

LESSON 4 Impacts of Climate Change

Lesson at a Glance

Students will create a model and conduct an experiment to determine how the melting of glaciers and sea ice will affect sea level. Students will also examine how computer simulations can analyze and describe the effects of climate change, including predictions of rise in sea levels, increased number and severity of hurricanes, and droughts. This lesson focuses particularly on developing skills in interpreting data from line graphs, bar graphs, and graphic images (all scientific models of data), and using interpretations to draw conclusions.

Lesson Duration

Two 45-minute periods

Essential Question(s)

How does the melting of glaciers and sea ice affect sea level?

How do scientists predict future effects of climate change and its impact on Hawai‘i?

Key Concepts

- The predicted sea level rise of one meter over the next 100 years will seriously impact the Hawaiian Islands.
- Scientists create models to help predict potential changes in climate in the future.
- Models and simulations are created through the collection and analysis of data.

Instructional Objectives

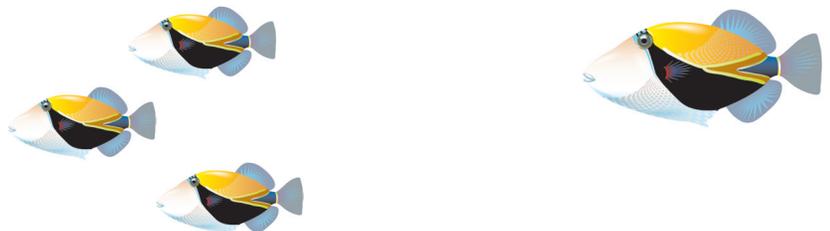
- I can model one potential effect of climate change.
- I can identify the importance of controlling variables in scientific experiments.
- I can model a problem situation like glacier and iceberg melt, record the data in a table, and draw conclusions based on the data collected.

Related HCPSIII Benchmark(s):

Science SC 5.1.1
Identify the variables in scientific investigations and recognize the importance of controlling variables in scientific experiments

Science SC 5.2.1
Use models and/or simulations to represent and investigate features of objects, events, and processes in the real world.

Math MA 5.10.2
Model problem situations with objects or manipulatives and use representations (e.g., graphs, tables, equations) to draw conclusions



Assessment Tools

Benchmark Rubric:

Topic		Scientific Inquiry	
Benchmark SC.5.1.1		Identify the variables in scientific investigations and recognize the importance of controlling variables in scientific experiments	
Rubric			
Advanced	Proficient	Partially Proficient	Novice
Identify the variables in scientific investigations, explain why variables need to be controlled, and give examples of how to control variables in scientific experiments	Identify the variables in scientific investigations and recognize the importance of controlling variables in scientific experiments	Identify, with assistance, the variables in a scientific investigation or the importance of controlling the variables	Recognize, with much assistance, the variables in scientific investigations

Topic		Unifying Concepts and Themes	
Benchmark SC.5.2.1		Use models and/or simulations to represent and investigate features of objects, events, and processes in the real world	
Rubric			
Advanced	Proficient	Partially Proficient	Novice
Consistently select and use models and simulations to effectively represent and investigate features of objects, events, and processes in the real world	Use models and/or simulations to represent and investigate features of objects, events, and processes in the real world	With assistance, use models or simulations to represent features of objects, events, or processes in the real world	Recognize examples of models or simulations that can be used to represent features of objects, events, or processes

Topic		Numeric and Algebraic Representations	
Benchmark MA.5.10.2		Model problem situations with objects or manipulatives and use representations (e.g., graphs, tables, equations) to draw conclusions	
Rubric			
Advanced	Proficient	Partially Proficient	Novice
Model problem situations with objects or manipulatives and use representations to draw conclusions, with accuracy	Model problem situations with objects or manipulatives and use representations to draw conclusions, with no significant errors	Model problem situations with objects or manipulatives and use representations to draw conclusions, with a few significant errors	Model problem situations with objects or manipulatives and use representations to draw conclusions, with many significant errors

Assessment/Evidence Pieces

Lesson

- Student Worksheets *Sea Level Rise Experiment*

Materials Needed

Teacher	Class	Group	Student
<ul style="list-style-type: none"> • Method to project PowerPoint 	<ul style="list-style-type: none"> • None 	<ul style="list-style-type: none"> • Clear watertight container, at least 6 inches high • Clay • Potato cut in half widthwise, or any non-water absorbing material to make an island • Ruler and tape • Water • Ice Cubes, for each group approximately 3 per trial 	<ul style="list-style-type: none"> • None

Instructional Resources

Teacher Reading: *Impacts of Climate Change*

Student Reading: *Sea Level Rise Experiment - Lab Station Instructions*

Student Worksheets: *Sea Level Rise Experiment*

PowerPoint Presentation: *Examining Potential Impacts*

Video: *Computer Model: Oahu 1 Meter Sea Level Rise*

Video: *Computer Model: Sea Level Rise*

Video: *Computer Model: Air Temperature Change*



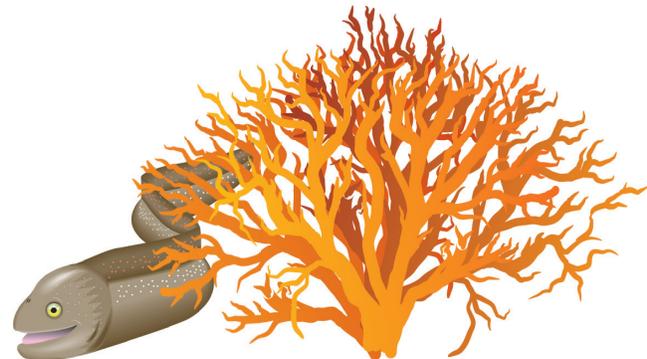
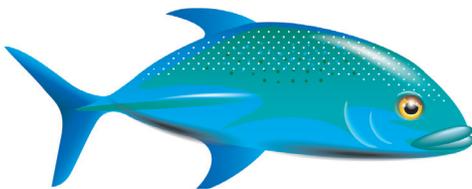
Student Vocabulary Words

climate: the long-term average of conditions in the atmosphere (weather), ocean, ice sheets on land and sea ice.

drought: a period of time when there is not enough water to support needs.

hurricane: a severe cyclone with heavy winds and rains.

sea level: height of the ocean surface halfway between low and high tides.



Lesson Plan

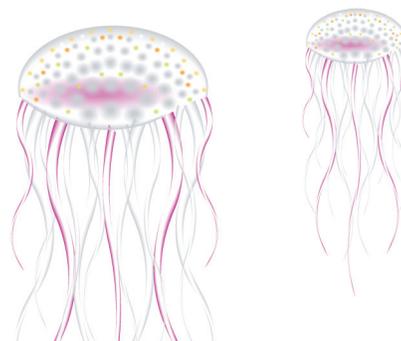
Lesson Preparation

- Review the Science Background provided in the Unit Overview and the Teacher Reading *Impacts of Climate Change*.
- Set up lab stations to accommodate student groups of 3-4 students.
- Print *Sea Level Rise Experiment - Lab Station Instructions* and place at each lab station.
- Print Student Worksheets *Sea Level Rise Experiment* all four pages, one for each student.
- Collect sufficient materials for lab.
- Write out Instructional Objective *I can* statement for this lesson.
- Preview PowerPoint *Examining Potential Impacts*, and make arrangements to project it.

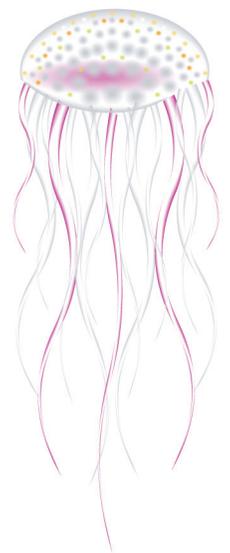
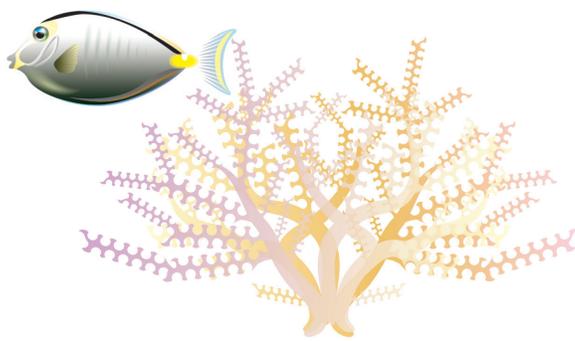


I. Sea Level Rise Experiment

- Review the concept of increased greenhouse gases and the effect of increase carbon dioxide (CO₂) levels; discuss how this might increase temperature. Discuss how we, as humans, are contributing to this increase in carbon dioxide in the atmosphere. Ask students, *What are we as humans doing to try and slow down our contribution to (CO₂) in the atmosphere?* Explain to the class that the increase in these greenhouse gases causes an increase in temperatures around the world. This increase is causing glaciers and icebergs to melt. Ask students to tell you the global effect of glaciers and icebergs melting (Sea Level Rise).
- Distribute Student Worksheet *Sea Level Rise Experiment*, create student groups (approximately 3-4 students) and have students go to a lab station.
- Distribute a clear watertight container representing the ocean, clay or half-potato (or any non-water absorbing material to make an island), ruler and tape to each group.
- Instruct each group of students to create an island inside the clear watertight container. The island must touch the ground and have a flat surface on top to “hold” a glacier.
- Place a ruler along the inside of the watertight container. Use a piece of tape, along the top of the container, to secure the ruler in place. The ruler should be positioned so that measurements can be recorded by looking at the ruler through the watertight container.
- Once each group has secured their island and ruler inside of the watertight container, distribute water to each group. Add water to the tank, but be sure not to submerge the island.
- Review the Student Worksheet *Sea Level Rise Experiment*. Explain that they will be investigating the impact of glacier and iceberg melting on sea level rise. Review what variables are and identify the variables for this experiment. Discuss why it is important to control variables in an investigation (i.e., Why can’t you test glacier and iceberg melt at the same time?).



- H. Review what a hypothesis is. Instruct the groups to develop their hypothesis and write it down. Some possible guiding questions...
- What will happen when you add icebergs?
 - What will happen when you add a glacier?
 - Will it be the same or different?
- I. Ask students to record the initial height of the water and where they placed their ice cubes.
- J. Distribute three ice cubes per group. Have students place the cubes in the water to act as icebergs. Icebergs are in water, not connected to land.
- K. Monitor the groups as they complete Trial #1. Once the groups complete the first trial, briefly discuss what variable each group is going to modify.
- L. Then, distribute ice cubes to each group again. If needed, pour out some of the water from the first trial. Have students place the cubes on top of their island to represent glaciers. Glaciers start connecting to land.
- M. Remind students to record the water level data once more before and after glacier melting. Within their groups, they should summarize what happened between their two trials and form a conclusion.
- N. Discuss as a class the difference between what they thought would happen (hypothesis) and what actually happened (results and conclusion).
- O. Conclude activity with a discussion about the “real world” implications of glacier melting and sea level rise.



II. *Examining Potential Impacts*

- A. Introduce the lesson to students by reviewing the results from the Sea Level Rise Experiment. Lead a discussion with the class about the impact of the increased sea level that they observed.
- B. Explain that scientists use computer simulations to predict the effects of sea level rise. A computer simulation is a type of model. The logic is that if the Earth is becoming warmer, then the ocean temperatures will increase, causing sea levels to rise. Warming and melting of glaciers and icebergs will also cause sea level to rise. In the PowerPoint *Examining Potential Impacts*, there are examples of some scientists' predictions about flooding that will occur if sea level rises.
- C. Use the PowerPoint *Examining Potential Impacts*. This PowerPoint is an introduction to the other changes we might experience with increased climate variability.
- D. The PowerPoint *Examining Potential Impacts* includes scientific model simulations of what might happen with increased sea level, which is one type of model.
- E. Emphasize that these models and computer simulations are predictions based on past data that can give us an idea of future scenarios. Remind students of the evidence they studied that climate has undergone great natural changes in the past, including ice ages and warming periods.

LESSON 4 - Teacher Reading

Impacts of Climate Change

Changes in climate may affect our lives in a number of different ways. Scientists are studying changes in sea level height as well as numbers of landfall hurricanes and droughts on Hawai‘i and the mainland.

Rising Temperatures - Although climate has continuously changed naturally throughout the history of the Earth, we are now facing human-induced climate change. As a result of the Industrial Revolution, in which increasing quantities of fossil fuels that release carbon dioxide were used, there has been an increase in carbon dioxide in the atmosphere above natural levels. This increase has caused the temperatures on Earth to rise at 0.7 °C (1.3 °F) over the past 100 years. As pointed out in the following paragraphs, rising temperatures can cause a number of other changes.

Sea Level Rise - Melting ice caps and glaciers have contributed additional water to the Earth’s oceans.

For Hawai‘i, sea level rise is of significant consequence because of the following threats:

- Increase in tidal range and coastal flooding.
- Increased erosion of the shoreline.
- Loss of habitat (for humans and animals) at the coasts.
- Increase in salinity of aquifers.

Simulation Models for PowerPoint *Examining Potential Impacts*

Flooding O‘ahu: For images showing step-by-step flooding with sea level rise, see www.soest.hawaii.edu/HMRG/FloodingOahu/stepbystep.html.

For projected 1-meter (39 inches) sea level coastal inundation all around the U.S., see http://www.architecture2030.org/pdfs/nation_under_siege_lr.pdf.

Hurricanes - There is not complete agreement on the connection between global climate change and hurricanes, but evidence suggests that hurricanes may increase in number and intensity as a result of global warming.

In Hawai‘i, an increase in hurricanes means an increase in the three primary types of hurricane damage:

- Increase in inland flooding.
- Increase in storm surge.
- Increase in damage to buildings.

Droughts - There is not complete agreement on the connection between global climate change and droughts, but much of the evidence suggests that, as a result of global warming, droughts on the mainland and Hawai‘i may increase in number, duration, and frequency. In terms of Hawai‘i, an increase in the number, duration, and frequency of droughts on the mainland means:

- Increase in the cost of goods produced in areas with droughts.
- Increase in the cost of food grown in areas with droughts.
- Increase in people relocating from drought regions to regions without droughts.

An increase in droughts on Hawai‘i means:

- Lack of water for human consumption.
- Lack of water for agriculture.
- Lack of water for other industries, including tourism (Plants and animals may not have enough water to survive.).

LESSON 4 - Student Reading

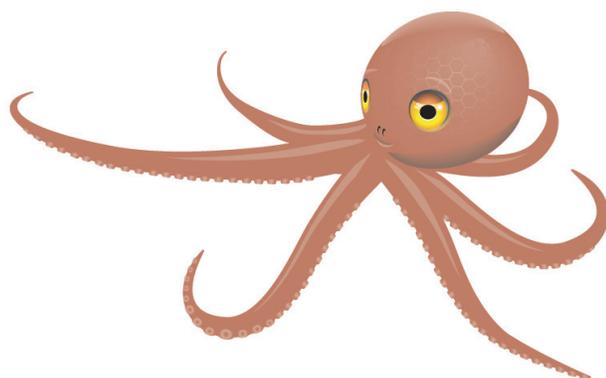
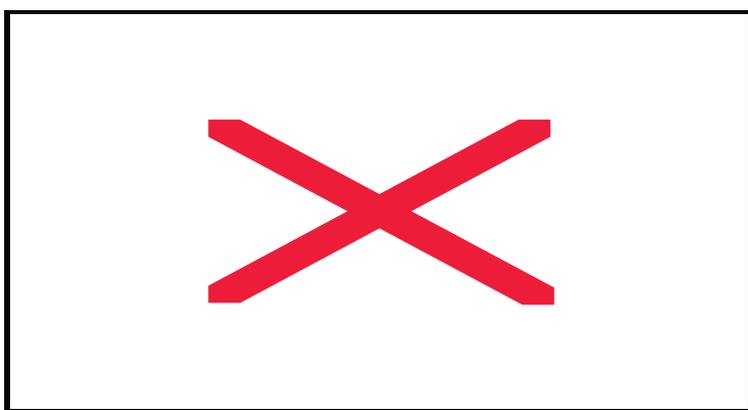
Sea Level Rise Experiment – Lab Station Instructions

Purpose:

To determine how the melting of glaciers and icebergs will affect sea level.

Methods:

1. You will create a Sea Level Rise Model, like the one shown here:



- Container = the ocean
 - Clay, potato, or other material that doesn't absorb water = island
 - Ice cubes = glaciers or icebergs, depending on where the ice cubes are placed.
 - Water = the sea level
 - Ruler = sea level gauge
2. Create the model of an island with clay or potato or other material. Make sure you can place ice cubes (glaciers) on top of your island without them sliding off.
 3. Place the model on the bottom of the plastic container. The plastic container is the “ocean” around your island.
 4. Tape a ruler to the inside of the container.
 5. Add water to the container. Leave some of the island above the water.
 6. Follow the instructions on your *Sea Level Rise Experiment* lab data sheet.

LESSON 4

Name: _____ Date: _____

Sea Level Rise Experiment

The Scientific Method

Question: How does the melting of icebergs and glaciers affect an island community?

Hypothesis: If icebergs melt, then _____

because _____

Hypothesis: If glaciers melt, then _____

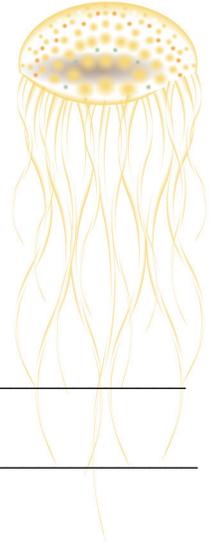
because _____

Trial #1: Add icebergs (ice cubes) in the water near your island.

- Measure the water and write it down on the form below.
- Wait for the iceberg to melt, and record the height of the water on your chart.
- Question: Did the water level change?

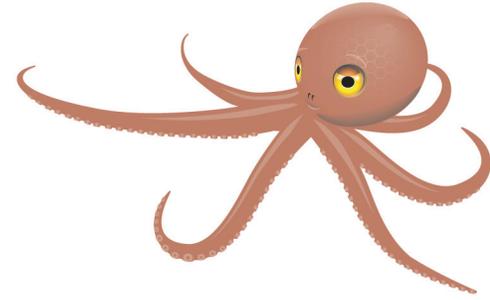
Trial #2: Add the same # of cubes, but this time place them on the island to represent glaciers.

- Record the water level BEFORE the ice melts.
- Record the water level AFTER the ice melts.
- Question: Did the water level change?



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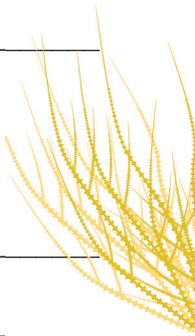


Questions

1. Identify the variable(s) that you controlled in these experiments.

2. Explain why it is important to control this part of the experiment.

3. What might have happened if these variables were NOT controlled?



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4. How does this simulation of melting icebergs and glaciers help you better understand what's happening in the real world?

5. How might a rise in sea levels affect how you live?

6. What else would I like to know about melting glaciers and icebergs? Write at least one question.

