Before you begin the activity, please hand out the pre-test to each student. The pre-test has two different grade levels, make sure to use the correct one for your age group. The pre-test will help us evaluate how effective this unit is on teaching kids about the engineering method. At the end of the quarter the same test will be administered again to see how much knowledge students have gained.
Write and/or explain the 8 steps in the Scientific Inquiry Process.

1. ____________________________________________________________________________________
   ____________________________________________________________________________________

2. ____________________________________________________________________________________
   ____________________________________________________________________________________

3. ____________________________________________________________________________________
   ____________________________________________________________________________________

4. ____________________________________________________________________________________
   ____________________________________________________________________________________

5. ____________________________________________________________________________________
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7. ____________________________________________________________________________________
   ____________________________________________________________________________________

8. ____________________________________________________________________________________
   ____________________________________________________________________________________
**Quarter 1: Earth & Space Sciences**

Next Generation Science Standards (NGSS):

MS-ESS1-1. Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.

**Background Information:**

The universe is everything that exists such as space, time, energy and matter. The universe has been expanding since it formed, and it is likely that parts of it will never be seen from Earth. However, what we can see from Earth are all the stars in the night sky that are apart of our local galaxy. Who can tell me the name of our local galaxy? The Milky Way is right. By day, we see a single star in the sky and that star is... the Sun! The Sun is 4.6 billion years old and is by far the largest object in the Solar System. The most prominent object in our nighttime sky is the Moon. The Moon is a cold, dry, lifeless ball of rock that shines by reflecting the light of the Sun. The Moon locked to Earth in a synchronous spin, which means on its axis in the same time it makes one orbit of Earth. This means the same side of the moon always faces Earth.

We reside on planet Earth. A planet is an object that orbits a star and is large enough for its own gravity to have pulled it into a spherical shape. Eight planets orbit the Sun, shining by reflecting sunlight. Who can tell me what these planets are? Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune. Depending on the time of year, several planets may be seen in the night sky. All planets except for Neptune can be seen with a naked eye.

Focusing in on our planet, planet Earth, who can tell me why we have a daytime and a nighttime? What is Earth’s place in the Universe? How can the motion of Earth explain seasons and eclipses? If you don’t know... well hopefully after these activities you will be able to answer these questions confidently.

**Setting the Stage:**

**Ask:** Why do we have seasons? Record all answers on the board and avoid correcting any misconceptions.

**Note:** As an extension you may show the YouTube video “a private universe” to show how even the people who seem to be the “smartest” in your class may have the largest misconception to the answer to this question.

https://www.youtube.com/watch?v=TrXaQu_qGeo

**Explain:** Earth is always moving. Every day, Earth makes one rotation on its axis. This causes day and night. Every year, Earth makes one complete orbit around the Sun. Its axis always tilts in the same direction, so the parts of Earth that receive more direct sunlight and have more daylight hours change throughout the year. This causes seasons—times of the year with particular patterns of weather and daylight, which vary depending on where you live. Most places experience four seasons: spring, summer, autumn, and winter.

**Show/Investigation:** Go to http://www.pbslearningmedia.org/resource/npls13.sci.ess.seasons/why-seasons/ and the answer to this question on PBS. Launch the “Why do we have seasons?” interactive. Let the students explore this interactive on their own or with a partner.
Quarter 1: Earth & Space Sciences

Next Generation Science Standards (NGSS):

MS-ESS1-1. Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.

Key Vocabulary:

**Axis:** an imaginary line through the center of a planet around which it spins  
**Rotate/Rotation:** one full spin of an object on its axis (makes day & night on Earth)  
**Revolve/Revolution:** the movement of one object around another object (this + tilt = seasons)  
**Orbit:** the curved path of an object around another object in space  
**Season:** each of the four divisions of the year (spring, summer, autumn, and winter) caused by the earth's changing position with regard to the sun  
**Tilt:** slant at an angle

Materials:

- Styrofoam Ball (enough for the whole group)  
- Wooden Skewers  
- Poster Paper  
- Colored Markers/Pencils/ Crayons  
- Flashlight  
- Globe (to serve as a model)

Activity Instructions:

1. Set out all the materials and tell students to work in teams to design a model that can answer the question of “Why do we have seasons?” Leave it open ended and really try to encourage students to take what they have learned in this lesson thus far and design a model that can help them confidently answer this question. Let them know that they will be sharing their products.

2. If students are having trouble starting you can start by pushing the skewer through the styrofoam ball to demonstrate axis and tilt.

3. Get globe. Explain how the styrofoam ball and the skewer, as well as the globe, represent the tilt of the earth. Emphasize that the axis is invisible. Slowly spin the globe to demonstrate how it rotates (rotation).

4. Locate Oregon on the globe.

5. Have a student stand in center of room with flashlight (sun). Using the globe, walk around the sun, stopping after each quarter to observe the way to light is hitting the earth.

6. Describe that the earth revolves around the sun (revolution) the same way that you are walking the globe around the flashlight. This is its orbit.

7. At each stop, find Oregon and identify how the “sun’s” rays are hitting Oregon. Name each season as you continue orbiting the “sun”

8. Don’t forget to have students share their models!

*End the lesson with taking a quick poll on how many students can confidently answer the question of why do we have seasons with a model.*
Next Generation Science Standards (NGSS):
MS-ESS1-3. Analyze and interpret data to determine scale properties of objects in the solar system.
MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.

Background Information:
Since ancient times, people have imagined shapes among the stars in the night sky and have linked stars to form constellations. These figures are named after the shapes they are thought to resemble. Does anyone have an example of constellations they have seen or have heard of?

*Note: Have the students spend some time researching constellations either in library books or browsing websites. They must choose their favorite constellation and if they find the story behind that constellation and would like to share that could be a fun extension of this lesson.

Setting the Stage:
**Ask:** What is your favorite constellation? Why?

*Note: You can share your favorite constellation and the myth about it to include yourself in the activity with the kids.

**Explain:** You will be designing a constellation box with a small group. My hope is that each group chooses a different constellation so that we can turn off the lights and display all the constellations on the white board. Have students try to identify which season their constellation can be best viewed in the night sky.

**Show:** If students are interested in learning how to spot certain constellations here is a video that helps students look for the constellation. [https://www.youtube.com/watch?v=X_xTSztG-tE](https://www.youtube.com/watch?v=X_xTSztG-tE)
Key Vocabulary:
None

Materials:
- Shoe Box, Tissue Box or Cereal Box
- Tape (Duct or Masking)
- Pushpins
- 3x5” Index Cards
- Scissors
- Small Flashlights

Examples for possible websites:
http://www.southernskyphoto.com/constellations/constellations.htm
http://www.seasky.org/constellations/constellations-intro.html

Activity Instructions:
1. Prep the constellation box. Break into small groups. Each group gets one box, which must be completely enclosed. If using a shoebox, they should tape the lid on tightly. If using a tissue box, they should cut a piece of paperboard and tape it over the opening. Then students should cut a hole- just big enough to fit the flashlight in the center of one of small ends of the box.

2. Choose a constellation. Ask each group to choose one constellation to display with their constellation box. Guide each group to choose a different constellation so you have a variety to display.

3. Make a constellation template. Have groups sketch their constellation on an index card, and then use a pushpin to poke the stars of the constellation in the card. Now, flip the card over, so students are looking at the mirror image of the constellation.

4. Use the template to poke holes in the constellation box. Have students tape the card over the other small end of the box and use a pushpin to poke the stars of the mirror image of the constellation in the box. Otherwise, it will project backward! Groups can now remove the card. Students who finish early can decorate their constellation box possibly with images of what their constellation means.

5. Display constellations. Hand out flashlights to each group. One student in each group should insert the flashlight into the hole at the end of the box. Then turn out the lights in the room and tell the students to aim their constellation at the ceiling or wall. They can experiment with holding the box at different distances. Have each group shine its constellation one at a time.

*Note: As an extension you can have students share what they learned through their research about their constellation. They can share what the constellation represents and what the myth is behind it.
Background Information:
Today we are going to explore the question of, what is Earth’s place in the Universe? Who remembers what galaxy we live in? That is right, the Milky Way galaxy. If you were to travel away from towns and cities and look at the sky on a clear, dark night, and the faint, misty glow of the Milky Way becomes visible in the sky. The Milky Way contains several hundred billion stars besides the sun, around which the planets of our Solar System orbit.

Setting the Stage:

**Ask:** Some questions that I want to think about while we are doing this activity is what is Earth's place in the Universe? What aspects of Earth, make it different than every other planet in our galaxy.

**Explain:** You will be working in small groups to create a model of the universe and where we are in the universe. Remind students to be prepared to share their models with the rest of the group.

**Show:** Watch 10:34 of episode 1 of Cosmos: A Spacetime Odyssey “Standing Up in the Milky Way.” This will give students a background of what our galaxy looks like and all that is out there behind our home on planet Earth. You can watch the episode for free at [http://www.disclose.tv/action/viewvideo/168516/Cosmos_A_Spacetime_Odyssey__Episode_1__Standing_up_in_the_Milky_Way/](http://www.disclose.tv/action/viewvideo/168516/Cosmos_A_Spacetime_Odyssey__Episode_1__Standing_up_in_the_Milky_Way/) or you could purchase the episode on iTunes for $1.99.
Quarter 1: Earth & Space Sciences

Next Generation Science Standards (NGSS):

MS-ESS1-2. Develop and use a model to describe the role of gravity in the motions within galaxies and the solar system.

COSMOS: A SPACETIME ODYSSEY

WEEK 3

Cosmos: A SpaceTime Odyssey

Key Vocabulary:
None

Materials:
- Scissors
- Glue
- Tape
- A variety of Crayons/ Colored Pencils/ Markers
- Large Sheets of Poster Paper for groups
- Clay or Play-Doh will allow for more creative models if available
- Other model construction supplies-anything you have available that seems appropriate like construction paper, balloons, Styrofoam balls, popsicle sticks, marbles, string, straws, toothpicks, pipe cleaners, pasta, and/or beans.

Activity Instructions:

1. Have students divide into small group of 3-4. Students should make sure that they all have a role in developing their model of the universe.
2. With all the materials in front of them, challenge students to create a model of the universe in 20 minutes. Tell students it is important to have an explanation for why they put object where they do in their model.
3. As the facilitator, it is important to go around and make sure all groups are working together and contributing to their model.
4. After the 20 minutes, have students share the model. Make sure each group shares, what features of the universe does their model represent, where is Earth in your model and what questions came up as your group worked on your model.

*To end the lesson have a group discussion of what patterns they noticed after looking at everyone’s model of the universe. Also what would you need to know to design a better model?

Extensions:
Cosmic Distance Scale: This feature gives a feeling for how immense our Universe is, starting with an image of the Earth and then zooming out to the furthest visible reaches of our universe.
http://heasarc.gsfc.nasa.gov/docs/cosmic/
Click begin to start this activity.
HISTORY OF EARTH

WEEK 4
History of Earth

Quarter 1: Earth & Space Sciences

Next Generation Science Standards (NGSS):
MS-ESS1-4. Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history.

Background Information:
Earth was formed about 4.6 billion years ago. In the very beginning of Earth's history, this planet was a giant, red hot, roiling, boiling sea of molten rock - a magma ocean. The heat had been generated by the repeated high-speed collisions of much smaller bodies of space rocks that continually clumped together as they collided to form this planet. As the collisions tapered off the earth began to cool, forming a thin crust on its surface. As the cooling continued, water vapor began to escape and condense in the earth's early atmosphere. Clouds formed and storms raged, raining more and more water down on the primitive earth, cooling the surface further until it was flooded with water, forming the seas. Since we can only measure as far back in time as we had solid rock on this planet, we are limited in how we can measure the real age of the earth. Due to the forces of plate tectonics, our planet is also a very dynamic one with new mountains forming, old ones wearing down, volcanoes melting and reshaping new crust. So let's explore how we have figured out that the Earth and life on Earth have changed over

Setting the Stage:

Ask: How do people figure out that the Earth and life on Earth have changed over time? How does the movement of tectonic plates impact the surface of the Earth?

Explain: In small groups you will be creating the timeline of Earth’s history given specific materials and detailed information. Working in teams and with the specific materials provided you will have 20 minutes to create the timeline of Earth. It may be helpful to use the iPad apps to help you develop your timeline.

Show: Explore iPad apps Geotimescale and Planet Earth 3D to help students envision what the history of Earth looks like on a time scale.

Supporting Materials
- Resources: Geologic Timeline Challenge

Prep:
- See Instructions
HISTORY OF EARTH

WEEK 4
History of Earth

Key Vocabulary:
None

Materials:
- Meter Stick of Measuring Tape
- Masking Tape
- String or Yarn (at least 5 meters long)
- Event Print Out (pdf)
- Colored Construction Paper

Activity Instructions:

Before Class: Measure out 4.6 meters in a straight line. Place a piece of tape every half meter from the beginning. Each meter represents 1 billion years of earth’s history, each centimeter represents 10 million years, and each millimeter represents 1 million years. Mark the first piece of tape as the present, the next piece as 500 million years ago, the next as 1 billion years ago, and continue on – the last piece of tape will read 4.5 billion years ago, add one extra piece of tape at the end to represent 4.6 billion years ago and the formation of the planet.

20 Minutes: Break students up into small groups (3-5 students is ideal). Each group will get a subset of the 15 event cards (see included PDF “Timeline Cards” – these should be cut up along the black lines). Ideally, each group will get a set of cards printed out on different colored paper, or the sets can be marked with colored markers to distinguish between each group. All groups can place their ‘formation of planet Earth’ card at the beginning of the timeline. Ask students to work together to place the rest of the event cards in the appropriate place along their timeline. The students do not need any prior knowledge to put their events on the timeline – the idea is for them to work together to figure out their events – let the students know it’s OK to be wrong!

10 Minutes: After each group has placed their events on the timeline, start a classroom discussion on where each group placed each event. Did everyone agree? If not, have groups try to justify their decisions.

15 Minutes: After the discussion, work with the students to place the events in their correct location along the timeline. As you re-place each event, engage the students in a brief discussion. If time permits, discuss any events that the students were surprised by. Note that the last two events will be totally indistinguishable from each other and from the end of the timeline – this is key! Events that we think of as being really old, like the extinction of mammoths, are actually very recent when compared to the entire history of the Earth.

Extensions:
Song by the amoeba people to explain continental drift in a creative way.
https://www.youtube.com/watch?v=T1-cES1Ekto

Next Generation Science Standards (NGSS):

MS-ESS1-4. Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth’s 4.6-billion-year-old history.
Resources:

Geologic Timeline Challenge Events:

1. Oceans and continents start to form – 4400 million years ago – 4.4 meters from present day (end of timeline)
2. First evidence of life – 3500 million years ago – 3.5 meters from present day
3. Initial of atmospheric oxygen – 2400 million years ago – 2.4 meters from present day
4. Evolution of eukaryotic (non-bacterial) life – 1800 million years ago – 1.8 meters from present day.
5. Cambrian Radiation of Animals – 542 million years ago – 54.2 centimeters from present day.
6. Plants move on to Land – 450 million years ago – 45 centimeters from present day
7. Animals move on to Land – 430 million years ago – 43 centimeters from present day
8. Permo-Triassic Mass Extinction – largest known! – 251 million years ago – 25.1 centimeters from present day
9. Evolution of Mammals – 195 million years ago – 19.5 centimeters from present day
10. Opening of the Atlantic Ocean – 160 million years ago – 16 centimeters from present day
11. Extinction of the Dinosaurs – 65 million years ago – 6.5 centimeters from present day
12. Rise of the Himalayan Mountains – 20 million years ago – 2 centimeters from present day
13. Evolution of our species, Homo sapiens – 200,000 years ago – 0.2 million years ago – 0.02 centimeters from present day (0.2 mm)
14. Extinction of the Wooly Mammoth – 10,000 years ago – 0.01 million years ago – 0.001 centimeters from present day (0.01 mm)
<table>
<thead>
<tr>
<th>Rise of the Himalayan Mountains</th>
<th>First Oceans &amp; Continents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Animals Move onto Land</td>
<td>Opening of the Atlantic Ocean</td>
</tr>
<tr>
<td>First Animals</td>
<td>First Evidence of Life</td>
</tr>
<tr>
<td>First Mammal</td>
<td>Rise of Atmospheric Oxygen</td>
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<td></td>
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<td>Event</td>
<td>Image</td>
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<tr>
<td>Extinction of Wooly Mammoths</td>
<td>![Mammoth Image]</td>
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<tr>
<td>First Land Plant</td>
<td>![First Land Plant Image]</td>
</tr>
<tr>
<td>Extinction of Dinosaurs</td>
<td>![Dinosaur Image]</td>
</tr>
<tr>
<td>First Human</td>
<td>![First Human Image]</td>
</tr>
<tr>
<td>Formation of Planet Earth</td>
<td>![Planet Earth Image]</td>
</tr>
<tr>
<td>First Eukaryote</td>
<td>![First Eukaryote Image]</td>
</tr>
<tr>
<td>Permo-Triassic Mass Extinction</td>
<td>![Extinction Image] 86% genera</td>
</tr>
</tbody>
</table>
Next Generation Science Standards (NGSS):

MS-ESS2-4. Develop a model to describe the cycling of water through Earth’s systems driven by energy from the sun and the force of gravity.

**Background Information:**
Water is found almost everywhere on Earth, from high in the atmosphere (as water vapor) to low in the atmosphere (precipitation, droplets in clouds) to mountain snowcaps and glaciers (solid) to running liquid water on the land, ocean, and underground. Energy from the sun and the force of gravity drive the continual cycling of water among these reservoirs. Sunlight causes evaporation and propels oceanic and atmospheric circulation, which transports water around the globe. Gravity causes precipitation to fall from clouds and water to flow downward on the land through watersheds. The question we are going to focus on this week is, “How does water influence weather, circulate in the oceans, and shape Earth’s surface?”

**Setting the Stage:**

**Ask/Explain:** Print off copies of the water cycle handout below. Students should fill this out as they are watching the video. Just FYI the video doesn’t have narration, but gives great visuals for the water cycle.

**Show** the water cycle video. Students should be labeling their blank diagrams as they watch. This version of the water cycle is more complex than the one on their capture sheets.

**Students** only need to copy the ones from the word bank. [http://www.youtube.com/watch?v=iohKd5FWZOE](http://www.youtube.com/watch?v=iohKd5FWZOE). This video has no narration so you will need to talk the kids through it, pausing as necessary.

**Ask:** “Which of the stages in the water cycle required energy from the Sun?” (Answers: Evaporation and Transpiration.)

**Ask:** “Which of the stages requires water to give off heat? (Answer: Condensation)

**Ask:** “Which of the stages are driven by the force of gravity?” (Answers: Precipitation, Runoff, Infiltration, Groundwater Flow)

**Show:** You may be wondering why understanding the water cycle is relevant to us. Well the amount of freshwater that we can actually use is limited to our needs. This NASA video helps explain how much water we have available to us. [http://pmm.nasa.gov/education/videos/show-me-water](http://pmm.nasa.gov/education/videos/show-me-water)
Quarter 1: Earth & Space Sciences

Next Generation Science Standards (NGSS):
MS-ESS2-4. Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.

Key Vocabulary:
- Evaporation  
- Condensation  
- Precipitation  
- Run Off  
- Groundwater Run Off  
- Transpiration  
- Infiltration  
- Solar Radiation

Materials:
- To allow for collaboration it might be helpful to have students complete this activity in partners or groups of three at the most
- Poster Paper (enough for all groups of students in program)
- Computer Paper for those who choose to do a comic strip
- Optional: Construction Paper, Colored Pencils/ Markers, Glue
- iPads available for those that want to complete their project electronically

Activity Instructions:
Students will complete a mini-project in which they describe one possible path that a water molecule can take through the water cycle. They have the following choices in order to demonstrate their understanding:

They may make a mini-poster with a diagram of the water cycle. (8.5" X 11" maximum)
- The diagram should have the water molecule moving from one step to another.
- Each step in the cycle needs to have text that describes what is happening to the molecule. This text can be ‘spoken’ by the drop, or written as a caption near the drop.

Or-
They may make a comic strip with a molecule of water as the main character.
- The comic must include text that explains what is happening in each frame.
- The text can be dialog ‘spoken’ by the drop, or written as a caption at the bottom of the frame.

Or-
Electronic Options for students who prefer to use a computer:
- Computer generated comic strip

The goal is to use water cycle vocabulary.
Here is what the water cycle handout should look like afterwards:

II. Water Cycle Video. There is no audio, so be sure to watch carefully as the sun comes up and heats the land and water, and then goes through the whole water cycle. Be sure to label the arrows on your water cycle diagram as you watch. Use the word bank for help.

Word Bank:
- Evaporation
- Condensation
- Precipitation
- Run off
- Groundwater Runoff
- Transpiration
- Infiltration
- Solar Radiation

Show the water cycle video. Students should be labeling their blank diagrams as they watch. This version of the water cycle is more complex than the one on their capture sheets. Students only need to copy the ones from the word bank. [http://www.youtube.com/watch?v=iohKd5FWZOE](http://www.youtube.com/watch?v=iohKd5FWZOE). This video has no narration so you will need to talk the kids through it, pausing as necessary.
Next Generation Science Standards (NGSS):

PS1.A: Structure and Properties of Matter: The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish. The changes that occur with variations in temperature or pressure can be described and predicted using these models of matter.

ESS3.D: Global Climate Change: Human activities such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth’s mean surface temperature (global warming).

Objectives

Students will:

1. Plan, carry out, and interpret results of a scientific investigation.
2. Explain why melting land ice causes sea levels to rise, but melting sea ice does not.
3. Recognize the far-reaching effects of global climate change.

Background Information:

See worksheet.
Quarter 1: Earth & Space Sciences

Next Generation Science Standards (NGSS):

PS1.A: Structure and Properties of Matter: The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish. The changes that occur with variations in temperature or pressure can be described and predicted using these models of matter.

ESS3.D: Global Climate Change: Human activities such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth’s mean surface temperature (global warming). See

Key Vocabulary:
- Global Climate Change
-Density
- Greenhouse Gases
- Displacement

Materials:
- 2 Identical Clear Storage Boxed, about 6” square
- 8 Sticks of Modeling Clay per group
- 1 Ruler per group
- 1 Tray of Ice Cubes per group
- 1 liter of water per group
- Sea Level Rise Worksheets

Activity Instructions:
See worksheet.
Weather & Climate - Cont’d

Quarter 1: Earth & Space Sciences

Next Generation Science Standards (NGSS):

PS1.A: Structure and Properties of Matter: The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish. The changes that occur with variations in temperature or pressure can be described and predicted using these models of matter.

ESS3.D: Global Climate Change: Human activities such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth’s mean surface temperature (global warming).

Background Information:
One consequence of climate change is the melting of ice caps, glaciers, and sea ice, including polar ice in Greenland and Antarctica. Substantial melt of these massive glaciers will cause a rise in sea level along coastlines throughout the globe. This activity explores how melting ice impacts sea level.

Water is an unusual liquid because it expands when it freezes. In general, liquids do not expand upon freezing, but rather contract and become denser as temperature drops. Like other liquids, as water begins to cool, it becomes more and more dense. But, because of the physical structure of the water molecule, it continues to become denser until just before freezing when it expands. This expansion occurs at the point at which freezing begins (4 degrees C).

When objects are totally submerged in water, they are displaced. When floating ice melts, the melted water is equal only to the volume of the ice that is submerged. This means that when floating ice melts, it contributes no additional volume to the body of water. We see this phenomenon when we let ice melt in a glass of water. The water does not overflow because the ice has already displaced water equal to the volume it will take up upon melting.

Ice already in the oceans does not contribute to the sea level rise, but ice covering land will contribute to sea level rise upon melting.

Objectives:
Students will:

1. Plan, carry out, and interpret results of a scientific investigation.
2. Explain why melting land ice causes sea levels to rise, but melting sea ice does not.
3. Recognize the far-reaching effects of global climate change.
Instructor Notes:

Weather & Climate - Cont’d

WEEK 7
Weather & Climate - Cont’d

Quarter 1: Earth & Space Sciences

Next Generation Science Standards (NGSS):

PS1.A: Structure and Properties of Matter: The amount (weight) of matter is conserved when it changes form, even in transitions in which it seems to vanish. The changes that occur with variations in temperature or pressure can be described and predicted using these models of matter.

ESS3.D: Global Climate Change: Human activities such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth’s mean surface temperature (global warming).

Key Vocabulary:
- Global Climate Change
- Greenhouse Gases
- Density
- Displacement

Materials:
- 2 Identical Clear Storage Boxed, about 6” square
- 8 Sticks of Modeling Clay per group
- 1 Ruler per group
- 1 Tray of Ice Cubes per group
- 1 liter of water per group
- Sea Level Rise Worksheets

Activity Instructions:
1. Place half of the clay into one side of each box. Form the clay to represent land rising out of the ocean.
2. Place about 6 ice cubes on the "land" (clay) in the first box. Place the same number of ice cubes next to the clay in the second box, so that they are resting on the bottom of the container.
4. Pour water in to the container where the ice is resting on the bottom until the ice is floating (NOT resting on the bottom).
5. Pour water into the container with the ice resting on the clay until the water levels in the two containers are approximately equal.
6. Have students measure and record initial measurements of water depth (in mm). They may wish to draw a line in the clay at the initial water level.
7. Leave the setup. Students should measure the water depth every hour (or other regular interval) and record the results, until the ice is completely melted.

Interpret the Data:
1. Have each group graph their results on the board or chart paper (see sample graph on next page) and display the graphs so everyone can see.

Conclusion:
1. Have discussion about global climate change. Use the following questions to generate discussion:
   1. Why might we be concerned about sea level rise? Coastal areas will be flooded. People will lose their homes. Habitat loss will occur, etc.
   2. What can we do to help slow this process? Take public transit, eat local foods, turn off lights, etc.
Objectives

Students will be introduced to:

1. The concepts of climate change and the greenhouse effect.

2. Common sources of greenhouse gas emissions generated by humans.

3. The Global Warming Wheel Card, which enables students to see how their own actions generate greenhouse gas emissions.

4. Ways in which students might reduce their individual, family, school, and community contributions to the greenhouse effect.

Adapted from: United States Environmental Protection Agency - Office of Air and Radiation.
Activity Instructions:
1. Cut out the two large circles and the two large rectangular pieces.
2. Cut out the two little rectangular windows on each of the large rectangular pieces.
3. Put glue on the backs of both circles and put them together to make the “wheel” of the wheel card, making sure that you align them so that the four labels that run along the outside of each circle (Waste Disposal, Home Heating, Electricity Use, and Transportation) line up with the corresponding labels on the other side. The Waste Disposal label on one side should line up with the Waste Disposal label on the other side, and so on.
4. Lay the rectangular piece entitled “What Can You Do?” upside-down on the table with the larger of the two cutouts closer to you. If you lift up the edge of the rectangular piece and see the words “Global Warming—What Can You Do?” right side up, you’ve done it correctly.
5. Put the glued-together wheel on top of the rectangular piece, with the side that has all the questions (such as “On average, how much does your household spend on electricity each month?”) facing up.
6. Lay the other rectangular piece entitled “What’s Your Score?” on top of the wheel, with the smaller of the two cutouts closer to you.
7. Look for the “belly button” on the pasted-together wheel and the two large rectangular pieces. Push a paper fastener (“brad”) through the “belly button” to hold all the pieces together.
8. Glue the large rectangular pieces in all four corners just enough to hold the rectangles together but allowing the wheel to turn freely.
9. If you wish, highlight each line inside the windows in a different color to make it easier to read. If you have access to a color printer, this step will be unnecessary.
10. If you are putting the wheel together to use in a demonstration, now you’re ready to calculate the greenhouse gas emissions “score” of members of your audience and what they can do to reduce it.
Global Warming Wheel Card: Side 2 (outside)

**Home Heating**
- Replace 10 75-watt incandescent light bulbs with 20-watt ENERGY STAR lights.
- Replace old refrigerator with a new ENERGY STAR model.
- Turn up your air conditioner’s thermostat by 2 degrees Fahrenheit in summer.

**Transportation**
- Turn down your heating thermostat by 8 degrees Fahrenheit on winter nights.
- Replace single-glazed windows with ENERGY STAR windows.
- Replace your old gas or oil furnace or boiler with an ENERGY STAR model.

**Electricity Use**
- Reduce your waste generation by 25 percent.
- Reduce half of your potentially recyclable materials (paper, plastics, glass, magazines, aluminum and steel cans).

**Waste Disposal**
- Buy a vehicle that gets 20 miles per gallon more than your current one.
- Reduce the number of miles you drive by 25 miles per week by carpooling, walking, biking, or taking mass transit instead.

**Global Warming — What Can You Do?**
- Reduce your waste generation by 25 percent.
- Reduce half of your potentially recyclable materials (paper, plastics, glass, magazines, aluminum and steel cans).
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**Transportation**
- Turn down your heating thermostat by 8 degrees Fahrenheit on winter nights.
- Replace single-glazed windows with ENERGY STAR windows.
- Replace your old gas or oil furnace or boiler with an ENERGY STAR model.

**Electricity Use**
- Reduce your waste generation by 25 percent.
- Reduce half of your potentially recyclable materials (paper, plastics, glass, magazines, aluminum and steel cans).

**Waste Disposal**
- Buy a vehicle that gets 20 miles per gallon more than your current one.
- Reduce the number of miles you drive by 25 miles per week by carpooling, walking, biking, or taking mass transit instead.
Background Information:
The Wheel Card introduces students to common sources of carbon dioxide, such as manufacturing processes, power plants, and automobiles. The front side of the wheel allows students to estimate how much carbon dioxide they and their families produce in a typical year through these sources. The back side of the wheel provides them with examples of activities that they can undertake to reduce carbon dioxide emissions.

Objectives

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4. Ways in which students might reduce their individual, family, school, and community contributions to the greenhouse effect.
HUMAN IMPACTS

WEEK 9
Human Impacts

Key Vocabulary:
None

Materials:
- Four Sheets of paper
- Scissors
- Glue
- Small Paper Fastener or “Brads”
- Wheel Card

Activity Instructions:
1. Cut out the two large circles and the two large rectangular pieces.
2. Cut out the two little rectangular windows on each of the large rectangular pieces.
3. Put glue on the backs of both circles and put them together to make the “wheel” of the wheel card, making sure that you align them so that the four labels that run along the outside of each circle (Waste Disposal, Home Heating, Electricity Use, and Transportation) line up with the corresponding labels on the other side. The Waste Disposal label on one side should line up with the Waste Disposal label on the other side, and so on.
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6. Lay the other rectangular piece entitled “What’s Your Score?” on top of the wheel, with the smaller of the two cutouts closer to you.
7. Look for the “belly button” on the pasted-together wheel and the two large rectangular pieces. Push a paper fastener (“brad”) through the “belly button” to hold all the pieces together.
8. Glue the large rectangular pieces in all four corners just enough to hold the rectangles together but allowing the wheel to turn freely.
9. If you wish, highlight each line inside the windows in a different color to make it easier to read. If you have access to a color printer, this step will be unnecessary.
10. If you are putting the wheel together to use in a demonstration, now you’re ready to calculate the greenhouse gas emissions “score” of members of your audience and what they can do to reduce it.
Global Warming Wheel Card: Side 2 (outside)

Home Heating

- Replace 10 75-watt incandescent light bulbs with 20-watt ENERGY STAR lights.
- Replace old refrigerator with a new ENERGY STAR model.
- Turn up your air conditioner’s thermostat by 2 degrees Fahrenheit in summer.
- 900 lbs/year
- 3,600 lbs/year

Transportation

- Turn down your heating thermostat by 8 degrees Fahrenheit on winter nights.
- Replace single-pane windows with ENERGY STAR windows.
- Replace your old gas or oil furnace or boiler with an ENERGY STAR model.
- Mass transit instead of driving.
- Combining trips or taking public transit.
- Walking, biking, carpooling.
- Drive by 25 miles per week by reducing the number of miles you currently drive.
- Buy a vehicle that gets 20 miles per gallon or more than your current one.
- Reduce your waste generation by 25 percent.
- 1,100 lbs/year
- 700 lbs/year
- 300 lbs/year

Electricity Use

- Reduce your current electricity use.
- Reduce your electrical use by 25 percent.
- Recycle half of your potentially recyclable materials (paper, plastics, glass, magazines, aluminum and steel cans).
- 3,000 lbs/year
Write and/or explain the 8 steps in the Scientific Inquiry Process.

1. _______________________________________________________________
   _______________________________________________________________

2. _______________________________________________________________
   _______________________________________________________________

3. _______________________________________________________________
   _______________________________________________________________

4. _______________________________________________________________
   _______________________________________________________________

5. _______________________________________________________________
   _______________________________________________________________

6. _______________________________________________________________
   _______________________________________________________________

7. _______________________________________________________________
   _______________________________________________________________

8. _______________________________________________________________
   _______________________________________________________________