



The Climate Change Connection (MS lesson)

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Overview

This lesson builds a foundation for climate literacy by exploring greenhouse gases, the relationship between emissions and rising temperatures, local climate impacts, and actions that can be taken in their own community. Through graph analysis, hands-on model observation, and discussion, students will investigate the sources of greenhouse gas emissions and strategies to reduce them. This lesson pairs well with a field trip to the WaterShed Climate and Water Education Center at boisewatershed.org. Field trips can be booked up to 6 months in advance.

Objectives

Students will...

- Understand the definition and role of greenhouse gases in Earth's climate
- Trace the source of fossil fuels through the lens of the carbon cycle
- Explain the relationship between CO₂ emissions and rising temperatures
- Analyze and discuss the impacts of climate change in the Treasure Valley
- Use local emission data to brainstorm action items for reducing emissions in the community

Length of lesson

1 Hour

Grade levels

MS

Standards covered

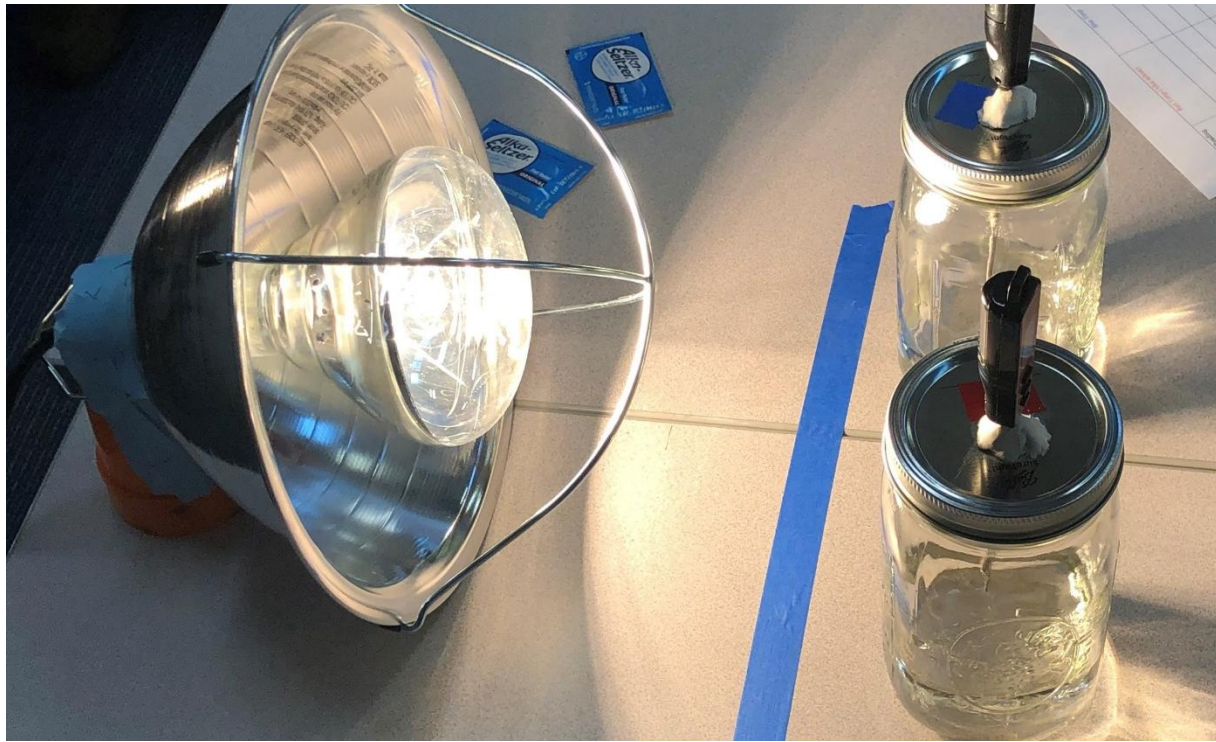
ESS3-MS-5. Ask questions to interpret evidence of the factors that cause climate variability.
ESS3-MS-4. Construct an argument supported by evidence for how increases in human population and per capita consumption of natural resources impact Earth's systems.

Materials

- PowerPoint Slides
- 2 Mason Jars with lids
- Heat Lamp(s)
- 2 Thermometers
- 2 Alka Seltzer tabs
- A large sheet of paper and markers

Set-up

- This lesson works best when students are arranged in small discussion groups of 3-4 students.
- Set up a greenhouse gas demo at the front of the class, without the light turned on.



- On the whiteboard, draw a simple table for keeping track of temperature, similar to the one below.

Control (Water Only)	Temp:	Temp:	Temp:
Experiment (Alka-Seltzer, CO ₂)	Temp:	Temp:	Temp:

- Set out a piece of butcher paper and markers for each student at every table.

Introduction to climate change (5 mins)

Slide 3: Tell students that there are news stories almost every week that relate to climate change. Ask them to share their answers. As they share answers, collect a list on the whiteboard. Add content that is relevant and comfortable. Students often mention:

- Global warming: "Global warming" refers to the rise in global temperatures due to increasing concentrations of greenhouse gases in the atmosphere. "Climate change" refers to increasing changes in the measures of climate over a long period of time – including temperature, and wind patterns.¹
- Polar bears/glaciers melting: Our poles are experiencing climate change faster than the rest of Earth. We'll see a graphic later that shows this, and I can explain more. However, it's not just our poles that's melting, it's also our own snowpack.
- Scary stuff "we're all gonna die"

It's useful to do an inventory of what emotions or knowledge students are coming into the classroom with. Make connections between what they are discussing and what we are exploring today.

Slide 4: This slide can be a bridge between emotions or observations that came up in the beginning of the remaining content. You can say something like "climate change is something that is happening in the oceans, but it's also happening in Idaho. We see these changes in our snow and glaciers. By learning more about the science behind climate change, you'll better understand what's happening in our backyard and what we can do about it."

Slide 5: To really understand climate science, we need to zoom way out — all the way

Introduction to our atmosphere

and greenhouse gasses (10 mins)

This photo was actually taken by astronauts on the Artemis 2 mission. Look at the edge—do you see that thin blue glow around the planet? That's our atmosphere.

Even though it looks tiny from space, our atmosphere does some really important jobs: it lets us breathe, it blocks harmful rays from the sun, and it helps keep our planet at just the right temperature. Here's a way to think about how thin it really is: if the Earth were the size of a basketball, our atmosphere would be about as thick as a single sheet of plastic wrap around the ball. Super thin—but essential. Without it, Earth would be a lot like the moon—freezing cold at night and scorching hot during the day. Our atmosphere is what makes life here possible.

Slide 6: Even though our atmosphere is thin, it has an essential role in keeping our planet warm. This is because the atmosphere is filled with gases, called greenhouse gases, that absorb heat from the sun. Greenhouse gases in the atmosphere work like glass greenhouses for growing plants: they trap heat from escaping the planet. Or, like when you wrap a blanket around yourself to warm up, the planet warm.

Greenhouse gases serve an important role. Without them, Earth would be too cold to support life. They are like a dial on the thermostat for Earth's temperature. The more greenhouse gases in the air, the warmer Earth's temperature becomes.

Slide 7: Let's take a closer look at some of the greenhouse gases in our atmosphere.

- Water vapor: Water vapor is the most common greenhouse gas in our atmosphere. It's also really good at trapping heat. If you've ever been somewhere humid, you know how it feels.
- Carbon dioxide: On the earth, carbon is stored in rocks, the ocean, and in living things. It's naturally released back into the atmosphere when plants and animals die, as volcanoes erupt, and volcanoes erupt. Carbon is unique because it can change forms easily between solid, liquid, and gas.
- Natural emissions of nitrous oxide are mainly from bacteria breaking down nitrogen in the soil.
- Methane is released when living things decompose. It is also released in swamps and landfills.

Slide 8: When people talk about greenhouse gases, you'll hear a lot about one in particular: carbon dioxide. For the rest of our lesson, we are going to monitor an experiment that interacts with carbon dioxide. We have two jars, that, like the Earth, have a lot of water in them, and a simple "atmosphere" of air. We have some air in our model, and a sun—the heat lamp. I am going to change the makeup of one of our "Earths" by adding Alka-Seltzer. I told you earlier that carbon dioxide can change from a solid to a gas. This tab of Alka-Seltzer has carbon in a solid form, as sodium bicarbonate. When it reacts with water, it will carbonate (like a soda when it fizzes) and release carbon dioxide. Remember, carbon dioxide is one of our greenhouse gases.

Throughout the rest of our time, I will be monitoring the temperature of our two Earth models. *Take the initial temperature of both jars. Then add an Alka-Seltzer tab to one of the models.*

Every ~5-10 minutes, check the temperature of the jars and record it on the whiteboard.

Slide 9: We have added an extra source of heat-absorbing greenhouse gases to one of our Earth models. Make a prediction of what we will see in our experiment?

Slide 10: The hypothesis that adding CO₂ to our atmosphere will increase our global temperature was first recorded in 1856 by a scientist named Eunice Foote.³

She placed a glass cylinder full of carbon dioxide in sunlight and found it heated up more than a cylinder of ordinary air and made the conclusion that more carbon dioxide results in a warmer planet. That's exactly what we're testing with our jars right now.

Carbon Cycle (10 mins)

Slide 11: Eunice Foote showed us how CO₂ warms things up. But that brings up a big question: where does that extra CO₂ come from? Some of it happens naturally: volcanoes, wildfires, and dead animals all release CO₂. But over the last 200 years, humans have been adding a lot more. Carbon dioxide is a gaseous form of carbon. Carbon is an important element, so much so that it's called "the building block of life". You're made of carbon, as are trees, plants, cows and...

Let's look at how carbon moves through a living thing to understand where it ends up. A tree takes in carbon dioxide from the air and stores the carbon in its trunk, branches, and roots. The carbon stays in the tree, and when the tree dies, some of the carbon moves into the soil.

Slide 12: "Now imagine that happening with every living thing on Earth — every tree, every animal — over millions and millions of years. Under the right conditions (you need heat and pressure over time) that carbon-rich material gets compressed deeper and deeper underground. Over time, it has been transformed into coal, oil, and natural gas. This is why it is called "fossil fuel". Your car was made of carbon stored in plants and animals (maybe even a dinosaur!) millions of years ago.

Humans have figured out that if you burn coal, oil, and natural gas you can release a lot of energy to power our houses, cars, and cities. But, when we move this carbon from a solid form into a gas form, ancient, stored carbon gets released in the form of carbon dioxide gas.

Slide 13: We know that carbon dioxide naturally occurs in the atmosphere, and we know we've added more by taking carbon stored in the ground and converting it into a gas. This graph shows how much CO₂ we have added to the atmosphere. On the Y-axis we have the amount of CO₂ shown in parts per million. On the x-axis, we have how long ago the amount of CO₂ in the air was. So, 10,000 years ago, we see about 265 parts per million carbon dioxide in the air. Does anyone have any guesses as to how we might know how much CO₂ was in the air 10,000 years ago? Take student guesses and help them tease out if they are guessing things like "dig down in the ground". Ask them things like "where would we find air in the ground?"

Slide 14: We find atmospheric carbon dioxide by releasing air stored in ice! When you pop a glass and it makes popping noises, that is air being released. In the case of your ice, that's two million years old. Scientists in Antarctica drill down deep—3 miles deep!—and release the air in bubbles. They measure the components in it. We can see volcanic eruptions, pollen from ancient plants, and carbon dioxide in the air from thousands of years ago. The oldest core that has been drilled from the Antarctic ice sheet is 800,000 years old.

(image 2): For more recent air, we measure air high up in stations like the Mauna Loa Observatory. The Mauna Loa observatory has been monitoring and collecting data since the 1950s.

Slide 15: So that's how scientists measure CO₂ in the atmosphere — in parts per million. Use this graph with your group. What patterns do you notice? When does something seem to change? As students share, guide them toward these key observations: For thousands of years, CO₂ levels shifted slightly but never climbed above 300 parts per million. Then, during the Industrial Revolution, something changed. Check for understanding here — ask students what they think that might be. Make sure they connect it to the burning of coal, oil, and gas to power factories and cars around the world. Since then, that number has kept climbing. Consider posing this challenge question: "Some people say humans couldn't possibly have caused this. It could be a volcano or wildfire. Looking at this graph, what would you say to them?" Help students see that volcanoes and large fires have happened throughout Earth's history, but they don't see some of those peaks in the graph. But none of them compare to what happened during the Industrial Revolution. Human activity since 1750 has increased atmospheric CO₂ by 40%, from 280 to 431 parts per million as of 2026.

Relationship between CO2 emissions and temperature (5 mins)

Slide 16: Note: updated NASA visualizations of temperature are longer animations (4 min) but we've opted to keep this 2024 version.

Now we have predicted that, since greenhouse gasses like CO2 trap heat, that if the atmosphere, we would see higher temperatures. Let's observe this map which shows temperatures from 1880 to 2024. A darker blue spot shows a colder than average temperature 140 years, where red spots represent a warmer than average temperature.

Play the visualization, then ask what students notice.

If they mention that the poles got warmer, you can mention that places covered in ice melt more rapidly. This is because of the albedo effect⁵. Snow reflects more light than a surface like rock. As ice melts and exposes soil and rock below, more heat is absorbed, creating a feedback loop.

If they mention the cool spots in the ocean, you can mention that the Earth's oceans are helping regulate the temperature on our planet. Water is really good at absorbing and storing heat, which slows down warming in some areas — but it also means our oceans are absorbing a lot of heat, producing.

After students make observations, pose this question: from this visualization, we can see that the average temperature on our planet has increased by around 3 degrees. Does three degrees matter? Have your group why or why not.

As students share out, facilitate a discussion. Some points you can make:

- Imagine you're up at Bogus Basin and it's 33 degrees out with precipitation coming — you're getting — rain or snow? Now imagine it's 32 degrees. Just one degree is the difference between snow on the slopes and rain.
- If you wake up and your temperature is 98 degrees, you feel fine. If it's 100 degrees, you feel terrible. Two degrees make a real difference — because your body is a system where small changes matter together. Earth is the same way.

Slide 17: The good news is that we know why temperature is increasing. Scientists have a clear explanation — solar activity, volcanic cycles, natural variation — and none of them are the cause of what we're seeing. The only thing that does is us. As our heat-capturing emissions have gone up, the temperature has gone up.

Note: feel free to explore [this resource](#) to learn about other, longer-term climate variations. It helps explain how rapidly the planet has warmed in the past 200 years. While the site looks a bit cluttered, the data and framing is very helpful. For example, a misconception: "it's sunspots". The science shows that during global warming, the sun has shown a slight cooling trend. Sun and climate have been moving in opposite directions."

Climate Change in Idaho (5 mins)

Slide 18: And this increase in temperature is happening in Idaho too. This is a graph that shows the average temperature in Idaho since 1850. The darker blue stripes represent a colder than average temperature, and the darker red stripes represent a warmer than average temperature. Over these 175 years, the trend is warming.

- Students will likely notice that it's getting warmer, but it may also be worth pointing out that there is a cooler year, overall the *trend* in the data is warming. One cold year is not a trend. Years of sustained change constitutes climate.

Slide 19: You all have felt the impacts of this warming climate. For example, raise your hand if you had a sports game or recess cancelled from wildfire smoke? This is a new trend, and the wildfire season in Idaho is 70 days longer than it was in the 1980s.

Note: It can be powerful to weave in your own lived experience here. For example: a) Have you noticed changes in your lifetime? Do you remember sleeping with the windows open in the past but still able to do that in August. Check [out climate stories project.org](https://outclimatestoriesproject.org) for inspiration on how to use your personal climate change markers.

Here are some of the impacts of a warming climate on Idaho:

- Frequent hot days in the summer are becoming more common. 2026 is forecasted to have a strong El Niño, bringing record-breaking heat ⁶
- Poor air quality days: As wildfires continue to increase in frequency and magnitude, more wildfires within Idaho and across the Western U.S. will travel to our region. ⁷
- Heavy Precipitation Days
- More droughts

Ask students how they think we could have both heavy precipitation days and more snow. The key is *how* precipitation falls, not just *how much*. As winters warm, more precipitation falls as rain instead of snow. Snow acts like a natural water storage system — it builds up all winter and slowly melts, steadily feeding our rivers and groundwater. Rain doesn't do that. It runs off quickly and evaporates before we can use it. Rain falling on existing snowpack can also cause it to melt rapidly, reducing snowpack even further.

So even if we get the same amount of total precipitation, losing our snowpack means less water available — and that leads to drought.

Emission sources in Idaho (5 mins)

Slide 20: While the impacts of climate change can be scary, we do know why it is happening: greenhouse gases caused by burning fossil fuels—so we also know what we need to do to reduce emissions. On this graph, you can see the sources of greenhouse gas emissions in Boise. The largest source of emissions is Transportation. When we burn gasoline to move our cars, this adds carbon dioxide to the atmosphere. Commercial energy is the fuel used to power, heat, and cool our large businesses. Residential energy is the fuel used to power your house. When the electricity that powers your house or turn on the lights comes from fossil fuels, this releases pollution. Solid waste is the methane released by your trash when it accumulates in our landfills.

Your job is to work with your group to:

1. Choose a source of greenhouse gas emissions and
2. Brainstorm as many ways as possible to reduce emissions from your source.

Circulate to different groups and help students expand on their ideas. If they say “more bikes,” ask “would we have to change to have more bikes on our roads?” If they say “use less energy,” ask “more specific ideas.”

Emission reduction brainstorm (5 mins)

Local Action (15 minutes)

Slide 21: Prompt students to share their most interesting or impactful idea. Create a board of their answers. If they share something that is happening in the community, prompt them to real-world action. To become more comfortable with local climate action:

- Check out the [City of Boise's Climate Action Roadmap](#)
- Visit Project [Drawdown Explorer](#)
- Book a field trip to the [WaterShed Education Center](#). Let us know you've booked a pre-visit activity so we can build off your students' knowledge!

Slide 22: Schools are a very important site for climate action. Their school is like a neighborhood in the neighborhood. So, if they can get their school to be powered by renewable energy on a low-power day, that is a significant emission reduction. The Boise School District has over 10 million square feet of buildings, so this can really add up! Consider checking in with your Sustainability Team Lead to share any interesting sustainability projects that their school is focusing on.

Today you followed carbon from ancient soil all the way into our atmosphere, and how that carbon in the atmosphere into rising temperatures right here in Idaho. You tested the same method that Foote tested in 1856.

Climate change can feel overwhelming. But you now understand *why* it is happening, where emissions come from, and *what* kinds of actions can actually make a difference. Scientists will keep studying. Engineers will keep innovating. And communities like ours will be making decisions about how we get around, power our buildings, and manage our resources. These decisions need people who understand the science, and I appreciate you standing up today!