Warren Township Schools
Science Curriculum
8th Grade

Structure and Properties of Matter

NGSS Performance Expectations

Students who demonstrate understanding can:

MS-PS1-1. **Develop models to describe the atomic composition of simple molecules and extended structures.**

MS-PS1-3. **Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.**

MS-PS1-4. **Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.**

DCI:PS1.A: Structure and Properties of Matter	Student Learning Objectives	Suggested Assessments
• 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. (MS-PS1-1) • Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS-PS1-3) *(Note: This Disciplinary Core Idea is also addressed by MS-PS1-2.)* • Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. (MS-PS1-4) • 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. (MS-PS1-4) • Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). (MS-PS1-1) • The changes of state that occur with variations	• Understand the composition of matter is made up of atoms that may join together to form molecules, and that the state of matter is determined by the arrangement and motion of the atoms and molecules • Apply definition for atom, element and molecule • Classify and distinguish between pure substances as elements or compounds and mixtures • Differentiate between solutions, suspensions, or colloid • Explain and measure properties of matter such as mass, volume, weight, density, etc • Calculate and compare substance based on density • Observe, identify and apply the physical properties of matter while collecting data • Understand differences and analyze data to determine physical properties, physical changes, chemical properties, and chemical changes • Predict the identity of a substance based on the evidence that indicated a physical	• Introduction to Matter Self Reflection Form • Property of Matter Anchor Activity • General Properties of Matter Lab • Properties of Matter Assessment • Recognizing Physical & Chemical Changes Lab Check • Classification of Matter Lab (Pins & Outs of Matter) • Scientific Law of Volume Lab • Liquid Olympics Lab • CSI Warren Lab • Separate a Mixture Lab • Gummy Bear Lab • Mega Density Stations Lab • Oil Spill Solutions Project • Oil Spill Solution Project Rubric • Determining the Densities of a Liquid Lab Check • Distillation Lab • Pressure vs. Volume Lab • Pressure Quiz • Gas Laws Quiz • Density Quiz • Conclusion Writing Rubric

in temperature or pressure can be described and predicted using these models of matter. (MS-PS1-4)	change has taken place • Compare and identify substances based on density • Describe the relationship between density and whether an object sinks or floats • Utilize concepts of density to act as environmental & chemical engineers during a manmade disaster • Plan, design, construct, test and analyze a containment and collection system to an aquatic oil spill • Identify the physical properties that allow separation of a mixture and experiment with various methods • Apply filtration and distillation methods to separate a mixture of sand and salt and analyze data • Describe states of matter and explain the difference between them • Describe how energy is involved in a phase change and explain what happens to the motion, arrangement, and average kinetic energy of molecules during phase changes • Define pressure and gas pressure • Observing the behavior of gases • Predict and identify changes in gas pressure due to changes in temperature, volume, and number of particles	
DCI: PS1.B: Chemical Reactions	**Student Learning Objectives**	**Suggested Assessments**
• 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. (MS-PS1-3) *(Note: This Disciplinary Core Idea is also addressed by MS-PS1-2 and MS-PS1-5.)*	• Describe chemical properties of matter • Describe clues that indicate a chemical change is taking place • Distinguish chemical changes from physical changes • Observe, identify and explain chemical changes of matter • Show how substances can react to form new substances with different properties	• CSI Warren Lab • Recognizing Physical and Chemical Changes Lab • A Simple Chemical Reaction Lab • Conclusion Writing Rubric

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	in a chemical reaction • Analyze data to determine physical properties, physical changes, chemical properties, and chemical changes	
DCI: PS3.A: Definitions of Energy	**Student Learning Objectives**	**Suggested Assessments**
• 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. *(secondary to MS-PS1-4)* • 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 internal energy) of a system depends jointly on the temperature, the total number of atoms in the system, and the state of the material. *(secondary to MS-PS1-4)*	• Describe how energy is involved in a phase change • Explain what happens to the motion, arrangement, and average kinetic energy of water molecules during phase changes • Describe states of matter and explain the difference between them	• Boiling Point of Water Lab - Vernier LabQuest Probeware • Gizmo: Phases of Water and Molecular Movement • Borax Snowflake Lab • Can Crusher Lab • Pressure Vs. Volume Lab - Lab Quest • Gizmo: Boyle’s & Charles’ Law • Producing H_2 Gas Lab • States of Matter Assessment • Conclusion Writing Rubric

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Science and Engineering Practices	Crosscutting Concepts
• Developing and Using Models • Obtaining, Evaluating, and Communicating Information	• Cause and Effect • Scale, Proportion, and Quantity • Structure and Function ***Connections to Engineering,Technology, and Applications of Science*** • Engineering advances have led to important discoveries in virtually every field of science and scientific discoveries have led to the development of entire industries and engineered systems. (MS-PS11-1) • The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by differences in yearsuch factors as climate, natural resources, and economic conditions. Thus technology use varies from region to region and over time. (MS-PS1-3)

Available Resources

Physical Science Concepts in Action: Chapter 2 & 12
General Properties of Matter Exploration & Self-Reflection
"The Atoms Family" Song
Kinetic Theory of Matter - Popcorn Demonstration
Scientific Law of Volume Demonstration
Demo A Day: Density, Pressure & Gas Laws Demonstrations
BrainPop website www.brainpop.com
STC/MS Properties of Matter Module
Scholastic.com/ScienceWorld www.scholastic.com/scienceworld
Explore Learning Gizmo simulations www.explorelearning.com
Ted Ed Video - Archimedes https://www.youtube.com/watch?v=ijj58xD5fDI&list=PL3sajqULMjvt3YiMjcbW_3elbELzO2Hqy&index=24

Unit Summary

In this unit, students will formulate an answer to the question, "How do atomic and molecular interactions explain the properties of matter that we see and feel?" by building an understanding of what occurs at the atomic and molecular scale. Students will be able to apply understanding that pure substances have characteristic physical and chemical properties and are made from a single type of atom or molecule. They will be able to provide molecular level accounts to explain states of matters

and changes between states. The crosscutting concepts of patterns; cause and effect; scale, proportion and quantity; energy and matter; structure and function; interdependence of science, engineering, and technology; and influence of science, engineering and technology on society and the natural world are called out as organizing concepts for these disciplinary core ideas. Students will develop and demonstrate proficiency in developing and using models, analyzing and interpreting data, designing solutions, and obtaining, evaluating, and communicating information.

Prior Knowledge and Skills

By the end of 5th grade students will understand that:

- A situation that people want to change or create can be approached as a problem to be solved through engineering. Such problems may have many acceptable solutions.
- Asking questions, making observations, and gathering information are helpful in thinking about problems.
- Before beginning to design a solution, it is important to clearly understand the problem.
- Designs can be conveyed through sketches, drawings, or physical models. These representations are useful in communicating ideas for a problem's solutions to other people.
- Because there is always more than one possible solution to a problem, it is useful to compare and test designs.
- People also use a variety of devices to communicate (send and receive information) over long distances.

Students will be expected to have a an understanding of laboratory safety, measurement tools, bunsen burner use, variable identification, identify problems that can be solved by conducting experiments, and perform calculations involving dimension analysis. These skills will be reinforced during this unit through inquiries which explore the structure and properties of matter.

Anticipated instructional days for unit: 35 days

Technology, Differentiation and Assessment Strategies:

https://docs.google.com/document/d/1KITFsbhtE1NLWTV9D2MLB0_MBHYxbq-ISfwl6uBTtic/edit

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Chemical Reactions

NGSS Performance Expectations

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.**

MS-PS1-5. **Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.**

MS-PS1-6. **Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.***

DCI: PS1.A: Structure and Properties of Matter	Student Learning Objectives	Suggested Assessments
• Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS-PS1-2) *(Note: This Disciplinary Core Idea is also addressed by MS-PS1-3.)*	• Understand the atom using the Periodic Table • Identifying the protons, neutrons, and electrons of an atom • Drawing Lewis Dot Diagram • Drawing Bohr Diagrams of the atom • Count atoms in a chemical formula • Describe how properties of elements change across a period in the Periodic Table • Explain how atomic mass is determined and how atomic mass units are defined • Predict the density of germanium based on the density of elements in the Carbon Family • Graph data and formulate a line of best fit	• The Periodic Table Basics Project • The Structure of an Atom and Periodic Table Basics Quiz • PADLET PROJECT • Periodic Table Assessment • A Good Cold Pack Lab • Periodic Table Basics Project • Chemistry Battleship • Drawing Atomic Structures - Lewis and Bohr Diagrams • Alien Periodic Table • Conclusion Writing Rubric
DCI: PS1.B: Chemical Reactions	**Student Learning Objectives**	**Suggested Assessments**

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• 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. (MS-PS1-2),(MS-PS1-5) *(Note: This Disciplinary Core Idea is also addressed by MS-PS1-3.)* • The total number of each type of atom is conserved, and thus the mass does not change. (MS-PS1-5) • Some chemical reactions release energy, others store energy. (MS-PS1-6)	• Become familiar with chemical properties to identify unknowns • Identify properties and predict the reactivity of some elements based on their locations within a group/family • Identify the general properties of metals nonmetals, and metalloids • Relate the properties of ionic compounds to the structure of crystalline lattices • Understand that atoms are most stable with a full set of 8 valence electrons • Calculate the charge of an ion by subtracting the number of electrons from protons • Count atoms in a chemical formula and a chemical equation • Interpret chemical equations in terms of reactants, products, and conservation of mass • Balance equations by manipulating coefficients • Describe the law of conservation of mass • Classify chemical equations as Combination (Synthesis), Decomposition, Single, and Double Replacement reactions • Recognize the characteristic colors given off by the atoms of certain metals when the electrons are heated to higher energy levels	• The Periodic Table Basics Project • The Structure of an Atom and Periodic Table Basics Quiz • Alien Periodic Table • Flame Test Lab Check • Periodic Table Assessment • Ionic Bonding Quiz • Chemical Bonding Assessment • Chemical Equation and Types of Chemical Equations Test • Balancing Equations • Flame Test Lab • Alkaline Earth Metals Lab • Predicting the Density of an Element Lab • Drawing Ionic and Covalent Bonds • Oxidation Numbers and Criss-Cross Method • Gizmo: Covalent Bonds • Candy Compounds Bonding Lab • Comparing Compounds Lab (Liver Lab) • Law of Conservation of Mass Lab (Reaction in a Bag) • Balancing Chemical Equations • Gizmo: Balancing Chemical Equations • Synthesis Lab • Decomposition Lab • Single-Displacement Lab • Double-Displacement Lab • Conclusion Writing Rubric
DCI: ETS1.B: Developing Possible Solutions	**Student Learning Objectives**	**Suggested Assessments**
• A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. *(secondary to MS-PS1-6)*	• Develop and test a plan for making the best cold pack using various solid substances and water	• A Good Cold Pack Lab • Engineering Design Practices • Conclusion Writing Rubric
DCI: ETS1.C: Optimizing the Design Solution	**Student Learning Objective**	**Suggested Assessment**

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• 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. *(secondary to MS-PS1-6)* • 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. *(secondary to MS-PS1-6)*	• Some chemical reactions release energy, while others store energy. • The transfer of thermal energy can be tracked as energy flows through a designed or natural system. • Models of all kinds are important for testing solutions. • There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. • A solution needs to be tested and then modified on the basis of the test results in order for it to be improved.	• Evaluate, retest and determine the coldest temperature result using 3.0 grams of one of the solid substances and the best amount of water.

Science and Engineering Practices	Crosscutting Concepts
• Developing and Using Models • Analyzing and Interpreting Data • Constructing Explanations and Designing Solutions	• Patterns • Energy and Matter ***Connections to Nature of Science*** • Scientific knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-PS1-2) • Laws are regularities or mathematical descriptions of natural phenomena. (MS-PS1-5)

Available Resources

Physical Science Concepts in Action: Chapters 4, 5, 6 & 7
The Element Song – Tom Lehere https://www.youtube.com/watch?v=zGM-wSKFBpo
The New Periodic Table Song - Asap Science https://www.youtube.com/watch?v=VgVQKCcfwnU
Meet the Elements Video - They Might be Giants https://www.youtube.com/watch?v=d0zION8xjbM
Ted Ed Video - Genius of Medeleev https://www.youtube.com/watch?v=fPnwBITSmgU&list=PL3sajqULMjvt3YiMjcbW_3elbELzO2Hqy&index=7
Mendeleev Song https://www.youtube.com/watch?v=kuQ0Um4Wcz0&list=PL3sajqULMjvt3YiMjcbW_3elbELzO2Hqy&index=8
Don't Break the Law Music Video by Mark Rosengaten https://www.youtube.com/watch?v=QjVYz00-Kxc
Chemical Reaction Video Collection: youtube.com
Brain Pop website www.brainpop.com
Scholastic.com/ScienceWorld www.scholastic.com/scienceworld
Explore Learning Gizmo simulations www.explorelearning.com

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Unit Summary

In this unit, students will formulate an answer to the question, “How do atomic and molecular interactions explain the properties of matter that we see and feel?” by building an understanding of what occurs at the atomic and molecular scale. 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. The crosscutting concepts of patterns and energy and matter provide a framework for understanding these disciplinary core ideas Students will be able to demonstrate proficiency in developing and using models, analyzing and interpreting data, designing solutions, and obtaining, evaluating, and communicating information. Students use these scientific and engineering practices to demonstrate understanding of the disciplinary core ideas.

Prior Knowledge and Skills

By the end of Grade 5, students understand that:

- When two or more different substances are mixed, a new substance with different properties may be formed.
- No matter what reaction or change in properties occurs, the total weight of the substances does not change.

Students will be expected to have an understanding of laboratory safety, measurement tools, bunsen burner use, variable identification, identify problems that can be solved by conducting experiments, and perform calculations involving dimension analysis. These skills will be reinforced during this unit through inquiries which explore chemical reactions.

Anticipated instructional days for unit: 40 days

Technology, Differentiation and Assessment Strategies:
https://docs.google.com/document/d/1KITFsbhtE1NLWTV9D2MLB0_MBHYxbq-ISfwl6uBTtic/edit

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Forces and Interactions

NGSS Performance Expectations

Students who demonstrate understanding can:

MS-PS2-1. **Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects.***

MS-PS2-2. **Plan 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.**

MS-PS2-4. **Construct and present arguments using evidence to support the claim that gravitational interactions are attractive and depend on the masses of interacting objects.**

MS-PS2-5. **Conduct an investigation and evaluate the experimental design to provide evidence that fields exist between objects exerting forces on each other even though the objects are not in contact.**

DCI: PS2.A: Forces and Motion	Student Learning Objectives	Suggested Assessments
• 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). (MS-PS2-1) • 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. (MS-PS2-2) • All positions of objects and the directions of forces	• Define that a force is a push or a pull • Explain how the motion of an object is affected when balanced and unbalanced forces act on it • Explain how action and reaction forces are related according to Newton's 3rd Law • Understand and apply concepts of buoyant forces • Explain the difference between mass and weight • Define and apply acceleration due to gravity • Identify Frame of Reference and describe how it is used to measure motion	• Density & Buoyancy Assessment • Motion Formula Quiz • Motion Assessment • Gravity & Newton's Law Quiz • Newton's Law Quiz • Mysterious Journey of a Raisin Lab • Sink, Float or Hover Lab • Intro to Position, Distance & Displacement Practice • Gizmo: Measuring Motion • Speed Challenge Lab • Velocity Lab - Lab Quest • Forces at Work – Vector Diagrams • Gizmo: Free Fall Tower

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. (MS-PS2-2)	• Calculate displacement using vectors • Apply vector addition to real life scenarios • Calculate and analyze speed, velocity and acceleration • Create and understand Position Vs. Time Graphs • Create and understand Velocity Vs. Time Graphs • Describe and Newton's first law of motion and its relation to inertia • Calculate the momentum of an object and describe what happens when momentum is conserved	• Inertia Centers • SPLAT Lab • Balloon Rocket Lab • Conclusion Writing Rubric
DCI: PS2.B: Types of Interactions	**Student Learning Objectives**	**Suggested Assessments**
• 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. (MS-PS2-3) • 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. (MS-PS2-4) • 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). (MS-PS2-5)	• Identify the forms of electromagnetic force that can both attract and repel • Describe the effects of gravity on an object • Discover that in a vacuum, all objects fall at the same rate • Find the terminal velocity of objects falling through air, with or without a parachute • Explain the difference between mass and weight • Collect and analyze data that could include the effect of the number of turns of wire on the strength of an electromagnet	• Investigating Forces and Distance Lab • Weight & Force of Gravity Lab • Playing with Center of Gravity Lab • Making an Electromagnet Lab

Science and Engineering Practices	Crosscutting Concepts

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- Asking Questions and Defining Problems
- Planning and Carrying Out Investigations
- Constructing Explanations and Designing Solutions
- Engaging in Argument from Evidence

Connections to Nature of Science

- Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-PS2-2) (MS-PS2-4)

- Cause and Effect
- Systems and System Models
- Stability and Change

Connections to Engineering,Technology, and Applications of Science

- The uses of technologies and any limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (MS-PS2-1)

Available Resources

Physical Science Concepts in Action: Chapters 11, 12 & 13
Bell Jar and Vacuum Demonstrations
Brain Pop website www.brainpop.com
Scholastic.com/ScienceWorld www.scholastic.com/scienceworld.com
Explore Learning Gizmo simulations www.explorelearning.com
Frame of Reference Video https://www.youtube.com/watch?v=5oSrDrDLylw&list=PL3sajqULMjvt3YiMjcbW_3elbELzO2Hqy&index=5
They Might Be Giants - Speed and Velocity w/ Marty Beller https://www.youtube.com/watch?v=DRb5PSxJerM
TED Ed video - Newton's 3 Laws with a Bicycle https://www.youtube.com/watch?v=JGO_zDWmkvk&list=PL3sajqULMjvt3YiMjcbW_3elbELzO2Hqy&index=17

Unit Summary

In this unit students will generate and explore ideas related to why some objects will keep moving, why objects fall to the ground and why some materials are attracted to each other while others are not. Students will be able to answer the question, "How can one describe physical interactions between objects and within systems of objects?" This unit is broken down into two sub-ideas: Forces and Motion and Types of Interactions. Students will be able to apply Newton's Third Law of Motion to relate forces to explain the motion of objects. Students also apply ideas about gravitational, electrical, and magnetic forces to explain a variety of phenomena including beginning ideas about why some materials attract each other while other repel. In particular, students will develop understanding that gravitational interactions are always attractive but that electrical and magnetic forces can be both attractive and negative. Students also develop ideas that objects can exert forces on each other even though the objects are not in contact, through fields. Students are also able to apply an engineering practice and concept to solve a problem caused when objects collide. The crosscutting concepts of cause and effect; system and system models; stability and change; and the influence of science, engineering, and technology on society and the natural world serve as organizing concepts for these disciplinary core ideas. Students are expected to demonstrate proficiency in asking questions, planning and carrying out investigations, and designing solutions and engaging in argument; and to use these practices to demonstrate understanding of the core ideas.

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Prior Knowledge and Skills

By the end of Grade 5, students understand that:

- Each force acts on one particular object and has both strength and a direction.
- An object at rest typically has multiple forces acting on it, but these forces add to give zero net force on the object.
- Forces that do not sum to zero can cause changes in the object's speed or direction of motion.
- The patterns of an object's motion in various situations can be observed and measured; when the past motion exhibits a regular pattern, future motion can be predicted from it.
- The gravitational force of Earth acting on an object near Earth's surface pulls that object toward the planet's center.
- When objects collide, the contact forces the transfer of energy so as to change the object's motions.

Students will be expected to have an understanding of laboratory safety, measurement tools, bunsen burner use, variable identification, identify problems that can be solved by conducting experiments, and perform calculations involving dimensional analysis. These skills will be reinforced during this unit through inquiries which explore forces and interactions of matter.

Anticipated instructional days for unit: 30 days

Technology, Differentiation and Assessment Strategies:
https://docs.google.com/document/d/1KITFsbhtE1NLWTV9D2MLB0_MBHYxbq-ISfwl6uBTtic/edit

Energy

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NGSS Performance Expectations

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.**

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.**

MS-PS3-3. **Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.***

MS-PS3-4. **Plan an investigation to determine the relationships among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.**

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.**

DCI: PS3.A: Definitions of Energy	Student Learning Objectives	Suggested Assessments
• 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. (MS-PS3-1) • A system of objects may also contain stored (potential) energy, depending on their relative positions. (MS-PS3-2) • 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. (MS-PS3-3),(MS-PS3-4)	• Describe kinetic and potential energy • Relate kinetic energy to mass and speed and calculate these quantities using KE= $1/2mv^2$ • Analyze how potential energy is related to an object's position • Quantify the boiling point of water using probeware	• Potential and Kinetic Energy Lab • Dropper Popper Lab • Investigating a Spring Clip Lab • Boiling Point of Water: LabQuest • Teacher developed assessments including tests, quizzes and projects
PS3.B: Conservation of Energy and Energy	**Student Learning Objectives**	**Suggested Assessments**

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Transfer		
• When the motion energy of an object changes, there is inevitably some other change in energy at the same time. (MS-PS3-5) • 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. (MS-PS3-4) • Energy is spontaneously transferred out of hotter regions or objects and into colder ones. (MS-PS3-3)	• Describe conversion of energy from one form to another • State and apply the law of conservation of energy • Analyze how energy is conserved in conversions between kinetic energy and potential energy and solve equations that equate initial energy to final energy • Explain what happens to the motion, arrangement, and average kinetic energy of water molecules during phase changes	• How Can Energy Change Form Anchor Activity • Gizmo: Potential Energy on a Shelf • Burning a Peanut Lab • Conservation of Energy: Shaking Water Lab • Conclusion Writing Rubric
DCI: PS3.C: Relationship Between Energy and Forces	**Student Learning Objectives**	**Suggested Assessments**
• When two objects interact, each one exerts a force on the other that can cause energy to be transferred to or from the object. (MS-PS3-2)	• Experiment with the different types of friction: static, rolling, fluid, and sliding	• Friction Lab
DCI: ETS1.A: Defining and Delimiting an Engineering Problem	**Student Learning Objectives**	**Suggested Assessments**
• 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. *(secondary to MS-PS3-3)*	• Students will design, construct, test, and re-design (if necessary) a cold pack for treating physical injuries • Determine design criteria and constraints for a device that either minimizes or maximizes thermal energy transfer	• A Good Cold Pack Lab
ETS1.B: Developing Possible Solutions	**Student Learning Objectives**	**Suggested Assessments**
• 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 to how well they meet	• Some chemical reactions release energy, while others store energy • The transfer of thermal energy can be tracked as energy flows through a	• A Good Cold Pack Lab

criteria and constraints of a problem. *(secondary to MS-PS3-3)*	designed or natural system • Models of all kinds are important for testing solutions	

Science and Engineering Practices	Crosscutting Concepts
• Developing and Using Models • Planning and Carrying Out Investigations • Analyzing and Interpreting Data • Constructing Explanations and Designing Solutions • Engaging in Argument from Evidence	• Scale, Proportion, and Quantity • Systems and System Models • Energy and Matter ***Connections to Nature of Science*** • Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-PS3-4)) (MS-PS3-5)

Available Resources

Physical Science: Concepts in Action: Chapters 15 & 16
Brain Pop website www.brainpop.com
Scholastic.com/ScienceWorld www.scholastic.com/scienceworld.com
Explore Learning Gizmo simulations www.explorelearning.com

Unit Summary

In this unit, students formulate an answer to the question, “How can energy be transferred from one object or system to another?” This unit is broken down into four sub-core ideas: Definitions of Energy, Conservation of Energy and Energy Transfer, the Relationship between Energy and Forces, and Energy in Chemical Process and Everyday Life. Students develop their understanding of important qualitative ideas about energy, including that the interactions of objects can be explained and predicted using the concept of transfer of energy from one object or system of objects to another, and that that the total change of energy in any system is always equal to the total energy transferred into or out of the system. Students understand that objects that are moving have kinetic energy and that objects may also contain stored (potential) energy, depending on their relative positions. Students will also come to know the difference between energy and temperature, and begin to develop an understanding of the relationship between force and energy. Students are also able to apply an understanding of design to the process of energy transfer. The crosscutting concepts of scale, proportion, and quantity; systems and system models; and energy are called out as organizing concepts for these disciplinary core ideas. Students will demonstrate proficiency in developing and using models, planning investigations, analyzing and interpreting data, and designing solutions, and engaging in argument from evidence; and to use these practices to demonstrate understanding of the core ideas in PS3.

Prior Knowledge and Skills

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By the end of Grade 5, students understand that:

- Energy is present whenever there are moving objects, sound, light, or heat.
- When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced.
- Light transfers energy from place to place.
- Energy can be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light.
- Transforming the energy of motion into electrical energy may have produced the currents to begin with.
- When objects collide, the contact forces transfer energy so as to change the object's' motion.

Students will be expected to have a an understanding of laboratory safety, measurement tools, bunsen burner use, variable identification, properties of matter, identify problems that can be solved by conducting experiments, and perform calculations involving dimension analysis. These skills will be reinforced during this unit through inquiries which explore energy.

Anticipated instructional days for unit: 30 days

Technology, Differentiation and Assessment Strategies:
https://docs.google.com/document/d/1KITFsbhtE1NLWTV9D2MLB0_MBHYxbq-ISfwl6uBTtic/edit

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Waves and Electromagnetic Radiation

NGSS Performance Expectations

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.**

MS-PS4-2. **Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.**

MS-PS4-3. **Integrate qualitative scientific and technical information to support the claim that digitized signals are a more reliable way to encode and transmit information than analog signals.**

DCI: PS4.A: Wave Properties	Student Learning Objectives	Suggested Assessments
• A simple wave has a repeating pattern with a specific wavelength, frequency, and amplitude. (MS-PS4-1) • A sound wave needs a medium through which it is transmitted. (MS-PS4-2)	• Describe the repeating pattern of waves in terms of a specific wavelength, frequency, and amplitude • Describe a simple model for waves that includes how the amplitude of a wave is related to the energy in a wave • Graphs and charts can be used to identify patterns in data • Waves can be described with both qualitative and quantitative thinking • Explore the properties of waves and the behavior of waves through varying mediums and at reflective endpoints	• How Does a Disturbance Produce Waves Anchor Activity • Observing Waves in a Medium Lab • Comparing Frequency and Wave Speed Lab • Investigating Sound Waves Lab
DCI: PS4.B: Electromagnetic Radiation	**Student Learning Objectives**	**Suggested Assessments**
• 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. (MS-PS4-2) • The path that light travels can be traced as straight	• Classify materials as transparent, translucent or opaque to visible light • Describe what happens when light is reflected, refracted, polarized or scattered • Explain how a prism disperses white light	• Arbor Scientific Light & Color Labs - Light Box & Optical Set • Teacher developed assessments including tests, quizzes and labs

lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends. (MS-PS4-2) ● A wave model of light is useful for explaining brightness, color and the frequency-dependent bending of light at a surface between media. (MS-PS4-2) ● However, because light can travel through space, it cannot be a matter wave, like sound or water waves. (MS-PS4-2)	into different colors ● Analyze factors that determine the color of an object ● Distinguish between matter waves and light waves	
DCI: PS4.C: Information Technologies and Instrumentation	**Student Learning Objectives**	**Suggested Assessments**
● Digitized signals (sent as wave pulses) are a more reliable way to encode and transmit information. (MS-PS4-3)	● Structures can be designed to use properties of waves to serve particular functions ● Waves can be used for communication purposes ● Wave-related technologies extend the measurement, exploration, modeling, and computational capacity of scientific investigations ● Integrate qualitative scientific and technical information in written text with that contained in media and visual displays to clarify claims that digitized signals are a more reliable way to encode and transmit information than analog signals are	● Rotary Phones vs. Cell Phones Project

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Science and Engineering Practices	Crosscutting Concepts
Developing and Using Models ● Using Mathematics and Computational Thinking ● Obtaining, Evaluating, and Communicating Information	● Patterns ● Structure and Function ***Connections to Engineering, Technology, and Applications of Science*** ● Technologies extend the measurement, exploration, modeling, and computational capacity of scientific investigations. ***Connections to the Nature of Science*** ● Advances in technology influence the progress of science and science has influenced advances in technology. (MS-PS4-3) ● Science knowledge is based upon logical and conceptual connections between evidence and explanations. (MS-PS4-1)

Available Resources

Physical Science Concepts in Action Textbook: Chapters 17 & 18
PHeT Simulation: Waves on a String, Sound Waves www.phet.com
Brain Pop website www.brainpop.com
Scholastic.com/ScienceWorld www.scholastic.com/scienceworld.com
Explore Learning Gizmo simulations www.explorelearning.com
Arbor Scientific Light and Color Manual

Unit Summary

In this unit, students formulate an answer to the question, “What are the characteristic properties of waves and how can they be used?” This unit is broken down into Wave Properties, Electromagnetic Radiation, and Information Technologies and Instrumentation. Students are able to describe and predict characteristic properties and behaviors of waves when the waves interact with matter. Students can apply an understanding of waves as a means to send digital information. The crosscutting concepts of patterns and structure and function are used as organizing concepts for these disciplinary core ideas. These performance expectations focus on students demonstrating proficiency in developing and using models, using mathematical thinking, and obtaining, evaluating and communicating information; and to use these practices to demonstrate understanding of the core ideas.

Prior Knowledge and Skills

By the end of Grade 5, students understand that:

- The faster a given object is moving, the more energy it possesses.

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- Energy can be moved from place to place by moving objects or through sound, light, or electric currents.
- Energy is present whenever there are moving objects, sound, light, or heat.
- When objects collide, energy can be transferred from one object to another, thereby changing their motion. In such collisions, some energy is typically also transferred to the surrounding air; as a result, the air gets heated and sound is produced.
- Light transfers energy from place to place.
- Energy can be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by the transformation of energy of motion into electrical energy.
- Waves, which are regular patterns of motion, can be made in water by disturbing the surface.
- When waves move across the surface of deep water, the water goes up and down in place; there is no net motion in the direction of the wave except when the water meets a beach.
- An object can be seen when light reflected from its surface enters the eyes.
- Digitized information can be transmitted over long distances without significant degradation.

High-tech devices, such as computers or cell phones, can receive and decode information—convert it from digitized form to voice—and vice versa.
Students will be expected to have an understanding of laboratory safety, measurement tools, bunsen burner use, variable identification, forces and interactions of matter, identify problems that can be solved by conducting experiments, and perform calculations involving dimension analysis. These skills will be reinforced during this unit through inquiries which explore the waves and electromagnetic radiation.

Anticipated instructional days for unit: 15 days

Technology, Differentiation and Assessment Strategies:
https://docs.google.com/document/d/1KITFsbhtE1NLWTV9D2MLB0_MBHYxbq-ISfwl6uBTtic/edit