Chemistry of a Cell

Macromolecule Notes

Learning Targets

I can…

1. **Explain the difference between organic and inorganic compounds**
2. **Describe the structure and function of the 4 main macromolecules: carbohydrates, lipids, proteins, and nucleic acids.**

Organic vs Inorganic

- All substances can be classified as either organic or inorganic.
  - Organic Compounds – contain carbon and are generally associated with living things
    - Very large compared to inorganic compounds
    - Often contain large amounts of oxygen and hydrogen

Organic vs Inorganic

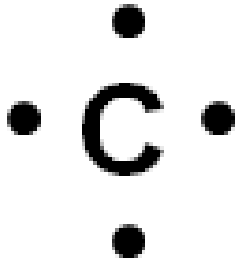
- **Inorganic Compounds – anything NOT considered organic**
  - **May be metals or nonmetals, pure substances or compounds**
  - **Have many different uses based on properties**
    - **EX: water, salts, and other minerals all play an important role in how your body functions**

Carbon and Organic Molecules

- Carbon atoms form the backbone of many molecules that make up biological systems on Earth
  - **Biological Molecules** – made up of chains of carbon atoms bonded to individual atoms of hydrogen, oxygen, nitrogen, or sulfur
    - Groups of atoms known as functional groups can be present that give molecules specific properties

Carbon and Organic Molecules

- Why carbon?!
  - Carbon is a small, less-bulky atom that bonds easily to other atoms
  - Carbon has 4 valence electrons which allows it to bond with up to 4 other elements
    - Can also create double and triple bonds making it more versatile

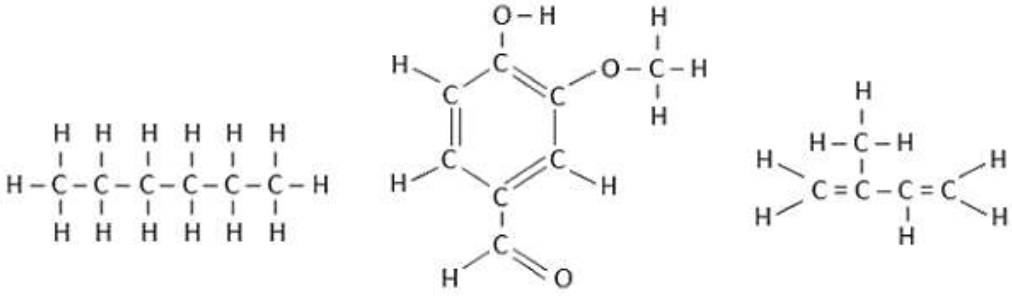


Key Elements

- Element – a type of matter composed of only one kind of atom which cannot be broken down into a simpler structure
- 6 Elements Commonly Found in Cells:
  - Sulfur (S)
  - Phosphorus (P)
  - Oxygen (O)
  - Nitrogen (N)
  - Carbon (C)
  - Hydrogen (H)

Organic Molecules

- More than 90% of all known chemical compounds are organic in nature
  - Small carbon-containing molecules can link together to form a variety of larger molecules that are essential for life
  - When forming compounds, carbon atoms can bond to one another in chains, rings, and branching networks



Chain Structure

Ring Structure

Branched Structure

Complex Organic Molecules

- Biological molecules are composed of small repeating subunits that form larger molecules
  - Monomer: subunit, or building block, of organic compounds
- 4 Basic Categories of Complex Organic Molecules:
  - Proteins
  - Carbohydrates
  - Lipids
  - Nucleic Acids

Carbohydrates

- **Carbohydrate – often called sugars and are an *immediate* energy source**
- **Structurally, they are chains of carbon units with hydroxyl groups (-OH) attached**
- **Simplest = monosaccharides**
- **Disaccharides = 2 monomers**
- **Oligosaccharides = 3-10**
- **Polysaccharides = 10+**

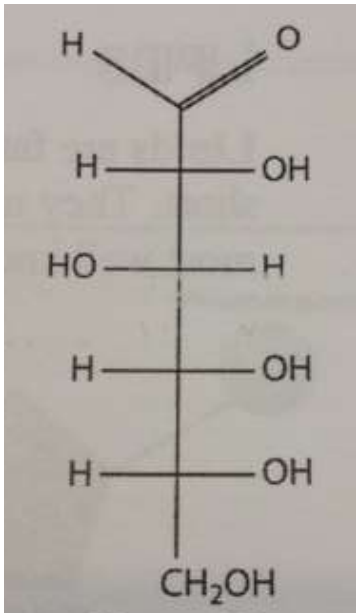


Figure 6.6
Fischer Diagram of Glucose

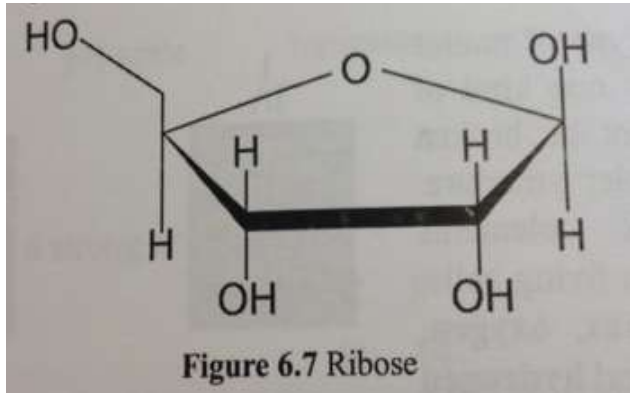


Figure 6.7 Ribose

Lipids

- **Lipids** – fats, oils, and waxes
- **Structure** – made up of chains of methyl (-CH) units
  - Chains may be long or short, straight or rings
- **Function** – most well known is fat that stores energy
  - Also used to make up cell membranes

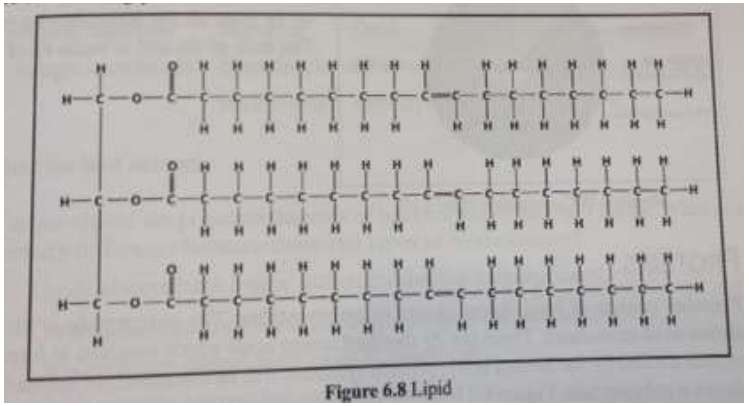


Figure 6.8 Lipid

Nucleic Acids

- **Nucleic Acids** – found in the nucleus of a cell
- Made up of a *nucleotide* monomer
  - Consists of a sugar, phosphate group, and a nitrogenous base
  - 2 Main Types:
    - RNA – ribonucleic acid – involved in the production of proteins
    - DNA – deoxyribonucleic acid – stores genetic info

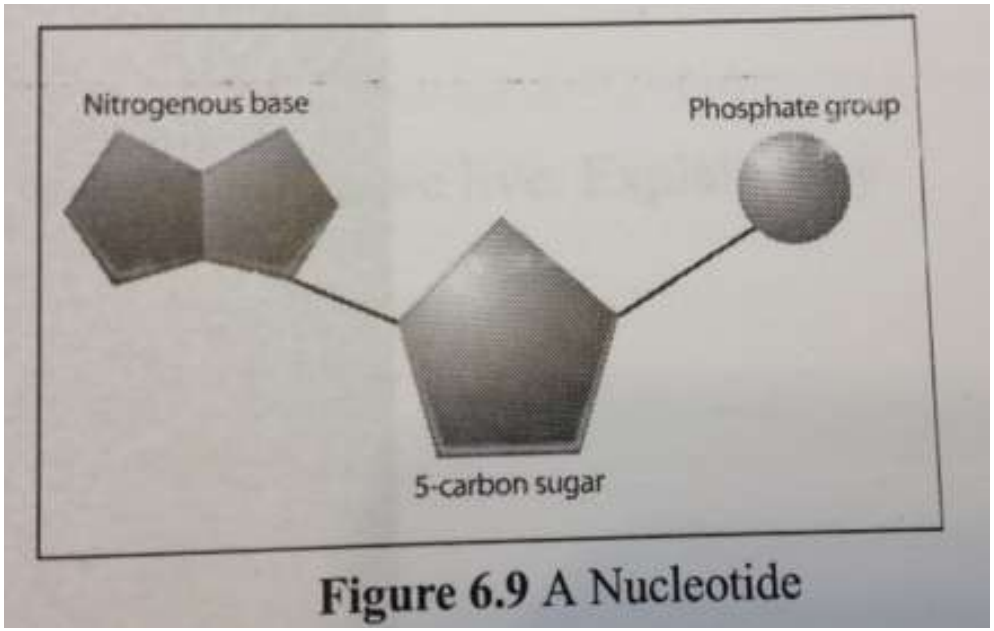
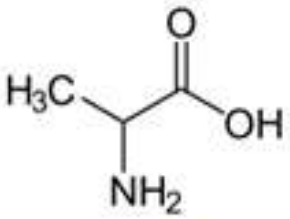


Figure 6.9 A Nucleotide

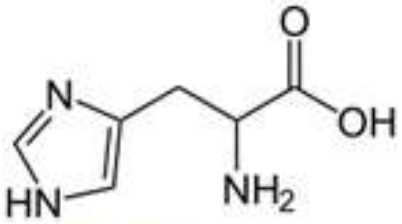
Proteins

- **Proteins** – consist of long, linear chains of polypeptides
- 20 standard **amino acids** combine to form every protein needed by the human body
  - Examples: structural proteins, regulatory proteins, contractile proteins, transport proteins, storage proteins, protective proteins, membrane proteins, and enzymes
- The make up of the protein's unique **side chain** determines the final structure of the protein
  - Side chains can be linear, branched, or ring-shaped
  - Interactions of side chains determines 3D shape
- Structure determines function of protein
- Must eat protein in order to gain the amino acids NOT made by the body

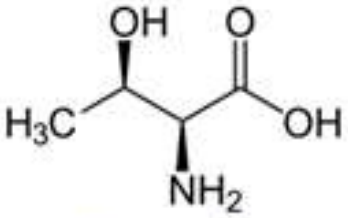
Proteins



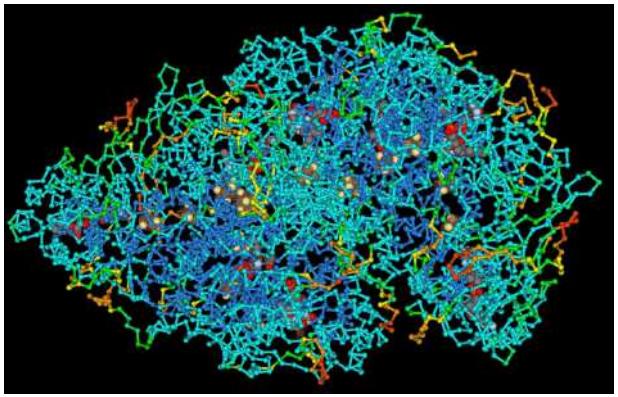
Alanine



Histidine



Threonine



Visual Review

- Take out each item in your provided bag
- Determine which item represents each macromolecule (carbohydrate, lipid, protein, and nucleic acid). Write this down on your note guide
- Tell ***WHY*** you think that represents each
- **BE PREPARED TO BE CALLED ON!**

Section Review Questions

- Using the ***Quality Core Biology End-of-Course Assessment Book*** complete the following questions:
  - **P.107**
    - **Part B & C**

Section Review Questions

- B.
  - 1. Carbon chains are principal feature of both carbohydrates and lipids. What is the primary difference between these two types of biomolecules?
    - B – Carbohydrates carry hydroxyl groups on their carbon backbone
  - 2. What molecule makes up the bulk of a cell?
    - D – Water
  - 3. Carbon is important to living things because
    - C - It can form four covalent bonds with other atoms
  - 4. Nucleotides are to nucleic acids as amino acid are to –
    - C - Proteins

Section Review Questions

- C
  - 1. All living things have a common tie with the Earth on which we live. Explain why this is true.
    - All living things are made up of carbon which is found in the make up of Earth as well
  - 2. What are the 6 elements commonly found in living things?
    - Sulfur, Phosphorus, Carbon, Hydrogen, Nitrogen, Oxygen
  - 3. Why is carbon important to living things?
    - It can create 4 bonds with other elements create very stable and complex molecules