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| **Forces and Motion**  **PSc.1.1 Understand motion in terms of speed, velocity, acceleration, and momentum.** | | |
| **Objectives** | **What Learner Should Know, Understand, and Be Able to Do** | **Teaching Notes and Resources** |
| PSc.1.1.1 Explain motion in terms of frame of reference, distance, and displacement. | Interpret all motion as relative to a selected reference point. Identify distance and displacement as a scalar-vector pair. | 1.Force and Motion: Newton’s Three Laws video clip (2 minutes): <http://www.teachertube.com/viewVideo.php?video_id=143432>  2. Distance and Displacement Activity: <http://msclantonsphysicalsciencepage.weebly.com/distance-and-displacement-lab-activity-page-one.html>  3. Explanation of Distance and Displacement: <http://www.physicsclassroom.com/class/1dkin/u1l1c.cfm> |
| Describe motion qualitatively and quantitatively in terms of an object’s change of position, distance traveled, and displacement. | 1. Vectors: <http://galileoandeinstein.physics.virginia.edu/lectures/vectors.htm> |
| PSc.1.1.2 Compare speed, velocity, acceleration, and momentum using investigations, graphing, scalar quantities, and vector quantities. | Compare speed and velocity as a scalar-vector pair. Velocity is a relationship between displacement and time: | 1. Speed/Velocity Definition:  <http://examples.yourdictionary.com/examples-vector-scalar-quantity-physics.html>  2. Speed/Velocity Education Video:  <http://www.youtube.com/watch?v=6U-cOWW1z4o>  3. Speed/Velocity Comparison Video: <http://www.youtube.com/watch?v=c-iBy1-nt0M> |
| Apply concepts of average speed and average velocity to solve conceptual and quantitative problems. | 1. Khan Academy Problem Video: <http://www.khanacademy.org/science/physics/one-dimensional-motion/displacement-velocity-time/v/calculating-average-velocity-or-speed> |
| Explain acceleration as a relationship between velocity and time: | 1. Khan Academy Definition Video for Acceleration:  <http://www.khanacademy.org/science/mcat/physical-processes/acceleration-mcat/v/acceleration>  2. Acceleration Video: <http://www.physicsclassroom.com/mmedia/kinema/acceln.cfm> |
| Using graphical analysis, solve for displacement, time, and average velocity. Analyze conceptual trends in the displacement vs. time graphs such as constant velocity and acceleration. | 1. Khan Academy Definition Video Graphs: <http://www.khanacademy.org/science/physics/one-dimensional-motion/kinematic_formulas/v/deriving-displacement-as-a-function-of-time--acceleration-and-initial-velocity> |
| Using graphical analysis, solve for velocity, time, and average acceleration. Analyze conceptual trends in the velocity vs. time graphs such as constant velocity and acceleration. | 1. Khan Academy Definition Video Graphs: <http://www.khanacademy.org/science/physics/one-dimensional-motion/kinematic_formulas/v/plotting-projectile-displacement--acceleration--and-velocity> |
| Infer how momentum is a relationship between mass and velocity of an object p=mv . The focus should be on the conceptual understanding that the same momentum could be associated with a slow-moving massive object and an object moving at high velocity with a very small mass (e.g.- 100 kg object moving 1 m/s has the same momentum as a 1-kg object moving 100m/s) | 1. Khan Academy Introduction to Momentum:  <http://www.khanacademy.org/science/physics/linear-momentum/momentum-tutorial/v/introduction-to-momentum>  2.Youtube Momentum Video:  <http://www.youtube.com/watch?v=2FwhjUuzUDg>  http://www.youtube.com/watch?v=h5uceO/r/3g |
| Explain change in momentum in terms of the magnitude of the applied force and the time interval that the force is applied to the object. Everyday examples of the impulse/momentum relationship include: the use of airbags in cars; time of contact and “follow-through” in throwing, catching, kicking, and hitting objects in sports; bending your knees when you jump from a height to the ground to prevent injury. | 1. Khan Academy Momentum Continued:  <http://www.khanacademy.org/science/physics/linear-momentum/momentum-tutorial/v/momentum--ice-skater-throws-a-ball> |
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| **Forces and Motion**  **PSc.1.2 Understand the relationship between forces and motion.** | | |
| **Objectives** | **What Learner Should Know, Understand, and Be Able to Do** | **Teaching Notes and Resources** |
| PSc.1.2.1 Explain how gravitational force affects the weight of an object and the velocity of an object in free fall. | Recognize that the weight of an object is a measure of the force of gravity and is the product of its mass and the acceleration due to gravity: Fg = mg | 1. Introduction to gravity:  <http://www.khanacademy.org/science/physics/newton-gravitation/gravity-newtonian/v/introduction-to-gravity>  2. Easy Weight Comparison Activity:  <http://www.spacegrant.hawaii.edu/class_acts/Weight.html>  3. Quiz: <http://www.mathsisfun.com/measure/weight-mass.html>  4. Comparison Between Mass and Weight: <http://www.khanacademy.org/science/physics/newton-gravitation/gravity-newtonian/v/mass-and-weight-clarification>  4. Simulator: <http://phet.colorado.edu/en/simulation/mass-spring-lab> |
| With negligible air resistance, explain acceleration due to gravity as an example of uniformly changing velocity: g= 9.8 m/s2 | 1. Acceleration Due to Gravity: <http://www.khanacademy.org/science/physics/newton-gravitation/gravity-newtonian/v/acceleration-due-to-gravity-at-the-space-station> |
| Relate the presence of air resistance to the concept of terminal velocity of an object in free fall. | 1. Air resistance example:  <http://www.khanacademy.org/science/physics/forces-newtons-laws/balanced-unbalanced-forces/v/balanced-and-unbalanced-forces>  2. Program/Video of Air Resistance Explanation: <http://www.khanacademy.org/cs/modeling-air-resistance/966875281> |
| PSc.1.2.2 Classify frictional forces into one of four types: static, sliding, rolling, and fluid. | Identify friction as a force that opposes motion of an object. (Review from middle school.) | 1. Friction Lesson Plan w/ Sim:  <http://phet.colorado.edu/en/contributions/view/2846>  2. Friction Lab: <http://www.ccmr.cornell.edu/ret/modules/documents/Friction.pdf> |
| Classify the frictional forces present in a situation such as a book resting on a table (static), a box pushed across the floor (sliding), a ball rolling across the floor (rolling), a boat moving through a river (fluid), or an object in free-fall (air resistance). | 1. Friction Wiki: <http://en.wikipedia.org/wiki/Friction>  2. Rolling Friction: <http://en.wikipedia.org/wiki/Rolling_resistance>  3. Sliding Friction Lab: <http://www.pa.uky.edu/~phy211/Friction_book.html>  4.Friction Lab: <http://www.physicsclassroom.com/lab/newtlaws/NL8tg.pdf> |
| PSc.1.2.3 Explain forces using Newton’s three laws of motion. | Explain the property of inertia as related to mass - the motion of an object will remain the same (either at rest or moving at a constant speed in a straight line) in the absence of unbalanced forces; if a *change in motion* of an object is observed, there must have been a net force on the object. | 1.Intro to Newton’s Laws of Motion:  <http://www.khanacademy.org/science/physics/forces-newtons-laws/newtons-laws-of-motion/v/newton-s-1st-law-of-motion>  <http://csep10.phys.utk.edu/astr161/lect/history/newton3laws.html>  2. First Law Explanation Video: <http://www.khanacademy.org/science/physics/forces-newtons-laws/newtons-laws-of-motion/v/newton-s-first-law-of-motion-concepts> |
| Explain balanced and unbalanced forces mathematically and graphically with respect to acceleration to establish the relationship between net force, acceleration, and mass: aα F and aα 1/m (no trigonometry). Note: α is symbol for angular acceleration. | 1. Balanced and Unbalanced Forces: <http://www.khanacademy.org/science/physics/forces-newtons-laws/balanced-unbalanced-forces/v/balanced-and-unbalanced-forces>  2. Balanced/Unbalanced Lab: <https://ims.ode.state.oh.us/ODE/IMS/Lessons/Web_Content/CSC_LP_S03_BB_L08_I03_01.pdf> |
| Explain qualitatively and quantitatively the relationship between force, mass and acceleration– the greater the force on an object, the greater its change in motion; however, the same amount of force applied to an object with less mass results in a greater acceleration. | 1. NFL Learning: <https://www.nbclearn.com/nfl/cuecard/50974>  2. Second Law of Motion Video:  <http://www.khanacademy.org/science/physics/forces-newtons-laws/newtons-laws-of-motion/v/newton-s-second-law-of-motion>  3. Physics Classroom: <http://www.physicsclassroom.com/class/newtlaws/u2l3a.cfm>  4. Motion Simulation: <http://phet.colorado.edu/en/simulation/forces-and-motion-basics> |
| While the second law describes a single object, forces always come in equal and opposite pairs due to interaction between objects. Give examples of interaction between objects describing Newton’s third law – whenever one object exerts a force on another, an equal and opposite force is exerted by the second on the first. The third law can be written mathematically as FA→B = -F B→A. Students should explain why these forces do not “cancel each other out”. | 1. Third Law of Motion:  <http://www.khanacademy.org/science/physics/forces-newtons-laws/newtons-laws-of-motion/v/newton-s-third-law-of-motion>  2. Third Law of Motion Test: <http://www.khanacademy.org/science/physics/forces-newtons-laws/newtons-laws-of-motion/e/newtons-third-law>  3. Newton’s Laws Summary:  <http://www.physicsclassroom.com/class/newtlaws/u2l3a.cfm> |
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| **Matter: Properties and Change**  **PSc.2.1 Understand types, properties, and structure of matter.** | | |
| **Objectives** | **What Learner Should Know, Understand, and Be Able to Do** | **Teaching Notes and Resources** |
| PSc.2.1.1 Classify matter as: homogeneous or heterogeneous; pure substance or mixture; element or compound; metals, nonmetals, or metalloids; solution, colloid, or suspension. | Classify a sample of matter as homogeneous or heterogeneous based on uniformity of the material. | 1. Homo/Hetero Exercise:  <http://ebookbrowsee.net/classifying-mixtures-heterogeneous-or-homogeneous-student-ws-pdf-d298914691>  2. Foundations of Chemistry: <http://www.chem.memphis.edu/bridson/FundChem/T05a1100.htm>  3.Slide Show for Mixtures: [http://wiki.answers.com/Q/What\_is\_a\_heterogeneous\_and\_a\_homogeneous\_mixture? - slide=1](http://wiki.answers.com/Q/What_is_a_heterogeneous_and_a_homogeneous_mixture?#slide=1) |
| Classify a sample of matter as a pure substance or mixture based on the number of elements or compounds in the sample. | 1. Pure Substance Vs. Mixture Worksheet:  [http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&ved=0CDEQFjAB&url=http%3A%2F%2Fclassrooms.tacoma.k12.wa.us%2Fsami%2Fkhiggins%2Fdocuments%2Fdownload%2Fmatter\_packet.pdf%3Fid=71611&ei=yYvQUofQGMilsQSQ3oDwDw&usg=AFQjCNHVZj9ET6v27EnOxSqEM\_hUF](http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=2&ved=0CDEQFjAB&url=http%3A%2F%2Fclassrooms.tacoma.k12.wa.us%2Fsami%2Fkhiggins%2Fdocuments%2Fdownload%2Fmatter_packet.pdf%3Fid%3D71611&ei=yYvQUofQGMilsQSQ3oDwDw&usg=AFQjCNHVZj9ET6v27EnOxSqEM_hUF)  2. Mixtures Vs. Pure Substances Explanation:  <http://www.dummies.com/how-to/content/how-to-distinguish-pure-substances-and-mixtures.html> |
| Classify an element as a metal, nonmetal, or metalloid based on its location on the periodic table. | 1. Metalloid Explanation:  <http://chemistry.about.com/od/elementgroups/a/metalloids.htm>  2: Metal Explanation:  <http://chemistry.about.com/od/elementgroups/a/metals.htm>  3. Nonmetal Explanation:  <http://chemistry.about.com/od/elementgroups/a/nonmetals.htm>  4. Periodic Table Explanation:  <http://www.dummies.com/how-to/content/the-periodic-table-metals-nonmetals-and-metalloids.html>  5. Metals/Nonmetals/Metalloids:  <http://galileo.phys.virginia.edu/outreach/8thgradesol/Metals.htm> |
| Classify a substance as an element or compound using its chemical formula. | 1. Element Vs. Compound Explanation: <http://www.diffen.com/difference/Compound_vs_Element>  2. Element Vs. Compound Example:  [http://chemed.chem.purdue.edu/genchem/topicreview/bp/ch2/ - element](http://chemed.chem.purdue.edu/genchem/topicreview/bp/ch2/#element) |
| Classify samples and sets of matter as a solution, colloid or suspension based on the application of characteristic properties: particle size, “settling out” of one or more components, and interaction with light (Tyndall Effect). | 1. Solution, Colloid or Suspension: <http://chemistry.about.com/od/lecturenotesl3/a/colloids.htm>  2. Solution, Colloid or Suspension Video: <http://www.youtube.com/watch?v=b3HS_woWaJQ>  3. Tyndall Effect Video: <http://www.youtube.com/watch?v=E2ULbn7Uxsk>  4. Khan Academy Video:  <http://www.khanacademy.org/science/chemistry/states-of-matter/v/suspensions--colloids-and-solutions> |
| PSc.2.1.2 Explain the phases of matter and the physical changes that matter undergoes. | Develop a conceptual cause-and-effect model for the phase change process that shows the relationship among particle attraction, particle motion, and gain or loss of heat - when a solid melts it has absorbed heat that increased the potential energy of its particles (space between particles) thus reducing the attraction between particles so that they can flow in a liquid phase. (Consider conditions of normal atmospheric pressure as well as the qualitative affects of changes in pressure involving gases.) | 1. Explanation:  <http://crescentok.com/staff/jaskew/isr/chemistry/class16.htm>  2. Activity:  <http://www.oakland.k12.mi.us/portals/0/learning/kmtphasechanges.pdf>  3. Simulation:  <http://phet.colorado.edu/en/simulation/states-of-matter>  4. Khan Video:  <http://www.khanacademy.org/science/chemistry/states-of-matter/v/states-of-matter> |
| The focus should be on the following phase changes: solid to liquid (melting), liquid to gas (vaporization), gas to liquid (condensation), and liquid to solid (freezing). | 1. Phase Change Video:  <http://www.youtube.com/watch?v=0-ZWS9Wq-uc> |
| Compare the process of evaporation to vaporization – materials that evaporate versus those which do not; attraction between surface particles and colliding air molecules. | 1. Evap/Vap Video:  <http://www.showme.com/sh/?h=xn2pJkq>  2. Evap/Vap Explanation:  <http://www.differencebetween.net/science/difference-between-vaporization-and-evaporation/> |
| Recognize that the formation of solutions is a physical change forming a homogenous mixture. (Review from middle school). | 1. Solutions Wiki: http://en.wikipedia.org/wiki/Solution  2. Solution Activity:  <http://atlantis.coe.uh.edu/texasipc/units/solution/sunit.pdf> |
| Develop a conceptual model for the solution process with a cause and effect relationship involving forces of attraction between solute and solvent particles. A material is insoluble due to a lack of attraction between particles. | 1. Khan Video:  <http://www.khanacademy.org/science/chemistry/states-of-matter/v/solubility>  2. Solution Explanation:  [http://webs.anokaramsey.edu/pieper/Chem1020/Chapter 13.pdf](http://webs.anokaramsey.edu/pieper/Chem1020/Chapter%2013.pdf)  3. Solution Lab: <http://serendip.brynmawr.edu/sci_edu/farber/pdf/solution.pdf>  4. Solution Simulation: <http://phet.colorado.edu/en/simulation/sugar-and-salt-solutions> |
| Interpret solubility curves to determine the amount of solute that can dissolve in a given amount of solvent (typically water) at a given temperature. | 1. Solubility Curve Video:  <http://www.youtube.com/watch?v=D2NAw-A0V1s>  <http://www.youtube.com/watch?v=y616V7Vo2tA>  2. Understanding Solubility Curves  <http://chemwiki.ucdavis.edu/Physical_Chemistry/Physical_Properties_of_Matter/Solutions/Solubilty/Types_of_Saturation> |
| Qualitatively explain concentration of solutions as saturated, unsaturated or supersaturated; dilute or concentrated. | 1. Solubility Video: (0 min to 2min 10sec)  <http://www.youtube.com/watch?v=D2NAw-A0V1s>  2. Different Saturations Presentation:  <http://www.youtube.com/watch?v=0hfd6KwZLPM>  3. Dilute Vs. Concentrated Explanation (See Pages 1-2):  <http://ice.chem.wisc.edu/KitComponents/Samples/CompanionSample.pdf>  4. Dilute VS. Concentrated Prezi:  <http://prezi.com/1gx0vjv3cxed/solubility-and-dilute-vs-concentrated-solutions/> |
| PSc.2.1.3 Compare physical and chemical properties of various types of matter. | Calculate the density of different substances using the relationship. D=M/V | 1. Density Simulation: <http://phet.colorado.edu/en/simulation/density>  2. Density Explanation Video: <http://www.youtube.com/watch?v=VDSYXmvjg6M> |
| Compare physical properties of a mixture that could be used to separate its components such as solubility, density, boiling point, magnetic property, etc. | 1. Physical Property: <http://www.elmhurst.edu/~chm/vchembook/104Aphysprop.html>  2.Density Clarification – Physical Property:  <http://everydaylife.globalpost.com/density-considered-physical-property-rather-chemical-property-matter-31179.html>  3. Solubility Clarification Physical Property: <http://www.slideshare.net/MMoiraWhitehouse/solubility-a-physical-property>  4. Boiling Point Clarification – Physical Property:  <http://www.elmhurst.edu/~chm/vchembook/104Aphysprop.html>  5. Magnetic Properties – Physical Property:  <http://www.science.uwaterloo.ca/~cchieh/cact/applychem/propertyp.html> |
| Compare various physical and chemical properties of metals, nonmetals and metalloids such as state of matter at a given temperature, density, melting point, boiling point, luster, conductivity, ductility, malleability, color, reactivity, etc. | 1. Physical and Chemical Properties of METALS flash cards: <http://quizlet.com/14213452/chemicalphysical-properties-of-metals-flash-cards/>  2.Physical and Chemical Properties of Metals/nonmetals and metalloids quiz: <http://quizlet.com/2318314/properties-of-metalloids-metals-and-nonmetals-flash-cards/>  3. Metalloids About Page: <http://chemistry.about.com/od/elementgroups/a/metalloids.htm>  4. Metals About Page:  <http://chemistry.about.com/od/elementgroups/a/metals.htm>  5. Nonmetals About Page:  <http://chemistry.about.com/od/elementgroups/a/nonmetals.htm> |
| Compare physical and chemical properties of various everyday materials such as salt, sugar, baking soda, corn starch, rubbing alcohol, water, etc. | 1. Sugar Properties:  <http://www.ask.com/question/what-are-the-properties-of-sugar>  2. Salt Properties:  [http://wiki.answers.com/Q/What\_are\_Physical\_and\_chemical\_properties\_of\_sodium\_chloride? - slide=1](http://wiki.answers.com/Q/What_are_Physical_and_chemical_properties_of_sodium_chloride?#slide=1)  3. Baking Soda Properties:  [http://wiki.answers.com/Q/What\_are\_Physical\_and\_chemical\_properties\_of\_sodium\_chloride? - slide=1a](http://wiki.answers.com/Q/What_are_Physical_and_chemical_properties_of_sodium_chloride?#slide=1a)  4. Cornstarch Labs:  <http://www.physics.uoguelph.ca/outreach/resources/grade5/goop_5_teachersguide.pdf>  <http://ice.chem.wisc.edu/KitComponents/Samples/FwCSample_CornStarchPutty.pdf>  5. Rubbing Alcohol Properties: <http://en.wikipedia.org/wiki/Isopropyl_alcohol>  6. Water Properties:  <http://www.infoplease.com/encyclopedia/science/water-chemical-physical-properties.html> |
| PSc.2.1.4 Interpret the data presented in the Bohr model diagrams and dot diagrams for atoms and ions of elements 1 through 18. | Describe the charge, relative mass, and the location of protons, electrons, and neutrons within an atom. | 1. Periodic Table: <http://www.cnet.com.au/how-to-learn-the-periodic-table-in-three-minutes-339344400.htm>  2. Atom Intro Video: <http://www.youtube.com/watch?v=Vi91qyjuknM>  3. Khan Atom Video:  <http://www.khanacademy.org/science/chemistry/introduction-to-the-atom/v/introduction-to-the-atom> |
| Calculate the number of protons, neutrons, electrons, and mass number in neutral atoms and ions. | 1. Calculation Protons, Neutrons, Electrons:  <http://misterguch.brinkster.net/PRA007.pdf> |
| Explain how the different mass numbers of isotopes contributes to the average atomic mass for a given element (conceptual, no calculations). | 1. Atomic Mass Lab:  <http://www.brighthubeducation.com/science-lessons-grades-9-12/11042-teach-atomic-mass-concepts-isotopes-and-natural-abundance-in-chemistry-class/>  2. Definition of Atomic Mass: <http://chemwiki.ucdavis.edu/Physical_Chemistry/Atomic_Theory/Atomic_Mass> |
| Use isotopic notation to write symbols for various isotopes (ex. Carbon-12, C-12, 12C, etc.) | 1. Isotopes Definition:  <http://www.chem4kids.com/files/atom_isotopes.html>  2. Nuclear Symbol Problem:  <http://chemistry.about.com/od/workedchemistryproblems/a/isotopes-nuclear-symbols-3.htm>  3. Isotopic Notation Definition:  <http://preparatorychemistry.com/Bishop_Isotope_Notation.htm> |
| Explain Bohr’s model of the atom. | 1. Bohr’s Model Explained:  <http://www.pcs.k12.va.us/tms/periodictable/>  <http://abyss.uoregon.edu/~js/glossary/bohr_atom.html>  <http://science.sbcc.edu/physics/solar/sciencesegment/bohratom.swf> |
| Draw Bohr models from hydrogen to argon including common isotopes and ions. |
| Construct dot diagrams, a shorthand notation for Bohr models, using the element symbol and dots to represent electrons in the outermost energy level. | 1. Lewis Dot Structures Explanation: <http://www.roymech.co.uk/Related/Chemistry/Lewis_dot_structure.html>  [http://www.kentchemistry.com/links/AtomicStructure/lewis Dots.htm](http://www.kentchemistry.com/links/AtomicStructure/lewis%20Dots.htm)  3. Lewis Dot structures Practice:  <http://www.chem.ufl.edu/~itl/4411/lectures/lewis_ramyess/pjb_ramyess.html>  <http://www.chem.purdue.edu/vsepr/practice.html> |
| **Matter: Properties and Changes**  **PSc.2.2 Understand chemical bonding and chemical interactions.** | | |
| **Objectives** | **What learner Should Know, Understand and Be Able to Do** | **Teaching Notes and Resources** |
| PSc.2.2.1 Infer valence electrons, oxidation number, and reactivity of an element based on it location in the periodic table. | Predict the number of valence electrons of representative elements (A Groups or 1, 2, 13-18) based on its location in the periodic table. | 1. Valence Video:  <http://www.youtube.com/watch?v=3b8XSs73-9w>  2. Valence Lab: See Attached File |
| Predict an element’s oxidation number based on its position in the periodic table and valence electrons. (Representative groups including multiple oxidation states for tin and lead). | 1. Oxidation Cheat Sheet  <http://www.faculty.sfasu.edu/langleyricha/Chem133/OxNos.pdf>  2. Oxidation Explanation:  <http://www.youtube.com/watch?v=8_CvNPuuhiM> |
| Predict reactivity of metals and nonmetals from general periodic trends. | 1. Tool For Trends:  <http://dl.clackamas.cc.or.us/ch104bk/lesson7/periodic.htm> |
| PSc.2.2.2 Infer the type of chemical bond that occurs, whether covalent, ionic or metallic, in a given substance. | Describe how ionic, covalent, and metallic bonds form and provide examples of substances that exhibit each type of bonding. | 1. Khan Video: <http://www.khanacademy.org/science/chemistry/periodic-table-trends-bonding/v/ionic--covalent--and-metallic-bonds>  2. Bond Explanation:  <https://www.etap.org/demo/Chemistry/chem3/instruction1tutor.html> |
| Predict the type of bond between two elements in a compound based on their positions in the periodic table. |
| PSc.2.2.3 Predict chemical formulas and names for simple compounds based on knowledge of bond formation and naming conventions. | Name and write formulas for simple binary compounds containing a metal and nonmetal using representative elements (A Groups or 1, 2, 13-18) and compounds involving common polyatomic ions: ammonium (NH4+), acetate (C2H3O2-), nitrate (NO3-), hydroxide (OH-), carbonate (CO32-), sulfate (SO42-), phosphate (PO43-). | 1. Khan Video Demonstration for Balancing:  <http://www.khanacademy.org/science/chemistry/chemical-reactions-stoichiometry/v/balancing-chemical-equations>  2. Balancing Equations:  <http://www.youtube.com/watch?v+RnGu3xO2h74> |
| Name and write formulas for binary compounds of two nonmetals using Greek prefixes (mono-, di-, tri-, tetra-, etc.). |
| PSc.2.2.4 Exemplify the law of conservation of mass by balancing chemical equations. | Use coefficients to balance simple chemical equations involving elements and/or binary compounds. | 1. Khan Video Demonstration Empirical Formula:  <http://www.khanacademy.org/science/chemistry/chemical-reactions-stoichiometry/v/molecular-and-empirical-formulas>  2. Khan Video Demonstration Mass Composition:  <http://www.khanacademy.org/science/chemistry/chemical-reactions-stoichiometry/v/formula-from-mass-composition>  3. Khan Video Demonstration Mass Composition #2: <http://www.khanacademy.org/science/chemistry/chemical-reactions-stoichiometry/v/another-mass-composition-problem> |
| Conclude that chemical equations must be balanced because of the law of conservation of matter. | 1. Explanation:  <http://www.ck12.org/book/CK-12-Physical-Science-Concepts-For-Middle-School/r11/section/3.18/> |
| PSc.2.2.5 Classify types of reactions such as synthesis, decomposition, single replacement or double replacement. | Classify chemical reaction as one of four types: single replacement, double replacement, decomposition and synthesis. (Neutralization reaction is a type of double replacement reaction.) | 1. Types of Chemical Reactions:  <http://misterguch.brinkster.net/6typesofchemicalrxn.html>  2. Lab: (See GED WORK folder, doc)  3. Khan Video for Stoichiometry Understanding:  <http://www.khanacademy.org/science/chemistry/chemical-reactions-stoichiometry/v/stoichiometry> |
| Summarize reactions involving combustion of hydrocarbons as not fitting into one of these four types. Hydrocarbon + oxygen 🡪 carbon dioxide + water. | 1. Combustion Reaction Explanation:  [http://www.iun.edu/~cpanhd/C101webnotes/chemical reactions/combustion.html](http://www.iun.edu/~cpanhd/C101webnotes/chemical%20reactions/combustion.html)  2. Combustion Reaction Live Video:  <http://www.youtube.com/watch?v=UygUcMkRy_c> |
| PSc.2.2.6 Summarize the characteristics and interactions of acids and bases. | Recognize common inorganic acids including hydrochloric (muriatic) acid, sulfuric acid, acetic acid, nitric acid and citric acid. | 1. Acids:  <http://hyperphysics.phy-astr.gsu.edu/hbase/chemical/acidcom.html>  2. Khan Section of Videos (All Acid and Base Videos):  <http://www.khanacademy.org/science/chemistry/acids-and-bases> |
| Recognize common bases including sodium bicarbonate, and hydroxides of sodium, potassium, calcium, magnesium, barium and ammonium. | 1. Base – Comparison:  [http://www.chemtutor.com/acid.htm - pbase](http://www.chemtutor.com/acid.htm#pbase)  2. In Depth Acid and Base Explanation:  <http://chemistry.tutorvista.com/inorganic-chemistry/acids-bases-and-salts.html> |
| Define acids and bases according to the Arrhenius theory. | 1. Theory:  <http://www.chemguide.co.uk/physical/acidbaseeqia/theories.html> |
| Develop an understanding of the pH scale and the classification of substances therein. |  |
| Generalize common characteristics of acids and bases—pH range, reactivity with metals and carbonates (acids) or fats/oils (bases), conductivity. | 1. Explanation:  <http://chemistry.tutorvista.com/inorganic-chemistry/acids-bases-and-salts.html> |
| Relate general household uses of acids and bases with their characteristic properties. | 1. Explanation:  <https://www.sciencenter.org/chemistry/d/activity_guide_acids_bases.pdf> |
| Explain what happens in a neutralization reaction, identifying each component substance. | 1. Explanation:  <http://www.chem.memphis.edu/bridson/FundChem/T16a1100.htm>  2. Video:  <http://www.youtube.com/watch?v=64_HqEFZ_TI> |
| **Matter: Properties and Changes**  **PSc.2.3 Understand the role of the nucleus in radiation and radioactivity.** | | |
| **Objectives** | **What Learner Should Know, Understand, and Be Able to Do** | **Teaching Notes and Resources** |
| PSc.2.3.1 Compare nuclear reactions including alpha decay, beta decay, and gamma decay; nuclear fusion and nuclear fission. | Compare the characteristics of alpha and beta particles and gamma rays – composition, mass, penetrability. | 1. Khan Video Types of Decay:  <http://www.khanacademy.org/science/chemistry/radioactive-decay/v/types-of-decay>  2. Particle Explanation:  <http://www.nrc.gov/about-nrc/radiation/health-effects/radiation-basics.html> |
| Compare alpha, beta, and gamma decay processes –alpha decay reduces the mass of an atom by 4 and the atomic number by 2; beta decay increases the atomic number by 1 (a neutron decays into a proton and electron); gamma rays are electromagnetic waves released from the nucleus along with either an alpha or beta particle. | 1. Decay Process Essay:  <http://www.rsc.org/images/essay3_tcm18-17765.pdf>  2. Particle Explanation:  <http://library.thinkquest.org/3471/radiation_types_body.html> |
| Compare the processes of fission (splitting of a very large atom) and fusion (joining of atoms) in terms of conditions required for occurrence, energy released, and the nature of products. | 1. Nuclear fission vs. Nuclear fusion:  <http://chemwiki.ucdavis.edu/Physical_Chemistry/Nuclear_Chemistry/Fission_and_Fusion/Nuclear_Fission_vs_Nuclear_Fusion> |
| PSc.2.3.2 Exemplify the radioactive decay of unstable nuclei using the concept of half-life. | Conceptually explain half-life using models. | 1. Half-Life Calculation: <http://zunal.com/webquest.php?w=99019>  2. Half-Life Lab & Demonstration: <http://serc.carleton.edu/sp/library/demonstrations/examples/26461.html>  3. Khan Video Half-Life:  <http://www.khanacademy.org/science/chemistry/radioactive-decay/v/half-life> |
| Perform simple half-life calculations based on an isotope’s half-life value, time of decay, and/or amount of substance. | 1. Half-Life Problems: <http://www.mdc.edu/kendall/chmphy/nuclear/halflive.htm>  <http://go.hrw.com/resources/go_sc/ssp/HK1MSW35.PDF> |
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| **Energy: Conservation and Transfer**  **PSc.3.1 Understand types of energy, conservation of energy and energy transfer.** | | |
| **Objectives** | **What Learner Should Know, Understand, and Be Able to Do** | **Teaching Notes and Resources** |
| PSc.3.1.1 Explain thermal energy and its transfer. | Infer the ability of various materials to absorb or release thermal energy in order to conceptually relate mass, specific heat capacity, and temperature of materials to the amount of heat transferred. (Calculations with *q* = *m*Cp ΔT should be used to aid in conceptual development through laboratory investigation and analysis, not as problem-solving exercises.) | 1. Thermal Energy Explanation: <http://chemwiki.ucdavis.edu/Physical_Chemistry/Thermodynamics/State_Functions/THERMAL_ENERGY>  2. Specific Heat Virtual Lab:  <http://www.sciencegeek.net/VirtualLabs/SpecificHeatLab.html> |
| Compare thermal energy, heat, and temperature. | 1. Comparison PDF: <http://teacherweb.com/MA/ChocksettMiddleSchool/Petit/Chapter14section1.pdf> |
| Relate phase changes to latent heat that changes the potential energy of particles while the average kinetic energy of particles (temperature) remains the same. (Link to PSc.2.1.2) | 1. Latent Heat Explanation:  <https://www.boundless.com/physics/heat-and-heat-transfer/phase-change-and-latent-heat/latent-heat/>  2. Module: <http://www.nc-climate.ncsu.edu/edu/k12/.lsheat> |
| Compare conduction, convection, and radiation as methods of energy transfer. |
| PSc.3.1.2 Explain the law of conservation of energy in a mechanical system in terms of kinetic energy, potential energy and heat. | Exemplify the relationship between kinetic energy, potential energy, and heat to illustrate that total energy is conserved in mechanical systems such as a pendulum, roller coaster, cars/balls on ramps, etc. | 1. Explanation:  <http://www.dbooth.net/mhs/chem/heatandenergy01.html>  [http://resources.saylor.org/CHEM/CHEM101/Unit 6/CHEM101-6.1.1-EnergyHeatAndWork-BY-SA\_files/CHEM101-6.1.1-EnergyHeatAndWork-BY-SA.html](http://resources.saylor.org/CHEM/CHEM101/Unit%206/CHEM101-6.1.1-EnergyHeatAndWork-BY-SA_files/CHEM101-6.1.1-EnergyHeatAndWork-BY-SA.html)  3. Pendulum Understanding:  [http://www.clarkson.edu/highschool/k12/project/documents/Lesson3 - Understanding Energy.pdf](http://www.clarkson.edu/highschool/k12/project/documents/Lesson3%20%20-%20Understanding%20Energy.pdf)  4. Khan Video:  <http://www.khanacademy.org/science/physics/work-and-energy/work-and-energy-tutorial/v/conservation-of-energy> |
| Relate types of friction in a system to the transformation of mechanical energy to heat. | 1. Friction Khan:  <http://www.khanacademy.org/science/physics/work-and-energy/work-and-energy-tutorial/v/work-energy-problem-with-friction> |
| PSc.3.1.3 Explain work in terms of the relationship among the applied force to an object, the resulting displacement of the object, and the energy transferred to an object. | Explain scenarios, in which work is done, identifying the force, displacement, and energy transfer- work requires energy; when work is done on an object, the result is an increase in its energy and is accompanied by a decrease in energy somewhere else. | 1. Work Explanation:  <http://www.physicsclassroom.com/class/energy/u5l1a.cfm>  <http://hyperphysics.phy-astr.gsu.edu/hbase/work2.html> |
| Compare scenarios in which work is done and conceptually explain the differences in magnitude of work done using the relationship W= FΔd. |
| PSc.3.1.4 Explain the relationship among work, power and simple machines both qualitatively and quantitatively. | Infer the work and power relationship: | 1. Explanation:  <http://hyperphysics.phy-astr.gsu.edu/hbase/work.html> |
| Determine the component simple machines present in complex machines – categorize a wedge and screw as variations of an inclined plane; a pulley and wheel & axle as variations of a lever. | 1. Simulation:  <http://phet.colorado.edu/en/simulation/ramp-forces-and-motion> |
| Explain the relationship between work input and work output for simple machines using the law of conservation of energy. | 1. Explanation: <http://facstaff.gpc.edu/~pgore/PhysicalScience/work-energy-power.html> |
| Define and determine ideal and actual mechanical advantage: , | 1. Explanation: <http://www.jnoodle.com/ps_2/psb6.htm>  2. Khan:  <http://www.khanacademy.org/science/physics/work-and-energy/mechanical-advantage/v/introduction-to-mechanical-advantage> |
| Define and determine efficiency of machines: | 1. Explanation:  <http://formulas.tutorvista.com/physics/efficiency-formula.html> |
| Explain why no machine can be 100% efficient. |

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| **Energy: Conservation and Transfer**  **PSc.3.2 Understand the nature of waves.** | | |
| **Objectives** | **What Learner Should Know, Understand, and Be Able to Do** | **Teaching Notes and Resources** |
| PSc.3.2.1 Explain the relationships among wave frequency, wave period, wave velocity, amplitude, and wavelength through calculation and investigation. | Identify the basic characteristics of a longitudinal (compressional) wave: amplitude, rarefaction, and compression. | 1. Khan Video:  <http://www.khanacademy.org/science/physics/waves-and-optics/v/introduction-to-waves>  2. Explanation:  [http://www.chemistry.wustl.edu/~coursedev/Online tutorials/Waves.htm](http://www.chemistry.wustl.edu/~coursedev/Online%20tutorials/Waves.htm) |
| Recognize the relationship between period and frequency (focus on conceptual understanding of this inverse relationship). | 1. Explanation:  <http://www.physicsclassroom.com/class/waves/u10l2b.cfm>  2. Khan Video:  <http://www.khanacademy.org/science/physics/waves-and-optics/v/amplitude--period--frequency-and-wavelength-of-periodic-waves> |
| Explain the relationship among velocity, frequency, and wavelength and use it to solve wave problems: vw = *f λ* | 1. Explanation:  <http://www.light-measurement.com/measures-of-wave/> |
| Exemplify wave energy as related to its amplitude and independent of velocity, frequency or wavelength. | 1. Explanation:  <http://www.physicsclassroom.com/class/waves/u10l2c.cfm> |
| PSc.3.2.2 Compare waves (mechanical, electromagnetic, and surface) using their characteristics. | Classify waves as one of three types: mechanical, electromagnetic or surface waves based on their characteristics. | 1. Explanation:  <http://www.physicsclassroom.com/class/waves/u10l1c.cfm> |
| Compare different wave types based on how they are produced, wave speed, type of material (medium) required, and motion of particles. |
| PSc.3.2.3 Classify waves as transverse or compressional (longitudinal). | Compare compressional (longitudinal) and transverse waves in terms of particle motion relative to wave direction. | 1. Explanation:  <http://www.physicsclassroom.com/class/waves/u10l1c.cfm> |
| PSc.3.2.4 Illustrate the wave interactions of reflection, refraction, diffraction, and interference. | Illustrate reflection and refraction of waves at boundaries: reflection of a transverse pulse at the fixed-end of a spring or rope; reflection of sound (SONAR) and radio waves (RADAR); reflection of water (surface) waves; refraction of water waves as the depth of the water changes; sounds as it changes media; refraction of light as it passes from air into water, glass, oil, etc. | 1. Explanation:  <http://www.physicsclassroom.com/class/waves/Lesson-3/Reflection,-Refraction,-and-Diffraction>  2. Explanation:  <http://www.physicsclassroom.com/class/sound/Lesson-3/Reflection,-Refraction,-and-Diffraction>  3. Explanation:  <http://en.wikipedia.org/wiki/Sonar> |
| Illustrate the effects of wave interference (superposition)-constructive and destructive interference of surface waves, mechanical waves (sound, pulses in springs/ropes, etc.) light (soap bubbles/thin films, diffraction gratings). Emphasis on conceptual understanding-not mathematical relationships. |

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| **Energy: Conservation and Transfer**  **PSc.3.3 Understand electricity and magnetism and their relationship.** | | |
| **Objectives** | **What Learner Should Know, Understand, and Be Able to Do** | **Teaching Notes and Resources** |
| PSc.3.3.1 Summarize static and current electricity. | Identify interactions between charged objects - opposite charges attract and like charges repel. | 1. Explanation:  <http://www.physicsclassroom.com/class/estatics/Lesson-1/Charge-Interactions>  2. Khan Video:  <http://www.khanacademy.org/science/physics/electricity-and-magnetism/v/electrostatics--part-1---introduction-to-charge-and-coulomb-s-law> |
| Compare the three methods of charging objects: conduction, friction, and induction – explain the re-distribution or transfer of electrons for each method for both positively and negatively charged objects. | 1. Friction Explanation:  <http://www.physicsclassroom.com/class/estatics/Lesson-2/Charging-by-Friction>  2. Induction Explanation:  <http://www.physicsclassroom.com/class/estatics/Lesson-2/Charging-by-Induction>  3. Conduction Explanation:  <http://www.physicsclassroom.com/class/estatics/Lesson-2/Charging-by-Conduction> |
| Compare static and current electricity related to conservation of charge and movement of charge (without calculations). | 1. Comparison:  <https://learn.sparkfun.com/tutorials/what-is-electricity/static-or-current-electricity> |
| PSc.3.3.2 Explain simple series and parallel DC circuits in terms of Ohm’s law. | Interpret simple circuit diagrams using symbols. | 1. Explanation:  <http://www.bbc.co.uk/schools/gcsebitesize/science/add_aqa/electricity/circuitsrev1.shtml> |
| Explain open and closed circuits. | 1. Explanation:  <http://198.185.178.104/iss/electricity/pages/a12.xml> |
| Apply Ohm’s law and the power equation to simple DC circuits: V=IR and P=VI | 1. Explanation:  <http://www.electronics-tutorials.ws/dccircuits/dcp_2.html> |
| Compare series and parallel circuits. Conceptually explore the flow of electricity in series and parallel circuits. (Calculations may be used to develop conceptual understanding or as enrichment.) | 1. Explanation:  <http://physics.bu.edu/py106/notes/Circuits.html>  2. Khan Video:  <http://www.khanacademy.org/science/physics/electricity-and-magnetism/v/circuits--part-1> |
| Explain how the flow of electricity through series and parallel circuits is affected by voltage and resistance. | 1. Explanation:  <http://hyperphysics.phy-astr.gsu.edu/hbase/class/phscilab/electric.html> |
| PSc.3.3.3 Explain how current is affected by changes in composition, length, temperature, and diameter of wire. | Explain how the wire in a circuit can affect the current present – for a set voltage, the current in a wire is inversely proportional to its resistance (more current exists where resistance is low); the resistance of a material is an intensive property called resistivity; increasing the length of a wire increases the resistance; increasing the temperature increases the resistance; increasing the diameter of a wire decreases its resistance. | 1. Simulation:  <https://phet.colorado.edu/en/simulation/resistance-in-a-wire>  2. Explanation:  <http://www.physicsclassroom.com/class/circuits/u9l3b> |
| Explain using a cause-and-effect model how changes in composition, length, temperature, and diameter of a wire would affect the current in a circuit. | 1. Explanation:  <http://www.studymode.com/essays/What-Factors-Affect-The-Current-Flowing-65942.html> |
| PSc.3.3.4 Explain magnetism in terms of domains, interactions of poles, and magnetic fields. | Describe the characteristics and behaviors of magnetic domains. | 1. Explanation:  <http://www.ndt-ed.org/EducationResources/HighSchool/Magnetism/magneticdomain.htm> |
| Explain the attractions of unlike poles and the repulsion of like poles in terms of magnetic fields. | 1. Explanation:  <http://armymedical.tpub.com/md0950/md09500047.htm>  2. Simulation:  <http://phet.colorado.edu/en/simulation/magnet-and-compass> |
| Explain magnetic fields produced around a current-carrying wire and wire coil (solenoid). | 1. Explanation:  <http://www2.rps205.com/Parents/Academics/Learning/Science/Documents/PhysicsFirstTextbook/Chapter17.pdf> |
| Explain the relationship between strength of an electromagnet and the variance of number of coils, voltage, and core material. | 1. Explanation:  <http://abyss.uoregon.edu/~js/21st_century_science/lectures/lec04.html> |
| PSc.3.3.5 Explain the practical application of magnetism. | Explain the relationship between electricity and magnetism in practical applications such as generators and motors – the process of electromagnetic induction in electric generators that converts mechanical energy to electrical energy; transformation of electric energy to mechanical energy in motors. | 1. Explanation:  <http://www.nuffieldfoundation.org/practical-physics/electromagnetism>  2. Simulations  <http://phet.colorado.edu/en/simulation/magnets-and-electromagnets> |
| Extrapolate other practical applications such as security cards (ATM, credit or access cards), speakers, automatic sprinklers, traffic signal  triggers, seismometers, battery chargers, transformers, AC-DC adapters. | 1. Explanation:  <http://www.howmagnetswork.com/uses.html>  2. Explanation:  <http://science.howstuffworks.com/magnet4.htm> |

**Sources:**

*NC Public School Essential Standards for Physical Science*

Numerous websites identified throughout this document.