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# K-12 Partnership Lesson Plan

# Brook Wilke

# *Is CO2 an Atmospheric Pollutant*

# *Panel Discussion*

## Overview

The United States Supreme Court is currently (December, 2006) debating the question, “Is carbon dioxide an atmospheric pollutant?” This lesson provides middle school students with an opportunity to learn about and discuss rising carbon dioxide levels in the atmosphere, which may drastically change their lives in the future. A panel discussion with two-three adults is used to engage students in a discussion about the Supreme Court case. Adults help to share as much information as possible about the issue with students to help them form their own – unbiased opinion on the matter.

**Objectives**

At the conclusion of the lesson, students will be able to:

* Define what carbon dioxide (CO2) is
* State why the concentration of CO2 is rising in the atmosphere
* Understand how CO2 in the atmosphere will cause rapid climate change
* Understand that rising CO2 increases growth among many plant species
* Identify ways to remove CO2 from the atmosphere
* Define air pollutant based on the definition set forth in the Clean Air Act
* Use the data collected by science to make an educated argument regarding the question of, “Is CO2 an atmospheric pollutant?”
* Identify ways that they can personally limit the amount of CO2 released to the atmosphere

**Length of Lesson**

Two 1 hour sessions

**Grade Levels**

6th

**Standards covered (NGSS)**

Disciplinary Core Ideas:

* **MS-ESS3-5**: ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century
* **MS-ESS3-4**: construct an argument supported by evidence for how increases in human population and per-capita consumption of natural resources impact Earth’s systems

Cross Cutting Concepts:

* Patterns
* Stability and change of systems

Science and Engineering Practices

* Engaging in argument from evidence
* Obtaining, evaluating, and communicating information

***Previous Michigan Standards Met:***

* **I.1.MS.1 (C 7):** generate scientific questions about the world, based on observation
* **I.1.MS.5 (C 11):** use sources of information to help solve problems
* **II.1.MS.1 (R6):** evaluate the strengths and weaknesses of claims, arguments, or data
* **II.1.MS.3 (R8):** show how common themes of science, mathematics, and technology apply in selected real-world concepts
* **II.1.MS.5 (new):** develop an awareness of and sensitivity to the natural world
* **III.5.MS.6 (LEC 11):** describe ways in which humans alter the environment
* **II.1.MS.4 (R 9):** describe the advantages and risks of new technologies or patterns of human activity

**Materials**

* Encyclopedias (paper or online)
* Attached Newspaper Article (available on the “Is CO2 an Atmospheric Pollutant” lesson page on the KBS GK-12 website)
* Two adults to serve on the panel and a teacher to mediate

**Background**

### *Strategy:* *theoretical storyline*: applying principles to processes in systems

### *Observations, patterns, and explanations*

### *Introduction/Anticipatory Set*

* During the first hour of the lesson, students will read the attached newspaper article from the Associated Press regarding the U.S. Supreme Court case about carbon dioxide (2006/2007). Several states are bringing a suit against the U.S. Government, requesting that the U.S. EPA label carbon dioxide as an air pollutant. The Supreme Court will be deciding an answer to the question, “Is carbon dioxide an air pollutant?”
* Students will do some research about carbon dioxide (CO2) so that they can effectively participate in the panel discussion. The students should be given the following questions to research:
* What is carbon dioxide?
* It is produced by aerobic respiration. Most aerobic animals give off CO2 just through normal respiratory processes as they decompose their food. These food sources can be plants, animals, rotting wood, etc..Decomposition of organic carbon from fossil sources through burning of coal, natural gas, oil, gasoline, etc. is another source of CO2.
* Why is CO2 rising in the atmosphere?
* People burn fossil fuels (carbon that is millions of years old) for energy. This process started during the Industrial Revolution and has continued to progress since then.
* People have cleared much of the landscape, including forests, for agriculture and urban sprawl. This process accelerates decomposition and limits the amount of carbon that can be stored in biomass.
* Cement production gives off substantial amounts of CO2.
* How does CO2 cause rapid climate change?
* CO2 absorbs infrared radiation as it moves from the Earth’s surface into the atmosphere. This is called radiative forcing, and traps heat on the earths surface, enhancing the greenhouse effect
* Changes in surface temperature on the Earth may alter many other climactic variables including desert formation, drought, hurricanes, severe weather, etc.
* Warming may cause substantial rises in the sea level through melting of ice
* Reductions in the amount of ice may decrease the amount of solar radiation reflected back to space, further warming the planet.
* However, rising sea levels will increase the amount of water, which may eventually reverse global warming and cause an ice age.
* How does CO2 directly affect ecosystems?
* Most plants rely on CO2 as their carbon source to grow. Enhanced CO2 concentrations may cause enhanced plant growth, but only in some species due to physiological differences between plants
* Higher CO2 concentrations will allow plants to use less water, which may lead to higher soil water levels and increased surface water runoff and flooding.
* How can CO2 be removed from the atmosphere?
* Much of the CO2 in the air will diffuse into the ocean, but will take many years since most of the ocean water never reaches the surface.
* Replanting forests will help store carbon in biomass.
* No-till and organic agriculture help to store more carbon in soils
* How does the Clean Air Act define a pollutant?
* “Unwanted chemicals or other materials found in the air. Pollutants can harm health, the environment and property. Many air pollutants occur as gases or vapors, but some are very tiny solid particles: dust, smoke or soot.”

### Activities of the session

1. During the second hour period, as a class, the teacher and students should discuss the six questions that were posed during the first hour above. The teacher should make sure that the students understand the answers to each of the six questions before proceeding. (10 min.)
2. Each of the two adult panelists should take a seat in front of the classroom while the teacher explains to the class what the panel discussion will involve. The goal of this discussion should be to give the students as much background knowledge as possible, but to ultimately allow them to make up their own decision about the argument.
3. One panelist should make a statement for five minutes for “Yes” carbon dioxide is a pollutant. Following are a few arguments that can be made (5 min.)

* Rising sea levels
* Enhanced severe, unpredictable weather and changing environment
* Any reduction, even if minor, helps this cause
* Individual countries can serve as an example to other countries
* Many people will be affected by climate change that do not contribute to the problem, such as small sea villages and local farming communities
* Certain plants will enhance growth and others will not, which changes the ecosystem function
* These effects are long-term
* Based on the definition of air pollutant, CO2 definitely falls under the category of “harming the environment”

1. The other panelist should make a five minute statement for “No” carbon dioxide is not a pollutant. Following are a few reasons why: (5 min.)

* Carbon dioxide is essential for all life
* There does not appear to be eminent danger to human health
* If one country limits CO2 production, what’s to say that any other countries will follow
* Methane and Nitrous Oxide, although not as abundant in the atmosphere as carbon dioxide, are much more potent as greenhouse gases
* Limiting carbon dioxide emissions could seriously harm the country’s economy

1. After listening to the opening statements, students can ask the panelists questions. Panelists should be free to discuss with the students, maintaining their role. (15 min.)
2. Students are given 10 minutes to discuss in small groups about the topic, to further help formulate their own decision (10 min.)
3. Conduct a silent vote among the students to find out how they would answer the question: “Is CO2 an atmospheric pollutant?” Collect and tally the votes for yes and no.

**Conclusion**

* Finally, discuss some of the ways that students and their families can personally reduce CO2 emissions, regardless of whether it is a pollutant or not:
* Drive less
* Turn off lights and buy compact fluorescent light bulbs
* Flush the toilet less
* Buy more efficient vehicles and use biofuels
* Ask for fewer Christmas presents
* Buy food at the farmer’s market rather than the grocery store
* Buy organic food
* Sign up for “Green Energy” or participate in Carbon Trading programs
* Write a letter to politicians asking them to help reduce CO2 emissions
* In a public location, post the results of the poll that the students silently participated in

**Resources**

There are many useful websites for learning more about this issue, or tracking your own carbon footprint:

* http://epa.gov/climatechange/index.html
* http://www.earthday.net/footprint/index.asp#
* http://www.bestfootforward.com/footprintlife.htm
* www.carboncounter.org

**Extensions and Modifications**

Students can calculate how much iron they ingest by eating cereal in an entire year by calculating how much iron is in the cereal and estimating how much cereal they eat in a year.

**Assessment**

Students should write down a commitment to make one change in their lives that will help to reduce carbon dioxide emissions. After a set period of time (one week – one semester), students should write a summary paragraph about whether or not they actually changed their lives in the way they initially said.

**Post-lesson Comments and Reflection**

*12.15.06*

*This lesson worked extremely well. Sixth graders are at an age where they can understand the format of a panel discussion and really absorb the material that they are given. Many of the environmental problems of today’s world don’t make it into the classroom, but they are really the most important issues to teach kids. Even if they didn’t understand a specific idea, they were still very interested in learning about it and had a lot of questions.*

*A few students did not express a lot of interest, but we had the whole class’ attention for the entire discussion, which was great for 6th grade. Many students were genuinely concerned with the problem.*