



Chemistry Learning Targets

Atomic and Molecular Structure
1. Know how to use the periodic table to identify metals, semimetals, nonmetals and halogens and relate the position of an element in the periodic table to its atomic number and atomic mass.
2. Know how to use the periodic table to determine the number of electrons available for bonding and to identify alkali metals, alkaline earth metals, transition metals, trends in ionization energy, electro-negativity, and relative sizes of ions and atoms.
3. Understand the structure of the atom and know that although the nucleus is a small portion of the volume of an atom, the nucleus contains most of the mass of the atom.
Chemical Bonds
4. Understand how atoms combine to form molecules by covalent and ionic bonding, and identify compounds that have covalent and ionic bonds.
5. Know how to draw Lewis dot structures and how to predict the shape of simple molecules and their polarity from their Lewis dot structures.
6. Know that atoms and molecules in liquids move in a random pattern because the intermolecular forces are too weak to hold the atoms or molecules in a solid form.
Conservation of Mass and Stoichiometry
7. Understand how to describe chemical reactions by writing balanced equations and how to calculate the masses of reactants and products in a chemical reaction from the mass of one of the reactants and the relevant atomic masses.
8. Know the definition of a mole as it relates to carbon 12 atoms, and that one mole equals 6.02×10^{23} particles.
9. Understand how to determine the molar mass of a molecule from its chemical formula and how to convert the mass of a molecular substance to moles or volume of a gas at standard temperature and pressure.
Gases and Their Properties
10. Know that the diffusion of a gas can be explained by the random motion of its molecules and that these random motions and the collisions of molecules with a surface create pressure on that surface.
11. Understand the meaning of standard temperature and pressure (STP) and how to apply the gas laws to relations between pressure, temperature, and volume of ideal gases.
12. Understand that there is no temperature lower than 0 Kelvin and know how to convert between the Celsius and Kelvin temperature scales.
Acids and Bases
13. Know the observable properties of acids, bases and salt solutions, and understand how to use the pH scale to characterize acid and base solutions.
14. Know acids are hydrogen-ion-donating and bases are hydrogen-ion-accepting substances.
15. Understand that strong acids and bases fully dissociate and that weak acids and bases dissociate only partially.
16. Know how to calculate pH from hydrogen ion concentration, and that buffers stabilize pH in acid-base reactions.
Solutions
17. Know the definitions of solute and solvent and how to describe the dissolving

process at the molecular level.
18. Understand how to calculate the concentration of a solute and how temperature, pressure, and surface area affect the dissolving process.
Chemical Thermodynamics
19. Know how to describe temperature and heat flow in terms of molecular motion and understand how to solve problems involving heat flow and temperature changes, using known values of specific heat and latent heat of phase changes.
20. Understand the how heat is absorbed and released when a material changes state (e.g. condenses, freezes, melts, or evaporates).
21. Understand that chemical processes can either release thermal energy (as in exothermic reactions) or absorb thermal energy (as in endothermic reactions).
Reaction Rates
22. Understand how to determine reaction rates and that reaction rates depend on factors such as concentration, temperature and pressure.
23. Understand the role of a catalyst in increasing the reaction rate and the role of activation energy in a chemical reaction.
Chemical Equilibrium
24. Understand how to predict the effect of changes in concentration, temperature and pressure in chemical reactions.
25. Know that equilibrium is established when forward and reverse reaction rates are equal.
Organic Chemistry and Biochemistry
26. Know that large molecules such as proteins, nucleic acids and starch are formed by repetitive combinations of simple subunits, and that amino acids are the building blocks for proteins.
27. Understand how the bonding characteristics of carbon result in the formation of a large variety of organic molecules.
Nuclear Processes
28. Know that protons and neutrons in the nucleus of an atom are held together by nuclear forces that overcome the electromagnetic repulsion between the protons.
29. Understand different types of radioactive decay (alpha, beta and gamma) produce different amounts and kinds of damage in matter and different types of changes in the nucleus.
30. Know the energy release per gram of material is much larger in nuclear fusion or fission reactions than in chemical reactions, and that the change in mass is small but significant in nuclear reactions.