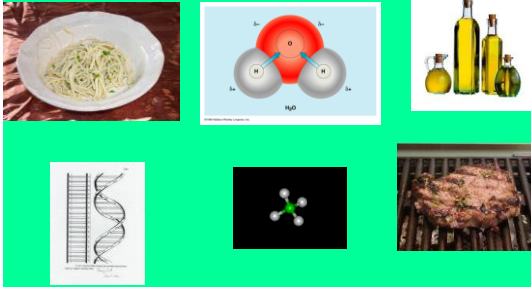
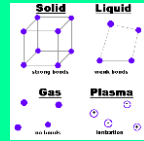


Chemical Basis of Life



I. Structure of Matter

- Matter-anything taking up space and mass
- Elements
 - Life requires about 20
 - Cannot be chemically broken down into other substances
 - About 111 (92 occur naturally)
 - CHON make up 95% of living matter.



Periodic Table of Elements

Legend - click to find out more...

- gas
- LI solid
- synthetic
- non-metals
- Transition-Metals
- Pure Earth Metals
- Alkali Metals
- Alkali Earth Metals
- Other Metals
- Halogens
- Inert Elements

I. Structure of Matter

- Atomic Structure
 - Determines behavior of element
 - Subatomic Particles- protons, neutrons, electrons
 - Atomic Number = # of protons = equals # of electrons(if neutral), written as $_1\text{H}$
 - Atomic Mass= # protons and neutrons, written as ^2H
 - Isotopes
 - same Atomic # but different Mass #
 - react chemically the same as the element
 - useful as biological tracers

The Atom

Electrons (negative charge) surround the nucleus.

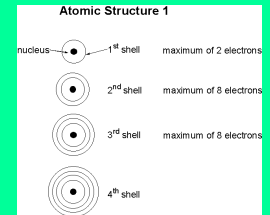
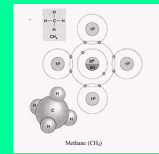
Nucleus: Protons (positive charge) Neutrons (neutral charge)

mass number = 1 proton AND 1 neutron

atomic number = 1 electron OR 1 proton

I. Structure of Matter

- Bonding of Atoms
 - Electrons are only particle involved in chemical reactions
 - Orbitals: 3-D space where an electron can be found 90% of the time
 - Valence electrons: electrons in the outermost shell
 - Octet rule- valence shells are complete when it contains 8 electrons.



I. Structure of Matter

- Compounds
 - Two or more elements in a fixed ratio
 - Have new properties from atoms
 - Covalent Bonds
 - sharing valence electrons
 - very strong bond
 - structural formula: H-H, O=O
 - molecular formula: H₂, O₂
 - Ionic Bonds
 - transfer of electrons
 - Anion- gaining of electrons(-)
 - Cation- loss of electrons(+)

Compounds

Sodium + Chlorine → Sodium Chloride

Hydrogen + Oxygen → A molecule of water

Water + Oxygen → 2H₂O

Water + Oxygen → 2H₂O

Water + Oxygen → 2H₂O

Water + Oxygen → 2H₂O

I. Structure of Matter

- Chemical Reactions
 - Synthesis (anabolic)
 - Decomposition (catabolic)
 - Exchange (replacement)
 - Reversible
- Acids and Bases
 - electrolytes release ions in water
 - Acids release H⁺ ions
 - Bases release OH⁻ ions
 - Normal pH is 7.4
 - pH < 7.35 = acidosis
 - pH > 7.45 = alkalosis
 - ph lower than 6.9 or higher than 7.8 = Death

Table 6.4. Summary of Reaction Types

Reaction Type	Example
Synthesis	A + B → AB
Decomposition	AB → A + B
Single Replacement	A + BC → AC + B
Double Replacement	AB + CD → AD + CB
Hydrolysis Formation	2H ₃ N ⁺ + 2KOH + 3/2O ₂ → K ₂ N ₂ O + 2H ₂ O
Bicarbonate Formation	CO ₂ (g) + H ₂ O (lq) → H ₂ CO ₃ (lq)
	KOH + H ₂ CO ₃ → KHCO ₃ + H ₂ O

The pH Scale

0: Battery acid

1: Lemon juice

2: Vinegar

3: Adjust fish die

4: Fruit ripen/production of lactate

5: Milk

6: Precipitation of stream water

7: Neutral

8: Baking soda

9: Sea water

10: Milk of Magnesia

11: Ammonia

12: Lye

13: Lye

14: Lye

Courtesy of Environment Canada (http://www.ms.sc.gc.ca/)

II. Chemical Composition of Cells

I. Inorganic Substances

A. Usually electrolytes (dissolve in water)

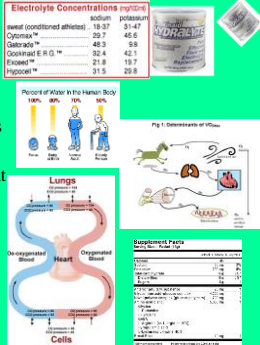
B. Water

- 1) most abundant compound (2/3 body wt)
- 2) environment where reactions occur
- 3) transports chemicals and heat

C. Oxygen: releases energy from glucose, driving metabolism

D. Carbon Dioxide: produced by metabolism

E. Inorganic Salts: provide ions for metabolism



II. Chemical Composition of Cells

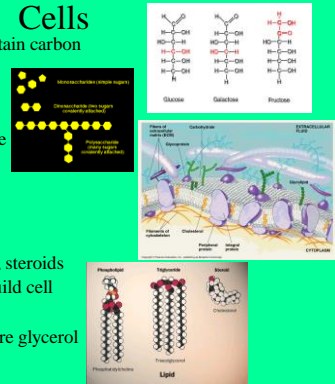
2. Organic Substances (contain carbon and hydrogen)

A. Carbohydrates

- 1) provide energy
- 2) part of cell structure
- 3) mono-, di-, and polysaccharides

B. Lipids

- 1) insoluble in water
- 2) fats, phospholipids, steroids
- 3) store energy and build cell parts
- 4) monomers of fats are glycerol and fatty acids



II. Chemical Composition of Cells

C. Proteins

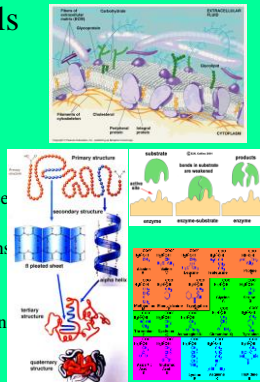
1) structural materials, energy sources, hormones, cell surface receptors, antibodies, enzymes.

2) Monomers are amino acids (only 20)

3) Vary in number and sequence of amino acids

4) Hydrogen bonds give protein their shape

5) Excessive heat, radiation, electricity, pH, or chemicals can denature (change shape) of proteins.



II. Chemical Composition of Cells

D. Nucleic Acids

1) genetic material (RNA and DNA)

2) control cellular activities

3) monomers are nucleotides (sugar, phosphate, nitrogen base)

4) DNA is blueprints for proteins

5) RNA is used to construct proteins.

