

## 1 The Chemistry of Life

Mark Mayo  
Cypress College

## 2 Introduction to Inorganic Chemistry

### ■ Basic terms:

- Chemistry - the study of the elements and their interactions
- C, H, O, N, Ca, AND P make up 98% of cellular contents

## 3 Introduction to Inorganic Chemistry

### ■ Basic terms:

- Inorganic chemistry - ionic chemistry of elements usually without carbon
- Organic chemistry - complex chemistry always having the element carbon in one molecule
- Biochemistry - the special organic chemistry of living organisms

## 4 Introduction to Inorganic Chemistry

### ■ Basic terms:

- Atom - smallest portion of an element that still retain all of the properties of the element
- Molecule - when two or more elements chemically combine

## 5 Introduction to Inorganic Chemistry

### ■ Basic terms:

- Chemical formula - shorthand used to designate the element or compound
- Empirical formula - just shows the quantity of each element
- Structural formula - a map of where each atom is attached

## 6 Introduction to Inorganic Chemistry

### ■ Basic terms:

- Chemical equation - show how substances react to form new compounds

## 7 Atomic Structure

### ■ Basic terms:

- Nucleus \* - contains the protons (+) and the neutrons (glue) \*
  - # of protons = atomic number \*
  - neutrons =  
atomic mass - atomic number
- Orbital (electron cloud) – zone where electrons (-) can be found
  - # of electrons = atomic number \*

## 8 Ions and Radicals

- Ions - charged atoms or groups of atoms formed by the loss or gain of electrons
  - cations have a positive (+) charge
  - anions have negative (-) charge
- Radicals - usually refers to groups of atoms that collectively have gained or loss electrons

## 9 Ions and Radicals

- Some examples of loss and gain of electrons \* :

- $Pb^{2+}$  has \_\_\_\_\_
- $Fe^{2+}$  has \_\_\_\_\_
- $Li^+$  has \_\_\_\_\_
- $Br$  has \_\_\_\_\_
- $Cu^{2+}$  has \_\_\_\_\_

## 10 Bonding

- Ionic bonds - the bonds formed by the transfer (loss or gain) of electrons (inorganic mostly)
- Covalent bonds - the bonds formed by the sharing of electrons (mostly organic compounds)

## 11 Biologically Important Ions or Radicals (polyatomic ions)

Name	Atom	Ion
Sodium	Na	$Na^+$
Potassium	K	$K^+$
Iron	Fe	$Fe^{3+}$ or $Fe^{2+}$
Calcium	Ca	$Ca^{2+}$
Hydrogen	H	$H^+$
Chlorine	Cl	$Cl^-$
Hydroxide		$OH^-$
Carbonate		$CO_3^{2-}$
Sulfate		$SO_4^{2-}$
Bicarbonate		$HCO_3^-$
Phosphate		$PO_4^{3-}$
Acetate		$CH_3COO^-$
Ammonium		$NH_4^+$
Magnesium	Mg	$Mg^{2+}$
Iodide	I	$I^-$

## 12 Biochemistry

- Lipids-fats, oils, and waxes
  - usually based on the glycerol molecule
  - Saturated - all single bonds
  - Unsaturated - some double bonds

## 13 Biochemistry

- Lipids-fats, oils, and waxes
  - lipid bilayer in plasma membranes – usually phospholipid
  - glycerol on the outside edges
  - fatty acids in the center

## 14 Biochemistry

- Lipids-fats, oils, and waxes
  - phospholipid-lipid with an amino group and a phosphate

- Hydrophilic - water loving end of the lipids (glycerol end)
- Hydrophobic - water hating ends (fatty acids)

## 15 Biochemistry

- Carbohydrates \*
  - Sugars \*
  - Glycogen \* (sugar storage in animals)
  - Starches \* (food storage in plants\*)
  - Cellulose \* (in plants)

## 16 Biochemistry

- Carbohydrates Monosaccharides
  - single sugars
  - EXAMPLES of monosaccharides \* - glucose, fructose, galactose, ribose
  - usually 5 or 6 carbon rings
  - always have one OH group or more

## 17 Biochemistry

- Carbohydrates
  - Disaccharides
    - double sugars
    - EXAMPLES (of disaccharides)
      - maltose
      - sucrose
      - lactose
    - two rings of 6 or 5 combined
    - they need to be digested into monosaccharides

## 18 Biochemistry

- Carbohydrates
  - Polysaccharide
    - animals store glucose as glycogen in their livers
    - plants store glucose as starch
    - cellulose is the "roughage" or "fiber" needed for correct digestion.
    - cellulose cannot be digested by humans
    - cellulose in our diet promotes defecation and reduces colon cancer!

## 19 Biochemistry

- Proteins \*
  - structural, enzymes and hormones
  - composed of the 20 or so amino acids \*
  - amino acids are connected by peptide bonds \*
  - the sequence of amino acids yields the great variety of proteins found in humans

– make up many body structures - lens of eye, hair, cell walls, muscles

20  **Biochemistry**

■ **Proteins**

– substitution in one amino acid can cause drastic changes in the action of the protein (Sickle cell anemia)

21  **Biochemistry**

■ **Nucleic acids - DNA & RNA**

– DNA - carries the genetic code from parent to child  
– DNA bases = adenine, thymine, guanine, and cytosine  
– double helix

22  **Biochemistry**

■ **Nucleic acids - DNA & RNA**

– RNA - 3 types  
a. transfer RNA  
b. messenger RNA  
c. ribosomal RNA

23  **Acids, bases and pH**

■ **Acids** - a substance that dissociates (breaks up in water) to yield  $H^+$  and anion

24  **Acids, bases and pH**

■ **Bases** - bases dissociate in water to form hydroxide radicals ( $OH^-$ )

25  **Acids, bases and pH**

■ **pH** =  $-\log$  of the hydrogen ion concentration  
■ pH measures the hydrogen ion concentration \*  
■ pH scale

26  **Acids, bases and pH**

■ **A buffer** is a substance that resists a change in pH