

# Weather, Sea Level Rise and Climate Change Course

Inquiry Lesson 5E model

Paula deDiego

Objective: To examine factors that affect glacial melting

Vocabulary

Input and Output factors

Specific gravity

Molarity

## *Engage*

### **12. [Earth System: Ice and Global Warming](http://www.teachersdomain.org/asset/ess05_vid_esglaciers/)**

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Scientific evidence strongly suggests that different regions on Earth do not respond equally to increased temperatures. Ice-covered regions appear to be particularly sensitive to even small changes in global temperature. This video segment adapted from NASA's Goddard Space Flight Center details how global warming may already be responsible for a significant reduction in glacial ice, which may in turn have significant consequences for the planet

Background Essay

Ice covers 10 percent of Earth's land surface. One form of ice, found as glaciers, can form anywhere that snow and ice persist year-round. The two primary types of glaciers are valley glaciers, which are long, wedge-shaped masses that form in mountainous areas, and continental ice sheets, which are slightly dome-shaped and may cover millions of square kilometers. Non-glacial sea ice forms on the surface of seawater where it either persists year-round or melts and reforms seasonally.

Ice affects the entire Earth system in a variety of ways. In the ocean and at the land-sea boundary, ice prevents relatively warm ocean water from evaporating, transferring heat to the colder atmosphere, and thereby increasing global air temperature. Ice also reflects sunlight, thus preventing additional heat from being absorbed by water or land. However, the most significant role played by sea ice in the global climate system may be related to its role in ocean circulation. When sea ice forms, pure water crystallizes and leaves behind salt, thus increasing the salinity of the ocean. This cold, saline-enriched water is dense, and it sinks, creating a temperature and density gradient that moves ocean currents from the equator to the poles.

The well-documented retreat of the world's glaciers and diminution of sea ice is ominous. Data generated from satellites that monitor the formation of polar sea ice indicate that both coverage and thickness have decreased over the past three decades. Recent studies

show that the world's highest glaciers (in the Himalayas) are receding at an average rate of 10 to 15 meters (33 to 49 feet) per year. If global warming accelerates melting, the predictability of water supplies for agriculture and other economic activities would be compromised. But even small changes in ice volume may have a significant impact on global climate and ocean circulation patterns, not to mention polar animal habitats.

Lastly, the breakup of the extensive ice shelves of the West Antarctic Ice Sheet, where sea temperature has risen by 4.5°C (8°F) in the past 50 years, could precipitate the collapse of the entire sheet. Should the West Sheet slide off the continent, the amount of water contained in it could raise global sea level by six meters (20 feet), flooding huge areas of low-lying coastlines.

To learn more about how glacial melting might affect global sea level, check out [Mountain of Ice: If the Ice Melts](#).

To learn more about dramatic changes in the West Antarctic Ice Sheet, check out [Antarctic Ice: Sea Level Change](#).

To learn more about how water is circulated in the world's oceans, check out [Great Ocean Conveyor Belt: Part I](#) and [Great Ocean Conveyor Belt: Part II](#).

Media Type: **QuickTime Video**

Length: **3m 04s** Size: **3m 04s**

#### Discussion Questions

- Questions for Discussion
- Discuss the factors that influence the balance between inputs and outputs to and from glaciers.
- Why are glaciers indicators of climate change?
- What impact does global warming have on the balance between glacier inputs and outputs?
- Discuss some of the influences ice has on the surrounding areas.
- Imagine that in 2100 the sea level has risen two feet. What effects would this have on humans? List and explain as many impacts as possible

#### Standards

Massachusetts

Strand: Earth and Space Science

Materials and Energy Resources

1. Water, rocks, soil, and living organisms are found on the earth's surface.

Earth Processes and Cycles

3.4 Water flows into and through a watershed.

National Science Education Standards

## Content Standard F: Science in Personal and Social Perspectives

### Changes in Environments

Changes in environments can be natural or influenced by humans. Some changes are good, some are bad, and some are neither good nor bad. Pollution is a change in the environment that can influence the health, survival, or activities of organisms, including humans.

Some environmental changes occur slowly, and others occur rapidly. Students should understand the different consequences of changing environments in small increments over long periods as compared with changing environments in large increments over short periods.

### Personal Health

Natural environments may contain substances (for example, radon and lead) that are harmful to human beings. Maintaining environmental health involves establishing or monitoring quality standards related to use of soil, water, and air.

### Natural Hazards

Human activities also can induce hazards through resource acquisition, urban growth, land-use decisions, and waste disposal. Such activities can accelerate many natural changes.

### Risks and Benefits

Students should understand the risks associated with natural hazards (fires, floods, tornadoes, hurricanes, earthquakes, and volcanic eruptions), with chemical hazards (pollutants in air, water, soil, and food), with biological hazards (pollen, viruses, bacterial, and parasites), social hazards (occupational safety and transportation), and with personal hazards (smoking, dieting, and drinking).

## ***Explore***

Design and experiment to test this question.

Does the change in salinity have an effect on glacial melt rate?

(Set at least 5 different molar concentrations)

Materials you can use are:

Ice cubes, Styrofoam cups, thermometer, salt, distilled water, rulers, specific gravity meter, graduated cylinder, scale, other materials may be available upon request

## ***Explain***

After collecting data, have one member of each team move to sharing tables. Each person will be able to share their experiment and data with another 2 – 3 groups and hear those groups findings. Write down ideas and questions this generates regarding your own experiment design or findings.

## ***Elaborate***

GO back to home “teams”. As a group, communicate your findings in writing. Be sure to include a procedure, materials, variables, control, graph, and conclusion statement.

### ***Evaluate***

Have groups share by presenting a power point presentation to the class. Teacher will be looking to clear up misconceptions and provide feedback on experimental design.

Ask students would they add this as a significant “input” or “output” factor?  
Have a brief question and answer period following presentation to check for understanding.

## Lab Report : Lab report

Teacher Name: **Paula deDiego**

Student Name: \_\_\_\_\_

CATEGORY	4	3	2	1
<b>Experimental Design</b>	Experimental design is a well-constructed test of the stated hypothesis.	Experimental design is adequate to test the hypothesis, but leaves some unanswered questions.	Experimental design is relevant to the hypothesis, but is not a complete test.	Experimental design is not relevant to the hypothesis.
<b>Calculations</b>	All calculations are shown and the results are correct and labeled appropriately.	Some calculations are shown and the results are correct and labeled appropriately.	Some calculations are shown and the results labeled appropriately.	No calculations are shown OR results are inaccurate or mislabeled.
<b>Analysis</b>	The relationship between the variables is discussed and trends/patterns logically analyzed. Predictions are made about what might happen if part of the lab were changed or how the experimental design could be changed.	The relationship between the variables is discussed and trends/patterns logically analyzed.	The relationship between the variables is discussed but no patterns, trends or predictions are made based on the data.	The relationship between the variables is not discussed.
<b>Data</b>	Professional looking and accurate representation of the data in tables and/or graphs. Graphs and tables are labeled and titled.	Accurate representation of the data in tables and/or graphs. Graphs and tables are labeled and titled.	Accurate representation of the data in written form, but no graphs or tables are presented.	Data are not shown OR are inaccurate