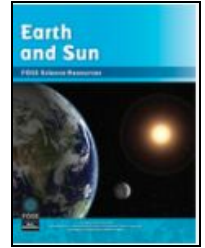


Investigation 1 - The Sun

Students trace their shadows in the morning and afternoon. They use this information to monitor the position of the Sun as it moves across the sky. After using a compass to orient a Sun tracker, students make hourly records of the position of the shadow cast by a golf tee. Back in the classroom, students use flashlights to reproduce the shadow movements. Students imagine an observer on Earth (their head) and position themselves around a lamp to observe day and night. They discover that rotation of Earth produces day and night.



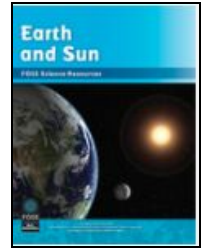
Standard - 5-ESS1-2

Investigation 1	Summary of Lesson	Priority
Part 1: Shadow Shifting	<p>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.</p> <p><i>FQ - How and why does your shadow change during the day?</i></p>	<p>High This lesson is the introduction of shadows.</p>
Part 2: Sun Tracking	<p>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.</p> <p><i>Read, "Changing Shadows".</i> <i>Activity, "Tutorial: Sun Tracking" and "Shadow Tracker".</i></p> <p><i>FQ -What can be learned by studying the length and direction of shadows?</i></p>	<p>High This lessons continues from Part 1 on understanding the use of shadows to follow movement of the sun.</p>
Part 3: Day and Night	<p>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.</p> <p><i>Read, "Sunrise and Sunset".</i> <i>Activity, "Seasons".</i></p> <p><i>FQ - What causes day and night?</i></p>	<p>High This lesson helps students understand the rotation of the Earth around the sun.</p>
Assessment	i-Check	

5-ESS1-2 Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.

Investigation 2 - Planetary Systems

Students take a field trip to the schoolyard to look for the Moon. The class starts a Moon calendar, on which they record the Moon's appearance every day for a month and analyze their observations to discover the sequence of changes. Students grapple with the size and distance relationships among the Moon, Earth, and the Sun, and build a model of the Earth/Moon/Sun system.



Based on previous knowledge, information on solar system cards, and information provided by the teacher, students organize a model of the solar system. Gravity is introduced as the force that pulls on planets, changing their direction of travel to produce circular orbits. Students are introduced to constellations as patterns of stars. They simulate Earth's rotation to observe the appearance of stars rising in the east and setting in the west. Students observe a demonstration of why different stars are visible in different seasons.

Standards - 5-PS2-1, 5-ESS1-1, 5-ESS1-2

Investigation 2	Summary of Lesson	Priority
Part 1: Night-Sky Observations	<p>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.</p> <p><i>Read, "The Night Sky" and "Looking through Telescopes".</i></p> <p><i>FQ - 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?</i></p>	<p>Medium</p> <p>The observation of the moon could be done after recess on a walk back to the classroom to save time. Due to the time of year, this lesson could be difficult. Could replace with on-line tracking if it is difficult to see moon outside.</p>
Part 2: How Big and How Far?	<p>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 systems.</p> <p><i>Read, "Apollo 11 Space Mission" and "How did Earth's Moon form?"</i></p> <p><i>FQ - How would you describe the size of and distance between Earth, the Moon, and the Sun?</i></p>	<p>High</p> <p>Strongly meets standard 5-ESS1-1.</p>
Part 3: Phases of the Moon (optional)	<p>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.</p> <p><i>Read, "Changing Moon", "Lunar Cycle" and "Eclipses".</i></p> <p><i>Video, "All about the Moon".</i></p> <p><i>Activity, "Lunar Calendar".</i></p> <p><i>FQ - How does the shape of the Moon change over 4 weeks?</i></p>	<p>High</p> <p>Strongly meets standard 5-ESS1-2.</p>

Part 4:The Solar System	<p>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 planet's direction of travel and produces circular orbits.</p> <p><i>Read, "Exploring the Solar System", and "Why doesn't Earth fly off into Space?"</i></p> <p><i>Video, "The Planets and the Solar System".</i></p> <p><i>FQ - How do the parts of the solar system interact?</i></p>	<p>Medium/High</p> <p>This lesson is important in discussing gravity and inertia. The card activity could be skipped.</p>
Part 5:Stars	<p>Students are introduced to constellations as traditional stars 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 settling in the west. Students observe a demonstration of the relationships and orientation 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.</p> <p><i>Read, "Stargazing", "Star Scientists", and "Our galaxy".</i></p> <p><i>Video, "All about Stars".</i></p> <p><i>Activity, "Stellar Motions".</i></p> <p><i>FQ - Why do stars appear to move across the night sky?</i></p>	<p>High</p> <p>Strongly meets standard 5-ESS1-2.</p>
Assessment	i-Check	

Investigation 2 cont. - Planetary Systems

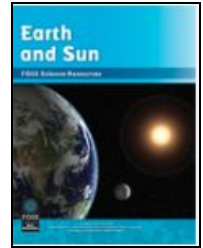
5-PS2-1 Support an argument that the gravitational force exerted by Earth on objects is directed down.

5-ESS1-1 Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from the Earth.

5-ESS1-2 Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.

Investigation 3 - Earth's Atmosphere

Students explore air by working with syringes and tubes to discover that air takes up space and is compressible. They are introduced to the atmosphere as a mixture of gases with properties that change with altitude above Earth's surface. They review local weather reports and determine the variables that combine to produce the weather. They use a weather station to monitor the weather and look for patterns.



Standards - 5-PS1-1, 5-ESS2-1

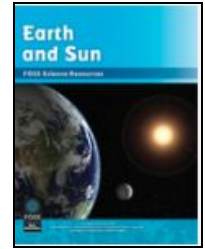
Investigation 3	Summary of Lesson	Priority
Part 1: The Air around Us	<p>Students take a close look at the air surrounding us. They explore the properties of air by working with syringes and tubes to discover that air takes up space and is compressible. Students discuss evidence that air is matter and has mass.</p> <p><i>Read, "What is air?"</i></p> <p><i>Video, "Ball on a scale", "Fizz Keeper Experiment" and "Soda Can Experiment".</i></p> <p><i>FQ - What is air?</i></p>	<p>High</p> <p>This lesson introduces the concept that air has properties.</p>
Part 2: The Atmosphere	<p>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.</p> <p><i>Read, "Earth's Atmosphere"</i></p> <p><i>Video, "Earth's Atmosphere"</i></p> <p><i>Activity, "Tutorial: Air and Atmosphere".</i></p> <p><i>FQ - What is Earth's atmosphere?</i></p>	<p>High</p> <p>This lesson introduces the concept that air has properties.</p>
Part 3: Local Weather	<p>Students review local weather reports and determine the variables that combine to produce 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.</p> <p><i>Read, "Weather Instruments".</i></p> <p><i>Video, "All about Meteorology".</i></p> <p><i>Activity, "Weather Grapher".</i></p> <p><i>FQ - How do meteorologists measure and record weather variables?</i></p>	<p>Low</p> <p>This lesson could be skipped.</p>
Assessment	i-Check	

5-PS1-1 Develop a model to describe that matter is made of particles too small to be seen.

5-ESS2-1 Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.

Investigation 4 - Heating Earth

Students investigate energy transfer on Earth. They investigate uneven heating by recording and graphing temperature changes when two earth materials absorb solar energy. They observe examples of energy transfer by radiation and conduction and discuss mechanisms of energy transfer to and from the air. Students observe convection currents in water as a model of what happens in air. They test different designs for solar water heaters. Students consider how the atmosphere, hydrosphere, and geosphere interact.



Standards - 5-ESS2-1, 5-ESS3-1, 3-5 ETS1-2, 3-5 ETS1-3

Investigation 4	Summary of Lesson	Priority
Part 1: Heating Earth Materials	<p>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.</p> <p><i>Read, "Uneven Heating".</i> <i>Activity, "Tutorial: Radiation" and "Virtual Investigation" Uneven Heating".</i></p> <p><i>FQ - What happens to Earth materials when they are exposed to sunlight?</i></p>	<p>High This lesson introduces new concepts and vocabulary.</p>
Part 2: Conduction	<p>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 reradiation from Earth's surface, and conduction between Earth's surface and air particles.</p> <p><i>Read, "Wind and Convection" and "Wind Power".</i> <i>Video, "Convection".</i> <i>Activity, "Energy Transfer".</i></p> <p><i>FQ - What does energy transfer to the air?</i></p>	<p>High This lesson introduces the concept of conduction.</p>
Part 3: Convection	<p>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.</p> <p><i>Read, "Solar Technology".</i></p> <p><i>FQ - What happens when a volume of fluid is warmed at the bottom?</i></p>	<p>High This lesson introduces the concept of convection.</p>

Part 4: Color and Energy Transfer	<p>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.</p> <p><i>Read, "Solar Technology".</i></p> <p><i>FQ - What is the best design for a solar water heater?</i></p>	High
Assessment		

5-ESS2-1 Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.

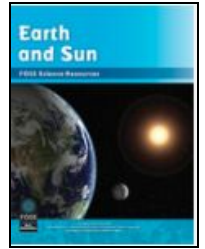
5-ESS3-1 Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

3-5 ETS1-2 Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.

3-5 ETS1-3 Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.

Investigation 5 - Water Planet

Students experience the phenomenon of 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.



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.

Students use light wave energy to 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.

Standards - 5-ESS2-1, 5-ESS2-2, 5-ESS3-1

Investigation 5	Summary of Lesson	Priority
Part 1: Condensation	<p>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.</p> <p><i>Read, "Condensation".</i></p> <p><i>FQ - What causes condensation to form?</i></p>	<p>High</p> <p>This lesson introduces the concept of condensation.</p>
Part 2: Evaporation	<p>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.</p> <p><i>FQ - How does water vapor get into the air?</i></p>	<p>High</p> <p>This lesson introduces the concept of evaporation.</p>
Part 3: Water Cycle	<p>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 freshwater and saltwater, and their distribution on Earth. They simulate the travels of a water drop through the water cycle.</p> <p><i>Read, "Where is Earth's Water?", "The Water Cycle", and</i></p>	<p>High</p> <p>This lesson reinforces the concepts of water and the water cycle.</p>

	<p><i>“Severe Weather”.</i> <i>Video, “Water Cycle”.</i> <i>Activity, “Water-Cycle Game”</i></p> <p><i>FQ- What is the water cycle?</i></p>	
Part 4:Climate	<p>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.</p> <p><i>Read, “Earth’s Climates” and “Global Climate Change”.</i> <i>Video, “Climate and Seasons”.</i> <i>Activity, “Climate Regions Map”.</i></p> <p><i>FQ - What is the difference between weather and climate?”</i></p>	<p>Low This lesson could be skipped.</p>
Assessment		

Investigation 5 cont. - Water Planet

5-ESS2-1 Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.

5-ESS2-2 Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth.

5-ESS3-1 Obtain and combine information about ways individual communities use science ideas to protect the Earth’s resources and environment.