



# CLIMATE CONTROLLED: SEA ICE OR LAND ICE?



AmeriCorps

## TIME & AUDIENCE LEVEL

- 6th-12th Grade
- 30 minutes—1 hour

## VOCABULARY

- Climate Change
- Weather
- Anthropogenic
- Greenhouse effect
- Greenhouse gases
- Sea level rise
- Permeable

## MATERIALS

- Two identical, clear plastic food-storage containers
- Clay/Playdough
- Container of ice cubes
- Ruler
- Measuring cup
- Timer or stopwatch
- Water
- Data sheet
- Permanent marker

## OPTIONAL MATERIALS

- Blue food dye
- Two additional, clear plastic storage containers
- Plastic cling wrap or the lids fitted to the storage containers

## SUMMARY

The changing climate has major impacts on all living things, especially sea turtles. In this activity, students will become climate scientists and help Scute determine the main driving factors of one of the main concerns of climate change: sea level rise. Does land ice or sea ice contribute more?

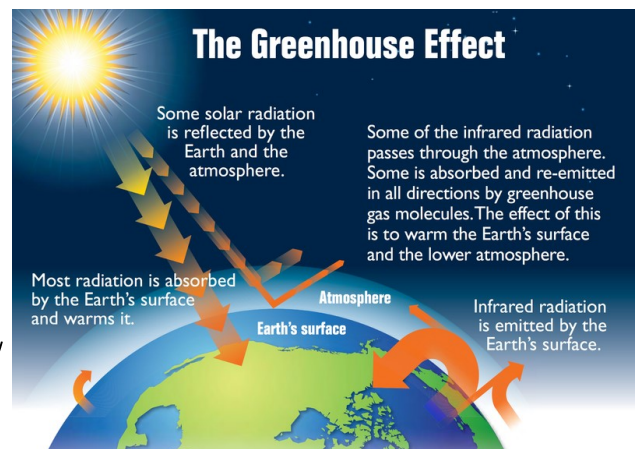
## OBJECTIVES

- Students will hypothesize, set up, and record outcomes of an experiment
- Students will synthesize how land ice and sea ice contributes to sea level rise
- Students will identify how sea level rise affects different animals and ecosystems

## BACKGROUND INFORMATION

Earth's climate is always changing. Throughout its history, our world has gone through many periods of warming and cooling. However, in the recent decades, scientists have recorded the climate changing at a never-before-seen rate. **Climate Change** refers to long-term shifts in temperature and weather patterns (flooding, droughts, sea level rise). Strong evidence points to human activity as a driving force behind this accelerated warming. **Weather**, however, refers to short term atmospheric conditions, like rain, sleet, and snow.

The earth is a perfect temperature to sustain life because it is insulated by gases that allow the warmth from the sun in, but then trap the heat from escaping back to space. This phenomenon is called the **greenhouse effect**, because it works in the same way a greenhouse works for plants. The gasses that trap this heat are called **greenhouse gases**. For example, carbon dioxide ( $\text{CO}_2$ ), water vapor ( $\text{H}_2\text{O}$ ), and methane ( $\text{CH}_4$ ). These gases also happen to be a very common by-products of modern day life.



## NGSS

**MS-ESS2-2:** Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales.

**MS-ESS3-5:** Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

**HS-ESS2-2:** Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems.

**HS-ESS3-5:** Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth's systems.

## GEORGIA STANDARDS OF EXCELLENCE

**S6E5:** Obtain, evaluate, and communicate information to show how Earth's surface is formed.

**S6E6:** Obtain, evaluate, and communicate information about the uses and conservation of various natural resources and how they impact the Earth.

**S7L4:** Obtain, evaluate, and communicate information to examine the interdependence of organisms with one another and their environments.

**SES3:** Obtain, evaluate, and communicate information to explore the actions of water, wind, ice, and gravity as they relate to landscape change.

**SEV2:** Obtain, evaluate, and communicate information to construct explanations of stability and change in Earth's ecosystems.

**SEV4:** Obtain, evaluate, and communicate information to analyze human impact on natural resources.

Since the Industrial Revolution in the 1800s, we have seen an influx of these gases released into the atmosphere. This shift in concentrations is causing extreme changes to our current climate.

One of these changes is **sea level rise**. With the warming of the atmosphere, sea and land ice have slowly started to melt back into the ocean. It is a slow and gradual process, but the effects are already being seen on beaches and coastal communities around the world.

The majority of the ice on the planet resides in The North and South poles—Antarctica (~90%) and Greenland (~10%), but glaciers are found in every continent, even Africa. Although sea ice melts at a faster rate, the real concern for the rising seas is actually from land ice. As sea ice melts, no volume of water is added—the water molecules will just shift from being in solid to liquid form. Land ice, however, runs off into the ocean, adding volume to the water, and contributing the most to sea level rise.

How does this affect animals like sea turtles? With the rising seas, nesting beaches and nests are increasingly vulnerable. Returning female sea turtles might find their typical nesting areas completely washed over and unusable, or already laid nests might find themselves washed over by the high tide. Sea turtle eggs are **permeable**, meaning water is able to get through. For an already endangered species, these factors could be detrimental to the survival of the species.

In this activity, students will become climate scientists and observe natural phenomenon as they happen to predict which form of ice will contribute the most to sea level rise. Looking at the outcomes, we can also determine the effects sea level rise has on sea turtle populations and land-based habitats.

## SET UP

Before starting this activity, gather all the materials and lay them out on a flat surface. Ensure you have enough supplies for each student or group to have two identical empty containers, clay or playdough, a permanent marker, ruler, timer, a container of ice, and a container of water. Review with students the difference between climate and weather. Invite them to brainstorm why climate change has a big impact on living things, especially sea turtles.

- What sort of animals rely on these beaches?
- What role might Earth's frozen water play in sea level rise?

## ACTIVITY PROCEDURE

1. Provide each student or group with a data sheet and ask them to make a hypothesis as to which contributes more to sea level rise: land or sea ice. If working in groups, assign a recorder and measurer to each group.

## OCEAN LITERACY STANDARDS

### **Principle #6. The Ocean and Humans are inextricably interconnected.**

- A. The ocean affects human life. The ocean moderates Earth's climate, influences our weather, and affects human health.
- B. The ocean provides foods, medicines, and mineral and energy resources. It supports jobs and national economies, serves as a highway for transportation of goods and people, and plays a role in national security.
- D. Humans affect the ocean in a variety of ways. Human development and activity leads to pollution (point source, non-point source, and noise pollution), changes to ocean chemistry (ocean acidification) and physical modifications (changes to beaches, shores, and rivers).
- E. Changes in ocean temperature and pH due to human activities can affect the survival of some organisms and impact biological diversity
- F. Much of the world's population lives in coastal area. Coastal regions are susceptible to natural hazards (tsunamis, hurricanes, cyclones, sea level change, and storm surges)
- G. Everyone is responsible for caring for the ocean. The ocean sustains life on Earth and humans must live in ways that sustain the ocean. Individual and collective actions are needed to effectively manage ocean resources for all.

## REFERENCES

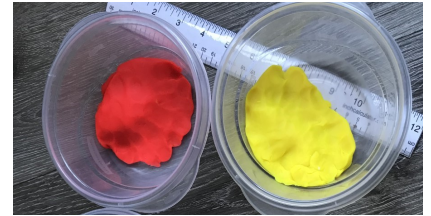
Greenhouse Gas Image source: EPA

[www.climate.nasa.gov](http://www.climate.nasa.gov)

[Ocean.si.edu/through-time/ancient-seas/sea-level-rise](http://Ocean.si.edu/through-time/ancient-seas/sea-level-rise)

<https://coast.noaa.gov/digitalcoast/tools/slr.html>

2. Ask each group to press equal amounts of clay into one side of each container, creating an elevated, smooth, flat surface with a natural curve down. This represents a sea turtle nesting beach; the elevated area being the dunes, and the shallower area being the beach and ocean. Ask students to use their ruler to ensure the height width and depth of the clay in each container is similar.



3. Using a permanent marker ask the group to draw 3-4 X's on the clay in various locations to represent sea nests. Invite students to write a prediction on whether the nests will survive and why.



4. In one container, place ice cubes on the clay covering it as much of the elevated portion as possible. This represents land ice. In the other container, use the same number of ice cubes as was used in the first container, but place the ice on the lower part of the container as far away from the X's as possible. This represents sea ice.



5. Pour an identical amount of water into each container, carefully avoiding disturbance to the ice. Ensure there is enough water to make the sea ice float but not too much that it is higher than the elevated land portion of the container.



6. Using a ruler, measure the water level (mm) on each tub. Record data on data sheet. Alternatively, mark the water level on the outside of the container.

7. At regular intervals (we suggest every 2 minutes), measure the water level and record it on data sheet. Allow both tubs to melt completely. The optimal time will depend on the size of your container, temperature of the water, and other environmental factors.





## ADDITIONAL RESOURCES

Encourage students to take a deeper dive into their individual impacts on the changing climate by calculating their own carbon footprint:

[www.footprintcalculator.org/home](http://www.footprintcalculator.org/home)

To further explore the impact of sea level rise, explore a simulation to see how communities would be affected: <https://coast.noaa.gov/digitalcoast/tools/slr.html>

Discover how to reduce food, water, and energy waste, and learn about the Circular Economy to extend the life of your stuff:

[Yourplanetyourplanet.sustainability.google](http://Yourplanetyourplanet.sustainability.google)

Learn more about sea level rise: <https://www.nationalgeographic.com/environment/article/sea-level-rise-1>

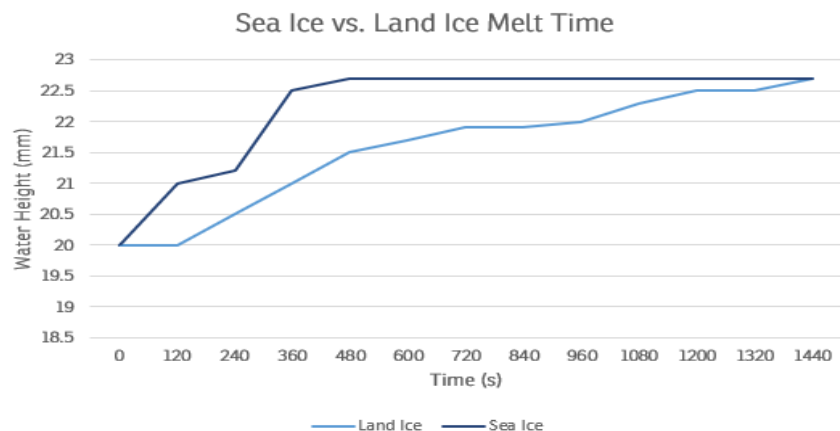
Dig deeper into sea level rise and its causes and consequences:

[https://www.activesustainability.com/climate-change/sea-level-rise-causes-and-consequences/?\\_adin=02021864894](https://www.activesustainability.com/climate-change/sea-level-rise-causes-and-consequences/?_adin=02021864894)

## CONTACT INFORMATION

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8. Using the graphing sheet, record each water measurement in a line graph to compare side by side. The graphs should look similar to the example below.



9. After all the ice has melted, encourage students to think critically and discuss what this would mean for the ecosystem, coastal communities, and animals who use the beach, like sea turtles.

## **WRAP UP/CONSERVATION MESSAGE**

With the waters slowly creeping up the beaches, we are seeing a loss of suitable nesting habitat for sea turtles. This creates a big challenge as researchers and scientists work to save sea turtles from extinction.

We can all be a part of the solution. Encourage students to look at their own actions. In what ways can they become more climate conscious? What actions can they take in order to help the climate crisis?

## **EXTENSION**

### *Greenhouse Gas Effect*

Add two additional containers to the experiment (four total) setting up two sea ice and two land ice containers. Place a lid on plastic wrap over one sea ice and one land ice container to demonstrate the increased warming due to the greenhouse effect. Follow the same data collection protocol.

If additional time is available, ask the students to work together to develop mitigation strategies and techniques for the rising oceans. Encourage them to research their ideas and present their findings.



# Data Sheet

Will land or sea ice contribute more to sea level rise? Write your hypothesis here:

Will the sea turtle nests you marked survive? Write your hypothesis here:

Record your data!			
Time	Water Height (mm) Land Ice Tub	Water Height (mm) Sea Ice Tub	Observations

# Data Sheet

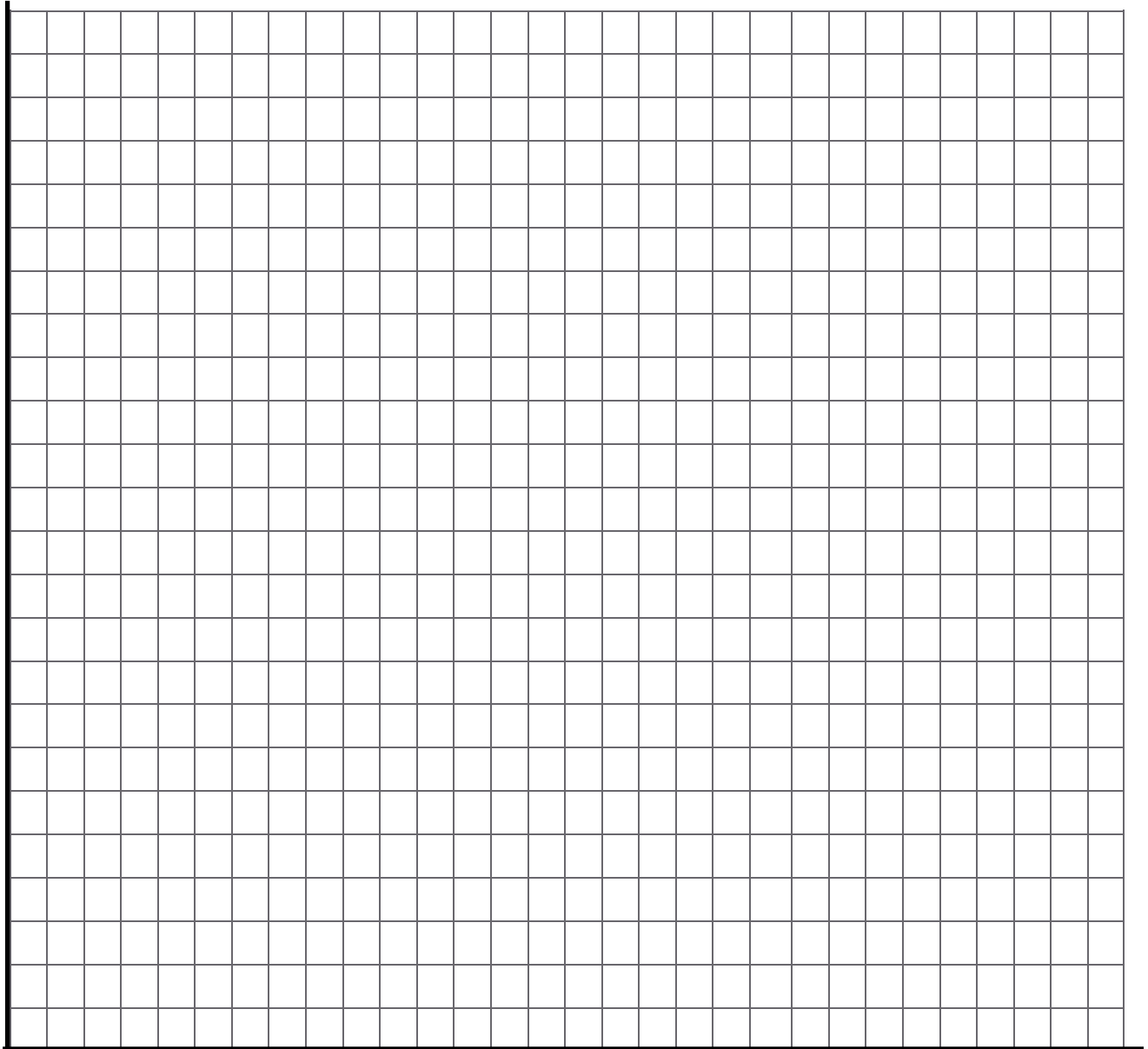
Will land or sea ice contribute more to sea level rise? Write your hypothesis here:

Will the sea turtle nests you marked survive? Write your hypothesis here:

[illegible]

# Draw your data!

*Don't forget to label your axes!*



What do you notice from this graph? Write down any observations or conclusions. Did your hypothesis prove true?

Which type of ice do you think would contribute the most to sea level rise? Why?

Did your sea turtle nests survive? What would this mean for animals and ecosystems who rely on these beaches?

## Educator Guide

Will land or sea ice contribute more to sea level rise? Write your hypothesis here:

Answers could look like: I believe land ice will contribute more to sea level rise because its adding more volume of water to the oceans. (This is actually the correct hypothesis).

Will the sea turtle nests you marked survive? Write your hypothesis here:

Answers could look like: I believe the sea turtle nests will survive because they are really far away from the water, so it would take a lot of water to contribute that much to sea level rise.

What would this mean for animals and ecosystems who rely on these beaches?

With rising seas, animals might find that their usual habitats are disappearing. This can cause populations to plummet as animals, like sea turtles, find that there is no longer a suitable place for their young and/or are not able to adapt to the changing environment. With rising seas, we may see important ecosystems like marshes disappear. More information on sea level rise and its consequences can be found in the additional resources section on page 4.

Record your data! <span style="color: red;">Example</span>			
Time (s)	Water Height (mm) Land Ice Tub	Water Height (mm) Sea Ice Tub	Observations
0	20.0	20.0	
120	20.0	21.0	
240	20.5	21.2	Sea ice almost completely gone
360	21.0	22.5	Sea ice completely melted
480	21.5	22.7	2/4 of sea turtle nests still alive
600	21.7	22.7	
720	21.9	22.7	
840	21.9	22.7	
960	22	22.7	
1080	22.3	22.7	
1200	22.5	22.7	
1320	22.7	22.7	Land ice completely melted