**Chapter 3 Notes**

Carbon

* Framework of biological molecules consists primarily of carbon bonded to
	+ Carbon
	+ O, N, S, P or H
* Can form up to 4 covalent bonds
* Hydrocarbons – molecule consisting only of carbon and hydrogen
	+ Nonpolar
	+ Functional groups add chemical properties

Isomers

* Molecules with the same molecular or empirical formula
	+ Structural isomers
	+ Stereoisomers – differ in how groups attached
		- * Mirror image molecules
			* D-sugars and L-amino acids

Macromolecules

* Polymer – built by linking monomers
* Monomer – small, similar chemical subunits
* 4 Major Groups:
	+ Carbohydrates
	+ Lipids
	+ Proteins
	+ Nucleic Acids
* Dehydration synthesis
	+ Formation of large molecules by the removal of water
	+ Monomers are joined to form polymers
* Hydrolysis
	+ Breakdown of large molecules by the addition of water
	+ Polymers are broken down to monomers

Carbohydrates

* Molecules with a 1:2:1 ratio of carbon, hydrogen, oxygen
* Empirical formula (CH2O)*n*
* C—H covalent bonds hold A LOT of **energy**
	+ Carbohydrates are good energy storage molecules
	+ Examples: sugars, starch, glucose
* Monosaccharides
	+ Simplest carbohydrate
	+ 6 carbon sugars play important roles
	+ Example: Glucose C6H12O6
	+ Fructose is a structural isomer of glucose
	+ Galactose is a stereoisomer of glucose
	+ Enzymes that act on different sugars can distinguish structural and stereoisomers of this basic six-carbon skeleton
* Disaccharides
	+ 2 monosaccharides linked together by dehydration synthesis
	+ Used for sugar transport or energy storage
	+ Examples: sucrose, lactose, maltose
* Polysaccharides
	+ Long chains of monosaccharides
	+ Linked through dehydration synthesis
	+ Polysaccharides serve as energy storage
	+ Plants use starch
	+ Animals use glycogen
	+ Polysaccharides serve as Structural support
	+ Plants use cellulose
	+ Arthropods and fungi use chitin

Nucleic Acids

* Polymer – nucleic acids
* Monomers – nucleotides
	+ sugar + phosphate + nitrogenous base
	+ sugar is deoxyribose in DNA or ribose in RNA
	+ Nitrogenous bases include
		- Purines: adenine and guanine
		- Pyrimidines: thymine, cytosine, uracil
	+ Nucleotides connected by phosphodiester bonds
* Deoxyribonucleic Acid (DNA)
	+ Encodes information for amino acid sequence of proteins
	+ Sequence of bases
	+ Double helix – 2 polynucleotide strands connected by hydrogen bonds
	+ Base-pairing rules
		- A with T (or U in RNA)
		- C with G
* Ribonucleic Acid (RNA)
	+ RNA similar to DNA except
	+ Contains ribose instead of deoxyribose
	+ Contains uracil instead of thymine
	+ Single polynucleotide strand
	+ RNA uses information in DNA to specify sequence of amino acids in proteins
* Other nucleotides
	+ ATP adenosine triphosphate
		- Primary energy currency of the cell

Proteins

* Protein functions include:
	+ Enzyme catalysis
	+ Defense
	+ Transport
	+ Support
	+ Motion
	+ Regulation
	+ Storage
* Proteins are polymers
	+ Composed of 1 or more long, unbranched chains
	+ Each chain is a polypeptide
	+ Amino acids are monomers
* Amino acid structure
	+ Central carbon atom
	+ Amino group
	+ Carboxyl group
	+ Single hydrogen
	+ Variable R group
	+ Joined by dehydration synthesis
		- Peptide bond
* The shape of a protein determines its function
	+ 4 Levels of Structure:
		- Primary structure – sequence of amino acids
		- Secondary structure – interaction of groups in the peptide backbone
			* a helix
			* b sheet
		- Tertiary structure – final folded shape of a globular protein
			* Stabilized by a number of forces
			* Final level of structure for proteins consisting of only a single polypeptide chain
		- Quaternary structure – arrangement of individual chains (subunits) in a protein with 2 or more polypeptide chains
* Domains
	+ Functional units within a larger structure
	+ Most proteins made of multiple domains that perform different parts of the protein’s function
* Chaperones
	+ Once thought newly made proteins folded spontaneously
	+ Chaperone proteins help protein fold correctly
	+ Deficiencies in chaperone proteins implicated in certain diseases
		- * Cystic fibrosis is a hereditary disorder
				+ In some individuals, protein appears to have correct amino acid sequence but fails to fold
* Denaturation
* Protein loses structure and function
* Due to environmental conditions
	+ pH
	+ Temperature
	+ Ionic concentration of solution
* Dissociation
	+ subunits may be dissociated
	+ without losing their individual tertiary structure

Lipids

* Loosely defined group of molecules with one main chemical characteristic
	+ They are insoluble in water
* High proportion of nonpolar C—H bonds causes the molecule to be hydrophobic
* Fats, oils, waxes, and even some vitamins
* Excellent for energy storage
* Fats
* Triglycerides
	+ Composed of 1 glycerol and 3 fatty acids
* Fatty acids
	+ Need not be identical
	+ Chain length varies
	+ Saturated – no double bonds between carbon atoms
		- Higher melting point, animal origin
		- solid at room temp
	+ Unsaturated – 1 or more double bonds
		- Low melting point, plant origin
		- Liquid at room temp
	+ Trans fats produced industrially
* Phospholipids
* Composed of
	+ Glycerol
	+ 2 fatty acids – nonpolar “tails”
	+ A phosphate group – polar “head”
	+ Form all biological membranes
	+ Micelles – lipid molecules orient with polar (hydrophilic) head toward water and nonpolar (hydrophobic) tails away from water
	+ Phospholipid bilayer – more complicated structure where 2 layers form
		- Hydrophilic heads point outward
		- Hydrophobic tails point inward toward each other