

Air Pollution in El Paso/Juarez: Effects of Carbon Dioxide Emissions from our Cars

Created and delivered by **Olamide O. Fagbola**, Geophysics PhD candidate
Prepared for Henderson Middle School Grade 6, El Paso, Texas, May 2007

TEKS Objectives

(6.1) Scientific processes. The student conducts laboratory investigations using safe, environmentally appropriate, and ethical practices.

(A) demonstrate safe practices during laboratory investigations.

(6.2) Scientific processes. The student uses scientific inquiry methods during laboratory investigations. The student is expected to:

(A) plan and implement investigative procedures including asking questions, formulating testable hypothesis, and selecting and using equipment and technology;

(B) collect data by observing and measuring;

(C) analyze and interpret information to construct reasonable explanations from direct and indirect evidence;

(D) communicate valid conclusions; and

(E) construct graphs, tables, maps, and charts using tools (including computers) to organize, examine, and evaluate data.

(6.3) Scientific processes. The student uses critical thinking and scientific problem solving to make informed decisions.

(A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information.

(B) draw inferences based on data related to promotional materials for products and services.

(D) evaluate the impact of research on scientific thought, society, and the environment.

(6.4) Scientific processes. The student knows how to use a variety of tools and methods to conduct science inquiry. The student is expected to:

(A) collect, analyze and record information using tools including beakers, Petri dishes, meter sticks, graduated cylinders, weather instruments, timing devices, hot plates, test tubes, safety goggles, spring scales, magnets, balances, microscopes, telescopes, thermometers, calculators, field equipment, compasses, computers, and computer probes; and

(B) identify patterns in collected information using percent, average, range and frequency.

(6.9) Science concepts. The student knows that obtaining, transforming, and distributing energy affects the environment. The student is expected to:

(A) identify energy transformations occurring during the production of energy for human use such as electrical energy to heat energy or heat energy to electrical energy.

(C) research and describe energy types from their source to their use and determine if the type is renewable, non-renewable, or inexhaustible.

References

http://whrc.org/resources/online_publications/warming_earth/

Materials Required

Safety goggles, matches, **Lab Sheets (L1, L2, L3)**, carbon dioxide emission levels for the United States, **graph sheet**, yeast and molasses solution, test tubes, beakers, Phenol red solution, jars and basins, drinking straws, hot stove, sugar, **Pre-test (A1), Post-test (A2)**

Preparation

Laboratory instructions and laboratory data sheets should be printed. An inquiry based presentation will be given at the beginning of the class period. The presentation will simplify and discuss important aspects of air pollution, air quality, and the types of pollutants (Ozone, Carbon dioxide and particulate matter) in El Paso. Students will be provided worksheet to graph carbon dioxide emission data.

http://www.mongabay.com/images/2006/graphs/co2_country_1990-2025.jpg

Safety Information

This lesson provides minimal safety hazard. Safety goggles are required and equipment must be handled with care.

Engagement Technique

Day 1: Demonstrating possible sources of carbon dioxide

Focus Question: Tell us what is good about carbon dioxide.

A presentation will be given at an introductory level discussing the importance of carbon dioxide to us as human beings. We will discuss how carbon dioxide is also essential to us. How bad or good is carbon dioxide? Human beings breathe out carbon dioxide while plants need carbon dioxide to make their food through photosynthesis.

Day 2: Release of carbon dioxide by Yeast

Focus Questions: How does carbon dioxide enter the atmosphere? How can carbon dioxide be removed from the atmosphere?

A presentation will be given, also at an introductory level, discussing importance of fossil fuels and their sources. How carbon dioxide enters the atmosphere (through burning of fossil fuels like oil, natural gas and coal) and how it is removed from the atmosphere (when absorbed by plants) through photosynthesis. A brief discussion on the three air pollutants in El Paso and their greenhouse effects will also be discussed. Review with students their prior knowledge of sedimentary rocks, fossil fuels and petroleum products. Reinforce the connection between coal/charcoal and sedimentary rocks. Ask students to suggest other materials that have tendency to burn and their sources. Most, if not all of them will come from plants or fossil fuels. Ask students also what might be responsible for the burning of these carbon materials.

We will also talk about the single-cell microscopic fungi called yeast and its production of carbon dioxide in the process called fermentation. Students will be asked to list any non-living (or living) thing that can also produce carbon dioxide.

The class will be divided into groups. Each group will be given the necessary objects to experiment with.

Day 1: Activities demonstrating sources of carbon dioxide

1) The students will be provided a chemical solution called phenol red in a test tube. The students will be asked to hypothesize what they think will happen to the solution when they breathe into it. They will be given drinking straws and asked to blow air into the straw. There will be a color change because of the carbon dioxide been released. The students will be asked what they think is responsible for the color change.

2) Give each team (of about 4 students) a basin, a jar filled with water, jar cover and a drinking straw. Ask students to cover the jar filled with water and overturn into the basin without the water in the jar spilling out. Ask them to carefully insert a drinking straw into the overturned jar and blow into it. Students should continue blowing into the jar until there is no more water in it. Advise students to carefully cover the jar and bring it out of the basin. I will go around each table and place a lighted a match in the jar. The students will be asked what they think is responsible for the matching going off.

Day 2: Activity demonstrating other source of carbon dioxide

1) Students will be provided yeast solution in a beaker, a beaker filled with warm water and a drinking straw. Student will be asked to place well mixed yeast solution into the beaker of warm water. Students will observe bubbles forming which will be due to the yeast releasing carbon dioxide. The students will again be provided a chemical solution called phenol red in a test tube. Students will use drinking straw to collect some of the bubbles and then put into the beaker containing phenol red. There will be a color change because of the carbon dioxide been released. The students will be asked what they think is responsible for the color change.

Lesson Vocabulary

The following vocabularies with their definitions and explanations will be given to the students at the end of the first two activities. Cornell notes will also be used for further understanding of the terms.

- 1) Fossil fuels**
- 2) Greenhouse effect**
- 3) Greenhouse gases (water (H₂O), nitrous oxide (N₂O), methane (CH₄), and carbon dioxide (CO₂))**
- 4) Carbon dioxide**
- 5) Pollution**
- 6) Carbon**
- 7) Yeast**

Exploration

Students will be asked questions about the experiments. The students will be asked if the carbon dioxide released by human beings has any effect on our environment. Students will also create graphs of carbon dioxide emission and population in the US. Students will meet in their groups to analyze and discuss

possible reasons for their results. They should conclude that with increase in population, there will be a corresponding increase in the number of cars and thus an increase in carbon dioxide production.

Explanation, Elaboration, and Extension

Students will be asked to name any non living organism that produces carbon dioxide (if any).

Evaluation

Students will be given a pre-test (in form of a short quiz) so as to know what they know before the activities and a post-test after the activities so as to know what the students have learned. Each student will also answer questions explaining the results of the experiments and drawing conclusions:

- to show (if there is any) a relationship between carbon dioxide amount and population,
- the effects of high carbon dioxide on the global temperature
- the effects of increase in population on carbon dioxide emission in the El Paso/Juarez region (Will provide population of El Paso and Juarez - about 2 million people).
- Will also ask students what they think can be done to limit the production of the greenhouse gases and if possible suggest an alternate source of energy that will not produce carbon dioxide. In other words, students will be asked to list energy sources
- Also ask students the immediate solution to how the numbers of cars on our roads can be reduced.

Have students share their explanations with their groups.

Peer Review

This lesson will be reviewed by Jeannine Kennedy and a group of University of Texas, El Paso peers. The lesson will also be reviewed by Ms. Molly Abu-Issa from Henderson Middle School.