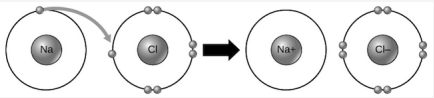
Ionic Bonds



Electrons transfer to the more electronegative element, creating ions

Chemical Bond Strength

Covalent bonds are **strong**

Weak noncovalent:	>ionic
	>hydrogen
	>van der waals

Composition of a Cell

Water

>cytoplasm, lumen, inside nucleus, etc.

Inorganic ions

>$Fe^{2+/3+}$, Ca^{2+}, Mg^{2+}, K^{+}, Na^{+}, Cl^{-}, $PO4^{2-}$, etc.

>many function as **cofactors**	>pieces of a protein aside from amino acid that is needed for protein to carry out function

Organic Molecules

>4 major classes	>Carbohydrates, Proteins, Nucleic Acids, Lipids

>3 are polymers, Lipids are *not*

Nucleic Acids

Deoxyribonucleic acid (DNA) and Ribonucleic acid (RNA)

Monomer: **Nucleotide**	>5 carbon sugar, charged phosphate group, nitrogenous base
>Deoxynucleotide (ATGC) - deoxyribose - lacking 1 oxygen	>Ribonucleotide (AUGC) - ribose

Nitrogenous Bases

Pyrimidine: cytosine, uracil, thymine	Purine: guanine, adenine
>CUT the py	>Pur As Gold

Nucleotides are joined by **phosphodiester bonds**

>forms sugar-phosphate backbone

RNA functions for information transfer and processing (how much proteins are produced, how much gene expression, etc.)	DNA functions for information storage

>RNA also functions for enzymatic activity (catalyze reactions) in form called **Ribozymes**

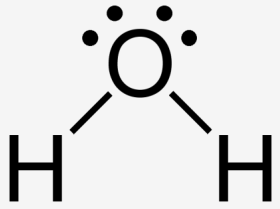
Nucleotide derivatives (ATP, GTP) also have important functions:

Nucleic Acids (cont)

>*Energy*- Adenosine triphosphate, guanosine triphosphate, nicotinamide adenine dinucleotide	>ATP, GTP, NADH
>*Intracellular signaling*- Cyclic AMP (adenosine monophosphate)	>for vasodilation and constriction

Transcription is polymerization of ribonucleotides.
Translation is polymerization of amino acids.
Replication is polymerization of deoxynucleotides.

Covalent Bonds



Electrons are shared, either equally (nonpolar) or unequally (polar).
An example of nonpolar is methane, and and example of polar is water.
Nonpolar- think C-H and C-C bonds
Polar- think O-H, N-H, and S-H bonds

Lipids

NOT POLYMERS	>not chains and not repeating
All display degree of *hydrophobic* behavior	>water insoluble due to predominantly nonpolar bonds

Simplest lipids are fatty acids

Some are *amphipathic*- both hydrophobic and hydrophilic in one molecule

Triglycerols- aka triglycerides or "fats"

>glycerol + 3 fatty acids	>function as energy/metabolism (fatty acid -> Acetyl CoA for citric acid cycle)

Phospholipids

>glycerol + 2 fatty acids + 1 polar head group	>fatty acids=hydrophobic, polar head group=hydrophilic

>*very* amphipathic (orientation of double bilayer membrane)

>key components of membrane structure

>signaling	(not just proteins doing inter & intracellular signaling)

Lipid Diversity - Sources of Diversity:

1. fatty acid length	>about 14-20 carbons long (tends to be even #s)

Lipids (cont)

2. number of C-C bonds in fatty acids	>**saturated**- more H due to all single bonds
	>**unsaturated**- less H due to double C=C bond
3. variability in molecule attached to glycerol	>fatty acid species, type of polar head group (phospholipids), oligosaccharides (glycolipids)

Sterols/Steroids

Nonpolar, hydrophobic

Functions for cell membrane structure	>cholesterol, ergosterol
Functions as hormones	>testosterone, progesterone, estrogen

Functions for vitamin synthesis

Hydrogen Bonding

responsible for the basic properties of water	>adhesion, cohesion, density

H-bonding starts with *polar* covalent bonding with a positively charged Hydrogen

Hydrophilic- polar covalent, like water	**Hydrophobic**- nonpolar covalent, unlike water
>eg. acetone	eg. 2-methyl--propane

Hydrogen Bonding (cont)

Intramolecular H-bonding: biological molecules H-bond within themselves	*Intermolecular* H-bonding: biological molecules H-bond with other molecules
>eg. proteins	>eg. nucleotide base pairing

Polymers

Monomer (1) -> **Dimer** (2) -> **Oligomer** (few) -> **Polymer** (many)

Polymerization- completed with **Dehydration Synthesis/Condensation** reactions	>2 monomers condensed= dimer

Hydrolysis reactions break

Draw diagrams of dehydration synthesis and hydrolysis

Sugars (Carbohydrates)

Monosaccharides -> **Oligosaccharides** -> **Polysaccharides**

>Monosaccharides- $(CH_2O)_n$	>glucose, fructose, galactose - typically 5 or 6 carbon sugars, joined by **glycosidic linkages**

Monosaccharides

>role of energy generation	>Glucose -> ATP produced

Sugars (Carbohydrates) (cont)

>synthesis of/conversion to other molecules	>ribose/deoxyribose

Oligosaccharides

>Glycosylation-covalently join to proteins and lipids on extracellular cell surface	>glycoproteins, glycolipids, protein structure, cell-cell structure, *cell-cell adhesion*, *cell identification*

Polysaccharides

>energy storage	>in form of starch (polymer of glucose in plants), and glycogen (animal equivalent of starch, in muscle cells)
>cell structure	>cellulose (cell wall component in plants, glucose=monomer), and chitin (fungi cell wall, monomer=glucose variant)

Proteins

Amino acids -> **(Oligo)peptides** (small stretch of a.a.) -> **Peptides** (sometimes finished, sometimes unfinished)-> **Proteins** (finally folded and funcitonable)

>20 different amino acids (R side chain)	>not identical, but similar (concept of a monomer)
>can be charged at cytosolic pH (in cell)	>amine group functions as base and picks up H^+, carboxylic acid donates H^+
>a.a. joined by **peptide bonds** through dehydration synthesis	>joined at carboxyl and amine group (H of NH2 and OH of COOH)

Protein Structure and Function

>Functional diversity	>Structural diversity

>metabolism, DNA replication, structure and motility, transport, communication