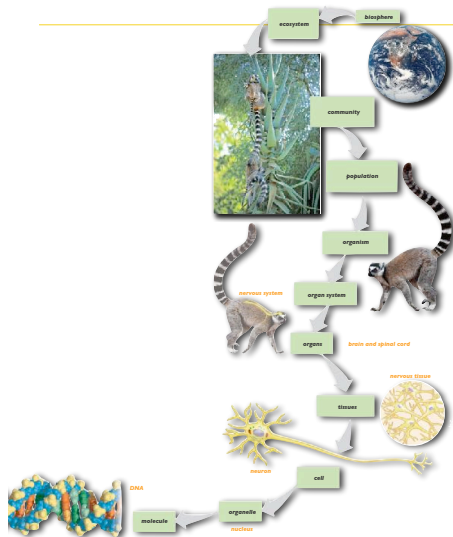


# introduction

ch 1,2



## organization

- **biosphere**
  - ecosystem
  - community
  - population
  - organism
  - organ
  - tissue
  - cell
    - organelles
    - molecules

## properties of life

- **order**
- **reproduction**
- **growth and development**
  - controlled by DNA
- **energy processing**
  - chemical energy is stored and used
- **response to stimuli**
- **regulation**
- **evolution**



## scientific method

- controlled experiments
- variables
- observational studies

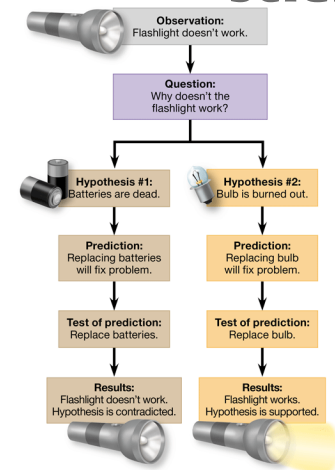
## what is science?

- guided by natural law
- testable
- conclusions are tentative
- falsifiable

## pseudoscience?

- polygraphs
- homeopathy/naturopathy
- anti-vaccine rhetoric

## science





## •three domains **classification**

- bacteria, archaea, eukarya
- within eukarya:
  - protista, fungi, animalia, plantae
  - KINGDOMS?

## •linnaean system

- kingdom
- phylum
- class
- order
- family
- genus
- specific epithet

# chemistry stuff

ch 2,3

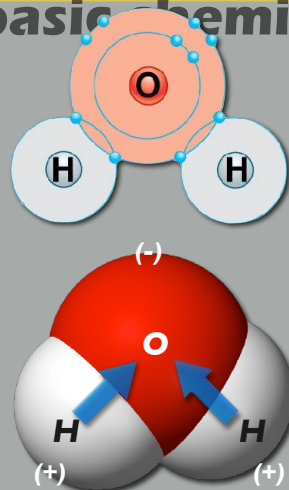
## basic chemistry

### •covalent bonds

- shared pairs of electrons

### •polarity

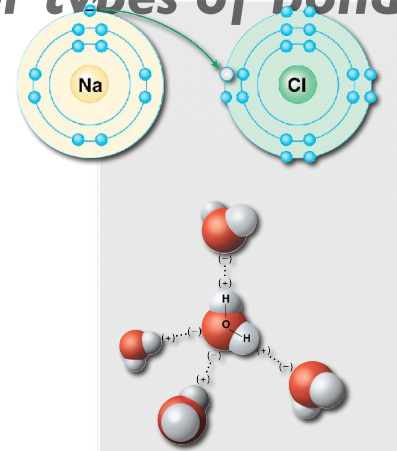
- polar molecules - asymmetrical charge
- non-polar molecules
- some molecules have polar and non-polar regions
- polar functional groups are hydrophilic



## other types of bonds

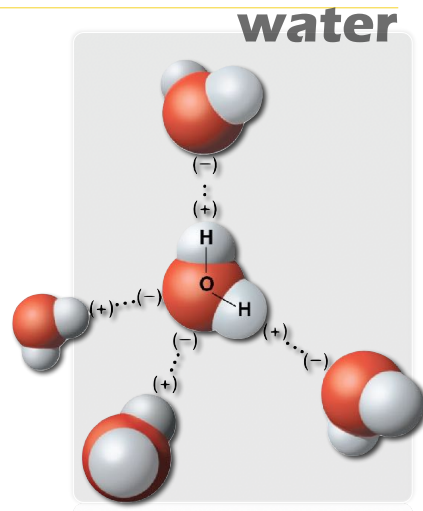
### •non-covalent bonds

- ionic bonds
  - NaCl
    - dissolves in water
  - proteins associated with DNA often form ionic bonds
- hydrogen bonds
  - due to polarity
  - water cohesion
  - DNA base pairs
- van der Waals interactions
  - due to fluctuations in charge
  - aided by comp. surfaces



## • life supporting properties of water

- polarity
  - asymmetrical
    - both covalent bonds are highly polarized
      - each atom forms hydrogen bonds
- cohesion
- adhesion
- specific heat
- excellent solvent
  - polarity



- acids
- bases
- amphoteric / amphiprotic
- acidity

- pH
  - $\text{pH} = -\log[\text{H}_3\text{O}^+]$
  - ion product constant for  $\text{H}_2\text{O} = 10^{-14}$
  - so, for neutral aqueous solution (25°C):
    - $\text{H}_3\text{O}^+ = 10^{-7} \text{ M}$  (pH = 7)
    - $\text{OH}^- = 10^{-7} \text{ M}$

- buffers
  - resist changes in pH

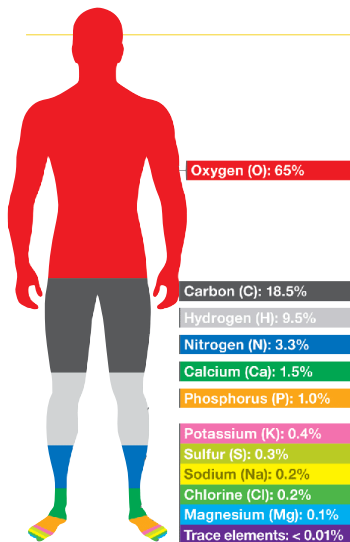
## acidity

[H <sup>+</sup> ] moles/liter	pH	[OH <sup>-</sup> ] moles/liter	some solutions and their pH values
1	0	10 <sup>-14</sup>	battery acid (0.5)
10 <sup>-1</sup>	1	10 <sup>-13</sup>	stomach acid (1.5)
10 <sup>-2</sup>	2	10 <sup>-12</sup>	lemon juice (2.3), cola (2.5)
10 <sup>-3</sup>	3	10 <sup>-11</sup>	orange juice (3.5)
10 <sup>-4</sup>	4	10 <sup>-10</sup>	beer (4.5)
10 <sup>-5</sup>	5	10 <sup>-9</sup>	black coffee (5.0), acid rain (5.6)
10 <sup>-6</sup>	6	10 <sup>-8</sup>	urine (6.0), milk (6.5)
10 <sup>-7</sup>	7	10 <sup>-7</sup>	pure water (7.0)
10 <sup>-8</sup>	8	10 <sup>-6</sup>	sea water (8.0)
10 <sup>-9</sup>	9	10 <sup>-5</sup>	hand soap (9.5)
10 <sup>-10</sup>	10	10 <sup>-4</sup>	milk of magnesia (10.5)
10 <sup>-11</sup>	11	10 <sup>-3</sup>	household ammonia (11.9)
10 <sup>-12</sup>	12	10 <sup>-2</sup>	non-phosphate detergent (12.0)
10 <sup>-13</sup>	13	10 <sup>-1</sup>	bleach (12.5)
10 <sup>-14</sup>	14	1	caustic soda (13.5)

## compounds

### • molecules

- two or more atoms joined by chemical bonds
- chemical compounds
- chemical combinations of elements
  - joined by bonds
  - emergent properties



## organic chemistry

### • organic compounds

- carbon
- hydrogen

### • functional groups

- hydroxyl
- carbonyl
- carboxyl
- amino
- phosphate
- methyl

Chemical Group	Examples
Hydroxyl group -OH	 Alcohol
Carbonyl group C=O	 Aldehyde      Ketone
Carboxyl group -COOH	 Carboxylic acid      Ionized
Amino group -NH <sub>2</sub>	 Amine      Ionized
Phosphate group -COP <sub>3</sub>	Adenosine Organic phosphate
Methyl group -CH <sub>3</sub>	 Methylated compound

# Macromolecules

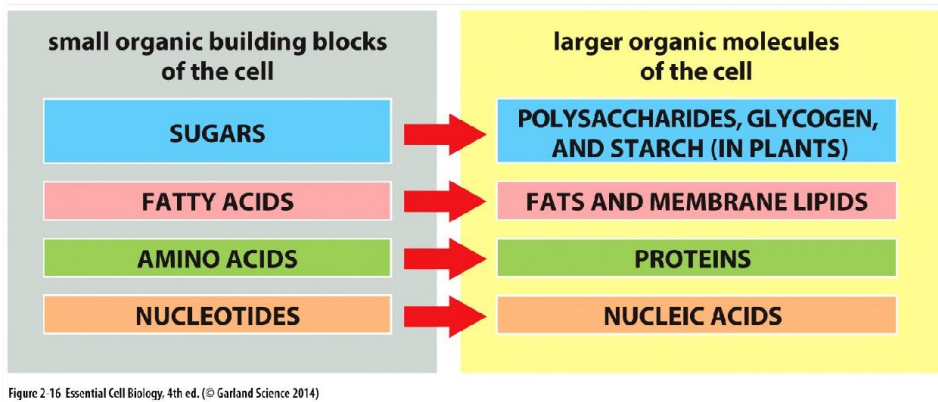
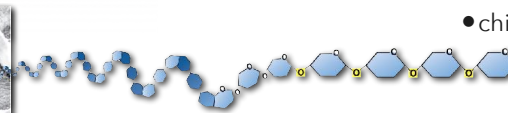
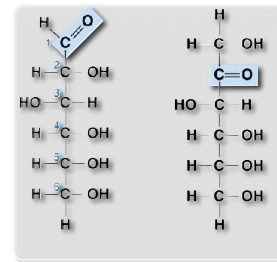


Figure 2-16 Essential Cell Biology, 4th ed. (© Garland Science 2014)

# carbohydrates



## • monomer

- monosaccharides -  $x(\text{CH}_2\text{O})$
- glucose, galactose, fructose

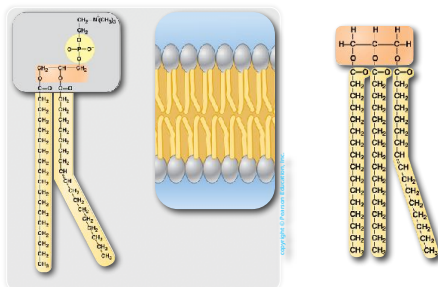
## • disaccharides

- lactose, maltose, sucrose

## • polysaccharides

- starch
- glycogen
- cellulose
- chitin

# lipids



## • fats

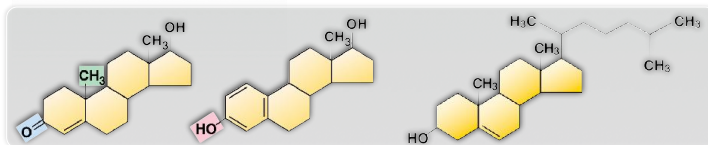
- glycerol
- 3 fatty acid

## • phospholipids

- glycerol + phosphate
- 2 fatty acids

## • steroids

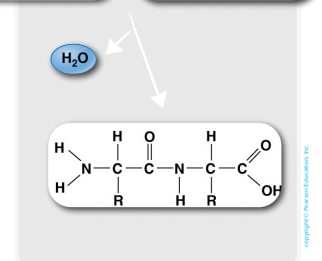
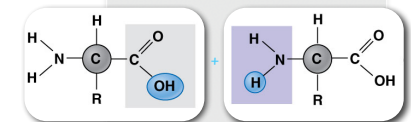
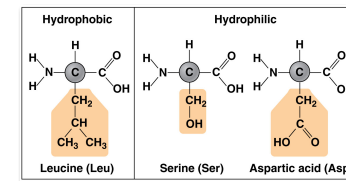
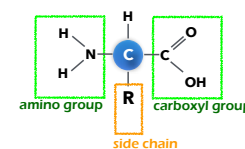
- cholesterol, testosterone, estradiol
- anabolic steroids



# proteins

## • polypeptides

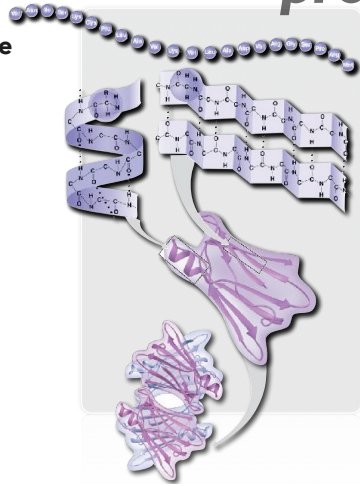
- amino acids
- amino end
- carboxyl end
- side chain
- polar
- non-polar



# proteins

- **proteins have complex structure**

- primary
- secondary
- tertiary
- quaternary



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# nucleic acids

- **monomer**

- nucleotides

- **double helix**

- sides of the ladder
  - backbone of sugars and phosphates
- rungs
  - nitrogenous base pairs

- **sequence of bases**

- codes for polypeptides
- each set of 3 bases codes for an amino acid

