

Lesson #1: Climate Change & Carbon Cycling

Focus Questions: What is climate change? How are humans contributing to climate change?

Learning Goals

- Students can explain that scientists have documented a rise in Earth's temperature in the last fifty years
- Students can explain how the element carbon naturally cycles through the atmosphere, ocean, and land
- Students can explain that through the use of fossil fuels, humans are moving stored carbon into the atmosphere much faster than what would be natural, creating a heat-trapping blanket of greenhouse gas that is warming the Earth

Related NGSS Disciplinary Core Ideas: ESS3.C: Human Impacts on Earth Systems, ESS3.A: Natural Resources, ESS2.D: Weather and Climate, ESS3.D: Global Climate Change, MS-LS2-B: Cycle of Matter and Energy Transfer in Ecosystems

Related NGSS Grade Standards: MS-ESS3–5. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century

Related NGSS Science and Engineering Practices: Developing and using models

Materials:  Introduction to Climate Change Slides.pptx Presentation with visuals, Printed Out  Carbon Cycle Modeling Print Outs.pptx , Playing cards or other manipulative to model carbon

Intros: 5 Minutes

1. Introduce yourself via a slide
2. Have students go around and say their names, pronouns, and icebreaker of choice.

Engage

Warm Up: 10 Minutes

1. Pass out one sticky note to each student. Prompt students to write a response to one of three questions: What is one thing you know about climate change? What is one thing you want to know about climate change? What is one thing that confuses you about climate change?
2. While students are thinking and writing, create a chart on the board. After one minute, have students post their responses on the board. Look at the board as a class and have students share another response that resonates with them.

3. Keep sticky notes and tell students you will reflect on their initial responses in your final class.

Intro to Global Warming: 15 minutes

Note: Explain to students that the word “global warming” refers to the rising temperature of the Earth. The word “climate change” refers to global warming and all of its side effects, like droughts, melting ice, and extreme storms. For our class, it’s okay to use both words interchangeably.

1. Display the graph of rising temperature over time. Ask for a student volunteer to help explain what the graph is showing. What are the dots? What is the line?
 - Dots (individual years) and Lines (average trend)
2. Explain that scientists from across the world have been consistently measuring temperature. While there is variation in the years (students may have noticed some years are hotter or rainier than others), scientists have noticed that the average temperature of the Earth is increasing.
3. Use the Greenhouse Gases slide to explain the Greenhouse Gas effect. Before explaining, prompt students to share any Greenhouse Gases that they have heard of (Methane, CO₂, Water Vapor). Explain that humans are impacting the amount of carbon dioxide in the atmosphere. End with the question: **How are humans putting carbon dioxide in the atmosphere?** The next activity will help answer this question.

Explore

Carbon & Fossil Fuel Cycle Modeling: 25 Minutes

1. Pose these questions and ask for student volunteers to answer them. Write answers on the board, guiding students to correct answers if necessary. These terms should be review for students.

- What is **Photosynthesis**? Process where plants use sunlight to turn carbon dioxide and water into oxygen and sugar.
- What is **Respiration**? Process where organisms use oxygen and sugar to make energy, with carbon dioxide and water as waste products.
- What is **Weathering**? Process where rocks are broken down by physical processes (rain, wind, freeze/thaw cycles) or chemical reactions
- What is **Decomposition**? Process where dead organic matter (living things) are broken down by microorganisms (emphasize it is broken down into carbon)

2. Assign one area of class to be the ocean, one area to be the land, and one area to be the atmosphere. Break the students into seven groups: **Trees (Land Plants), Algae**

(Aquatic Plants), Land Animals, Marine Snails (Aquatic Animals), Rocks & Sediments, Atmosphere, Ocean. Give each group a card with their role and their options giving or receiving carbon written on the back.

3. Distribute 2-4 ping pong balls to each group and explain that these represent carbon atoms.

4. Have students in each group review their role play card to figure out their role in the carbon cycle and decide as a group using their "Options for carbon movement" how they are going to move their carbon.

- Explain that they can only move two atoms at a time. Carbon cycling is slow!
- Explain that carbon exists in all of these things at the same time and only a portion of the carbon in each thing moves. Therefore, when each group moves their carbon, they can't give away all their carbon: they must keep at least one carbon atom.
- As they move their carbon, they must say their script lines to explain the carbon movement that they have chosen.

4. One at a time, ask each group to give their carbon to another group (or groups).

5. Run the role-play a number of times, telling students to make different choices about carbon movement each time.

6. One of the instructors will now act as the **Human**. Ask student volunteers to direct the Human to model the following interactions.

- **Humans extract and burn fossil fuels for energy** (Student volunteer directs Human to take all the ping pong balls from Rocks & Sediments and moves them into the atmosphere)
- **Humans cut down and burn trees to use land for farming or building.** (Student volunteer directs the Human to take some ping pong balls from Trees and move them into the atmosphere)

Explain: Discussion

1. What were the two ways humans put carbon dioxide into the atmosphere?
2. Did humans move faster or slower than the natural carbon cycle?
3. What other ways might humans impact the carbon cycle?
4. **Display slide with answers to questions and fill in any gaps that students did not cover with their discussion.**