

Today I Learned About Sea Level Rise, Part 1

Description:

Through a hands-on demonstration, students will gain a clear understanding of the two major factors influencing sea level rise – land ice melt and thermal expansion. Additional solutions-oriented background information expands real-world connections.

Today I Learned About Sea Level Rise, Part 2 includes Dive Deeper assignments lead students to explore data related to the impacts of thermal expansion, land ice melt, storm surge, and high-tide flooding.

Skills & Objectives

SWBAT

- Understand that the burning of fossil fuels is causing a buildup of heat-trapping gases, which is warming the atmosphere and ocean.
- Explain that melting land ice adds to rising seas, while melting sea ice does not.
- Observe and explain that warm water molecules expand, taking up more space.
- List and consider some real-world solutions for sea level rise.

Skills

- Modeling
- Reading graphs
- Critical thinking

Students Should Already Know That

- All things are made of molecules which behave differently depending on temperature.
- The ocean is large and complex.

Standards Alignment:

HS-ESS2-4: Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes.

CCSS.ELA-LITERACY.RI Informational Texts

Disciplinary Core Ideas:

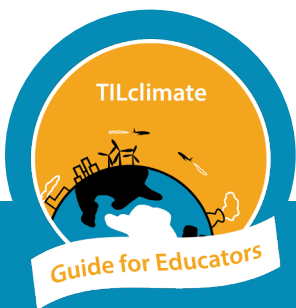
ESS2.C: The Roles of Water in Earth's Surface Processes

ESS2.D: Weather and Climate

ESS3.B: Natural Hazards

ESS3.C: Human Impacts on Earth Systems

ESS3.D: Global Climate Change



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How To Use These Activities:

Pages with the circular “TILclimate Guide for Educators” logo are intended for educators. Simpler pages without the dark band across the top are meant for students.

Each of the included activities is designed to be used as a standalone, in sequence, or integrated within other curriculum needs. A detailed table of contents, on the next page, explains what students will do in each activity. The two demonstrations take about the same amount of time, and so could be done by two teams of students at the same time.

A Note About Printing

All student pages are designed to be printable in grayscale.

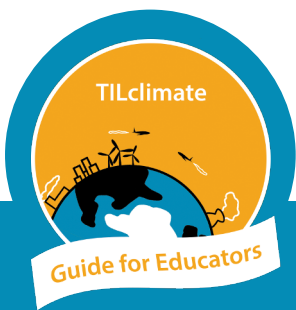
The worksheets do not leave space for students to answer questions. Students may answer these questions in whatever form is the norm for your classroom – a notebook, online form, or something else. This allows you, the teacher, to define what you consider a complete answer.

Materials

For one example of each demonstration (multiply if necessary):

- Two equal-sized clear containers with flat bottoms
- Modeling clay or similar waterproof moldable material
- Ice cubes (smaller is better – they will melt more quickly)
- A clear plastic bottle with a screw-on lid (12-20oz size)
- Food coloring or liquid watercolor
- A clear plastic straw
- Tape or a marker to mark the sides of containers and straw
- Hot glue or waterproof caulk
- Cold water
- Room-temperature water
- Optional, to speed up heating: two heat lamps

Podcasts in the Classroom: Throughout these Guides for Educators, we invite students to think about how they would share their learning with family and friends. Student-created podcasts are shareable, creative, and have multiple options for embedded assessment. We would love to hear any podcasts or see any other projects you or your students create! Email us at tilclimate@mit.edu, Tweet us @tilclimate, or tag us on Facebook @climateMIT.



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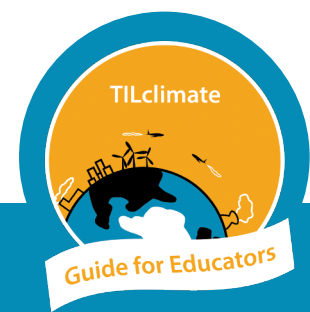
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Detailed Table of Contents

Page	Title	Description	Time (min)
	Podcast Episode	Students listen to TILclimate: TIL about sea level rise, part 1, either as pre-class work at home or in the classroom. https://climate.mit.edu/podcasts/til-about-sea-level-rise-part-1	10-15
1-2	Materials and Setup	Instructions to set up the two demonstrations, which could be done ahead of time by a teacher or during class by students, depending on time.	15-20
3	Land Ice vs Sea Ice model	Students model the different effects of melting land ice (glaciers, ice sheets) and sea ice (icebergs, arctic ice) on sea level rise. Time to melt ice varies by the temperature of the room and/or a heat lamp.	Active: 5-10 Total: 30 min to overnight
4	Thermal Expansion model	Students model the effect of warming on water volume. Time to see a result varies by the relative temperature of the water and the room and/or a heat lamp.	Active: 5-10 Total: 30 min to overnight
5-6	Reading: Sea Level Rise	Two-page reading with a graph and a map, giving background on the effects of thermal expansion and land ice melt.	10-15
7	Solutions	Students are introduced to the four major categories of climate change solution. Depending on curriculum needs, this could segue into a research project, be a classroom discussion, or add to another project.	variable



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Sea Level Rise

This Educator Guide includes two hands-on demonstrations, a reading, and a solutions guide. Educators may pick and choose among the pieces of the Guide, as suits their class needs.

Parts of this Guide may align with the following topics:

- Physical science: thermal expansion, molecular movement
- Life/environmental science: effects of sea level rise on coastal ecosystems and communities, climate change impacts
- History/social science: effects on low-lying populations and nations, effects of governmental and intergovernmental policy on worldwide climate change
- ELA/literature: connection to fictional works set in a future with higher sea levels
- ELA/nonfiction: reading and communicating about complex science topics

Extensions

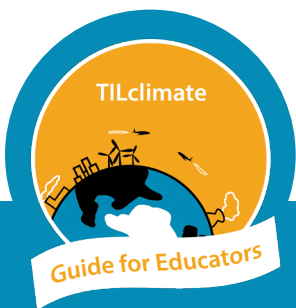
There are points in this Guide that may lead to questions for students. Some off-ramps to other topics include:

- Measuring the exact amount of sea level rise in each of your models.
- Measuring the exact change in temperature in the thermal expansion model.
- The effect of plate tectonics on sea level rise.
- Heat-trapping gases in the atmosphere.

MIT Resources

We recommend the following as resources for your own better understanding of climate change or as depth for student investigations. Specific sections are listed below:

- Climate Science, Risk & Solutions, an interactive introduction to the basics of climate change. <https://climateprimer.mit.edu/>
 - 02 The greenhouse effect and us
 - 07 Understanding risk
 - 08a Sea level rise
 - 10 What can we do?
- MIT Climate Portal Explainers are one-page articles describing a variety of climate topics. <https://climate.mit.edu/explainers>
 - Sea Level Rise
 - Coastal Ecosystems and Climate Change
 - Cities and Climate Change
 - Greenhouse Gases



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Wrap-Up Discussion Questions

- Where else in our lives do we see the effects of ice melt or thermal expansion?
- Through the early 2000s, thermal expansion and ice melt added about equally to sea level rise. Since 2005, melting has been adding almost twice as much as thermal expansion. Why do you think this is? What do you think the trend will be in the future?
- Why doesn't the sea level rise equally everywhere?
- We looked at solutions in the categories energy shift, energy efficiency, adaptation, and talking about it. Which of these do you think is the most important? Why? Does the importance change depending on where you live?

Climate Solutions

Climate solutions can be thought of as falling into four co-equal categories. Across all categories, a focus on community-level solutions leads to more effective action. Community-level solutions change decision-making so that the default option for individuals is the one that has the best result for the climate. For example, policies that increase the solar and wind mix in the electric grid, instead of asking homeowners to install solar panels. For more on talking about climate change in the classroom, see “How to Use This Guide”

•Energy Shift

How do decision-makers make the switch from carbon-producing energy to carbon-neutral and carbon-negative energy?

•Energy Efficiency

What products and technologies exist to increase energy efficiency, especially in heating and cooling buildings?

•Adaptation

How can we adapt buildings to keep people safe from heat and cold?

•Talk About It

Talking about climate change with friends and family can feel overwhelming. What is one thing you have learned that you could share to start a conversation?

What solutions are the most exciting in your classes? We would love to hear from you or your students! Images, video, or audio of student projects or questions are always welcome. Email us at tilclimate@mit.edu, Tweet us @tilclimate, or tag us on Facebook @climateMIT.

