



Experimenting with Ice Melt

High School Grades

Lesson Summary

Students design their own experiments to establish the difference between melting sea ice and melting continental ice and their relationship to sea level rise.

Prior Knowledge & Skills

- Basic Knowledge of the Polar Regions
- Knowledge of the experimental process

AAAS Science Benchmarks

The Nature of Science

Scientific Inquiry

NSES Science Standards

Science as Inquiry

Abilities Necessary to Do Scientific Inquiry

Science in Personal and Social Perspectives

Environmental Quality

Natural and Human Induced Hazards

Teaching Time: Two 50-minute classes

Materials

- Computer with internet access
- Rulers
- Large containers as experimental chambers
- Some “land” for experiment (ie. block of wood or modeling clay)

Advanced Planning

Preparation Time: ~10 minutes

1. Review the instructions
2. Gather the necessary supplies.
3. Prepare several large “glaciers” and “icebergs” the day before

Overview of the box

Concepts and Standards

Lessons:

1 Consequences
of global warming▼ 2 Experimenting
with ice melt

Activities:

1 Experiment design

2 Melting sea & continental ice

▶ 3 Glacial evidence

▶ 4 Fossil evidence

▶ 5 Impacts of topography

6 Impacts on ecosystems

Online resources

Student Web Page

Teaching Boxes Home

Lesson 2: Experimenting with Ice Melt**Experimenting with Ice Melt**

This lesson consists of two activities in which students explore the relationship between melting sea ice vs. melting continental ice and sea level rise. Students make a hypothesis about the differences between the impact of melting sea ice and continental ice. They then design and carry out an experiment to test their hypotheses.

**Concepts and learning
outcomes**

Students will understand that:

- Sea level change is primarily the result of changes in the volume of water contained in continental ice sheets.
- Temperature fluctuations result in the formation and melting of ice sheets.

Time requirements

Two 50-minute classes

Vocabulary

continental ice, sea ice, glacier

Activities

1. Experiment Design: Students design and conduct their own experiments to determine the differences in sea level change between the melting of sea ice and continental ice.
2. Melting Sea and Continental Ice: Students conduct their experiments to test their hypotheses on the differences in sea level change between the melting of sea ice and continental ice.

Resources used

[Sea Level Change - Melting Sea Ice](#) (attached)
<http://rise.org.au/EandP/schools/act/jha/sea.pdf> or at <http://wwwphys.murdoch.edu.au/rise/EandP/schools/act/jha/sea.pdf>

[Sea Level: Ice Volume Changes](#)
http://oceandrilling.coe.tamu.edu/curriculum/Sea_Level/Ice_Volume/activity.html

[Global Warming](#)
<http://earthobservatory.nasa.gov/Library/GlobalWarming/>

Overview of the box

Concepts and Standards

Lessons:

1 Consequences of global warming

▼ 2 Experimenting with ice melt

Activities:

1 Experiment design

2 Melting sea & continental ice

▶ 3 Glacial evidence

▶ 4 Fossil evidence

▶ 5 Impacts of topography

6 Impacts on ecosystems

Online resources

Student Web Page

Teaching Boxes Home

Lesson 2: Experimenting with Ice Melt

Activity 1

Experiment Design

Materials / Preparation

- A list of materials that your students will use for designing their experiments is available on the worksheet at [Sea Level Change - Melting Ice](#). You will need to add a metric ruler to the list of available materials. You can either provide a list for the students or list them on the board.
Note that ice is required for this experiment. This may take some time to freeze before beginning the activity.

Grouping

Groups of two

Teacher tips

Teachers may want to read the text and take a look at the two hot linked simulations of sea ice and continental ice melt experiments at [Sea Level: Ice Volume Changes](#) to get a good idea of what the student experiments should show.

Note that in the [Sea Level Change – Melting Sea Ice](#), worksheets continental ice is referred to as sheet ice. You should discuss this with students to prevent confusion.

You will need to set aside time to go through the experiment designs and give suggestions to your students. If you prefer, you could have the entire class design the experiment and still have students work in groups to perform the experiment.

Procedures

- Begin the class by asking students to recall the previous discussion on the effects of global warming. Make sure they mention ice melt.
 - Ask the class "Where do we find ice?" After eliciting the response of "on land and in the sea", ask them to predict what would happen if the sea ice melted and then to consider what would happen if the land (continental) ice melted. Students should write their predictions in their notebooks.
Note: This provides a good opportunity to introduce writing If/then statements for predictions. If sea ice melted, then..... If continental ice melted...
 - Record their responses on the board or on a poster.
 - Ask students if they think the impact between the melting of sea ice and continental ice would be different or the same? If different, which would have the greater impact? They should write this down in their notebooks as a hypothesis.
 - Inform students that they will be designing an experiment to test their hypotheses.
- Provide students with a list of available materials with which they will be able to design their experiments (materials should include those listed on the worksheets at [Sea Level Change – Melting Sea Ice](#) worksheets plus a metric ruler). Have each pair of students design an experiment and turn in a "Design Plan" that includes their hypothesis, required materials, steps for set-up of the experiment, a drawing of the design, and an explanation of the steps they will take to conduct the experiment. Remind students that they should be able to make measurements and that the experiments should be as controlled as possible.
Note: The experiment designs can be stapled into student notebooks after being checked by the teacher.
- Students should use the rest of the period to design their experiments. Conclude by having a brief class discussion of what the groups' ideas are for experiment designs and what each group's hypothesis is.

Homework

If their design plan is not completed by the end of class, ask students to complete this as homework.

Resources used

[Sea Level Change - Melting Sea Ice](#)

<http://www.phys.murdoch.edu.au/rise/EandP/schools/act/jha/sea.pdf>

[Sea Level: Ice Volume Changes](#)

http://oceandrilling.coe.tamu.edu/curriculum/Sea_Level/Ice_Volume/activity.html

Overview of the box

Concepts and Standards

Lessons:

1 Consequences of global warming

▼ 2 Experimenting with ice melt

Activities:

1 Experiment design

2 Melting sea & continental ice

▶ 3 Glacial evidence

▶ 4 Fossil evidence

▶ 5 Impacts of topography

6 Impacts on ecosystems

Online resources

Student Web Page

Teaching Boxes Home

Lesson 2: Experimenting with Ice Melt**Activity 2****Melting Sea and Continental Ice****Materials / Preparation**

- A copy of the [Melting Ice Record Sheet](#) for each student.
- All of the materials listed at [Sea Level Change - Melting Sea Ice](#)
- Two plastic metric rulers for each group
- The experiment requires a visible clock in the classroom that students can all access while conducting their experiments. If this is not available, you will need to provide each group of students with a timer.

Grouping

Groups of four

Teacher tips

The experiment and worksheet on [Sea Level: Ice Volume Changes](#) may also be used as a teacher demonstration in which students complete a worksheet while watching the teacher demonstration instead of the student activity suggested in this activity.

Students will be doing both experiments at the same time. They might want to assign tasks e.g. Measurement Taker and Timer for sea ice experiment and Measurement Taker and Timer for continental ice experiment. However, all students are responsible for completing both tables on the worksheet.

If it is not sunny or warm in your classroom, you can also have several heat lamps on hand for students to use.

The student worksheet requires that they measure the "amount of ice" in their experiments. This could be done by either measuring the dimensions of the ice cube, or only the height, depending on your students' comfort level with these types of measurements.

Procedures

1. Return the experiment designs to each team and have them set up all aspects of their experiments before passing out the ice. Explain to them that they will be doing both parts of their experiment simultaneously, so they will need to assign tasks. (See teacher tip above.)
2. As students begin the experiment, ask them "Is there anything we have learned about that would make ice on Earth melt at a faster rate?" Elicit the response that rising global temperatures will increase the rate of ice melt. Ask, "What could we do to simulate rising global temperatures in our experiment?" Allow students to suggest moving the experiments outside into the sun, and then move the experiments outdoors, or set up the heat lamps.
3. Pass out the [Melting Ice Record Sheet](#) to each student. Once each of the teams is set, pass out the ice to them, have them measure and record the amount of ice and the water level at the start of the experiment. They will be making similar measurements every five minutes.
4. When students complete the experiment, make sure they answer all the questions on the worksheets. Additionally, ask that they also answer the question, "Was my hypothesis supported? Why or why not?"
5. Have a brief discussion of what they found focusing on what results supported or refuted their hypotheses. If necessary, have students revise their hypotheses in their notebooks based on the results of their experiments.
6. Conclude by asking the question, "Now that we know that melting continental ice causes more sea level rise than melting sea ice, can you think of any ways that we might be able to tell if continental ice ever melted and caused sea level rise on Earth in the past?" Record their answers and tell them that tomorrow they will explore this question further.

Resources used

[Sea Level Change - Melting Sea Ice](#)

<http://rise.org.au/EandP/schools/act/jha/sea.pdf> or at <http://wwwphys.murdoch.edu.au/rise/EandP/schools/act/jha/sea.pdf>

[Sea Level: Ice Volume Changes](#)

http://oceandrilling.coe.tamu.edu/curriculum/Sea_Level/Ice_Volume/activity.html

Name: _____ Class: _____ Date: _____

Melting Ice Record Sheet

Record your observations of "sea level" change in the tables below. As soon as your teacher says you are ready to begin, take a measurement of the water level and amount of ice in each set up in the "start" column. You will be recording measurements on both set-ups every five minutes over a 30-minute period.

A. Sea Ice

	Start	5 min	10 min	15 min	20 min	25 min	30 min
Water level							
Amount of ice							

B. Continental Ice

	Start	5 min	10 min	15 min	20 min	25 min	30 min
Water level							
Amount of ice							

QUESTIONS:

A. Sea Ice

1. Did the water level change as the sea ice melted?
2. How can you explain this?

B. Continental Ice

1. Did the water level change as the continental ice melted?
2. How can you explain this?

C. Comparing Sea and Continental Ice Melts

1. Suggest some reasons why the melting of the two different ice types has different effects on the sea level.
2. Did this experiment support your original hypothesis? Why or why not?

Sea Level Change - Melting Sea Ice

One of the greatest threats to the environment from Global Warming is the effect that an increased global temperature will have on sea level. Many scientists believe that low lying countries, such as Bangladesh will be flooded because of an increase in the Earth's sea level as a result of melting ice.

This activity looks at what effect melting sea ice, or icebergs will have on the sea level. In Melting Sheet Ice , you will investigate what effect melting land ice will have on the sea level.

Materials

Large bowl
Ice cubes
Water

Method

1. Place the ice cubes in bottom of the bowl and place the bowl out into the sun light
2. Carefully fill the bowl with water until the water is level with the top of the bowl
3. Note the amount of ice floating in the bowl
4. Check the water level and the amount of ice remaining every ten minutes throughout the session

Results and Discussion

Record your observations of the water level and the amount of ice remaining in the bowl in the table below:

	Start	5 min.	10 min.	15 min.	20 min.	25 min.	30 min.
Water Level							
Amount of Ice							

1. Did the water level in the bowl change as the ice melted?

2. How can you explain your observation in question 1?

.
.
.

After you have completed the Melting Sheet Ice activity, complete the following question:

1. Will melting sea ice or melting sheet ice have the greatest effect on the sea level? Why?

.
.
.
.

Sea Level Change - Melting Sheet Ice

All of the world's ice can be divided into two different types: Sea Ice (Icebergs) and Sheet Ice (ice on land). Both types of ice are at risk of melting if there is an increase in the average global temperature of the Earth, but they have very different effects on the global sea level.

This activity looks at what effect melting sheet ice, or land ice will have on the sea level. In Melting Sea Ice activity, you will investigate what effect melting sea ice will have on the sea level.

Materials

Large bowl
Flat piece of wood
Ruler
Ice cubes
Water

Method

1. On your block of wood, mark out the compass points around the four edges of the block.
2. Along the N-S edge, draw or score lines every 2 mm so that you can measure the water level.
3. On the E-W face, mark lines every 1 cm.
4. Carefully fill the bowl with water until the water is about 2.5 cm from the top of the bowl.
5. Place the wood in the bowl and place the bowl out into the sun light.
6. Put 1 to 2 blocks of ice on the Northern most edge of the block of wood.
7. Note the level of water on the North and South edges of the block.
8. Re-check the water level and the amount of ice remaining every ten minutes throughout the session

Results and Discussion

Record your observations of the water level on the Northern and Southern edges of the block of wood in the table below:

	Start	5 min.	10 min.	15 min.	20 min.	25 min.	30 min.
Water Level							
North Edge							
South Edge							

1. Did the water level in the bowl change as the ice melted?
2. How can you explain your observation in question 1?

After you have completed the Melting Sheet Ice activity, complete the following question:

1. Suggest some reasons why the melting of the two different ice types have such different effects on the sea level.

.....
.....