

**Chemistry
Science Curriculum
Francis Howell School District**

**Francis Howell
School District**



LEARNING TOGETHER

Board Approved: May 7, 2009

Francis Howell School District

Mission Statement

Francis Howell School District is a learning community where all students reach their full potential.

Vision Statement

Francis Howell School District is an educational leader that builds excellence through a collaborative culture that values students, parents, employees, and the community as partners in learning.

Values

Francis Howell School District is committed to:

- Providing a consistent and comprehensive education that fosters high levels of academic achievement for all
- Operating safe and well-maintained schools
- Promoting parent, community, student, and business involvement in support of the school district
- Ensuring fiscal responsibility
- Developing character and leadership

Francis Howell School District Graduate Goals

Upon completion of their academic study in the Francis Howell School District, students will be able to:

1. Gather, analyze and apply information and ideas.
2. Communicate effectively within and beyond the classroom.
3. Recognize and solve problems.
4. Make decisions and act as responsible members of society.

Science Graduate Goals

The students in the Francis Howell School District will graduate with the knowledge, skills, and attitudes essential to leading a productive, meaningful life.

Graduates will:

- Understand and apply principles of scientific investigation.
- Utilize the key concepts and principles of life, earth, and physical science to solve problems.
- Recognize that science is an ongoing human endeavor that helps us understand our world.
- Realize that science, mathematics, and technology are interdependent, each with strengths and limitations that impact the environment and society.
- Use scientific knowledge and scientific ways of thinking for individual and social purposes.

Course Rationale

Science education develops science literacy. Scientific literacy is the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity. A sound grounding in science strengthens many of the skills that people use every day, like solving problems creatively, thinking critically, working cooperatively in teams, using technology effectively, and valuing life-long learning. Scientific literacy has become a necessity for everyone.

To accomplish this literacy, science courses will reflect the following:

- Develop scientific reasoning and critical thinking skills.
- Extend problem-solving skills using scientific methods.
- Include lab-based experiences.
- Strengthen positive attitudes about science.
- Incorporate the use of new technologies.
- Provide relevant connections to personal and societal issues and events.

Course Description

Chemistry – Course # 131245

Credit: 1 unit

Prerequisite: Physical Science (C or better recommended); completion of Algebra I (or equivalent) AND concurrent enrollment in or completion of Algebra II

This course is highly recommended for students planning on enrolling in college or technical school. General Chemistry is the fundamental course in the study of matter and energy. Topics include measurement skills, atomic theory, classification of matter, nomenclature, stoichiometry, gas laws, periodic table, chemical bonding, solutions, acids and bases. Lab experiences are an integral part of the course.

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Francis Howell School District General Chemistry Curriculum Map

First Semester: (First and Second Quarters) 15 weeks

| <u>Inquiry</u> | <u>Atomic Theory</u> | <u>Electrons and Periodic Trends</u> | <u>Bonding and Nomenclature</u> | <u>Reactions</u> |
|--|--|---|--|---|
| <ul style="list-style-type: none"> ● Scientific process ● Density ● Identify Pure Substances ● Lab Safety ● Significant Figures | <ul style="list-style-type: none"> ● Atomic theory evolution (Dalton, Thomson, Rutherford, Bohr, Quantum Mechanical) ● Atomic structure ● Calculate protons, electrons, neutrons ● Scientific notation ● Wavelength, energy and frequency ● Calculate atomic mass from isotope abundance | <ul style="list-style-type: none"> ● Identify Pure Substances ● Classify metals, nonmetals, metalloids, Noble gases ● Periods / groups (repeating and common properties) ● Electron configurations ● Valence electrons ● Electronegativity and reactivity ● Atomic size ● Ionization energy | <ul style="list-style-type: none"> ● Ionic and covalent bonding ● Ions and atoms ● Lewis structures ● Polar bonds ● Molecular geometry (VSEPR) ● Nomenclature of ionic and covalent compounds (polyatomic ions included) | <ul style="list-style-type: none"> ● Classify and predict products of synthesis, decomposition, single replacement, double replacement, acid base and combustion reactions ● Nuclear decay (alpha, beta, gamma), fission and fusion |
| IN1Aa IN1Be IN1Ab IN1Bf IN1Ac IN1Ca IN1Ad IN1Cb IN1Ae IN1Cc IN1Af IN1Da IN1Ag IN1Db IN1Ba IN1Dc IN1Bb ME1Aa IN1Bc ST3Da IN1Bd ST3Db | IN1Ac IN1Ag IN1Cd IN1Da IN1Db ME1Ea ME1Eb ME1Ec ME2Ab ME2Ad ST2Aa ST2Ba | ME1Ab ME1Ad ME1Ea ME1Eb ME1Ec ME1Fa ME1Fb ME1Fc ME1Ha | ME1Ac ME1Ad ME1Fb ME1Ha ME1Hc ME1He | ES1Cb ME1Ac ME1Ec ME1Hd ME2Ea IN1Ac IN1Ba IN1Ca IN1Cd IN1Da |
| 4 weeks | | | | |

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|--|---------------|----------------|----------------|----------------|
| | <u>3 week</u> | <u>3 weeks</u> | <u>3 weeks</u> | <u>2 weeks</u> |
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Francis Howell School District General Chemistry Curriculum Map

Second Semester: (Third and Fourth Quarters) 19 weeks

| <u>Chemical and Physical Changes</u> | <u>Mole and Stoichiometry</u> | <u>Solutions</u> | <u>Acids and Bases</u> | <u>Energy</u> | <u>Gas Laws</u> |
|---|--|--|---|--|---|
| <ul style="list-style-type: none"> Chemical vs. physical changes Identify Pure Substances Heating Curves Phase Diagrams | <ul style="list-style-type: none"> Dimensional Analysis Mole Molar Mass Balance equations Stoichiometry Limiting reagents Percent yield | <ul style="list-style-type: none"> Solubility Curves Dissolving process Molecular geometry (VSEPR) Effects of polarity, surface area, agitation and temperature on solubility Molarity Separation techniques | <ul style="list-style-type: none"> Properties of acids, bases, and neutral solutions Compare and contrast Arrhenius, Bronsted-Lowry and Lewis theories Scientific notation Calculate pH, pOH, [H⁺] and [-OH] Acid-base neutralization Titration of an unknown acid or base Nomenclature of acidic compounds | <ul style="list-style-type: none"> Thermal energy, heat and temperature Chemical (bond energies), nuclear and thermal energy Conservation of energy Exothermic / endothermic reactions | <ul style="list-style-type: none"> Kinetic Theory Ideal Gas Law |
| ME1Ab ME1Da ME1Db ME1Dc ME1Ga | ME1Ia ME1Ib ME1Hc ME1Hd ME1He IN1Ab IN1Ac IN1Ag IN1Ba IN1Bb IN1Bc IN1Bd IN1Be | ME1Ba ME1Bc IN1Aa IN1Ab IN1Ac IN1Ag IN1Ba IN1Bb IN1Bc IN1Bd IN1Be IN1Ca IN1Cb IN1Cc IN1Da | ES1Ba ES2Fa ME1Ab ME1Bb ME1Hd ME1He ST2Ba ST3Ba ST3Bb IN1Aa IN1Ab IN1Ac IN1Ag IN1Ba IN1Bb IN1Bc IN1Bd IN1Be IN1Ca IN1Cb IN1Cc IN1Cd IN1Da | ME2Aa ME2Da ME2Fc IN1Aa IN1Ab IN1Ac IN1Ag IN1Ba IN1Bb IN1Bc IN1Bd IN1Be IN1Ca IN1Cb IN1Cc IN1Cd IN1Da | ES1Ca ME1Aa ME1Db ME1Dc IN1Aa IN1Ab IN1Ac IN1Ag IN1Ba IN1Bb IN1Bc IN1Bd IN1Be IN1Ca IN1Cb IN1Cc IN1Da |
| 2 weeks | | | | | |

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|--|----------------|----------------|----------------|----------------|----------------|
| | <u>6 weeks</u> | <u>4 weeks</u> | <u>3 weeks</u> | <u>2 weeks</u> | <u>2 weeks</u> |
|--|----------------|----------------|----------------|----------------|----------------|

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| Content Area: Science | Course: Chemistry | Strand: Scientific Inquiry |
| Learner Objectives: <ul style="list-style-type: none"> Science understanding is developed through the use of science process skills, scientific knowledge, scientific investigation, reasoning, and critical thinking. IN1 | | |

Concepts:

- A. Scientific inquiry includes the ability of students to formulate a testable question and explanation, and to select appropriate investigative methods in order to obtain evidence relevant to the explanation. IN1A
- B. Scientific inquiry relies upon gathering evidence from qualitative and quantitative observations. IN1B
- C. Scientific inquiry includes evaluation of explanations (laws/principles, theories/models) in light of evidence (data) and scientific principles (understandings). IN1C
- D. The nature of science relies upon communication of results and justifications of explanations. IN1D

| Students Should Know | Students Should Be Able to |
|--|--|
| <ul style="list-style-type: none"> It is not always possible, for practical or ethical reasons, to control some conditions (e.g., when sampling or testing humans, when observing animal behaviors in nature) IN1Ad Some scientific explanations (e.g., explanations of astronomical or meteorological phenomena) cannot be tested using a controlled laboratory experiment, but instead by using a model, due to the limits of the laboratory environment, resources, and/or technologies IN1Ae There is no fixed procedure called “the scientific method”, but that some investigations involve systematic observations, carefully collected and relevant evidence, logical reasoning, and some imagination in developing hypotheses and other explanations IN1Af Observation is biased by the experiences and knowledge of the observer (e.g., strong beliefs about what should happen in particular circumstances can prevent the detection of other results) IN1Bf The independent variable is manipulated by the experimenter. The dependent variable is the measured variable of the outcome. Constant variables are conditions that remain constant throughout the experiment so as not to affect the outcome. A control in an experiment is the standard by which the dependent variable can be compared. Scientist typically perform 3 trials of each condition in an experiment validate accuracy. | <ul style="list-style-type: none"> Formulate testable questions and hypotheses IN1Aa Analyzing an experiment, identify the components (i.e., independent variable, dependent variables, control of constants, multiple trials) and explain their importance to the design of a valid experiment IN1Ab Design and conduct a valid experiment IN1Ac Evaluate the design of an experiment and make suggestions for reasonable improvements IN1Ag Make qualitative and quantitative observations using the appropriate senses, tools and equipment to gather data (e.g., microscopes, thermometers, analog and digital meters, computers, spring scales, balances, metric rulers, graduated cylinders) IN1Ba Measure length to the nearest millimeter, mass to the nearest gram, volume to the nearest milliliter, force (weight) to the nearest Newton, temperature to the nearest degree Celsius, time to the nearest second IN1Bb Determine the appropriate tools and techniques to collect, analyze, and interpret data IN1Bc Judge whether measurements and computation of quantities are reasonable IN1Bd Calculate the range, average/mean, percent, and ratios for sets of data IN1Be |

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|--|--|
| <ul style="list-style-type: none"> ● Quantitative data is numerical data. Qualitative data is descriptive data. Correct lab procedures are followed to ensure safety. ● Significant figures are used in measurements and calculations to relay accuracy. | <ul style="list-style-type: none"> ● Use quantitative and qualitative data as support for reasonable explanations (conclusions) IN1Ca ● Analyze experimental data to determine patterns, relationships, perspectives, and credibility of explanations (e.g., predict/extrapolate data, explain the relationship between the independent and dependent variable) IN1Cb ● Identify the possible effects of errors in observations, measurements, and calculations, on the validity and reliability of data and resultant explanations (conclusions) IN1Cc ● Analyze whether evidence (data) and scientific principles support proposed explanations (laws/principles, theories/models) IN1Cd ● Communicate the procedures and results of investigations and explanations through: <ul style="list-style-type: none"> ➤ Oral presentations ➤ Drawings and maps ➤ Data tables (allowing for the recording and analysis of data relevant to the experiment such as independent and dependent variables, multiple trials, beginning and ending times or temperatures, derived quantities) ➤ Graphs (bar, single, and multiple line) ➤ Equations and writings IN1Da ● Communicate and defend a scientific argument IN1Db ● Explain the importance of the public presentation of scientific work and supporting evidence to the scientific community (e.g., work and evidence must be critiqued, reviewed, and validated by peers; needed for subsequent investigations by peers; results can influence the decisions regarding future scientific work) IN1Dc |
|--|--|

Instructional Support

| Student Essential Vocabulary | | | | | |
|------------------------------|------------|----------------------|--------------------|-------------------|---------|
| Problem statement | Hypothesis | Independent variable | Dependent variable | Constant variable | Control |
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| Sample Learning Activities | Sample Assessments | | | | | | | | | | | | | | | | | | | | | | |
|--|--|--|-----|-----------------------------------|---------|----------|---------|--|--|------------------------|--|-----|---------------------|---------|-----|---------|--|-----|----------------------------|----------------------|---------------------|------|--|
| <p>Learning Activity #1 : (See Appendix A) Dirty Water Lab- The purpose of this activity is to 1) design and conduct a valid experiment, 2) formulate testable questions and hypotheses, 3) explain the importance of the independent variable, dependent variable, constant variables and the control in creating a valid experiment and 4) evaluate the design of the experiment and make suggestions for reasonable improvements.</p> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 10px;"> <thead> <tr> <th colspan="2" style="text-align: center;">Activity's Alignment</th> </tr> </thead> <tbody> <tr> <td style="width: 20%;">CLE</td> <td>IN1Aa, IN1Ab, IN1Ac, IN1Ag, ES1Ba</td> </tr> <tr> <td>CONTENT</td> <td>SC7, SC5</td> </tr> <tr> <td>PROCESS</td> <td> 1.1 – Develop research questions/ideas 1.3 – Design/conduct investigations 1.6 – Discover/evaluate relationships 1.7 – Evaluate information 1.8 – Organize data and ideas 2.3 – Exchange ideas and take others' perspectives 3.1 – Identify and define problems 3.3 – Apply one's own strategies 3.4 – Evaluate problem-solving processes 3.5 – Reason logically (inductive/deductive) 3.7 – Evaluate strategies </td> </tr> </tbody> </table> | Activity's Alignment | | CLE | IN1Aa, IN1Ab, IN1Ac, IN1Ag, ES1Ba | CONTENT | SC7, SC5 | PROCESS | 1.1 – Develop research questions/ideas 1.3 – Design/conduct investigations 1.6 – Discover/evaluate relationships 1.7 – Evaluate information 1.8 – Organize data and ideas 2.3 – Exchange ideas and take others' perspectives 3.1 – Identify and define problems 3.3 – Apply one's own strategies 3.4 – Evaluate problem-solving processes 3.5 – Reason logically (inductive/deductive) 3.7 – Evaluate strategies | <p>Assessment #1: (See Appendix B) Experimental Design Evaluation Assessment – Students evaluate a hypothetical experiment and suggest reasonable improvements.</p> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 10px;"> <thead> <tr> <th colspan="2" style="text-align: center;">Assessment's Alignment</th> </tr> </thead> <tbody> <tr> <td style="width: 20%;">CLE</td> <td>IN1Aa, IN1Ab, IN1Ag</td> </tr> <tr> <td>CONTENT</td> <td>SC7</td> </tr> <tr> <td>PROCESS</td> <td> 1.7 – Evaluate information 1.10 – Apply information, ideas and skills 3.5 – Reason logically (inductive/deductive) 4.5 – Develop/revise plans of action </td> </tr> <tr> <td>DOK</td> <td>DOK 3 – Strategic Thinking</td> </tr> <tr> <td>LEVEL OF EXPECTATION</td> <td>Mastery Level - 85%</td> </tr> <tr> <td>ISTE</td> <td> </td> </tr> </tbody> </table> | Assessment's Alignment | | CLE | IN1Aa, IN1Ab, IN1Ag | CONTENT | SC7 | PROCESS | 1.7 – Evaluate information 1.10 – Apply information, ideas and skills 3.5 – Reason logically (inductive/deductive) 4.5 – Develop/revise plans of action | DOK | DOK 3 – Strategic Thinking | LEVEL OF EXPECTATION | Mastery Level - 85% | ISTE | |
| Activity's Alignment | | | | | | | | | | | | | | | | | | | | | | | |
| CLE | IN1Aa, IN1Ab, IN1Ac, IN1Ag, ES1Ba | | | | | | | | | | | | | | | | | | | | | | |
| CONTENT | SC7, SC5 | | | | | | | | | | | | | | | | | | | | | | |
| PROCESS | 1.1 – Develop research questions/ideas 1.3 – Design/conduct investigations 1.6 – Discover/evaluate relationships 1.7 – Evaluate information 1.8 – Organize data and ideas 2.3 – Exchange ideas and take others' perspectives 3.1 – Identify and define problems 3.3 – Apply one's own strategies 3.4 – Evaluate problem-solving processes 3.5 – Reason logically (inductive/deductive) 3.7 – Evaluate strategies | | | | | | | | | | | | | | | | | | | | | | |
| Assessment's Alignment | | | | | | | | | | | | | | | | | | | | | | | |
| CLE | IN1Aa, IN1Ab, IN1Ag | | | | | | | | | | | | | | | | | | | | | | |
| CONTENT | SC7 | | | | | | | | | | | | | | | | | | | | | | |
| PROCESS | 1.7 – Evaluate information 1.10 – Apply information, ideas and skills 3.5 – Reason logically (inductive/deductive) 4.5 – Develop/revise plans of action | | | | | | | | | | | | | | | | | | | | | | |
| DOK | DOK 3 – Strategic Thinking | | | | | | | | | | | | | | | | | | | | | | |
| LEVEL OF EXPECTATION | Mastery Level - 85% | | | | | | | | | | | | | | | | | | | | | | |
| ISTE | | | | | | | | | | | | | | | | | | | | | | | |

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| | 4.1 – Support decisions 4.5 – Develop/revise plans of action |
| DOK | DOK 4 – Extended Thinking |
| INSTRUCTIONAL STRATEGIES | Similarities and differences Generating and testing hypotheses |
| ISTE | |

Learning Activity #2: (See Appendix C)

Iron Nail Lab-

The purpose of this activity is to have students 1) use quantitative data as support for reasonable explanations (conclusions), 2) make suggestion for reasonable improvements and 3) compare the mass of the reactant to the mass of the products in a chemical reaction as support for the Law of Conservation of Mass.

| Activity's Alignment | |
|--------------------------|--|
| CLE | IN1Ab, IN1Ag, IN1Ba, IN1Bb, IN1Be, IN1Ca, IN1Cc, IN1Cd, IN1Da, ME1Ia |
| CONTENT | SC 7, SC 1 |
| PROCESS | 1.2 – Conduct research 1.8 – Organize data and ideas 1.10 – Apply information, ideas and skills 2.6 – Apply communication techniques 3.5 – Reason logically (inductive/deductive) 4.1 – Support decisions |
| DOK | DOK 3 – Strategic Thinking |
| INSTRUCTIONAL STRATEGIES | Summarizing and note taking Generating and testing hypotheses |

Assessment #2: (See Appendix D)

Iron Nail Lab Assessment –

Students analyze data to determine if it is reasonable and whether it supports the Law of Conservation of Mass. Stoichiometry will be used to determine a theoretical yield so that a % yield can be determined. The % yield from 3 trials is used to determine an average.

| Assessment's Alignment | |
|------------------------|--|
| CLE | IN1Bd, IN1Be, IN1Ca, ME1Ia |
| CONTENT | SC 7, SC1 |
| PROCESS | 1.7 – Evaluate information 1.8 – Organize data and ideas 1.10 – Apply information, ideas and skills 3.5 – Reason logically (inductive/deductive) 4.1 – Support decisions |
| DOK | DOK 2 – Skill/Concept |
| LEVEL OF EXPECTATION | Mastery Level -75% |

| Student Resources | Teacher Resources |
|--|--|
| <ul style="list-style-type: none"> <u>World of Chemistry</u>, McDougal Littell © 2007 | <ul style="list-style-type: none"> <u>World of Chemistry</u>, McDougal Littell © 2007 |

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| Identity Equity and Readiness | | | |
|-------------------------------|--|----------------------|--|
| Gender Equity | | Technology Skills | |
| Racial/Ethnic Equity | | Research/Information | |
| Disability Equity | | Workplace/Job Prep | |

| | | |
|---|--------------------------|----------------------------------|
| Content Area: Science | Course: Chemistry | Strand: Matter and Energy |
| Learner Objectives: | | |
| <ul style="list-style-type: none"> Changes in properties and states of matter provide evidence of the atomic theory of matter. (ME1) | | |

Concepts:

- A. Objects, and the materials they are made of, have properties that can be used to describe and classify them. (ME1A)
- B. Properties of mixtures depend upon the concentrations, properties, and interactions of particles. (ME1B)
- C. Physical changes in states of matter due to thermal changes in materials can be explained by the Kinetic Theory of Matter. (ME1D)
- D. The atomic model describes the electrically neutral atom. (ME1E)
- E. The periodic table organizes the elements according to their atomic structure and chemical reactivity. (ME1F)
- F. Properties of objects and states of matter can change chemically and/or physically. (ME1G)
- G. Chemical bonding is the combining of different pure substances (elements, compounds) to form new substances with different properties. (ME1H)
- H. Mass is conserved during any physical or chemical change. (ME1I)

| Students Should Know | Students Should Be Able to |
|--|--|
| <ul style="list-style-type: none"> • Nomenclature is an essential component of chemical literacy (ME1He) • The number of atoms of the reactants and products in a chemical equation are balanced (ME1Ib) • The mole is a fundamental unit (ME1He) • Density is mass/volume • Matter is classified by its physical and chemical properties • Elements contain 1 type of atom and compounds contain 2 or more types of atoms • Elements can be classified according to reactivity, the number of valence electrons, malleability, luster and conductivity • Solutions can be described according to the following terms: <ul style="list-style-type: none"> ○ Dilute – a solution in which a relatively small amount of solute is dissolved in a solution. ○ Concentrated – a solution in which a relatively large amount of solute is dissolved in a solution. ○ Saturated – a solution that contains as much solute as will dissolve at that temperature. ○ Unsaturated – a solution in which more solute can dissolve than is dissolved already at that temperature. | <ul style="list-style-type: none"> • Compare the densities of regular and irregular objects using their respective measures of volume and mass (ME1Aa) • Identify pure substances by their physical and chemical properties (i.e., color, luster/reflectivity, hardness, conductivity, density, pH, melting point, boiling point, specific heat, solubility, phase at room temperature, chemical reactivity) (ME1Ab) • Classify a substance as being made up of one kind of atom (element) or a compound when given the molecular formula or structural formula (or electron dot diagram) for the substance (ME1Ac) • Compare and contrast the common properties of metals, nonmetals, metalloids (semi-conductors), and noble gases (ME1Ad) • Classify solutions as either dilute or concentrated; as either saturated, unsaturated, or supersaturated (ME1Ba) • Compare and contrast the properties of acidic, basic, and neutral solutions (ME1Bb) • Calculate pH, pOH and concentration from the equation: $\text{pH} = -\log [\text{H}^+]$ • Predict the effects of solvent and solute polarity on solubility (“like dissolves like”); and predict the effects of temperature, surface area, particle size, and agitation on rates of solubility (ME1Bc) |

- Supersaturated – a solution that contains more solute than a saturated solution will hold at that temperature.
- Acids have a pH <7, bases have a pH >7 and a pH of 7 is considered neutral
- Polar solvents dissolve polar solutes; non-polar solvents dissolve non-polar solutes
- Changes in temperature, surface area, particle size and agitation can affect the rate of solubility
- Molarity is a term used to specify concentration of a solution
- Homogeneous solutions can be separated using a group of techniques called chromatography
- Heterogeneous solutions can be separated using filtration
- During a phase change, the temperature of the substance remains constant as the distance between atom/molecules changes
- A phase diagrams show the relationship between temperature and pressure and the resulting state of matter
- An atom has a dense, positive nucleus surrounded by a cloud of negative electrons
- The mass number is the number of protons + neutrons
- The atomic number is the number of protons
- The number of electrons = the atomic number in all atoms
- The atomic mass can be calculated from the relative abundances of the isotopes
- Elements with common properties are arranged in vertical groups/families
- Elements can have periodic properties such as ionization energy, atomic radius and electronegativity
- Elements are classified as metals, metalloids and nonmetals based upon their position on a Periodic Table
- The reactivity of an element can be determined from an element's electronegativity
- Very high and very low electronegativities indicate high reactivity
- Electron configurations can be used to determine the number of valence electrons
- In general, a metal + nonmetal results in an ionic bond
- In general, two nonmetals result in a covalent bond
- Chemical changes result in a new compound being formed
- Determine simple molecular shapes using the Valence Shell Electron Repulsion Theory
- Determine the concentration of an unknown acid or base by titration
- Using the Kinetic Theory model, explain the changes that occur in the distance between atoms/molecules and temperature of a substance as energy is absorbed or released during a phase change (ME1Da)
- Predict the effect of a temperature change on the properties (e.g., pressure, density) of a material (solids, liquids, gases) (ME1Db)
- Predict the effect of pressure changes on the properties (e.g., temperature, density) of a material (solids, liquids, gases) (ME1Dc)
- Calculate pressure, volume, moles or temperature of a gas using the Ideal Gas Law
- Calculate molarity of a solution
- Perform paper chromatography and calculate Rf values for resultant color bands
- Describe the atom as having a dense, positive nucleus surrounded by a cloud of negative electrons (ME1Ea)
- Calculate the number of protons, neutrons, and electrons of an isotope, given its mass number and atomic number (ME1Eb)
- Describe the information provided by the atomic number and the mass number (i.e., electrical charge, chemical stability) (ME1Ec)
- Explain the structure of the periodic table in terms of the elements with common properties (groups/families) and repeating properties (periods) (ME1Fa)
- Classify elements as metals, nonmetals, metalloids (semi-conductors), and noble gases according to their location on the Periodic Table (ME1Fb)
- Predict the chemical reactivity of elements, and the type of bonds that may result between them, using the Periodic Table (ME1Fc)
- Distinguish between physical and chemical changes in matter (ME1Ga)
- Construct an electron configuration for an element
- Describe how the valence electron configuration determines how atoms interact and may bond (ME1Ha)
- **Chem II Content** Predict the reaction rates of different substances based on their properties (i.e., concentrations of reactants, pressure, temperature, state of matter, surface area, type of reactant material) (ME1Hb)

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| <ul style="list-style-type: none"> ● Physical changes involve changes that do not result in a new compound being formed ● Atoms with 3 or fewer valence electrons are likely to form ionic bonds ● Atoms with 4 or more valence electrons are likely to form covalent bonds or accept electrons from those with 3 or fewer valence electrons ● Ionic bonds result in a transfer of electrons and an electrostatic attraction ● Covalent bonds result in the sharing of electrons ● Lewis structures are useful in determining bonding and molecular shape in conjunction with the Valence Shell Electron Pair Repulsion Theory. ● Polar bonds occur between atoms with different electronegativities ● The reaction of a strong acid and strong base results in water and a salt ● Combustion reactions involve oxygen as a reactant and carbon dioxide and water as typical products ● Metals can combine with oxygen to form metal oxides ● The Law of Conservation of Mass states that matter cannot be created or destroyed | <ul style="list-style-type: none"> ● Compare and contrast the types of chemical bonds (i.e., ionic, covalent) (ME1Hc) ● Predict the products of an acid/base (neutralization), oxidation (rusting), and combustion (burning) reaction (ME1Hd) ● Compare the mass of the reactants to the mass of the products in a chemical reaction or physical change as support for the Law of Conservation of Mass (ME1Ia) ● Calculate the molar mass of a given substance (ME1Hd) ● Predict various stoichiometric relationships (to be locally assessed) ● Solve problems using Dimensional Analysis ● Calculate the mass of the products in a chemical reaction from the mass of the reactants ● Calculate the limiting reagent in a chemical reaction ● Calculate the percent yield from the theoretical yield and the experimental yield |
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Instructional Support

| Student Essential Vocabulary | | | | | |
|------------------------------|-------------|----------------|--------------------|--------------------|-----------------------|
| Malleable | Luster | Periodicity | Ionization energy | Electronegativity | Atomic radius |
| Density | Atomic mass | Metal | Metalloid | Nonmetal | Noble gas / inert gas |
| Conductivity | Synthesis | Decomposition | Single Replacement | Double Replacement | Acid / Base Reaction |
| Combustion | Reactants | Products | Protons | Electrons | Neutrons |
| Atomic number | Mass number | Isotope | Ion | Atom | Element |
| Compound | Nucleus | Electron cloud | | | |

| Sample Learning Activities | Sample Assessments |
|---|--|
| <p>Learning Activity #1 : (See Appendix E) Periodic Table Activity- The purpose of this activity is to recreate Mendeleev’s discovery of the classification of the elements and the periodic trends that occur using a special deck of element cards. Students will organize these cards based upon an element’s ionization energy, atomic mass, density, atomic radius and electronegativity. Once this is completed, students will identify the element and categorize them as a metal, metalloid or nonmetal to determine periodic tendencies in these categories. The activity will conclude with a web search to determine common properties of metals, metalloids, nonmetals and Noble gases in order to determine the similarities and differences between the categories.</p> | <p>Assessment #1: Questions:</p> <ol style="list-style-type: none"> 1. An unknown element is dull, brittle and does not conduct electricity. Classify the element as a metal, metalloid or nonmetal. Then justify your answer in a complete sentence with complete thought. 2. Create a graphic organizer that compares and contrasts the common properties of metals, metalloids, nonmetals and Noble gases. 3. Match each classification with the descriptions. Classifications may be used more than once or not at all. <p style="text-align: center;">a. Noble Gases c. Metals</p> |
| Activity’s Alignment | |

| | |
|--------------------------|--|
| CLE | ME1Ad, ME1Ec, ME1Fa, ME1Fb |
| CONTENT | SC1, CA3, CA4 |
| PROCESS | 1.6 – Discover/evaluate relationships 1.10 – Apply information, ideas and skills 2.3 – Exchange ideas and take others’ perspectives 2.7 – Use information technology 3.5 – Reason logically (inductive/deductive) 4.1 – Support decisions |
| DOK | DOK 3– Strategic Thinking |
| INSTRUCTIONAL STRATEGIES | Similarities and differences Summarizing and note taking Setting objectives and providing feedback Questions, cues, and advanced organizers |
| ISTE | 3b – use digital tools to find and use information |

b. Metalloids d. Nonmetals

- 1) Element 114 is likely to have characteristics that are similar to this classification
- 2) Some elements in this group gain electrons and some elements lose electrons when bonding
- 3) This group exhibits both metal and nonmetal behavior
- 4) These two groups contain gases that do not conduct electricity

Answers:

1. The element is a nonmetal. Nonmetals characteristically are dull, brittle and have low to no conductivity.
2. An assessment is contained in the **Periodic Table Activity** that has students create a graphic organizer that compares and contrasts the common properties of metals, metalloids, nonmetals and Noble gases. Accuracy is assessed according to the following rubric:

2 points-- The graphic organizer includes a clear comparison of the pieces and includes luster, malleability, conductivity, and the gain/loss of electrons. The graphic organizer is labeled with the titles: metal, metalloid, nonmetal and Noble gas/Inert gas.

1 point-- The response includes a comparison of the pieces, but the comparison is either incorrect or incomplete.

0 points-- The response does not include any accuracy in the comparison of metals, metalloids, nonmetals or Noble gases/Inert gases.

3. 1) Metals (c) 2) Metalloids (b) 3) Metalloids (b)
4) Noble Gases (a) and Nonmetals (d)

Assessment's Alignment

| | |
|----------------------|---|
| CLE | ME1Ad, ME1Fb |
| CONTENT | SC1, CA4 |
| PROCESS | 1.10 – Apply information, ideas and skills 3.5 – Reason logically (inductive/deductive) 4.1 – Support decisions |
| DOK | DOK 2 – Skill/Concept |
| LEVEL OF EXPECTATION | Mastery Level – 80% |
| ISTE | |

**Learning Activity #2: (See Appendix F)
Investigating Chemical Reactions -**

The purpose of this activity is to have students categorize chemical reactions into 6 categories (synthesis, decomposition, combustion, single replacement, double replacement and acid/base reactions) through an inquiry lesson. They will use similarities and differences to categorize the types of reactions and then apply this knowledge to identify reaction types and predict reaction products.

| Activity's Alignment | |
|----------------------|---|
| CLE | ME1Hd |
| CONTENT | SC1 |
| PROCESS | 1.3 – Design/conduct investigations 1.6 – Discover/evaluate relationships 1.8 – Organize data and ideas 1.10 – Apply information, ideas and skills 2.3 – Exchange ideas and take others' perspectives 3.5 – Reason logically (inductive/deductive) |
| DOK | DOK 3 – Strategic Thinking |

**Assessment #2: (See Appendix G)
Reaction Type Assessment –**

A. Graphic Organizer / Flow Chart – (Sample Organizer in Appendix)

Create a graphic organizer/flow chart to show the process in which you take to determine the Reaction Type of a chemical reaction. Your graphic organizer/flow chart will contain the following categories: synthesis, decomposition, combustion, single replacement, double replacement and acid/base reactions. Please include category titles and distinguishing characteristics of each reaction type. The organizer will be evaluated based upon the ability of the organizer to produce a correct classification. The flow chart is created using Smart Ideas.

2 points-- The graphic organizer includes category titles and distinguishing characteristics of each reaction type. When followed, the graphic organizer will produce a correct classification.

1 point-- The graphic organizer includes incorrect or incomplete category titles or distinguishing characteristics of each

| | |
|--------------------------|---|
| INSTRUCTIONAL STRATEGIES | Similarities and differences Summarizing and note taking Setting objectives and providing feedback Generating and testing hypotheses |
| ISTE | |

reaction type. The graphic organizer is partially accurate in producing a correct classification.

0 points-- The response does not include category titles or distinguishing characteristics of each reaction type. It does not produce any correct classifications..

B. Did I Get It? Identifying Reaction Types and Predicting Reaction Products – (Answer Key in Appendix)

| Assessment's Alignment | |
|------------------------|--|
| CLE | ME1Hd |
| CONTENT | SC1 |
| PROCESS | 1.4 – Organize information using tools 1.10 – Apply information, ideas and skills 2.4 – Present perceptions and ideas 2.7 – Use information technology 3.5 – Reason logically (inductive/deductive) 3.7 – Evaluate strategies |
| DOK | DOK 3 – Strategic Thinking |
| LEVEL OF EXPECTATION | Mastery Level – 75% |
| ISTE | 1b – use technology to create original works 3c – use digital tools to complete specific tasks |

**Learning Activity #3: (See Appendix H)
Proton, Neutron and Electron Learning Activity –**
The purpose of this activity is to compare and contrast isotopes of an element using manipulatives.

| Activity's Alignment | |
|----------------------|--------------|
| CLE | ME1Eb, ME1Ec |
| CONTENT | SC1 |

**Assessment #3: (See Appendix I)
Atomic Structure Formative**

| Assessment's Alignment | |
|------------------------|--|
| CLE | ME1Eb, ME1Ec |
| CONTENT | SC1 |
| PROCESS | 1.10 – Apply information, ideas and skills 3.5 – Reason logically (inductive/deductive) |
| DOK | DOK 2 – Skill/Concept |

| | | | |
|--------------------------|---|----------------------|---------------------|
| PROCESS | 1.4 – Organize information using tools 1.6 – Discover/evaluate relationships 1.8 – Organize data and ideas 1.10 – Apply information, ideas and skills 3.5 – Reason logically (inductive/deductive) 4.1 – Support decisions | LEVEL OF EXPECTATION | Mastery Level – 85% |
| DOK | DOK 2 – Skill /Concept | ISTE | |
| INSTRUCTIONAL STRATEGIES | Similarities and differences Cooperative Learning Generating and testing hypotheses | | |
| ISTE | | | |

| Student Resources | Teacher Resources |
|--|--|
| <ul style="list-style-type: none"> <u>World of Chemistry</u>, McDougal Littell © 2007 | <ul style="list-style-type: none"> <u>World of Chemistry</u>, McDougal Littell © 2007 http://www.sparknotes.com/testprep/books/sat2/chemistry/chapter4section6.rhtml - Website classifying properties of metals, metalloids and nonmetals http://chemistry.about.com/od/elementgroups/a/metals.htm - Website classifying properties of metals, metalloids and nonmetals http://www.rsc.org/chemsoc/visualelements/Pages/data/intro_groupi_data.html - Website classifying properties of metals, metalloids and nonmetals http://www.chemtutor.com/react.htm#what – Website classifying chemical reactions http://www.usoe.k12.ut.us/CURR/Science/sciber00/8th/matter/sciber/chemtype.htm - Website classifying chemical reactions |

| Identity Equity and Readiness | | | |
|-------------------------------|--|----------------------|--|
| Gender Equity | | Technology Skills | |
| Racial/Ethnic Equity | | Research/Information | |

| | | | |
|-------------------|--|--------------------|--|
| Disability Equity | | Workplace/Job Prep | |
|-------------------|--|--------------------|--|

| | | |
|--|--------------------------|----------------------------------|
| Content Area: Science | Course: Chemistry | Strand: Matter and Energy |
| Learner Objectives: | | |
| <ul style="list-style-type: none"> Energy has a source, can be stored, and can be transferred but is conserved within a system. ME2 | | |

Concepts:

- A. Forms of energy have a source, a means of transfer (work and heat), and a receiver. ME2A
- B. Mechanical energy comes from the motion (kinetic energy) and/or relative position (potential energy) of an object. ME2B
- C. Electromagnetic energy from the Sun (solar radiation) is a major source of energy on Earth. ME2C
- D. Chemical reactions involve changes in the bonding of atoms with the release or absorption of energy. ME2D
- E. Nuclear energy is a major source of energy throughout the universe. ME2E
- F. Energy can be transferred within a system as the total amount of energy remains constant (i.e., Law of Conservation of Energy). ME2F

| Students Should Know | Students Should Be Able to |
|---|---|
| <ul style="list-style-type: none"> Thermal energy is the total energy of a substance which is dependent upon mass. Heat is thermal energy that transfers from one object to another due to a difference in temperature. Temperature is the measure of the average kinetic energy of molecules or atoms in a substance. Wavelength is inversely proportional to frequency. $E = hv$ where E is energy, h is Planck's constant and v is frequency. Scientific notation is used to simplify calculations. As frequency increases so does the damaging effects on the Earth and living organisms. Exothermic reactions produce an increase in temperature. Endothermic reactions produce a decrease in temperature. Fusion involves the combining of atomic nuclei. Fission involves the splitting of atomic nuclei. There are 3 general types of radiation, alpha, beta and gamma. The Law of Conservation of Energy state that energy cannot be created or destroyed. Energy can be classified as chemical, nuclear, thermal, mechanical, electromagnetic, kinetic and potential energies. | <ul style="list-style-type: none"> Differentiate between thermal energy (the total internal energy of a substance which is dependent upon mass), heat (thermal energy that transfers from one object or system to another due to a difference in temperature), and temperature (the measure of average kinetic energy of molecules or atoms in a substance) ME2Aa Describe the relationship among wavelength, energy, and frequency as illustrated by the electromagnetic spectrum ME2Ab Calculate wavelength, energy or frequency using: $E = hv$ Chem II Content Describe sources and common uses of different forms of energy: chemical (the energy stored in the electrical fields between atoms in a compound), nuclear, thermal, mechanical, electromagnetic ME2Ac Describe the effect of different frequencies of electromagnetic waves on the Earth and living organisms (e.g., radio, infrared, visible, ultraviolet, gamma, cosmic rays) ME2Ad Chem II Content Relate kinetic energy to an object's mass and its velocity ME2Ba Chem II Content Describe how electromagnetic energy is transferred through space as electromagnetic waves of varying wavelength and frequency ME2Cb Describe evidence of energy transfer and transformations that occur during exothermic and endothermic chemical reactions ME2Da |

- | | |
|--|---|
| | <ul style="list-style-type: none">● Describe how changes in the nucleus of an atom during a nuclear reaction (i.e., nuclear decay, fusion, fission) result in emission of radiation ME2Ea● Classify the different ways to store energy (i.e., chemical, nuclear, thermal, mechanical, electromagnetic) and describe the transfer of energy as it changes from kinetic to potential, while the total amount of energy remains constant, within a system (e.g., using gasoline to move a car, photocell generating electricity, biochemical reaction, energy generated by nuclear reactor) ME2Fc |
|--|---|

Instructional Support

| Student Essential Vocabulary | | | | | |
|------------------------------|------------------------|-------------|-----------------------|-----------------|-------------------|
| Alpha decay | Beta decay | Gamma decay | Fission | Fusion | Radiation |
| Radioactive | Endothermic | Exothermic | Thermal energy | Heat | Temperature |
| Wavelength | Electromagnetic energy | Frequency | Electromagnetic waves | Chemical energy | Mechanical energy |
| Kinetic energy | Potential energy | | | | |

| Sample Learning Activities | Sample Assessments | | | | | | | | | | | | |
|--|---|--|-----|-------|---------|---------------|---------|---|-----|----------------------|--------------------------|-----------------------------|---|
| <p>Learning Activity #1 : (See Appendix J) Nuclear Reactions - The purpose of this activity is to do an internet search to complete a table and several questions regarding nuclear reactions. The goal of the activity is to prepare the student for the culminating activity of describing how changes in the nucleus of an atom during a nuclear reaction result in emission of radiation.</p> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 10px;"> <thead> <tr style="background-color: #d3d3d3;"> <th colspan="2">Activity's Alignment</th> </tr> </thead> <tbody> <tr> <td style="width: 20%;">CLE</td> <td>ME2Ea</td> </tr> <tr> <td>CONTENT</td> <td>SC1, CA3, CA4</td> </tr> <tr> <td>PROCESS</td> <td>1.5 – Comprehend/evaluate resources 1.6 – Discover/evaluate relationships 1.7 – Evaluate information 1.8 – Organize data and ideas 1.10 – Apply information, ideas and skills 2.6 – Apply communication techniques 2.7 – Use information technology</td> </tr> <tr> <td>DOK</td> <td>DOK2 – Skill/Concept</td> </tr> <tr> <td>INSTRUCTIONAL STRATEGIES</td> <td>Summarizing and note taking</td> </tr> </tbody> </table> | Activity's Alignment | | CLE | ME2Ea | CONTENT | SC1, CA3, CA4 | PROCESS | 1.5 – Comprehend/evaluate resources 1.6 – Discover/evaluate relationships 1.7 – Evaluate information 1.8 – Organize data and ideas 1.10 – Apply information, ideas and skills 2.6 – Apply communication techniques 2.7 – Use information technology | DOK | DOK2 – Skill/Concept | INSTRUCTIONAL STRATEGIES | Summarizing and note taking | <p>Assessment #1: Nuclear Reactions Assessment - Questions:</p> <ol style="list-style-type: none"> 4. Polonium-210 is a naturally radioactive element. It decays by the loss of an alpha particle. What is the other product of this decay? 5. Which type of nuclear decay is characterized by the emission of an electron resulting from a neutron converting into a proton? 6. What type of nuclear reaction occurs in the sun to produce its energy? Write the chemical equation that occurs. 7. How is energy produced during an alpha decay? <p>Answers:</p> <ol style="list-style-type: none"> 1. Lead-206 2. beta decay 3. Fusion occurs in the sun. The chemical equation is: ${}^2_1\text{H} + {}^3_1\text{H} \rightarrow {}^4_2\text{He} + {}^1_0\text{neutron}$ 4. The energy released during alpha decay comes from a slight change in mass between the reactant and products. The mass of the products are slightly less than the mass of the reactant. Using Einstein's equation, $E = mc^2$, the mass is converted into energy. |
| Activity's Alignment | | | | | | | | | | | | | |
| CLE | ME2Ea | | | | | | | | | | | | |
| CONTENT | SC1, CA3, CA4 | | | | | | | | | | | | |
| PROCESS | 1.5 – Comprehend/evaluate resources 1.6 – Discover/evaluate relationships 1.7 – Evaluate information 1.8 – Organize data and ideas 1.10 – Apply information, ideas and skills 2.6 – Apply communication techniques 2.7 – Use information technology | | | | | | | | | | | | |
| DOK | DOK2 – Skill/Concept | | | | | | | | | | | | |
| INSTRUCTIONAL STRATEGIES | Summarizing and note taking | | | | | | | | | | | | |
| Assessment's Alignment | | | | | | | | | | | | | |

| | |
|------|--|
| ISTE | 3b – use digital tools to find and use information 3c – use digital tools to complete specific tasks 6a – use technology systems |
|------|--|

| | |
|----------------------|--|
| CLE | ME2Ea |
| CONTENT | SC1 |
| PROCESS | 1.10 – Apply information, ideas and skills 3.5 – Reason logically (inductive/deductive) |
| DOK | DOK2 – Skill/Concept |
| LEVEL OF EXPECTATION | Mastery Level - 85% |
| ISTE | |

Learning Activity #2: (See Appendix K)

Exothermic and Endothermic Reactions Lab -

The purpose of this activity is to compare the temperature changes in chemical reactions in order to identify them as exothermic or endothermic reactions.

Assessment #2:

Exothermic and Endothermic Reactions Assessment -

Questions:

1. A clear solution has a temperature of 25°C. After adding a white powder to the solution, the temperature stabilized at 75°C. Is this an exothermic reaction or an endothermic reaction? Explain your answer with the supporting evidence.
2. Describe evidence of energy transfer that occurs during exothermic and endothermic chemical reactions.

Answers:

1. *This is an exothermic reaction because energy was released to the surroundings making the temperature increase.*
2. *In an exothermic reaction, energy from the reaction is transferred to the surroundings in the form of heat. This makes the temperature of the surroundings increase. In an endothermic reaction, energy from the surroundings is transferred to the chemical bonds of the products of the reaction. This makes the temperature of the surroundings decrease.*

| Activity's Alignment | |
|--------------------------|--|
| CLE | ME2Da, IN1Ac, IN1Ba, IN1Bb, IN1Be, IN1Ca |
| CONTENT | SC1, SC6, CA4 |
| PROCESS | 1.3 – Design/conduct investigations 1.6 – Discover/evaluate relationships 1.7 – Evaluate information 1.8 – Organize data and ideas 1.10 – Apply information, ideas and skills 3.5 – Reason logically (inductive/deductive) 4.1 – Support decisions |
| DOK | DOK 3 – Strategic Thinking |
| INSTRUCTIONAL STRATEGIES | Similarities and differences Summarizing and note taking |

| Assessment's Alignment | |
|------------------------|----------|
| CLE | ME2Da |
| CONTENT | SC1, CA4 |

| | | |
|--|----------------------|---|
| | PROCESS | 1.10 – Apply information, ideas and skills 3.5 – Reason logically (inductive/deductive) 4.1 – Support Decisions |
| | DOK | DOK 2 – Skill / Concept |
| | LEVEL OF EXPECTATION | Mastery Level - 90% |

| Student Resources | Teacher Resources |
|--|--|
| <ul style="list-style-type: none"> • World of Chemistry, McDougal Littell © 2007 • http://www.lbl.gov/abc/Basic.html • http://chemistry.about.com/od/chemistryfaqs/f/radioactivity.htm • http://www.chem.duke.edu/~jds/cruise_chem/nuclear/stability.html • http://en.wikipedia.org/wiki/Radioactivity • http://www.gcsescience.com/prad36-nuclear-power-electricity.htm • http://schools.wikia.com/wiki/Nuclear_Fission • http://hif.lbl.gov/tutorial/tutorial.html#Overview • http://library.thinkquest.org/17940/texts/radioactivity/radioactivity.html • http://www.gcsescience.com/prad11-physics-radioactivity-penetrating-ability.htm | <ul style="list-style-type: none"> • World of Chemistry, McDougal Littell © 2007 • http://www.lbl.gov/abc/Basic.html • http://chemistry.about.com/od/chemistryfaqs/f/radioactivity.htm • http://www.chem.duke.edu/~jds/cruise_chem/nuclear/stability.html • http://en.wikipedia.org/wiki/Radioactivity • http://www.gcsescience.com/prad36-nuclear-power-electricity.htm • http://schools.wikia.com/wiki/Nuclear_Fission • http://hif.lbl.gov/tutorial/tutorial.html#Overview • http://library.thinkquest.org/17940/texts/radioactivity/radioactivity.html • http://www.gcsescience.com/prad11-physics-radioactivity-penetrating-ability.htm |

| Identity Equity and Readiness | | | |
|-------------------------------|--|----------------------|--|
| Gender Equity | | Technology Skills | |
| Racial/Ethnic Equity | | Research/Information | |
| Disability Equity | | Workplace/Job Prep | |

| | | |
|---|--------------------------|---|
| Content Area: Science | Course: Chemistry | Strand: Processes and Interactions of the Earth's Systems (Geosphere, Atmosphere, and Hydrosphere) |
| Learner Objectives: <ul style="list-style-type: none"> • Earth's Systems (geosphere, atmosphere, and hydrosphere) have common components and unique structures. (ES1) • Earth's Systems (geosphere, atmosphere, and hydrosphere) interact with one another as they undergo change by common processes. (ES2) | | |

Concepts:

- A. The hydrosphere is composed of water (a material with unique properties) and other materials. (ES1B)
- B. The atmosphere (air) is composed of a mixture of gases, including water vapor, and minute particles. (ES1C)
- C. Climate is a description of average weather conditions in a given area due to the transfer of energy and matter through Earth's systems. (ES2F)

| Students Should Know | Students Should Be Able to |
|--|--|
| <ul style="list-style-type: none"> • Water is an important solvent in the environment as it relates to acid rain and water pollution (ES1Ba) • Ozone absorbs UV radiation. | <ul style="list-style-type: none"> • Relate the composition of gases and temperature of the layers of the atmosphere (i.e., troposphere, stratosphere, ionosphere) to cloud formation and transmission of radiation (e.g., ultraviolet, infrared) (ES1Ca) • Describe the causes and consequences of observed and predicted changes in the ozone layer (ES1Cb) • Provide evidence (e.g., variations in sea level, glaciation, and permafrost layers, fossils, desertification) that supports theories of climate change due to natural phenomena and/or human interactions (ES2Fa) |

Instructional Support

| Student Essential Vocabulary | | | | | |
|------------------------------|---------------|----------------|----|--|--|
| Acid rain | Carbonic acid | Carbon dioxide | pH | | |
| | | | | | |
| | | | | | |

| Sample Learning Activities | Sample Assessments | | | | | | | | | | | | | | | | | | | | | | | | |
|--|---|--|-----|--|---------|-------------------------|---------|---|-----|----------------------------|--------------------------|---|--|------------------------|--|-----|--------------|---------|---------------|---------|---|-----|----------------------------|----------------------|---------------------|
| <p>Learning Activity #1 : (See Appendix L) Acid Rain Lab Activity- The purpose of this activity is to demonstrate the chemical reaction that occurs between water and carbon dioxide to produce carbonic acid, a contributor to acid rain. Carbonic acid production is monitored with universal indicator. Students then make conclusions about acid rain based upon the experimental results.</p> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 10px;"> <thead> <tr style="background-color: #d3d3d3;"> <th colspan="2">Activity's Alignment</th> </tr> </thead> <tbody> <tr> <td style="width: 20%;">CLE</td> <td>ES1Ba, ME1Bb, IN1Ac, IN1Ca, IN1Cb, ST3Bb</td> </tr> <tr> <td>CONTENT</td> <td>SC5, SC1, SC7, SC8, CA4</td> </tr> <tr> <td>PROCESS</td> <td>1.6 – Discover/evaluate relationships 1.7 – Evaluate information 1.8 – Organize data and ideas 1.10 – Apply information, ideas and skills 3.5 – Reason logically (inductive/deductive) 4.1 – Support decisions</td> </tr> <tr> <td>DOK</td> <td>DOK 3 – Strategic Thinking</td> </tr> <tr> <td>INSTRUCTIONAL STRATEGIES</td> <td>Similarities and differences Summarizing and note taking</td> </tr> </tbody> </table> | Activity's Alignment | | CLE | ES1Ba, ME1Bb, IN1Ac, IN1Ca, IN1Cb, ST3Bb | CONTENT | SC5, SC1, SC7, SC8, CA4 | PROCESS | 1.6 – Discover/evaluate relationships 1.7 – Evaluate information 1.8 – Organize data and ideas 1.10 – Apply information, ideas and skills 3.5 – Reason logically (inductive/deductive) 4.1 – Support decisions | DOK | DOK 3 – Strategic Thinking | INSTRUCTIONAL STRATEGIES | Similarities and differences Summarizing and note taking | <p>Assessment #1: (See Appendix M) Acid Rain Assessment</p> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 20px;"> <thead> <tr style="background-color: #d3d3d3;"> <th colspan="2">Assessment's Alignment</th> </tr> </thead> <tbody> <tr> <td style="width: 20%;">CLE</td> <td>ES1Ba, ST3Bb</td> </tr> <tr> <td>CONTENT</td> <td>SC5, SC8, CA4</td> </tr> <tr> <td>PROCESS</td> <td>1.5 – Comprehend/evaluate resources 1.6 – Discover/evaluate relationships 1.7 – Evaluate information 1.10 – Apply information, ideas and skills 3.5 – Reason logically (inductive/deductive) 3.6 – Examine solutions from many perspectives 4.1 – Support decisions</td> </tr> <tr> <td>DOK</td> <td>DOK 3 – Strategic Thinking</td> </tr> <tr> <td>LEVEL OF EXPECTATION</td> <td>Mastery Level - 85%</td> </tr> </tbody> </table> | Assessment's Alignment | | CLE | ES1Ba, ST3Bb | CONTENT | SC5, SC8, CA4 | PROCESS | 1.5 – Comprehend/evaluate resources 1.6 – Discover/evaluate relationships 1.7 – Evaluate information 1.10 – Apply information, ideas and skills 3.5 – Reason logically (inductive/deductive) 3.6 – Examine solutions from many perspectives 4.1 – Support decisions | DOK | DOK 3 – Strategic Thinking | LEVEL OF EXPECTATION | Mastery Level - 85% |
| Activity's Alignment | | | | | | | | | | | | | | | | | | | | | | | | | |
| CLE | ES1Ba, ME1Bb, IN1Ac, IN1Ca, IN1Cb, ST3Bb | | | | | | | | | | | | | | | | | | | | | | | | |
| CONTENT | SC5, SC1, SC7, SC8, CA4 | | | | | | | | | | | | | | | | | | | | | | | | |
| PROCESS | 1.6 – Discover/evaluate relationships 1.7 – Evaluate information 1.8 – Organize data and ideas 1.10 – Apply information, ideas and skills 3.5 – Reason logically (inductive/deductive) 4.1 – Support decisions | | | | | | | | | | | | | | | | | | | | | | | | |
| DOK | DOK 3 – Strategic Thinking | | | | | | | | | | | | | | | | | | | | | | | | |
| INSTRUCTIONAL STRATEGIES | Similarities and differences Summarizing and note taking | | | | | | | | | | | | | | | | | | | | | | | | |
| Assessment's Alignment | | | | | | | | | | | | | | | | | | | | | | | | | |
| CLE | ES1Ba, ST3Bb | | | | | | | | | | | | | | | | | | | | | | | | |
| CONTENT | SC5, SC8, CA4 | | | | | | | | | | | | | | | | | | | | | | | | |
| PROCESS | 1.5 – Comprehend/evaluate resources 1.6 – Discover/evaluate relationships 1.7 – Evaluate information 1.10 – Apply information, ideas and skills 3.5 – Reason logically (inductive/deductive) 3.6 – Examine solutions from many perspectives 4.1 – Support decisions | | | | | | | | | | | | | | | | | | | | | | | | |
| DOK | DOK 3 – Strategic Thinking | | | | | | | | | | | | | | | | | | | | | | | | |
| LEVEL OF EXPECTATION | Mastery Level - 85% | | | | | | | | | | | | | | | | | | | | | | | | |

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| Student Resources | Teacher Resources |
|--|---|
| <ul style="list-style-type: none"> • <u>World of Chemistry</u>, McDougal Littell © 2007 | <ul style="list-style-type: none"> • <u>World of Chemistry</u>, McDougal Littell © 2007 • http://www.esi.utexas.edu/outreach/groundwater/resources/lessons/a/cidRain.pdf |

| Identity Equity and Readiness | | | |
|-------------------------------|--|----------------------|--|
| Gender Equity | | Technology Skills | |
| Racial/Ethnic Equity | | Research/Information | |
| Disability Equity | | Workplace/Job Prep | |

| | | |
|--|--------------------------|---|
| Content Area: Science | Course: Chemistry | Strand: Science, Technology and Human Activity |
| Learner Objectives: <ul style="list-style-type: none"> • Historical and cultural perspectives of scientific explanations help to improve understanding of the nature of science and how science knowledge and technology evolve over time. ST2 • Science and technology affect, and are affected by, society. ST3 | | |

Concepts:

- A. People of different gender and ethnicity have contributed to scientific discoveries and the invention of technological innovations. ST2A
- B. Scientific theories are developed based on the body of knowledge that exists at any particular time and must be rigorously questioned and tested for validity. ST2B
- C. Social, political, economic, ethical and environmental factors strongly influence, and are influenced by, the direction of progress of science and technology. ST3B
- D. Scientific information is presented through a number of credible sources, but is at times influenced in such a way to become non-credible. ST3D

| Students Should Know | Students Should Be Able to |
|--|--|
| <ul style="list-style-type: none"> • Contributions to science are not limited to the work of one particular group, but are made by a diverse group of scientists representing various ethnic and gender groups ST2Aa • The atomic model has evolved from Dalton’s atomic theory to the current Quantum Mechanical model. • Well-designed and conducted scientific experiments increase the experimental credibility of conclusions. • The ability of other scientific investigators to replicate the results of an experiment increases the experimental credibility of the conclusions. | <ul style="list-style-type: none"> • Identify and describe how explanations (laws/principles, theories/models) of scientific phenomena have changed over time as a result of new evidence (e.g., model of the solar system, basic structure of matter, structure of an atom, Big Bang and nebular theory of the Universe) ST2Ba • Analyze the roles of science and society as they interact to determine the direction of scientific and technological progress (e.g., prioritization of and funding for new scientific research and technological development is determined on the basis of individual, political and social values and needs; understanding basic concepts and principles of science and technology influences debate about the economics, policies, politics, and ethics of various scientific and technological challenges) ST3Ba • Identify and describe major scientific and technological challenges to society and their ramifications for public policy (e.g., global warming, limitations to fossil fuels, genetic engineering of plants, space and/or medical research) ST3Bb • Evaluate a given source for its scientific credibility (e.g., articles in a new periodical quoting an “eye witness,” a scientist speaking within or outside his/her area of expertise) ST3Da |

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| | <ul style="list-style-type: none">● Explain why accurate record-keeping, openness, and replication are essential for maintaining an investigator's credibility with other scientists and society ST3Db |
|--|--|

Instructional Support

| Student Essential Vocabulary | | | | | |
|------------------------------|---------|--------------------------|---------|-------|--------|
| Peer reviewed | P value | Statistical significance | Orbital | Orbit | Proton |
| Electron | Neutron | Nucleus | | | |
| | | | | | |

| Sample Learning Activities | Sample Assessments | | | | | | | | | | | | |
|---|--|--|-----|--------------|---------|---------------|---------|--|-----|----------------------------|--------------------------|---|---|
| <p>Learning Activity #1 : (See Appendix N) The Evolution of the Atomic Model Activity- The purpose of this activity is to have the students cooperatively develop the evolution of the atomic model by researching the experiments and contributions of Dalton, Thomson, Rutherford, Bohr and the Quantum Mechanical model (Schrodinger). Students will depict the models through pictures and create mnemonic devices for easier recall. They will share their research and recall devices with other students.</p> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 10px;"> <thead> <tr style="background-color: #d3d3d3;"> <th colspan="2">Activity's Alignment</th> </tr> </thead> <tbody> <tr> <td style="width: 20%;">CLE</td> <td>ST2Ba, IN1Cd</td> </tr> <tr> <td>CONTENT</td> <td>SC8, SC7, CA3</td> </tr> <tr> <td>PROCESS</td> <td>1.5 – Comprehend/evaluate resources 1.6 – Discover/evaluate relationships 1.7 – Evaluate information 1.8 – Organize data and ideas 2.1 – Plan and make presentations 2.6 – Apply communication techniques 2.7 – Use information technology 4.6 – Identify cooperative tasks</td> </tr> <tr> <td>DOK</td> <td>DOK 3 – Strategic Thinking</td> </tr> <tr> <td>INSTRUCTIONAL STRATEGIES</td> <td>Similarities and differences Summarizing and note taking</td> </tr> </tbody> </table> | Activity's Alignment | | CLE | ST2Ba, IN1Cd | CONTENT | SC8, SC7, CA3 | PROCESS | 1.5 – Comprehend/evaluate resources 1.6 – Discover/evaluate relationships 1.7 – Evaluate information 1.8 – Organize data and ideas 2.1 – Plan and make presentations 2.6 – Apply communication techniques 2.7 – Use information technology 4.6 – Identify cooperative tasks | DOK | DOK 3 – Strategic Thinking | INSTRUCTIONAL STRATEGIES | Similarities and differences Summarizing and note taking | <p>Assessment #1: The Evolution of the Atomic Model Assessment – Use your knowledge of the atomic models developed by Bohr, Dalton, Rutherford, Schrodinger and Thomson to create a timeline to show the evolution of the atomic model. Your timeline must include 1) the scientist, 2) the major contribution to the model, 3) the experiment and conclusions that led to the major contribution to the model and 4) a pictorial and written depiction of the atomic model.</p> <div style="border: 1px solid black; padding: 10px; margin-top: 20px;"> <p><i>5 points—The timeline includes 1) the scientist, 2) the major contribution to the model, 3) the experiment and conclusions that led to the major contribution to the model, 4) a pictorial depiction of the atomic model and 5) a written depiction of the atomic model. The information is accurate for each scientist (Dalton, Thomson, Rutherford, Bohr and Schrodinger) and is in the correct time order.</i></p> <p><i>3 points – The timeline contains accurate information, but is incomplete.</i></p> <p><i>2 points – The timeline contains accurate and inaccurate information.</i></p> <p><i>0 points – The timeline only contains inaccurate information.</i></p> </div> |
| Activity's Alignment | | | | | | | | | | | | | |
| CLE | ST2Ba, IN1Cd | | | | | | | | | | | | |
| CONTENT | SC8, SC7, CA3 | | | | | | | | | | | | |
| PROCESS | 1.5 – Comprehend/evaluate resources 1.6 – Discover/evaluate relationships 1.7 – Evaluate information 1.8 – Organize data and ideas 2.1 – Plan and make presentations 2.6 – Apply communication techniques 2.7 – Use information technology 4.6 – Identify cooperative tasks | | | | | | | | | | | | |
| DOK | DOK 3 – Strategic Thinking | | | | | | | | | | | | |
| INSTRUCTIONAL STRATEGIES | Similarities and differences Summarizing and note taking | | | | | | | | | | | | |
| Assessment's Alignment | | | | | | | | | | | | | |

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|------|---|
| | Nonlinguistic representations Cooperative learning |
| ISTE | 3b – use digital tools to find and use information 3c – use digital tools to complete specific tasks |

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|----------------------|---|
| CLE | ST2Ba |
| CONTENT | SC8 |
| PROCESS | 1.8 – Organize data and ideas 1.10 – Apply information, ideas and skills |
| DOK | DOK 2 – Skill / Concept |
| LEVEL OF EXPECTATION | Mastery Level - 75% |

Learning Activity #2: (See Appendix O)

Evaluating Experiments: What Makes Research Credible? -

The purpose of this activity is to determine the key aspects of credible research. The student will read an article about an experiment that assessed subject's perspective about the credibility of online health information. After a brief lecture that identifies key aspects that support scientific credibility, students will read selected articles on the internet and evaluate their credibility based upon these key aspects.

| Activity's Alignment | |
|--------------------------|--|
| CLE | ST3Da, ST3Db, IN1Ag, IN1Dc |
| CONTENT | SC8, SC7, CA3 |
| PROCESS | 1.5 – Comprehend/evaluate resources 1.7 – Evaluate information 1.10 – Apply information, ideas and skills 2.7 - Use information technology 3.5 – Reason logically (inductive/deductive) 4.1 – Support decisions |
| DOK | DOK 3 – Strategic Thinking |
| INSTRUCTIONAL STRATEGIES | Similarities and differences Summarizing and note taking |
| | 3b – use digital tools to find and use information |

Assessment #2: (See Appendix P)

Evaluating Experiments: Does Milk Help You Lose Weight?

| Assessment's Alignment | |
|------------------------|--|
| CLE | ST3Da, ST3Db, IN1Ag, IN1Dc |
| CONTENT | SC8, SC7, CA3 |
| PROCESS | 1.5 – Comprehend/evaluate resources 1.7 – Evaluate information 1.10 – Apply information, ideas and skills 2.4 – Present perceptions and ideas 2.7 - Use information technology 3.5 – Reason logically (inductive/deductive) |
| DOK | DOK 3 – Strategic Thinking |
| LEVEL OF EXPECTATION | Mastery Level - 80% |
| | 3b – use digital tools to find and use information 4c – use digital tools to analyze data to make decisions |

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| Student Resources | Teacher Resources |
|---|--|
| <ul style="list-style-type: none"> ● World of Chemistry, McDougal Littell ©2007 ● http://jcmc.indiana.edu/vol6/issue4/eastin.html ● http://www.innutria.com/pdf/Effects%20of%20calcium%20and%20dairy%20on%20body%20composition.pdf ● http://www.nature.com/ijo/journal/v29/n8/abs/0802895a.html ● http://www.cababstractsplus.org/abstracts/Abstract.aspx?AcNo=20053209691 ● http://www.thedietchannel.com/Weight-Loss-Research.htm ● http://www.chinapost.com.tw/health/nutrition-&-fitness-/2008/05/16/156743/Dairy-doesnt.htm ● http://www.highbeam.com/doc/1G1-152258422.html | <ul style="list-style-type: none"> ● World of Chemistry, McDougal Littell ©2007, Teacher Edition ● http://jcmc.indiana.edu/vol6/issue4/eastin.html ● http://www.innutria.com/pdf/Effects%20of%20calcium%20and%20dairy%20on%20body%20composition.pdf ● http://www.nature.com/ijo/journal/v29/n8/abs/0802895a.html ● http://www.cababstractsplus.org/abstracts/Abstract.aspx?AcNo=20053209691 ● http://www.thedietchannel.com/Weight-Loss-Research.htm ● http://www.chinapost.com.tw/health/nutrition-&-fitness-/2008/05/16/156743/Dairy-doesnt.htm ● http://www.highbeam.com/doc/1G1-152258422.html |

| Identity Equity and Readiness | | | |
|-------------------------------|--|----------------------|--|
| Gender Equity | | Technology Skills | |
| Racial/Ethnic Equity | | Research/Information | |
| Disability Equity | | Workplace/Job Prep | |

Appendix

Learning Activities and Assessments

- A. Dirty Water Lab
- B. Experimental Design Evaluation Assessment
- C. Iron Nail Lab
- D. Iron Nail Lab Assessment
- E. Periodic Table Activity
- F. Investigating Chemical Reactions
- G. Reaction Type Assessment
- H. Proton, Neutron and Electron Learning Activity
- I. Atomic Structure Formative
- J. Nuclear Reactions
- K. Exothermic and Endothermic Reactions Lab
- L. Acid Rain Lab
- M. Acid Rain Assessment
- N. The Evolution of the Atomic Model Activity
- O. Evaluating Experiments: What Makes Research Credible?
- P. Evaluating Experiments: Does Milk Help You Lose Weight?