Honors Biology – Unit 1 – Chapter 3
"THE MOLECULES OF CELLS"

1. organic molecules, the chemistry of the carbon atoms

2. hydrocarbons, various shapes of carbon skeletons

3. large molecules: monomers vs. polymers

4. CARBOHYDRATES: monosaccharides, disaccharides, polysaccharides

   - organic, polar, water-soluble, $C_6H_{12}O_6$
   - monosaccharide: glucose, fructose
   - disaccharides: sucrose, lactose
   - polysaccharies: cellulose, glycogen, plant starch

5. LIPIDS: triglycerides, phospholipids, steroids

   - organic, non-polar, non-water-soluble, made of long hydrocarbon chains
   - triglycerides: body fat, animal fat, corn oil, olive oil, etc…
   - phospholipids: hydrophilic heads, hydrophobic tails
   - steroids: estrogen, testosterone, cholesterol, anabolic steroids

6. PROTEINS: amino acids, polypeptides

   - organic, polar or non-polar, water-soluble or non-water-soluble
   - levels of protein structure: primary vs. secondary vs. tertiary vs. quaternary
   - functions: contractile proteins, enzymes, peptide hormones, antibodies
     chemical transporters, structural proteins
   - structure vs. function, denaturation

7. NUCLEIC ACIDS: DNA and RNA

   - deoxyribonucleic acid (two strands) vs. ribonucleic acid (one strand)
   - sugar, phosphate group, nitrogenous base
   - 4 bases in DNA: A, T, C, G
   - 4 bases in RNA: A, U, C, G

8. lactose tolerance vs. lactose intolerance:

   - evolutionary history
   - involves nucleic acids (DNA), carbohydrates (lactose), proteins (lactase)

Honors Biology – Chapter 3 Word Roots
"THE MOLECULES OF CELLS"

de- = without or remove; **hydro-** = water (*dehydration reaction:* a chemical process in which two molecules become covalently bonded to each other with the removal of a water molecule)

di- = two; **-sacchar** = sugar (*disaccharide:* a sugar molecule consisting of two monosaccharides linked by a dehydration reaction)

carb- = coal (*carboxyl group:* a functional group in an organic molecule, consisting of an oxygen atom double-bonded to a carbon atom that is also bonded to a hydroxyl group)

glyco- = sweet (*glycogen:* an extensively branched polysaccharide of many glucose monomers that serves as an energy-storage molecule in animal liver and muscle cells)

helic- = a spiral (*alpha helix:* spiral shape created by the coiling of polypeptides in a protein's secondary structure); *double helix:* the form of native DNA, composed of two adjacent polynucleotide strands wound into a spiral shape)

hydro- = water (*hydrocarbon:* a chemical compound composed only of the elements carbon and hydrogen) -**lyse** = break (*hydrolysis:* a chemical process in which polymers are broken down by the chemical addition of water molecules to the bonds linking their monomers); **-philos** = loving (*hydrophilic:* "water-loving": refers to polar, or charged, molecules [or parts of molecules] that are soluble in water.) **-phobos** = fearing (*hydrophobic:* "water-fearing": refers to non-polar molecules [or parts of molecules] that do not dissolve in water)

iso- = equal (*isomer:* one of several organic compounds with the same molecular formula but different structures and, therefore, different properties)

macro- = large (*macromolecule:* a giant molecule in a living organism formed by the joining of smaller molecules)

mono- = single (*monosaccharide:* simplest type of sugar; **meros-** = part (*monomer:* a chemical subunit that serves as a building block of a polymer)

poly- = many (*polymer:* a large molecule consisting of many monomers covalently joined together in a chain; *polysaccharide:* many monosaccharides joined together)

quatr- = four (*quaternary structure:* the fourth level of protein structure; the shape resulting from the association of two or more polypeptide subunits)

terti- = three (*tertiary structure:* the third level of protein structure; the overall, three-dimensional shape of a polypeptide due to interactions of the R groups of the amino acids making up the chain)

PROPERTY OF:

HONORS BIOLOGY – UNIT 1 – CHAPTER 3 NOTES

THE MOLECULES OF CELLS

Organic Molecules
- Organic Molecule = a chemical that contains carbon
  Carbon can form 4 covalent bonds
- Polar molecule = a chemical that contains an electronegative atom (oxygen)
- Non-Polar molecule = a chemical that does not contain electronegative atoms (oxygen)
- Water-soluble = a chemical that can mix with water (also called hydrophilic)
  polar chemicals are water-soluble (they have oxygen)
  Why? Water is also a polar chemical
  "LIKE DISSOLVES LIKE!"
- Not Water Soluble = a chemical that cannot mix with water (also called hydrophobic)
  non-polar chemicals are not water-soluble (they have little or no oxygen)
- Saturated molecule = a molecule with all the carbons surrounded by hydrogen atoms
- Unsaturated molecule = a molecule that does not have all the carbons surrounded by hydrogens

Questions

1.	C_3H_8	Is it polar? (____)	Is it organic? (____)
2.	C_3H_7OH	Is it polar? (____)	Is it organic? (____)
3.	NaCl	Is it polar? (____)	Is it organic? (____)
4.	H_2O	Is it polar? (____)	Is it organic? (____)

Chemical Reactions
- Smaller molecules are joined together using dehydration synthesis reactions.
  A water molecule is produced (released).
- Larger molecules are broken down using hydrolysis reactions.
  A water molecule is split (used up).

Carbohydrates
- Chemical Formula of glucose: $C_6H_{12}O_6$
- Sugar always have the formula: $C_nH_{2n}O_n$
- If you reduce the numbers in the sugar formula, you get: C-H_2O (literally carbon and hydrate)
- Is it polar? (yes) Is it organic? (yes)
- 3 categories of carbohydrates:
  monosaccharide = 1 simple sugar
  disaccharide = 2 simple sugars joined together
  polysaccharide = many simple sugars joined together

- 7 types of carbohydrates:
    1. glucose = blood sugar (water-soluble; monosaccharide)
    2. fructose = fruit sugar (water-soluble; monosaccharide)
    3. sucrose = table sugar (water-soluble; disaccharide)
    4. lactose = milk sugar (water-soluble; disaccharide)
    5. cellulose = gives toughness + structure to plants (not water-soluble; poly)
    6. glycogen = energy source for animals, stored in the liver (water-soluble; poly)
    7. starch = energy source for plants (water-soluble; polysaccharide)

<u>Lipids</u>

- 3 categories of lipids:
    1. triglyceride = 3 hydrocarbon chains that are linked together at the top
       (organic = yes, polar = no, water-soluble = no)
    2. phospholipid = 2 hydrocarbon chains that are linked at the top and have a polar "phosphate group"
       (HEAD: polar = yes, water-soluble = yes; TAIL: polar = no, water-soluble = no)
    3. steroid = 4 fused ring structures made of carbon and hydrogen
       (organic = yes, polar = no, water-soluble = no)
- 3 types of lipids:
    1. adipose = fat tissue, energy storage (not water-soluble)
    2. phospholipids = found on the cell membrane, creates a barrier around the cell
       (heads are water-soluble, tails are not water-soluble)
    3. steroid = found in cholesterol, produces sex hormones (not water-soluble)
       (testosterone = male sex hormone; estrogen = female sex hormone)

<u>Proteins</u>

- structure of amino acids:
    1. central carbon atom, amino group acid group, R group
    2. The R group is different for each amino acid.
    3. R groups can be large or small, polar or non-polar, charged or neutral.
    4. The structure of the R group determines the function of the amino acid.
- levels of protein structure:
    1. primary structure = the amino acid sequence connected by covalent bonds.
    2. secondary structure = the amino acids fold into helices or sheets and are held together by H-bonds
    3. tertiary structure = the folded structures combine into a single 3-dimensional subunit and may or may not be functions
    4. quaternary structure = the functional protein containing all necessary subunits
- 8 categories of proteins:
    hormonal proteins = relays messages throughout the body
    receptor proteins = used to receive messages from other cells
    contractile and motor proteins = used for muscle contractions or for cellular movements
    structural proteins = gives shape and protection to cells
    enzymatic proteins (enzymes) = used to speed up chemical reactions
    defensive proteins (antibodies) = used to destroy foreign pathogens (immune system)
    storage proteins = used to store amino acids for a growing organism
    transport proteins = used to carry molecules across a cell membrane or through the blood