KEYSTONE REVIEW SESSION #1

Intro to Science
Characteristics of Life
Biochemistry (water & macromolecules)

UNIT 1: INTRODUCTION TO SCIENCE & CHARACTERISTICS OF LIFE

- Distinguish between the scientific terms: hypothesis, inference, law, theory, principle, fact, and observation).
- Describe the characteristics of life shared by all prokaryotic and eukaryotic organisms.
- Describe and interpret relationships between structure and function at various levels of biological organization (organelles, cells, tissues, organs, organ systems, and multicellular organisms).

SCIENTIFIC METHOD TERMINOLOGY

- **Observation**: process of noticing and describing events or processes in a careful, orderly way
  - Uses 5 senses
- **Inference**: a logical interpretation based on prior knowledge and experience
- **Hypothesis**: possible explanation for a set of observations or possible answer to a scientific question
- **Theory**: explains why something happens
  - Well-tested
- **Law/Principle**: describes a pattern or event in nature
  - Well-tested
- **Fact**: a statement that is consistent with reality or can be proven with evidence.

SCIENTIFIC METHOD

The Scientific Method as an Ongoing Process

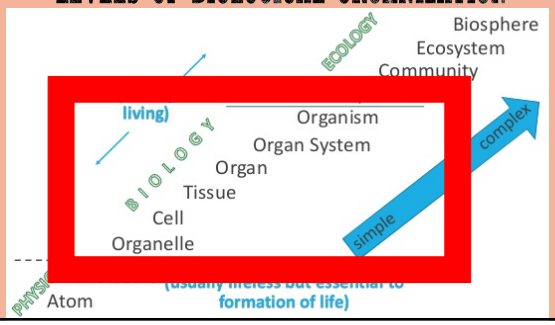
CHARACTERISTICS OF LIFE

Metabolism (obtain & use materials and energy)
Reproduce (sexually or asexually)

DNA (universal genetic code)

Grow & Develop
Respond to stimuli (environment)
Evolve & Adapt (change over time)
Cells (unicellular or multicellular)
Homeostasis (maintain a stable internal environment)

LEVELS OF BIOLOGICAL ORGANIZATION

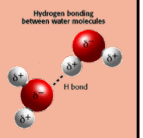


UNIT 3: BIOCHEMISTRY

- Describe the unique properties of water and how these properties support life on Earth (freezing point, high specific hear, cohesion)
- Explain how carbon is uniquely suited to form biological macromolecules.
- Describe how macromolecules form from monomers.
- Compare the structure and function of carbohydrates, lipids, proteins, and nucleic acids in organisms.
- Describe the role of an enzyme as a catalyst in regulating a specific biochemical reaction.
- Explain how factors such as pH, temperature, and concentration levels can affect enzyme function.

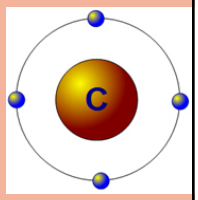
PROPERTIES OF WATER

- Polarity: uneven distribution of electrons
  - Oxygen is partially negative, hydrogen is partially positive
- Hydrogen Bonding
  - Negative oxygen is attracted to the positive hydrogen
  - Weak bond
- Cohesion/Adhesion
  - Cohesion: water is attracted to other water molecules
    - Surface tension
  - Adhesion: water is attracted to other substances
    - Capillary action
- Heat Capacity
  - High heat capacity: takes a large amount of heat energy to increase its temperature
    - Protects aquatic life
- Density
  - Solid water is less dense compared to liquid water
  - Ice floats



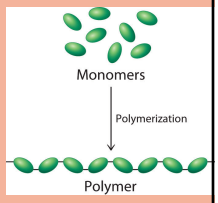
CARBON

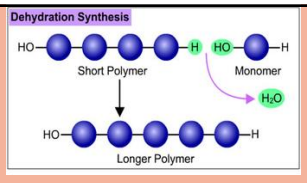
- Carbon
  - 4 valence electrons so it can bond to up to four other atoms
    - Can form single, double, or triple bonds
    - Strong, covalent bonds
    - Form complex molecules (long chains/rings)

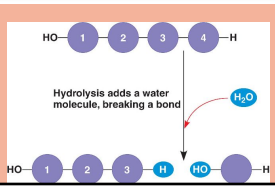


MACROMOLECULES

- Macromolecules = large organic molecules
  - Form from monomers joining into a polymer through the process of dehydration synthesis
    - Break polymer down using hydrolysis
  - 4 main types:
    - Carbohydrates
    - Lipids
    - Proteins
    - Nucleic Acids

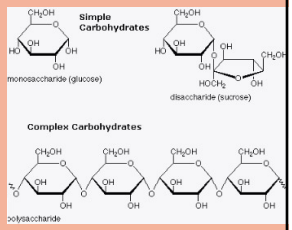






CARBOHYDRATES

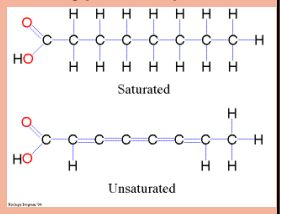
- Carbohydrates = C, H, O in a 1:2:1 ratio
  - Function: short-term energy and structure
  - Monomer = monosaccharide
    - Example: glucose
  - Polymer = polysaccharide
    - Examples: glycogen, starch, cellulose
    - Bonded by glycosidic bonds



- Usually end in -ose

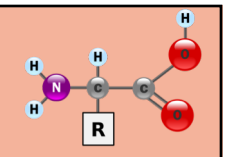
LIPIDS

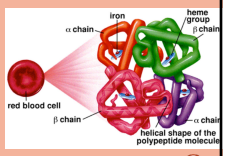
- Lipids = mostly C & H
  - Function: long-term energy, biological membranes, waterproof coverings
  - Grouped based on their hydrophobicity (hates water)
  - No monomer/polymer form
  - Examples: Fats, oils, waxes, steroids/hormones
  - Ester bonds
- Fat = glycerol + fatty acid tails



PROTEINS

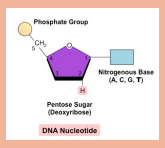
- Proteins = C, H, O, N
  - Fuctions: diverse, assist with almost everything
  - Monomer: amino acids
    - Example: proline, valine, glutamic acid
  - Polymer: polypeptide
    - Example: hemoglobin,, collagen
    - Bonded by peptide bonds

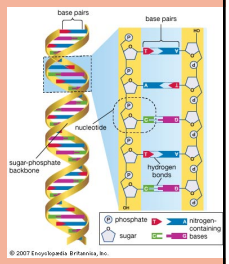




NUCLEIC ACIDS

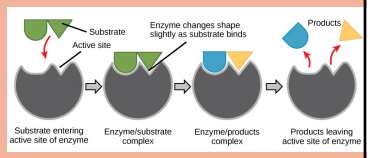
- Nucleic Acids = C, H, O, N, P
  - Monomer: nucleotide (sugar, phosphate group, & a nitrogenous base)
  - Polymer: polynucleotide
    - Example: DNA or RNA
    - Bonded by phosphodiester bonds



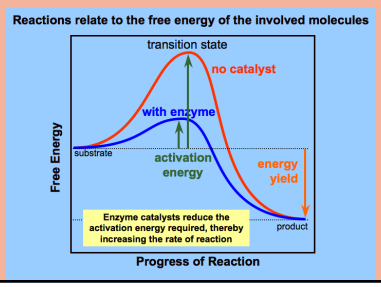


ENZYMES

- Activation energy is required to start all chemical reactions
- Enzymes are biological catalysts that lower the activation energy by bringing the reactants closer together
  - Speeds up reactions
  - Very specific – usually only catalyzing one reaction
  - Usually end in -ase

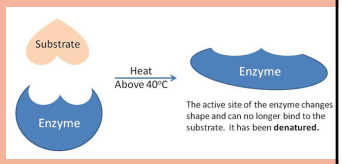


ENZYMES



FACTORS AFFECTING ENZYMES

- Factors can affect enzymes and cause them to denature (fall apart/change shape)
  - Enzymes can become unfunctional
  - It is possible to renature enzymes if put back in acceptable conditions
  - Factors include:
    - pH (buffers help!)
    - Temperature
    - Salinity
- Concentration of enzymes or substrates can affect the reaction rate



VIDEO REVIEW

- Ameoba Sisters – Characteristics of Life
- Ameoba Sisters – Levels of Biological Organization
- Ameoba Sisters – Properties of Water
- Ameoba Sisters – Macromolecules
- Ameoba Sisters – Enzymes