Global Climate Change

Week 2 – Day 3

Lesson Overview

The purpose of this lesson is to begin to lay out the complexities of wheat farming in the context of global climate change. Students will explore and learn about global climate change by looking at data published by NASA (National Aeronautics and Space Administration) and NOAA (National Oceanic and Atmospheric Administration). Students will analyze data, read an article, participate in a greenhouse effect game, and make inferences and predictions based on data analysis.

Lesson Vocabulary

climate, weather, climate temperature, anomaly, CO_2, Mauna Loa, greenhouse effect, and climate change

Standards and Learning Targets for Lessons
Learning Targets • I can explain how the greenhouse effect contributes to global climate change.
Next Generation Science Standards • 5-ESS2 – Earth's Systems - Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact.
Idaho Science Standards • 5.S.1.2.1 – Goal 1.2 Understand Concepts and Processes of Evidence, Models, and Explanations - Use observations and data as evidence on which to base scientific explanations and predictions.
Common Core ELA Standards • RI.5.3 – Reading Informational Text - Explain the relationships or interactions between two or more individuals, events, ideas, or concepts in a historical, scientific, or technical text based on specific information in the text.

Materials

- Computer
- Projector
- "Mauna Loa Data" (Print one copy for each student.)
- Text "Global Climate Change" (Print one copy for each student.)

- NASA global temperature anomaly animation (https://svs.gsfc.nasa.gov/cgi-bin/details.cgi?aid=4419)
- Exit ticket (Print one copy for each student.)

Lesson Duration

Approximately 2 hours

Lesson Description

Engage (5 minutes)

- Project the NASA global temperature anomalies animation (https://svs.gsfc.nasa.gov/cgi-bin/details.cgi?aid=4419).
- Have students watch the video and make predictions as to what they think is causing the changes in temperature anomalies.

Explore (15 minutes)

- Ask students to analyze the Mauna Loa global CO_2 data and write down their thinking around the following questions:
  - *Why do you think CO_2 increases and decreases within each year?*
  - *Why do you think global CO_2 is increasing each consecutive year?*
  - *What do you think is the link between the CO_2 data and the NASA temperature anomaly data?*
- Next, ask students to get into small groups and share their responses to the three questions. (3–5 minutes)

Explain (30 minutes)

- Unpack the learning target: *I can explain how the greenhouse effect contributes to global climate change*. Write the learning target on the board or on chart paper. Discuss the meaning of key words. Discuss the purpose of the lesson in terms of what students will be able to do by the end of the lesson. (15-minute mini-lesson)
- Ask student groups to collaboratively read the short text on global climate change and revise their thinking around the questions from Explore. (15 minutes)

Elaborate (30 minutes)

- Have students play the Greenhouse Effect Game:
  - Select one student to be "heat" and three students to be CO_2. The idea of the game is to have the "heat" run past the CO_2, touch an object or wall designated as the surface of the Earth and try to run back past the $C0_2$ (make sure the CO_2 lets the heat run to the object or wall first before trying to stop them).
  - Play the game in rounds and after each round add three more CO_2 players. (As time progresses, there will be more and more CO_2 and the "heat" will have a harder and harder time getting out.)

  - After each round all students will collect data on how easily the "heat" left the "atmosphere."
  - The game will be over once all students have been added to the "atmosphere."
- Greenhouse Effect Game debrief: have students plot their data on how much CO_2 was in the atmosphere and compare that to how easy or difficult it was for "heat" to be trapped in the atmosphere.

Evaluate (20 minutes)

- Have students independently complete the exit ticket (intended for use as a formative assessment).

Extension Ideas

- Do the 30-minute activity to visualize the concept of the greenhouse gas effect http://www.education.com/activity/article/Observe_Greenhouse_Effect/
- Students can watch the CO_2 animation "History of Atmospheric Carbon Dioxide from 800,000 Years Ago until January, 2016" http://www.esrl.noaa.gov/gmd/ccgg/trends/history.html

Resources Used in Lesson Development

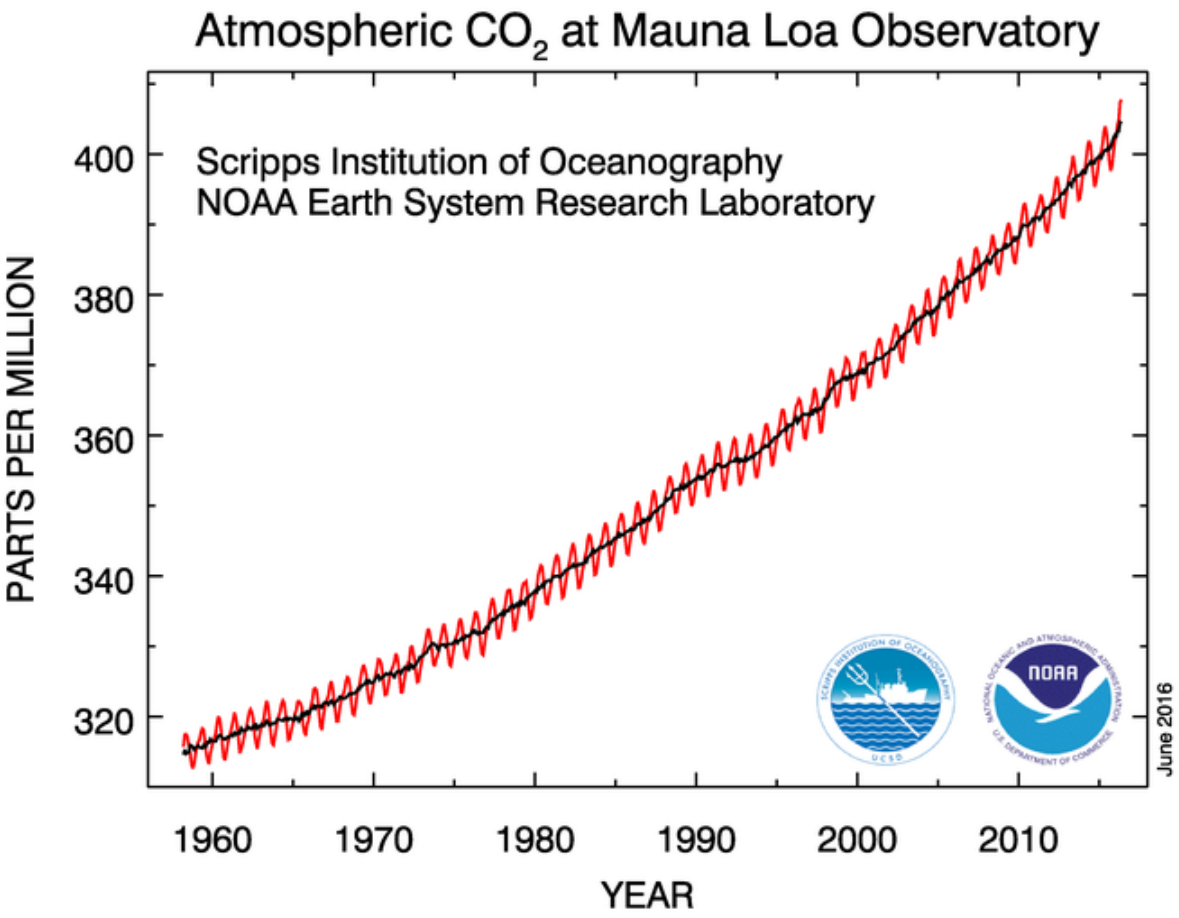
https://svs.gsfc.nasa.gov/cgi-bin/details.cgi?aid=4419

http://www.esrl.noaa.gov/gmd/ccgg/trends/full.html

http://climatekids.nasa.gov/menu/weather-and-climate/

https://www3.epa.gov/climatechange/kids/index.html

Mauna Loa Data



1. Why do you think the CO_2 increases and decreases within each year?

2. Why do you think global CO_2 is increasing each consecutive year?

3. What do you think is the link between the CO_2 data and the NASA temperature anomaly data?

Global Climate Change

If you were packing your bags to leave tomorrow for a weeklong trip to New York City, how would you decide what clothes to bring? One piece of information that will help you is the weather forecast. Weather scientists, called meteorologists, use technology to predict what the weather is likely to look like in one hour, tomorrow, and over the next few days. **Weather** is a specific event or condition that happens over a period of hours or days. For example, a thunderstorm, a snowstorm, and today's temperature all describe the weather. So you could read a weather report to see if it is likely to be rainy, snowy, windy, sunny, hot, or cold next week in New York City. The weather report can help you decide what clothes to pack for your trip next week.

But what if you were packing your bags today for a trip you will take to New York City to celebrate YOUR fortieth birthday? That's a trip you will take thirty years from now. How could you decide what clothes to pack? Information about the climate will help you much more than next week's weather report. **Climate** refers to the average weather conditions in a place over many years (usually at least 30 years). For example, the climate in New York City is cold and snowy in the winter and hot and humid in the summer. So you could use your knowledge of the general climate patterns in New York City to plan for your trip in thirty years, but it's very hard to predict the actual weather you will encounter when you get there.

Weather conditions can change from one year to the next. New York City might have a warmer winter one year and a much colder winter the next year. This kind of change is normal. But when the average pattern of weather over many years changes the result is **climate change**. Our world is always changing. Look out your window long enough and you might see the weather change. Look even longer and you'll see the seasons change. The Earth's climate is changing too, but in ways that you can't always see by looking out your window.

Global climate is the average climate over the entire planet. Global climate is a measure of the planet's health. Think about it this way: when a doctor or nurse takes your pulse and your temperature, she or he is "checking your vital signs." These measurements are called "vital" because they are very important signs of your health. The same is true of our planet. Two "vital" signs for the health of our planet Earth are global average temperature and the composition of the Earth's atmosphere. Let's talk about why these measurements are so important in understanding how our planet is doing.

The first vital sign, **global average temperature,** combines the temperatures of all the hot, warm, and cold places on Earth. It is a very important measure of changes happening on Earth. A rise of just one degree Fahrenheit (°F) on a sunny day where you live might have little effect. But over the whole Earth a rise of 1°F makes a big difference. Just think, normally, water at 32°F is solid ice. But water at 33°F is liquid water. Even a small rise in Earth's global

temperature means melting ice at the North and South poles. It means rising seas. It means flooding in some places and drought in others. It means that some plants and animals thrive while others starve. It can mean big changes for humans too. And that's why this number is a very big deal.

The second vital sign, the **composition of the Earth's atmosphere,** is causing the global temperature to rise. The Earth's atmosphere is the thin layer of gases that surrounds the Earth and is the air we breathe. The Earth's atmosphere is made up of 78% nitrogen, 21% oxygen, 0.9% argon, 0.03% carbon dioxide, and small amounts of other gases. All of these gases exist naturally in the atmosphere and they help keep the Earth warm enough for plants and animals to live. This is called the **greenhouse effect** because the Earth is like a greenhouse.

A greenhouse is a house made of glass or plastic where people can grow plants all year long. Sunlight shines in and warms the plants and air inside. The heat is trapped and can't escape. So a greenhouse stays warm inside even during winter. **Earth's atmosphere does the same thing as a greenhouse.** Gases in the atmosphere such as carbon dioxide do what the roof of a greenhouse does. During the day, the sun shines through the atmosphere and the Earth's surface warms up. At night the Earth's surface cools as the heat is released back into the atmosphere. But some of the heat is trapped by the greenhouse gases in the atmosphere, keeping our Earth warm.

The greenhouse effect of Earth's atmosphere keeps some of the Sun's energy from escaping back into space at night. However, if the greenhouse effect is too strong Earth gets warmer and warmer. This is what is happening now. Too much carbon dioxide and other greenhouse gases in the air are making the greenhouse effect stronger. The Earth is getting warmer because we are adding heat-trapping gases, called **greenhouse gases,** to the atmosphere (see three figures below). These extra gases are causing the Earth to get warmer, setting off all sorts of other changes around the world—on land, in the oceans, and in the atmosphere. These changes affect people, plants, and animals in many ways.

More than 100 years ago people around the world started burning large amounts of coal, oil, and natural gas to power their homes, factories, and vehicles. Today most of the world relies on these **fossil fuels** for their energy needs. Burning fossil fuels releases carbon dioxide, a heat-trapping gas, into the atmosphere which is the main reason why the climate is changing. People produce more carbon dioxide than any other greenhouse gas and it is responsible for most of the Earth's warming that is happening now. Carbon dioxide and other greenhouse gases are changing the Earth's climate.

How do we know the amount of greenhouse gases in the atmosphere is increasing?

Scientists measure the amount of greenhouse gases in the atmosphere in several ways. They use satellites and other instruments to measure the amount of greenhouse gases in the

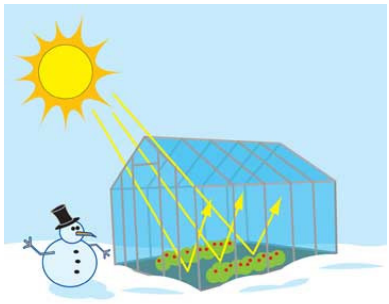
air all around the world. They also collect samples of air and then analyze these samples in a laboratory.

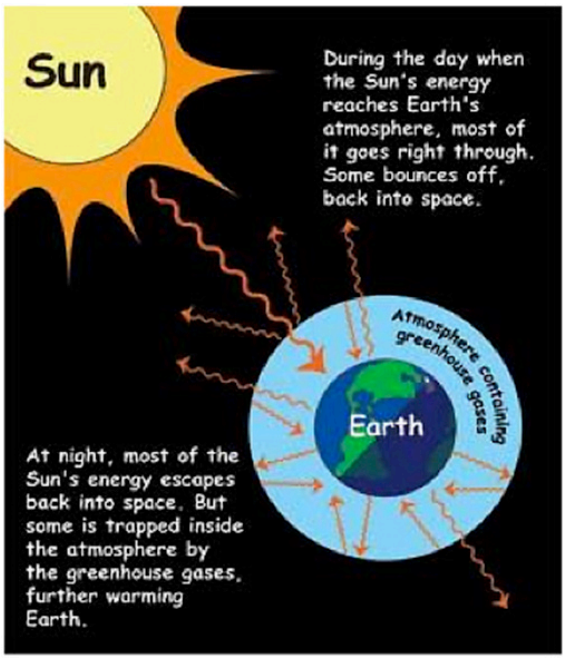
The Earth also gives us clues about the levels of greenhouse gases that existed in the past. For example, ancient air bubbles trapped deep in the ice of Greenland and Antarctica reveal how much carbon dioxide was present long ago.

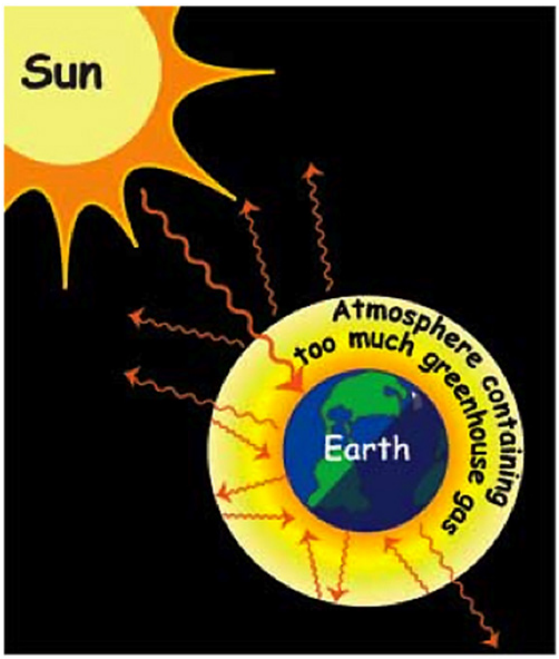
Scientists have carefully examined all this evidence and made a startling discovery. There is more carbon dioxide in the atmosphere now than at any other time in at least 650,000 years! The amount of carbon dioxide and other greenhouse gases is continuing to increase.

Scientists, and folks like you and me, are concerned because the Earth's global climate is changing. The planet is warming up fast—faster than at any time scientists know about from their studies of Earth's entire history. The Earth's climate has changed before, but this time is different. Scientists have discovered that human-made greenhouse gases are the leading cause of the observed warming on planet Earth. People are causing these changes, which are bigger and happening faster than any climate changes that modern society has ever seen before.

Text adapted from the following sources:
http://climatekids.nasa.gov/menu/weather-and-climate/
https://www3.epa.gov/climatechange/kids/index.html







Exit Ticket

Name: _____

What is the greenhouse effect?

Draw a diagram of the greenhouse effect.

Describe HOW the greenhouse effect is influencing global climate change.