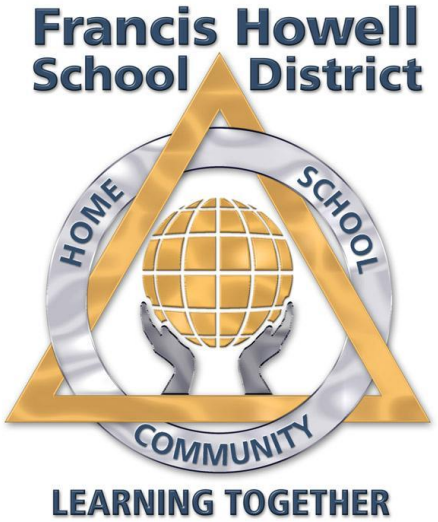
Physical Science 8th Grade

Curriculum



Board Approved:

Francis Howell School District

Mission Statement

The mission of the Francis Howell School District is to prepare students today for success tomorrow.

Vision Statement

Every student will graduate with college and career readiness skills.

Values

Francis Howell School District is committed to:

- Providing a consistent and comprehensive education that fosters high levels of academic achievement
- Operating safe and well-maintained facilities
- Providing a safe learning environment for all students
- Promoting parent, community, student, and business involvement in support of the school district
- Ensuring fiscal responsibility
- Developing responsible citizens
- Operating as a professional learning community
- Making appropriate use of technology

Francis Howell School District Graduate Goals

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

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

Science Graduate Goals

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

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

Physical Science 8th Grade Course Rationale

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

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

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

Physical Science 8th Grade Course Description

This course is the first year of a two-year sequence for Physical Science students completed by Physical Science 9th Grade. Grade 8 Physical Science will allow students to investigate and apply scientific processes through inquiry, research, and hands-on activities. Students will have the opportunity to use technology and experimentation in the study of the following areas: scientific inquiry, process skills, properties of matter, forms of energy: light, sound, heat, and electricity and magnetism, energy and transformations, force and motion, Newton's Laws, and the history and scientists that have contributed to these areas of study. As the content becomes more rigorous, the students begin to complete formal lab reports and reflections on the engineering process.

Physical Science 8th Grade Curriculum Team

Curriculum Committee

Ellen Hall	Saeger Middle School
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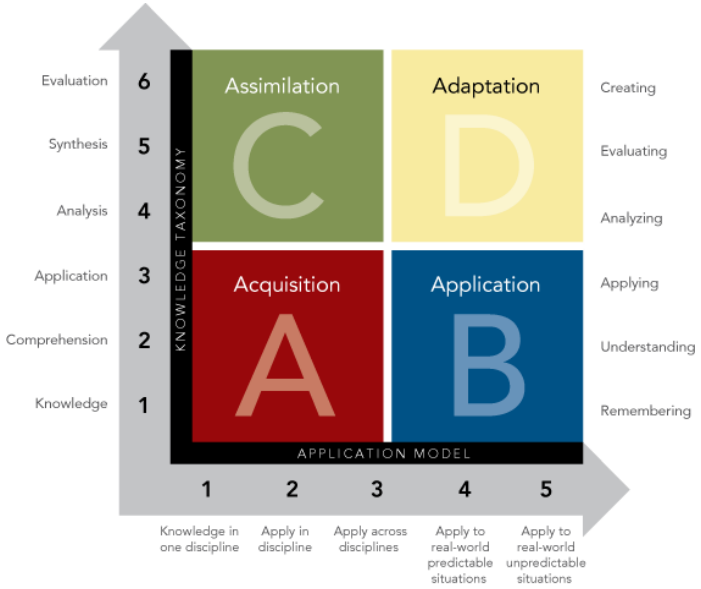
Curriculum Notes

All FHSD performance tasks and sample learning activities are aligned not only to understandings and standards, but also the Rigor and Relevance Framework and 21st Century Skills. Information on these two things is provided below or by clicking on the hyperlinks.

Rigor and Relevance Framework

The Rigor/Relevance Framework is a tool developed by the International Center to examine curriculum, instruction, and assessment along the two dimensions of higher standards and student achievement.



The Rigor/Relevance Framework has four quadrants.
Quadrant A represents simple recall and basic understanding of knowledge for its own sake. Examples of Quadrant A knowledge are knowing that the world is round and that Shakespeare wrote Hamlet.

Quadrant C represents more complex thinking but still knowledge for its own sake. Quadrant C embraces higher levels of knowledge, such as knowing how the U.S. political system works and analyzing the benefits and challenges of the cultural diversity of this nation versus other nations.

Quadrants B and D represent action or high degrees of application. Quadrant B would include knowing how to use math skills to make purchases and count change. The ability to access information in wide-area network systems and the ability to gather knowledge from a variety of sources to solve a complex problem in the workplace are types of Quadrant D knowledge.

A	B	C	D
Students gather and store bits of knowledge and information. Students are primarily expected to remember or understand this knowledge.	Students use acquired knowledge to solve problems, design solutions, and complete work. The highest level of application is to apply knowledge to new and unpredictable situations.	Students extend and refine their acquired knowledge to be able to use that knowledge automatically and routinely to analyze and solve problems and create solutions.	Students have the competence to think in complex ways.

21st Century Skills

These skills have been pared down from 18 skills to what are now called the 4Cs. The components include critical thinking, communication, collaboration, and creativity. Critical thinking is focused, careful analysis of something to better understand and includes skills such as arguing, classifying, comparing, and problem solving. Communication is the process of transferring a thought from one mind to others and receiving thoughts back and includes skills such as choosing a medium (and/or technology tool), speaking, listening, reading, writing, evaluating messages. Collaboration is working together with others to achieve a common goal and includes skills such as delegating, goal setting, resolving conflicts, team building, decision-making, and managing time. Creativity is expansive, open-ended invention and discovery of possibilities and includes skills such as brainstorming, creating, designing, imagining, improvising, and problem-solving.

Standards

Standards aligned to this course can be found:

6 - 12 Missouri State Science Standards
Missouri Science Standards 6-12

Next Generation Science Standards
Next Generation Science Standards

National Educational Technology Standards
http://www.iste.org/STANDARDS

Units & Standards Overview

Semester 1 **Semester 2**

Unit 1: Structure and Properties of Matter	Unit 2: Chemical Reactions	Unit 3: Force and Interactions	Unit 4:Energy	Unit 5: Waves and Their Properties
Evidence Statements **MS-PS1-1** 6-8.PS1.A.3 6-8.PS1.A.4	Evidence Statements MS-PS1-2 **MS-PS1-5** MS-PS1-6 MS-ETS1-4	Evidence Statements MS-PS2-1 **MS-PS2-2** MS-PS2-3 MS-PS2-4 MS-PS2-5	Evidence Statements MS-PS3-1 MS-PS3-2 MS-PS3-3 MS-PS3-4 **MS-PS3-5**	Evidence Statements MS-PS4-1 **MS-PS4-2**
Disciplinary Core Ideas **PS1.A** PS3.A	Disciplinary Core Ideas PS1.A **PS1.B** ETS1.B ETS1.C	Disciplinary Core Ideas **PS2.A** PS2.B	Disciplinary Core Ideas PS3.A **PS3.B** PS3.C PS3.D ETS1.A ETS1.B ETS1.C	Disciplinary Core Ideas PS4.A **PS4.B**
Science Engineering Practices: 2, 3, 4, 6, 7	Science Engineering Practices: 2, 4, 5, 7, 8	Science Engineering Practices: 1, 2, 3, 6, 7	Science Engineering Practices: 1, 2, 3, 4, 7	Science Engineering Practices: 2, 5, 8
Cross Cutting Concepts 1, 2, 3	Cross Cutting Concepts 1, 5	Cross Cutting Concepts 2, 4, 7	Cross Cutting Concepts 3, 4, 5	Cross Cutting Concepts 1, 6
PE Assessment: Atomic and Molecular Structure	PE Assessment: Matter & Its Interactions	PE Assessment: Spoon Launcher	PE Assessment: Law of Conservation of Energy	PE Assessment:Slinky Lab

Course Map

	Unit Description	PE Summary	PE Standards
Unit: Structure and Properties of Matter **14 weeks**	This unit will discuss the idea that all matter is made up of particles, is identified by its properties, and can change physically and chemically. It will discuss particle motion, temperature, and the state of a pure substance when energy is added or removed.	This Performance Event is two fold. The first portion of the PE will address two different models of simple molecules. The student will be asked to evaluate and determine which model is a better representation of water and bromine molecules and explain their choice. The second portion will have students evaluate the structure of two atoms. With a periodic table, they will use the atomic number and mass to identify the number of protons, neutrons, and electrons. They will also be asked to draw a Bohr Model of the two elements. Students will be asked to compare and contrast their structures and evaluate the element's chemical reactivity.	**MS-PS1-1** *DCI: PS1.A* *SEP: 2* *CCC: 3, 4, 5, 6*
Unit: Chemical Reactions **4 weeks**	This unit will explore in depth chemical changes as a result of a chemical reaction. Students will discover that matter does not reveal its chemical properties until it reacts chemically creating one or more new substances. In the process, students will validate the Law of Conservation of Mass and that energy is involved and is transferred during chemical reactions.	Students will review examples of matter and energy changes, and determine the type of change and provide evidence to support their claim. Students will explain how mass is conserved during a chemical reaction with evidence to include a model of a chemical reaction and explain energy transfer during and after a chemical reaction.	MS-PS-2, **MS-PS1-5** MS-PS1-6 *DCI: PS1.B* *SEP: 2, 4, 5, 6, 7* *CCC: 1, 2, 4, 5*
Unit: Force and Interactions **9 weeks**	This unit will focus on how forces affect motion and how motion of an object is described by its change in position relative to another object. It will focus on Newton's Laws of Motion and how they explain the interactions of mass and forces. This unit explores contact forces such as normal, friction, tension, air resistance, applied, and spring, as well as non-contact forces such as gravity, electric, and magnetic.	Students are given the following scenario: *Dylan wants to find out if the mass of a piece of clay will affect how fast it moves when launched with a spoon and rubber band launcher. He launches three pieces of clay from a spoon launcher. Each piece of clay is a different mass. He launches each piece three times and measures the distance traveled and the time it took to hit the ground.* Students will be asked to identify the variables, write a testable question, and hypothesis for this experiment.	**MS-PS2-2** DCI: PS2.A SEP: 3, 4, 5, 6 CCC: 4, 6

		Students will then analyze the data looking at the correlation between distance traveled, time and the object's velocity. They will create a line graph with the clay's mass and their calculated velocity. Students will be asked to use their final velocities to calculate the acceleration of each of the pieces of clay. They will then use Newton's 1st and 2nd Law to answer some conclusion questions about the experiment.	
Unit: Energy **4 weeks:**	This unit will explore the idea that energy has a source, can be transferred, and can be transformed into various forms but is conserved between and within systems.	Students demonstrate their understanding of the Law of Conservation of Energy. They will need to be able to trace energy through a system by identifying its type (potential or kinetic) and its form (chemical, heat, electrical, mechanical, nuclear, radiant, sound). Students should be able to follow the energy from the Sun all the way through a wind up toy being used. They will give a description of how the energy is transforming in each step.	**MS-PS3-5** *DCI:* *PS3.A* *PS3.B* *SEP: 2, 4, 7* *CCC:* *1, 2, 4, 5*
Unit: Waves and Their Properties **3 weeks:**	This unit will discuss the different properties of waves, and the behaviors of waves when they interact with matter. The central ideas focus around sound waves, light waves, and the paths that they travel.	Students will be completing a lab to view a longitudinal wave and transversal wave through the medium of a slinky. Students will follow a set of procedural steps to imitate the movement through the coils of a slinky and will answer analysis questions. After completion of the lab, students will be asked to apply this concept to earthquakes and the way seismic waves travel. They will be given a prompt comparing longitudinal and transverse waves to p and s waves. Students will be asked to compare the different waves. Using their data from the lab, students will need to decide whether p or s waves move faster and which would be more destructive. Students apply their understanding of the way each wave moves and explain why it changes when the waves travel through different mediums.	**MS-PS4-2** *DCI: **PS4.B*** *SEP: 2, 4, 5, 6, 8* *CCC: 2, 6*

Unit 1: Structure and Properties of Matter

Content Area: Science	**Course: Physical Science 8th Grade**	**UNIT: Structure and Properties of Matter**
Unit Description: This unit will discuss the idea that all matter is made up of particles, is identified by its properties, and can change physically and chemically. It will discuss particle motion, temperature, and the state of a pure substance when energy is added or removed.		**Unit Timeline:** 14 weeks

DESIRED Results

Transfer Goal (Science and Engineering Practices) - ***Students will be able to independently use their learning to……***

1. Ask questions and define problems.
2. Develop and use models.
3. Plan and carry out investigations.
4. Analyze and interpret data.
5. Use mathematical and computational thinking.
6. Construct explanations and design solutions.
7. Engage in argument from evidence.
8. Obtain, evaluate, and communicate information.

Understandings (Cross Cutting Concepts) – *Students will understand… (Big Ideas)*

1. Patterns
2. Cause and Effect
3. Scale, Proportion, & Quantity
4. Systems & System Models
5. Energy and Matter
6. Structure and Function
7. Stability and Change

Essential Questions: ***Students will keep considering…***

- How can particles combine to produce a new substance with different properties?
- How does thermal energy affect particles?
- Why would your weight change if you went to Mars?
- What happens to matter during a physical change?
- If you have two pennies, how can you determine which penny is pure copper?
- If you leave your soccer ball out in the cold overnight, will you notice any change in the distance it travels when kicked?
- How are letters in the alphabet similar to elements in a compound?
- What do you think happens to sugar when added to ice tea?
- If we discover a brand new element, element #119, where would it go on the Periodic Table and what would its properties be?

Phenomena used to ground the unit: Surface Tension - Unique property of matter - Animals walking on water

Standards Addressed

Students who demonstrate understanding can:

MS-PS1-1 Develop models to describe the atomic composition of simple molecules and extended structures. [Clarification Statement: Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examples of extended structures could include sodium chloride or diamonds. Examples of molecular level models could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms.]

6-8.PS1-3 Gather, analyze, and present information to describe that synthetic materials come from natural resources and how they impact society**.** [Clarification Statement: Emphasis is on natural resources that undergo a chemical process to form the synthetic material. Examples of new materials could include new medicine, foods, and alternative fuels.] LInked to NGSS MS-PS1-3

6-8.PS1.-4 Develop a model that describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed. [Clarification Statement: Emphasis is on qualitative molecular-level models of solids, liquids, and gases to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. Examples of models could include drawings and diagrams. Examples of particles could include molecules or inert atoms. Examples of pure substances could include water, carbon dioxide, and helium.] Linked to NGSS MS-PS1-4

Disciplinary Core Ideas **Students will know...**	**Science and Engineering Practice** **Students will be able to...**	**Cross Cutting Concepts** **Students will understand...**
PS1.A Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms.	**Understand and explain that the number of protons determine the elements.** **Explain that the ability of elements to form compounds are based on the element's electron configuration.**	**A variety of scales to observe and analyze models of matter such as elements and compound structures.**
PS1.A Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.	**Identify substances based on their physical and chemical properties.** **Engage in arguments from evidence to choose an appropriate material for a real-world situation based on its properties.**	**Patterns within the periodic table to describe the element's physical and chemical properties. (e.g., metals, nonmetals, metalloids)**
PS1.A Gases and liquids are made of molecules or inert atoms that are moving about relative to each other.	Engage in an argument that particles are in constant motion based on the Kinetic theory of matter.	The cause and effect relationship between the amount of thermal energy added or removed from a system to explain physical changes in matter.
PS1.A In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations.	Develop a model to describe the attraction, volume and shape, and movement of the molecules that make up solids, liquids, and gasses.	Various scales to observe the movement of particles in different states of matter (solids, liquids, or gasses). Patterns to recognize changes in states when energy is added or removed (endothermic and exothermic changes).
PS1.A Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals).	Plan and carry out an investigation to describe how crystals (e.g., salt) may form be formed from molecules.	Recognize the patterns of a crystalline structure in a solid with repeating subunits.

	Describe that crystalline solids have a three-dimensional lattice-structure.	
PS1.A The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. *(relates to 6-8.PS1.A.4)*	Construct an explanation of the relationship between temperature and pressure on matter. Use models to provide a causal account of what happens when thermal energy is transferred from a substance including that the pressure that a gas exerts decreases because the kinetic energy of the gas molecules decreases, and the slower molecules exert less force in collisions with other molecules in surrounding materials.	Patterns to recognize the relationship between temperature and pressure, and their effect on different states of matter.
PS3.A The term “heat” as used in everyday language refers both to thermal energy (the motion of atoms or molecules within a substance) and the transfer of that thermal energy from one object to another. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects. [evolving standard] *(relates to 6-8.PS1.A.4)*	Analyzing qualitative data from a graph to show that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs.	The cause and effect relationship between the amount of thermal energy added or removed from a system to explain state of matter changes.
PS3.A The temperature of a system is proportional to the average internal kinetic energy and potential energy per atom or molecule (whichever is the appropriate building block for the system’s material). The details of that relationship depend on the type of atom or molecule and the interactions among the atoms in the material. Temperature is not a direct measure of a system's total thermal energy. The total thermal energy (sometimes called the total	Describe how thermal energy increases molecular movement. Use models to provide a causal account of the relationship between the addition or removal of thermal energy from a substance and the change in the average kinetic energy of the particles in the substance. Describe and use the gas laws.	The cause and effect of pressure, volume and temperature of a substance within a system.

internal energy) of a system depends jointly on the temperature, the total number of atoms in the system, and the state of the material. *(relates to 6-8.PS1.A.4)*		

Unit 1 Assessment: Molecular Structure

EVIDENCE of LEARNING			
Understanding(s) 3, 4, 5, 6	Standards **MS-PS1-1** **2- Develop and Use Models**	**Unit Performance Assessment**: **Description of Performance Task:** Unit 1 Performance Event This Performance Event is two-fold. The first portion of the PE will address two different models of simple molecules. The student will be asked to evaluate and determine which model is a better representation of water and bromine molecules and explain their choice. The second portion will have students evaluate the structure of two atoms. With a periodic table, they will use the atomic number and mass to identify the number of protons, neutrons, and electrons. They will also be asked to draw a Bohr Model of the two elements. Students will be asked to compare and contrast their structures and evaluate the element's chemical reactivity. **Teacher will assess:** Teacher will observe the following criteria of student performance: 1. Students develop models of atomic composition of simple molecules and extended structures. In the models, students identify the relevant components including individual atoms and molecules. 2. In the model, students describe relationships between components including: a. Individual atoms, from two to thousands, combine to form molecules, which can be made up of the same type or different types of atoms. b. Some molecules can connect to each other. c. In some molecules, the same atoms of different elements repeat; in other molecules, the same atom of a single element repeats. 3. Students use models to describe that:	**R/R Quadrant** **21 Century** C Critical thinking Communication

		a. Pure substances are made up bulk quantity of individual atoms or molecules. Each pure substance is made up of one of the following: i. Individual atoms of the same type that are connected to form extended structures. ii. Individual atoms of different types that repeat to form extended structures. iii. Individual atoms that are not attracted to each other. iv. Molecules of the same type of atom that are not attracted to each other. v. Molecules of the same type of atom that are attracted to each other. vi. Molecules of different types of atoms that are not attracted to each other. b. Students use models to describe how the behavior of substances depends on their structure at atomic and molecular levels, which are too small to see. **Performance:** **Mastery:** Students will show that they understand atomic composition of simple molecules and extended structures when they score a 75% or above on the performance event. **Scoring Guide:** Unit 1 Performance Event Scoring Guide	

Unit 1: Sample Activities

SAMPLE LEARNING PLAN				
Understanding	**Standards**	**Major Learning Activities:**	**Instructional Strategy Category:**	**R/R Quadrant: 21C:**
6- Structure and Function	**PS1.A** 2- Develop and use models 8- Obtaining, Evaluating, and Communication of Information	**1. Lesson**: What is Matter? **Objective**: Students will be able to describe the two properties common to all matter (mass and volume). **Learning activity:** 1. Teacher will demonstrate that matter has both mass and volume by attaching a balloon to the end of a meter stick and suspending the meter stick from the room ceiling with a string tied to the middle of the meter stick. Balloon demonstration 2. Teacher presents notes in a concept map on what is matter. Matter Notes 3. Using the graphic organizer in the notes, students will individually identify examples and nonexamples of matter. Discuss student answers. (Answers will vary, most examples of matter include items in the classroom that can be seen. Non-examples include energy forms, emotions, etc.) 4. Show a short You tube video to summarize- What is Matter (3:30) **Check for understanding:** Exit Slip - On a 3 x 5 card, student answer: What is matter? Provide example of matter and why and a non-matter example and why.	*Summarizing and note taking* *Identifying Similarities and Differences*	A Critical Thinking
6- Structure and Function 3-Scale,	**PS1.A** 2-Develop and use models 8-Obtain, Evaluate, and	**2. Lesson:** Basic Unit of Matter - The Atom **Objective**:Students will be able to: ● Describe the basic unit of matter - the atom. ● Describe the structure of an atom and its subatomic particles (protons, neutrons, electrons). ● Explain how the number of subatomic particles are responsible for unique properties of matter.	*Summarizing and note taking* *Identifying Similarities and Differences*	B Critical Thinking Collaboration

Proportion, and Quantity	Communicate Information	• Create basic models of atoms. **Learning activity:** 1. Teacher presents bell ringer question: What is the smallest thing you can see? Answers will vary. Teacher shows examples of items that can only be seen with the aid of a light and electron microscope. 2. Working in pairs students, complete a concept map on atoms after reading pages 318-323 in the Physical Science textbook. Atom Concept Map Key 3. Atom Concept Map Prezi 4. Additional Notes on Neil Bohr Atomic Theory		
1- Patterns 2- Develop and use models	PS1.A	**3. Lesson**: Periodic Table **Objective**: Students will understand the formation and organization of the Periodic Table of Elements. **Learning activity:** This activity should be completed before students have learned about the periodic table. Before beginning the lesson, teacher should print the Periodic Table Pieces and cut each card to have one shape. Students should be placed in groups of 3 or 4 and given a bag with cards that contain the random shapes with different colors and numbers on them. The teacher will give students the following instructions: • Work together to figure out the best way to organize these pieces. • Take turns. Each student will grab one card and organize it the best of their ability. The next student can revise the organization of the previous card or draw a new card to organize. • All pieces must be used. • Cards may NOT be organized into in a straight line. • There is one correct answer. (Teachers may choose to wait on giving them this instruction.) Allow the students time to attempt to organize it. The teacher should walk around and evaluate the progress. No hints should be given. Students may call over the teacher when they believe they have organized it correctly. Solution Picture Do not allow a team to be completed unless the oranges have their own column, it should not overlap with another column.	Cues, Questions, and Advance organizers Non-linguistic representations	C Creativity Collaboration

		Once a group completes it correctly, call over all students to come see their arrangement. Ask students the following questions: ● What were you doing wrong? ● Explain why this is organized? ● What's missing? How do you know? ● How do you know nothing is missing from the top row? ● What happens if we switch a few pieces to make it increasing by the bottom number? ● Is it still organized? Point out how it 'periodically' repeats itself (by row). Send students back to tables to arrange their pieces correctly. **Check for understanding:** Periodic Table Discovery Sheet		
1- Patterns	PS1.A 2- Developing and Using Models 7- Engaging in Argument from Evidence	**4. Lesson:** Density **Objective:** Students will understand that liquids will form layers according to their densities. **Learning activity:** *Prior this lesson, students should have already learned about density and that liquids will form layers based on their densities.* Each student needs a Layering Liquids Lab Sheet. Present each lab group with three unidentified liquids. Liquid A is red-colored water, liquid B is vegetable oil, and liquid C is dark corn syrup. The teacher will ask the question, "Does the order in which you add liquids of different densities to a container affect the order of the layers formed by those liquids?" In this lab, students will layer different liquids with different densities and observe their position in the graduated cylinder. Each lab group will decide which order they wish to pour the liquids into the graduated cylinders. Students will answer questions about how to determine which liquids has the least and greatest density. Lab groups will then compare their results with classmates who added the liquids in a different order.	Non-linguistic representations Generating and Testing Hypotheses	C Critical Thinking
2-Cause and Effect	PS1.A	**5. Lesson**: Investigating States of Matter **Objective**: Students will be able to describe the motion, arrangement, and	*Cues,*	B

	1-Ask questions and define problems. 3- Carry out investigations.	average kinetic energy of the molecules in a solids, liquids and gases. **Learning activity:** Students will begin with a quick write using the prompt "What does the phrase "State of Matter" mean to you?" Have students write in their Interactive Science Notebook. Discuss the student's answers as a class while the teacher writes their ideas on the SMARTboard. Use these ideas to generate a list of the different states of matter. Use States of Matter Student Notes as pages that the students glue into their notebooks. Use the lesson plan Investigating States of Matter which includes the following activities with questions: 1. Investigating the speed of water molecules in different temperature water. 2. What makes the liquid in a thermometer go up? 3. Brass ball and ring demonstration. (This apparatus needs to be purchased for the demonstration or the demonstration can be found on teachertube and shown). 4. How does heating and cooling affect a gas? **Check for understanding:** Exit Card on last page of lesson.	*Questions, and Advance organizers* *Non-linguistic representations* *Summarizing and note taking*	Critical Thinking
1-Patterns *5- Energy and Matter*	PS3.A *3-Carry out investigations* *4- Analyze and interpret data* *8- Obtain, evaluate, and communicate information*	**6. Lesson:** Phase Change Lab **Objective:** Students will be able to create a phase change diagram from experimental data to demonstrate that adding or removing thermal energy increases or decreases kinetic energy of the particles until a change of state occurs. **Learning Activity**: Each student will need a copy of the Phase Change Lab. Note: teachers may use butane burners instead of alcohol burners. In this lab students will gather data and create the phase diagram for salt water. The students will start with a solution of salt water and ice and proceed to turn the solution into a gas. They will gather data as they heat the solution and then plot the data to develop a phase change diagram. Each lab group will need a burner, ring stand, test tube clamp, and thermometer. Students will answer the questions on the lab sheet as a check for understanding and application to real world situations.	Non-linguistic representations Generating and Testing Hypotheses	B Critical Thinking
1 - Patterns	*PS1.A*	7. Lesson: Growing Crystals	Generating and	B

2 - Cause and Effect *3 - Scale, Proportion, and Quantity* *4- Systems and System Models* *5 - Energy and Matter*	*3-Carry out investigations* *4-Analyze and interpret data* *8- Obtain, evaluate, and communicate information*	**Objective:** Student will be able to observe that solid matter can have a repeating pattern related to the molecular structure of the matter. **Learning Activity:** Students will conduct an investigation using sodium borate (Borax) dissolved in water and observe the growth of the crystals. Student can create supersaturated solutions and seed crystals by heating the water and dissolving the borax. Students are able to dissolve more borax than what is normally possible at room temperature. As the solution cools, the solution is supersaturated until a seed crystal or other disturbance, such as your pipe cleaner, is added. Crystals of sodium borate will start to form on the pipe cleaner. The pipe cleaner is a great surface for crystal formation because it has so much surface area on each little fiber. Formation of crystal size - Sodium borate forms a particularly shaped crystal but the crystal can vary in size based on the speed at which the solution cools. The faster the solution cools, the smaller the crystals because they don't have as much time to organize themselves. Slow-cooling solutions will tend to have larger crystals. Borax Snow Crystals Visit this website and watch this video for an overview of the activity. Crystal Growing Activity - video	Testing Hypotheses	Critical Thinking

Unit 1: Resources

UNIT RESOURCES
Teacher Resources: Physical Science, Holt, Teacher's Edition ©2007 Brainpop – States of Matter Brainpop – Changing States of Matter Brainpop - Atoms Gizmo - Density Laboratory Gizmo - Determining Density via Water Displacement

Fun Crystal Activities
Science Friday Link - Physics & Chemistry

Student Resources:
Physical Science, Holt, Student Edition ©2007
Phet interactive http://phet.colorado.edu/
Online interactive periodic table http://www.ptable.com/

Vocabulary:
Matter - anything that has mass and volume
Volume - the amount of space an object occupies
Mass - the amount of matter in an object
Density - the amount of mass in a given amount of space.
Atoms - the smallest unit of an element that maintains the properties of that element
Elements - the substances that cannot be separated or broken down into simpler substances by chemical means
Molecules - a combination of two or more atoms
Compound - a substance made up of atoms of two or more different elements joined by chemical bonds
Pure substances - samples of matter, either a single element or a single compound that has definite chemical and physical properties
Physical property - any characteristic of matter such as color, shape, and taste—that can be detected by the senses without changing the identity of the matter
Chemical property - a characteristic of something that permits it to change into something new
Mixture - a combination of two or more substances that are not chemically combined
Solution - a homogeneous mixture whose elements and/or compounds are evenly mixed at the molecular level but are not bonded together
Kinetic Theory of Matter - states that particles that make up matter (atoms, molecules) are always in constant motion. These particles are held together by the forces between them. This theory defines whether an object will be a solid, liquid, gas, or plasma.
Evaporation - the process that occurs when a substance changes from a liquid to a gas only on the surface
Boiling - the process that occurs when a substance changes from a liquid to a gas inside the liquid as well as on the surface
Condensation is the change of state from a gas to a liquid

Unit 2: Chemical Reactions

Content Area: Science	**Course: Physical Science 8th Grade**	**UNIT: Chemical Reactions**
Unit Description: Students will be able to provide molecular level accounts to explain that chemical reactions involve regrouping of atoms to form new substances, and that atoms rearrange during chemical reactions. Students are also able to apply an understanding of the design and the process of optimization in engineering to chemical reaction systems.		**Unit Timeline:** 4 Weeks

DESIRED Results
<u>Transfer Goal</u> - ***Students will be able to independently use their learning to……*** 1. Ask questions and define problems. 2. Develop and use models. 3. Plan and carry out investigations. 4. Analyze and interpret data. 5. Use mathematical and computational thinking. 6. Construct explanations and design solutions. 7. Engage in arguments from evidence. 8. Obtain, evaluate, and communicate information.

<u>Understandings (Cross Cutting Concepts)</u> – *Students will understand… (Big Ideas)*

1. Patterns
2. Cause and Effect
3. Scale, Proportion, & Quantity
4. Systems & System Models
5. Energy and Matter
6. Structure and Function
7. Stability and Change

Essential Questions: ***Students will keep considering…***

- What causes fireworks to have different colors and effects?
- What changes take place when a firework is lit?
- What happens when new materials are formed? What stays the same and what changes?
- In regards to fireworks and other chemical reactions, how is energy involved in the change of matter ?

Phenomena used to ground the unit: Firework Display Link

Standards Addressed		
Students who demonstrate understanding can: MS-PS1-2 Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. [Clarification Statement: Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrogen chloride.] **MS-PS1-5 Develop and use a model to describe how the total number of atoms remains the same during a chemical reaction and thus mass is conserved.** [Clarification Statement: Emphasis is on law of conservation of matter and on physical models or drawings, including digital forms that represent atoms.] MS-PS1-6 Construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes. [Clarification Statement: Emphasis is on the design, controlling the transfer of energy to the environment, and modification of a device using factors such as type and concentration of a substance. Examples of designs could involve chemical reactions such as dissolving ammonium chloride or calcium chloride.] MS-ETS1-4 Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.		
Disciplinary Core Ideas **Students will know...**	**Science and Engineering Practice** **Students will be able to...**	**Cross Cutting Concepts** **Students will understand...**
PS1.A Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it.	Understand and be able to identify substance using physical and chemical properties.	Recognize patterns (physical and chemical properties) in matter to determine identity of the substance.

PA1.B Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants.	Understand and be able to explain with evidence if a physical or chemical change is occurring resulting in a change in properties of matter.	Recognize patterns in matter to determine if a chemical reaction/change is occurring or physical change.
PS1.B The total number of each type of atom is conserved, and thus the mass does not change.	**Plan and carry out an investigation to determine if the mass is conserved as a result of a chemical reaction.**	**Determine if the amount of matter and energy in the substance(s) has changed as a result of a chemical reaction.**
PS1.B Some chemical reactions release energy, others store energy.	Plan and carry out an investigation to determine if energy is conserved as a result of a chemical reaction.	Determine if the amount of matter and energy in the substance(s) has changed as a result of a chemical reaction.
ETS1.B A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. *(relates to 6-8.PS1.B.2)*	Conduct investigation on physical and chemical changes. Analyze and interpret data to determine type of change. Propose changes and improvements to experiment and conduct a revised investigation. Determine similarities and difference between the two investigations.	Students will need to create a data table, analysis collected data, and summaries results of experimentation.
ETS1.C Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of the characteristics may be incorporated into the new design. (*relates to 6-8.PS1.B.2)*	Conduct investigation on physical and chemical changes. Analyze and interpret data to determine type of change. Propose changes and improvements to experiment and conduct a revised investigation. Determine similarities and difference between the two investigations.	Students will need to create a data table, analysis collected data, and summaries results of experimentation.

ETS1.C The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. *(relates to 6-8.PS1.B.2)*	Conduct investigation on physical and chemical changes. Analyze and interpret data to determine type of change. Propose changes and improvements to experiment and conduct a revised investigation. Determine similarities and difference between the two investigations.	Student will need to predict, collect data analysis results, and accept or reject hypothesis based on results of experiments.

Unit 2 Assessment: Matter and Its Interaction

EVIDENCE of LEARNING			
Understanding *1,2,4,5*	Standards MS.PS1-2 **MS.PS1-5** MS.PS1-6 PS1.A **PS1.B** 2, 4, 5, 6, 7	**Unit Performance Assessment**: **Description of Performance Task** Unit 2 Performance Event - Chemical Reactions Students will review examples of matter and energy changes and determine the type of change and provide evidence to support their claim. Students will explain how mass is conserved during a chemical reaction with evidence to include a model of a chemical reaction and explain energy transfer during and after a chemical reaction. **Teacher will assess:** *Can Students:* 1. *Determine if a change is chemical or physical using evidence.* 2. *Explain how a endothermic and exothermic changes are different.* 3. *Provide an explanation for mass change by applying the Law of Conservation Mass.* **Performance:** **Mastery:** Students will show that they understand chemical reactions, Law of Conservations of Mass, and change in energy when they score a 75% or above on the performance event. **Scoring Guide:** Unit 2: Performance Event Scoring Guide	**R/R Quadrant** C **21 Century** critical thinking communication

Unit 2: Sample Activities

SAMPLE LEARNING PLAN				
Understanding	**Standards**	**Major Learning Activities:**	**Instructional Strategy Category:**	**R/R Quadrant: 21C:**
1- Patterns 5-Energy & Matter	**PS1.B** 4- Analyze & Interpret Data *8*- Obtain, Evaluate, & Communicate Information	**Lesson 1**: Physical and Chemical Change Lab Activity will take at least two class periods. **Objective**: Students will understand the nature of changes in matter by observing and evaluating evidence of chemical and physical change (e.g., change in shape, size, phase) - Identify observable evidence of a chemical change (e.g., color change, heat or light given off, change in odor, gas given off). **Activity:** Put students in small groups and have them perform the 10 separate experiments at different stations. Students complete a student investigation sheet as each station experiment is conducted. Students will create a single data table that shows the station number, station name, their observations, and whether each station is an example of a chemical change or a physical change. Data Analysis: Students will analyze their observations to first differentiate whether a physical or chemical change has occurred (is the original substance still present after the change has occurred). **Check for understanding:** Stop the students periodically to see if they correctly identified the chemical and physical changes that occurred.	*Identifying Similarities and Differences* *Generating and Testing Hypotheses*	B, C Critical Thinking
1-Patterns 5- Energy &	**PS1.B** 4- Analyze & Interpret Data	**Lesson 2**: Chemical Change Simulation - Explorelearning.com Gizmo May take two class periods to complete. **Objective**: Students will … ● observe and measure chemical reactions using a variety of tools (visual	Identifying Similarities and Differences Generating and Testing	B, C Critical Thinking

Matter	*8-* Obtain, Evaluate, & Communicate Information	evidence, thermometer, indicator solution, magnifying glass, glowing splint, and scent). ● determine if a chemical change has taken place based on observational evidence. ● identify exothermic and endothermic processes. ● demonstrate the law of conservation of matter/mass by showing that, in a closed system, the total mass does not change during a chemical reaction. **Activity:** The Chemical Changes Gizmo is an introduction to chemical reactions. In the Gizmo, students will explore a variety of combinations of reactants, including a few combinations that don't result in a chemical reaction. Students can use a variety of tools to make observations, and the reactions take place on a digital balance to demonstrate conservation of matter. - Student Exploration Sheet - Student Exploration Key - Chemical Changes Vocabulary Sheet - Teacher Guide **Check for understanding: Chemical Reactions Online Assessment**	Hypotheses	
2-Cause and Effect 3- Scale, Proportion, and Quantity 5-Energy and Matter	**PS1.B** 2-Developing and Using Models 3- Planning and carrying out investigations 7- Engaging in argument from	**Lesson 3**: Temperature and the Rate of a Chemical Reaction **Objective**: Students will be able to identify and control variables to design an experiment to see if temperature affects the rate of a chemical reaction. Students will be able to explain, on the molecular level, why the temperature of the reactants affects the speed of the reaction. **Activity:** Students will make the same two clear colorless solutions (baking soda solution and calcium chloride solution) from Lesson 3. They will help design an experiment to see if the temperature of the solutions affects how fast they react. Students will then try to explain, on the molecular level, why the temperature affects the rate of the reaction. **Check for understanding:** Student Activity sheet will serve as the evaluation tool for this activity.	*Summarizing and note taking* *Assigning Homework and Providing Practice* *Identifying Similarities and Differences* *Generating and Testing Hypotheses*	B, C *Collaboration* *Communication* *Critical Thinking*

	evidence			

Unit 2: Resources

UNIT RESOURCES
Teacher Resources: ● Brainpop - Property Changes ● Brainpop - Chemical Bonds ● Brainpop - Chemical Equations ● Bozeman- Chemical Change ● Periodic Table Youtube Channel *(lots of engaging videos)* ● CK-12 Foundation - Physical Science Resources
Student Resources: *Physical Science, Holt, Student Edition ©2007*
Vocabulary: **Chemical Reaction -** the process by which one or more substances change to produce one or more different substances **Precipitate -** a solid that is produced as a result of a chemical reaction **Physical change** - a change in a substance that does not change its identity; for example, a change of state **Chemical change** - a change that occurs when one or more substances change into entirely new substances with different properties **Law of Conservation of Mass** - states that mass is not created or destroyed during ordinary chemical or physical changes **Law of Conservation of Energy** - states that energy cannot be created or destroyed but can be changed from one form to another **Exothermic Reaction** - a chemical reaction in which heat is released to the surroundings **Endothermic Reaction** - a chemical reaction that requires heat energy from the surroundings **Activation Energy** - the minimum amount of energy (J) required to start a chemical reaction. **Catalyst -** a substance changes the rate of chemical change without being used or changed by in the chemical reaction **Reactant** - a substance that participates in a chemical reaction **Products** - the substance that forms as a result of a chemical reaction

Unit 3: Force and Interactions

Content Area: Science	**Course: Physical Science 8th Grade**	**UNIT: Force and Interactions**
Unit Description: This unit will focus on how forces affect motion and how motion of an object is described by its change in position relative to another object. It will focus on Newton's Laws of Motion and how they explain the interactions of mass and forces. This unit explores contact forces such as normal, friction, tension, air resistance, applied, and spring, as well as non-contact forces such as gravity, electric, and magnetic.		**Unit Timeline:** 9 weeks

DESIRED Results
Transfer Goal - ***Students will be able to independently use their learning to……*** 1. Ask questions and define problems. 2. Develop and use models. 3. Plan and carry out investigations. 4. Analyze and interpret data. 5. Use mathematical and computational thinking. 6. Construct explanations and design solutions. 7. Engage in argument from evidence. 8. Obtain, evaluate, and communicate information.

Understandings (Cross Cutting Concepts) – *Students will understand… (Big Ideas)*

1. Patterns
2. Cause and Effect
3. Scale, Proportion, & Quantity
4. Systems & System Models
5. Energy and Matter
6. Structure and Function
7. Stability and Change

Essential Questions: ***Students will keep considering…***

- How can one describe physical interactions between objects and within systems of objects?
- Imagine that you are riding on the schoolbus and looking out the window. What evidence do you have that you are moving?
- What is the most important factor in a team winning a tug-o-war?
- What is wrong with the phrase "There's no gravity in space"?
- What would happen if a cannonball had more mass than the cannon that fired it?
- If a bullet was dropped and an identical bullet was horizontally shot from the same height (without wind) which would hit the ground first?
- A bug hits the windshield of a school bus. Which force is greater? The bug on the bus or the bus on the bug? Or are they the same?
- Why does a rocket get faster and faster as it travels into space if the amount of thrust stays the same?

Phenomena used to ground the unit: Objects in orbit around Earth are in constant free-fall

Standards Addressed
Students who demonstrate understanding can: MS-PS2-1 Apply physics principles to design a solution that minimizes the force of an object during a collision and develop an evaluation of the solution. LInked to NGSS MS-PS2-1 **MS-PS2-2 Plan and conduct an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object. [Clarification Statement: Emphasis is on balanced (Newton's First Law) and unbalanced forces in a system, qualitative comparisons of forces, mass and changes in motion (Newton's Second Law), frame of reference, and specification of units.] Linked to NGSS MS-PS2-2** MS-PS2-3 Analyze diagrams and collect data to determine the factors that affect the strength of electric and magnetic forces. [Clarification Statement: Examples of devices that use electric and magnetic forces could include electromagnets, electric motors, or generators. Examples of data could include the effect of the number of turns of wire on the strength of an electromagnet, or the effect of increasing the number or strength of magnets on the speed of an electric motor.] Linked to NGSS MS-PS2-3 MS-PS2-4 Create and analyze a graph to use as evidence to support the claim that gravitational interactions depend on the mass of interacting objects. [Clarification Statement: Examples of evidence for arguments could include data generated from simulations or digital tools; and charts displaying mass, strength of interaction, distance from the Sun, and orbital periods of objects within the solar system.] Linked to NGSS

MS-PS2-4
MS-PS2-5 Conduct an investigation and evaluate the experimental design to provide evidence that electric and magnetic fields exist between objects exerting forces on each other even though the objects are not in contact. [Clarification Statement: Examples of this phenomenon could include the interactions of magnets, electrically-charged strips of tape, and electrically-charged pith balls. Examples of investigations could include first-hand experiences or simulations.] LInked to NGSS Ms-PS2-5

Disciplinary Core Ideas **Students will know...**	**Science and Engineering Practice** **Students will be able to...**	**Cross Cutting Concepts** **Students will understand...**
PS2.A For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's third law).	Develop and use a model to demonstrate the force that will be exerted by the first object on the second object in a collision. Explain that for every action, there is an equal and opposite reaction (action reaction pairs). Construct an explanation and design a solution using Newton's Third Law of motion to solve a given problem involving a collision. Analyze and interpret data regarding mass, time, and speed and their impact on force in a collision.	Systems and system models to represent the components within a system that are involved in a collision. The cause-and-effect relationship between the mass of an object and the force exerted on the other object.
PS2.A The motion of an object is determined by the sum of the forces acting on it; if the total force on the object is not zero, its motion will change. The greater the mass of the object, the greater the force needed to achieve the same change in motion. For any given object, a larger force causes a larger change in motion.	**Provide evidence that the change in an object's motion is due to unbalanced forces acting on the object and the mass of the object.** **Analyze and interpret numerical data for an object that is subjected to balanced forces (F=0) will not change its motion and an object subjected to unbalanced forces (F≠0) will change its motion over time.** **Explain that an object at rest will stay at**	**Stability and change of the motion of an object and the forces acting on the object.** **Proportional thinking to evaluate the relationship between force, mass, and acceleration.**

	rest and an object in motion will stay in motion, unless acted upon by an outside force. (Newton's 1st Law) **Explain that an object's inertia is directly proportional to its mass.** **Use mathematical and computational thinking to demonstrate the relationship between force, mass, and acceleration. (Newton's 2nd Law)**	
PS2.A All positions of objects and the directions of forces and motions must be described in an arbitrarily chosen reference frame and arbitrarily chosen units of size. In order to share information with other people, these choices must also be shared.	Analyze and interpret a graph that represents the relationship between distance and time. Use mathematical thinking to calculate speed, velocity, and acceleration. Analyze and interpret data to determine if a value is a vector or scalar.	Patterns to analyze the relationship between distance and time of an object to determine its motion.
PS2.B Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects.	Engage in arguments relating voltage to electric current and resistance to electric current in different types of material. Engage in an argument describing the advantages and disadvantages of series and parallel circuits. Understand and explain that forces that are electric and magnetic can be attractive or repulsive. Provide evidence that the magnitude of an electric current changes due to the magnitude of the magnetic field present.	Use scientific principles to predict the strength of electric and magnetic forces due to a cause and effect relationship. System and system models to observe series and parallel circuits.

PS2.B Gravitational forces are always attractive. There is a gravitational force between any two masses, but it is very small except when one or both of the objects have large mass—e.g., Earth and the sun.	Engage in arguments using evidence that distance between two objects and their masses affect the strength of the gravitational pull between objects in a system.	System and systems models to graphically represent the dependence of mass and gravitational pull.
PS2.B Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, or a ball, respectively).	Use evidence to engage in arguments that two interacting objects can exert forces on each other even though the two interacting objects are not in contact with each other. Construct explanations for how distance and charges affect the interactions of magnets.	Cause and effect relationship between the distance between objects, the charge, and magnitude of the charge on the strength of the magnetic field.

Unit 3 Assessment: Spoon Launcher

EVIDENCE of LEARNING			
Understanding 2, 3, 4	Standards **MS-PS2-2** **PS2.A**	**Unit Performance Assessment** **Description of Performance Task:** Unit 3 Performance Event Students will be given the following scenario: *Dylan wants to find out if the mass of a piece of clay will affect how fast it moves when launched with a spoon and rubber band launcher. He launches three pieces of clay from a spoon launcher. Each piece of clay is a different mass. He launches each piece three times and measures the distance traveled and the time it took to hit the ground.* Students will be asked to identify the variables, write a testable question, and hypothesis for this experiment. Students will then analyze the data looking at the correlation between distance traveled, time and the object's velocity. They will create a line graph with the clay's mass and their calculated velocity. Students will be asked to use their final velocities to calculate the acceleration of each of the pieces of clay. They will then use Newton's 1st and 2nd Law to answer some conclusion questions about the experiment. **Teacher will assess:** Can students identify the following: 1. velocity of a moving object 2. acceleration of a moving object 3. application of Newton's Laws on a catapult 4. implementation of scientific inquiry skills **Performance:** **Mastery:** Students will show that they really understand an object's motion depends on the sum of the forces on the object and the mass of the object when they score a 75% or above on the performance event. **Scoring Guide:** Unit 3 Performance Event Scoring Guide	**R/R Quadrant** **21 Century** C 4C- critical thinking communication

Unit 3: Sample Activities

SAMPLE LEARNING PLAN				
Understanding	**Standards**		**Instructional Strategy Category:**	**R/R Quadrant: 21C:**
2 - Cause and Effect 4 - Systems and System Models	PS2.A 2- Developing and Using Models	**Lesson**: Blast Off! Model Making Lab of Newton's 3rd Law of Motion **Objective**: Students will build and analyze a model that demonstrates Newton's 3rd Law of Motion. **Activity:** Tape fishing line to the ceiling of the classroom for each lab group of three students . Teacher can pre-assemble the dixie cup baskets before the lab to make the lab go faster. Use the SMART Notebook Blast Off to introduce the lab to the students. Students will build a rocket using a balloon that is attached to a fishing line by a straw. Students will increase the payload of the rocket by adding paper clips (pennies may also be used) to a dixie cup that is attached to the bottom of the balloon. Students will record their data in the Blast Off Lab Sheet. **Check for understanding:** Students will answer the analyze the results, draw conclusions and applying your data questions from their lab sheet as homework.	Non-linguistic representations Assigning Homework and Providing Practice Generating and Testing Hypotheses	C Creativity, Collaboration, Communication, Critical Thinking
2- Cause and Effect	**PS2.A** 4-Analyze and interpret data	**Lesson**: Newton's 1st Law Stations **Objective**: Students will be able to analyze and observe Newton's 1st Law of Motion at seven activity stations. **Activity:** The teacher should begin the lesson by asking students to describe Newton's 1st Law in their own words and to give an example from their own life in their science notebook. The teacher will set up seven activity stations in the classroom using the Teacher Directions. Place the directions for the activity at each station, Station Directions. Break students into groups of three or four students per group. Have students rotate through stations starting with the station set up at their table. Have students fill in their Student Data Sheet while	Cues, Questions, and Advance organizers Non-linguistic representations Summarizing and note taking	C Collaboration Critical Thinking

		rotating through stations. (Stations should take one class period.) **Check for understanding:** Use the Page Keeley Probe, A Push in Space, as an exit card.	Generating and Testing Hypotheses	
1- Patterns	PS2.A 4- Analyze and interpret data 8- Obtain, evaluate, and communicate information	**Lesson**: Motion Graphs - Walker Lab **Objective**: Students will be able to analyze and interpret a graph that shows the relationship between distance and time. **Activity:** This activity can be used as an introduction activity to motion graphs. Students will discover speed, velocity and acceleration and how various motions are represented graphically. Teacher Instructions Before beginning the lesson, print out the job cards, walker cards and distance markers on brightly colored paper. Task Cards and Distance Markers Suggestion: tape a washer on the back of each of the distance markers to weight them down. You will also need an open area where you are able to mark down every meter for 25-30 meters. Recommended to do outside on a flat, concreted area. Each student needs a Lab Sheet with the four graphs and conclusion questions. Depending on class sizes, determine how many groups you will need to perform the lab. The recommended group size is 11-13 students. You will need 1 timer, 1-3 data recorders, 4 walkers, 5-7 distance markers. As each walker walks, a timekeeper calls out the time every 2 seconds. Distance markers are placed along the walking track where the walkers feet are located every 2 seconds and data is recorded. After data has been collected on all 4 walkers, students create line graphs using the data. Students are able to see visual representations of their classmates motions on the graphs. Students will see the following motions represented graphically: constant speed, acceleration, low speed, high speed, stopped (no motion), and returning to start. **Check for understanding:**	Cooperative learning Non-linguistic representations	C Collaboration, Communication, Critical Thinking

		Students will complete conclusion questions asking them to analyze their graphs.		
2- Cause and Effect 5- Energy and Matter 6- Structure and Function	PS2.B 2- Develop and use models	**Lesson**: Series and Parallel Circuits - Snap Circuits **Objective**:Students will... ● understand the different components of a circuit. ● understand the advantages and disadvantages of a series and parallel circuit. ● understand the relationship between current and resistance**.** ● be able to build a series and parallel circuit. **Activity:** Snap Circuit Worksheet This lesson should be completed after students have been introduced to series and parallel circuits. Students will use the worksheet and follow the given instructions to build different circuits. They will analyze their different circuits and answer analysis questions. Students should work in groups of 3 or 4. **Check for understanding:** Exit slip - Students will answer the question, “What are two advantages and disadvantages for series and parallel circuits?”	Cooperative learning Non-linguistic representations	C Collaboration Critical Thinking
2- Cause and Effect 1- Patterns 3- Scale, Proportion, and Quantity	PS2.B 2-Develop and use models. 4- Analyze and interpret data. 5-Use mathematical and computational thinking.	**Lesson**: Gravitational Forces - My Solar System **Objective**: Students will analyze the effect of the mass of objects and distance between them on their gravitational attraction. **Activity: My Solar System PHET Simulation** Students will use the PHET computer simulation while completing the My Solar System guided worksheet. **Check for understanding:** Students will answer questions on the guided worksheet to analyze the attractive force of gravity in the solar system.	Non-linguistic representations Generating and Testing Hypotheses	C Critical Thinking

	ISTE.4.c.			
4- Systems and Systems Models 5- Energy and Matter 6- Structure and Function	PS2.B Develop and use models	**Lesson**: Electromagnetism - DC Motor **Objective**: Students will be able to analyze the workings of the parts of a direct current motor using magnets and electricity. **Activity:** Students will build a direct current motor. Students will use their knowledge of magnets and electricity to wire a motor using a styrofoam cup, batteries, copper wire, paper clips, magnets, tape, and alligator wires. The DC Motor Lab contains all needed materials and procedural steps for this activity. **Check for understanding:** Students will be asked to give a detailed explanation of how the motor works in a follow-up question the next day.	Non-linguistic representations	D Creativity, Collaboration, Communication, Critical Thinking

Unit 3: Resources

UNIT RESOURCES
Teacher Resources: ● Science Court: Inertia- Tom Snyder ● Science Court: Gravity ● www.classzone.com ● www.edheads.com ● www.science-class.net ● www.brainpop.com Gravity ● Book- Stop Faking It- Force and Motion ● United Streaming – Real World Science: Push & Pull ● United Streaming – Real World Science: Changing the Shape of an Object Using a Force ● United Streaming – Real World Science: Modes of Forces: Gravity, Electromagnetism, & Nuclear Forces ● United Streaming – Science Investigations: Physical Science: Investigating Motion, Forces, and Energy – The Physics of Bridge Design and Construction ● www.brainpop.com Acceleration - Faster and Faster

- United Streaming – Science Investigations: Physical Science: Investigating Motion, Forces, and Energy – Speed & Acceleration
- *Science Court- Inertia*
- *www.brainpop.com Newton's Laws of Motion*
- *United Streaming – Basics of Physics: Exploring the Laws of Motion*
- www.brainpop.com Electric Circuits- Watch the Electrons Flow
- www.brainpop.com Static Electricity – It's a Shocker!
- Explorelearning.com – interactive circuit building (requires subscription)
- Physics Education Technology – interactive sites (could be included as a resource for all): http://phet.colorado.edu/new/simulations/index.php?cat=Electricity_Magnets_and_Circuits
- United Streaming – Static electricity, current electricity
- Conductors and insulators interactive site: http://www.bbc.co.uk/schools/scienceclips/ages/8_9/circuits_conductors_fs.shtml
- CK-12 Foundation - Physical Science Resources

This is how orbit works - Fire a cannonball into space.

Student Resources:

- *Physical Science, Holt, Student Edition ©2007*
- *Phet interactive http://phet.colorado.edu/*
- *Physics Education Technology – interactive sites http://phet.colorado.edu/new/simulations/index.php?cat=Electricity_Magnets_and_Circuits*
- *Conductors and insulators interactive site: http://www.bbc.co.uk/schools/scienceclips/ages/8_9/circuits_conductors_fs.shtml*
- Scholastic http://www.scholastic.com/teachers/activity/energy-light-and-sound-10-studyjams-interactive-science-activities

Vocabulary:

- **Motion** - an object's change in position relative to a reference point
- **Reference point** - - a stationary object
- **Weight** - a measure of the gravitational force exerted on an object; its value can change with the location of the object in the universe; measured in Newton
- **Mass** - a measurement of the amount of matter in an object; measured in grams
- **Velocity** - - speed in a specific direction (V = d ÷ t)
- **Acceleration** - - any change in velocity over time (speed up, slow down, change direction) (a = F ÷ m)
- **Force** - a push or pull
- **Newton** - the SI unit for force
- **Inertia** - the tendency of an object to resist a change in its motion
- **Balanced forces** – equal forces acting on an object in opposite directions

- **Unbalanced forces** – two or more forces acting on an object that do not cancel and cause the object to accelerate.
- **Circuit** - a kind of closed pathway
- **Electric circuit** - a complete, closed path through which electric charges flow
- **Series circuit** - a circuit in which all parts are connected in a single loop
- **Parallel circuit** - a circuit in which loads are connected side by side; charges in a parallel circuit have more than one path in which they can travel
- **Resistance** - the opposition presented to the current by a material or device; measured in **Ohms**
- **Voltage** - the difference in electrical potential between two places in a circuit; electrical current measured in **Volts**
- **Electrical current** - the rate at which charges pass through a given point; measured in **Amperes (Amps)**
- **Conductor -** material in which charges can move easily
- **Insulator** - materials in which charges cannot move easily
- **Magnetic Force** - the force of attraction or repulsion generated by moving or spinning electric charges

Unit 4: Energy

Content Area: Science	Course: Physical Science 8th Grade	UNIT: Energy
Unit Description: This unit will discuss the idea that energy has a source, can be transferred, and can be transformed into various forms but is conserved between and within systems.		**Unit Timeline:** 4 weeks

DESIRED Results

Transfer Goal - ***Students will be able to independently use their learning to……***

1. Ask questions and define problems.
2. Develop and use models.
3. Plan and carry out investigations.
4. Analyze and interpret data.
5. Use mathematical and computational thinking.
6. Construct explanations and design solutions.
7. Engage in argument from evidence.
8. Obtain, evaluate, and communicate information.

Understandings (Cross Cutting Concepts) – *Students will understand… (Big Ideas)*

1. Patterns
2. Cause and Effect
3. Scale, Proportion, & Quantity
4. Systems & System Models
5. Energy and Matter
6. Structure and Function
7. Stability and Change

Essential Questions: ***Students will keep considering…***

- How can energy be transferred from one object or system to another?
- Can you trace the energy used in any situation back to the Sun?
- Is it possible for a pendulum to swing back and forth forever?

- When a match burns, what forms of energy were converted?
- Why would you expect to have to inflate your tires on the coldest day of the year?
- Why is it incorrect to say “Close the door, you are letting the cold air in”?
- How could you keep a clay pot of water cold on a hot day without using ice or a refrigerator?
- Why would an orange farmer spray his crops with water right before a frost?
- Why are the expensive pots and pans made from copper and not Iron?

Phenomena used to ground the unit: ***Youtube: Amazing Energy Facts***

Energy is a property of matter. It can be transferred between objects, and converted in form. It cannot be created or destroyed.

Standards Addressed
Students who demonstrate understanding can… MS-PS3-1 Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object. [Clarification Statement: Emphasis is on descriptive relationships between kinetic energy and mass separately from kinetic energy and speed. Examples could include riding a bicycle at different speeds, rolling different sizes of rocks downhill, and getting hit by a whiffle ball versus a tennis ball.] MS-PS3-2 Develop a model to describe that when the arrangement of objects interacting at a distance changes, different amounts of potential energy are stored in the system. [Clarification Statement: Emphasis is on relative amounts of potential energy, not on calculations of potential energy. Examples of objects within systems interacting at varying distances could include: the Earth and either a roller coaster cart at varying positions on a hill or objects at varying heights on shelves, changing the direction/orientation of a magnet, and a balloon with static electrical charge being brought closer to a classmate’s hair. Examples of models could include representations, diagrams, pictures, and written descriptions of systems.] MS-PS3-3 Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer. [Clarification Statement: Examples of devices could include an insulated box, a solar cooker, and a Styrofoam cup.] 6-8 PS3-4 Plan and conduct an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the temperature of the sample.[Clarification Statement: Examples of experiments could include comparing final water temperatures after different masses of ice melted in the same volume of water with the same initial temperature, the temperature change of samples of different materials with the same mass as they cool or heat in the environment, or the same material with different masses when a specific amount of energy is added.] Linked to NGSS MS-PS3-4

MS-PS3-5 Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object. [Clarification Statement: Examples of empirical evidence used in arguments could include an inventory or other representation of the energy before and after the transfer in the form of temperature changes or motion of object.]

MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

MS-ETS1-3. Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.

MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

Disciplinary Core Ideas **Students will know...**	**Science and Engineering Practice** **Students will be able to...**	**Cross Cutting Concepts** **Students will understand...**
PS3.A Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed.	Use graphical displays to organize the given data of mass, velocity, and KE.	Scale, Proportions, & Quantity Conduct experiments and construct graphs and interpret the data. Students will discover how force and mass proportional effect KE.
PS3.A A system of objects may also contain stored (potential) energy, depending on their relative positions.	Observe components of a model (force, height,mass) to determine the effect on gravitational potential energy.	Scale, Proportions, & Quantity Conduct experiments and construct graphs and interpret the data. Students will discover how force, height and mass effect GPE.
PS3.A Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present.	Analyze and interpret data on the thermal conductivity of different substance.	Energy and Matter Conduct experiment to determine the thermal conductivity of different substance.

PS3.B When the motion energy of an object changes, there is inevitably some other change in energy at the same time.	**Engage in an argument using evidence describing how energy is transferred and conserved.**	**Energy and Matter** **Conduct experiment to determine the thermal conductivity of different substance.**
PS3.B The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment.	**Analyze and interpret data on the thermal conductivity of different substance**	**Energy and Matter** **Conduct experiment to determine the thermal conductivity of different substance.**
PS3.B Energy is spontaneously transferred out of hotter regions or objects and into colder ones.	**Construct explanations and design solutions** **on how energy is transferred from one form to another.**	**Using a model explain how energy transfer from one form another.**
PS3.C When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object.	**Engage in an argument using evidence describing how energy is transferred and conserved.**	**Energy and Matter** **Conduct experiment to determine the thermal conductivity of different substance.**
ETS1.A The more precisely a design task's criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that is likely to limit possible solutions.	Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.	Energy and Matter Conduct experiment or present a demonstration on energy transformation
ETS1.B A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. There are systematic processes for evaluating solutions with respect	Conduct investigation on energy transformation. Analyze and interpret data to determine type of change	Energy and Matter Conduct experiment or present a demonstration on energy transformation

to how well they meet criteria and constraints of a problem.	Propose changes and improvements to experiment and conduct a revised investigation.	

Unit 4 Assessment: Law of Conservation of Energy

EVIDENCE of LEARNING			
Understanding 1, 2, 4, 5	Standards **MS-PS3-5** **PS3.B** 2, 4, 7	**Unit Performance Assessment**: Unit 4 Performance Event **Description of Performance Task:** Students demonstrate their understanding of the Law of Conservation of Energy (PS3.B). They will need to be able to trace energy through a system by identifying its type (potential or kinetic - PS3.A) and its form (chemical, heat, electrical, mechanical, nuclear, radiant, sound). Students should be able to follow the energy from the sun all the way through a wind up toy being used. They will give a description of how the energy is transforming in each step. **Teacher will assess:** *Can Students:* 1. *Determine if the form of energy is potential or kinetics using evidence.* 2. *Determine the form of kinetic energy.* 3. *Provide an explanation an explanation and application of the the Law of Conservation of Energy.* **Performance:** **Mastery:** Students will show mastery of potential and kinetic energy, and the Law of Conservations of Energy when they score a 75% or above on the performance event. **Performance:** **Scoring Guide:** Unit 4 Performance Event Scoring Guide	**R/R Quadrant** **21 Century** B, C critical thinking creativity

Unit 4: Sample Activities

SAMPLE LEARNING PLAN				
Understanding	**Standards**	**Major Learning Activities:**	**Instructional Strategy Category:**	**R/R Quadrant: 21C:**
3- Scale , Proportion, and Quantity 4- Systems and System Models 5- Energy and Matter	MS-PS3-5 PS3.A PS3.B PS3.C PS3.D *2- Develop and use models* *7-Engage in Arguments from Evidence*	**Lesson 1**: Energy and Transfer Overview Slide Presentation **Objective**: Students will be able to: • state how energy is different than matter. • explain the difference between potential energy and kinetic energy. • identify the different forms of energy and provide examples of each. • describe the flow of forms of energy from a car engine. **Activity:** Teacher presents an interactive slide presentation on energy and its different forms. Students take notes on the different forms, create a flowchart/model of the flow of energy in a system, and watch discuss a variety of objective related videos. Assigned Chapter 9-2 Energy Direct Read **Check for understanding:** Teacher has students complete and exit card on the flow of energy of a car - see presentation for details.	Summarizing and note taking Assigning Homework and Providing Practice Identifying Similarities and Differences	*A* *Communication* *Critical Thinking*
3- Scale , Proportion, and Quantity 4- Systems and System Models 5- Energy and Matter	**MS-PS3-1** **MS-PS3-2** **MS-PS-3.B** PS3.B PS3.C 3- Plan and Carry Out Investigations	**Lesson 2**: Energy Conversion in a System Simulation - Gizmo **Objective**: Students will be able to describe how gravitational potential energy can be converted into heat energy and use the gravitational potential energy equation to calculate an object's potential energy. **Activity:** Students explore different ways to heat a glass of water. The Student Exploration sheet contains three activities: Activity A – Students determine how changing the cylinder's height affects how much energy it transfers to the water. Activity B – Students determine how changing the cylinder's mass affects how	Summarizing and note taking Identifying Similarities and Differences Generating and	*C* *Communication* *Critical Thinking*

	4- Analyze and Interpret Data ISTE 3b	much energy it transfers to the water. Optional Activity C – Students discover the relationship between heat and temperature and calculate the specific heat capacity of water. Student Exploration Sheet Student Exploration Key Energy Conversion in a System Vocabulary Sheet Teacher Guide Observe that a falling weight attached to a stirring device can cause water to heat up. Relate the potential energy of the weight to the temperature change in the water. Investigate how the mass and initial temperature of water affect its temperature change. Calculate the specific heat capacity of water. **Check for understanding:** Student Gizmo Assessment - Energy Conversion in a System Online Assessment	Testing Hypotheses	
3- Scale , Proportion, and Quantity 4- Systems and System Models 5- Energy and Matter	MS-PS-4 PS3.B 3- Plan and Carry Out Investigations 4- Analyze and Interpret Data ISTE 3.b	**Lesson 3**: Heat Transfer by Conduction Simulation Gizmo **Objective**: Students will be able to explain the relationship between the rate of temperature change and the temperature difference between the two containers. **Activity:** Students will measure the rate of heat transfer through a material that connects two beakers of water with different initial temperatures. Four different materials (aluminum, copper, steel, and glass) can be compared and classified. The Student Exploration sheet contains two activities: Activity A – Students relate the rate of heat transfer to the temperature difference between the water in two beakers. Activity B – Students compare the rate of heat transfer through different materials. Student Exploration Sheet Student Exploration Key Heat Transfer Vocabulary Sheet Teacher Guide Students will observe and measure the transfer of heat from one container to another via a thermal conductor, interpret a graph of heat transfer, compare the	Identifying Similarities and Differences Generating and Testing Hypotheses	*C* *Communication* *Critical Thinking*

		rate of heat transfer for different materials and classify materials as thermal conductors or thermal insulators. **Check for understanding:** Student Gizmo Assessment - Heat Transfer Online Assessment		
4- Systems and System Models 5- Energy and Matter	MS-PS3-1 MS-PS3-2 PS3.B PS3.C 3- Plan and Carry Out Investigations 4- Analyze and Interpret Data	**Lesson 4: Potential and Kinetic Energy Lab** **Objectives:** Students will be able to: • define, describe and show how to calculate potential energy. • define, describe and show how to calculate kinetic energy. • describe how potential and kinetic energy are related to the principle of conservation of energy. **Activity:** Students working in lab groups will be visiting stations to explore Kinetic and Potential Energy under different circumstances. Students will create hypotheses, collect data, construct graphs and interpret the data. Students will discover how force, height and mass effect GPE and conversion to KE. **Check for Understanding:** Upon completion of the lab, teacher assigns PE KE Calculation worksheets as homework GPE Worksheet PE KE Worksheet	Identifying Similarities and Differences Generating and Testing Hypotheses	*A* *Communication* *Critical Thinking*
3- Scale , Proportion, and Quantity 4- Systems and System Models 5- Energy and Matter	**MS-PS-3** **PS3.A** **PS3.B** **PS3.C** 3- Plan and Carry Out Investigations 4- Analyze and	**Lesson 5**: Energy Conversion Simulation - Gizmo **Objective**: Students will be able to: • create energy pathways to show where our energy comes from. • describe the different forms of energy. • identify ways that energy is converted from one form to another. • determine that sunlight is the primary source of most of the usable energy on Earth. Solar cells convert sunlight to electricity. Sunlight causes wind and rain, powering wind turbines and hydroelectric dams. Sunlight provides energy for plant growth. Plants or plant remains can be burned or eaten to provide energy. • describe four types of renewable resources. (Extension)	Identifying Similarities and Differences Generating and Testing Hypotheses	*B* *Communication* *Critical Thinking*

	Interpret Data ISTE 3.b	**Activity:** In the Energy Conversion Gizmo, students explore ways that energy can be converted from one form to another. The Gizmo allows students to create a variety of energy pathways, all beginning with the Sun. The Student Exploration sheet contains three activities, one of which is an extension: Activity A – Students practice building energy paths. Activity B – Types of energy are defined and energy conversions are identified. Extension – Students describe four types of renewable resources. Student Exploration Sheet Student Exploration Key Energy Conversion Vocabulary Sheet Teacher Guide **Check for understanding:** Student Gizmo Assessment - Energy Conversion Online Assessment		
3- Scale , Proportion, and Quantity 4- Systems and System Models 5- Energy and Matter	MS-PS3-4 PS3.A PS3.B 3- Plan and Carry Out Investigations 4- Analyze and Interpret Data	**Lesson 6:** Thermal Conductivity Demonstration (can be modified to be a stand alone lab group investigation.) **Objective:** Students will be able to: ● provide evidence to support the concept that the amount of energy transfer needed to change the temperature of a sample by a given amount depends on the thermal conductivity of the matter, the size of the sample, and the environment. ● determine the essentials elements of scientific investigation (IV, DV and constants). **Activity:** This activity can be teacher demonstrated or investigation can be conducted by a student lab group. Students complete a pre-lab assignment on key terms. Using the 5-rod conductormeter consisting of a brass center about 19mm in diameter to which is attached to a wooden handle and from which five different metals extend radially. Near the end of each rod there is a depression for holding wax. All wax should be of equal size. The conductormeter will be held over a heat source with the wax facing upwards. As soon as the conductormeter is over the heat source record time (sec) for each metal rod to	Assigning Homework and Providing Practice Summarizing and note taking Identifying Similarities and Differences Generating and Testing Hypotheses	*A* *Communication* *Critical Thinking*

		melt the wax. Data is collected and record in a data table. Complete three trials. Results are graphed. Students answer questions that relate to the demonstration. **Check for understanding:** Prior to the demonstration, investigation, conduct a teacher led discussion using the pre-lab terms. Teacher conducts a review of the key terms after the data was collected and asks how the investigation results relate to the key terms.		
3- Scale , Proportion, and Quantity 4- Systems and System Models 5- Energy and Matter	MS-PS3-3 MS-PS3-4 **MS-PS3-5** PS3.B PS3.D ETS1.A ETS1.B ETS1.C 2- Develop and use Models 3-Plan and Carry Out Investigations 4- Analyze and Interpret Data 6- Construct Explanations and Design Solutions 7- Engage in Arguments	**Lesson 8:** Save the Penguins is a series of lessons designed to help students understand concepts related to heat and energy as well as teach them the basics of engineering design. They also come away with a sense of how engineers are people who design solutions to problems. The students' goal is to design and build a shelter for an ice cube shaped penguin that reduces heat transfer and keeps the ice from melting. **Concepts Explored:** Heat transfers in predictable ways · Engineers follow a general process to design solutions to problems. **Lesson 8.1** – Introduction and Insulation · Heat transfers from areas of high temperatures to areas of lower temperature. · Insulators slow down the rate of heat transfer. Engineers must identify the problem in order to solve it. **Lesson 8.2** – Conduction, Radiation, and Convection · Heat transfers in three different ways. · Engineers must research and understand the problem in order to solve it. **Lesson 8.3** – Review of Heat Transfer and Introduction to Experimental Design Materials affect the rate of heat transfer. · Different materials vary in their ability to reduce heat transfer. · Engineers must use their knowledge of science to brainstorm possible solutions to the problem. **Lesson 8.4** – Design and Construct Penguin Dwellings · Materials can be used in conjunction with one another to affect the rate of heat transfer. · Different materials prevent different types of heat transfer. · Engineers work within constraints (time, materials, space, money) and use scientific knowledge and	Summarizing and note taking Identifying Similarities and Differences Generating and Testing Hypotheses Cooperative learning	*A, B, C, D* *Critical thinking* *Collaboration* *Communication* *Creativity*

	from Evidence ISTE 3a, 3c, 3d, 4a, 6a,6b, 6c, 6d	creativity to design solutions to problems. **Lesson 8.5**– Test Penguin Dwellings, Re-design and Final Testing · Scientific knowledge can be used in the design, construction, and evaluation of a device. · Engineering is an iterative process of designing, testing, re-designing, and retesting. · Engineers must document their process of design and present their solution to the problem. **Check for understanding:** See Save The Penguins, Appendix B Assessment on Heat Transfer **Additional Resources related to Save the Penguin Project**		

Unit 4: Resources

UNIT RESOURCES
Teacher Resources: ● Physical Science, Holt, Teacher's Edition ©2007 ● Scientific Method Resources Folder ● *Roller coasters - http://www.funderstanding.com/k12/coaster/* ● *Teacher's domain - http://www.teachersdomain.org/resources/hew06/sci/phys/maf/rollercoaster/index.html* ● *www.brainpop.com Potential Energy* ● *www.brainpop.com Kinetic Energy* ● *www.brainpop.com Energy Sources* ● *www.brainpop.com Forms of Energy* ● *www.brainpop.com Heat* ● *United Streaming – Exploring Energy* ● *Energy conversions calculator - http://www.uccs.edu/~energy/courses/energyconv.html* ● *Energy kids page - http://www.eia.doe.gov/kids/energyfacts/science/energy_calculator.html* ● *"Stop Faking It—Energy" p. 100* ● *United Streaming – Exploring Heat* ● www.brainpop.com Electromagnetic Spectrum – Do the Wave ● www.brainpop.com Refraction and Diffraction – More Than Just a Trick of the Light ● www.brainpop.com Light ● www.science-class.net

- Youtube Heat Transfer video
- www.classzone.com
- Energy Resource Folder
- CK-12 Foundation - Physical Science Resources
- Energy and Transfer Overview Slide Presentation

Student Resources:

- *Physical Science, Holt, Student Edition ©2007*
  Phet interactive http://phet.colorado.edu/
  Scholastic http://www.scholastic.com/teachers/activity/energy-light-and-sound-10-studyjams-interactive-science-activities

Vocabulary:

- **Energy** - the ability to do work and cause change
- **Potential energy** - the energy that an object has because of the position, shape, or condition of the object; energy that is stored
- **Kinetic energy** - the energy of an object that is due to the object's motion; energy in moving things
- **Law of Conservation of Energy** - energy cannot be created nor destroyed, it can only be converted from one form to another
- **Energy conversion** - a change from one form of energy to another
- **Thermal energy** - the random motion (**kinetic energy**) of molecules or atoms within a substance
- **Temperature** - a measure of the average kinetic energy of the particles in an object
- **Conduction** - heat transferred by contact of particles
- **Convection** - heat transferred by currents in a fluid
- **Radiation** - heat transferred by electromagnetic waves
- **Insulator** - a material that does not easily transfer heat between its particles
- **Conductor** - a material that easily transfers heat between its particles
- **Thermal conductivity** - physical property of matter, the rate at which heat passes through a specified material, expressed as the amount of heat that flows per unit time through a unit area with a temperature gradient of one degree per unit distance.
- **Joules -** the SI unit of work or energy

Unit 5: Waves and Their Properties

Content Area: Science	**Course: Physical Science 8th Grade**	**UNIT: Waves and their Properties**
Unit Description: This unit will discuss the different properties of waves and the behaviors of waves when they interact with matter. The central ideas focus around sound waves, light waves, and the paths that they travel.		**Unit Timeline:** 3 weeks

DESIRED Results
Transfer Goal - ***Students will be able to independently use their learning to……*** 1. Ask questions and define problems. 2. Develop and use models. 3. Plan and carry out investigations. 4. Analyze and interpret data. 5. Use mathematical and computational thinking. 6. Construct explanations and design solutions. 7. Engage in an argument from evidence. 8. Obtain, evaluate, and communicate information.

Understandings (Cross Cutting Concepts) – *Students will understand… (Big Ideas)*

1. Patterns
2. Cause and Effect
3. Scale, Proportion, & Quantity
4. Systems & System Models
5. Energy and Matter
6. Structure and Function
7. Stability and Change

Essential Questions: ***Students will keep considering…***

- What are the characteristic properties of waves and how can they be used?
- What is the relationship between frequency and wavelength?
- Does blue light travel any faster than red light? Does infrared travel faster than gamma radiation?
- How would the moon look different to you through a telescope compared to just using your eyes?
- Why do you SEE fireworks before you HEAR them?

Phenomena used to anchor the unit:
Images shift when looking through water
Bluebirds aren't blue

Standards Addressed		
Students who demonstrate understanding can: MS-PS4-1 Use mathematical representations to describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave. [Clarification Statement: Emphasis is on describing waves with both qualitative and quantitative thinking.] **MS-PS4-2 Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials. [Clarification Statement: Emphasis is on both light and mechanical waves. Examples of models could include drawings, simulations, and written descriptions.]**		
Disciplinary Core Ideas **Students will know...**	**Science and Engineering Practice** **Students will be able to...**	**Cross Cutting Concepts** **Students will understand...**
PS4.A A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude.	Use mathematical thinking to identify the frequency, amplitude, and wavelength of a wave model. Develop and use models to represent a longitudinal and transverse wave.	Patterns to observe the repetition of a wavelength, frequency, and amplitude.
PS4.A A sound wave needs a medium through which it is transmitted.	Develop a model of a mechanical wave and identify its key components (crest, trough, amplitude, frequency, wavelength).	The structure of a sound wave to identify relevant characteristics of the wave after it has interacted with material.

	Analyze and interpret data regarding the characteristics of the wave after it has interacted with different mediums at different states and temperatures. (e.g., frequency, amplitude, wavelength)	
PS4.B When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light.	**Construct an explanation regarding the interaction of light waves with different materials (reflected, absorbed, transmitted).** **Develop and use models to describe why materials with certain properties are well-suited for particular functions (e.g., lenses and mirrors, sound absorbers, colored light filters, sound barriers).**	**Structure of light wave to determine if it will reflect, absorb or transmit through material.**
PS4.B The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends.	Explain that light waves can travel in straight lines through empty space. Obtain and evaluate information from light waves that bend at the interface between materials when it travels from one material to another.	Cause and effect relationship between the structure of a light wave and the type of material it interacts with to determine behavior.
PS4.B A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media.	**Analyze the electromagnetic spectrum and interpret the relationship between wavelength and the amount of energy the wave carriers.**	**Patterns to analyze the relationship between the 7 types of electromagnetic waves (Gamma, x-rays, ultraviolet, visible, infrared, microwaves, radio).**
PS4.B However, because light can travel through space, it cannot be a matter wave, like sound or water waves.	Construct explanations that demonstrate light does not require a material for transmission, but matter waves do require a material for transmission.	Structure of a light wave and a sound wave to determine the types of materials they can travel through.

	Develop and use a model for the interaction of the particles in a light wave and show its movement through empty space.	Understanding of energy and matter to evaluate the movement of a light wave through empty space and material.

Unit 5 Assessment: Slinky Lab

EVIDENCE of LEARNING			
Understanding *1,4,5,6*	Standards MS-PS4-1 **MS-PS4-2**	**Unit Performance Assessment**: **Description of Performance Task:** Unit 5 Performance Event Students will be completing a lab to view a longitudinal wave and transversal wave through the medium of a slinky. Students will follow a set of procedural steps to imitate the movement through the coils of a slinky and will answer analysis questions. After completion of the lab, students will be asked to apply this concept to earthquakes and the way seismic waves travel. They will be given a prompt comparing longitudinal and transverse waves to p and s waves. Students will be asked to compare the different waves. Using their data from the lab, students will need to decide whether p or s waves move faster and which would be more destructive. Students apply their understanding of the way each wave moves and explain why it changes when the waves travel through different mediums. **Teacher will assess:** *What criteria will be used in each assessment to evaluate attainment of the desired results?* Teacher will assess the students understanding of the following items: 1. Difference between the movement of a longitudinal wave and transverse wave. 2. Speed of the different waves. 3. Application of information to seismic waves.	**R/R Quadrant** **21 Century** C critical thinking collaboration

		Performance: **Mastery:** Students will show that they really understand the way a wave is transmitted through different material when they score a 75% or above on the performance event. **Scoring Guide:** Unit 5 PE Scoring Guide	

Unit 5: Sample Activities

SAMPLE LEARNING PLAN				
Understanding	**Standards**	**Major Learning Activities:**	**Instructional Strategy Category:**	**R/R Quadrant: 21C:**
2. Cause and Effect 4. Systems and System Models 5. Energy and Matter	PS4.A Analyze and interpret Data Develop and use models Use mathematical and computational thinking ISTE.4.c	**1. Lesson**: Waves on a String **Objective**: Students will be able to make observations about the relationships between frequency, wavelength, speed of waves in a rope, and observe how these change with changing tension in the rope. **Activity:** Waves on a String Student Worksheet In this activity, students will be completing an online simulator called Waves on a String through PHeT. (http://phet.colorado.edu) They will begin by looking at the relationship between the amplitude of a wave and the wave speed. From there, students will evaluate the relationship between tension and wave speed. They will end with one last experiment relating wavelength and frequency. There are procedural steps on the student sheet along with conclusion questions. **Check for understanding:** Students will complete the lab sheet and answer the conclusion questions after they have completed the online simulator.	Non-linguistic representations	A Critical Thinking
2. Cause and effect 5. Energy and matter	PS4.A 4-Analyzing and interpreting data	**Lesson**: Sound Waves **Objective:** Students will perform several activities that will demonstrate that the properties and interactions of sound all depend on the energy carried by sound waves. **Activity:** Sound Wave Lab	Non-linguistic representations Summarizing and note taking	C Collaboration, Communication,

	Obtain, evaluate, and communicate information	Students will perform several activities: A. Students place a vibrating tuning fork in water to demonstrate how sound waves vibrate matter. B. Students use a tuning fork to demonstrate how the frequency of a sound wave travels through the air and causes another tuning fork to vibrate. C. Students use two tuning forks to observe constructive and destructive interference. D. Students observe how the doppler effect causes a listener to perceive a higher pitch sound when a sound wave is moving toward them and a lower pitch when a sound is moving away from them. These activities will demonstrate that sound waves vibrate, have resonance, have constructive and destructive interference, and produce the doppler effect. Making a Doppler Ball **Check for understanding:** Lab questions will be assigned as homework.	Assigning Homework and Providing Practice	Critical Thinking
1-Patterns	PS4.B 4-Analyzing and Interpreting Data	**Lesson**: Looking Through Lenses Activity **Objective**: Students will evaluate light waves as they are refracted, reflected and diffracted through different materials. Students will also evaluate light as it bends through concave and convex lenses to construct an explanation regarding the interaction of light waves with different materials (reflected, absorbed, transmitted) **Activity:** Introduce the Interaction of Light Waves with the Interaction of Light SMART Notebook which includes four quick lab activities: Law of Reflection, Refraction Rainbow, Scattering Milk, and Mixing Colors. Looking Through Lenses Lab The students will use convex and concave lenses to look at different objects and draw how the lenses (transparent materials, e.g. glass) bend the light. **Check for understanding:** Exit Question: Why is an image right side up on the back of a spoon but upside down on the inside of a spoon?	Non-linguistic representations Summarizing and note taking	B Collaboration, Critical Thinking

1 - Patterns, 2- Cause and Effect	PS4.B 2-Develop and Use Models	**Lesson**: Shifting Images in Water **Objective**: Students will be able to describe the concept of refraction and how it affects the way an image is viewed. **Activity:** Each lab group will need the following: ● clear glass of water ● white paper ● writing utensil Students will be asked to draw an image on a white piece of paper. Suggestion: an arrow works best for this activity. Ask the students to hold it behind the glass and look through the water at the image. https://www.ngssphenomena.com/#/looking-through-water/ If viewed correctly, students will see an image that is reversed from what they drew. They are demonstrating refraction of light. There should then be a teacher led discussion about how when light passes from one material to another, it can bend, or refract. **Check for understanding:** Students will complete an exit slip asked them to draw what is happening to the light between the eye and the glass of water. Example: http://www.physicscentral.com/experiment/physicsathome/images/convexlenstree.jpg	Non-linguistic representations Summarizing and note taking	C Creativity, Critical Thinking
5 - Energy and Matter 6 - Structure and Function	PS2.B Obtain, evaluate, and communicate information	**Lesson**: Electromagnetic Spectrum Sketch notes **Objective**: Students will be able to describe the 7 different types of electromagnetic waves and their properties. **Activity:** Students will be completing sketch style notes that focus around the electromagnetic waves. Each student will receive a Notes Sheet that allows room to give a general	Summarizing and note taking	A Critical Thinking

		definition of electromagnetic spectrum and wave length. Students will be asked to draw the change of wavelength from low energy to high energy. There is space for students to give an example and give a description for each of the 7 types of waves. This can be done as whole class instruction or individually. Students can use tech devices or textbooks to look at the different types of waves and fill in the notes. Students can then talk with their shoulder partners about their findings and collaborate on their understandings. **Check for understanding:** Students will be given an exit slip and asked the answer the following question: Why is it important for EM waves to be able to travel through empty space?		

Unit 5: Resources

UNIT RESOURCES
Teacher Resources: ● www.brainpop.com Electromagnetic Spectrum – Do the Wave ● www.brainpop.com Refraction and Diffraction – More Than Just a Trick of the Light ● www.brainpop.com Light ● www.science-class.net ● www.classzone.com ● United streaming: Sound, Waves: Energy in Motion, ● Holt Science- Virtual Investigations CD ● Teacher Resources - http://www.acoustics.salford.ac.uk/schools/teacher/lesson1/lesson1interactive.html ● Sound waves: What do they look like? http://www.fi.edu/fellows/fellow2/apr99/soundvib.html· Science Court, Sound - Tom Synder ● www.brainpop.com Waves – Surf's Up Dude ● www.brainpop.com Sound – Good Vibrations ● www.brainpop.com Hearing
Student Resources: ● *Phet interactive http://phet.colorado.edu/* ● *Scholastic http://www.scholastic.com/teachers/activity/energy-light-and-sound-10-studyjams-interactive-science-activities*
Vocabulary: ● **Reflection** - occurs when a wave strikes an object or surface and bounces off

- **Refraction** - the bending of a wave as it moves from one medium into another medium
- **Transparent material** - a material that transmits light without scattering it
- **Translucent material** - matter that transmits light but that does not transmit an image
- **Opaque material** - an object that is not transparent or translucent; a material that reflects or absorbs all of the light that strikes it
- **Convex lens** - a lens that is thicker in the center than at the edges; the rays are refracted toward each other
- **Concave lens** - a lens that is thinner in the center than at the edges; the rays are refracted away from each other
- **Longitudinal wave** - a wave moves in the same direction as the medium
- **Vibration** - a repeated back and forth or up and down motion
- **Sound wave** - a longitudinal wave that is caused by vibrations and that travels through a material medium
- **Wavelength** - the distance between two corresponding parts of a wave
- **Amplitude** - the maximum distance the particles of a medium move away from their rest positions.
- **Speed** - the distance a wave travels per unit of time
- **Frequency** - the number of complete waves that pass a given point in a certain amount of time
- **Hertz** - unit of measurement for frequency equaling the number of waves per second (Hz)
- **Mechanical wave** - a wave that travels through a medium
- **Rarefaction** - the part of longitudinal wave where the particles of the medium are far apart
- **Compressions** - the part of longitudinal wave where the particles of the medium are close together
- **Pitch** - a description of how high or low a sound seems to a person
- **Doppler effect** - an observed change in the frequency of a wave when the source or the observer is moving