# Today I Learned About Winter Storms

## Description:

We know Earth is warming, so why do we still get extreme winter storms? Students learn about albedo, climate, weather, the jet stream, and the polar vortex through hands-on demonstrations, data visualizations, and reading scientific writing.

## Skills & Objectives

### SWBAT

- Define albedo
- Explain the difference between climate and weather
- Understand the concepts of the jet stream and polar vortex

### Skills

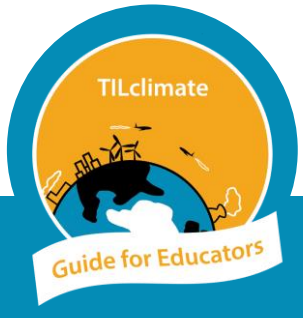
- Reading scientific texts
- Map reading
- Graph reading

### Students Should Already Know That

- Global temperatures are rising due to excess carbon dioxide and other heat-trapping gases from human activities.

**Standards Alignment:**
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-ESS2-4 Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.
RST.9-12.2 Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.

**Disciplinary Core Ideas:**
ESS2.A Earth Materials and Systems
ESS2.D Weather and Climate
ESS3.D Global Climate Change



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## How To Use These Activities:


Pages with the circular "TILclimate Guide for Educators" logo and dark band across the top 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.

## 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.

## A Note About Materials

Three versions of the hands-on demonstration of albedo are included. Each one requires different amounts of time, space, and materials.

a) Hand-held infrared thermometers (also called no-contact thermometers) can be bought from hardware and office supply retailers for $15-30 each. One thermometer is needed for each group, depending on class and group size.

b) A standard desk or clamp lamp with an incandescent (not CFL or LED) lightbulb is perfect for this demonstration.

c) T-shirts, paper, or painted cardboard all work well for this activity. It can be done outside in the sun or in a sunny windowsill.

**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. One way to do this is to encourage your students to create their own podcasts - they're 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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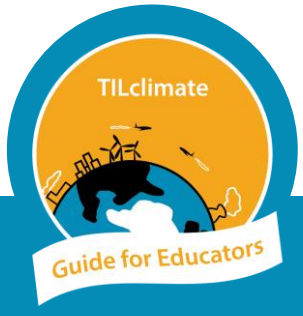
## Detailed Table of Contents



## A Note About Internet Use

Various activities in this Guide require internet use. In classrooms with limited internet access, the following modifications may be made:

- Project the videos and data visualizations for Albedo, Jet Stream, and Polar Vortex on the wall for all students.
- Generate and print one graph for Weather vs Climate.




Many activities in this Guide take about the same amount of time and could be done as stations or by student teams in a jigsaw, with time for shared learning after the activity.

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## Winter Weather and Atmospheric Science

This Educator Guide includes readings, data investigations, and data visualizations. 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: Atmospheric science, pressure, and temperature.
- Life/environmental science: Weather and climate.
- History/social science: Effects of extreme winter weather on communities.
- ELA/nonfiction: Understanding scientific writing.

## 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/

  Chapter 02b

  Chapter 03a

  Chapter 06

  Chapter 08c

- MIT Climate Portal Explainers are one-page articles describing a variety of climate topics. New Explainers are posted monthly. https://climate.mit.edu/explainers

  Heating and Cooling

  Extreme Heat

  Permafrost

  Climate Models

  Climate Sensitivity

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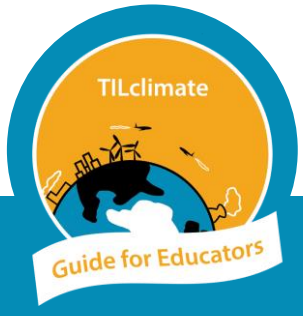
## Wrap-Up Discussion Questions

- The Arctic is warming faster than any other region of Earth. How would you expect this to affect albedo?
- What are some other effects of albedo? (Think about summer heat, as well.)
- How is the arctic ice melting a positive feedback loop?
- What is the jet stream? What does it have to do with weather?
- What is the polar vortex? How does it affect winter storms?
- If the temperature is going up in general due to global warming, why can we still have colder-than-average winters?

## Climate Solutions

Climate solutions can be thought of as falling into four categories outlined below. Across all categories, solutions at the community, state or federal level are generally more impactful than individual actions. For example, policies that increase the nuclear, solar and wind mix in the electric grid are generally more effective at reducing climate pollution than 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 cities and towns adapt to the impacts of climate change?
- **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.