School District of Springfield Township
Montgomery County, PA

PLANNED COURSE OF STUDY

Course Title	Fourth Grade Science
Grade Level	Fourth Grade
Length of Course	All Year
Author(s)	Kim Dallinga

Course Description:
In fourth grade, students learn and use the habits and techniques of scientists, including setting up experiments and making observations. In the Earth and Sun module, students study the relationship and interaction between the Earth and Sun, including their positions in the solar system and the transfer of energy between them. In the Energy module, students explore magnetism and electricity, in addition to studying energy transfer through waves. In the Rocks and Minerals module, students observe the properties and differences between rocks and minerals, and record observations of mineral properties.

Course Rationale:
Throughout this course of study, students are learning and experiencing the practice of scientists. They are setting up investigations, recording and describing their observations, and drawing conclusions. Also, they are connecting their active investigations with nonfiction literature and with domain-specific vocabulary. Students are learning to express their observations and conclusions through writing, using this specific vocabulary.

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Curriculum Map (Year Long Course)

Month	Typical # of Weeks	Topics Covered this Month
September	4 weeks	Social Studies during this month
October	4 weeks	Earth and Sun
November	3 weeks	Earth and Sun
December	3 weeks	Social Studies during this month
January	4 weeks	Social Studies during this month
February	4 weeks	Energy
March	4 weeks	Energy
April	(Remember PSSAs this month)	Social Studies during this month
May	4 weeks	Rocks and Minerals
June	2 weeks	Rocks and Minerals

Unit Title	**Earth and Sun**
Unit Description	In the Earth and Sun module, students study the relationship and interaction between the Earth and Sun, including their positions in the solar system and the transfer of energy between them.
Essential Questions & Enduring Understandings	**Essential Questions:** -How and why does your shadow change during the day? -What can be learned by studying the length and direction of shadows? -What causes day and night? -How can you explain why we see some natural objects only in the night sky, some only in the day sky, and some at both times? -How would you describe the size of and distance between Earth, the Moon, and the Sun? -How does the shape of the Moon change over 4 weeks? -How do the parts of the solar system interact? -Why do stars appear to move across the night sky? -What is air? -What is Earth's atmosphere? -How do meteorologists measure and record weather variables? -What happens to earth materials when they are exposed to sunlight? -How does energy transfer to the air? -What happens when a volume of fluid is warmed at the bottom? -What causes condensation to form? -How does water vapor get into the air? -What is the water cycle? -What is the difference between weather and climate? -What is the best design for a solar water heater? **Enduring Understandings** -Air is a mixture of gases held by gravity near Earth's surface. -Air has mass, takes up space, and is compressible. -Most of Earth's air resides in the troposphere, the layer of the atmosphere closest to Earth's surface. -Weather happens in the troposphere.

	-Weather is the condition of Earth's atmosphere at a given time in a given place. -Meteorology is the science of weather, and meteorologists are the scientists who study Earth's weather. -Weather is described in terms of several variables. -The Sun is the major source of energy that heats Earth. -The different energy-transferring properties of earth materials (soil and water) can lead to uneven heating of Earth's surface. The atmosphere is heated by conduction between Earth's surfaces and air particles as a result of contact, and by absorption of energy radiated directly from the Sun and reradiated from Earth's surfaces. -Convection is the circulation of fluid (liquid or gas) that results in energy transfer. Convection currents are driven by uneven heating of Earth's surface. -A solar water heater is a system that uses solar energy to heat water. -As temperature increases, the rate of evaporation increases. -Most of Earth's water (97%) is salt water in the ocean; Earth's fresh water is found in the atmosphere, lakes and rivers, soil, ground ice, ground water, and glaciers. -The Sun's energy drives weather. -Climate is the average or typical weather that can be expected to occur in a region of Earth's surface

PA Academic Standards	Assessment Anchors
3.1.5.A2 & 9 3.1.5.B6 3.1.5.C4 3.2.5.A1 & 6 3.2.5.B2, 3 & 7 3.3.5.A4-A7 3.3.5.B1-B3 3.4.5.A1 3.4.5.B1, 3 & 4 3.4.5.C3 3.4.5.D3 3.4.5.E3	S4.A.1.1 S4.A.1.3 S4.A.2.1 S4.A.2.2 S4.A.3.1 S4.A.3.2 S4.A.3.3 S4.B.3.2 S4.D.1.3 S4.D.2.1 S4.D.3.1

Key Unit Vocabulary	**Investigation 1: The Sun** *axis, compass, day, night, North Pole, North Star, orbit, orientation, revolution, rotation, shadow, sun, days, opaque, rotate, season* **Investigation 2: Planetary Systems** *asteroid, asteroid belt, comet, constellation, crescent moon, dwarf planet, first-quarter moon, force, full moon, gas giant, planet, gibbous moon, gravity, Kuiper belt, lunar cycle, new moon, phase, planet, solar system, star, terrestrial planet, third-quarter moon, waning moon, waxing moon, astronomers, astronomy, atmosphere, axis, Big Dipper, black hole, clouds, cycle, diameters, galaxy, gravitational attraction, hurricanes, liquid, lunar eclipse, magnify, mass, matter, Milky Way* **Investigation 3: Earth's Atmosphere** *air, air pressure, atmosphere, barometer, compress, forecast, humidity, hygrometer, mass, matter, meteorologist, precipitation, pressure, temperature, thermometer, troposphere, visibility, weather, weather variable, wind, wind direction, wind speed, wind vane, absorbs, anemometers, condensation, exosphere, evaporation, humidity, mesosphere, ozone, photosynthesis, radiation, rain, stratosphere, thermosphere, water vapor, variables, wind meters* **Investigation 4: Heating Earth** *absorb, conduction, contract, convection current, earth material, energy transfer, expand, experiment, fluid, geosphere, hydrosphere, less dense, more dense, radiant energy, radiation, ray, reflect, re-radiation, solar collector, solar energy, solar energy, exposure, solar water heater, uneven heating, variable, conduction,* *conserve, fossil fuels, kinetic energy, renewable resource, thunderstorms, tornadoes* **Investigation 5: Water Planet** *climate, climatologist, condensation, dew, drought, evaporation, fog, glacier, groundwater, hurricane, ice cap, lake, ocean, recycle, river, salt water, severe weather, thunderstorm, tornado, water*

	cycle, water vapor, blizzards, frost, greenhouse effect, hail, sleet, transpiration

Learning Objectives – *The student will…*	Assessment Opportunities
-Trace his or her shadow in the morning and afternoon and use this information to monitor the position of the Sun as it moves across the sky. -Use a compass to orient a Sun tracker. -Make hourly records of the position of the shadow cast by a golf tee. -Use flashlights to reproduce the shadow movements. -Imagine an observer on Earth (his or her head) and position him/ herself around a lamp to observe day and night. -Discover that rotation of Earth produces day and night.	Science notebook entries Response Sheet Investigation 1 I-check
-Observe the Moon. -Start a Moon calendar, on which he or she records the Moon's appearance every day for a month and analyze his or her observations to discover the sequence of changes. -Build a model of the Earth/Moon/Sun system. -Organize a model of the solar system. -Understand that gravity is introduced as the force that pulls on planets, changing their direction of travel to produce circular orbits. -Understand that constellations as patterns of stars. -Simulate Earth's rotation to observe the appearance of stars rising in the east and setting in the west. -Observe a demonstration of why different stars are visible in different seasons.	Science notebook entries Response sheet Investigation 2 I-Check
-Explore air by working with syringes and	Performance assessment

tubes to discover that air takes up space and is compressible. -Understand the atmosphere is a mixture of gases with properties that change with altitude above Earth's surface. -Review local weather reports and determine the variables that combine to produce the weather. -Use a weather station to monitor the weather and look for patterns.	Science notebook entries Investigation 3 I-Check
-Investigate energy transfer on Earth and uneven heating by recording and graphing temperature changes when two earth materials absorb solar energy. -Observe examples of energy transfer by radiation and conduction and discuss mechanisms of energy transfer to and from the air. -Observe convection currents in water as a model of what happens in air. -Test different designs for solar water heaters. -Consider how the atmosphere, hydrosphere, and geosphere interact.	Science notebook entries Response sheet Performance assessment Investigation 4 I-Check
-Consider why Earth is called the water planet. -Investigate systems to observe condensation on cold surfaces and determine the components of the water cycle. -Explore the conditions that promote evaporation. -Simulate the travels of a drop of water through the water cycle to explore the complexities of the process. -Explore world climate regions and global climate change.	Performance assessment Response sheet Science notebook entries Posttest

Sequence of Teaching and Learning		
Number of Lessons / Blocks	Lesson Topic	Lesson Activities
2	(Begin Investigation 1) Shadow Shifting	Students trace their shadows in the morning and afternoon, and compare the tracings. They use this information to determine the position of the Sun as it appears to move throughout the day.
3-4	Sun Tracking	Pairs of students construct Sun trackers. After using a compass to orient the Sun tracker north-south, students make hourly records of the position of the tip of the shadow cast by a golf tee. Back in the classroom, students use flashlights to reproduce the movement of the Sun throughout the day. Students read "Changing Shadows" article
4 (including 2 for the assessment)	Day and Night	Students imagine one of their eyes as an observer on Earth and position themselves around a lamp to observe day and night. They discover that rotation of Earth results in day and night and, in the process, figure out which direction Earth rotates on its axis. Read "Sunrise and Sunset" Complete Investigation 1 I-check
4	(Begin Investigation 2) Night-Sky Observations	Students take a mini–field trip to the schoolyard to look for the Moon. After recording the Moon's appearance, the class starts a Moon calendar, on which they will record the Moon's appearance every day for a month. Students observe the night sky for 4 days at home. Read "The Night Sky" "Looking through Telescopes"
3	How Big and How Far?	Students grapple with the size and distance relationships among Earth, the Moon, and the Sun. They work together to build a model of the Earth/Moon/Sun system. Read "Comparing the Size of Earth and the Moon," "Apollo 11 Space Mission," and "How Did Earth's Moon Form?"
4	Phases of the Moon (optional)	Students analyze the Moon observations to discover the sequence of changes. They learn the names for the four specific phases and the intermediate phases. Students use a light source and sphere to simulate an Earth–Moon–Sun system and explore the cause of Moon phases. Read

		"Changing Moon" (optional), "Lunar Cycle" (optional), "Eclipses" (optional) Video- All about the Moon, Online Activity -"Lunar Calendar"
4	The Solar System	Students work in pairs with a set of solar system cards. Based on previous knowledge, information on the cards, and information provided by the teacher, students organize the objects into a model of the solar system. Students observe a ball swinging in a circle on the end of a string as a model of gravity's effect. Gravity is introduced as the force that changes planets' direction of travel and produces circular orbits. Read "Exploring the Solar System," "Planets of the Solar System," "Why Doesn't Earth Fly Off into Space?" Watch video "The Planets and the Solar System"
6 (including 2 for assessment)	Stars	Students are introduced to constellations as traditional star patterns. They identify images in patterns of stars and give them names. Students simulate Earth's rotation. While rotating, they observe the appearance of stars rising in the east, traveling across the sky, and setting in the west. Students observe a demonstration of the relationships and orientations of Earth, the Sun, and the Milky Way to explain why different stars are visible in different seasons. Students watch a video that shows how star brightness, distance, and alignment converge to produce constellations. Complete Investigation 2 I-check
2	(Begin Investigation 3) The Air around Us	Students take a close look at the air surrounding us. They explore the properties of air by working with syringes and tubes to discover that air takes up space and is compressible. Students discuss evidence that air is matter and has mass. Read "What Is Air?" Watch videos-Ball on a Scale, Fizz Keeper Experiment, Soda Can Experiment
2	The Atmosphere	Students study Earth's atmosphere, using diagrams, photos from space, and a reading. They are introduced to the atmosphere as a mixture of gases with properties that change with distance above Earth's surface. Read "Earth's Atmosphere," watch video "Earth's Atmosphere," Online Activity "Tutorial: Air and Atmosphere"

4 (including 2 sessions for assessment)	Local Weather	Students review local weather reports and determine the variables that combine to produce the weather. They are introduced to weather instruments—a thermometer, barometer, hygrometer, compass, and wind vane. They use a digital weather station with a receiver outdoors to gather weather data, and develop a plan for acquiring daily data and sharing them with the class. Complete Investigation 3 I-check
4	(Begin Investigation 4) Heating Earth Materials	Students set up an investigation to monitor temperature changes when solar energy is transferred to two earth materials: water and dry soil. Students record the temperature of the two materials in sunshine and in shade. They graph the data to discover that the temperature of the dry soil goes higher than water and cools to a lower temperature than that of water. The concept of uneven heating is introduced. Read "Uneven Heating" Online Activities-"Tutorial: Radiation," "Virtual Investigation: Uneven Heating"
3	Conduction	Students observe two examples of heat transfer by conduction: from hot water to a container of cold water, and from one end of a metal strip to the other. Students discuss the mechanisms by which energy transfers to and from the air: radiation and re-radiation from Earth's surface, and conduction between Earth's surface and air particles. Read "Heating the Air: Radiation and Conduction" Watch video-Aluminum and Steel Strips Online Activities-"Particles in Solids, Liquids, Gases" "Energy Transfer"
2	Convection	Students use a fluid, water, at different temperatures to discover the relationship between temperature and density. They put a layer of cold blue water on the bottom of a vial of room-temperature water. They put a bag of hot water against the vial and watch the blue water rise as it warms, cools, and descends, creating a convection current. Students discuss how the same process results in wind on Earth. Read "Wind and Convection," "Wind Power" Watch video-"Convection" Online Activity-"Energy Transfer"
6 (including 2 sessions for assessment)	Color and Energy Transfer	Students set up solar water heaters using black and white collectors to see if color affects temperature change in water. They also set up open and covered solar water heaters to find out if exposure to air affects temperature change in water. Complete Investigation 4 I-check

3	(Begin Investigation 5) Condensation	Students set up cups of ice water and room temperature water and observe condensation on the ice-water cup. They investigate other systems to observe condensation on cold surfaces. They learn that water vapor in the air condenses into liquid dew (or frost) on cold surfaces. Read "Condensation"
2	Evaporation	Students observe a demonstration in which two cups with equal amounts of water are placed on a balance. Both cups are open to the air, but one cup is under a lamp. Water temperatures are monitored over time. One day later, students find that more water evaporated from the cup that was heated by the lamp.
4	Water Cycle	Students consider why Earth is called the water planet. They toss an inflatable globe, keeping track of how often their fingers end up on water. They take part in a demonstration that shows the relative amounts of fresh water and salt water, and their distribution on Earth. They simulate the travels of a water drop through the water cycle. Read "Where Is Earth's Water?" "The Water Cycle" "Severe Weather" Watch video-"Water Cycle" Online Activity "Water-Cycle Game"
6 (including 2 sessions for assessment)	Climate	Students are introduced to climate and suggest schemes for describing world climate regions, based on their understanding of weather variables. They view a video to gather information on climate and compare their climate-region scheme to those of climatologists. Students develop an awareness about global climate change. Read "Earth's Climates" "Global Climate Change" Watch Video-"Climate and Seasons" Online Activity "Climate Regions Map" Complete Benchmark Assessment Posttest

Unit Title	**Energy**
Unit Description	The Energy Module provides first-hand experiences in physical science dealing with energy and change. Students investigate electricity and magnetism as related effects and engage in engineering design while learning useful applications of electromagnetism in everyday life. They explore energy transfer through waves, repeating patterns of motion, that result in sound and motion.
Essential Questions & Enduring Understandings	**Essential Questions:** -What is needed to light a bulb? -What is needed to make a complete pathway for current to flow in a circuit? -How can you light two bulbs brightly with one D-cell? -Which design is better for manufacturing long strings of lights—series or parallel? -What materials sticks to magnets? -What happens when two or more magnets interact? -What happens when a piece of iron comes close to or touches a permanent magnet? -What happens to the force of attraction between two magnets as the distance between them changes? -How can you turn a steel rivet into a magnet that turns on and off? -How does the number of winds of wire around a core affect the strength of the magnetism? -How can you reinvent the telegraph using your knowledge of energy and electromagnetism? -What do we observe that provides evidence that energy is present? -How does the starting position affect the speed of a ball rolling down a ramp? -What happens when objects collide? -How are waves involved in energy transfer? -How does light travel? -How can you make a motor run faster using solar cells? **Enduring Understandings** -Energy is evident whenever there is motion, electric current, sound, light, or heat. Energy can transfer from place to place. -An electric circuit is a system that includes a complete

	pathway through which electric current flows from an energy source to its components. -Conductors are materials through which electric current can flow; all metals are conductors. -In a series circuit, there is a single pathway from the energy source to the components; in a parallel circuit, each component has its own direct pathway to the energy source. -The energy of two energy sources (D-cells or solar cells) adds when they are wired in series, delivering more power than a single source. Two cells in parallel have the same power as a single cell. -Magnets interact with each other and with some materials. -Magnets stick to (attract) objects that contain iron. Iron is the only common metal that sticks to magnets. -All magnets have two poles, a north pole at one end (side) and a south pole at the other end (side). Like poles of magnets repel each other, and opposite poles attract. -Magnets are surrounded by an invisible magnetic field, which acts through space and through most materials. -When an iron object enters a magnetic field, the field induces magnetism in the iron object, and the object becomes a temporary magnet. -The magnetic force acting between magnets declines as the distance between them increases. -Earth has a magnetic field. -A magnetic field surrounds a wire through which electric current is flowing. -The magnetic field produced by a current-carrying wire can induce magnetism in a piece of iron or steel. -An electromagnet is made by sending electric current through an insulated wire wrapped around an iron core. -The number of winds of wire in an electromagnet coil affects the strength of the magnetism induced in the core (more winds = more magnetism). -The amount of electric current flowing in an electromagnet circuit affects the strength of the magnetism in the core (more current = stronger magnetism). -A telegraph system is an electromagnet based technology used for long-distance communication. -Energy is evident whenever there is motion, electric current,

	sound, light, or heat. Energy can be transferred from place to place. -Objects in motion have energy. The faster a given object is moving, the more kinetic energy it has. -When objects collide, energy can transfer from one object to another, thereby changing their motion. -Kinetic energy is energy of motion; potential energy is energy of position. For identical objects at rest, the objects at higher heights have more potential energy than the objects at lower heights. -Waves are a repeating pattern of motion that transfer energy from place to place. Some electromagnetic waves can be detected by humans (light); others can be detected by designed technologies (radio waves, cell phones). -There are sound waves, light waves, radio waves, microwaves, and ocean waves. -Waves have properties—amplitude, wave length, and frequency. -Light travels in straight lines and can reflect (bounce) off surfaces. -Light can refract (change direction) when it passes from one transparent material into another. -Matter can absorb light. -An object is seen only when light from that object enters and is detected by an eye. -White light is a mixture of all colors (wavelengths) of visible light. -Solar cells are designed technologies to transfer visible light into electricity. -The energy of two energy sources (D-cells or solar cells) adds when they are wired in series, delivering more power than a single source. -Two cells in parallel have the same power as a single cell.

PA Core Standards	Assessment Anchors
3.1.4.B6	S4.A.1.1
3.1.4.C4	S4.A.1.3
3.2.4.A6	S4.A.2.1
3.4.4.D1, 2 & 3	S4.A.2.2
3.4.4.E3 & 4	S4.A.3.1

	S4.A.3.2 S4.C.1.1 S4.C.2.1 S4.C.3.1

Key Unit Vocabulary	**Investigation 1: Energy and Circuits** *bulb base, bulb casing, circuit, closed circuit, component, conductor, contact point, d-cell, electric current, electricity, energy, energy source, filament, insulator, light, metal, motion, motor, open circuit, parallel circuit, series circuit, shaft, short circuit, switch, system, terminal, transfer, wire, battery, coil, complete circuit, constraint, criteria, engineer, generator, heat, incomplete circuit, light source, prototype, solar cell, solution, sound, stored energy, technology, tool, work* **Investigation 2: The Force of Magnetism** *attract, compass, force, gravity, induced magnetism, interact, iron, magnet, magnetic field, magnetism, north pole, opposite, permanent magnet, pole, repel, south pole, steel, temporary magnet, orient* **Investigation 3: Electromagnets** *code, coil, core, electromagnet, electromagnetism, key, rivet, telegraph, frequency, mirror, pitch, telegraph, vibration* **Investigation 4: Energy Transfer** *collide, collision, friction, fuel, heat, kinetic energy, potential energy, sound, stationary, transfer of energy, absorb, accelerate, fossil fuel, gravity, load, newton (N), speed* **Investigation 5: Waves** *amplitude, compression, cycle, frequency, mirror, peak, ray, reflect, reflection, refract, refraction, solar cell, trough, wave, wavelength, crest, oscillation, oscilloscope, property, sine wave, sound, source*

Learning Objectives – *The student will…*	Assessment Opportunities
-Investigate electric current and circuits, using a variety of components -Compare the functioning of components in series and parallel circuits -Formulate and justify predictions, based on observations of electricity transferring	Science notebook entries Response sheet Performance assessments Investigation 1 I-Check

energy to produce light and motion.	
-Investigate the properties of magnets and their interactions with materials and each other. -Find objects in the environment that are attracted to magnets -Conduct an investigation to determine if like or opposite poles of a magnet interact. -Construct a simple compass and use it to detect magnetic effects -Discover that magnetism can be induced in a piece of iron. -Investigate the strength of the force of attraction between two magnets by graphing data to look for patterns of interaction.	Science notebook entry Response sheet Performance assessment Benchmark Assessment Investigation 2 I-Check
-Learn how to use electricity to make an electromagnet. -Explore the variables that influence the strength of his/her electromagnet. -Use all the concepts they have learned to engineer a simple telegraph system and communicate using a click code.	Science notebook entry Response sheet Performance assessment Investigation 2 I-Check
-Observe energy transfer that results in heat, light, sound and motion. -Know the sources of energy and components that store energy. -Conduct structured investigations with steel balls and ramps to discover how the variable of starting position on the ramp affects the speed of the rolling ball. -Test the variables of mass and release position to find out how these variables affect energy transfer.	Performance assessment Science notebook entry Response sheet Investigation 4 I-Check
-Experience waves through firsthand experiences using ropes, demonstrations with waves in water, spring toys, and a sound generator. -Understand that waves are repeating patterns of motion that transfer energy from	Science notebook entry Response sheet Performance assessment Posttest

place to place. -Use mirrors to experience reflecting light. -Observe light in numerous ways using flashlights, mirrors and water. -Understand that light can reflect and refract. -Build a conceptual model about how light travels. -Design series and parallel solar cell circuits. -Observe series and parallel solar cell circuits' effects on the speed of a motor. -Read about alternative energy solutions.	

Sequence of Teaching and Learning		
Number of Lessons / Blocks	Lesson Topic	Lesson Activities
3	(Begin Investigation 1) Lighting a Bulb	Students are introduced to electricity and energy. They discover how to make a complete circuit using a D-cell, wires, and a lightbulb. Upon successfully lighting their bulbs, students discuss the electricity's pathway in the circuit and the function of each of the system's components. They also take a close look at the anatomy of a lightbulb. Read "Edison Sees the Light" Online Activities- "Lighting a Bulb" and "Flow of Electricity"
2	Conductors and Circuits	Students are introduced to a switch and a motor and make a circuit that they can turn on and off. Students use a circuit and a collection of objects to determine which materials can complete the pathway (conductors) and which cannot (insulators). After developing the rule that metals are conductors, students consider foils and use evidence to confirm that foils are indeed metal. Read "Energy Sources," Online Activities- "Tutorial: Simple Circuits," "Tutorial: Conductors and Insulators," "Turn on the Switch," "Conductor Detector," "D-Cell Orientation"
3	Conductors and Circuits	Students find ways to operate more than one lightbulb in a circuit. They devise a series circuit to operate two bulbs with one D-cell, but the lights are dim. Students learn that they can connect two bulbs in a way that allows both to shine

		brightly using two cells or a single D-cell. They wire two bulbs in parallel and find that many bulbs can be made to shine brightly on a single D-cell when they are wired in parallel. Read "Series and Parallel Circuits"
5 (2 sessions for assessment)	Solving the String-of-Lights Problem	Students investigate which type of circuit would be the best design for a string of lights. They analyze the designs and make a recommendation based on their knowledge of circuitry. Read "Science Practices," "Engineering Practices," "Thinking Like and Engineer," "Engineering a Solar Lighting Solution"
2	(Begin Investigation 2) Magnets and Materials	Students discover that iron-containing objects stick to permanent magnets; other objects do not. They generate a rule for magnetic interaction with materials: If a magnet sticks to an object, that object is most likely made of iron or its alloy, steel. Students go outdoors and use their magnets as iron detectors. Online Activity- "Virtual Investigation: What Sticks and What Conducts?"
3	Magnetic Fields	Students observe that the two sides (poles) of magnets are different, attracting or repelling one another, depending on orientation. Students work with magnets and other objects to discover that magnetism acts through air, most metals, and all nonmetals. They also discover that bringing a magnet close to a piece of iron induces magnetism in the iron. Students learn that these effects are manifestations of the invisible magnetic field that surrounds every magnet. Read "When Magnet Meets Magnet" Watch Video "All About Magnets" Online Activities- "Tutorial: Magnetic Poles," "Magnetic Poles," "Magnetic Poles Quiz"
6 (2 sessions for assessment)	Magnetic Force	Students use a balance to measure the force of attraction between magnets. They increase the distance between the magnets and re-measure the force. Students learn that the force of attraction between magnets decreases as the distance between them increases. Read "Magnificent Magnetic Models," "Make a Magnetic Compass" Complete Performance Assessment and Investigation 2 I-Check
3	(Begin Investigatio	Students discover that a steel core becomes a magnet when current flows through an insulated wire wound around the

	n 3) Building an Electromagn et	steel core. They find out where to wind the wire on the core to produce the strongest magnet. Read "Electricity Creates Magnetism"
2	Changing the Strength	Students experiment to find out how the number of winds of wire affects the strength of magnetism. After collecting data for a 20-wind, 30-wind, and 40-wind electromagnet, students graph the results. They predict the strength of magnetism based on the graph. Read "Using Magnetic Fields" and "Electromagnets Everywhere" Online Activities "Kitchen Magnets," "Tutorial: Electromagnets" and "Virtual Electromagnet"
5 (2 sessions for assessment)	Reinventing the Telegraph	Students apply their knowledge of circuitry and electromagnetism to build a telegraph. They invent a code and use their telegraphs to send messages to each other. Finally, they take on the long-distance challenge by wiring two telegraph units together using long wires. Read ""Morse Gets Clicking" Complete Investigation 3 I-check
3	(Begin Investigatio n 4) Presence of Energy	Students work in centers to explore evidence of energy when sound, heat, and light are produced, and when objects are in motion. Read "Energy" Video- "Candle"
3	Rolling Balls Down Slopes	Students roll steel balls of different sizes down ramps and explore the system's variables. They conduct structured investigations to discover how the variables of starting position on the ramp and ball size (mass) affect the speed of a rolling ball. Read "What Causes Change of Motion?" Videos- "Soccer," "Ball on Table," "Wagon"
6 (2 Sessions for Assessment)	Collisions	Students place an obstacle (cork) in the pathway of a steel ball rolling down a ramp, forcing them to collide. They investigate the variables that determine how far the cork will move along the runway. Using controlled experiments, students test the variables of mass and starting position to find out how these variables affect energy transfer. Read "Bowling," "Force and Energy," "Potential and Kinetic

		Energy at Work" Video- "All about the Transfer of Energy" Complete the Investigation 4 I-Check
3	(Begin Investigation 5) Forms of Waves	Students experience waves through firsthand experiences using ropes, demonstrations with waves in water, spring toys, and a sound generator. They also use videos, animations, and readings to gather information. Through these experiences, students learn that waves are repeating patterns of motion that transfer energy from place to place. They analyze compression waves (sound waves) to learn the general properties of waves- amplitude, wavelength, and frequency. Read "Waves," "More about Sound" Videos- "Sound Energy," "Waves," "Real World Science: Sound" "All about Waves"
5	Light Travels	Students use mirrors to experience reflecting light. They start by using mirrors outdoors to see objects behind them and to reflect a bright image of the Sun onto walls. In the classroom, they determine that a mirror can be used to reflect light. Students then use flashlights, mirrors, and water to observe light in numerous ways, reinforcing the idea that light can reflect and refract. Students build a conceptual model about how light travels. Read "Light Interactions" "Throw a Little Light on Sight" "More Light on the Subject" Videos- "All about Light," Online Activities "Reflecting Light" "Colored Light"
6 (2 sessions for Assessment)	Engineering with Solar Cells	Students design series and parallel solar cell circuits and observe the effect on the speed of a motor. They observe that cells in series make the motor run faster, but cells in parallel do not deliver additional power to the motor. They read about alternative energy sources.

Unit Title	**Earth Materials**
Unit Description	The Earth Materials Module consists of four sequential investigations dealing with observable characteristics of solid materials from the earth – rocks and minerals. The focus is on taking materials apart to find what they are made of and putting materials together to better understand their properties. The module introduces fundamental concepts in earth science and takes advantage of the students' intrinsic interest in the subject matter and in the physical world around them.
Essential Questions & Enduring Understandings	**Essential Question:** -What are some of the properties we can use to describe individual rocks? -How can we determine the ingredients of a rock? -How can we separate the ingredients of a rock? -What properties can we use to identify minerals? **Enduring Understandings:** -Rocks have many properties, including shape, size, color, and texture. -Geologists use rock properties to help identify different rocks. -Some dimensions of rocks can be measured and compared. -Rocks are made of ingredients called minerals; minerals are made of only one ingredient. -Some ingredients can be identified by breaking rocks apart. -Water can be used to separate ingredients: some break into smaller pieces, and some dissolve. -Rocks are made of minerals. -Evaporation is a way to separate liquid and solid ingredients. -Mineral crystals have identifiable shapes. -A mineral is a basic earth material that cannot be physically broken down any further. -Minerals are the ingredients that make up rocks. -It is usually necessary to know several properties of a mineral in order to identify it. -Hardness, a mineral property, is the resistance of a mineral to being scratched. -Minerals can be seriated by hardness. -When comparing the hardness of any two objects, the harder one will scratch the softer one.

	-Rocks are made of minerals. -Calcite is one of the most common minerals on Earth. -Putting acid on a rock is a tool geologists use to identify calcite. -Sometimes more than one test is needed to provide conclusive evidence. -Evaporation is a technique used to separate liquid from solid parts of a mixture or solution. -Crystal patterns can help us identify certain minerals. -Limestone and marble are two rocks that contain calcite. -Rocks are made of ingredients called minerals. -Rocks and minerals have identifiable characteristics. -The minerals that make up a rock can be identified by observing certain characteristics.

PA Core Standards	Assessment Anchors
3.1.4.C & E 3.2.4.A - C 3.4.4.A 3.5.4.A & B 3.8.4.A & B 4.2.4.A 4.8.4.A	S4.A.1.2 S4.A.2.1 S4.A.2.2 S4.A.3.2 S4.A.3.3 S4.C.1.1 S4.D.1.1 S4.D.1.2

Key Unit Vocabulary	**Investigation 1: Mock Rocks** *balance, circumference, crystal, depth, diameter, dissolve, earth materials, erosion, evaporate, fossil, geologist, geology, glacier, magma, mass, meter tape, microscope, mineral, monolith, outcrop, property, rock, sedimentary rock, texture, weigh* **Investigation 2: Scratch Test** *calcite, carat, deposit, evaporate, excavate, fluorite, gemstone, gypsum, hardness, quartz, magnetometer, meteorite, opaque, prospector, sediment, smelt, vein* **Investigation 3: Calcite Quest** *acid, basalt, evidence, limestone, marble, plaster of Paris, sandstone, vinegar* **Investigation 4: Take it for Granite**

	feldspar, granite, hornblende, igneous rock, mica, memorial, metamorphic rock, monument, obelisk, pyramid

Learning Objectives – *The student will…*	Assessment Opportunities
-Record and discuss observations about a rock. -Compare observations. -Take apart a mixture by separating the ingredients. -Observe and describe how rock materials separate and settle in water. -Observe the results of evaporation. -Understand that: ▪ Rocks can be separated into their components. ▪ Rocks exhibit a variety of properties, including shape, size, color, and texture. ▪ Water, settling, and evaporation can separate rocks into their components. ▪ Crystals form from evaporation of a saltwater mixture. ▪ Rocks are composed of earth materials called minerals that cannot be physically broken apart any further.	Teacher Observation Response Sheet- Mock Rocks Assessment Chart for Investigation 1
-Observe the properties of a group of minerals. -Record properties of minerals. -Organize observations. -Seriate minerals based on hardness. -Understand that: ▪ Rocks are composed of earth materials called minerals that cannot be physically broken apart any further. ▪ The property of hardness can be used to seriate minerals. ▪ Examples of minerals are quartz,	Student Sheet- Mineral Properties Response Sheet- Scratch Test

fluorite, calcite, and gypsum.	
-Observe directly and indirectly the special properties of a mineral. -Observe and record results of an investigation. -Compare results. -Identify one ingredient from a mixture. -Understand that: ▪ Calcite is a mineral that fizzes when placed in an acid. ▪ Minerals have different properties. Rocks can easily be tested for the presence of calcite using an acid such as vinegar. ▪ Examples of rocks are sandstone, limestone, marble, and granite.	Assessment Chart for Investigation 3 Response Sheet- Calcite Quest
-Observe properties of a rock and several minerals. -Sort objects according to properties. -Record observations. -Compare observations of properties. -Understand that: ▪ Rocks are made of minerals. ▪ The rock granite is made up of the minerals mica, feldspar, quartz, and hornblende. ▪ Some mineral properties are color and hardness. ▪ Properties of minerals are used to find out which minerals make up a rock.	Assessment Chart for Investigation 4 Performance Assessment

Sequence of Teaching and Learning		
Number of Lessons / Blocks	Lesson Topic	Lesson Activities
1	(Begin Investigation 1) Investigating Mock Rocks	Students make and record observations of mock rocks. They compare the properties of mock rocks with those of real rocks. Students choose appropriate measuring tools to determine the diameter, circumference, depth and mass.
1	Taking Rocks Apart	Students use a nail as a geologist's pick to take a mock rock apart. Not all ingredients can be separated in this way, so students use water to effect a further separation. Students shake vials containing water and earth material and observe them before and after settling.
2	Observing Crystals	After vial ingredients settle overnight, students observe the separation that has occurred. They set up evaporation dishes to determine any further ingredients. After the water evaporates, students find crystals in the dish. They determine these are salt crystals. Read "Written in Stone" and "Postcards from the Ledge"
1	(Begin Investigation 2) Observing Minerals	Students investigate four unknown minerals. They record observations and find that they need more information to make a confident identification of the minerals. Easily visible properties aren't enough.
1	Testing for Hardness	Students are introduced to hardness as a property that can help a geologist identify a mineral. They use paper clips, pennies, and their fingernails to do the scratch test, make hardness comparisons, and help identify minerals. Using this knowledge, they identify and order four minerals by hardness.
1	Science Stories	Read "Treasure Underfoot" "X Marks the Spot" "Digging it Up: Mining for Minerals" "Birthstones: A Mineral for Each Month"
1	(Begin Investigation 3) Detecting Calcite	Students investigate one interesting property of the mineral calcite. They place a piece of calcite in vinegar and observe bubbles and fizzing. They place several rock samples in vinegar and look for evidence of calcite as an ingredient.

2	Looking for More Evidence	After the rocks sit in vinegar overnight, students pour the liquid into small dishes and let it evaporate. Students find a white needlelike crystal and a powdery white residue in two of the dishes-evidence that calcite is an ingredient. Read "Old Man and the Rock: A Native American Tale" "The Two Boys: An Aborigine Story from Australia"
1	(Begin Investigation 4) Identifying Minerals in Granite	Students sort a set of earth materials and find that one is a rock, granite, and the rest are minerals. Students test the minerals to identify which of the minerals are ingredients in pink granite.
determined by teacher	Choosing Your Own Investigation (Performance Assessment)	Students review the investigations they have participated in over the past several weeks and identify a subject they would like to investigate in greater detail. They select a project to further their understanding as well as to inform the rest of the class. Read "Rock of Ages" "Identifying Minerals" "Where Do Rocks Come From?"