



Melting Mountains: Climate Change and Glaciers

Ashley Schopieray

INTRODUCTION

In this lesson, students will learn how increases in CO₂ production influence climate change and increase Earth's temperature. They will also gain an understanding of how glaciers are affected by rising temperatures through a case study of Glacier National Park in Montana, USA. A basic understanding of climate change and the greenhouse effect would be helpful to students before starting this lesson.

LESSON OVERVIEW

Grade Level and Subject: Grades 5-8: Science

Length: 1-2 class periods: Day 1: Warm-up through Activity Two
Day 2: Activity Three through Wrap-up

Objectives:

After completing this lesson, students will be able to:

- Explain the “greenhouse effect,” where CO₂ comes from and what effect it has on the Earth
- Explain the effect of increased temperatures on mountaintop glaciers
- Describe the effects of increased glacial melting in the mountains

National Standards Addressed:

This lesson addresses the following National Science Education Standards¹:

- **Content Standard: [NS.5-8.4 EARTH AND SPACE SCIENCE](#)**
As a result of activities in grades 5-8, all students should develop
 - Structure of the earth system
 - Earth's history
 - Earth in the solar system
- **Content Standard: [NS.5-8.6 PERSONAL AND SOCIAL PERSPECTIVES](#)**
As a result of activities in grades 5-8, all students should develop
 - Personal health
 - Populations, resources, and environments

¹ Education World (2008) *U.S. National Education Standards*. Retrieved February 12, 2009, from <http://www.education-world.com/standards/national/index.shtml>.

- Natural Hazards
- Risks and benefits
- Science and technology in society
- **Content Standard:** [NL-ENG.K-12.1 READING FOR PERSPECTIVE](#)
 - Students read a wide range of print and nonprint texts to build an understanding of texts, of themselves, and of the cultures of the United States and the world; to acquire new information; to respond to the needs and demands of society and the workplace; and for personal fulfillment. Among these texts are fiction and nonfiction, classic and contemporary works.

Materials Needed:

- A hat, scarf, jacket, sweatpants, blanket, and gloves for each group of 4-6 students. Ask students to bring some in from home.
- Whiteboard, chalkboard, flipchart, etc. and markers
- Overhead projector or equivalent
- Access to a computer that can project onto a screen
- Reproducible #1- **Earth as a Greenhouse**
- Reproducible #2- **CO₂ Emission Cards**
- Reproducible#3- **“Melting Away” Article**
- Reproducible #4- **“Melting Away” Reflection Questions**

Assessment: Students will be assessed through the following activities:

- Participation in class discussion and group work
- Completion of **Reproducible #4- “Melting Away” Reflection Questions**

LESSON BACKGROUND

Relevant Vocabulary:

- **Glacier:** a large body of ice slowly flowing over the landscape.
- **Global Climate Change:** current increase in the earth’s temperature due to human-caused pollution and an increase in the greenhouse effect.
- **Carbon Dioxide:** A molecule made from 1 carbon and 2 oxygen atoms. Carbon Dioxide (CO₂) is a greenhouse gas, helping to block the sun’s rays from leaving the atmosphere.
- **Greenhouse Effect:** Earth’s natural process for keeping warm by trapping the sun’s rays in the atmosphere.
- **Greenhouse Gas:** Gases that add to the greenhouse effect by increasing the ability of earth’s atmosphere to trap the sun’s rays.

Information:

The greenhouse effect helps to keep the Earth warm by using carbon dioxide to trap the sun’s rays inside the atmosphere. Carbon dioxide is produced naturally by Earth to keep its temperature in balance, but recent human actions, such as industry, automobiles, and deforestation, have increased

the amount of CO₂ being added into the atmosphere. This has caused the Earth's temperature to increase, as the extra CO₂ allows more heat to be trapped, which in turn has caused many other changes to the Earth.

For instance, rising temperatures have begun to melt the glaciers and ice caps of the world. This is important because glaciers and ice caps are a huge source for fresh water, making them an important natural resource. Glaciers in the western United States are melting earlier in the spring than usual, making it hard for dams to catch all the water, and the excess flows out into the ocean to become salt water. This also contributes to rising sea-levels, changes to oceanic temperatures and disruption of ocean current patterns.

Resources:

- Information on greenhouse gases: <http://spaceplace.jpl.nasa.gov/en/kids/tes/gases/>
- Information on global climate change: <http://www.pewclimate.org/global-warming-basics/kidspage.cfm>
- Greenhouse effect: <http://www.epa.gov/climatechange/kids/greenhouse.html>
- Basics on climate change: <http://www.epa.gov/climatechange/basicinfo.html>
- Link to article in Reproducible #3: <http://magma.nationalgeographic.com/ngexplorer/0501/articles/mainarticle.html>
- Slideshow of glaciers melting at Glacier National Park: <http://www.livescience.com/php/multimedia/imagegallery/igviewer.php?imgid=626&gid=42&index=0>

LESSON STEPS

Warm Up: *Thinking about CO₂*

1. Start the lesson by dividing a chalkboard, whiteboard, flipchart, etc. into two columns.
2. Label one side of the column with 'what do we know about CO₂?' and ask students to tell you what they already know about the molecule (*for example, it stands for Carbon Dioxide, we exhale CO₂, trees and plants convert CO₂ to Oxygen, it is a greenhouse gas, etc.*)
3. When students are done, label the other side of the chart 'what do we NOT know about CO₂?' and have them ask questions they have about CO₂ (*for example, is CO₂ good or bad? Where does CO₂ come from? What is a greenhouse gas and why is it called that? Etc.*)
4. Tell students to keep the chart in mind as they work through the lesson

Activity One: *What makes the Earth sweat?*

1. Talk with students about the Greenhouse Effect and how it works. Explain that it is Earth's natural process of keeping warm, and that CO₂ in the atmosphere helps to form a blanket around the earth so that all living things can survive. This effect allows for life to exist on Earth; otherwise, Earth would have no protection from the coldness of outer space. This is similar to how the glass of a greenhouse allows sunlight to enter but helps hold it in, keeping

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the inside air warmer than the outside air. Put **Reproducible #1- Earth as a Greenhouse** on the overhead and discuss with students.

2. Break students into small groups of about 4-6. Have one student from each group volunteer to be “Earth.” Let them know that they will have to be dressed up in layers of clothing, so choose a student who is comfortable with this. Ensure that each group has a scarf, hat, jacket, sweatpants, gloves, and a blanket. (*Note- this could be done as a whole class with only one student being the “earth”*).
3. Using **Reproducible #2- CO₂ Emission Cards**, have a student pick a card out of the deck and read what it says. Have groups follow the directions as listed on the card for which layer of clothing to add to “Earth.”
4. Continue with the next card until all cards have been chosen and the “Earth” is covered in layers.
5. Discuss with students how adding layers to their classmate was a representation of adding CO₂ to Earth’s atmosphere. Explain that the greenhouse effect is natural on Earth and needed to support life, just as we need a couple of layers of clothing to stay warm, but too much warmth can be a bad thing. Mention that the Earth’s temperature has historically fluctuated, but it is the rate at which its temperature is currently warming that is an issue. Have students think about what happens when they have too many layers on (they sweat). The same process happens with the Earth, but the Earth sweats by melting glaciers!

Activity Two: *Thinking about Glaciers*

1. Introduce the concept of glaciers to students to prepare them for the next day’s lesson. Ask questions such as:
 - a) What do you already know about glaciers?
 - b) Have you ever seen or been to a glacier?
 - c) What types of animals and vegetation use glaciers as a habitat?
 - d) Where are glaciers located?
 - e) How do glaciers help to form landscapes?

Activity Three: *Melting Mountains in Glacier National Park*

1. On day two, introduce students to Glacier National Park. (*Located in Montana, shares a border with Canada, part of US Parks System, designated in 1910 as the 10th national park, preserved federal land because of its beauty and importance as a resource and ecosystem*). Point out Montana on a map and discuss how near or far it is to your school. Have you or any of your students been to Glacier National Park? Have them share their impressions and experiences.
2. Access the slideshow “Glaciers Before and After” to view glaciers melting at Glacier National Park:
<http://www.livescience.com/php/multimedia/imagegallery/igviewer.php?imgid=626&gid=42&index=0>

3. As you are going through the slide show with students, talk with them about how much the glaciers have shrunk and why that is a problem (*Glaciers are a top fresh water resource, and they melt each spring to replenish our water supply. However, with rising temperatures they are melting faster and earlier, making it harder to contain all that water in our dams; therefore a lot of it flows into the ocean. This interferes with sea levels and ocean currents. Glaciers also provide habitats for animals, help to regulate Earth's temperature, are important to the water cycle etc.*)
4. Ask students how they think the ocean is affected by the extra water flowing into it from glaciers? What types of problems does this cause? (*Water from glaciers increases sea levels in the ocean and many coastal areas are already under water. Sea levels will continue to rise and destroy coastal areas as more water flows into the ocean.*)

Activity Three: *Reading About Climate Change*

1. Either as a class or individually, have students read **Reproducible #3- “Melting Away”**
2. When finished, have students break into groups and discuss the reflection questions on **Reproducible #4- “Melting Away” Reflection Questions.**
3. Bring the class all together and have them share what they discussed in their groups.

Wrap Up: *Connecting CO₂ Production and Water Resources*

1. Ask students the following questions to ensure understanding of the main concepts:
 - a. What does CO₂ do for the Earth? Is this a natural process? How do humans contribute to this process, and what are the repercussions?
 - b. How are glaciers affected by adding CO₂ into the atmosphere? Why is this important?
2. Have them look at the side of the flip chart where they asked questions about CO₂ - have those questions been answered?

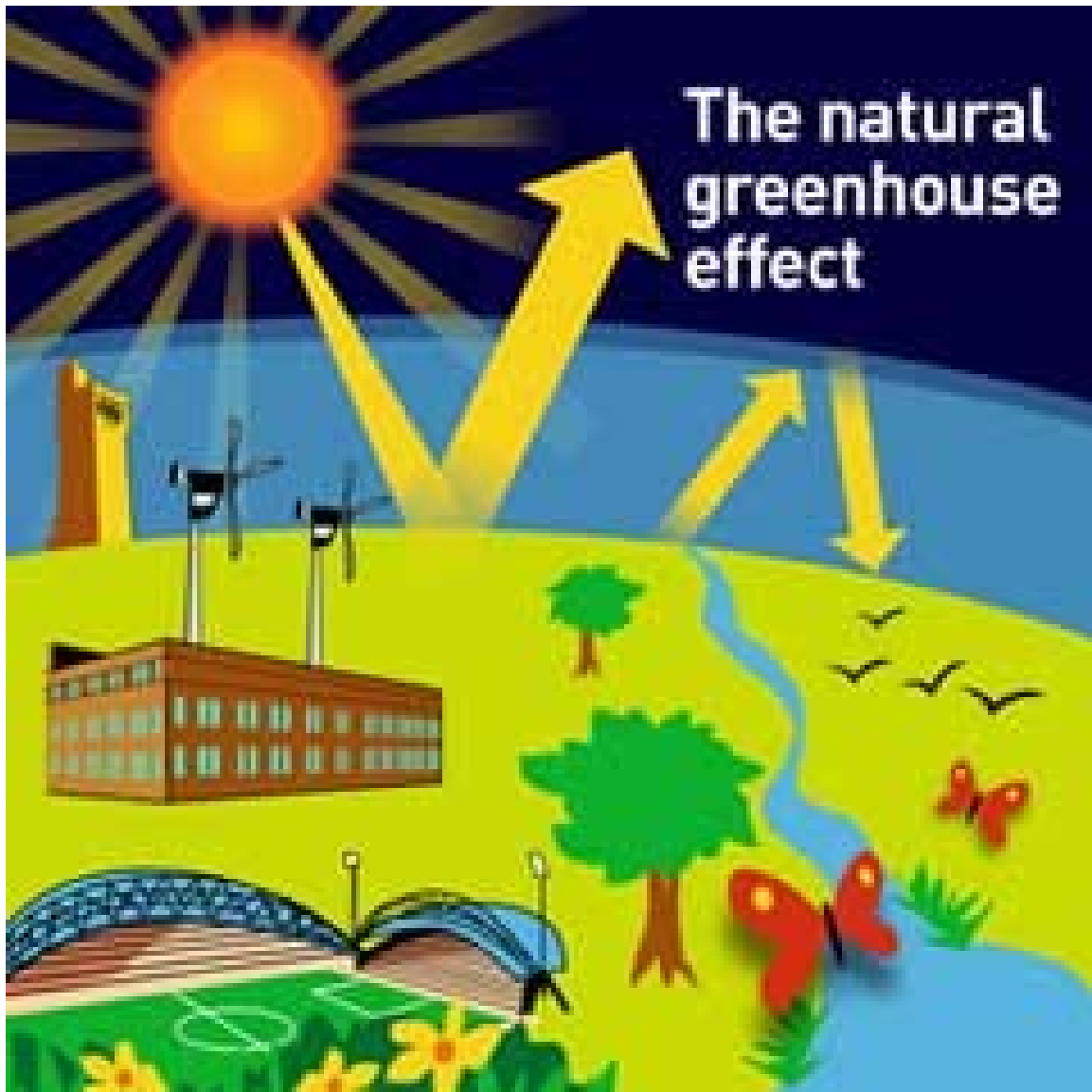
Extension: *Measuring Your Carbon Footprint*

Have students visit the interactive measuring tool at <http://www.earthday.net/footprint/index.html> to determine how much CO₂ they produce and what they can do to reduce their impact. Ask them to come up with some goals for how they are going to reduce their emissions, and have them write out a plan for how they are going to accomplish those goals.

CONCLUSION

At the end of this lesson, students should be able to explain the “greenhouse effect” and what role CO₂ plays in the process. They should also be able to explain where CO₂ comes from, how humans are affecting the process, and how warmer temperatures are having an effect on glaciers.

Earth as a Greenhouse



Source: <http://www.kirklees.gov.uk/community/environment/green/climatechange.shtml>
Accessed February 12, 2009

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<p style="text-align: center;">You Bought Some Groceries at a Supermarket</p> <p>Add a scarf to “Earth”</p> <p>12% of total greenhouse gases come from growing and shipping food.</p>	<p style="text-align: center;">You Turned On the Heat in Your House</p> <p>Add a jacket or heavy sweater to “Earth”</p> <p>The average household produced 12.4 tons of carbon dioxide from household operations in 2003.</p>	<p style="text-align: center;">You Bought a New Video Game that You’ve Always Wanted</p> <p>Add a hat to “Earth”</p> <p>Anything you buy from a store took energy, and the release of CO₂, to produce it and get it there.</p>
<p style="text-align: center;">A Parent Drove You to School</p> <p>Add sweat pants to “Earth”</p> <p>The average household produced 11.7 tons of carbon dioxide from automobile emissions in 2003.</p>	<p style="text-align: center;">You Are a Citizen of the United States</p> <p>Wrap “Earth” in a warm blanket</p> <p>The United States emits about 25% of the Earth’s total CO₂.</p>	<p style="text-align: center;">You Walk into an Air Conditioned Store</p> <p>Add gloves to “Earth”</p> <p>CO₂ emissions still occur in our daily lives, even if we aren’t the ones directly emitting them.</p>

Source: Hinkle Charitable Foundation. How Do We Contribute Individually to Global Warming? Retrieved February 11, 2009 from <http://www.thehcf.org/emaila5.html>



Melting Away

Temperatures are rising worldwide. That's causing weather to change. It is also affecting wildlife.

Glacier National Park in Montana is a place of beauty. It has towering cliffs, jagged ridges, and deep valleys. All these features were made by ice.

That's right: Ice carved the rocks. Of course, small pieces of ice could not do all that. But giant ice sheets could and did. Ice still covers some parts of the park.

ICE AT WORK

Ice sheets form when more snow falls in winter than can melt in summer. Year after year, the snow piles up. Huge mounds cover the land. The bottom layers of snow slowly turn into ice.

When the ice grows heavy enough, it starts to move downhill. That's when a sheet of ice becomes a **glacier**. People often describe glaciers as "rivers of ice." Some glaciers were once more than a mile thick. Only the highest mountains poked through the giant ice sheets.

This has been happening at Glacier National Park for millions of years. Glaciers have slowly moved across the land, changing the landscape. They plowed away the soil. They ground down mountains. They carved out valleys.

Glaciers don't last forever, though. If the weather heats up, they melt. That happened at Glacier National Park about ten thousand years ago. And it is happening again today.

I'M MELTING

Today, 26 glaciers cover parts of the park. Those glaciers are still changing the land.

The park's glaciers, however, are in danger of melting away. Take Grinnell Glacier, for instance. It's the most famous one in the park.

In 1910, Grinnell Glacier covered almost 440 **acres**. By 1931, it had shrunk to 290 acres. In 1998, only 180 acres remained. Water from the glacier has formed a new lake in the park.

At this rate, the once mighty Grinnell Glacier could soon vanish completely. So could the park's 25 other glaciers.

TURNING UP THE HEAT

Why is Grinnell Glacier wasting away? It's simple: The park is getting warmer. Since 1910, the average summer temperature there has risen more than three degrees Fahrenheit (F).

The park isn't the only place that's warming up. Most scientists agree that the rest of Earth is slowly warming up too.

The rising surface temperature is called **global warming**. Since 1850, Earth has warmed by about one degree F. Some places, such as Glacier National Park, have warmed up more. Some have warmed up less.

WORLDWIDE WARMING

One degree may seem small. But it is causing big changes worldwide. In the Antarctic and Arctic, sea ice is melting. The meltdown forms clouds that can make more snowfall than usual. More snow can harm wildlife.

Penguins in Antarctica are having a hard time finding a place to lay eggs. They normally lay eggs on dry ground in the spring. But more snow is falling today. The penguins have to lay their eggs in the snow. When the snow melts, the water rots many of the eggs. That's causing the number of penguins to drop.

TROUBLE IN THE TROPICS

Earth's warmer areas are also affected. Tiny animals called **coral polyps** build huge reefs in warm ocean water. Reefs come in many different colors. Fish dart around the reefs. Lots of other creatures call coral reefs home. But many coral reefs are in trouble.

Because of global warming, ocean water is heating up. If the water near a reef gets too warm, the polyps die. Then the once colorful reef turns white. When a reef dies, fish and other creatures have to find new homes, or they die too.

WHAT'S GOING ON?

No one is sure what is causing the worldwide warm-up. Most scientists blame some gases in Earth's atmosphere. They point to one gas in particular—carbon dioxide.

That gas keeps our planet warm by trapping heat from the sun. If there isn't enough of the gas, temperatures go down. If too much of the gas builds up, temperatures rise.

Many things make carbon dioxide. For example, erupting volcanoes make it. Cars, trucks, factories, and power plants also make it. All these things combined may be causing the gas to build up in Earth's atmosphere.

Some scientists blame the sun. They say its temperature can change. Right now, it is warming. This also happened 1,000 to 500 years ago. Then the sun cooled. Now the sun and Earth are warming again.

THE MELTDOWN

If the warming continues, glaciers in Glacier National Park will continue to melt. Of course, the park will still be there. Only the glaciers will be gone.

The melting glaciers could push wildlife out of the area. Grizzly bears are one example. They often move into the park's meadows to eat berries and other favorite snack foods.

Huge **avalanches** make the meadows. An avalanche happens when lots of snow suddenly crashes down a mountainside. The crashing snow tears down trees, giving berry bushes a place to grow. Without avalanches, there will be fewer berries. That means fewer bears. And bears are just one of the many animals affected by global warming.

The warming trend could affect many plants and animals because it is happening very fast. Some plants and animals might have to find new homes. Others might die out, or become **extinct**. To survive, they will all have to find ways to beat the heat.

*Article by Glen Phelan. Online Extra and Links by Brian LaFleur. "Melting Away" appears on pages 4-9 of the **January-February 2005** issue. Accessed February 11, 2009 from <http://magma.nationalgeographic.com/ngexplorer/0501/articles/mainarticle.html>*

Name _____

“Melting Away” Reflection Questions

1. How do glaciers form? What service do they provide for humans?
2. How did glaciers help to form the landscape at Glacier National Park?
3. What is global climate change? How are “greenhouse gases” involved?
4. Draw a small diagram explaining the process of the “greenhouse effect.”

5. Name 3 ways mentioned in the article that wildlife is affected by global climate change? Can you come up with any other examples of wildlife you think would be affected by global warming?

a)

b)

c)

6. What will happen if all the glaciers melt in Glacial National Park? How will this affect humans?