Ledyard Public Schools
Science Curriculum

Chemistry

Level-1

1431

Instructional Council Approval June 1, 2005

Atoms and Molecules

Suggested Time - Approximately 8 Weeks.

Essential Question

How does structure of an atom determine the properties of elements and bonding between atoms?

Focus Questions

1. How has the historical progression of theories and discoveries relating to the atom and its parts led our modern concept of an atom.

   Learning Objectives/Student Outcomes - The Student will be able to:

   a. Explain how the historical progression of atomic model development has led to our present understanding of the atom, its parts and structure. (from Dalton to quantum mechanics, including at least Thomson, Rutherford, Marsden & Geiger, Chadwick, Bohr, Planck, Einstein, Heisenberg, de Broglie, Schrodinger)
   b. Assess the contribution of key historical developments to our modern view of the periodic table, atomic and electronic structure. (Periodic Table(in order)-Dobereiner, Dumas, de Chancourtois, Odling, Newlands, Mendelev, Meyer, Moseley, Seaborg, plus modern arrangements)(Atoms'-Leucippus and Democritus, Dalton, Brown, Einstein, Perrin)

2. What are the characteristics of electrons in an atom?

   Learning Objectives/Student Outcomes - The Student will be able to:

   a. delineate the characteristics of light and the classifications within the electromagnetic spectrum.
   b. calculate the frequency, wavelength and energy of light based on their mathematical relationships.
   c. evaluate the relationship between excited electrons and their emission spectra
   d. evaluate the effect of frequency and intensity changes on the Photoelectric effect.
   e. use orbital shapes(s, p, d, f), orbital box diagrams, electron configurations (including the Noble gas shortcut, the outer and complete electron configurations) and quantum numbers to characterize, the electronic structure of an atom.

3. How does atomic structure account for the periodic properties of elements?

   Learning Objectives/Student Outcomes - The Student will be able to:

   a. evaluate the relationship between the arrangement of the periodic table and atomic orbitals
   b. predict and compare the periodicity of certain properties of elements including, at least, ionization energy, electronegativity, atomic radii and ionic radii
   c. evaluate the relationship between atomic structure and the properties of atoms (including ionization energy, electronegativity, atomic radi and ionic radiii)

4. How is the bonding between atoms and the geometry of molecules determined by the interaction of electrons between atoms?

   Learning Objectives/Student Outcomes - The Student will be able to:

   a. portray valence electrons, ionic and covalent bonding using Lewis structures
   b. characterize and determine bond types using the concept of electronegativity.
   c. use VSEPR theory and hybridization to explain, in writing, molecular geometry. (including sp hybridization to d^2sp^3 hybridization and all related molecular geometries)
   d. compare and give examples of pi and sigma bonding in molecules.

Assessments

Science assessment includes: tests, which assess content knowledge and application, skill acquisition and application of knowledge at all levels of critical thinking; quizzes; formal laboratory assessments as full lab reports, parts of lab reports or quiz type lab assessments; a variety of written, oral and visual presentations; as well as a variety of other individual and group work assessments. All tests must include free response questions (or constructed response) as well as appropriate content and/or skill assessment and, except where inappropriate, must be balanced in terms of the critical thinking skills expected of students. Laboratory reports (or parts) will follow the Ledyard High School standard Laboratory format. Other Laboratory assessments should reflect CAPT Style multiple choice and / or open-ended questions.

Required Activities

The following **types** of laboratory activities are **required**. Titles in parentheses are suggested but not required and lab procedures for these activities are available in the appendix.

An Atom/Isotope activity
(Size of a molecule, Pennium, Beanium)
A Light / Spectra Activity
(Flame tests, Emission Spectra, Photoelectric effect, Solar cell performance task)
A Spectroscopy activity
(The absorbance spectra of a colored solution, Beer's Law)
A Periodic Trends activity
(Alien Periodic table, Imaginary Periodic table, Determining Trends in a group, Reactivity of the Halides,)
A Bonding activity
(Electric solutions)
A molecular modeling activity
(Molecular modeling - Alkanes to oxygen containing compounds)

****(Meets Ledyard Academic Expectation for Problem Solving)

Resources

Student: **Chemistry**, Olmsted and Williams, John Wiley & Sons, 2002

Teacher: **Chemistry**, Olmsted and Williams, John Wiley & Sons, 2002
Study Guide, Test bank, Solutions Manual, Transparencies
Lab manual, Other electronic ancillaries
Merck Index
CRC Handbook of Chemistry and Physics

Curriculum Alignment with Connecticut Content Standards and Expected Performances
All areas address State Standards for Scientific Inquiry, Literacy and Numeracy

Focus Question	CT Content Standard	CT Expected Performance
1. The Atom	9.4	D10
2. Electrons	9.4	D10
3. Periodic Properties	9.4	D10
4. Bonding & Geometry	9.4, 9.5, 9.6	D11, D13, D15, D16, D17

States of Matter

Suggested Time - Approximately 4 Weeks

Essential Question

What are the characteristics, interactions and dynamics of matter as a collection of particles?

Focus Questions

1. What makes up matter and how is matter characterized?
   Learning Objectives - The Student will be able to:
   a. compare and contrast, using molecular pictures, each of the three phases of matter
   b. explain, including the use of molecular pictures, to characterize transitions between phases (i.e. phases changes, equilibrium systems)
   c. characterize, including the use of molecular pictures, mixtures of particles
   d. compare and contrast particle motions in the three phases of matter and their transitions.
   e. compare, contrast and identify the different types of particles that make up matter.

2. How does the Kinetic Theory of Gases explain the behavior of gas molecules?
   Learning Objectives - The Student will be able to:
   a. explain the characteristics of a gas as a collection of particles.
   b. explain the behavior of gas particles and the properties of gases using the Kinetic Molecular Theory. (including molecular speed, mean free path, collision frequency, kinetic energy)
   c. explain the relationships between the pressure, volume and temperature of gases using Kinetic Molecular Theory (the gas laws) and the distribution of kinetic energies and velocities of gaseous molecules.

3. What are the quantitative relationships of gases in relation to their conditions and quantities?
   Learning Objectives - The Student will be able to:
   a. calculate, using the ideal gas law, quantities and conditions of gases
   b. calculate, using Dalton's law of Partial Pressures, pressures and quantities in a mixture of gases.

Assessments

Science assessment includes: tests, which assess content knowledge and application, skill acquisition and application of knowledge at all levels of critical thinking; quizzes; formal laboratory assessments as full lab reports, parts of lab reports or quiz type lab assessments; a variety of written, oral and visual presentations; as well as a variety of other individual and group work assessments. All tests must include free response questions (or constructed response) as well as appropriate content and/or skill assessment and, except where inappropriate, must be balanced in terms of the critical thinking skills expected of students. Laboratory reports (or parts) will follow the Ledyard High School standard Laboratory format. Other Laboratory assessments should reflect CAPT Style multiple choice and / or open-ended questions.

Required Activities

Cold Packs ****
A Boyle's Law laboratory activity (with Vernier gas pressure sensors)
A Gas constant/molar volume laboratory activity - Magnesium - Hydrochloric acid

****(Meets Ledyard Academic Expectation for Problem Solving)

Resources

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Curriculum Alignment
with
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Focus Question	CT Content Standard	CT Expected Performance
1. Matter as Particles	9.1	D1, D2, D3
2. Kinetic Theory	9.1	D1
3. Gas Laws	9.1	D3

Chemicals and Chemical Reactions

Suggested Time - Approximately 6 Weeks

Essential Question:

What are the characteristics of chemicals and the nature of chemical reactions?

Focus Questions

1. How are basic mathematical skills used in chemical calculations?
   Learning Objectives - The Student will be able to:
   a. use significant figures in all calculations.
   b. utilize dimensional analysis in chemical calculations
   c. assess the precision and accuracy of experimental data.
   d. utilize the mole concept to determine chemical quantities. (grams, liters, and # of particle conversions; percent composition)
   e. calculate an empirical and molecular formula from elemental analysis or percent composition.

2. What are the conventions for naming chemical compounds and writing formulae?
   Learning Objectives - The Student will be able to:
   a. demonstrate a basic knowledge of atoms, molecules, elements, compounds and the structure of the periodic table using molecular pictures where appropriate.
   b. apply the conventions of naming chemical compounds and writing formulas to: binary compounds; polyatomic ions and organic molecules from alkanes to oxygen containing compounds. (alkanes, alkenes, alkynes, alcohols, ethers, ketones, aldehydes, esters, acids)

3. What are the characteristics of chemicals and chemical reactions?
   Learning Objectives - The Student will be able to:
   a. differentiate between the chemical and physical properties of matter.
   b. compare, contrast and identify the characteristics of chemical reactions. (reactants, products and identification of reaction types)
   c. explain the process of polymerization and the properties and uses of polymers.
   d. evaluate the relationship between the chemical structure of polymers and their physical properties.
   e. (if time is available) determine factors that affect the rate of a reaction.
   f. (if time is available) distinguish the characteristics of reaction equilibria and le Chatelier's principle.

4. How does a chemical equation quantitatively show the relationships between the numbers of particles and the quantities of substances in a chemical reaction?
   Learning Objectives - The Student will be able to:
   a. use the law of conservation of matter to balance chemical equations.
   b. calculate reacting ratios, quantitative relationships, limiting reactants and percent yields of reactions using the principles of stoichiometry.
   c. calculate the concentration of a solution (Molarity)

Assessments:

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Required Activities

CAPT Synthetic Polymer Performance Task****
Fire Extinguisher****
The Behavior of Copper in a Solution of Silver Nitrate

The following **types** of laboratory activities are **required**. Titles in parentheses are suggested but not required and lab procedures for these activities are available in the appendix.

Introductory Laboratory activities (at least 2)
(Esterification, Conservation of Mass, Reaction Rate, The Distillation of an Unknown Mixture, Paper Chromatography, Strike it Rich, Al-$CuCl_2$ observation))
A Stoichiometry activity
(The Copper cycle, Determining the Empirical Formula of Magnesium Oxide, The Empirical Formula of a Compound ($MgCl_2$)
Chemical Reactions (each of Acid-Base, Precipitation and Redox)
(Determining the concentration of an Unknown Acid (including standardization), (pH changes during titration) (Precipitation Reactions, Colored Precipitates) (The reactivity of metals, The Corrosion of Iron, Oxidation states of Manganese, A hydrogen peroxide rainbow), Factors that affect the Rate of a Reaction, Reaction equilibrium, Le Chatelier's Principle
A Polymer activity (In addition to the Synthetic Polymer CAPT Performance task)
(Esterification, GlueP, Slime, Physical Characteristics of Polymers, Nylon)

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Curriculum Alignment with Connecticut Content Standards and Expected Performances
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Focus Question	CT Content Standard	CT Expected Performance
1. Mathematical Skills	9.4	D10, D12, D14
2. Nomenclature	9.4, 9.5	D13, D16
3. Chemicals & Reactions	9.1, 9.5, 9.6	D3, D14, D16, D17
4. Stoichiometry	9.4, 9.5	D12, D14