Study Questions

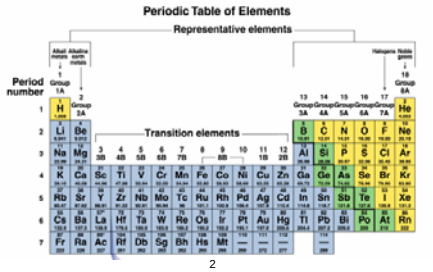
1. Describe the structure of an atom.
2. List 2 variations an atom can have and still be the same type of atom.
3. Explain the law of conservation of mass.
4. Compare and contrast acids and bases. Give examples of each.
5. Describe the pH scale.
6. Compare and contrast lipids, carbohydrates, proteins, and nucleic acids with regard to their composition, structure, and function.

1

Introduction to Chemistry

Matter: anything that takes up space and has mass

Elements: substance that cannot be broken down further by chemical means



2

Atom: smallest unit of matter unique to a particular element; building blocks of matter

Subatomic particles: Small particles that are the building blocks from which atoms are made

- **Protons**
- **Neutrons**
- **Electrons**

3

Protons:

- located in nucleus
- positive charge
- # protons specific to type of element
- # protons equals # electrons (for neutral atoms)

Neutrons:

- Located in nucleus
- No charge (neutral)
- # of neutrons can vary ("isotopes")

4

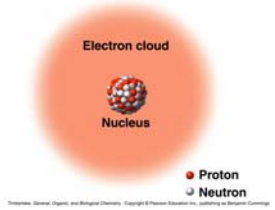
Electrons:

Orbit the nucleus

Have negative charge

electrons = # protons (in neutral atoms)

of electrons can vary ("ions")

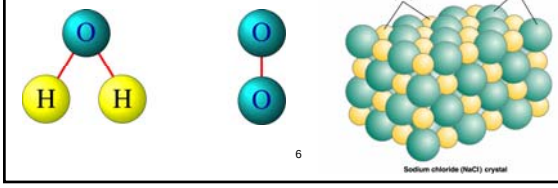


Chemical Bonding

Atoms join together to form molecules or compounds by forming **chemical bonds**

Covalent bonds: atoms share electrons

Ionic bonds: atoms transfer electrons



6

Chemical formula: represents the number and type of atoms in a molecule

Examples: H_2O, O_2, CO_2, $C_6H_{12}O_6$

Chemical reactions: interactions between atoms or molecules that produce new and different substances (different chemical formulas)

Example: $CH_4 + 2\ O_2 \rightarrow CO_2 + 2\ H_2O$

("reactants" on the left, "products" on the right of the reaction arrow)

7

Law of Conservation of Mass: atoms cannot be created or destroyed

Balanced chemical equation: written chemical reaction in which the number of atoms of each type of element is the same on both sides of the reaction arrow

$$CH_4 + 2\ O_2 \rightarrow CO_2 + 2\ H_2O$$

8

Practice: $SO_2 + O_2 \rightarrow SO_3$

Is this equation balanced?

$2SO_2 + O_2 \rightarrow 2SO_3$

Practice: $H_2 + Cl_2 \rightarrow HCl$

Is this equation balanced?

$H_2 + Cl_2 \rightarrow 2HCl$

9

Energy

Energy: capacity to do work

Examples: Light, heat, sound, X-ray, ultra-violet (UV), infrared (IR)

- **Kinetic:** energy of motion
- **Potential**: stored energy, energy of position

1st law of thermodynamics: energy is conserved, it is neither created nor destroyed

10

Acid/Base Chemistry

Acid: substance that donates H^+ ions

Base: substance that accepts H^+ ions

Examples of acids:

citric acid ($C_6H_8O_7$),acetic acid ($C_2H_4O_2$) hydrochloric acid (HCl), sulfuric acid (H_2SO_4), phosphoric acid (H_3PO_4)

Examples of bases:

ammonia (NH_3), lye (NaOH), baking soda ($NaHCO_3$)

11

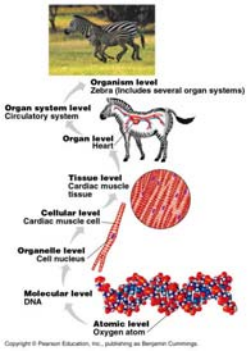
pH scale quantifies how acid or how basic a solution is

- pH scale ranges from 0-14
- pH less than 7 is **acidic**
- pH greater than 7 is **basic**
- pH equal to 7 is **neutral**

The more acidic a solution is, the lower its pH value and the more H^+ ions it has

12

Introduction to Biology



13

Cells: membrane-bound compartments within which processes of life occur

Organelles: small structures within cells that have specialized functions (nucleus, ribosomes, etc.)

14

Important Organic Molecules:

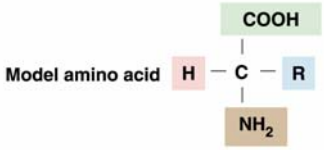
- Proteins
- Carbohydrates
- Lipids
- Nucleic Acids

Organic: carbon-based molecules that make up living organisms

15

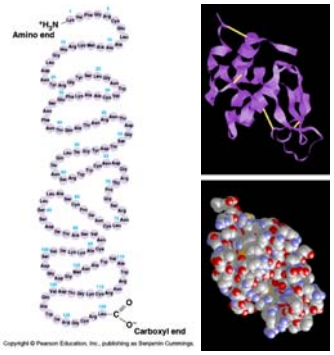
Proteins:

- Made of chains of amino acids
- Provide structure and support
- Function as enzymes (catalysts)



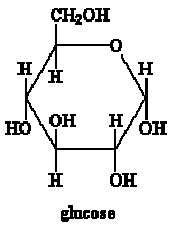
Structure (shape) of protein is key to its function

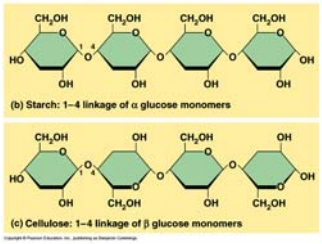
Denaturing (unfolding) proteins destroys them



Carbohydrates:

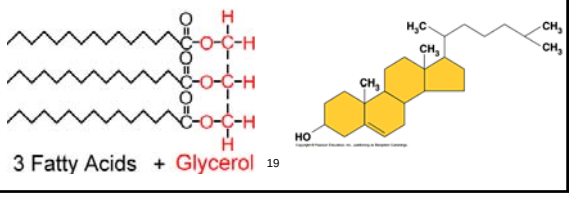
- Made of chains of sugar molecules (glucose, etc.)
- Provide structure
- Energy source





Lipids:

- Include fats, phospholipids, and steroids
- Provide structure (phospholipids)
- Energy source (fats)
- Hormones, vitamins (steroids)



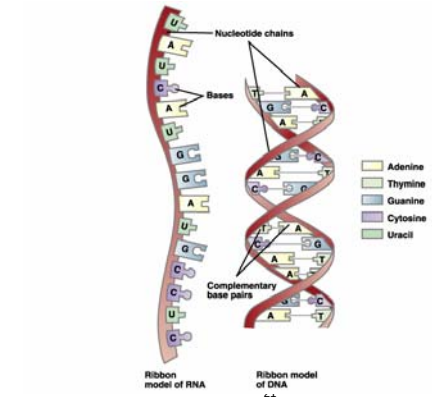
19

Nucleic Acids:

- Genetic information (DNA, RNA)
- Protein synthesis
- Energy carriers (ATP)
- Made of chains of nucleotides

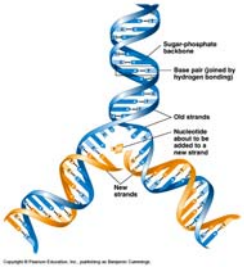
Nucleotide: a "backbone" and a "base" (adenine, guanine, cytosine, thymine, uracil)

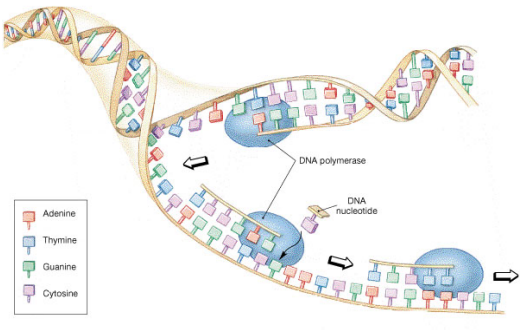
20



DNA was "Molecule of the Year" in 1943!

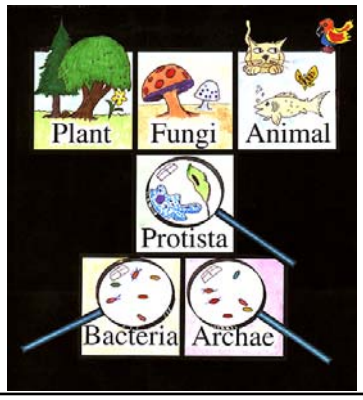
- DNA is the genetic "blueprint" for a cell
- DNA is replicated each time a cell divides
- Mutations in DNA can lead to changes in proteins



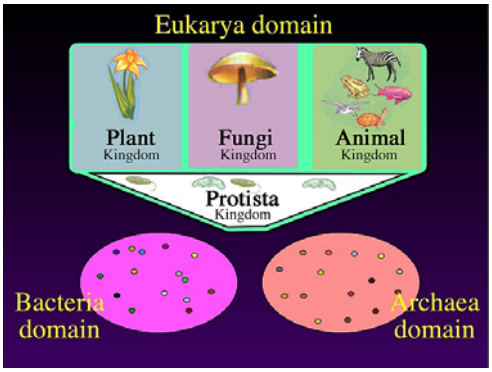


23

6 Kingdoms of Life



3 Domains of Life



Evolution: gradual changes due to random mutations in genetic material and competition for scarce resources