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.

Introduction to Chemistry
Matter: anything that takes up space and has mass
Elements: substance that cannot be broken down further by chemical means

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

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")

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

**Examples:** H₂O, O₂, CO₂, C₆H₁₂O₆

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

Example: CH₄ + 2 O₂ → CO₂ + 2 H₂O

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

**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

CH₄ + 2 O₂ → CO₂ + 2 H₂O

**Practice:** SO₂ + O₂ → SO₃

Is this equation balanced?

2SO₂ + O₂ → 2SO₃

**Practice:** H₂ + Cl₂ → HCl

Is this equation balanced?

H₂ + Cl₂ → 2HCl

**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

**Acid/Base Chemistry**

**Acid:** substance that donates H⁺ ions

**Base:** substance that accepts H⁺ ions

**Examples of acids:**

citric acid (C₆H₈O₇), acetic acid (C₂H₄O₂) hydrochloric acid (HCl), sulfuric acid (H₂SO₄), phosphoric acid (H₃PO₄)

**Examples of bases:**

ammonia (NH₃), lye (NaOH), baking soda (NaHCO₃)

**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
**Introduction to Biology**

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

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

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**Important Organic Molecules:**

- Proteins
- Carbohydrates
- Lipids
- Nucleic Acids

Organic: carbon-based molecules that make up living organisms

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**Proteins:**

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

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**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)

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)

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

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