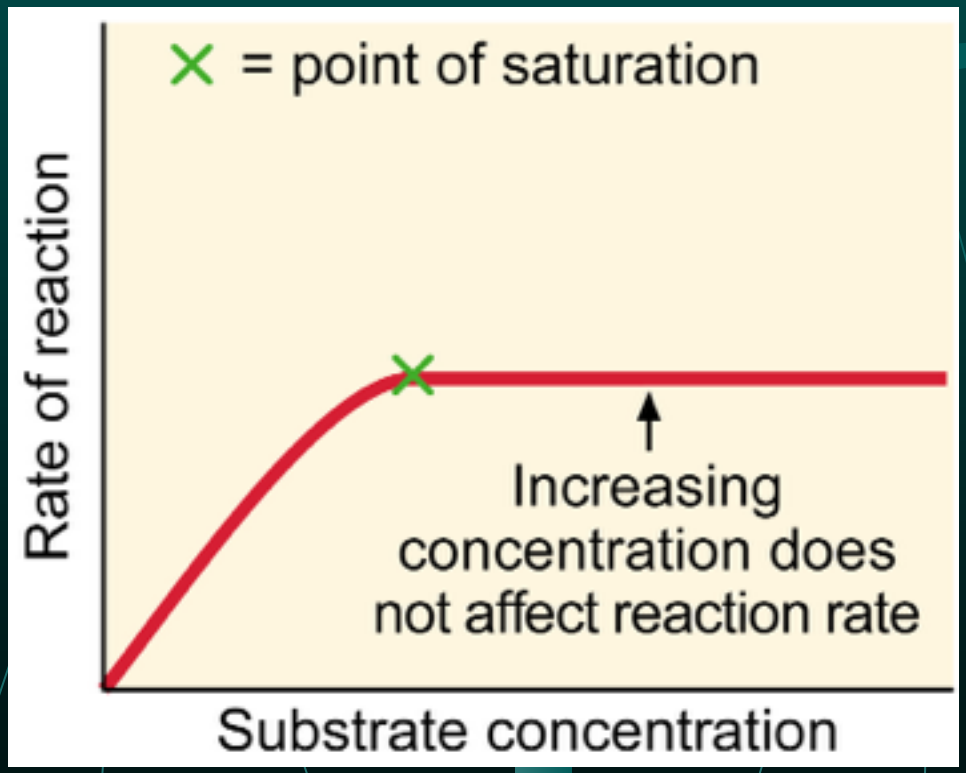
Enzymes work best at specific pH levels especially those that help with the digestion of food and absorption of nutrients



Substrate Concentration

- **Why?**

  the active sites of the enzyme molecules are saturated with substrate. The products must be released from the active sites before they are free to accommodate more substrate.



Enzyme Concentration

There is a direct relationship between enzyme concentration the rate of reaction

As the enzyme concentration increases so does the rate of reaction