



Lesson Time: 25–30 minutes

Where's the Evidence?

Objectives & Outcomes

Lesson Objectives: After creating graphs, students will be able to evaluate climate change data.

Lesson Outcomes: *Students will be able to...*

- create graphs from data related to indicators of climate change
- use data to analyze authentic scientific data

Subject Area Connection: Math

Background

Change in Earth's climate is not a new phenomenon. What is new is the rate at which this change is happening. Human activity has likely been the cause of the great increase in climate change indicators. Scientists monitor these indicators to provide evidence for climate change. Some of these indicators include: the level of carbon dioxide in the atmosphere, sea level, global temperature, ocean temperature, and the amount of ice stored in glaciers. Secondary data from events like extreme weather, ocean acidity, and wildlife behavior also provide scientists with valuable data. According to the Intergovernmental Panel on Climate Change, scientific evidence for warming of the climate system is unequivocal.

Climate change has become a debate among the public. Students may hear news stories and myths about climate change. This activity allows students to examine one sample of authentic climate change data.

“According to the Intergovernmental Panel on Climate Change, scientific **evidence for warming of the climate system is unequivocal.**”

Getting Ready

Teacher Preparation: To prepare for this lesson, copy the attached worksheet for students. Write the discussion questions on the board.

Materials Required:

- blackboard or whiteboard and markers
- graph paper and pencils or access to online graphing program
- climate change data (attached)

Introduction and Modeling

Begin by writing the terms “weather” and “climate change” on the board. Ask students if they can define the terms and differentiate between them. Emphasize that climate change is a pattern over a long period of time whereas weather refers to daily changes in temperature, humidity, wind speed, and precipitation. Ask students if they have heard that some people don't believe in climate change. Tell the students that although the public debates climate change, most scientists agree that this phenomenon is occurring at a faster rate due to human activity. Remind students that scientists rely on data to draw conclusions. As budding scientists, they are going to examine some of the real data.

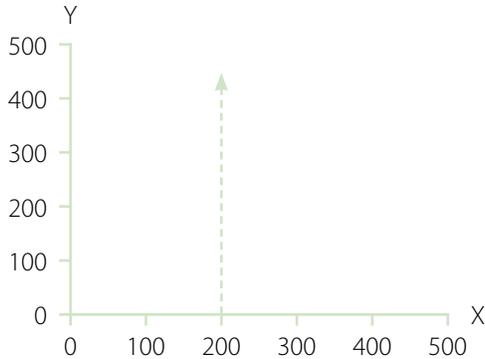
Key Vocabulary

climate change: changes in weather patterns over time.

weather: daily events including temperature, wind speed, humidity.

Procedure

1. Hand out the "It's a Gas" worksheet (attached). Review the directions with students.
2. Each student will prepare two graphs of the data on a separate piece of paper, either by hand or using a computer program. Review simple graphing by drawing an X Y axis graph on the board and reminding students of how to plot data on the graph:



3. Have students work in pairs to answer the following discussion questions written on the board:
 - Was the increase in atmospheric CO₂ from 1750–1850 gradual or dramatic? Explain.
 - In what year did CO₂ emission seem to increase dramatically? Can you suggest a reason?
 - What types of human activities produce CO₂?
 - What overall trend do you observe in the two graphs?

Discussion Questions

- Why do you think climate change is important?
- What do you think might happen in the future if people don't change how they interact with the environment (Earth's temperature will continue to rise, heat waves, droughts, flooding, species extinctions, etc.)?
- What are some things you can do to help impact climate change (recycle, turn off lights, walk or ride a bike instead of traveling by car, write letters to their city leaders, etc.)?

Evaluation

By a show of hands, ask students if they think that human activity is affecting CO₂ levels in the atmosphere.

Tips for Tailoring This Lesson

For Higher Grade Levels

- Students can investigate other evidence for climate change and report their findings.
- Students can produce an infomercial explaining the scientific data supporting climate change.

For Lower Grade Levels

- Students can work together in groups to prepare the graphs.
- Students can analyze prepared graphs of the data.

Alignment to Standards and Frameworks

Common Core State Standards: College & Career Readiness

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Anchor Standards for Speaking and Listening

CCRA.SL.5. Make strategic use of digital media and visual displays of data to express information and enhance understanding of presentations.

CCRA.SL.1. Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.

CCRA.SL.2. Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally.

Partnership for 21st Century Framework

Partnership for 21st Century Framework: the framework comprises the skills, knowledge and expertise students should master to succeed in work and life in the 21st century. Partnership for 21st Century Skills www.p21.org

Core Subjects and 21st Century Themes

Environmental Literacy

- Demonstrate knowledge and understanding of the environment and the circumstances and conditions affecting it, particularly as relates to air, climate, land, food, energy, water and ecosystems.
- Demonstrate knowledge and understanding of society's impact on the natural world (e.g., population growth, population development, resource consumption rate, etc.).

Next Generation Science Standards

Next Generation Science Standards: based on the Framework for K–12 Science Education developed by the National Research Council. Publisher: Achieve, Inc. on behalf of the twenty-six states and partners that collaborated on the NGSS. ©2013 www.nextgenscience.org

HS-ESS3-5.

Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.

Name: _____ Date: _____

It's a Gas

Greenhouse gases such as carbon dioxide are present in our atmosphere. They create a blanket that prevents energy from the sun from escaping back into space. This causes the atmosphere to heat up. The first data set shows carbon dioxide levels on Earth from 1750–2000. The second data set shows carbon dioxide emissions from human activity over the same time period.

- DIRECTIONS:**
1. Examine data set #1. Plot year on the x axis and CO₂ concentration on the y axis. Be sure to spread out both axes.
 2. Plot the data points carefully.
 3. Label your axes and give the graph a descriptive title.
 4. Repeat steps 1–3 with data set #2.
 5. Compare your graphs with another student.
 6. Work together to answer the discussion questions posed by your teacher.

DATA SET 1

CARBON DIOXIDE IN EARTH'S ATMOSPHERE

YEAR	CO ₂ CONCENTRATION IN PARTS PER MILLION (PPM)
1750	275
1800	275
1850	290
1900	300
1950	310
2000	360

DATA SET 2

CARBON DIOXIDE EMISSIONS FROM HUMAN ACTIVITY

YEAR	CO ₂ EMISSION IN MILLION METRIC TONS
1750	0
1800	0
1850	0
1900	700
1950	1800
2000	7000