CHEMISTRY, NUCLEAR CHEMISTRY FOR A&P

revised 25 Augutst 2016

Marieb, pp 26-61, JFL 22-43, Martini pp31-56, Martini's 7th, pp 27-57, 8th: 53-107, 9th: 27-61, 10th: 26-63

ATOMIC MODEL OF MATTER: Subatomic particles, atomic number, atomic weight (p28)
Major elements in cells: CHNOPS (p28)
Isotopes different forms of an element (with differing masses). (p28)

RADIOACTIVITY: Unstable mixture of N + P yields radioactive isotopes. (p28)

Radiation	composition	source	penetration	damage to tissues
alpha	2N + 2P	U, Pu, Ra, etc	low	great, esp. epithelium
beta	electron, positron	many: ex: ^{3}H, ^{14}C, ^{32}P, ^{131}I	moderate	moderate
gamma	electromagnetic ray	many	high	low

ionizing radiation: radiation with enough energy to eject orbiting electrons (ionization)

CANCER AND RADIATION: **CARCINOGENESIS:** (p106) 1) **mutation** of cell cycle regulatory genes
2) **repeated tissue trauma** to stimulate mitosis

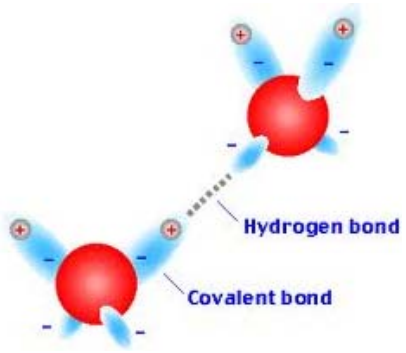
Radiation is a mutagen because it can mutate cell cycle regulatory genes
Tissue susceptibility is proportional to intrinsic mitotic rate:

Epithelial tissue	high mitotic rate (most common form of cancer)	form **carcinomas** ("crab tumor")
Connective tissue	moderate mitotic rate, can be stimulated to divide	form **sarcomas** ("flesh tumor")

CHEMICAL ACTIVITY: Orbital model, octet rule for chemical activity, valence shell, electronegativity (p 33)

Bonds: (p 30)
- ionic — *Complete transfer of* e^-, makes cations vs anions (p 33)
- covalent — strongest of chemical bonds (vs polar covalent bonds) (p 34)
- hydrogen bonds — crucial in biology, water as *universal solvent* (p 36)

KNOW: Oxidation-reduction: reducing agents give electrons, oxidizing remove. Oxidation = aging



WATER: solvent in which life's processes take place (solvent + solute = solution) (p 40)
- **pH**: acids vs bases, $pH = -\log_{10}[H^+]$ LEARN (p 42)
- **acid** donates protons, **base** accepts protons,
- **buffer** maintains concentration of protons in solution

CHEMICAL REACTIONS: (p 35)

anabolic ("up throw") uses ATP for energy)	synthesis	dehydration condensation
catabolic ("down throw") generates ATP	decomposition	hydrolysis

ORGANIC COMPOUNDS

Carbohydrates: $C_nH_{2n}O_n$ (p 43-45)
- monosaccharides: (p44) glucose, fructose, galactose (only monosaccharides can be absorbed, metabolized)
- disaccharides: (p45) maltose, lactose, sucrose (must be hydrolyzed before absorption)
- polysaccharides (glycans) (p46) starch, glycogen, cellulose (the latter is indigestible, serves as fiber in diet)
- mucopolysaccharides: (P56) in mucus, ground substance, synovial joint fluid (Proteoglycans)

Lipids: fats (triglycerides), fatty acids (simple fat), phospholipids, steroids (p 47-51)

Proteins: protein linear sequence of amino acids, joined by peptide bonds
comprise enzymes, structural proteins (p 52)
- protein structure, primary, secondary, tertiary, quaternary (p 53)
- fibrous proteins: collagen, keratin, elastin, actin and myosin
- globular proteins: hemoglobin, albumin
  transport, buffer (albumin) defense, hormones
  most secreted proteins are *glyco*proteins

enzymes *protein catalysts* (LEARN) (p 55)
- catalysis: speeds up a reaction by reducing the energy required for activation
- enzymes: protein catalysts, active site, substrate, *shape critical*.
  Alter shape of an enzyme, destroy activity (heat, cold, pH, high salt, *etc*)

nucleic acids: **genetic material** deoxyribonucleic acid, polymer of nucleotides A, T, G, C
ribonucleic acid, also a polymer, but with A, U, G, C, and ribose in backbone

CENTRAL DOGMA OF MODERN GENETICS:

DNA the "*genetic material*"chromosomes in the nucleus, reproduced by **replication**
↓ **TRANSCRIPTION:** DNA directs the synthesis of RNA, in the nucleus. (P 85)
RNA Messenger RNA leaves nucleus, taken up by ribosomes on rough ER
↓ **TRANSLATION:** Ribosomes use mRNA to direct protein synthesis (p 88-89)

PROTEIN Product of "gene expression" = enzymes, structural proteins, antibodies, etc.