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| **VSVS Lesson** |  | **TN Grade Level Expectation** | **VSVS Learning Goals** | **NGSS Framework** |
| **\*Acids and Bases** | ***Goal:*** To introduce students to acids, bases and the pH scale.***Abstract:***Vinegar and a baking soda solution are used to introduce acids and bases. Litmus paper, red cabbage juice and phydrion paper are used to show how indicators are used to distinguish between acids and bases. Different household items (eg detergents, foods, water) are tested with litmus paper. | **7PS1.2…..** |  | PS1.A Structure and Properties of MatterPS1.B Chemical Reactions |
| **\*Alternative Energy Sources** | ***Goal:*** To help students understand solar, wind, and electrical energy as alternative sources of energy to help reduce the use of fossil fuels ***Abstract:*** Students use Snap Circuit components to make voltage and amperage measurements for (1) Rechargeable battery, (2) Hand Crank, (3) Solar panel, (4) Windmill, and (5) Liquid Battery. |  |  | ESS3.C Human Impacts on Earth SystemsPS3.B Conservation of Energy and Energy TransferPS3.D Energy in Chemical Processes and Everyday Life |
| **\*Beanie Baby Mystery** | ***Goal:***To introduce students to the use of microscopes.***Abstract:*** Students learn how to use microscopes in the context of a missing Beanie Baby™ mystery.  |  |  | Dimension 1: Scientific and Engineering Processes |
| **Bed of Nails** | ***Goal:*** To demonstrate the physics of pressure and the difference between pressure and force. ***Abstract:*** Using a bed of nails apparatus in which nails can be rearranged, students investigate the relationships between pressure and force. |  |  | PS2.A Forces and Motion |
| **Blood Typing** | See Inheritance and Blood Typing |  |  | PS2.B Types of Interactions |
| **Bottle Rockets** | ***Goal:*** To study Newton’s 3rd Law with Bottle Rockets.***Abstract:*** The flight time of two different sized bottles pumped to the same pressure is compared, then one bottle is kept empty and water is added to the second. Students experiment with varying amounts of water. |  |  | PS2.A Forces and Motion PS2.B Types of Interactions |
| **Bubbles** | ***Abstract:*** Several 3-D models are created using Zometools and dipped into a bubble mixture. The shapes of the bubbles that are formed are observed. The model is re-immersed in the solution and changes in the bubble faces observed. A straw is inserted into the center of the bubble interfaces and blown through to create an inner shape. |  |  |  |
| **Buoyancy (submarine)** | ***Goal:*** To explain the properties of density and buoyancy.***Abstract:*** Students will be engaged in a discussion that helps them grasp the idea of density as the term relates to floating vs. sinking objects. An explanation will be provided to show that mass is not the only thing that determines the density of an object. Instead, density is a function of both mass and volume.  |  |  |  |
| **\*Carbon Dioxide- Its Effect on the Environment** | *Goal:* To investigate how the acidity of water changes after carbon dioxide is bubbled through it.*Abstract:* Students observe the pH (color) changes in “ocean” water (tap water with a few drops of sodium hydroxide added) with bromothymol blue added when a piece of dry ice is added. Students are asked if they can think of consequences of dissolving increasing amount of carbon dioxide in ocean waters. *:* Students add Dry Ice to limewater and make observations. The solution first becomes cloudy because of the formation of calcium carbonate. After a few minutes, the solution clears up because of the formation of soluble calcium bicarbonate. These results are used as a basis for discussion of the formation of limestone caves. | 7PS1.6, 7ESS.1, 7ESS3.2 |  | PS1.B Chemical ReactionsESS3.C Human Impacts on Earth SystemsESS3.D Global Climate Change |
| **\*Carbon Dioxide Properties- 5th grade version****(Illustrating Physical/Chemical Changes)** | ***Goal:***To introduce students to various properties of CO2 . To illustrate that changes in phases of matter are physical changes.***Abstract:*** Students observe a piece of dry ice and a piece of H2O ice that have been placed in separate ziploc bags. The ziploc bag containing dry ice inflates from CO2 gas given off when dry ice sublimes. Students place a piece of dry ice in water and are told to record everything they observe.  |  |  | PS1.A Structure and Properties of MatterPS1.B Chemical Reactions |
| **\*Carbon Dioxide Properties – 8th grade version****(Demonstrating Phase Changes)** | ***Goal:*** To demonstrate changes of state to students using CO2 . To illustrate that changes in states of matter are physical changes. ***Abstract:***Similar to the above lesson except that the states of matter are emphasized. |  |  | PS1.A Structure and Properties of MatterPS1.B Chemical Reactions |
| **Cartesian Divers** | *Goal:* To use a pipette bulb as a ‘submarine’ to explain the properties of density and buoyancy.*Abstract:*The students will construct a variant of the Cartesian diver that involves the use of plastic blades attached to the pipette bulb that make the diver spin while traveling through the water. |  |  |  |
| **Catching Counterfeiters** | *Goal:* To demonstrate how some scientific techniques are used in finding counterfeit money and fraudulent checks.*Abstract:* Different analytical techniques, including chromatography and observation using UV light, are used to determine differences between real and fake money. |  |  |  |
| **\*Chemical Energy Conversions** | **Goal:** To help students understand the energy conversions from chemical to light, sound, mechanical and thermal energy.Abstract: The following energy conversions are studied:1. **Chemical Energy → Thermal, Light, Sound, Mechanical Energy**

 Spray flammable Lycopodium powder is sprayed into a can with a lit tea candle1. **Chemical Energy → Light energy** uses alight stick
2. **Chemical Energy → Thermal Energy** uses arecyclable hand warmer and HotHands hand warmer.
3. **Thermal Energy → Chemical Energy**

 Potassium chloride is dissolved in water – students will observe a decrease in temperature.  | ***:*6.PS3.1, 6.PS3.2** | Students understand that chemical energy is a form of potential energy that is stored in the bonds of molecules. In part:1. Students observe at least 4 chemical energy conversions
2. Students can observe the release of light energy to determine that a chemical energy conversion has occurred
3. Students can observe the release of thermal energy to determine that a chemical energy conversion has occurred.
4. Students can explain how the recyclable hand warmer illustrates the **law of conservation of energy.**
5. Students can observe the conversion of thermal energy to chemical energy
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| **\*Chemical Reactions****(Evidence for)** | *Goal:* To introduce students to 3 different types of evidence that a chemical reaction has occurred – 1) reactions that give a precipitate; 2) reactions that produce a gas; and3) reactions that involve a color change.*Abstract:* Students will learn the difference between a physical change and a chemical change, and the visual indicators (color change, gas, precipitate) that a chemical change has taken place on a microscopic level. Students mix solutions of different chemicals in a well plate and make observations.  | **7PS1.2, ,** 7.PS1.3 7.PS1.4,  | * **Students can name the different indicators that a chemical reaction has occurred.**
* **Students can identify the specific indicators of a reaction and explain how to look for them**
* **Students can analyze compounds’ reactions with one another and use that data to identify an unknown compound.**
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| **\*Chemical Reactions****(Evidence for-Green Version)** | See above. This lesson is a version of the above lesson but uses only chemicals that are readily available over the counter rather than purchased through a chemical company. | See above | See above | PS1.B Chemical Reactions |
| **\*Chemical Reactions****(Types of)** | *Goal:* To introduce students to 3 types of chemical reactions.*Abstract:* Students review the difference between a chemical and physical reaction, then do experiments that show:1.Single Replacement Reaction Students do reactions with 3 metals (Al, Zn and Fe) with copper chloride solution and observe a copper precipitation.2. Double Replacement Reaction Students add sodium phosphate to copper chloride and observe a precipitate and color change in solution.3. Decomposition Reaction – Electrolysis of Water. Students use a 9V battery and nickel electrodes to decompose water. Universal indicator is used to observe the pH changes at the electrodes. | **7PS1.2, ,** 7.PS1.3 7.PS1.4, |  | PS1.B Chemical Reactions |
| **\*Chemistry in a Ziploc Bag** | *Goal:* To give a short hands-on activity in chemistry that illustrates the importance of recording observations.*Abstract:* Anhydrous calcium chloride and baking soda solids are mixed in a Ziploc bag. Then water containing phenol red indicator is added and the bag fills gas. The students are asked to write down everything they observe (color change, heat change, expansion of bag). | **7.PS1.2, : 7.PS1.3, : 7.PS1.4: 7.PS1.5**  | * Students record observations during chemical reactions
* **S**tudents use the scientific method to design an experiment.
* Students look at chemical reaction equations to understand balanced equations and conservation of matter.
 | PS1.B Chemical Reactions |
| **\*Chromatography** | *Goal:* To use chromatography – a technique or process for separating mixtures that is used by biologists, chemists, clinical scientists, and forensics scientists (detectives). *Abstract:* After learning how to separate colors and learning the procedure for chromatography, a fun “crime solver” scenario is introduced where each group of students does a chromatogram of a specific pen to determine the writer of a ransom note by comparing their chromatogram with a chromatogram of the ink on the ransom note. | 5PSU1.4 |  | PS1.A Structure and Properties of Matter |
| **Chromatography****(Mini-Lesson)** | Shortened version of above | 5PSU1.4 |  | PS1.A Structure and Properties of Matter |
| **Chromatography of Food Colors** | *Goal:* To learn how to separate color mixtures using chromatography.*Abstract:* Students learn to identify mixtures vs. compounds. Students then test food colors and Kool-Aid with chromatography paper and observe the separation of color mixtures. | 5PSU1.4 |  | PS1.A Structure and Properties of Matter |
| **Coffee Filter Chromatography** | **Coffee Filter Chromatography***Goal:* To demonstrate a technique or process for separating mixtures that is used by scientists. *Abstract:* Students learn how to separate colors using chromatography paper, water and a green pen. Coffee filters and an assortment of colored water-soluble pens are used to make tie-dyed patterns. | 5PSU1.4 |  | PS1.A Structure and Properties of Matter |
| **\*Comets** | *Goal:*To teach studentsthe importance of and composition of comets.*Abstract:* Students investigate what comets are, where they come from and what they are made of. Students simulate a comet by combining dry ice, water, charcoal, ammonia and dirt. Students watch their comet as it gives off gas. It can be broken with a hammer to observe the inner part of the comet. Dry ice is used to simulate the tail of the comet.Comets and Asteroids are compared. | 5.ETS2.2, 5ESS1.3, 5.PS1.1 | * Students understand that a comet is leftover debris from the early formation of our solar system that orbits the sun
* Students simulate their own comet of ice, dust, and rock.
* Students observe changes in states of matter and how these transitions contribute to the formation of comets.
* Students differentiate between comets and other celestial bodies.
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| **Common Chemicals** | Chemicals are listed by their common and chemical names, formula and source. |  |  |  |
| **\*Conduction****(Mini-Lesson)** | A shortened version of lesson below. | 6PS34.4 |  | PS3.B Conservation of Energy and Energy Transfer |
| **\*Conduction, Convection and Radiation** | *Goal*: To introduce students to conduction, convection and radiation.Students discuss the difference between temperature and heat. Liquid crystal sensors are used to help students “see” conduction, convection and radiation. The liquid crystal sensor is held beside a lamp to show radiation, above a heat pack to illustrate convection. Conduction is visualized using a heat pack and copper, iron and wood strips Students visualize conduction in, using a heat pack as the heat source. Students will observe that the ice on the aluminum melts faster than on the wood or Styrofoam. | 6PS34.4 | * Students understand that adding heat energy to a medium causes an increase in temperature.
* Students explain that energy is transferred through a solid during conduction, a liquid/gas during convection, and any medium during radiation.
* Students identify different tools that can be used to measure the transfer of energy
* Students use evidence to demonstrate that metal is a better conductor than wood
 | PS3.B Conservations of Energy and Energy Transfer |
| **\*Consumerism: Paper Towel Testing** | *Goal:* To introduce students to the challenge of scientifically comparing products using objective, quantifiable information thus enabling them to make informed consumer decisions. This experiment also demonstrates the use of tests and variables (possibly as preparation for science fair projects).*Abstract:* After determining the cost per sheet (cost efficiency), absorbency (amount of liquid able to hold), and wet strength (amount of weight a wet paper towel can hold) of various paper towel brands, data are graphed and analyzed to determine which brand is the best overall bargain. Important experimental concepts such as variables and conducting a “fair test” are stressed. |  |  | Dimension 1: Scientific and Engineering Practices |
| **\*Convection Currents** | *Goal:* To introduce students to convection in liquids and gases.*Abstract*: Students observe temperature readings on a liquid crystal thermometer and use a chimney apparatus and dry ice to investigate the flow of warm and cold air. Students use a jar of rheoscopic fluid placed on a hot pack to watch the flow of rising warm fluid. An ice cube is placed in the jar to create the flow of a cold mass. | 6PS34.4 |  | PS3.B Conservation of Energy and Energy TransferPS3.B Conservation of Energy and Energy Transfer |
|  |  |  |  | LS3.A Inheritance of TraitsLS3.B Variation of Traits |
| **Cryogenic Temperatures** | *Goal:* To investigate the properties of substances at extremely cold temperatures (referred to as cryogenic temperatures) and illustrate that changes in phases of matter are physical changes.*Abstract:* Certain cryogenic properties and the effects of very low temperatures are demonstrated using liquid nitrogen, such as hammering a nail with a banana dipped in liquid nitrogen, loss of flexibility of rubber tubing placed in liquid nitrogen, and the shrinking of a blown-up balloon exposed to liquid nitrogen. The making of ice cream is also demonstrated. Many properties of nitrogen are also explored. The difference between physical and chemical changes will be learned. | **5PS1.1, 5PS1.2** | * Students understand that different materials have different freezing and melting points.
* Students identify physical and chemical changes, and make observations about how they change the properties of matter.
	+ - * Students observe, describe, and explain physical changes that occur at cryogenic temperatures
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| **CSI Nashville** | Hand held microscopes are used to analyze sands from different locations to match that “found” in a mandible from a skeleton. Color, shape, and grain size of the sands are determined. | 7 |  |  |
| **\*Deep Ocean Currents** | *Goal:*To teach students about deep ocean currents and to allow them to visualize and understand how and why the currents form. *Abstract*: Students add colored salt water to one side of a partitioned rectangular container and fresh water to the other side. Plugs in the partition are removed and students watch the flow of water. Pepper is added to the surface of the water on both sides and students observe the circulation.Students watch how 2 containers with water at different temperatures mix. | 6.ESS2.1, 6.ESS2.2,  | * Students understand the two types of ocean currents
* Students observe how manipulations of mass and volume affect density.
* Students investigate solutions with different densities and find that a lower density solution layers on top of a solution with higher density.
* Students understand and observe how density drives deep ocean currents.
* Students understand and observe how temperature drives deep ocean currents.
 | ESS2.D Weather and Climate |
| **Density** | *Goal:* To explore the concept of density.*Abstract:* Four different liquids of four different densities are used to create a “layering” effect and observe that the densest liquid is on the bottom layer. Two common plastics are observed floating or sinking in the different liquids, and can be identified as PETE or HDPE.  |  |  | PS1.A Structure and Properties of Matter |
| **\*Density of Salt Water** | *Goal:* To demonstrate the concept of density using saltwater, and to share some information about the salinity of oceans.*Abstract:* Students put beads of different densities into pure water and observe what happens to them as known amounts of salt are added. The density of the beads can be calculated. Ocean salinity is discussed. | 6.ESS2.1 | * **Students learn about salinity differences in the ocean.**
* **Students learn the definition of density, and that density is a physical property of matter.**
* **Students observe that solids (beads) of different densities float or sink depending on the density of the liquid they are in.**
* **Students observe how density of a liquid impacts beads’ ability to float.**
 | PS1.A Structure and Properties of Matter |
| **Density Column** | *Goal:* To explain the concepts governing the recycling of plastics, *Abstract:* Students find the densities of 6 different types of recyclable plastics by immersing them in solutions of differing densities.  |  |  | PS1.A Structure and Properties of Matter |
| **\*Diffusion with Dialysis Tubing** | *Goal:* To understand diffusion, the selective movement of molecules through membranes of different porosity.*Abstract:* Motion of molecules and molecular size are discussed. Dialysis tubing containing 30% glucose and a starch suspension is placed in a cup of water for 20 minutes. A glucose test is conducted after 15 minutes, using the surrounding water to determine if any glucose “leaked” out of the tubing. Iodine is then added to the water and the solution INSIDE the dialysis tubing observed for a color change. A semi-permeable membrane is demonstrated using a wire screen separating beans and rye seeds. | **7.LS1.2** | * **Students define the term “semi-permeable membrane,” give real-world examples, and demonstrate how they can be used to separate different-sized molecules**
* **Students identify different indicators that can be used to systematically test for the presence of various molecules**
 | LS1.A Structure and Function |
| **Diffusion using Agar Blocks** | *Goal:* To show students that diffusion is a fairly slow process and a cell that relies primarily on diffusion to transport essential molecules into and throughout its interior—and to carry wasted products out—could conceivably grow too large for this process to work efficiently.*Abstract:* Agar blocks (doped with phenolphthalein) of different shapes and volumes are placed in NaOH solution for about 10 minutes. They are then sliced in half and the volume of agar that has changed color (indicating the NaOH that has diffused into the block) is noted. The amount of diffusion is correlated with the block’s surface-to-volume ratio. |  |  | LS1.A Structure and Function |
| **The Edible Cell** | *Goal*: To help students understand the physiology of cells by making an edible model of plant and animal cells. *Abstract:* Students make models of plant and animal cells from bread and candy.  |  |  | LS1.A Structure and Function |
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| **Effervescent Launchers** | *Goal:* To explain the concepts of angle of trajectory vs. distance and the horizontal/vertical components of projectile motion; also to apply basic graphing and data interpretation skills to the physics of projectile motion. *Abstract*: Projectile motion is investigated using film canisters set in “launchers” and effervescent tablets. The horizontal distance the lid is “launched” to is measured and graphed, and correlated with the angle of the launcher.  |  |  | PS2.A Forces and Motion |
| **\*Electrical Circuits: Series and Parallel Circuits** | *Goal:* To learn about series and parallel circuits and their properties. *Abstract:* Students use Elenco Snap Circuit™ boards to build a simple circuit. Then they build a series circuit and a parallel circuit that include two light bulb holders. Students learn the difference in the flow of electricity in series and parallel circuits by comparing the relative brightness of bulbs and current measurements in the two circuits. | 6.PS3.1, 6.ESS3.1, 6.ESS3.2, 6.ESS3.3 | Students differentiate between static and current electricity.Students understand that electrons can flow only if the circuit is complete.Students understand how electrons flow through a circuit.Students model energy flow and energy conversions in series and parallel circuits.Students observe energy losses using a regular light bulb.Students investigate electrical energy consumption using a regular light bulb and an LED. | PS3.B Conservation of Energy and Energy Transfer |
| **\*Electrical Conductivity** | *Goal:* To measure the conductivity of solids and solutions using an LED in a snap circuit. *Abstract:* Students test the solids and liquids to determine if it is a conductor or nonconductor. |  |  | PS3.B Conservation of Energy and Energy Transfer |
| **Electricity: Resistors and Capacitors** | ***Goal:*** To learn about the function of resistors and capacitors in electric circuits.*Abstract:* Students observe the relative brightness of the LED bulb as resistors, R1, R2, and R3 are placed in the circuit in series and parallel arrangements. Students observe both the brightness and the length of time the LED is lit for C4, C3, C5, and C2 capacitors in series and parallel arrangements. |  |  | PS3.B Conservation of Energy and Energy Transfer |
| **\*Electrolysis of Water** | *Goal:*To learn about the energy conversion from electrical energy to chemical energy in the electrolysis of water.*Abstract:* Students use two nickel electrodes and a 9-volt battery to test whether any reaction occurs in distilled water. Sodium sulfate and universal indicator are added and the changes at the electrodes are observed. |  |  | PS1.B Chemical Reactions PS3.B Conservation of Energy and Energy TransferPS3.D Energy in Chemical Processes and Everyday Life |
| **\*Electromagnetism** | Snap Circuits are used to investigate electromagnetism. | 8.PS2.1 | Students understand the main ideas about magnets and electromagnets.Students understand the components necessary for making an electromagnet and the steps needed to do so.Students explore how electromagnets’ magnetic properties can be modifiedIn a motor, electric energy is converted to kinetic energy.: Students know that an electric current can be induced by using a magnet and a wire. |  |
| **\*Elements, Compounds and Mixtures** | *Goal*: To help show the differences between elements, compounds and mixtures.*Abstract*: Students compare 32 different substances and decide whether each is an element, compound or a mixture. The students will be able to make this determination based on the chemical formula or lack of chemical formula. |  |  | PS1.A Structure and Properties of Matter |
| **\*Endothermic and Exothermic Processes** | *Goal:* To help students understand endothermic and exothermic processes by using the same chemicals which are in cold and hot packs.*Abstract:* Students dissolve potassium chloride in water and observe the drop in temperature – this illustrates how a cold pack operates. Conservation of energy is illustrated through exploration of a recyclable hand warmer. Students also mix anhydrous calcium chloride with water to observe the increase in temperatures (an exothermic process). |  |  | PS1.B Chemical Reactions PS3.B Conservation of Energy and Energy TransferPS3.D Energy in Chemical Processes and Everyday Life |
| **Energy Conversions** | *Goal:* To help students understand the energy conversions between chemical, electrical, and light energy.*Abstract:*  Electrolysis of salt water illustrates the conversion of electrical to chemical energy. Solar panels are used to run a digital clock (light to electrical energy). Copper and zinc strips inserted in two lemons provide electric current for a digital clock (chemical to electrical energy). Students use a voltmeter to measure voltages produced by different metals connected to copper. A light stick is used to demonstrate the conversion of chemical to light energy. |  |  | PS3.B Conservation of energy and Energy Transfer |
| **Energy Conversions in Roller Coasters** | *Goal:* To study energy conversions, the relationship of height to potential energy, and the resulting kinetic energy.*Abstract:* Students will use a “U”-shaped track and a toy car to demonstrate that energy simply changes from one form to another, but is not lost. Students will use tubing to create roller coasters that have several hills and loops, and must function so that a BB inserted at the starting opening will travel to the end. |  |   | PS3.B Conservation of energy and Energy Transfer |
| **\*Epidemic** | *Goal:* To demonstrate how a disease spreads and how the carrier is identified.*Abstract:* Students learn the steps scientists follow to test for a disease, how to read positive and negative controls, how a disease spreads to become an epidemic, and how to identify patient zero (the carrier). This is accomplished by a simulation utilizing the exchange of liquids in a cup between students. A weak solution of sodium hydroxide is the “infected” sample and phenolphthalein is used to detect “infected” samples after all students have mixed their cup of liquid with the liquid in cups of three other students. |  |  |  |
| **Epidemic****(Mini-Lesson)** | A shortened version of the above lesson. |  |  |  |
| **The Eye** | *Goal:* To learn basic science of the eye.*Abstract:* Students will learn the parts of the eye. The function of the pupil is demonstrated by shining a flashlight by the eye. Blind spots, peripheral vision, and depth perception are also explored. |  | SPI 0707.1.3: Explain the basic functions of a major organ system | LS1.A Structure and Function |
| **Fluorescence** |  | 7ESS3.2 |  | PS4.A Wave PropertiesPS4.B Electromagnetic Radiation |
| **\*Food Chemistry** | *Goal:* To investigate basic nutrients found in foods.*Abstract:* This experiment involves: 1) testing powdered egg whites for protein; 2) testing a piece of butter for fat; 3) testing for starch by adding iodine to flour; then 4) testing five different foods to see which nutrients (protein, fat, starch) are present. | GLE 0507.9.1: Observe and measure the simple chemical properties of common substances | SPI 0507.9.1: Distinguish between physical and chemical properties | PS1.A Structure and Properties of Matter |
| **Fossils** | *Goal:* To investigate the different kinds of fossils and understand how they are formed.*Abstract:* Students make models of sedimentary rocks, trace and true fossils, using clay, Plaster of Paris and glue. | 8ESS2.3 |  | ESS1.C The History of Planet Earth |
| **\*Fossils: Index Fossils** | *Goal:*To introduce students to the geological time scale, the fossil record and index fossils. *Abstract:* The time scale is represented by 19 feet of string, color coded for the different eons and eras. Students place identify select fossils and place them in the correct era on a placemat timeline that scans the Phanerozoic Eon. | 8ESS2.3 |  | ESS1.C The History of Planet Earth |
| **Glow-in-the-Dark Slime** | *Goal:* To demonstrate phosphorescence using slime.*Abstract:* Students make slime that they can take home with them. It glows in the dark by adding zinc sulfide, a “phosphor.” | G | N  | PS4.A Wave PropertiesPS4.B Electromagnetic Radiation |
| **Gluey Putty****(4th/5th Grade)** | *Goal:* To introduce the concepts of polymers and cross-linkers and to investigate their properties.*Abstract:* Students make Gluey Putty by mixing solutions of 50% water/glue and 4% borax and then perform a number of tests to determine its properties. Polymer chains and cross-linkers are visually demonstrated by the use of student volunteers linking arms. |  |  | PS1.A Structure and Properties of Matter |
| **\*Gluey Putty** | Similar to above lesson, but students make Gluey Putty by mixing solutions of 50% glue/water (white), 80%glue (blue), or 20% glue (green) and 4% borax.Students perform a number of tests on each Gluey Putty and compare them to each other |   |  | PS1.A Structure and Properties of Matter |
| **\*Household Chemicals** | *Goal:* To identify an unknown household chemical by comparing its physical and chemical properties to those of known household chemicals.*Abstract:* Water, vinegar, iodine, and red cabbage juice are used as indicators to test known household chemicals. The results from the tests with known household chemicals are then compared with test results from an unknown household chemical in order to determine which chemical it is. |  |  | PS1.B Chemical Reactions |
| **\*Igneous Rocks** | *Goal:* To introduce students to the types of igneous rocks, how they form, and what minerals combine to form them.Abstract: Students observe intrusive and extrusive, felsic and mafic igneous rocks and the minerals found in them. Pegmatite is examined and students asked to determine what type of igneous rock their sample of pegmatite is. Students study some special **volcanic** rocks | 8ESS2.3 |  | ESS2.A Earth Materials and Systems |
| **\*Inclined Plane** | *Goal:* To learn that simple machines can multiply the force put into it.*Abstract:* Students will use screws, wedges and inclined planes to find the Mechanical Advantage of different simple machines.  |  |  | PS2.A Forces and MotionPS2.B Types of Interactions |
| **\*Inheritance and Blood Typing** | *Goal:* To introduce the students to the study of genetics through an activity dealing with blood typing *Abstract*: Students are given a scenario involving organ transplantation and use Punnett squares to predict the inheritance pattern of genes. They then participate in a blood typing simulation to confirm or nullify their predictions. | 7L3.3 | S | LS3.A Inheritance of TraitsLS3.B Variation of Traits |
| **Inheritance Patterns** | *Goal:* To introduce the students to the fundamentals of genetics and probability.*Abstract:* Students will be introduced to Punnett Squares, and an “Inheritance Game” is played incorporating Punnett Squares and flipping a penny to determine which traits are inherited. | 7LS3.1, 7LS3.2, 7LS3.3,  | * **S**tudents distinguish between the terms allele genotype, and phenotype, and can describe their role in inheritance
* Students describe the role of dominant alleles, recessive alleles, incomplete dominance, and codominance in determining phenotype
* Students understand and use Punnett Squares as a visualization tool for predicting the likelihood that an offspring will have a particular genotype
 | LS3.A Inheritance of TraitsLS3.B Variation of Traits |
| **Inheritance Patterns in “Reebops”** | *Goal:* To understand recessive and dominant traitsStudents choose chromosome sets from 2 parents and create their offspring using marshmallows and candy. | 7LS3.1, 7LS3.2, 7LS3.3,  | * **S**tudents distinguish between the terms allele genotype, and phenotype, and can describe their role in inheritance
* Students describe the role of dominant alleles, recessive alleles, incomplete dominance, and codominance in determining phenotype
* Students understand and use Punnett Squares as a visualization tool for predicting the likelihood that an offspring will have a particular genotype
 | LS3.A Inheritance of TraitsLS3.B Variation of Traits |
| **\*Inheritance Patterns in Dragons** | *Goal:* To understand recessive and dominant traitsStudents choose chromosome sets from 2 parents and create their dragon offspring using different shapes of feet, wings, horns, flames etc. | 7LS3.1, 7LS3.2, 7LS3.3,  | * **S**tudents distinguish between the terms allele genotype, and phenotype, and can describe their role in inheritance
* Students describe the role of dominant alleles, recessive alleles, incomplete dominance, and codominance in determining phenotype
* Students understand and use Punnett Squares as a visualization tool for predicting the likelihood that an offspring will have a particular genotype
 | LS3.A Inheritance of TraitsLS3.B Variation of Traits |
| **\*Inheritance Patterns in Crazy Traits** | To understand some basic principles of heredity by building creatures determined by flipping a coin for different traits.This lesson was adapted from CPO Crazy Traits Lesson.Students choose chromosome sets from 2 parents and create offspring. | 7LS3.1, 7LS3.2, 7LS3.3,  | * **S**tudents distinguish between the terms allele genotype, and phenotype, and can describe their role in inheritance
* Students describe the role of dominant alleles, recessive alleles, incomplete dominance, and codominance in determining phenotype
* Students understand and use Punnett Squares as a visualization tool for predicting the likelihood that an offspring will have a particular genotype
 | LS3.A Inheritance of TraitsLS3.B Variation of Traits |
| **\*Iron in Cereal** | *Goals:* To learn the difference between elements, compounds, and mixtures by studying the different forms of iron. To explain why iron is useful in the diet, and to demonstrate how iron is used by the body.*Abstract:* Students look at 3 different vials containing elemental iron, iron oxide and a mixture of sand and magnetite. Students observe the differences in the formulas and perform tests to show different chemical behaviors. Students use the magnetic property of elemental iron to remove iron particles from one serving of a cereal that provides 85-100% of the Recommended Daily Amount for adults (18 mg). Since our bodies can’t use elemental iron, students learn through demonstrations how elemental iron is oxidized to iron ions.  | 5PS1.4 |  | PS1.A Structure and Properties of Matter |
| **K’Nex Engineering** | *Goal:* To introduce students to processes in engineering and demonstrate Newton’s third law of motion.*Abstract:* This is an inquiry activity in which students work in teams to design, build and test balloon-powered cars using K’nex™ pieces. |  |  | PS2.A Forces and MotionETS1.A Defining and Delimiting an Engineering Problem |
| **Lab Cart** | Newton’s Laws |  |  |  |
| **Lactose Intolerance** | *Goal:* To show students that the enzyme lactase breaks down lactose into glucose and galactose, which are easily digested by humans.*Abstract*: Students test regular milk and lactose-free milk with glucose strips. The regular milk is then treated with lactase and tested again to show that the enzyme breaks down the lactose. Other milk products are tested as well as soy milk. |  |  | LS1.A Structure and Function |
| **\*Light** | *Goal:* To demonstrate reflection of light, diffraction, and total internal reflection.*Abstract:* Mirrors, diffraction gratings and laser pointers are used to study absorption, scattering, reflection and refraction of light. The topic of internal reflection is introduced and studied with fiber optics cables. | 8PS4.1, 8PS4.2 | * Students should know the following:What is a wave? How do waves behave?
* Students will learn how waves behave by studying reflection, refraction and diffraction.
* Students will know what “laser” stands for and how a laser is used safely.
 | PS4.A Wave Properties |
| **Magic Sand** | *Goal:* To learn about “water-loving” (hydrophilic) and “water-hating” (hydrophobic) substances by using sand and coated sand (Magic Sand).*Abstract:* Observations are compared between the behavior of sand and Magic Sand when exposed to water in order to demonstrate hydrophobic and hydrophilic properties. Nanoscience technology is introduced | 5.ETS2.2, 5. ETS2.3, 5.PS1.4, | * At the nanoscale, many ordinary materials have different and unusual properties, compared with the same material at the macro level.
* Students understand the difference between macroscale and nanoscale and can classify these objects by size.
* Magic Sand has a nanoscale layer of a hydrophobic coating and behaves differently from regular sand.
* Students explore how the hydrophobic properties of Magic Sand keeps itself and other objects dry.
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| **\*Minerals** | *Goal:* To introduce students to some of the tests that geologists use to determine the properties of minerals.*Abstract:* Students will perform tests on some common minerals and record data about their properties. Tests performed include: streak, hardness, cleavage, magnetism and an acid test. | 8ESS2.3 |  | ESS2.A Earth Materials and Systems |
| **Minerals and Crystals** | *Goal***:** To develop an understanding of the characteristics of crystalline structure of minerals. *Abstract:* Students will observe crystalline structures in salt and Epsom salt, then use description cards to try to identify the crystal structure types of 5 given minerals.  |  |  | ESS2.A Earth Materials and Systems |
| **Minerals and Their Everyday Uses** | *Goal:* To help students think about where materials come from and to understand the importance of minerals in many products we use every day*Abstract:* The students will discover the everyday use of minerals and mineral resources by 1) recognizing characteristics of a few important minerals, and 2) matching minerals with their common-day materials and uses.  | 8ESS2.3 |  | ESS3.A Natural Resources |
|  |  |  |  |  |
| **\*Minerals, Density of** | *Goal:* To show students that the density is a unique property of a mineral.*Abstract:* Students willdetermine the density of mineral samples by using a spring balance to measure mass, and water displacement to measure volume. |  |  | ESS2.A Earth Materials and Systems |
| **Nanotechnology and Magnetism** | **Goal:** To introduce students to nanotechnology and new magnetic products (ferrofluids). *Abstract*: Students review properties of magnets and then compare the magnetic properties of lodestone, iron oxide powder, iron oxide powder in a liquid, and ferrofluid. Students are introduced to nanoscience and categorize objects into Macro, Micro and Nanoscale. The tools needed to observe small-sized objects are introduced.  | 8.ETS1.1, 8.ETS1.2, 8PS2.1 | * Students can identify the main magnetic properties and know what permanent, temporary, and induced magnets are.
* Students understand what ferrofluid is and why it is different from the powdered iron oxide that isn’t nano.
* Students understand the difference between the macro, micro, and nanoscale and can classify different objects as belonging to one of the categories.
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| **Newton’s Second Law****(Rubber Band Projectiles)** | *Goal*: To allow students to discover a relationship between the input force and the relationship (Newton’s Second Law of Motion.*Abstract*: The lesson consists of two different trials. In the first trial, the mass of the projectile block will be held constant and the input force varied by using one, two, and three rubber bands to launch the block. In the second trial, the input force will be held constant by selecting only one or two rubber bands to launch projectiles of three separate masses, 5, 10, and 20 grams each. The focus of the two trials is to observe what happens to acceleration and distance traveled when the input force increases with one mass and when the mass increases with one input force. |  |  | PS2.A Forces and Motion PS2.B Types of Interactions |
| **Oh Deer** | *Goal:* To help students understand the importance of suitable habitat for animal populations and recognize factors that may affect wildlife populations in changing ecosystems.*Abstract:* An ecosystem is simulated in which students are either deer or natural resources (food, water, shelter). Each “deer” that reaches its necessary habitat resource person takes the "food”, "water”, or "shelter” back to the deer side of the line. This represents the deer successfully meeting its needs and these deer return to the deer line for the next round. By meeting its needs, a deer "reproduces”, and the resource person becomes another deer for the next round. Any deer that fails to find its food, water, or shelter dies and becomes part of the habitat.  |  |  | LS2.A Interdependent Relationships in Ecosystems  |
| **Oil Spill** | *Goal:* For students to find the quickest and most cost effective method of cleaning an oil spill in an ocean-like environment.*Abstract:* A guided inquiry activity in which students choose various apparatus to clean a simulated oil spill. The students are constrained by budget and effectiveness of the approaches to clean the oil spill. |  |  |  |
| **\*Optical Illusions** | *Goal:* To study different features of the eye using optical illusions.*Abstract:* Peripheral vision and Moire patterns, persistence of vision using a slit camera and thaumatropes, the “hole in hand” illusion and an illusion of overlapping spots, and color blindness is all explored. |  |  | LS1.A Structure and Function |
| **\*Osmosis in Potato Slices** | *Goal:* To show that osmosis occurs when potato slices are placed in salt and deionized water.*Abstract:*  Students observe how a potato slice acts after it has soaked in de-ionized water and salt water. Students look at the effect of salt on sodium polyacrylate that has had water added to it. |  |  | LS1.A Structure and Function |
| **\*Oxidation of Iron** | *Goal:* To have students observe rusting of iron in a 15 minute time period. Students will  observe that the reaction is an oxidation reaction, that it can be classified as a combination reaction. Evidence that a chemical reaction has taken place is observed.*Abstract:* Oxidation, Combination reaction, and Rusting are defined.Students place iron filings on top of a piece of cotton and add hydrogen peroxide and salt to them. Rusting of the filings is noticeable in 5 minutes.Students add hydrogen peroxide and salt to a small piece of steel wool in a plastic bag. The temperature of the solution is recorded at the beginning and after 10 minutes. The solution turns orange and a gas is given off. Students look at the equation for oxidation of iron. |  |  | PS1.B Chemical Reactions |
| **Packing Peanuts****(Mini-Lesson)** | *Goal:* To run tests on two different types of packing peanuts to determine which one is more environmentally friendly.*Abstract:* Students will learn the definition of “biodegradable” – one of the packing peanuts is biodegradable and the other is not. Iodine solution is used to test for starch, since the packing peanut containing cornstarch is the biodegradable one. Students will then observe that the biodegradable peanut dissolves in water after approximately two minutes, making it much more environmentally friendly. |  |  |  |
| **pH** | *Goal:* To introduce students to acids, bases and the pH scale.*Abstract:* Students should thoroughly understand the pH scale after this experiment. Color changes for standard solutions are observed using red cabbage juice, then common household items are tested using red cabbage juice. Acidic and basic solutions are identified through comparison with the color changes observed for standard solutions. |  |  | PS1.A Structure and Properties of MatterPS1.B Chemical Reactions |
| **Phosphorescence and Fluoroscence** | *Goal:* To show students the difference between phosphorescence and fluorescence.*Abstract:*  Students are given a variety of materials to determine if they phosphoresce or fluoresce. Students place the material in a small box and irradiate it with a blacklight. The lid of the box is closed and the materials viewed through a slit in the lid to see if it is still glowing. Students use different colored filters to block high energy light from reaching a phosphorescent material and observe what kind of light is needed to cause phosphorescence.  | . |  | PS4.A Wave Properties PS4.B Electromagnetic Radiation |
| **Pinhole Optics** | *Goal:* To learn how a pinhole affects how we see things using a pinhole magnifier and pinhole camera. *Abstract:* Students learn that a pinhole in an index card can act like a magnifying glass, helping your eye focus on an object that is very close to you. Students then make a pinhole camera. |  |  | LS1.A Structure and Function |
| **Polymer Chemistry** | *Goal:* To introduce the concepts of polymers and cross-linkers and to investigate their properties.*Abstract:* Activities use student volunteers to help students understand the difference between solids, liquids, and gases, and to illustrate how polymers are formed from monomers. Students make slime and study its properties.See also Gluey Putty. | 5PS1.1, 5PS1.4 |  | PS1.A Structure and Properties of Matter |
| **Polymer Strand****(Mini-Lesson)** | *Goal:* To use a common food thickener additive to form a polymer strand.*Abstract:* Students will learn the concept of polymers, and how many smaller molecules fit together to form a larger molecule. In this experiment, sodium alginate and calcium chloride are mixed together to form a long, stringy polymer. |  |  | PS1.A Structure and Properties of Matter |
| **\*Potential Energy**  | *Goal:* To show that gravitational potential energy is related to the height and mass of an object. To investigate different forms of potential energy.*Abstract:* Three demonstrations (using a Tennis ball/Dropper Popper, an Astroblaster, and a Newton’s Cradle)are shown to illustrate the conversion of potential energy to kinetic energy and the conservation of energy. Students measure the distance a block of wood is moved as the starting height of the ramp (and therefore the potential energy of the ball) is changed. Students use two balls of different mass and measure the distance traveled by the wood block after it has collided with each ball. | 6PS3.1, 6PS3.2, 6PS3.3 | * Students identify examples of potential and kinetic energy in the real world.
* Students understand conservation of energy and how energy can be converted between potential and kinetic.
* Students use a ramp to understand how height and mass are related to potential energy.
* Students use a ramp to understand how height and mass are related to potential energy.
 | PS3.B Conservation of Energy and Energy Transfer |
| **Powers of 10** | Students are shown cubes whose volume increases by a power of ten. They are given a picture and told to draw a portion of it ten times larger.  |  |  |  |
| **\*Properties of Waves** | *Goal:* To investigate properties waves by studying reflection, diffraction and refraction of light.*Abstract:* A String-it wave machine is used to show the amplitude, crest, trough and wavelength of waves. Students use a laser pen, a mirror, and a popsicle stick to trace the path of the red laser beam when the pen is shone onto the mirror. Refraction is demonstrated in using a jar of water and a straw. Diffraction is observed using diffraction gratings and CD’s. Students will learn a “magic” trick (penny in water) using the concept of refraction. | 8PS4.1, 8PS4.2 | * Students should know the following:What is a wave? How do waves behave?
* Students will learn how waves behave by studying reflection, refraction and diffraction.
* Students will know what “laser” stands for and how a laser is used safely.
 | PS4.A Wave Properties |
| **\*Pulleys** | *Goal:* To understand how pulleys can be used to lift objects; to understand the mechanical advantage of different pulley systems.*Abstract:* A single fixed pulley, single movable pulley, single fixed pulley with single movable pulley, and double fixed pulley with single movable pulley are used to lift a 200-g weight and a spring balance reading is used to determine which system of pulleys lifted the weight with the least effort. |  |  |  |
| **\*Rates of Chemical Reactions** | *Goal:* To understand factors that affect the rates of chemical reactions - temperature, concentration of reacting substances in solutions, surface area (particle size) of solids in reactions with gases and liquids, and catalysts.*Abstract:* Students observe how fast bubbles of carbon dioxide are produced when room-temperature water and ice water are added to effervescent tablets in dry cups. Students observe the difference in the height of bubbles of carbon dioxide produced when two different concentrations of vinegar are added to baking soda. Students observe the effect of a catalyst on the rate of decomposition of hydrogen peroxide by seeing the bubbles of oxygen produced when manganese dioxide and a potato slice are added to hydrogen peroxide. Students observe how fast bubbles of carbon dioxide are produced when water is added to a whole tablet versus a crushed tablet in dry cups. The effects of surface area are demonstrated by spraying lycopodium powder into the flame of the tea candle, which produces a large flame; then, using a similar technique, the lid is blown off of a coffee can.  | 5PS1.3, 5PS1.4 |  | PS1.B Chemical Reactions |
| **Rates of Chemical Reactions using Chalk** | *Goal:* To understand factors that affect the rates of chemical reactions - temperature, concentration of reacting substances in solutions, surface area (particle size) of solids in reactions with gases and liquids, and catalysts.*Abstract:* Students observe how fast bubbles of carbon dioxide are produced when room-temperature vinegar and warm vinegar are added to chalk pieces in test tubes. Students observe the difference in the rate of bubbles of carbon dioxide produced when two different concentrations of vinegar are added to chalk pieces. Students observe the effect of a catalyst on the rate of decomposition of hydrogen peroxide by seeing the bubbles of oxygen produced when manganese dioxide and a potato slice are added to hydrogen peroxide. Students observe how fast bubbles of carbon dioxide are produced when vinegar is added to a piece of chalk versus crushed chalk in test tubes. The effects of surface area are demonstrated by spraying lycopodium powder into the flame of the tea candle, which produces a large flame; then, using a similar technique, the lid is blown off of a coffee can.  |  |  | PS1.B Chemical Reactions |
| **Rates of Chemical Reactions using Popping Film Canisters** | *Goal:* To correlate changes in the time it takes to pop a film canister with experimentalvariables. *Abstract:* A standard fun activity is to place a piece of alka seltzer tablet in a film canister with some water, and hold the canister until the lid pops off. This activity is based on measuring the length of time it takes for the lid to pop off when different conditions are present.  |  |  | PS1.B Chemical Reactions |
| **\*Refraction and Absorption** | *Goal:*  To introduce the concepts of refraction and absorption.*Abstract:* Refraction is demonstrated in using a jar of water and a straw. Students use red lasers to study cases where light does or does not refract. Students use differently colored filters and red and green laser pointers to study the absorption of light.  |  |  | PS4.A Wave Properties |
| **The Rock Cycle****(Game)** | *Goal*: To understand what factors cause rocks to break down and change.*Abstract:* Students roll word cubes to get directions to move through the different geologic states. A collection of 18 rocks and fossils that illustrate the type of rock (Sedimentary, Metamorphic, Igneous). Each rock has a card describing it and a colored picture showing where it may be found |  |  | ESS2.A Earth Materials and SystemsESS2.B Plate Tectonics and Large-Scale System Interactions |
| **\*Rusting** | *Goal:* To introduce students to common metals and investigate their oxidation. To investigate the rusting of iron.*Abstract:* Students investigate the conditions needed for rusting of iron. They use iron filings exposed to air, iron filings exposed to water, and iron filings exposed to salt and hydrogen peroxide. Students discuss ways that are commonly used to prevent iron from rusting. They compare the rate of rusting of a regular, a galvanized (zinc coated), and a brass coated nail, and a ceramic coated screw put into salt and hydrogen peroxide. | GLE 0507.9.1: Observe and measure the simple chemical properties of common substancesGLE 0807.9.3: Interpret data from an investigation to differentiate between physical and chemical changesGLE 0807.9.4 Distinguish among elements compounds and mixturesGLE 0807.9.8: Interpret the events represented by a chemical equation | SPI 0807.9.2: Identify the common outcome of all chemical changesSPI 0807.9.8: Interpret the results of an investigation to determine whether a physical or chemical change has occurred SPI 0507.9.1: Distinguish between physical and chemical propertiesSPI 0807.9.4 Differentiate between a mixture and a compoundSPI 0807.9.9 Identify the reactants and products of a chemical reaction. | PS1.B Chemical Reactions |
| **Solar Energy** | *Goal:* To help students understand the potential of solar energy as an alternate energy source.*Abstract:* Students connect a solar cell to a digital clock and observe that the clock works.Students observe that the calculator has solar cells and when they are covered up, the calculator doesn’t work. Students measure voltage of solar panels-one is wired in parallel and one is wired in series. Students hook up the fan motor to both solar panels to see which one runs the fan motor. |  |  | PS3.B Conservation of Energy and Energy Transfer |
| **\*Sound and Resonance** | *Goal:*To introduce students to tuning forks, resonance, and the speed of sound.*Abstract*: Students perform experiments to discover the relationship between the frequency of a tuning fork and the length of a tube that it will resonate with.  | : 8.PS4.1,, 8PS4.2 |  | PS4.A Wave Properties |
| **Sound and Vibrations** | *Goal:* To use hands-on activities to investigate the properties of sound as it moves through air and different types of solids.*Abstract*: Students use a variety of materials to investigate vibrations. | : 8.PS4.1,, 8PS4.2 |  | PS4.A Wave Properties |
| **Stratigraphy** | *Goal:* To teach students the how to determine the relative ages of sedimentary rock layers. Students will create a geological column which includes fossils and an igneous layer.*Abstract:* Students are introduced to the concepts of relative dating and absolute dating. Index fossils are used and the Principle of Faunal Succession is explained. The Law of Original Continuity is explained and used to correlate continuous layers. Students correlate 3 short stratigraphic columns. | 8ESS2.3 |  | ESS1.C The History of Planet Earth |
| **Stream Pollution** | *Goal:* To learn how pollution runoff can cause a fish kill by affecting the pH of different locations on a model river. *Abstract:*  Students look at a 3-D model of a town and its surrounding country and coordinate their map with the model so that they understand where everything is on the model. A fish-kill has occurred in the stream and the students use their knowledge of run-off, pH and pollution to determine where the point of pollution has occurred. | Embedded Inquiry for all grades | Embedded Inquiry for all grades | ESS3.C Human Impacts on Earth Systems |
| **Sunscreen** | *Goal:* To teach students how sunscreen and other materials block UV light.*Abstract:* UV disks are exposed to UV light from a black light and are “painted” with a layer of sunscreen to observe if the sunscreen actually blocks the transmission of the UV light. The lenses of sunglasses, milk bottles, and t-shirts are also tested for their effectiveness in blocking UV rays. | 7ESS3.2 |  | PS4.A Wave PropertiesPS4.B Electromagnetic Radiation |
| **\*Survivor** | Goal: Uses CPO Crazy Traits materials to build creatures with different traits. 11 different catastrophic scenarios are introduced and creatures given points if they are able to survive. | 88LS4.3, 8LS4.4 |  |  |
| **Taste** | *Goal:* To examine the sense of taste.*Abstract:* Students try to identify a jelly bean flavor when it is placed on the center of their tongue, with their eyes closed, and when they can’t smell. Cotton swabs are dipped in sweet, sour, salty and bitter samples and placed on different areas of the tongue to determine which regions best detect certain flavors. A PTC taste test is optional. | GLE 0707.1.3: Describe the function of different organ systems | SPI 0707.1.3: Explain the basic functions of a major organ system | LS1.A Structure and Function |
| **\*Ultraviolet Light** | *Goal:*To study the properties of ultraviolet light (UV light). To test the ability of various substances to absorb UV light.*Abstract:* Students observe where UV light occurs in the electromagnetic spectrum. Students use black lights to detect fluorescence from Chlorox2, and narra wood. Students test a variety of materials to determine what materials will block UV light.Students make a bracelet from UV detecting beads. | 7ESS3.2 |  | PS4.A Wave PropertiesPS4.B Electromagnetic Radiation |
| **Universal Indicators** | *Goal:* To help students understand natural indicators and pH.*Abstract:* Students will learn about acids, bases, and the pH scale. The natural indicators used in the lesson are: cranberry juice, grape juice, elderberry jam, blueberry jam, and turmeric. | GLE 0507.9.1: Observe and measure the simple chemical properties of common substances | SPI 0507.9.1: Distinguish between physical and chemical properties | PS1.A Structure and Properties of Matter |
| **Vitamin C Testing** | *Goal:* To teach students how to determine the Vitamin C content in different substances.*Abstract:* Students perform a “titration” to determine the amount of Vitamin C in different juices. A standardized curve will be produced using the solutions with known Vitamin C concentrations. The juices with unknown Vitamin C concentrations can then be compared to the standard curve to determine their Vitamin C content. A starch solution is used as an indicator because it turns blue-black in the presence of iodine but not iodide ion.  | GLE 0807.9.3: Interpret data from an investigation to differentiate between chemical and physical changesPS CLE 3202.1.4 Investigate chemical and physical changes | SPI 0807.9.8: Interpret the results of an investigation to determine whether a physical or chemical change has occurred | PS1.B Chemical Reactions |
| **Water Quality** | *Goal:* To show different methods of testing the quality of water found in pools, spas, and faucets. The students will be testing for chlorine and pH.*Abstract:* Students learn about common contaminants and the importance of frequent testing. The concept of parts per million (ppm) is introduced by using successive dilutions of a red food dye solution. A pool kit is used to test chlorine standards and water samples from drinking fountains, water faucets, and swimming pools. The pool kit is also used to test the pH of these samples. | Embedded Inquiry for all grades | Embedded Inquiry for all grades | PS1.A Structure and Properties of Matter |