



Earth’s Systems

Fifth Grade

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Standards

NVACS – Science Standards

* 5-ESS2-1: Develop a model using an example to describe the 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.
* 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 Earth.
* 5-ESS1-2: Represent in graphical displays to reveal patterns of daily changes in the length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.

Engineering:

* 3-5-ETS1-1: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.
* 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.

ELA:

* W.5.7: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.
* W.5.8: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work and provide a list of sources.
* RI.5.3: Explain the relationships or interactions between two or more individuals, events, ideas, or concepts in a historical, scientific, or technical text based on specific information in the text.
* RI.5.7: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.
* SL5.2: Summarize a written text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally.

Materials

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Item** | **Qty.** |  | **Item** | **Qty.** |
| Computer | 1 |  | BrainPOP/ BrainPOP jr. Logins | |
| Individual white boards | Class set (30) |  | White board markers | Class set (30) |
| Pencils | Class set (30) |  | Science notebooks | Class set (30) |
| 2-liter bottles | Class set (30) |  | Soil | 5 lbs. |
| Radish seeds | 5 pkgs |  | Measuring cups | 5 sets |
| Packing tape | 5 rolls |  | Masking tape | 5 rolls |
| Markers | Class set (30) |  | Styrofoam packing peanuts | 1 lb. |
| Biodegradable packing peanuts | 1 lb. |  | Sandwich bags | 5 boxes |
| Cornstarch | 5 boxes |  | Corn oil | 5 bottles |
| Food coloring | 5 sets |  | Tablespoons | 5 sets |
| Microwave (access) | 1 |  | Large clear plastic bowls | 8 |
| Pitchers | 10 |  | Clear plastic wrap | 5 rolls |
| Ceramic mugs | 8 |  | Salt | 5 containers |
| Spoons | Class set (30) |  | Birthday candles | 1 box |
| Plates | 10 |  | Clear drinking glasses | 10 |
| Matches | 1 box |  | Raw eggs | 2 dozen |
| Bowls | Class set (30) |  | Cups | Class set (30) |
| Droppers | Class set (30) |  | Cocoa powder | 5 containers |
| Dawn dishwashing detergent | 2 bottles |  | Generic dishwashing detergent | 2 bottles |
| Green Works detergent | 2 bottles |  | Feathers | 1 bag |
| Nails | Class set (30) |  | String | 2 rolls |
| Cardboard boxes | 8 |  | Magnets | Class set (30) |
| Clear tape | 5 rolls |  | Plastic heavy-duty trash bags | 5 boxes |
| Scissors | Class set (30) |  | Hole punch | 1 |
| Rulers | Class set (30) |  | Paper plates | Class set (30) |
| Play-Doh | 5 containers |  | Sharpies | Class set (30) |
| Flashlights | Class set (30) |  | Brads | 1 box |
| Paper clips | 1 box |  | Paper | 1 ream |
| Crayons | Class set (30) |  | 250 ml beakers | 10 |
| Gravel | 1 lb. |  | Cotton balls | 5 bags |
| Charcoal briquettes | 5 lbs. |  | Sand | 5 lbs. |
| Wood chips | 5 lbs. |  | Styrofoam packing | 5 lbs. |
| Charcoal | 5 lbs. |  | Screen | 1 package |
| Rubber bands | 1 bag |  | Test tubes | 10 |

Books with myON links (if available)

Sustaining our Natural Resources by Jen Green, <https://www.myon.com/reader/index.html?a=envch_susnatres_f11>

There Goes the Water: A Song About the Water Cycle by Laura Purdie Salas, <https://www.myon.com/reader/index.html?a=ss_water_s10>

The Story Behind Water by Christin Ditchfield, <https://www.myon.com/reader/index.html?a=hrt_truest_water_f11>

The Science Behind Wonders of the Water: Exploding Lakes, Ice Circles, and Brinicles by Suzanne Garbe, <https://www.myon.com/reader/index.html?a=sbnp_water_f16>

The Environment Challenge: Reducing Pollution and Waste by Jen Green, <https://www.myon.com/reader/index.html?a=envch_rdcplwas_f11>

How Effective is Recycling? by Catherine Chambers, <https://www.myon.com/reader/index.html?a=ed_rcycl_s15>

Great Scientific Theories: Gravity by Nick Hunter, <https://www.myon.com/reader/index.html?a=gst_gravt_f17>

The Sun and Our Solar System by Jen Green, <https://www.myon.com/reader/index.html?a=gst_soss_f17>

What Do We Know about Stars and Galaxies? by John Farndon, <https://www.myon.com/reader/index.html?a=earspb_exp_whastar_f11>

Totally Wacky Facts About Planets and Stars by Emma Carlson Berne, <https://www.myon.com/reader/index.html?a=mb_pstar_f15>

Are Humans Damaging the Atmosphere? by Catherine Chambers, <https://www.myon.com/reader/index.html?a=ed_atmsp_s15>

Cool Plastic Bottle and Milk Jug Science (page 20-23) by Tammy Enz, <https://www.myon.com/reader/index.html?a=rs_pbottl_f16>

The Gripping Truth about Forces and Motion by Agnieszka Biskup, <https://www.myon.com/reader/index.html?a=lolps_gtfmo_f12>

Shadows by Louise and Richard Spilsbury, <https://www.myon.com/reader/index.html?a=exli_shad_f15>

Vocabulary

|  |  |
| --- | --- |
| **Word** | **Definition** |
| Accumulation | When water vapor in the air turns from a gas back into a liquid and leaves the atmosphere |
| Air Pollution | Contamination of natural air by mixing it with different pollutants |
| Air Resistance | The frictional force air exerts against a moving object |
| Apparent Brightness | The brightness of a star as measured by an observer, as opposed to its intrinsic brightness when corrected for distance or absorption |
| Atmosphere | The layer of gas that surrounds the Earth |
| Axis | An imaginary line running through the Earth on which the Earth rotates |
| Biome | A large region of Earth that has a certain climate and living things |
| Biosphere | The sphere or area around Earth where life exists |
| Collection | Oceans and other bodies of water collect the water that has fallen |
| Constellation | A group of stars that make up an imaginary shape in the night sky, usually named after mythological characters, people, animals, and objects |
| Cycle | A set of events or actions that happen again and again in the same order |
| Density | How close together the molecules of a substance are or how much mass a substance has in a given space |
| Ecosystem | System involving all living things in a given area interacting with each other and with their non-living environments |
| Ellipse | An oval |
| Evaporation | When a liquid turns into a gas or vapor |
| Freshwater | Bodies of water containing low levels of salt, typically less than 1% |
| Filtration | A process by which impurities or particles are removed from a fluid, either a liquid or a gas |
| Geocentric | Related to or measured from the Earth’s center; having or relating to the Earth as a center |
| Geosphere | The solid Earth |
| Gravity | A force which tries to pull two objects toward each other |
| Hazardous | Involving risk or danger |
| Heliocentric | Referred to or measured from the sun’s center, or appearing as if seen from it |
| Hydrosphere | All of the Earth’s water, including surface water (water in oceans, lakes, and rivers,) groundwater (water in soil and beneath the Earth’s surface,) snow cover, ice, and water in the atmosphere, including water vapor |
| Light Pollution | Over illumination of a certain area that is considered obtrusive |
| Magnetic Field | An area that is magnetic, or has the power to attract and hold other objects |
| Mass | A measure of how much matter is in an object |
| Mnemonic | Assisting or intended to assist memory; uses a pattern of letters, ideas, or associations |
| Noise Pollution | Loud noises that disrupt the standard of living in the affected area |
| Non-Renewable | Natural resources that cannot be replaced after they are used: they exist in a fixed amount on Earth |
| Orbit | To move around, or another word for revolve; all orbits are elliptical in shape, meaning they’re oval rather than circular |
| Precipitation | The liquid and solid water particles that fall from clouds and reach the ground |
| Radioactive Pollution | Pollution of land and air with radioactive poisoning |
| Revolution | The action of moving around something in a circular path |
| Rotation | The act or process of moving or turning around a central point |
| Recycle | To transform back to its raw form and make something new |
| Reduce | To use less of something |
| Renewable | Made from resources that are replaceable and cannot run out; such as wind, water, and sunshine |
| Resource | Something found in nature and can be used by people |
| Reuse | To use something again in a new way |
| Saltwater | Water containing salts |
| Soil Pollution | Contamination of soil or the land that prevents growth of natural life |
| Star | Any of the heavenly bodies except planets which |
| Terrarium | A container for growing and displaying plants |
| Thermal Pollution | An increase in temperature in a particular area over time |
| True Brightness | The amount of energy (light) a star emits from its surface |
| Visual Pollution | Obstruction to views, caused by billboards, powerlines, construction areas, and/or high rises |
| Water Pollution | Contamination of water on Earth |
| Water Vapor | Water in the form of a vapor, or gas |
| Weight | The downward force caused by gravity on an object |

Lesson 1: What are Earth’s major systems?

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| --- | --- |
| **Learning Target**  **Objective**  **Standard** | The Earth is composed of four major systems (or spheres) including the geosphere, hydrosphere, atmosphere, and biosphere.  Students will be able to explain the importance and examples of each system.  5-ESS2-1: Develop a model using an example to describe the ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. |
| **Materials** | Computer, white boards, white board markers, pencils, science notebooks |
| **Books** | Are Humans Damaging the Atmosphere? by Catherine Chambers |
| **Vocabulary** | Biosphere: The sphere or area around Earth where life exists  Geosphere: The solid Earth  Hydrosphere: All the Earth’s water, including surface water (water in oceans, lakes, and rivers), groundwater (water in soil and beneath the Earth’s surface), snow cover, ice, and water in the atmosphere, including water vapor  Atmosphere: The layer of gas that surrounds the Earth  Biome: A large region of Earth that has a certain climate and living things |
| **Procedures** | **ENGAGE**  Ask the students: What do we know about the Earth? What have we learned about the structure of the Earth? How are different parts of the Earth different? What about underneath the surface? There are four different spheres in the Earth: the Biosphere, the Geosphere, the Hydrosphere, and the Atmosphere. Give students time to brainstorm different ideas about the Earth and what the different spheres might mean. As a class, make a KWL chart for what they want to know about the Earth.  Video: “Earth’s 4 Spheres for kids/4 Major Spheres” (3:38): <https://www.youtube.com/watch?v=b-4chsOyTLw>  **EXPLORE**  Video: “Four Spheres Part 1 (Geo and Bio): Crash Course Kids #6.1” (4:00): <https://www.youtube.com/watch?v=VMxjzWHbyFM>  Video: “Four Spheres Part 2 (Hydro and Atmo): Crash Course Kids #6.2” (3:30): <https://www.youtube.com/watch?v=UXh_7wbnS3A>  Create four different circle maps of each of the different spheres. Have students Mix-Freeze-Group (<https://www.kaganonline.com/>) to create groups of 4-6 students (depending on class size.) Assign each different group one of the spheres and have them write down the name in their science notebooks. Have the students brainstorm different items that are found within their sphere. For example, animals belong to the biosphere, while water belongs to the hydrosphere. If the weather is permitting, have the students go outside and make observations of different items they see that belong in each of the different spheres. Tell students they need to be able to justify their answers.  **EXPLAIN**  Review the different terms of the different spheres. Have each group read the different items they placed in their groups, along with a justification as to why they placed certain items in each group. If there are some disagreements, review the different spheres and decide as a class which sphere the items belong to. Document the different brainstormed ideas on the circle maps, and have the students take notes on the different spheres in their science notebooks.  The hydrosphere contains all the solid, liquid, and gaseous water of the planet. Approximately 97% of the Earth’s water is salty and only a small portion (about 3%) is non-salty. The saltwater gets collected along the Earth’s surface in deep valleys. This sphere ranges from 10 to 20 kilometers in thickness.  The biosphere of Earth includes all living things on planet Earth like animals and plants. Most of this like exists no deeper than 10 feet into the ground, or approximately 600 feet above it.  The geosphere can be defined as the outer boundary layer of solid Earth and discontinuity in the mantle. It is the crustal system composed of the layers which are the core, mantle, and outer crust. The actual thickness of this sphere varies from 40 to 280 kilometers.  The atmosphere is a complex fluid system of gases and suspended particles. This fluid system forms a gaseous envelope around the Earth with no defined boundaries. The atmosphere is made up of gases such as nitrogen, argon, oxygen, carbon dioxide, etc.  Book: Are Humans Damaging the Atmosphere? by Catherine Chambers, or use the myON link: <https://www.myon.com/reader/index.html?a=ed_atmsp_s15> |
| **Enrichment** | **EXTEND**  Ask the students: How do you think the different layers on the Earth interact with each other? Can one sphere exist without the others? Why or why not? |
| **Closure** | **ELABORATE**  All four spheres can be and are often present in a single location. For example, a piece of soil will contain minerals from the geosphere. Additionally, there will be elements of the hydrosphere present as moisture within the soil; the biosphere as insects and plants; and even the atmosphere as pockets of air between soil pieces. The complete system is what makes up life as we know it on Earth. |
| **Assessment** | **EVALUATE**  Formative: Check on students’ different circle maps for understanding. |

Differentiated Instruction

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| **Below Grade Level** | **On Grade Level** | **Above Grade Level** |
| Review the different spheres of the Earth, including the circle maps created by the students. Show the student different pictures of the spheres to check for understanding. | Review the different spheres of the Earth, including the circle maps created by the students. Ask the student: Which sphere do you think is the most important? Why? | Review the different spheres of the Earth, including the circle maps created by the students. Ask the student: What would happen if one of the spheres didn’t exist? |
| **ELL Strategies** | | |
| *Visual Aids:* Show the student pictures of the different spheres as described in the lesson, and/or have the student describe the different spheres of the Earth using the circle maps created by the class.  *Hands-On*: Using realia (objects and material from everyday life,) give the student a chance to handle different spheres, such as the circle maps they made in class. Give them a chance to explore the different spheres for understanding.  *Word Wall:* Post new vocabulary terms on the wall with similar terms near each other for easy reference. The flash cards with picture of the words can be incorporated into this strategy, or the student can add it in a notebook. Make sure the student draws their own pictures rather than relying on something drawn for them. | | |
| **DOK Question (Level 2)** | | |
| Ask students: How would you summarize the spheres of the Earth? How can all four different layers exist in one place? | | |
| **Interactive Technology** | | |
| App: GLOBE Observer: NASA  Interactive: Kids Geography: Earth’s Spheres: <https://kidsgeo.com/geography-for-kids/earths-spheres/> | | |

Lesson 2: How do the different systems on the Earth interact?

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| **Learning Target**  **Objective**  **Standard** | The Earth’s four major systems are constantly interacting.  Students will understand how any of Earth’s major systems interact with each other.  5-ESS2-1: Develop a model using an example to describe the ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. |
| **Materials** | Computer, white boards, white board markers, pencils, science notebooks, 2-liter bottles, soil, radish seeds, water, measuring cups, packing tape, masking tape, markers |
| **Books** | Cool Plastic Bottle and Milk Jug Science by Tammy Enz |
| **Vocabulary** | Biosphere: The sphere or area around Earth where life exists  Geosphere: The solid Earth  Hydrosphere: All the Earth’s water, including surface water (water in oceans, lakes, and rivers), groundwater (water in soil and beneath the Earth’s surface), snow cover, ice, and water in the atmosphere, including water vapor  Atmosphere: The layer of gas that surrounds the Earth  Terrarium: A container for growing and displaying plants |
| **Procedures** | **ENGAGE**  Ask the students: Do you think the four systems interact with each other, or do you think they are independent? Looking at the circle maps, do you think they have anything to do with each other? Ask students to Mix-Pair-Share (<https://www.kaganonline.com/>) to brainstorm about how the different systems might interact.  Video: “Geosphere, biosphere, hydrosphere, atmosphere” (3:35): <https://www.youtube.com/watch?v=HurK-1rrdb8>  **EXPLORE**  Video: “Big Idea 3: Earth’s Systems Interact” (5:49): <https://www.youtube.com/watch?v=BnpF0ndXk-8>  Science Lab: Earth Systems in a Bottle: <https://www.smusd.org/>  Have students Mix-Freeze-Group (<https://www.kaganonline.com/>) to create groups of 4-6 to create a terrarium to see how the different systems interact.  Before the experiment, the teacher should clean and cut the bottle in half, then cut four vertical slits in the top portion. Slide the top of the bottle over the bottom, pushing the alternate flaps to the inside. Each group will need: science notebooks, pencils, prepared 2-liter bottles, soil (2-3 cups,) radish seeds (4-5 seeds), ¼ cup water, measuring cups, packaging tape for sealing terrariums, masking tape for names, and markers for writing names.  Put about 3 cups of soil in the bottom section of the terrarium and pat the soil until it is firm. Add about ¼ cup of water and look at the soil from the side to make sure the soil gets wet. If there’s still dry soil, add more water. Drop 4-5 radish seeds on the surface of the soil. Use your fingertips to push the seeds just below the soil’s surface. Sprinkle a little more soil on the seeds to cover them. Place the top section of the terrarium on top, pushing alternate flaps to the inside and outside so it fits securely. Make sure the top is still on the bottom. Tape the top and bottom sections together to create an airtight seal. Label the terrarium with the names in the group and place in a sunny location. Have students document their terrarium in their science notebooks and label each item used. Ask the students: What system does the soil represent? The seeds? Water? What about the air?  **EXPLAIN**  Book: Cool Plastic Bottle and Milk Jug Science (page 20-23) by Tammy Enz, or use the myON link: <https://www.myon.com/reader/index.html?a=rs_pbottl_f16>  In the terrarium, all four of the Earth’s systems are represented. The soil is the geosphere; the seeds are the biosphere; the water is the hydrosphere, and the air is the atmosphere. As long as the systems are sealed tight in the bottle, all four spheres will be working together to grow plants. The sun will cause condensation to form in the bottle, which will drip into the soil to water the seeds and plants.  Video: “Build a Tiny Plant World! /Science Project for Kids” (4:43): <https://www.youtube.com/watch?v=0vu4wdHNo4Q> |
| **Enrichment** | **EXTEND**  The students can continue to observe their terrarium in their science notebooks. Students can also conduct a test where they build another terrarium but exclude one of the items representing the spheres. They can then compare the two terrariums. |
| **Closure** | **ELABORATE**  All four spheres can be and are often present in a single location. For example, a piece of soil will contain minerals from the geosphere. Additionally, there will be elements of the hydrosphere present as moisture within the soil; the biosphere as insects and plants; and even the atmosphere as pockets of air between soil pieces. The complete system is what makes up life as we know it on Earth. |
| **Assessment** | **EVALUATE**  Formative: Check on students’ notes on the terrarium for understanding. |

Differentiated Instruction

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| **Below Grade Level** | **On Grade Level** | **Above Grade Level** |
| Review the different spheres of the Earth, including the labeled terrarium. Show the student different pictures of the spheres to check for understanding. | Review the different spheres of the Earth, including the labeled terrarium. Ask the student: Which sphere do you think is the most important? Why? | Review the different spheres of the Earth, including the labeled terrarium. Ask the student: What would happen if one of the spheres didn’t exist? |
| **ELL Strategies** | | |
| *Visual Aids:* Show the student pictures of the different spheres as described in the lesson, and/or have the student describe the different spheres of the Earth using the circle maps created by the class.  *Hands-On*: Using realia (objects and material from everyday life,) give the student a chance to handle different spheres, such as the circle maps they made in class. Give them a chance to explore the different spheres for understanding.  *Word Wall:* Post new vocabulary terms on the wall with similar terms near each other for easy reference. The flash cards with picture of the words can be incorporated into this strategy, or the student can add it in a notebook. Make sure the student draws their own pictures rather than relying on something drawn for them. | | |
| **DOK Question (Level 2)** | | |
| Ask students: How would you summarize the spheres of the Earth? How can all four different layers exist in one place? | | |
| **Interactive Technology** | | |
| App: Science at 100,000 Feet: University of Colorado Boulder  Games: Earth’s Spheres: <https://www.wartgames.com/themes/science/earthspheres.html> | | |

Lesson 3: What types of resources are available on Earth?

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| --- | --- |
| **Learning Target**  **Objective**  **Standard** | Humans rely on Earth’s resources for nearly everything.  Students will compare renewable and nonrenewable resources on Earth.  5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth’s resources and environment. |
| **Materials** | Computer, white boards, white board markers, pencils, science notebooks, Styrofoam packing peanuts, biodegradable packing peanuts, sandwich bags, cornstarch, corn oil, water, food coloring, tablespoons, access to a microwave |
| **Books** | Sustaining our Natural Resources by Jen Green |
| **Vocabulary** | Renewable: Made from resources that are replaceable and cannot run out, such as wind, water, and sunshine  Non-Renewable: Natural resources that cannot be replaced after they are used: they exist in a fixed amount on Earth  Resource: Something found in nature and can be used by people |
| **Procedures** | **ENGAGE**  Ask the students: What is a resource? What are some examples of resources that are found on Earth? Where are different resources found? How are these resources used? Ask students to Mix-Pair-Share (<https://www.kaganonline.com/>) to brainstorm about how the different resources, and where they might be found.  Some resources are nonrenewable, and some are renewable. Renewable energy is a resource that can be used repeatedly, while nonrenewable resources can only be used once. Most nonrenewable resources are produced naturally, while renewable resources are grown or produced in a short amount of time. Using a t-chart, make a list of renewable and nonrenewable resources brainstormed by the class and have students copy it into their science notebooks.  Video: “Resources: Welcome to the Neighborhood – Crash Course Kids #2.1” (3:14): <https://www.youtube.com/watch?v=8LfD_EKze2M>  **EXPLORE**  Video: “Science Video for Kids: Natural Resources of the Earth” (5:16): <https://www.youtube.com/watch?v=Qw6uXh9yM54>  National Agriculture in the Classroom: Making Reusable Plastic: [https://www.agclassroom.org/teacher/matrix/lessonplan.cfm? lpid=141&author\_state=0&grade=3](https://www.agclassroom.org/teacher/matrix/lessonplan.cfm?%20lpid=141&author_state=0&grade=3)  Introduce the word “bioplastic” by breaking it into two parts: “Bio” means coming from a living thing, so “Bioplastic” is plastic that comes from a living thing.  Have students Mix-Freeze-Group (<https://www.kaganonline.com/>) to create groups of 4-6 to research renewable resources. Each group will need: 10 Styrofoam packing peanuts, 10 biodegradable packing peanuts, 3 sandwich bags, tablespoons, 1 tbsp cornstarch, corn oil, water, and food coloring.  Place 10 Styrofoam packing peanuts into one sandwich bag, and 10 biodegradable packing peanuts into another sandwich bag. Add one cup of water to each bag, seal tight, and shake The biodegradable peanuts will dissolve in less than 10 seconds, while the Styrofoam will remain unchanged. The biodegradable packing peanuts are made up of over 99% cornstarch, and a small amount of food grade oil. Ask the class the pros and cons of each type of packing peanuts.  Students are going to make bioplastic by combining 1 tbsp cornstarch, 2 drops of corn oil, 2 tbsp water, and 2 drops of food coloring into the plastic bag. Students should seal the bag and mix the ingredients by rubbing the outside of the bag with their fingers until the ingredients are combined. Once mixed, open the bag slightly, making sure it can vent, and place it in a microwave for 20-25 seconds. Carefully remove the bag from the microwave and let it cool for a few minutes and have students make their observations in their science notebooks.  **EXPLAIN**  Renewable energy uses energy sources that are not “used up.” For example, solar power from the sun is renewable as we won’t’ “use up” all the sunlight from the sun. Examples of non-renewable energy sources include fossil fuels such as coal and oil. Once we use these resources, they are gone forever. Much of the world relies on non-renewable energy to heat up their homes, power their electronic devices, and power their cars. However, once these energy sources are used up, they will be gone forever. Some renewable types of energy include wind power, solar energy, hydropower, wave and tidal power, geothermal energy, and biomass energy. Fossil fuels include coal, oil, natural gas, and nuclear power.  Book: Sustaining our Natural Resources by Jen Green, or use the myON link: <https://www.myon.com/reader/index.html?a=envch_susnatres_f11> |
| **Enrichment** | **EXTEND**  The students can discuss the advantages of having materials that are biodegradable and those that are not. Review how renewable energy can be sustained for many years. |
| **Closure** | **ELABORATE**  Some resources can be both renewable and nonrenewable. For example, if you chop trees down and plant some new ones, there is a renewable source and biomass (fuel made from plant matter.) |
| **Assessment** | **EVALUATE**  Formative: Check on students’ notes on renewable and nonrenewable energy for understanding. |

Differentiated Instruction

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| **Below Grade Level** | **On Grade Level** | **Above Grade Level** |
| Review renewable and nonrenewable resources for students, including the advantages to renewable energy. Show the student different pictures of the resources to check for understanding. | Review renewable and nonrenewable resources for students, including the advantages to renewable energy. Ask the student: Which source do you think should be used more often? Why? | Review renewable and nonrenewable resources for students, including the advantages to renewable energy. Ask the student: What happens when the Earth runs out of nonrenewable sources? |
| **ELL Strategies** | | |
| *Visual Aids:* Show the student pictures of the different resources as described in the lesson, and/or have the student describe the different resources of the Earth using the t-chart created by the class.  *Hands-On*: Using realia (objects and material from everyday life,) give the student a chance to handle different resources. Give them a chance to explore the different resources for understanding.  *Word Wall:* Post new vocabulary terms on the wall with similar terms near each other for easy reference. The flash cards with picture of the words can be incorporated into this strategy, or the student can add it in a notebook. Make sure the student draws their own pictures rather than relying on something drawn for them. | | |
| **DOK Question (Level 2)** | | |
| Ask students: How would you summarize the different types of resources? Why do you think renewable resources aren’t used more often, or exclusively? | | |
| **Interactive Technology** | | |
| Game: BrainPOP: Sortify: Natural Resources: <https://www.brainpop.com/games/sortifynaturalresources/>  Game: NeoK12: Natural Resources: <https://www.neok12.com/Natural-Resources.htm> | | |

Lesson 4: What are the roles of water on Earth?

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| **Learning Target**  **Objective**  **Standard** | Humans rely on Earth’s resources for nearly everything.  Students will study the water cycle and create a replica.  5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth’s resources and environment.  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. |
| **Materials** | Computer, white boards, white board markers, pencils, science notebooks, large glass or plastic bowls, pitchers, sheets of clear plastic wrap, ceramic mugs, water, access to either a microwave or kettle, ice, salt, spoon, birthday candle, plate, clear drinking glass, match |
| **Books** | There Goes the Water: A Song About the Water Cycle by Laura Purdie Salas |
| **Vocabulary** | Cycle: A set of events or actions that happen again and again in the same order  Water Vapor: Water in the form of a vapor, or gas  Evaporation: When a liquid turns into a gas or vapor  Condensation: When water vapor in the air turns from a gas back into a liquid and leaves the atmosphere  Precipitation: The liquid and solid water particles that fall from clouds and reach the ground  Accumulation: Oceans and other bodies of water collect the water that has fallen |
| **Procedures** | **ENGAGE**  Ask the students: What is a resource? What are some examples of resources that are found on Earth? One of the most important resources is water. Why is water so important to humans? How does it interact with other Earth systems? Ask students to Mix-Pair-Share (<https://www.kaganonline.com/>) to brainstorm about water and how it interacts with other systems.  Video: “Introduction to Water” (3:47): <https://www.youtube.com/watch?v=nSENolWbyYQ>  **EXPLORE**  Video: “Science Video for Kids: Natural Resources of the Earth” (5:16): <https://www.youtube.com/watch?v=Qw6uXh9yM54>  Video: “Where Does Water Come From?” (4:21): <https://www.youtube.com/watch?v=R0K7VKkksyc>  To create the water cycle, have students get into groups of 2-6 (depending on the class size.) Give each group: a large glass or plastic bowl, pitcher, sheet of clear plastic wrap, ceramic mug, salt, ice, and water. Make sure to heat up some water beforehand, either in a microwave or kettle.  Pour the hot water into the bowls until they are about ¼ full. Add some salt to the water and stir it up. This represents the ocean. Place the mug in the center of the bowl. Be careful not to splash any water into it. The mug represents the land. Cover the top of the bowl tightly with plastic wrap. Place 3-4 cubes of ice on top of the plastic wrap. The plastic wrap represents the clouds, and the ice represents the cool atmosphere.  Wait about 5 minutes. Once the hot water from the ocean evaporates, condensation is visible on the “clouds.” Once the condensation cools down from the ice, it will turn into precipitation. On the sides of the bowl, precipitation is also visible as it goes back into the ocean. After another 5 minutes (10 minutes total,) carefully remove the ice cubes from the top of the plastic wrap. Some of the ice may have melted: be careful when removing the plastic wrap that the water from the melted ice doesn’t fall into the bowl. Have the students look inside the mug and see the precipitation that has fallen on the “land.”  Book: There Goes the Water: A Song About the Water Cycle by Laura Purdie Salas, or use the myON link: <https://www.myon.com/reader/index.html?a=ss_water_s10>  **EXPLAIN**  Video: “The Great Aqua Adventure: Crash Course Kids #24.1” (4:28): <https://www.youtube.com/watch?v=z5G4NCwWUxY>  The water cycle starts when energy from the sun heats up the surface of the Earth, causing the temperature of the water to rise. When this happens, some of the water evaporates into the air, turning into a gas called water vapor. As the water vapor rises high into the sky, it cools and turns back into a liquid, forming clouds. This process is called condensation. When too much water has condensed, the water droplets in the clouds become too big and heavy for the air to hold them. They fall back to Earth as rain, snow, sleet, or hail; known as precipitation. When the water falls and all stays into one area; such as an ocean, river, lake, or stream; this is called collection.  Video: “Water Cycle – Blazer Fresh/Science Video/GoNoodle” (3:16): <https://www.youtube.com/watch?v=KM-59ljA4Bs> |
| **Enrichment** | **EXTEND**   |  | | --- | | Groundwater or water stored in the Earth's surface can remain there for thousands of years before moving. Really old groundwater is called fossil water. Why can’t water be found that is fossilized? | |
| **Closure** | **ELABORATE**  Salt is very difficult to remove from water. The energy and technology to remove the salt are both expensive; hence the quote “Water, water everywhere, but not a drop to drink.” |
| **Assessment** | **EVALUATE**  Formative: Check on students’ notes on the water cycle for understanding. |

Differentiated Instruction

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| **Below Grade Level** | **On Grade Level** | **Above Grade Level** |
| Review the water cycle, including the different stages, and check for understanding. Explain the different stages with the student until they can repeat them. | Review the water cycle, including the different stages, and check for understanding. Ask the student: What would happen if the cycle didn’t repeat? | Review the water cycle, including the different stages, and check for understanding. Ask the student: What would happen if one of the steps wasn’t in the cycle? |
| **ELL Strategies** | | |
| *Visual Aids:* Show the student pictures of the water cycle as described in the lesson, and/or have the student describe the different stages of the water cycle and how they work with the other stages.  *Hands-On*: Using realia (objects and material from everyday life,) give the student a chance to experiment with the different stages of the water cycle or look at pictures.  *Word Wall:* Post new vocabulary terms on the wall with similar terms near each other for easy reference. The flash cards with picture of the words can be incorporated into this strategy, or the student can add it in a notebook. Make sure the student draws their own pictures rather than relying on something drawn for them. | | |
| **DOK Question (Level 3)** | | |
| Ask students: How is the water cycle related to other cycles on the Earth (such as the life cycle?) What would happen if we didn’t have the water cycle? | | |
| **Interactive Technology** | | |
| App: Water Cycle VR – Victory Enterprises    Game: South East Water: Natural water cycle game: <https://www.educationsoutheastwater.com.au/resources/natural-water-cycle-game>  Game: Project Wet: A Trip Through the Water Cycle: <http://www.discoverwater.org/blue-traveler/>  Games: TurtleDiary: Water Cycle Games: <https://www.turtlediary.com/games/water-cycle.html> | | |

Lesson 5: How much water do we have on Earth?

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| **Learning Target**  **Objective**  **Standard** | Most of the Earth is water, made up of both fresh water and salt water.  Students will learn that most of the water on Earth is undrinkable in its natural state.  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. |
| **Materials** | Computer, white boards, white board markers, pencils, science notebooks, raw eggs, salt, clear cups, tablespoon, water |
| **Books** | The Story Behind Water by Christin Ditchfield |
| **Vocabulary** | Saltwater: Water containing salts  Freshwater: Bodies of water containing low levels of salt, typically less than 1%  Density: How close together the molecules of a substance are or how much mass a substance has in a given space |
| **Procedures** | **ENGAGE**  Ask the students: How often do you see water on the Earth? What percent of the Earth’s surface do you think is water? What percent is considered to be fresh water? What percent of the Earth’s water is in the ocean? Ask students to Mix-Pair-Share (<https://www.kaganonline.com/>) to brainstorm about water and the answers to the questions.  Book: The Story Behind Water by Christin Ditchfield, or use the myON link: <https://www.myon.com/reader/index.html?a=hrt_truest_water_f11>  **EXPLORE**  Explorable: Salt Water Egg Experiment: <https://explorable.com/salt-water-egg-experiment>  The Science Kiddo: Salt Water Experiment: <https://www.sciencekiddo.com/salt-water-experiment-ocean-science/>  Have students return to their original partners. Each group will need table salt, clear plastic cups, a tablespoon, spoons, water, two raw eggs, and small plastic jewels.  Dissolve 6 tablespoons of salt in one cup, and leave the other as plain, fresh water. Have the students predict which of the items will float and which will sink in the different water cups. Students should write down their predictions. Once they have made their predictions, they should drop the jewels into each cup. Make an observation as to what happens. Remove the jewels from each cup and repeat the process with the raw eggs. In both cases, the eggs and jewels should float.  **EXPLAIN**  Video: “Water Water Everywhere: Crash Course Kids #14.2” (4:55): <https://www.youtube.com/watch?v=SkAhB-8CtZg>  Density refers to the amount of matter contained in a given space or volume. When there’s more amount of matter in a given space or volume, the object is considered denser and heavier. However, this doesn’t mean density and weight are the same. Weight refers to the vertical force exerted by the mass of an object when subjected to gravity. Placing an object that is denser than fresh water automatically sinks. Because the egg is denser than the tap water, it pushes away the water particles to make space for itself, which makes it sink. However, since salt water is heavier than ordinary tap water, it is more capable of holding the egg up, making the egg float. Objects sink when their own density is greater than the liquid’s density.  If humans drank salt water, the salt would get absorbed into your blood along with the water. That would make your blood too salty. So, your kidneys would have to remove the salt. But to do that, they would need to use even more water. Drinking saltwater would make a person thirstier and can make you sick if you drink it too often. Although people can’t drink seawater, some marine mammals and seabirds can drink saltwater. Marine mammals have very efficient kidneys, and seabirds have a special gland in their nose that removes salt from the blood.  To answer the questions: water covers about 71% of the Earth’s surface. 96% of water on Earth is found in the ocean. Only 3% of water on Earth is considered to be fresh water. |
| **Enrichment** | **EXTEND**  Students can create a simple infographic to show the difference between salt water and fresh water found on Earth. An infographic is a visual image such as a chart or a diagram to represent information or data.  Free Templates: Water Infographic: <https://all-free-download.com/free-vector/save-water.html> |
| **Closure** | **ELABORATE**  While the Earth is 71% covered by water, the oceans hold about 97% of it, yet cannot be consumed. Salt is very difficult to remove from water. The energy and technology to remove the salt are both expensive; hence the quote “Water, water everywhere, but not a drop to drink.” |
| **Assessment** | **EVALUATE**  Formative: Check on students’ notes on saltwater vs. freshwater, especially the infographic. Check for understanding. |

Differentiated Instruction

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| **Below Grade Level** | **On Grade Level** | **Above Grade Level** |
| Review freshwater vs. saltwater, as well as the amounts of each on Earth. Explain the different types and the differences and check for understanding. | Review freshwater vs. saltwater, as well as the amounts of each on Earth. Ask the student: Do you think it would be possible to convert salt water into fresh water? Why or why not? | Review freshwater vs. saltwater, as well as the amounts of each on Earth. Ask the student: How can water conservation translate into more fresh water since all water stays in the cycle? |
| **ELL Strategies** | | |
| *Visual Aids:* Show the student pictures of bodies of saltwater and freshwater as described in the lesson, and/or have the student describe why objects float in saltwater, but not in freshwater.  *Hands-On*: Using realia (objects and material from everyday life,) give the student a chance to experiment with different objects floating or sinking in freshwater and saltwater.  *Word Wall:* Post new vocabulary terms on the wall with similar terms near each other for easy reference. The flash cards with picture of the words can be incorporated into this strategy, or the student can add it in a notebook. Make sure the student draws their own pictures rather than relying on something drawn for them. | | |
| **DOK Question (Level 2)** | | |
| Ask students: Can you explain why saltwater isn’t safe to drink, and a process that would remove the salt from the water? Why do you think it is so expensive? | | |
| **Interactive Technology** | | |
| App: Life Sustaining Water: Gyan Sahoo  Interactive: KidZone Science: The Water Cycle: <https://www.kidzone.ws/water/>  Game: BrainPOP: Water Cycle Game: <https://www.brainpop.com/games/watercyclegame/> | | |

Lesson 6: Where is all the freshwater on Earth?

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| **Learning Target**  **Objective**  **Standard** | Fresh water is important for life but is only found in certain places on Earth.  Students will be able to determine where the fresh water on Earth is located.  5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth’s resources and environment. |
| **Materials** | Computer, white boards, white board markers, pencils, science notebooks, access to the Internet |
| **Books** | The Science Behind Wonders of the Water: Exploding Lakes, Ice Circles, and Brinicles by Suzanne Garbe |
| **Vocabulary** | Saltwater: Water containing salts  Freshwater: Bodies of water containing low levels of salt, typically less than 1%  Ecosystem: System including all living things in a given area interacting with each other and with their non-living environments |
| **Procedures** | **ENGAGE**  Ask the students: Knowing that only 3% of the Earth’s water is freshwater, how much of that do you think can be consumed easily? Where do you think the freshwater on Earth is located? Ask students to Mix-Pair-Share (<https://www.kaganonline.com/>) to brainstorm about water and the answers to the questions. Create a circle map of where fresh water is located on Earth.  Book: The Science Behind Wonders of the Water: Exploding Lakes, Ice Circles, and Brinicles by Suzanne Garbe , or use the myON link: <https://www.myon.com/reader/index.html?a=sbnp_water_f16>  **EXPLORE**  Video: “The Basics of Freshwater: Crash Course Kids #14.1” (4:15): <https://www.youtube.com/watch?v=oaQCiwzjnCM>  Less than 1% of freshwater is easily accessible and available for human use. Since there is so little water that is available for human use, how do humans go about conserving water?  Video: “Water Fight!: Crash Course Kids #36.1” (4:03): <https://www.youtube.com/watch?v=4b2kdcEuWr4>  Have students watch the video about the amount of water used in one day.  Video: “How Much Water Do You Use in One Day?” (1:36): <https://www.youtube.com/watch?v=SYwEAR6CbQw>  Have students Mix-Freeze-Group (<https://www.kaganonline.com/>) to create groups of 4-6 (depending on class size) to discuss ways to conserve water. Have each group tackle one of the problems seen in the video: water use in the bathroom, laundry, etc. Give students a chance to research water conservation on the Internet to make a viable solution to preserve the Earth’s water.  **EXPLAIN**  Video: “Water Fix!: Crash Course Kids #36.2” (5:28): <https://www.youtube.com/watch?v=UYROQW9IDIg>  Freshwater ecosystems include lakes, ponds, rivers, and streams. Lakes are large bodies of freshwater surrounded by land, while ponds are smaller bodies of water surrounded by land. Rivers and streams are moving bodies of freshwater, which usually originate in mountains and come from melting ice or ground water, eventually flowing into the ocean.  Many animals live in freshwater ecosystems. Some need the movement of the stream or river water to survive. Without freshwater biomes, people would not be alive. Freshwater ecosystems are important because they provide water for drinking; energy and transportation; recreation; and jobs like fishermen and researchers. Another way rivers are used is to produce hydroelectric power.  To help freshwater biomes, water conservation is important. By using less water, it can be ensure that there is enough water for a healthy biome. People should also be careful not to pollute the water by not putting chemicals down the drain. |
| **Enrichment** | **EXTEND**  Students can create a visual representation of the amount of fresh water on Earth by using either a pie chart or a simple graph to show the distribution of water. |
| **Closure** | **ELABORATE**  Water conservation is important for everyone but can start at a young age. There are many websites to teach students about water conservation.  Water Use It Wisely: <https://wateruseitwisely.com/kids/> |
| **Assessment** | **EVALUATE**  Formative: Check on students’ notes on water and water conservation, including the notes on different areas of where water can be found. |

Differentiated Instruction

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| **Below Grade Level** | **On Grade Level** | **Above Grade Level** |
| Review the different locations to find freshwater, as well as the importance of water conservation. Explain the different types and the differences and check for understanding. | Review the different locations to find freshwater, as well as the importance of water conservation. Ask the student: Do you think it is important to conserve saltwater as well? Do you think it’s as big of a problem? Why or why not? | Review the different locations to find freshwater, as well as the importance of water conservation. Ask the student: Since there are inaccessible methods of freshwater, what do you think a solution for that should be? Do you think it’s necessary to find one? Why or why not? |
| **ELL Strategies** | | |
| *Visual Aids:* Show the student pictures of bodies of freshwater as described in the lesson, and/or have the student describe the different freshwater sources.  *Hands-On*: Using realia (objects and material from everyday life,) give the student a chance to experiment with different types of freshwater sources.  *Word Wall:* Post new vocabulary terms on the wall with similar terms near each other for easy reference. The flash cards with picture of the words can be incorporated into this strategy, or the student can add it in a notebook. Make sure the student draws their own pictures rather than relying on something drawn for them. | | |
| **DOK Question (Level 2)** | | |
| Ask students: Can you explain why freshwater is difficult to come by? Do you think conservation is enough? | | |
| **Interactive Technology** | | |
| App: Aquation: The Freshwater Access Game: Smithsonian Institution  Game: NASA Climate Kids: <https://climatekids.nasa.gov/menu/fresh-water/>  Interactive: EPA: Drinking Water & Ground Water Kids’ Stuff: <https://www3.epa.gov/safewater/kids/gamesandactivies.html> | | |

Lesson 7: How have humans impacted Earth’s systems?

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| **Learning Target**  **Objective**  **Standard** | Humans have impacted all of Earth’s systems.  Students will describe how human actions have impacted the Earth’s systems.  5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth’s resources and environment. |
| **Materials** | Computer, white boards, white board markers, pencils, science notebooks, bowls, cups, blue food coloring, droppers, cooking oil, cocoa powder, Dawn dishwashing detergent, a generic dishwashing detergent, Green Works (or any third type) dishwashing detergent, water, feathers. |
| **Books** | The Science Behind Wonders of the Water: Exploding Lakes, Ice Circles, and Brinicles by Suzanne Garbe |
| **Vocabulary** | Air pollution: Contamination of natural air by mixing it with different pollutants  Water pollution: Contamination of water on Earth  Soil pollution: Contamination of soil or the land that prevents growth of natural life  Noise pollution: Loud noises that disrupt the standard of living in the affected area  Radioactive pollution: Pollution of land and air with radioactive poisoning  Light pollution: Over illumination of a certain area that is considered obtrusive  Thermal pollution: An increase in temperature in a particular area over time  Visual pollution: Obstructions to views, caused by billboards, powerlines, construction areas, and/or high rises |
| **Procedures** | **ENGAGE**  Video: “The Lorax (original)” (25:13): <https://www.youtube.com/watch?v=8V06ZOQuo0k>  Start with the video – stop the video at 8:24. Ask the students: What do you think the message of the story is? How did the Onceler impact the environment in the short time since he arrived? Ask students to Mix-Pair-Share (<https://www.kaganonline.com/>) to brainstorm about what they saw, and how the fictional story relates to the real world issues facing the environment.  Book: The Environment Challenge: Reducing Pollution and Waste by Jen Green, or use the myON link: <https://www.myon.com/reader/index.html?a=envch_rdcplwas_f11>  **EXPLORE**  Almost Unschoolers: Oil Spills: <http://almostunschoolers.blogspot.com/2010/07/oil-spills-and-advertising-grease.html>  NPR: Why Dawn is the Bird Cleaner of Choice in Oil Spills: <https://www.npr.org/templates/story/story.php?storyId=127999735?storyId=127999735>  Have students listen to the NPR broadcast. Oil spills are a huge environmental hazard being dealt with by different agencies around the world. The students will be testing if Dawn truly works better than other detergents to clean feathers. Have students Mix-Freeze-Group (<https://www.kaganonline.com/>) to create groups of 4-6 (depending on class size) to test this theory. Each group will need: three bowls, a cup, blue food coloring, dropper, cooking oil, cocoa powder, Dawn dishwashing detergent, a generic dishwashing detergent, Green Works (or any third type) dishwashing detergent, water, and feathers.  Mix a combination of cooking oil and cocoa powder to make oil. Mix some blue food coloring and water into each of the bowls. Using a dropper, add some of the “oil” to each of the bowls. Have the students draw pictures of the bowls, including labels. Add a few drops of each of the detergents into each of the bowls and watch what happens when the detergent interacts with the oil. Document the results.  Next, dip three feathers into the oil. Try to clean the feathers with just water. Then, using the different types of detergent, clean off the feathers without damaging the feathers. Have students document the different results. Which detergent worked the best? Which was the least effective? Was Dawn truly the best choice?  **EXPLAIN**  Video: “What Is Pollution?” (2:48): <https://study.com/academy/lesson/what-is-pollution-lesson-for-kids-definition-facts.html>  When animals are covered in oil, it takes a long time to remove it safely without hurting the animal. Dawn is a petroleum-based soap. Dawn meets all the criteria for cleaning agents, which is: the ability to remove oils, effectiveness at low concentrations, non-irritating to skin and eyes, rapid removal from feathers, and is easily accessible.  Oil spills are just one of the ways the different spheres are being polluted. There is air pollution, water pollution, soil pollution, noise pollution, radioactive pollution, light pollution, thermal pollution, and visual pollution. Each type has a significant impact on the environment and can be incredibly harmful to the planet and those who live here.  Optional Video: “Bill Nye the Science Guy S01E13 Garbage” (23:00): <https://www.youtube.com/watch?v=JqUm3M1cpi8> |
| **Enrichment** | **EXTEND**  Create a tree map of the seven different types of pollutions. Have students give examples under each of the different types of pollution and think about how they can be changed or eliminated.  Different Types of Pollution: <http://www.differencebetween.info/different-types-of-pollution> |
| **Closure** | **ELABORATE**  Though there are many different types of pollution, there are also many ways to stop polluting the different spheres to keep the Earth healthy. By knowing and understanding the different types of pollution, they can be prevented by everyone to make our Earth a better place. |
| **Assessment** | **EVALUATE**  Formative: Check on students’ notes on water pollution, as well as their answers on the tree map. Check for understanding. |

Differentiated Instruction

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| **Below Grade Level** | **On Grade Level** | **Above Grade Level** |
| Review the different types of pollution, as well as how they are harmful to the planet. Explain the different types and the differences and check for understanding. | Review the different types of pollution, as well as how they are harmful to the planet. Ask the student: Which type of pollution do you think is the most harmful? Why? | Review the different types of pollution, as well as how they are harmful to the planet. Ask the student: How do you think oil spills could be prevented? |
| **ELL Strategies** | | |
| *Visual Aids:* Show the student pictures of different types of pollution, and/or how these types of pollution affect the Earth.  *Hands-On*: Using realia (objects and material from everyday life,) give the student a chance to look at the different types of pollution and their impact on the Earth.  *Word Wall:* Post new vocabulary terms on the wall with similar terms near each other for easy reference. The flash cards with picture of the words can be incorporated into this strategy, or the student can add it in a notebook. Make sure the student draws their own pictures rather than relying on something drawn for them. | | |
| **DOK Question (Level 2)** | | |
| Ask students: Can you explain why pollution is so harmful to the Earth? Is one type of pollution worse than another type? Why or why not? | | |
| **Interactive Technology** | | |
| App: Light Pollution Map – Dark Sky  App: Air Checker – AQI monitor: Air quality index monitoring  Games: Pollution: <https://www.wartgames.com/themes/science/pollution.html> | | |

Lesson 8: How have humans used science to protect the Earth?

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| **Learning Target**  **Objective**  **Standard** | Humans have used science and ingenuity to help solve and prevent many types of environmental issues.  Students will describe ways humans have used science to protect the Earth’s resources and the environment.  5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth’s resources and environment. |
| **Materials** | Computer, white boards, white board markers, pencils, science notebooks, various used materials from craft projects |
| **Books** | How Effective is Recycling? by Catherine Chambers |
| **Vocabulary** | Reduce: To use less of something  Reuse: To use something again in a new way  Recycle: To transform back to its raw form and make something new  Hazardous: Involving risk or danger |
| **Procedures** | **ENGAGE**  Ask the students: We know humans have had a negative impact on the environment, but what are some ways humans have had a positive impact? Do you think just one person can make a difference? Ask students to Mix-Pair-Share (<https://www.kaganonline.com/>) to brainstorm the positive impact humans have had on the environment and impact on Earth.  Book: How Effective is Recycling? by Catherine Chambers, or use the myON link: <https://www.myon.com/reader/index.html?a=ed_rcycl_s15>  **EXPLORE**  “REDUCE REUSE RECYCLE (The Documentary)” (6:40): <https://www.youtube.com/watch?v=6BkcviD65Bo>  Have students discuss different ways they can reduce, reuse, and recycle. Have each student bring in used materials from home. (The teacher may bring some in as well.) Materials may range from soda bottles to paper to whatever else they can think of. Some ideas are:  We Are Teachers: 21 Earth Day Crafts and Classroom Activities Using Recycled Materials: <https://www.weareteachers.com/earth-day-crafts-classroom-activities/>  Give students an opportunity to make a recycled craft item. Students should draw a picture of their item in their science notebook, along with labeling the different items they used to create it as instructions for others. Once the projects are finished, give students a chance to participate in Carousel Feedback (<https://www.kaganonline.com/>) to see each other’s creations.  Video: “Recycling Song Jack Johnson 3Rs” (2:06): <https://www.youtube.com/watch?v=d1mFymbRmv4>  Students should take notes on the differences for reducing, reusing, and recycling, as well as give examples to show understanding.  **EXPLAIN**  While craft projects may not seem like a way to save the environment it is keeping certain items from going into a landfill, or even using energy to be recycled. There are also many ways in which science goes into environmental protection.  Business Insider: 12 Ways Science Can Save The World: <https://www.businessinsider.com/12-ways-biology-can-save-the-world-pictures-2012-9>  Waste is anything we get rid of, throw away, or do not use. Some items, such as petroleum-based plastic bags, can hurt the environment and kill wildlife. Reducing is not always the easiest step. While it seems simple just to buy less, people can be set in their ways, relying heavily on products to which they are loyal. Reusing is a little easier, such as the projects the students did in the lesson. Recycling saves money: it only costs $30 per ton to recycle most materials, while it takes $50 per ton to take the garbage to the landfill, where the items sit and become a potentially dangerous part of the land.  Optional video: “Bill Nye the Science Guy S04E07 Pollution Solutions” (27:18): <https://www.youtube.com/watch?v=AdauM3AzqKw&t=2s> |
| **Enrichment** | **EXTEND**  Create a tree map of the three R’s: reduce, reuse, and recycle. Have students give examples under each and how they can do their part for each different form of saving the Earth.  Everyday Health: Teaching Our Children to Reduce, Reuse, Recycle, and Rebuy: <https://www.everydayhealth.com/green-health/earth-day-teaching-kids.aspx> |
| **Closure** | **ELABORATE**  75% of trash can be recycled. This practice ensures that we don’t waste perfectly reusable materials. It lowers the demand for new materials to be produced, and thereby lowers our energy consumption. Recycling also keeps non-usable trash from reaching landfills where they can add up to pollution. |
| **Assessment** | **EVALUATE**  Formative: Check on students’ notes on the differences between reducing, reusing, and recycling; as well as the examples for each one. |

Differentiated Instruction

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| **Below Grade Level** | **On Grade Level** | **Above Grade Level** |
| Review the differences between reducing, reusing, and recycling; as well as how they are beneficial to keeping the Earth healthy. Explain the different types and the differences and check for understanding. | Review the differences between reducing, reusing, and recycling; as well as how they are beneficial to keeping the Earth healthy. Ask the student: Which of the three R’s do you use the most in your house? Which would be the easiest to implement? Why? | Review the differences between reducing, reusing, and recycling; as well as how they are beneficial to keeping the Earth healthy. Ask the student: How do you think a recycling plan could be created in your school if there isn’t one already? |
| **ELL Strategies** | | |
| *Visual Aids:* Show the student pictures of differences between reducing, reusing, and recycling; and/or how these different processes can help the Earth.  *Hands-On*: Using realia (objects and material from everyday life,) give the student a chance to look at the three R’s and their impact on the Earth.  *Word Wall:* Post new vocabulary terms on the wall with similar terms near each other for easy reference. The flash cards with picture of the words can be incorporated into this strategy, or the student can add it in a notebook. Make sure the student draws their own pictures rather than relying on something drawn for them. | | |
| **DOK Question (Level 2)** | | |
| Ask students: Can you explain the way to create a reusable program at your school? What would the logistics be? Would it be difficult? | | |
| **Interactive Technology** | | |
| App: iRecycle: Earth911, Inc.  App: RecycleNation: Electronic Recyclers International, Inc.  App: Offroad Garbage Truck Simulator: Skippy Apps  Games: National Geographic Kids: Recycle Roundup: <https://kids.nationalgeographic.com/games/action/recycle-roundup-new/>  Game: EPA: Recycle City: <https://www3.epa.gov/recyclecity/> | | |

Lesson 9: What is gravity?

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| **Learning Target**  **Objective**  **Standard** | Gravity is the attraction between two masses.  Students will be able to explain gravity and its importance on Earth.  5-PS2-1: Support an argument that the gravitational force exerted by Earth on objects is directed down. |
| **Materials** | Computer, white boards, white board markers, pencils, science notebooks, nails, string, cardboard boxes, magnets, clear tape |
| **Books** | Great Scientific Theories: Gravity by Nick Hunter |
| **Vocabulary** | Gravity: A force which tries to pull two objects toward each other  Mass: A measure of how much matter is in an object  Weight: The downward force caused by gravity on an object  Air resistance: The frictional force air exerts against a moving object |
| **Procedures** | **ENGAGE**  Ask the students: When you throw a ball straight up into the air, what happens? Why do you think the ball comes back down? What about the movement in space – is it different from on the Earth? Why? Ask students to Mix-Pair-Share (<https://www.kaganonline.com/>) to brainstorm the idea of gravity and how it affects everything on Earth.  Book: Great Scientific Theories: Gravity by Nick Hunter, or use the myON link: <https://www.myon.com/reader/index.html?a=gst_gravt_f17>  **EXPLORE**  Video: “Science Experiment: Where is Gravity?” (3:31): <https://www.youtube.com/watch?v=iM1kDonMbL8>  Have students Mix-Freeze-Group (<https://www.kaganonline.com/>) to create groups of 4-6 (depending on class size.) Each group will need: a cardboard box, magnets, clear tape, string, and a nail.  Have the students take the string and tie a very tight knot around the nail. Make sure the knot is tight. Take the magnets and the clear tape: this experiment works best if the magnets are all in one line and working together. Take a length of plastic tape, place the column of magnets into the center, and stick the tape firmly to both sides. Once you’ve done that, stick the column of magnets to the top of the box. Make sure the tape is stuck firmly in place.  Hold the nail close to the column of magnets on the other side of the box. The students should feel the magnetic pull on the nail from the magnets through the box. Once they have figured out the attraction point with the nail to the magnets, use the clear tape to attach the string to the bottom of the box, leaving the nail a few centimeters away from the top of the box. Then, very carefully, lift the nail back into place until it is attracted to the magnets. The string will hold tight and be attracted to the magnets and make it look like the nail is hovering in the box.  The experiment demonstrates the balance between gravity and magnetic attraction. The gravity is pulling the nail down, while the magnets are pulling the nail back up, giving the illusion that the nail is floating. Have students draw a picture in their science notebook.  **EXPLAIN**  Video: “Gravity Compilation: Crash Course Kids” (14:32):  <https://www.youtube.com/watch?v=EwY6p-r_hyU>  Gravity is a force which tries to pull two objects toward each other. Anything which has mass also has a gravitational pull. The more massive an object is, the stronger its gravitational pull. Earth’s gravity is what keeps you on the ground and what causes objects to fall. Gravity is what holds planets in orbit around the Sun, and what keeps the Moon in orbit around the Earth. The closer you are to an object, the stronger its gravitational pull. Gravity is what gives objects weight. It is the force that pulls on all the mass in your body. |
| **Enrichment** | **EXTEND**  Examine the concept of air resistance, and how it can affect gravity. Air resistance is the frictional force air exerts against a moving object. As an object moves, air resistance slows it down. The faster the object’s motion, the greater the air resistance exerted against it. An object’s shape and surface area can increase or decrease the degree of air resistance it encounters. However, if air resistance is removed, objects will fall at a different rate.  Video: “Brian Cox visits the world’s biggest vacuum chamber – Human Universe: Episode 4 Preview – BBC Two” (4:41): <https://www.youtube.com/watch?v=E43-CfukEgs> |
| **Closure** | **ELABORATE**  Gravity keeps the moon orbiting the Earth. However, rather than falling in a straight line towards the Earth, the moon “falls” from a straight line into a curve (orbit) around the Earth and ends up revolving around it. |
| **Assessment** | **EVALUATE**  Formative: Check on students’ notes from the experiment, as well as on air resistance, and check for understanding. |

Differentiated Instruction

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| **Below Grade Level** | **On Grade Level** | **Above Grade Level** |
| Review the ideas behind gravity, including air resistance, mass, weight, and force. Explain the definition and the differences to check for understanding. | Review the ideas behind gravity, including air resistance, mass, weight, and force. Ask the student: What would happen if two bowling balls of different weights were dropped? Which would fall first? Why? | Review the ideas behind gravity, including air resistance, mass, weight, and force. Ask the student: How do you think weight would affect someone going down a slide? Explain the differences. |
| **ELL Strategies** | | |
| *Visual Aids:* Show the student pictures of different objects being affected by gravity, and how it is a force that pulls objects down towards the Earth.  *Hands-On*: Using realia (objects and material from everyday life,) give the student a chance to experiment dropping objects on the ground and how gravity works.  *Word Wall:* Post new vocabulary terms on the wall with similar terms near each other for easy reference. The flash cards with picture of the words can be incorporated into this strategy, or the student can add it in a notebook. Make sure the student draws their own pictures rather than relying on something drawn for them. | | |
| **DOK Question (Level 2)** | | |
| Ask students: How would you summarize gravity? How does gravity affect everything on Earth? | | |
| **Interactive Technology** | | |
| App: Grab Lab: Silly Gravity Arcade Puzzler  App: Gravitations – Player Made Missions  Games: Idaho Public Television: Gravity: Games: <http://idahoptv.org/sciencetrek/topics/gravity/games.cfm>  Interactive: NeoK12: Gravitation: <https://www.neok12.com/Gravitation.htm> | | |

Lesson 10: What does gravity do to objects on Earth?

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| **Learning Target**  **Objective**  **Standard** | Gravity is the attraction between two masses.  Students will be able to explain gravity and its importance on Earth.  5-PS2-1: Support an argument that the gravitational force exerted by Earth on objects is directed down. |
| **Materials** | Computer, white boards, white board markers, pencils, science notebooks, plastic heavy-duty trash bags, plastic sandwich bags, string, scissors, hole punch, eggs, rulers |
| **Books** | The Gripping Truth about Forces and Motion by Agnieszka Biskup |
| **Vocabulary** | Gravity: A force which tries to pull two objects toward each other  Mass: A measure of how much matter is in an object  Weight: The downward force caused by gravity on an object  Air resistance: The frictional force air exerts against a moving object |
| **Procedures** | **ENGAGE**  Ask the students: How does gravity affect objects on Earth? When objects are dropped from different heights, what happens to them? How does air resistance prevent an object from dropping too quickly to the ground? Ask students to Mix-Pair-Share (<https://www.kaganonline.com/>) to discuss the idea of gravity, and how air resistance can help with slowing the fall of an object.  Video: “Bill Nye the Science Guy A Gravity Demonstration” (1:17): <https://www.youtube.com/watch?v=PsIBz40PcQ8>  **EXPLORE**  Education.com: Science Project: Egg Parachute: <https://www.education.com/science-fair/article/egg-parachute/>  Have students Mix-Freeze-Group (<https://www.kaganonline.com/>) to create groups of 4-6 (depending on class size.) Each group will need: a plastic heavy-duty trash bag, plastic sandwich bags, string, scissors, hole punch, ruler, and eggs.  Each group should cut a square from the garbage bag that is 20 inches on each side. Use a hole punch to punch one hole in each corner of the piece of the plastic garbage bag. Cut four pieces of 20-inch long string. Thread a piece of string through each hole in the bag and secure by tying the string firmly on each corner.  Place one egg into the plastic sandwich bag, twist the top of the bag, and tie closed with the loose ends of strings. This will also attach the parachute to the bag holding the egg.  Take an egg without a parachute along with the eggs with parachutes to drop alongside for a comparison. Take the egg parachutes to somewhere high (preferably the second floor of a building) and have the teacher help as the students drop it from the window. Students should make a drawing of the parachute in their science notebooks and document the results.  Video: “Felix Baumgartner’s supersonic freefall from 128k – Mission Highlights” (1:30): <https://www.youtube.com/watch?v=FHtvDA0W34I>  **EXPLAIN**  Book: The Gripping Truth about Forces and Motion by Agnieszka Biskup, or use the myON link: <https://www.myon.com/reader/index.html?a=lolps_gtfmo_f12>  When the egg is dropped, the strings that are attached to the sandwich bag pull down and open the bag to full size, which creates a larger surface area and more air resistance. More air (or wind) resistance slows down the descent of the egg. Wind resistance, also called drag, is a force that acts on a solid object. Car designers often factor in wind resistance when designing a car to help it have greater fuel efficiency and accelerate it to high speeds more easily. In this experiment, the goal is to create the most air or wind resistance possible to slow the speed of the object.  The larger the mass of an object, the larger the force of gravity. Even though birds (among other things) fly, they must overcome gravity with a force called “lift.” Lift is a very active force, made by moving the wing at speed through air. It causes the bird to rise upwards. Birds hold the front part of its wing slightly higher than the back part. As the air passes over the wing (from front to back,) the air underneath is pushed downwards. This pushes the wing (and bird) upwards. A bird’s wings are just the right shape to build this upward force.  Optional Video: “Bill Nye The Science Guy S01E06 – Gravity” (22:55): <https://www.dailymotion.com/video/x3cpv1v> |
| **Enrichment** | **EXTEND**  Try different materials for the parachute; such as construction paper, plastic grocery bags, or other items in the classroom. Or, make a parachute of a different size, keeping in mind the strings for the parachute should be the same size as the parachute itself.  Ask the students: In the video of Felix Baumgartner, why didn’t Felix go into space when he jumped out of the capsule? |
| **Closure** | **ELABORATE**  Air resistance is basically friction with gas particles, which can slow down the speed of a falling object. Parachutes work on this idea, and this experiment is designed to show how air resistance can be used to safely drop an egg from 10 ft or higher. |
| **Assessment** | **EVALUATE**  Formative: Check on students’ notes from the experiment, as well as the different variations on the parachutes. Students should be able to explain why the parachute slowed the egg down from falling. |

Differentiated Instruction

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| **Below Grade Level** | **On Grade Level** | **Above Grade Level** |
| Review the ideas behind gravity’s effect on objects, including air resistance, mass, weight, and force. Explain the definition and the differences to check for understanding. | Review the ideas behind gravity’s effect on objects, including air resistance, mass, weight, and force. Ask the student: What would happen if two bowling balls were used instead of eggs? Would it work the same way? Why or why not? | Review the ideas behind gravity’s effect on objects, including air resistance, mass, weight, and force. Ask the student: How would testing something like this help in the real world? |
| **ELL Strategies** | | |
| *Visual Aids:* Show the student pictures of different objects being affected by gravity, especially using parachutes, and how it is a force that pulls objects down towards the Earth.  *Hands-On*: Using realia (objects and material from everyday life,) give the student a chance to experiment dropping objects on the ground and how gravity works.  *Word Wall:* Post new vocabulary terms on the wall with similar terms near each other for easy reference. The flash cards with picture of the words can be incorporated into this strategy, or the student can add it in a notebook. Make sure the student draws their own pictures rather than relying on something drawn for them. | | |
| **DOK Question (Level 2)** | | |
| Ask students: Can you explain how air resistance affects someone jumping out of an airplane? How does the parachute change how gravity is affecting the skydiver? | | |
| **Interactive Technology** | | |
| App: Basic Physics Lab: A fun way to learn physics  Game: Gravity Kid: <https://www.marketjs.com/item/gravity-kid>  Game: Gravity Launch!: <http://sciencenetlinks.com/interactives/gravity.html> | | |

Lesson 11: What is the order of the Solar System?

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| **Learning Target**  **Objective**  **Standard** | The solar system is organized in a specific way, including the sun, planets, and the moon.  Students will be able to describe the order of the Solar System.  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 Earth. |
| **Materials** | Computer, white boards, white board markers, pencils, science notebooks |
| **Books** | What Do We Know About the Solar System? by Ian Graham |
| **Vocabulary** | Mnemonic: Assisting or intended to assist memory; uses a pattern of letters, ideas, or associations  Orbit: To move around  Magnetic Field: An area that is magnetic, or has the power to attract and hold other objects  Heliocentric: Referred to or measured from the sun’s center, or appearing as if seen from it  Geocentric: Related to or measured from the Earth’s center; having or relating to the Earth as a center |
| **Procedures** | **ENGAGE**  Ask the students: What is the solar system? What types of objects make up the solar system? How are the objects in the solar system organized? Ask students to Mix-Pair-Share (<https://www.kaganonline.com/>) to discuss the different questions, as well as their theories on how gravity might relate to the orbit of the planets.  Book: The Sun and Our Solar System by Jen Green, or use the myON link: <https://www.myon.com/reader/index.html?a=gst_soss_f17>  **EXPLORE**  Video: “Outer Space: “We are the Planets,” The Solar System Song by StoryBots” (1:59): <https://www.youtube.com/watch?v=ZHAqT4hXnMw>  There are eight planets in our solar system, all which orbit around the sun. Orbiting is to move in a circle around something. To remember them we can use a mnemonic phrase – which is like a short poem or words to help memorize and remember things.  My (Mercury)  Very (Venus)  Educated (Earth)  Mother (Mars)  Just (Jupiter)  Served (Saturn)  Us (Uranus)  Nachos (Neptune)  Have students return to their partners from the previous discussion. Students can come up with their own mnemonic phrase to help them remember the order of the planets. Once they have finished, they can write them down in their science notebooks and share them with the class.  **EXPLAIN**  The Solar System is made up of the sun, and all the smaller objects that move around it. Apart from the Sun, the largest members of the Solar System are the eight major planets. Nearest the sun are four small, rocky planets: Mercury, Venus, Earth, and Mars. Beyond Mars is the asteroid belt – a region populated by millions of rocky objects. These are leftovers from the formation of the planets 4.5 billion years ago. On the far side of the asteroid belt are the four gas giants: Jupiter, Saturn, Uranus, and Neptune. These planets are much bigger than Earth, but very lightweight for their size, made up mostly of hydrogen and helium.  A planet orbiting the Sun is like the moon orbiting Earth. Planets orbit the Sun because the lighter object orbits the heavier one. The Sun is by far the heaviest object in the solar system. The sun is 1000 times heavier than the largest planet (Jupiter) and is more than 300,000 times heavier than Earth. In addition to being pulled toward the Sun, the planets are moving sideways. This is the same as the weight on the end of a string. If you swing it around, you are constantly pulling it toward your hand, just as the gravity of the Sun pulls a planet in. However, the motion sideways keeps the ball swinging around. Without the sideways motion, it would fall to the center; and without the pull toward the center, it would go flying off in a straight line. The gravity is like the string.  Video: “Everything Revolves Around You: Crash Course Kids #22.1” (4:25): <https://www.youtube.com/watch?v=Y0_GLKU0NEY> |
| **Enrichment** | **EXTEND**  Try the experiment of the sun pulling the planet with the class. Two or three partners holding on to one end of a rope represent the larger rope (the Sun) and one partner holding onto the other end represents the smaller object (the planet.) Keeping the rope taught, the planet “orbits” the sun at a rapid – but controllable – pace.  Spaceplace Nasa: “Why do planets go around the Sun?”: <https://spaceplace.nasa.gov/review/dr-marc-solar-system/planet-orbits.html>  (See: “Getting a Feel for Gravity”) |
| **Closure** | **ELABORATE**  Gravity not only creates orbit – gravity creates stars as well. Giant molecular clouds made up of gas and dust slowly collapse because of their inward pull of their gravity. When these clouds collapse, they form lots of smaller areas of gas and dust that will eventually collapse as well. When these fragments collapse, they form stars. Because the fragments from the original giant molecular clouds stay in the same general area, their collapse causes stars to form in clusters. |
| **Assessment** | **EVALUATE**  Formative: Check on students’ mnemonic poems and the order of the planets, as well as the sun’s gravitational pull on the objects in the solar system. |

Differentiated Instruction

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| **Below Grade Level** | **On Grade Level** | **Above Grade Level** |
| Review the order of the solar system, including the sun’s effect on the orbit of the planets. Have the student say the order several times, including naming other objects in the solar system. | Review the order of the solar system, including the sun’s effect on the orbit of the planets. Ask the student: What would prevent a spaceship from being pulled into the gravitational pull of the Earth or the Sun? | Review the order of the solar system, including the sun’s effect on the orbit of the planets. Ask the student: Why is understanding the order of the planets important? |
| **ELL Strategies** | | |
| *Visual Aids:* Show the student pictures of different planets and their order, including gravity’s effect on the different objects in the solar system.  *Hands-On*: Using realia (objects and material from everyday life,) give the student a chance to experiment with different models of the planets, including different facts about the models.  *Word Wall:* Post new vocabulary terms on the wall with similar terms near each other for easy reference. The flash cards with picture of the words can be incorporated into this strategy, or the student can add it in a notebook. Make sure the student draws their own pictures rather than relying on something drawn for them. | | |
| **DOK Question (Level 2)** | | |
| Ask students: How would you apply what you learned to develop a solar system model? How would you represent the other objects in the solar system? | | |
| **Interactive Technology** | | |
| App: Solar System Builder AR – Space: Universes in augmented reality  Games: NASA Space Place: <https://spaceplace.nasa.gov/menu/play/>  Game: Kids Astronomy: Make a Solar System: <https://kidsastronomy.com/astronomy-games/make-a-solar-system/> | | |

Lesson 12: How do objects in the solar system move?

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| **Learning Target**  **Objective**  **Standard** | The celestial objects in the solar system move in a predictable pattern.  Students will understand the movement of celestial objects in the solar system.  5-PS2-1: Support an argument that the gravitational force exerted by Earth on objects is directed down.  5-ESS1-2: Represent in graphical displays to reveal patterns of daily changes in the length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky. |
| **Materials** | Computer, white boards, white board markers, pencils, science notebooks, paper plates, Play-Doh, rulers, Sharpies, flashlights |
| **Books** | What Do We Know About the Solar System? by Ian Graham |
| **Vocabulary** | Rotation: The act or process of moving or turning around a central point  Revolution: The action of moving around something in a circular path  Axis: An imaginary line running through the Earth on which the Earth rotates  Orbit: Another word for revolve; all orbits are elliptical in shape, meaning they’re oval rather than circular  Ellipse: An oval |
| **Procedures** | **ENGAGE**  Ask the students: How do celestial bodies in the solar system move? How does the Earth move? How do the planets move in relation to the sun? How does the moon move in relation to the Earth? Ask students to Mix-Pair-Share (<https://www.kaganonline.com/>) to discuss the different questions, as well as the thoughts on how each different object in the solar system moves.  Video: “Earth’s Rotation & Revolution: Crash Course Kids 8.1” (4:00): <https://www.youtube.com/watch?v=l64YwNl1wr0>  **EXPLORE**  Video: “EXPLORE ACTIVITY – 5.8 C: EARTH’S ROTATION (Grade Level 5)” (2:05): <https://www.youtube.com/watch?v=CQViTzK0AsA>  Have students return to their partners. This activity should be started in the morning and repeated several times throughout the day. Each group will need: a paper plate, Play-Doh, a ruler, pencils, Sharpie, a flashlight, and their science notebooks. The students will be creating a sundial.  Have students fold the paper plate in half. Using the ruler and Sharpie, have students draw a line along the crease. Rotate the plate 90 degrees and fold the plate again. Draw a line on the second crease, dividing the paper plate into four quadrants. Place the Play-Doh securely at the center where the lines cross. As a final step, place a pencil firmly into the clay so it will stand upright. While indoors, students can test the sundial model with a flashlight. Shine the light from above to students can see how its shadow changes as the light moves.  Moving outside, place the sundial in a place that is both sunny and level. Go outside in the morning. Using a marker, note the location of the dial’s shadow and draw a line of the plate. Make a note of the length of the shadow using a ruler. Label the shadow with the time of day. Repeat the process several times throughout the day at 1-2-hour intervals. Have students record each shadow and the time of day it was observed in their science notebooks. What do they notice about the positioning of the shadows? What about the length of the shadows?  **EXPLAIN**  Video: “Following the Sun: Crash Course Kids #8.2” (4:52): <https://www.youtube.com/watch?v=1SN1BOpLZAs>  Objects on Earth cast shadows that show the Earth’s rotation. The angle of the sun, low in the sky to higher in the sky, changes the length of the shadow cast behind an object. As the Earth rotates, the Sun appears higher in the sky, and the shadows get shorter. At noon, with the Sun overhead, objects cast short shadows or no shadow at all. As Earth continues to rotate and the Sun appears lower in the sky toward the evening, the shadows get longer again.  The Earth moves in two ways: it rotates on its axis, taking about 24 hours; and it revolves around the Sun, taking a little over 365 days, or one year to make one full revolution. While all the planets revolve around the Sun, some take longer than others due to their distance away from the sun. If an object has less distance to travel, it will take less time to do so. Therefore, the objects that are further away from the sun take longer to make one revolution around the sun. |
| **Enrichment** | **EXTEND**  Look at the table. How does the distance from the sun relate to the orbital period? Give students time to compare and contrast the data from the table.  Windows to the Universe: Planets – Data Table: <https://www.windows2universe.org/?page=/our_solar_system/planets_table.html> |
| **Closure** | **ELABORATE**  The sundial is the most basic device for telling time. It reveals time according to the position of shadow that is cast by the sun. In the past, human beings did not have clocks or watches, so they used a shadow stick to keep track of time. At different times of the day, the shadow is in different positions and changes length. The sun is highest at midday, and casts a short shadow. In the afternoon when the sun is lower in the sky, the shadow is longer. The length of the shadow is also affected by the seasons. Winter shadows are longer than summer shadows. This is because the sun is lower in the sky in winter. |
| **Assessment** | **EVALUATE**  Formative: Check on students’ graphs regarding the shadows and their understanding of the length and position of the shadow, as well as the time of day. |

Differentiated Instruction

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| **Below Grade Level** | **On Grade Level** | **Above Grade Level** |
| Review the different types of movement in the sky, as well as how the shadows on Earth are affected. Have the student review the different shadows based on the time of day. | Review the different types of movement in the sky, as well as how the shadows on Earth are affected. Ask the student: Do you think you would be able to tell time from a sundial based on your graph? Why or why not? | Review the different types of movement in the sky, as well as how the shadows on Earth are affected. Ask the student: What challenges do you think were faced when people had to use a sundial to tell time? |
| **ELL Strategies** | | |
| *Visual Aids:* Show the student pictures of different sundials and shadows based on time, as well as the graphs created from the different rotations and orbits of the planets.  *Hands-On*: Using realia (objects and material from everyday life,) give the student a chance to look at a sundial and graph to see the documentation of shadows at different times of the day.  *Word Wall:* Post new vocabulary terms on the wall with similar terms near each other for easy reference. The flash cards with picture of the words can be incorporated into this strategy, or the student can add it in a notebook. Make sure the student draws their own pictures rather than relying on something drawn for them. | | |
| **DOK Question (Level 2)** | | |
| Ask students: What do you notice about the shadows you saw during the day? Do you think the shadows are the same every day at the same times? Why or why not? | | |
| **Interactive Technology** | | |
| App: Orbit Path – Space Physics Game: Blue Label Labs  App: Planet Families – Space Science Institute  Game: BrainPOP: Build a Solar System: <https://www.brainpop.com/games/buildasolarsystem/> | | |

Lesson 13: Do all stars look the same?

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| **Learning Target**  **Objective**  **Standard** | The brightness of a star can give an idea of its distance from Earth.  Students will understand that the brightness of the sun as compared to other stars is due to its distance from Earth.  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 Earth. |
| **Materials** | Computer, white boards, white board markers, pencils, science notebooks, flashlights |
| **Books** | What Do We Know about Stars and Galaxies? by John Farndon |
| **Vocabulary** | Star: Any of the heavenly bodies except planets which are visible at night and look like fixed points of light  Luminosity: The quality of being luminous, emitting or reflecting light  Apparent Brightness: The brightness of a star as measured by an observer, as opposed to its intrinsic brightness when corrected for distance or absorption  True Brightness: The amount of energy (light) that a star emits from its surface |
| **Procedures** | **ENGAGE**  Ask the students: How many stars do you think are in the solar system? What about in the Milky Way Galaxy? How many can you see on a clear night without a telescope? Do all stars look the same, or are some of them different? Ask students to Mix-Pair-Share (<https://www.kaganonline.com/>) to discuss the different questions, as well as their thoughts on stars. Students should write down their answers on their white boards.  Book: What Do We Know about Stars and Galaxies? by John Farndon, or use the myOn link: <https://www.myon.com/reader/index.html?a=earspb_exp_whastar_f11>  **EXPLORE**  Wait But Why: The Fermi Paradox: <https://waitbutwhy.com/2014/05/fermi-paradox.html>  Show the image from the Milky Way galaxy. Ask students if they can explain the relationship the Milky Way Galaxy has with the Solar System. The Earth is in the Solar System, and this system makes up a tiny portion of the galaxy. Ask students to think about their answers and see if they’d like to change any of them.  Nasa: How Many Stars in the Milky Way?: <https://asd.gsfc.nasa.gov/blueshift/index.php/2015/07/22/how-many-stars-in-the-milky-way/>  Show the second image from the Milky Way galaxy. The right half of the picture shows a small portion of the night sky magnified. After showing this image, ask students if they’d like to change their answers from the other questions, and have them share why.  Have students return to their original partners. Give each student a flashlight. Two students will hold the flashlights at an equal distance from the wall. The two flashlights represent two stars of the same size. Give students a chance to discuss what they notice about the two stars of the same brightness and document it in their science notebook.  Have one student move close to the wall, and one student move to the opposite side of the room. Ask students to make the same observations, and that even though the flashlights didn’t change in brightness, the distance made the lights more obvious.  Video: “Bill Nye the Science Guy on Outerspace (Full Clip)” (2:06): <https://www.youtube.com/watch?v=BdAqq-wEQV0>  **EXPLAIN**  Video: “Glow On: Crash Course Kids #20.2” (5:09): <https://www.youtube.com/watch?v=Zo-sKzMWYFA>  Stars in our solar system: One (the sun)  Stars are in the Milky Way galaxy: Scientists aren’t completely sure, but they estimate between 150 billion and 1 trillion  Stars can be seen on a clear night without a telescope: In perfect conditions (clear night, no clouds, no city lights) anywhere from 2,500 – 5,000  Stars do not look the same – they have different size, colors, and brightness  Stars are giant spheres of superhot gas made up of mostly hydrogen and helium. Stars get so hot by burning hydrogen into helium in a process called nuclear fusion. This is what makes them so hot and bright.  Stars start out in giant clouds of dust called nebulae. Gravity forces the dust to bunch together. As more and more dust bunches up, gravity gets stronger and it starts to get hot and becomes a protostar. Once the center gets hot enough, nuclear fusion will begin, and a young star is born.  Eventually the core of the star will start to make iron. This will cause the star to collapse. What happens to the star next depends on how much mass it had (how big it was). The average star will become a white dwarf star. Larger stars will create a huge nuclear explosion called a supernova. After the supernova it may become a black hole or a neutron star.  Video: “Largest star ever discovered, compared to our Sun” (1:32): <https://www.youtube.com/watch?v=g4iD-9GSW-0&feature=youtu.be> |
| **Enrichment** | **EXTEND**  The different types of stars vary in size and brightness. To tell stars apart, refer to the Hertsprung-Russell (H-R) diagram. Create a graph based on the different type of stars and their brightness in comparison to the sun.  Space: How to Tell Star Types Apart (Infographic): <https://www.space.com/30885-telling-star-types-apart-infographic.html> |
| **Closure** | **ELABORATE**  There are many different types of stars. Stars that are in their main sequence (normal stars) are categorized by their color. The smallest stars are red and don't give off much of a glow. Medium size stars are yellow, like the Sun. The largest stars are blue and are hugely bright. The larger the main sequence star, the hotter and brighter they are.   Smaller stars are called dwarf stars. Red and yellow stars are generally called dwarfs. A brown dwarf is one that never quite got large enough for nuclear fusion to occur. A white dwarf is the remnants of the collapse of a red giant star. Giant stars may be main sequence stars like a blue giant, or stars that are expanding like red giants. Some supergiant stars are as big as the entire Solar System. A neutron star is created from the collapse of a giant star. It's very tiny, but very dense. |
| **Assessment** | **EVALUATE**  Formative: Check on students’ observations of the stars and their understanding of luminosity and true brightness. |

Differentiated Instruction

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| **Below Grade Level** | **On Grade Level** | **Above Grade Level** |
| Review the reasons behind the stars appearing to have different brightness levels, as well as different types of stars. Have the student review why two stars that are the same look different. | Review the reasons behind the stars appearing to have different brightness levels, as well as different types of stars. Ask the student: Why do you think there are no stars located directly in the Milky Way Galaxy? | Review the reasons behind the stars appearing to have different brightness levels, as well as different types of stars. Ask the student: What challenges do you think scientists face when trying to determine the age of a star? |
| **ELL Strategies** | | |
| *Visual Aids:* Show the student pictures of different stars based on their size, as well as the graph of the different types and brightness levels of stars.  *Hands-On*: Using realia (objects and material from everyday life,) give the student a chance to look at different types of stars and how they are formed.  *Word Wall:* Post new vocabulary terms on the wall with similar terms near each other for easy reference. The flash cards with picture of the words can be incorporated into this strategy, or the student can add it in a notebook. Make sure the student draws their own pictures rather than relying on something drawn for them. | | |
| **DOK Question (Level 2)** | | |
| Ask students: What do you notice about the stars you see in the sky? Do they look the same on any given night? | | |
| **Interactive Technology** | | |
| App: Star Walk 2 Ads+: Sky Guide: Stars and Constellations in AR  App: SkySafari AR: Astronomy Night Sky Guide  Game: Kids Astronomy: Constellation Hunt: <https://kidsastronomy.com/the-universe/constellation-hunt/> | | |

Lesson 14: Does the night sky look the same throughout the year?

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| **Learning Target**  **Objective**  **Standard** | Just as the seasons change on Earth, so does the appearance of the night sky  Students will observe and display patterns of changes in the nighttime sky.  5-ESS1-2: Represent in graphical displays to reveal patterns of daily changes in the length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky. |
| **Materials** | Computer, white boards, white board markers, pencils, science notebooks, brads, scissors, rulers, paper clips, Constellation Guide, Universe in a Box template, circle sheet |
| **Books** | Totally Wacky Facts About Planets and Stars by Emma Carlson Berne |
| **Vocabulary** | Star: Any of the heavenly bodies except planets which are visible at night and look like fixed points of light  Constellation: A group of stars that make up an imaginary shape in the night sky, usually named after mythological characters, people, animals, and objects |
| **Procedures** | **ENGAGE**  Ask the students: What is a constellation? Where can you see constellations? Do you think you can see the same constellations always of the year? Why or why not? Ask students to Mix-Pair-Share (<https://www.kaganonline.com/>) to discuss the different questions, as well as their thoughts on constellations.  Book: Totally Wacky Facts About Planets and Stars by Emma Carlson Berne, or use the myON link: <https://www.myon.com/reader/index.html?a=mb_pstar_f15>  **EXPLORE**  Video: “Super Stars (Constellations): Crash Course Kids #31.1” (4:58): <https://www.youtube.com/watch?v=MZffhapfOgg>  Mystery Science: Astronomy: <https://mysteryscience.com/astronomy/mystery-3/seasons-earth-s-revolution/75?r=20977201#slide-id-1117>  Different constellations can be seen at different times of the year. Hand each student the constellation guide, universe in a box, and circle paper. Students should write the months of the year starting with January in a counter-clockwise fashion. Over months Nov-Feb, write “winter;” over Mar – May write “spring,” over Jun – Aug, write “summer;” and over Sept – Nov write “fall.”  Take the Universe in a Box sheet and cut along the thick outer rectangle. Cut on the four dotted lines. Be sure to stop cutting whenever there is a stop sign. Use the ruler to fold all the solid lines (near the center of the box.) Make a good crease on each fold. Cut on the circle on the Universe in a Box circle sheet. Then, carefully cut away the notch. Take the box template and poke the brad through the sun. Poke the brad through the center of the circle. Put it through the hole in the other paper, flip it over, and separate the prongs so they are flat against the bottom of the page. The circle should be on top of the box.  Lift the panels, fold in the “A” flaps, then fold the “Universe” panel down to secure it. Practice using the universe in a box. Spin the brad on the bottom to turn it to different months. Take a look where the notch is, and which constellations are available at the different times.  **EXPLAIN**  Video: “Constellation Location: Crash Course Kids #31.2” (3:48): <https://www.youtube.com/watch?v=BbzCA0Lgf3Y>  People can only see stars during the day because of the sun. The sun is too bright for people to see stars. As the Earth is rotating around the Sun, we can only see the stars that we are facing during that time of the year. For example, Orion can only be seen during the winter months because Orion is located on the opposite side of the sun as in the summer. Orion “disappears” during the spring because the orbit has changed, and we are looking in a new direction into the universe. Each season we are facing a different direction of the universe.  The seasons can be tracked using the stars. The stars all have a fixed pattern relative to each other from year to year, like the pattern of major cities on a map of the Earth. Many ancient cultures selected specific groupings of stars or constellations to represent certain animals or mythological figures. |
| **Enrichment** | **EXTEND**  Look at which constellations are visible during the season you are in. Give students a chance to go home at night and see which constellations they can find based on the season.  Star Patterns: <http://tboeve.weebly.com/uploads/3/7/1/9/37196463/13_anwer_key_star_patterns.pdf> |
| **Closure** | **ELABORATE**  The 88 constellations divide up the entire night sky as seen from all around the Earth. Star maps are made of the brightest stars and the patterns they make which give rise to the names of the constellations. The zodiac constellations are the constellations that are located within a band that is about 20 degrees wide in the sky. The band is considered special because it is the band where the Sun, the moon, and the planets all move.  Constellations had uses in ancient times. They were used to help keep track of the calendar. This was important so people knew when to plant and harvest crops. Another use for constellations was navigation. By finding Ursa Minor, it is easy to find the North Star (Polaris.) Using the height of the North Star in the sky, navigators could figure out their latitude helping ships to travel across the oceans. |
| **Assessment** | **EVALUATE**  Formative: Check on students’ constellation boxes, as well as their understanding of seeing different constellations during different times of the year. |

Differentiated Instruction

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| **Below Grade Level** | **On Grade Level** | **Above Grade Level** |
| Review the reasons behind the different views of the constellations, and how they helped with calendars in ancient times. Have the student review why a constellation in July can’t be seen at the same time as one from December. | Review the reasons behind the different views of the constellations, and how they helped with calendars in ancient times. Ask the student: Do you think stars in the northern hemisphere can see the ones in the southern hemisphere? Why or why not? | Review the reasons behind the different views of the constellations, and how they helped with calendars in ancient times. Ask the student: How do you think the North Star assists with navigation? |
| **ELL Strategies** | | |
| *Visual Aids:* Show the student pictures of different constellations based on their time of year, as well as the pictures of the constellations created by the project.  *Hands-On*: Using realia (objects and material from everyday life,) give the student a chance to look at pictures of the constellations and when they are visible.  *Word Wall:* Post new vocabulary terms on the wall with similar terms near each other for easy reference. The flash cards with picture of the words can be incorporated into this strategy, or the student can add it in a notebook. Make sure the student draws their own pictures rather than relying on something drawn for them. | | |
| **DOK Question (Level 2)** | | |
| Ask students: What do you notice about the constellations you see in the sky? Even though there are certain ones visible during certain months, do you think they’re always in the same part of the sky? | | |
| **Interactive Technology** | | |
| App: Find Constellation: Discover the sky  Games: Constellations: <https://www.wartgames.com/themes/science/constellations.html> | | |

Earth Science Activity: Shadow Pattern Observations (Full day)

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| **Learning Target**  **Objective**  **Standard** | Students will make observations to describe patterns that can be predicted.  Students will investigate and record the different daily patterns of shadows over an amount of time.  5-ESS1-2: Represent in graphical displays to reveal patterns of daily changes in the length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky. |
| **Materials** | Computer, white boards, white board markers, science journals, pencils, chalk, meter sticks, compass, flashlight, white paper, marker |
| **Books** | Shadows by Louise and Richard Spilsbury |
| **Vocabulary** | Shadow: A dark area where light from a light source is blocked by an opaque object |
| **Procedures** | **ENGAGE**  Ask the students: What effect does the sun in the sky have on where your shadow is pointed? How does the direction of the sun affect the shadows? When the Earth rotates, does it affect where the shadows are located? Have students StandUp-HandUp-PairUp (<https://www.kaganonline.com/>) to predict what will happen throughout the day to the shadows they will observe.  **EXPLORE**  Each student will discover how shadows will change throughout the day. Students should stay in their partners from the question and answer portion. Each pair will need their science notebooks, pencils, a compass, chalk, a marker, a flashlight, and meter sticks.  Teacher’s note: This activity should be done every hour throughout the day.  Have one student stand in a spot with plenty of room around them, as they will need room throughout the day. The second student should draw around the feet of the person casting a shadow and place his/her initials inside the feet. Each time they go outside today, the person will stand in the exact same spot. The second student will then have their feet traced with the first person doing the drawing and initialing inside the feet.  Take turns tracing around the shadow. Make sure to write the time inside of the shadow to make accurate observations. Whenever they go outside, always start by tracing and measuring the shadow. Look at the compass to see which direction the shadow is pointing.  As the day goes on, have a brief conversation after each outing. Ask the students what they notice, and how much shorter the shadows are getting, as well as the change in direction. After three observations, have the students draw a picture of their observation. Create a line graph with the time of day and the length of the shadow. Ask the students why their shadows are getting shorter, and what they think will happen throughout the day. What patterns do they notice?  At the end of the observations, have each student take a marker and stand it upright on a piece of paper. Hold the flashlight to one side and change the angle. Demonstrate using the flashlight to rotate up and over the marker to show the way the sun is shining on the marker, and the way the shadows are changing. Remind the students that it’s not the sun that is moving, but the Earth that is rotating.  **EXPLAIN**  Book: Shadows by Louise and Richard Spilsbury, or use the myON link: <https://www.myon.com/reader/index.html?a=exli_shad_f15>    Video: “Following the Sun: Crash Course Kids #8.2” (4:52): <https://www.youtube.com/watch?v=1SN1BOpLZAs>  The Earth is a sphere which rotates as it travels around the sun. One side of the Earth faces the sun, while the other side faces away. When the side we are on faces the sun, it is daytime. The side facing away is cooler and darker, and experiences night. Because the Earth is constantly spinning, we experience night and day. The far side of the Earth is in a shadow.  Shadows are longest first thing in the morning and shorten until the sun is directly overhead. The sun moves across the sky from the east to the west. A straight line can be drawn from the sun’s location to the shadow’s direction. Their shadows move in a circular, clockwise direction.  Video: “Day & night explained” (1:01): <https://www.youtube.com/watch?v=v9J2auAwD_I> |
| **Enrichment** | **EXTEND**  BBC: Light and Shadows: <http://www.bbc.co.uk/bitesize/ks2/science/physical_processes/light_shadows/play/>  Use the program, either as a class or individually, to explore shadows, both inside and outside. |
| **Closure** | **ELABORATE**  Different objects in the sky can be seen at different times due to the rotation of the Earth and the side that is facing the sun. Shadows are formed all the time, whether it is on the Earth or whether it is by the Earth itself. |
| **Assessment** | **EVALUATE**  Formative: Check the students’ journals and observations for understanding, as well as listening to student-led discussions. |

Differentiated Instruction

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| **Below Grade Level** | **On Grade Level** | **Above Grade Level** |
| Discuss how the times changed over the course of the observation, and the correlation to the difference in the shadows’ direction and length. Review the student’s science notebook to check for understanding. | Discuss how the times changed over the course of the observation, and the correlation to the difference in the shadows’ direction and length Ask the student: What did you notice about the times of day compared to the length of the shadows? | Discuss how the times changed over the course of the observation, and the correlation to the difference in the shadows’ direction and length. Ask the student: Could you use your observations to predict next month’s shadow lengths? Why or why not? |
| **ELL Strategies** | | |
| *Visual Aids:* Show the student pictures of the different vocabulary words described in the lesson, and/or have the student act out the different terms discussed, including rotation and revolution.  *Hands-On*: Using realia (objects and material from everyday life,) give the student a chance to explore the different ways the moon revolves, and the Earth rotates. Repeat the motions with the different balls and flashlight to ensure understanding.  *Word Wall:* Post new vocabulary terms on the wall with similar terms near each other for easy reference. The flash cards with picture of the words can be incorporated into this strategy, or the student can add it in a notebook. Make sure the student draws their own pictures rather than relying on something drawn for them. | | |
| **DOK Question (Level 2)** | | |
| Ask students: How are the Earth and Sun alike? What if the Earth wasn’t rotating? Would there still be shadows? Why or why not? | | |
| **Interactive Technology** | | |
| App: “Day & Night Map” – Volker Voecking Software Engineering  Game: Duckie Deck: “Day and Night”: <http://duckiedeck.com/play/day-and-night> | | |

Earth Science Activity: Constellation Observations (3-4 weeks)

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| **Learning Target**  **Objective**  **Standard** | Students will make observations to describe patterns that can be predicted.  Students will investigate and record the different daily patterns of the moon and constellations over a significant amount of time.  5-ESS1-2: Represent in graphical displays to reveal patterns of daily changes in the length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky. |
| **Materials** | Computer, white boards, white board markers, science journals, pencils, blank individual calendars |
| **Books** | Exploring Constellations by Sara Latta |
| **Vocabulary** | Constellation: The position of stars in the sky: any of 88 groups of stars forming patterns |
| **Procedures** | **ENGAGE**  Ask the students: We know the moon changes patterns with the moon cycle. How does this cycle work? Does it change every day? What about the stars? Do you think the stars have predictable patterns as well? Have students StandUp-HandUp-PairUp (<https://www.kaganonline.com/>) to predict what will happen as the moon phases and stars are observed over the course of a month.  **EXPLORE**  Each student will be making their very own calendar to record the location of the stars every night.  Teacher’s note: This activity can be done on its own, or simultaneously with other science activities.  Give each student a blank calendar. Write the name of the month (or months depending on when the observations are set to begin and end.) Fill in the days for each month for a duration of 4-5 weeks.  To complete the star experiment: Look skyward and pick out a bright star; then line it up with a nearby landmark (like a telephone pole or the peak of your neighbor’s roof.) Make sure you note the exact time and the exact spot when you lined up the star. Then, come back the next night at the exact same time and stand in the exact same place. You’ll see that the star has shifted slightly to the right (west) of the position it was in the previous night. The westward drift of the stars is a motion that is in addition to the daily rising, circling, and setting; because the Earth does not simply stand in the same spot in space and spins.  Once the calendars are set up, make the first observation online or assign it for homework. Use whatever website and information you decided on as a class to record the data every day for 3-4 weeks. Pick out a constellation in comparison to the location of the star chosen. Have the students draw a picture of it in their calendar as well. Draw a picture of the moon and its current phase on the calendar every day for a comparison.  After a week, look at the constellation observations so far. Ask the class: How have the constellations changed? Where are they located? Students should compare the constellations they chose with other students in the class. Have students create a graph of where they notice the constellations in the sky along with their classmates. Check in with the students every week with the same follow-up and add to the graph.  **EXPLAIN**  Video: “Constellation Location: Crash Course Kids #31.2” (3:48): <https://www.youtube.com/watch?v=BbzCA0Lgf3Y&t=149s>  Due to the earth’s rotation, stars appear to move.  As the Earth rotates from west to east, the stars appear to rise in the East, moving across south to set in the west.  The Sun will appear to move through the stars, making one complete circuit of the sky in 365 days.  Stars form patterns in the sky and are referred to as constellations.  It is these patterns that the ancient Greeks used to tell stories of mythology and their gods.  There are 88 constellations that make up the sky.  The earth is tilted 23.5 degrees off the vertical.  This not only gives us the seasons but also changes which constellations we see.  Those constellations that we can see year-round are called circumpolar.  These constellations all circle the North Star and because we live in the Northern Hemisphere, we see them all year round.  These constellations are: Ursa Major, Cassiopeia, Ursa Minor, and Cygnus the Swan. |
| **Enrichment** | **EXTEND**  After 3-4 weeks, look at the data and ask the students: What do you notice? How is the sky changing? |
| **Closure** | **ELABORATE**  By examining the sky and moon phases every day, a predictable pattern can be determined. Reading about this pattern is one thing; seeing it and documenting it is another thing. Just like the moon has predictable phases, the way the stars are viewed also have a pattern that is predictable based on the way the Earth orbits the Sun. |
| **Assessment** | **EVALUATE**  Formative: Check the students’ journals and observations for understanding, as well as listening to student-led discussions. |

Differentiated Instruction

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| **Below Grade Level** | **On Grade Level** | **Above Grade Level** |
| Discuss how the phases changed over the course of the observation, and the correlation to the point in the lunar cycle. Review the student’s science notebook to check for understanding. | Discuss how the phases changed over the course of the observation, and the correlation to the point in the lunar cycle. Ask the student: What did you notice about the stars? Could they ever go in a different order? Why or why not? | Discuss how the phases changed over the course of the observation, and the correlation to the point in the lunar cycle. Ask the student: After observing the stars, would you be able to predict how the stars will be next month? Why or why not? |
| **ELL Strategies** | | |
| *Visual Aids:* Show the student pictures of the different vocabulary words described in the lesson, and/or have the student discuss the location of the constellations.  *Hands-On*: Using realia (objects and material from everyday life,) give the student a chance to explore the different constellations. Repeat the terms with them until they can explain the reasons for the location of the constellations, and why the sky looks different every day.  *Word Wall:* Post new vocabulary terms on the wall with similar terms near each other for easy reference. The flash cards with picture of the words can be incorporated into this strategy, or the student can add it in a notebook. Make sure the student draws their own pictures rather than relying on something drawn for them. | | |
| **DOK Question (Level 2)** | | |
| Ask students: How would you apply what you learned to develop a star calendar for the same month next year? Do you think it would be the same? Why or why not? | | |
| **Interactive Technology** | | |
| App: SkyView Lite: Explore the Universe  App: Star Chart: Escape Velocity Limited  Game: Kids Astronomy: Constellation Hunt: <https://kidsastronomy.com/the-universe/constellation-hunt/> | | |

**Earth Science Unit Assessment**

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. List Earth’s major systems and one fact about each one.

2. Choose two of Earth’s systems and describe how they interact.

3. Describe the difference between a renewable and a non-renewable energy source.

4. Draw a picture of the water cycle and label the different stages.

5. Describe and graph the amounts and percentages of water and fresh water on Earth.

6. List the locations of freshwater on Earth, as well as the percentage accessible for human use.

7. List five different types of pollution. Describe three ways for humans to stop pollution.

8. Define gravity and how it relates to the planets orbiting the sun.

9. Support an argument describing why the sun is brighter than other stars in the sky.

10. Represent in a graphical display the daily change in the length and direction of shadows.

11. List two seasons, and how the stars look different in each.

Research Project: How do Earth’s four major systems interact during a natural or man-made event?

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| **Learning Target**  **Objective**  **Standard** | Earth’s four major systems interact on a daily basis.  Students will pick a man-made or natural event and discuss how two of the Earth’s systems interact with each other during the event.  5-ESS2-1: Develop a model using an example to describe the ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.  W.5.7: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.  W.5.8: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work and provide a list of sources.  RI.5.3: Explain the relationships or interactions between two ore more individuals, events, ideas, or concepts in a historical, scientific, or technical text based on specific information in the text.  RI.5.7: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.  SL5.2: Summarize a written text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally. |
| **Materials** | Computer, white boards, white board markers, science journals, pencils, crayons, access to the Internet for students |
| **Books** |  |
| **Vocabulary** | Biosphere: The sphere or area around Earth where life exists  Geosphere: The solid Earth  Hydrosphere: All the Earth’s water, including surface water (water in oceans, lakes, and rivers), groundwater (water in soil and beneath the Earth’s surface), snow cover, ice, and water in the atmosphere, including water vapor  Atmosphere: The layer of gas that surrounds the Earth  Biome: A large region of Earth that has a certain climate and living things |
| **Procedures** | **ENGAGE**  Ask the students: What are Earth’s four major systems? Review what has been learned so far about the four systems, as well as their similarities and differences. Ask the students: How do you think the different systems interact with each other? What about during a natural or man-made event? Ask students to Mix-Pair-Share (<https://www.kaganonline.com/>) to brainstorm about the different characteristics of the systems, and how they interact during an event.  **EXPLORE**  Give the students an opportunity to choose which natural or man-made event they would like to study. Events may include, but are not limited to: acid rain, deforestation, coal mining, drought, earthquake, flooding, mining, oil spill, pollution, hurricane, tornado, tsunami, volcano, and wildfires. Introduce the different websites and books the students will be able to use to write their research.  Interactions in the Earth System: <http://www.ucmp.berkeley.edu/education/dynamic/session4/sess4_interactions.htm>  Earth System Interactions: <https://www.csun.edu/science/books/sourcebook/chapters/8-organizing/files/earth-systems-interactions.html>  Video: “Big Idea 3: Earth’s Systems Interact” (5:49): <https://www.youtube.com/watch?v=BnpF0ndXk-8>  Students may also use any books or websites regarding the specific event.  Once the students have chosen an object, they will conduct research on the object. Students can work in pairs or independently depending on the teacher’s discretion. Students should take notes regarding the event they chose, and include the following information:   * The name of the natural or man-made event * Features of the event * At least two different systems combined for this event * How it was formed * How long it took to form (days, weeks, years, etc.) * Three other interesting facts   Based on their research, the paper should be about 1-2 pages long, with more than one source used and listed. Students may use an outline to take notes on their object.  The students will also be asked to give a presentation to the class. They may want to practice this several times. They must be able to describe their event, including the different features they researched. Once they finish their research, they should draw and color a picture based on what they have discovered.  Students may need several days to complete the research activity.  **EXPLAIN**  The Earth’s spheres are closely connected. For example, many birds (biosphere) fly through the air (atmosphere) while water (hydrosphere) often flows through the soil (geosphere.) In fact, the spheres are so closely connected that a change in one sphere often results in a change in one or more of the other spheres. Such changes that take place within an ecosystem are referred to as events.  Events that occur naturally, such as an earthquake or a hurricane; or they can be caused by humans, such as an oil spill or air pollution. An event can cause changes to occur in one or more of the spheres, and/or an event can be the effect of changes in one or more of the Earth’s four spheres. This two-way cause and effect relationship between an event and a sphere is called an interaction. Interactions can also occur among the spheres; for example, a change in the atmosphere can cause a change in the hydrosphere, and vice versa. |
| **Enrichment** | **EXTEND**  Have the students create a model at home of the object they studied. The model can either be 2-dimensional (poster) or 3-dimensional. The model should be an accurate representation of the event, including the different spheres. It should be easy to see from a distance and easy to present. The model should be able to be identified without using much prior knowledge about it (i.e. a “mountain” should look like a “mountain.”) If the student decides to do a poster, they only need to have the picture and a name of the object, although it may include a few interesting facts. The object does not have to be complicated but does need to be the student’s original work. Materials may be purchased to build the object, but the object should not be bought from the store already completed. |
| **Closure** | **ELABORATE**  It is important to explain why certain interactions occur. For example, a geosphere-biosphere interaction does not merely state what happened; it gives the reason why. Such explanations are important to understand the science behind the interactions. |
| **Assessment** | **EVALUATE**  Summative: See rubric |

Differentiated Instruction

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| **Below Grade Level** | **On Grade Level** | **Above Grade Level** |
| Discuss the different types of events and Earth’s systems. Student may require assistance in writing or drawing and can be paired up with a student at a higher level. | Discuss the different types of events and Earth’s systems. Student may be able to work more independently with teacher support. | Discuss the different types of events and Earth’s systems. Student may be able to work completely independently, as well as being paired with a student of a lower ability level. |
| **ELL Strategies** | | |
| *Visual Aids:* Show the student pictures of the different vocabulary words described in the lesson, and/or have the student discuss different systems and events and why they should be studied.  *Hands-On*: Using realia (objects and material from everyday life,) give the student a chance to explore different systems and Earth’s events. Repeat going over the different objects until they can be repeated and explained.  *Word Wall:* Post new vocabulary terms on the wall with similar terms near each other for easy reference. The flash cards with picture of the words can be incorporated into this strategy, or the student can add it in a notebook. Make sure the student draws their own pictures rather than relying on something drawn for them. | | |
| **DOK Question (Level 2)** | | |
| Ask students: How could you organize the different events and spheres? Do you think one sphere is more important than the others? Why or why not? | | |
| **Interactive Technology** | | |
| Game: Match the Memory: Earth’s Spheres: <https://matchthememory.com/Earthspheres> | | |

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| **Standard** | **Exceeds Expectations - 3** | **Meets Expectations - 2** | **Below Expectations - 1** |
| 5-ESS2-1: Develop a model using an example to describe the ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. | Student included details about how their event and two of the spheres interact. | Student included some details about how their event and two of the spheres interact. | Student included few or no details about how their event and two of the spheres interact. |
| W.5.7: Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic. | Student participated fully in research. | Student somewhat participated in research. | Student did not participate in class research. |
| W.5.8: Recall relevant information from experiences or gather relevant information from print and digital sources; summarize or paraphrase information in notes and finished work and provide a list of sources. | Student used at least 2 sources to find information about how their event and two of the spheres interact. | Student used one source to find information about how their event and two of the spheres interact. | Student did not use sources to find out information about how their event and two of the spheres interact. |
| RI.5.3: Explain the relationships or interactions between two or more individuals, events, ideas, or concepts in a historical, scientific, or technical text based on specific information in the text. | Student used two sources to connect information about how their event and two of the spheres interact. | Student used one source to locate information about their event and two of the spheres interact. | Student did not use sources or make a connection for information about their event and two of the spheres interact. |
| RI.5.7: Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently. | Student found many similarities in at least two sources regarding information and pictures/diagrams about how their event and two of the spheres interact. | Student found some similarities in at least two sources regarding information and pictures/diagrams about how their event and two of the spheres interact. | Student did not find similarities regarding information and pictures/diagrams about how their event and two of the spheres interact. |
| SL5.2: Summarize a written text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally. | Student can recall at least three details and present them orally regarding how their event and two of the spheres interact. | Student can recall one to two details and present them orally regarding how their event and two of the spheres interact. | Student is not able to recall details or present them orally regarding how their event and two of the spheres interact. |

Points: \_\_\_\_\_\_ / \_\_\_\_\_\_\_= \_\_\_\_\_\_\_\_% Comments:

STEM/Engineering Unit Project

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| **Learning Target**  **Objective**  **Standards** | Engineering design is a process used to solve real world problems. Students will use the five-step engineering design process to solve a problem.  Students will build a prototype of a scientific tool designed to protect the Earth’s resources and environment.  5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth’s resources and environment.  3-5-ETS1-1: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost.  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. |
| **Materials** | Computer, science notebooks, 2-liter bottles, scissors, 250 ml beakers, soil, gravel, cotton balls, scrap material, charcoal, sand, woodchips, Styrofoam packing, charcoal briquettes, screening, rubber bands, heat source, tap water, salt, food coloring, dish soap, test tubes |
| **Books** |  |
| **Vocabulary** | Filtration: A process by which impurities or particles are removed from a fluid, either a liquid or a gas |
| **Design Process** | **ASK**  Identify the problem. Identify the constraints  **IMAGINE** Identify some possible solutions  **PLAN** Draw a plan and identify the materials  **CREATE** Use the plan and create. Test it!  **IMPROVE** Modify your design to make it better. Test it out! |
| **Procedures** | **ASK**  Review pollution with the students. Tell the students: You are moving to an area where the very limited amount of fresh water is polluted. You will need to design a filtration system to remove impurities from the water, so it is drinkable. Have students brainstorm materials they could use to filter the water. The challenge is to design and build a prototype of a filter that is made using the provided materials.  Video: “Water and You: The Water Treatment Process” (4:19): <https://www.youtube.com/watch?v=tuYB8nMFxQA>  Earth Science Week: Water Filtration: <https://www.earthsciweek.org/classroom-activities/water-filtration>  **IMAGINE**  Have students Mix-Freeze-Group (<https://www.kaganonline.com/>) in groups of 3-5 (depending on class size.) Students should explore the given materials: 2-liter bottles, scissors, 250 ml beakers, soil, gravel, potting soil, cotton balls, scrap material, charcoal, sand, woodchips, Styrofoam packing, charcoal briquettes, screening, rubber bands, test tube, and a heat source. Students are going to create polluted water by mixing tap water, salt, food coloring, sand, and dish soap.  Example: Video: “$1 DIY Water Filter in a Bottle” (3:37): <https://www.youtube.com/watch?v=4N5hdOcsKrg>  **PLAN**  Have students draw a picture of what they want to build. Have the students label the parts of the filter, including what materials they want to use. Drawings can be basic, but should show an understanding of making something that will filter the polluted water  **CREATE**  Students should use the drawings to make a replica of their filter. Explain to students that scientists often make mistakes, and it is only in these mistakes that we can learn and grow. They can use any materials that they would like. To add another challenge, prices can be added to the materials, and a budget given. Have students participate in Carousel Feedback (<https://www.kaganonline.com/>) to give others ideas of what can be changed before the filters are tested. The 2-liter bottle will be cut in half. Turn the top of the bottle over (neck down) to use for the filtration chamber. Remove the cap and cover the opening with the screening, attaching it tightly with a rubber band. Have students draw a picture of their completed filter with labels.  To test the filter, students will use 250 ml of polluted water. Their filtration system will be placed into the bottom of the bottle to act as the collection chamber. Then the “polluted” water will be poured and allowed to filter for 10 minutes. The collected liquid can be tested for soap right away by taking a small amount into a test tube and heated up. The other “pollutants” can be tested for by evaporating the water away by using the heat source.  **IMPROVE**  Once the filters have been tested, some of them may end up not filtering the water as they had hoped. Students may make modifications based on feedback from peers, or feedback from the teacher. Materials can be added or taken away. Ask the students: If you had different materials, what else would you add? How would you make it better? |
| **Enrichment** | Discuss other materials that could be used to make filters. Ask the students: Could the materials in class be supersized to make a full-sized water filter? Why or why not? |
| **Closure** | Discuss how knowing the properties of materials assisted in the students creating the filters. What additional materials would they want to use? What materials would they not want to use? |
| **Assessment** | Students should be graded based on the rubric. |

Differentiated Instruction

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| **Below Grade Level** | **On Grade Level** | **Above Grade Level** |
| As the students are working, some may need help with construction and/or evaluating whether the designs were successful or not. Students can be paired based on ability. | Students should be able to create a filter either independently or with a partner. Students may need prompting to identify and adjust for any problems with the filter. | Students should be able to successfully create a filter, and identify any problems it had, as well as identifying a solution to the problem. They should also be able to assist students who are struggling. |
| **ELL Strategies** | | |
| *Visual Aids:* Show the student pictures of the different types of filters, as well as exploring the different filters made during the lesson.  *Hands-On*: Using realia (objects and material from everyday life,) give the student a chance to test out the different filters and how they work. Describe the differences between them, and what makes each one effective.  *Word Wall:* Post new vocabulary terms on the wall with similar terms near each other for easy reference. The flash cards with picture of the words can be incorporated into this strategy, or the student can add it in a notebook. Make sure the student draws their own pictures rather than relying on something drawn for them. | | |
| **DOK Question (Level 3)** | | |
| Ask students: How would you test a filter like this if it was full sized for an entire town? Would the same materials work, or would you need something stronger? Would you test a model or a full-sized version first? Why? | | |
| **Interactive Technology** | | |
| App: Biosand Filter (BSF) Videos: CAWST  Interactive: All About Water Filters: <http://all-about-water-filters.com/top-easiest-diy-water-filters-you-can-make-at-home/> | | |

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|  | Unsatisfactory Effort (0 points) | Effort Needs Improvement (1 point) | Satisfactory Effort (2 points) | Outstanding Effort (3 points) |
| I contributed to the team work. |  |  |  |  |
| I exhibited scientific thinking. |  |  |  |  |
| I maintained a positive attitude. |  |  |  |  |
| I completed the building task. |  |  |  |  |
| I reflected on my work. |  |  |  |  |

Grading Myself

Grading My Team

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| --- | --- | --- | --- | --- |
|  | Unsatisfactory Effort (0 points) | Effort Needs Improvement (1 point) | Satisfactory Effort (2 points) | Outstanding Effort (3 points) |
| My team worked well together. |  |  |  |  |
| My team displayed problem-solving skills. |  |  |  |  |
| My team had a positive attitude. |  |  |  |  |
| My team completed the building task. |  |  |  |  |
| My team discussed and reflected on our work. |  |  |  |  |

Graded by my Teacher

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|  | Unsatisfactory Effort (0 points) | Effort Needs Improvement (1 point) | Satisfactory Effort (2 points) | Outstanding Effort (3 points) |
| Student cooperated with team. |  |  |  |  |
| Student exhibited scientific thinking. |  |  |  |  |
| Student maintained a positive attitude. |  |  |  |  |
| Team completed the building task. |  |  |  |  |
| Student reflected on work. |  |  |  |  |

<http://www.morethanaworksheet.com/wp-content/uploads/2015/07/STEM-Rubric.pdf>

Websites/Videos

Miriam-Webster Word Central: <http://www.wordcentral.com/>

Kagan: <https://www.kaganonline.com/>

Easy Science for Kids: Four Spheres of Earth: <https://easyscienceforkids.com/four-spheres-earth/>

“Earth’s 4 Spheres for kids/4 Major Spheres” (3:38): <https://www.youtube.com/watch?v=b-4chsOyTLw>

“Four Spheres Part 1 (Geo and Bio): Crash Course Kids #6.1” (4:00): <https://www.youtube.com/watch?v=VMxjzWHbyFM>

“Four Spheres Part 2 (Hydro and Atmo): Crash Course Kids #6.2” (3:30): <https://www.youtube.com/watch?v=UXh_7wbnS3A>

“Geosphere, biosphere, hydrosphere, atmosphere” (3:35): <https://www.youtube.com/watch?v=HurK-1rrdb8>

“Big Idea 3: Earth’s Systems Interact” (5:49): <https://www.youtube.com/watch?v=BnpF0ndXk-8>

Science Lab: Earth Systems in a Bottle: <https://www.smusd.org/>

“Build a Tiny Plant World! /Science Project for Kids” (4:43): <https://www.youtube.com/watch?v=0vu4wdHNo4Q>

“Resources: Welcome to the Neighborhood – Crash Course Kids #2.1” (3:14): <https://www.youtube.com/watch?v=8LfD_EKze2M>

“Science Video for Kids: Natural Resources of the Earth” (5:16): <https://www.youtube.com/watch?v=Qw6uXh9yM54>

National Agriculture in the Classroom: Making Reusable Plastic: [https://www.agclassroom.org/teacher/matrix/lessonplan.cfm? lpid=141&author\_state=0&grade=3](https://www.agclassroom.org/teacher/matrix/lessonplan.cfm?%20lpid=141&author_state=0&grade=3)

“Introduction to Water” (3:47): <https://www.youtube.com/watch?v=nSENolWbyYQ>

“Science Video for Kids: Natural Resources of the Earth” (5:16): <https://www.youtube.com/watch?v=Qw6uXh9yM54>

“Where Does Water Come From?” (4:21): <https://www.youtube.com/watch?v=R0K7VKkksyc>

“Water Cycle – Blazer Fresh/Science Video/GoNoodle” (3:16): <https://www.youtube.com/watch?v=KM-59ljA4Bs>

South East Water: Natural water cycle game: <https://www.educationsoutheastwater.com.au/resources/natural-water-cycle-game>

Project Wet: A Trip Through the Water Cycle: <http://www.discoverwater.org/blue-traveler/>

TurtleDiary: Water Cycle Games: <https://www.turtlediary.com/games/water-cycle.html>

Explorable: Salt Water Egg Experiment: <https://explorable.com/salt-water-egg-experiment>

The Science Kiddo: Salt Water Experiment: <https://www.sciencekiddo.com/salt-water-experiment-ocean-science/>

“Water Everywhere: Crash Course Kids #14.2” (4:55): <https://www.youtube.com/watch?v=SkAhB-8CtZg>

Free Templates: Water Infographic: <https://all-free-download.com/free-vector/save-water.html>

“The Basics of Freshwater: Crash Course Kids #14.1” (4:15): <https://www.youtube.com/watch?v=oaQCiwzjnCM>

“Water Fight!: Crash Course Kids #36.1” (4:03): <https://www.youtube.com/watch?v=4b2kdcEuWr4>

“How Much Water Do You Use in One Day?” (1:36): <https://www.youtube.com/watch?v=SYwEAR6CbQw>

“Water Fix!: Crash Course Kids #36.2” (5:28): <https://www.youtube.com/watch?v=UYROQW9IDIg>

Water Use It Wisely: <https://wateruseitwisely.com/kids/>

“The Lorax (original)” (25:13): <https://www.youtube.com/watch?v=8V06ZOQuo0k>

Almost Unschoolers: Oil Spills: <http://almostunschoolers.blogspot.com/2010/07/oil-spills-and-advertising-grease.html>

NPR: Why Dawn is the Bird Cleaner of Choice in Oil Spills: <https://www.npr.org/templates/story/story.php?storyId=127999735?storyId=127999735>

“What Is Pollution?” (2:48): <https://study.com/academy/lesson/what-is-pollution-lesson-for-kids-definition-facts.html>

“Bill Nye the Science Guy S01E13 Garbage” (23:00): <https://www.youtube.com/watch?v=JqUm3M1cpi8>

Different Types of Pollution: <http://www.differencebetween.info/different-types-of-pollution>

“REDUCE REUSE RECYCLE (The Documentary)” (6:40): <https://www.youtube.com/watch?v=6BkcviD65Bo>

We Are Teachers: 21 Earth Day Crafts and Classroom Activities Using Recycled Materials: <https://www.weareteachers.com/earth-day-crafts-classroom-activities/>

“Recycling Song Jack Johnson 3Rs” (2:06): <https://www.youtube.com/watch?v=d1mFymbRmv4>

Business Insider: 12 Ways Science Can Save The World: <https://www.businessinsider.com/12-ways-biology-can-save-the-world-pictures-2012-9>

“Bill Nye the Science Guy S04E07 Pollution Solutions” (27:18): <https://www.youtube.com/watch?v=AdauM3AzqKw&t=2s>

Everyday Health: Teaching Our Children to Reduce, Reuse, Recycle, and Rebuy: <https://www.everydayhealth.com/green-health/earth-day-teaching-kids.aspx>

EPA: Recycle City: <https://www3.epa.gov/recyclecity/>

“Science Experiment: Where is Gravity?” (3:31): <https://www.youtube.com/watch?v=iM1kDonMbL8>

“Gravity Compilation: Crash Course Kids” (14:32): <https://www.youtube.com/watch?v=EwY6p-r_hyU>

“Brian Cox visits the world’s biggest vacuum chamber – Human Universe: Episode 4 Preview – BBC Two” (4:41): <https://www.youtube.com/watch?v=E43-CfukEgs>

“Bill Nye the Science Guy A Gravity Demonstration” (1:17): <https://www.youtube.com/watch?v=PsIBz40PcQ8>

Education.com: Science Project: Egg Parachute: <https://www.education.com/science-fair/article/egg-parachute/>

“Bill Nye The Science Guy S01E06 – Gravity” (22:55): <https://www.dailymotion.com/video/x3cpv1v>

“Outer Space: “We are the Planets,” The Solar System Song by StoryBots” (1:59): <https://www.youtube.com/watch?v=ZHAqT4hXnMw>

“Everything Revolves Around You: Crash Course Kids #22.1” (4:25): <https://www.youtube.com/watch?v=Y0_GLKU0NEY>

Spaceplace Nasa: “Why do planets go around the Sun?”: <https://spaceplace.nasa.gov/review/dr-marc-solar-system/planet-orbits.html>

“Earth’s Rotation & Revolution: Crash Course Kids 8.1” (4:00): <https://www.youtube.com/watch?v=l64YwNl1wr0>

“EXPLORE ACTIVITY – 5.8 C: EARTH’S ROTATION (Grade Level 5)” (2:05): <https://www.youtube.com/watch?v=CQViTzK0AsA>

“Following the Sun: Crash Course Kids #8.2” (4:52): <https://www.youtube.com/watch?v=1SN1BOpLZAs>

Windows to the Universe: Planets – Data Table: <https://www.windows2universe.org/?page=/our_solar_system/planets_table.html>

Wait But Why: The Fermi Paradox: <https://waitbutwhy.com/2014/05/fermi-paradox.html>

Nasa: How Many Stars in the Milky Way?: <https://asd.gsfc.nasa.gov/blueshift/index.php/2015/07/22/how-many-stars-in-the-milky-way/>

“Bill Nye the Science Guy on Outerspace (Full Clip)” (2:06): <https://www.youtube.com/watch?v=BdAqq-wEQV0>

“Glow On: Crash Course Kids #20.2” (5:09): <https://www.youtube.com/watch?v=Zo-sKzMWYFA>

“Largest star ever discovered, compared to our Sun” (1:32): <https://www.youtube.com/watch?v=g4iD-9GSW-0&feature=youtu.be>

Space: How to Tell Star Types Apart (Infographic): <https://www.space.com/30885-telling-star-types-apart-infographic.html>

“Super Stars (Constellations): Crash Course Kids #31.1” (4:58): <https://www.youtube.com/watch?v=MZffhapfOgg>

Mystery Science: Astronomy: <https://mysteryscience.com/astronomy/mystery-3/seasons-earth-s-revolution/75?r=20977201#slide-id-1117>

“Constellation Location: Crash Course Kids #31.2” (3:48): <https://www.youtube.com/watch?v=BbzCA0Lgf3Y>

Star Patterns: <http://tboeve.weebly.com/uploads/3/7/1/9/37196463/13_anwer_key_star_patterns.pdf>

Interactions in the Earth System: <http://www.ucmp.berkeley.edu/education/dynamic/session4/sess4_interactions.htm>

Earth System Interactions: <https://www.csun.edu/science/books/sourcebook/chapters/8-organizing/files/earth-systems-interactions.html>

“Big Idea 3: Earth’s Systems Interact” (5:49): <https://www.youtube.com/watch?v=BnpF0ndXk-8>

“Water and You: The Water Treatment Process” (4:19): <https://www.youtube.com/watch?v=tuYB8nMFxQA>

Earth Science Week: Water Filtration: <https://www.earthsciweek.org/classroom-activities/water-filtration>

“$1 DIY Water Filter in a Bottle” (3:37): <https://www.youtube.com/watch?v=4N5hdOcsKrg>

STEM-Rubric: <http://www.morethanaworksheet.com/wp-content/uploads/2015/07/STEM-Rubric.pdf>

Interactive: Kids Geography: Earth’s Spheres: <https://kidsgeo.com/geography-for-kids/earths-spheres/>

Earth’s Spheres: <https://www.wartgames.com/themes/science/earthspheres.html>

BrainPOP: Sortify: Natural Resources: <https://www.brainpop.com/games/sortifynaturalresources/>

NeoK12: Natural Resources: <https://www.neok12.com/Natural-Resources.htm>

South East Water: Natural water cycle game: <https://www.educationsoutheastwater.com.au/resources/natural-water-cycle-game>

Project Wet: A Trip Through the Water Cycle: <http://www.discoverwater.org/blue-traveler/>

TurtleDiary: Water Cycle Games: <https://www.turtlediary.com/games/water-cycle.html>

KidZone Science: The Water Cycle: <https://www.kidzone.ws/water/>

BrainPOP: Water Cycle Game: <https://www.brainpop.com/games/watercyclegame/>

NASA Climate Kids: <https://climatekids.nasa.gov/menu/fresh-water/>

EPA: Drinking Water & Ground Water Kids’ Stuff: <https://www3.epa.gov/safewater/kids/gamesandactivies.html>

Pollution: <https://www.wartgames.com/themes/science/pollution.html>

National Geographic Kids: Recycle Roundup: <https://kids.nationalgeographic.com/games/action/recycle-roundup-new/>

EPA: Recycle City: <https://www3.epa.gov/recyclecity/>

Idaho Public Television: Gravity: Games: <http://idahoptv.org/sciencetrek/topics/gravity/games.cfm>

NeoK12: Gravitation: <https://www.neok12.com/Gravitation.htm>

Gravity Kid: <https://www.marketjs.com/item/gravity-kid>

Gravity Launch!: <http://sciencenetlinks.com/interactives/gravity.html>

NASA Space Place: <https://spaceplace.nasa.gov/menu/play/>

Kids Astronomy: Make a Solar System: <https://kidsastronomy.com/astronomy-games/make-a-solar-system/>

BrainPOP: Build a Solar System: <https://www.brainpop.com/games/buildasolarsystem/>

Kids Astronomy: Constellation Hunt: <https://kidsastronomy.com/the-universe/constellation-hunt/>

Constellations: <https://www.wartgames.com/themes/science/constellations.html>

“Following the Sun: Crash Course Kids #8.2” (4:52): <https://www.youtube.com/watch?v=1SN1BOpLZAs>

Video: “Day & night explained” (1:01): <https://www.youtube.com/watch?v=v9J2auAwD_I>

BBC: Light and Shadows: <http://www.bbc.co.uk/bitesize/ks2/science/physical_processes/light_shadows/play/>

Duckie Deck: “Day and Night”: <http://duckiedeck.com/play/day-and-night>

“Constellation Location: Crash Course Kids #31.2” (3:48): <https://www.youtube.com/watch?v=BbzCA0Lgf3Y&t=149s>

Kids Astronomy: Constellation Hunt: <https://kidsastronomy.com/the-universe/constellation-hunt/>

Match the Memory: Earth’s Spheres: <https://matchthememory.com/Earthspheres>

All About Water Filters: <http://all-about-water-filters.com/top-easiest-diy-water-filters-you-can-make-at-home/>

Software Applications (Apps)

Water Cycle VR – Victory Enterprises

GLOBE Observer: NASA

Science at 100,000 Feet: University of Colorado Boulder

Water Cycle VR – Victory Enterprises

Life Sustaining Water: Gyan Sahoo

Aquation: The Freshwater Access Game: Smithsonian Institution

Light Pollution Map – Dark Sky

Air Checker – AQI monitor: Air quality index monitoring

iRecycle: Earth911, Inc.

RecycleNation: Electronic Recyclers International, Inc.

Offroad Garbage Truck Simulator: Skippy Apps

Grab Lab: Silly Gravity Arcade Puzzler

Gravitations – Player Made Missions

Basic Physics Lab: A fun way to learn physics

Solar System Builder AR – Space: Universes in augmented reality

Orbit Path – Space Physics Game: Blue Label Labs

Planet Families – Space Science Institute

Star Walk 2 Ads+: Sky Guide: Stars and Constellations in AR

SkySafari AR: Astronomy Night Sky Guide

Find Constellation: Discover the sky

Day & Night Map – Volker Voecking Software Engineering

SkyView Lite: Explore the Universe

Star Chart: Escape Velocity Limited

Biosand Filter (BSF) Videos: CAWST