Connecticut State Department of Education
Science - Chemistry Enrichment Standards
High School Grades 9-12

Essential Questions

Atomic and Molecular Structure
Chemical Bonds
Conservation of Matter and Stoichiometry
Organic Chemistry and Biochemistry
How does the structure of matter affect the properties and uses of materials?
Reaction Rates
How do materials cycle through the Earth's systems?

Chemistry Enrichment Standards

Atomic and Molecular Structure

The periodic table displays the elements in increasing atomic number and shows how periodicity of the physical and chemical properties of the elements relates to atomic structure

The nucleus of the atom is much smaller than the atom, yet contains most of its mass.

The quantum model of the atom is based on experiments and analyses by many scientists, including Dalton, Thomson, Bohr, Rutherford, Millikan and Einstein.

The position of an element in the periodic table is related to its atomic number.

The periodic table can be used to identify metals, semimetals, non-metals and halogens.

The periodic table can be used to identify trends in ionization energy, electronegativity, the relative sizes of ions and atoms, and the number of electrons available for bonding.

The electronic configuration of elements and their reactivity can be identified based on their position in the periodic table.

Chemical Bonds

Biological, chemical, and physical properties of matter result from the ability of atoms to form bonds from electrostatic forces between electrons and protons and between atoms and molecules

Atoms combine to form molecules by sharing electrons to form covalent or metallic bonds or by exchanging electrons to form ionic bonds.

Chemical bonds between atoms in molecules such as H_2, CH_4, NH_3, H_2CCH_2, N_2, Cl_2, and many large biological molecules are covalent.

Salt crystals, such as NaCl, are repeating patterns of positive and negative ions held together by electrostatic attraction.

The atoms and molecules in liquids move in a random pattern relative to one another because the intermolecular forces are too weak to hold the atoms or molecules in a solid form.

Lewis dot structures can provide models of atoms and molecules.

The shape of simple molecules and their polarity can be predicted from Lewis dot structures.

Electronegativity and ionization energy are related to bond formation.

Solids and liquids held together by Van der Waals forces or hydrogen bonds are affected by volatility and boiling/melting point temperatures.

Conservation of Matter and Stoichiometry
The conservation of atoms in chemical reactions leads to the principle of conservation of matter and the ability to calculate the mass of products and reactants.

Chemical reactions can be described by writing balanced equations.

The quantity one mole is set by defining one mole of carbon; 12 atoms to have a mass of exactly 12 grams.

One mole equals 6.02.x 1023 particles (atoms or molecules).

The molar mass of a molecule can be determined from its chemical formula and a table of atomic masses.

The mass of a molecular substance can be converted to moles, number of particles, or volume of gas at standard temperature and pressure.

Hess's law is used to calculate enthalpy change in a reaction.

Reaction Rates
Chemical reaction rates depend on factors that influence the frequency of collision of reactant molecules.

The rate of reaction is the decrease in concentration of reactants or the increase in concentration of products with time.

Reaction rates depend on factors such as concentration, temperature and pressure.

Equilibrium is established when forward and reverse reaction rates are equal.

Catalysts play a role in increasing the reaction rate by changing the activation energy in a chemical reaction.

Organic Chemistry and Biochemistry
The bonding characteristics of carbon allow the formation of many different organic molecules of varied sizes, shapes, and chemical properties and provide the biochemical basis of life.

Large molecules (polymers), such as proteins, nucleic acids and starch, are formed by repetitive combinations of organic monomers.

The bonding characteristics of carbon result in the formation of a large variety of structures, ranging from simple hydrocarbons to complex biological molecules and synthetic polymers.

Amino acids are the building blocks of proteins.