Shrinking Ice

From the Center for Science Education

<https://scied.ucar.edu/activity/shrinking-ice>

Grade Level: Elementary School

Time: 30 minutes

## Learning Goal

* Students learn that glaciers are found in places with cool and cold climates.
* Students learn that glaciers melt when the climate warms.

## Learning Objective

* Students will use information from photographs taken at the same Alaska locations over time to learn that glaciers changed quickly in the past century compared with other parts of the Earth system like rocks and water.

## Materials

[Image Pairs for A Century of Glacier Change and Shrinking Ice](https://scied.ucar.edu/sites/default/files/documents/A-Century-of-Glacier-Change_image-pairs.pdf) (see downloadable material)

* Projector and computer
* Map of the world or North America
* Ice cube
* Small dish

## Preparation

* Print enough copies of Glacier Image Pairs to have one for each student pair or group.
* Cut each sheet of paper in half to separate the glacier photos.
* Optional: Laminate all photos to make the sets more durable for repeated use.
* Do not share the first page with students until they have matched the pairs of photographs.
* The ice cube will need to be taken out during the activity, so prepare to keep it in a freezer or cooler until needed.

## Directions

### Introduction

#### Glaciers as part of the Earth system

* Introduce the parts of the Earth system. List water, ice, land, life, and air on the board and explain that these are the parts of the Earth system. If students have been introduced to the Earth system before, this will be a review. If they have not learned about it before, you may wish to connect the concept of the Earth system to what students already know, for example, by inviting students to classify the things they see in the classroom or out the window as either water, ice, land, life, or air.
* Share the photograph of Muir Glacier in 2004 (lower half of page 2, Glacier Image Pairs) on a screen for the class.
	+ Water (the hydrosphere): The bay is at the bottom of the photo.
	+ Ice (the cryosphere): Snow and ice in a glacier are on the mountainside.
	+ Land (the geosphere): The mountain is made of rocks and soil.
	+ Life (the biosphere): Plants cover the lower part of the mountain.
	+ Air (the atmosphere): Air is at the top of the photo.
* Explain that the ice in the photo is a glacier – ice that stays around for many years.

#### Consider the climate a glacier needs

* Put an ice cube in a dish and show it to students. Explain that a glacier is made of ice, but this ice cube is very small compared to a glacier. Some glaciers are large enough to cover whole states or countries. (The ice sheet covering Greenland is currently about [three times the size of Texas](https://nsidc.org/learn/parts-cryosphere/ice-sheets/ice-sheet-quick-facts), for example.)
	+ https://nsidc.org/learn/parts-cryosphere/ice-sheets/ice-sheet-quick-facts
* Ask students what they expect will happen to the ice cube if it’s left out in the classroom. (Students should recognize that it will melt unless your classroom is freezing!)
* Ask students what conditions keep ice frozen (cold temperatures).
	+ The ice cube will stay frozen if it’s in a freezer, which is very cold.
	+ A glacier will stay frozen if it's cold enough outdoors.
* Tell students that we are going to leave the ice cube here for now and will check on it again in a few minutes. (Leave the dish with the ice cube in the classroom, not in a freezer, for use at the end of the lesson.)
* Refer back to the picture of Muir Glacier on the screen. Tell students that this photo was taken in Alaska, U.S.
* Show students where Alaska is located on a world map or map of North America. Note that it’s not far from the Arctic – the area around the North Pole where the climate is cool to cold.
	+ (If students have learned about regional climates with the Climate Postcards activity, you may wish to connect this activity with that prior learning by reminding students of the map of regional climate zones.)
* Explain that there are many glaciers in Alaska and that in this lesson students will explore how they’ve changed over time.

### Matching Glacier Photos

* Pass out the photo sets to student pairs.
* Explain:
	+ Each photo has a year in the lower left corner indicating when it was taken.
	+ There are two photos taken at each location, but the photos were taken many years apart. The area may look very different from the first photo to the second.
	+ Students should match photos from the same location.
* Explain that for each location there will be one photo that was taken in the 1900s and a second photo that was taken in the 2000s. You may wish to explain that color photography didn’t become common until later in the century.
* Give students about 10 minutes to try to match the glacier photos from the same location.
	+ Note that it can be challenging for students to compare a black and white photo with a color photo. Also, some students may refer to changes to parts of the Earth system that they have heard about but are not visible in these photos, like changes in greenhouse gasses in the atmosphere and small amounts of erosion that are hard to spot at a landscape scale. Recognize these ideas if students voice them and also acknowledge that not all changes happening on Earth can be seen in the photos.
	+ Focusing on the rocks and mountains in the photos can help students match the pairs.
* Give students 5 minutes to compare their matches to those made by the other groups.
	+ Discuss what is the same and what has changed in each pair of photos.
* As a class, discuss the images and reveal the correct matches.

### Earth System Changes: Quick and Slow

* Ask: Which parts of the Earth system don’t appear to have changed between the older and more recent photos? Which parts of the Earth system look like they have changed over time?
* List the parts of the Earth system in the order below on the board and have students discuss each.
	+ **Land**: Students should notice that the rocks don’t show much change over time. In fact, because they look the same in photos from different times, students may have used their shapes to match the older and more recent photos.
	+ **Water**: Students might note that waves changed between the older and more recent photos, or they might argue that water didn’t change much over time because it still fills about the same area of each photo.
	+ **Life**: Students should also notice that, in several locations, the plants changed, with more plants visible in the more recent photos.
	+ **Atmosphere**: Students will be able to see changes in the clouds in the sky of the older and more recent photos. Remind students how quickly clouds can change in the sky (over minutes to hours).
	+ **Ice**: Students should notice that the glacier ice changed a lot over the years. In some of the more recent photos, there is little or no ice visible.

### Relate Glacier Changes to Climate

* Ask students to share their ideas about what they think happened to the glaciers in the photos. Where did the ice go? To help students focus their ideas, remind them of the ice cube. Explain that it is a clue to what happened to the glacier ice.
* Show students the dish with the ice cube left out from the beginning of the lesson and ask:
	+ What happened to the ice cube. (It melted.)
	+ Why did it melt? (It melted because the classroom was too warm to keep it frozen.)
* Relate the ice cube to the glaciers in the photos. They melted over many years because the climate was too warm to keep them frozen. Just like the ice cube is melting into water, the glaciers are melting too.
* Point out the water in the dish where the ice cube is melting and explain that when these glaciers melt, the water is added to the ocean.
* Explain that the climate used to be cold enough for them to stay frozen, but that’s changing. The climate is warmer than it used to be. Explain that it takes a very, very long time for glaciers to form (thousands of years), but these glaciers are melting much faster because the climate has warmed. (See the adaptations section below for ideas about how to extend learning about climate change.)

## Adaptations for Younger and Older Students

With younger elementary students, you may wish to limit the number of glacier photos that students need to match. Matching only three or four pairs of photos should lead to the same learning outcomes and may help younger students feel successful.

With more advanced students, you may wish to use this activity as an entry point to instruction on climate change and solutions. With the sequence of learning, document student questions about why it's getting warmer on chart paper or the board, and explain that they will be explored during upcoming lessons about climate change. Following this activity with the Elementary GLOBE Climate Module provides students with an opportunity to answer questions about why climate is changing and consider solutions.

## Background

Glaciers are either one of two types: a continental glacier, also called an ice sheet, such as those that occur in Antarctica; or an alpine or valley glacier found in mountain valleys. The photographs in this activity are all alpine glaciers from Alaska, U.S. Alpine glaciers occur all over the world yet require specific climate conditions to remain in existence. This usually includes a location that has high snowfall in the winter and cool temperatures in the summer to prevent snow from melting.

Glaciers form through the accumulation of snow over time. That snow slowly turns to ice. Under pressure from the weight of the ice, a glacier flows very slowly (which is not covered in this lesson). As more and more snow accumulates over years, decades, centuries, and longer periods of time, the glacier continues to move. In areas with little snowfall or low slope conditions, the glacier will flow downward and outward very slowly. If the ice is on a steep slope, if the bottom of the glacier is on smooth ground, and if there is high snowfall, then the glacier will flow faster. Often this rapid motion creates crevasses on the glacier's surface.

Glaciers become smaller because ice melts, because ice sublimates (becoming water vapor), because of snow evaporation (evaporation of liquid water in the snow), and because of strong, scouring winds. The process of a glacier getting smaller is called ablation. Over the 20th century, almost all glaciers worldwide experienced ablation, particularly during the latter decades of the century. In most cases, there is strong evidence that these glaciers shrunk because of our warming climate. This is most evident for alpine glaciers in the Arctic, which is warming faster than other regions, and for alpine glaciers at high elevations in tropical latitudes.

For more information about glaciers, visit the [Glacier Quick Facts from NSIDC](https://nsidc.org/learn/parts-cryosphere/glaciers/glacier-quick-facts). https://nsidc.org/learn/parts-cryosphere/glaciers/glacier-quick-facts