



## USING ALTERNATIVE FUEL SOURCES TO REDUCE EMISSION POLLUTANTS

### INTRODUCTION

Air pollution is a problem of growing importance and its long term effects have serious consequences. In this lesson, students will be introduced to air pollution emissions and where they originate through the evaluation of graphs, working in groups, and engaging in critical discussions. They will investigate the advantages and disadvantages of using alternative fuel sources and begin to discuss what measures can be taken to reduce harmful emissions in everyday life.

### LESSON OVERVIEW

**Grade Level & Subject:** Grades 5-8; Social Studies (Geography), Science and Health

**Length:** 2 class periods

#### Objectives:

After completing this lesson, students will be able to:

- Identify what emissions are and where they come from
- Investigate the advantages and disadvantages of using alternative fuel sources
- Identify actionable measures that can reduce air pollution

#### National Standards Addressed:

This lesson addresses the following National Education Standards:<sup>1</sup>

- Content Standard: **[NSS-G.K-12.5 ENVIRONMENT AND SOCIETY](#)**  
As a result of activities in grades K-12, all students should develop understanding of
  - Understand how human actions modify the physical environment.
  - Understand how physical systems affect human systems.
- Content Standard: **[NPH-H.5-8.1 HEALTH PROMOTION AND DISEASE PREVENTION](#)**  
As a result of activities in grades 5-8, all students will comprehend concepts related to health promotion and disease prevention:
  - Analyze how environment and personal health are interrelated.
- Content Standard: **[NPH-H.5-8.1 HEALTH PROMOTION AND DISEASE PREVENTION](#)**  
As a result of activities in grades 5-8, all students should develop understanding:
  - Populations, resources, and environments
  - Risks and benefits

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<sup>1</sup> <http://www.education-world.com/standards/>

- Science and technology in society

#### Materials Needed:

- **Reproducible #1 – Sources of World Emissions**
- **Reproducible #2 – Alternative Fuel Sources**
- **Reproducible #3 – Alternative Fuel Sources Answer Key**

#### Assessment:

Students will be assessed through the following activities:

- Participation in class discussion regarding **Reproducible #1 – Sources of World Emissions**
- Completion of **Reproducible #2 – Alternative Fuel Sources**
- Completion of alternative fuel advertisement poster and presentation

## LESSON BACKGROUND

#### Relevant Vocabulary:

- **Air Pollution:** the contamination of air by smoke and harmful gases, mainly oxides of carbon, sulfur, and nitrogen<sup>2</sup>
- **Biodiesel:** A fuel that is similar to diesel fuel and is derived from usually vegetable sources.<sup>3</sup>
- **Emission:** Substance discharged into the air (as by a smokestack or an automobile engine)<sup>4</sup>
- **Ethanol:** A colorless volatile flammable liquid that is the intoxicating agent in liquors and is also used as a solvent and in fuel.<sup>5</sup>
- **Hydrogen:** A nonmetallic element that is the simplest and lightest of the elements, is normally a colorless odorless highly flammable diatomic gas, and is used especially in synthesis<sup>6</sup>
- **Natural Gas:** A combustible mixture of methane and other hydrocarbons used chiefly as a fuel and raw material.<sup>7</sup>
- **Propane:** A heavy flammable gas found in crude petroleum and natural gas and used especially as fuel and in chemical synthesis.<sup>8</sup>
- **Respiratory System:** A system of organs functioning in respiration consisting especially of the

<sup>2</sup> “Air Pollution Entry.” Online Dictionary. Retrieved July 2011 from <http://dictionary.reference.com/browse/air+pollution>

<sup>3</sup> “Biodiesel Entry.” Merriam- Webster Online Dictionary. Retrieved March 2011 from <http://www.merriam-webster.com/dictionary/biodiesel?show=0&t=1304382665>.

<sup>4</sup> “Emission Entry.” Merriam- Webster Online Dictionary. Retrieved March 2011 from <http://www.merriam-webster.com/dictionary/emission>.

<sup>5</sup> “Ethanol Entry.” Merriam- Webster Online Dictionary. Retrieved March 2011 from <http://www.merriam-webster.com/dictionary/ethanol>.

<sup>6</sup> “Hydrogen Entry.” Merriam- Webster Online Dictionary. Retrieved March 2011 from <http://www.merriam-webster.com/dictionary/hydrogen>.

<sup>7</sup> “Natural Gas Entry.” Merriam- Webster Online Dictionary. Retrieved March 2011 from <http://www.merriam-webster.com/dictionary/natural%20gas>.

<sup>8</sup> “Propane Entry.” Merriam- Webster Online Dictionary. Retrieved March 2011 from <http://www.merriam-webster.com/dictionary/propane>.

nose, nasal passages, pharynx, larynx, trachea, bronchi, and lungs.<sup>9</sup>

### **Background Information:**

All around the world, **air pollution** is a part of everyday life. This type of pollution is usually invisible and the effects tend to occur over a long period of time, thus it is easy to forget how present this issue is in all of our lives. Air pollution is an enormous worldwide issue and, thus an important topic to be well informed about.

Air pollution is defined as the contamination of air by smoke and harmful gases, mainly oxides of carbon, sulfur, and nitrogen.<sup>10</sup> This type of pollution can exist as: exhaust, smog, factory **emissions**, or dust.<sup>11</sup> In the United States, the largest source of air pollution comes from the burning of fossil fuels in vehicles and factories. The combustion of fossil fuels is most often classified as “incomplete combustion,” which allows for the release of particulate matter into the atmosphere. This is the type of air pollution that is usually visible, such as that produced by a car’s tail pipe.

Air pollution is both an environmental concern and a health issue. When pollutants are pumped into the air, they do not affect just the atmosphere but also can make their way into ground water and soil. Thus, air pollution can be harmful even to the most unlikely organisms such as plants, birds, fish and mammals. Humans too are no exception to these effects. Air pollution can cause horrible health conditions such as lung cancer, asthma and heart disease. Although pollution can affect anyone, young children and the elderly are at the highest risk for these problems. Air pollution can also affect the built world by degrading buildings and damaging important crops. It is clear to scientists that if humans continue to pump so many harmful chemicals and particulate matter into the air, that the issue of climate change will only continue to grow.

Recently, the United States, along with other nations, have begun to research and utilize different forms of fuel to reduce the amount of pollution produced by burning fossil fuels. These newly developed fuels include **ethanol**, **biodiesel**, **natural gas**, **propane**, and **hydrogen**. Each of these fuels have advantages and drawbacks, but all of them burn cleaner than fossil fuels. If the world can begin to depend less upon fossil fuels and more upon alternative energy sources, better health and air quality could be just around the corner.

### **Resources:**

- **Fuel Facts** – *Texas Energy Conservation Association*:  
<http://www.energyeducation.tx.gov/pdf/6fuelfacts.pdf>.
- **Alternative Fuels** – *Department of Energy*:  
<http://www.fueleconomy.gov/feg/current.shtml>.
- **Emissions and Environment** – *Electric Drive Transportation Association*:  
[http://www.electricdrive.org/index.php?ht=d/Articles/cat\\_id/5516/pid/2550](http://www.electricdrive.org/index.php?ht=d/Articles/cat_id/5516/pid/2550).

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<sup>9</sup> “Respiratory System Entry.” Merriam- Webster Online Dictionary. Retrieved March 2011 from <http://www.merriam-webster.com/dictionary/respiratorysystem>.

<sup>10</sup> “Air Pollution Entry.” Online Dictionary. Retrieved July 2011 from <http://dictionary.reference.com/browse/air+pollution>

<sup>11</sup> “Air Pollution Entry.” Medical Online Dictionary. Retrieved June 2011 from <http://dictionary.reference.com/browse/air+pollution>

## LESSON STEPS

### Warm-up: Planes, Trains, and Automobiles!

1. Begin this lesson by asking students the following questions:
  - a) How many cars do you think the average American household owns today?  
*Answer: 2.28*
  - b) Do you think most families really *need* that many cars? *Answers will vary.* What factors should be considered when a family decides to buy another car? *Answer: price, necessity, emissions, etc.*
  - c) Did you know that emissions from cars, buses, and trucks in the US account for approximately half of all air pollution? Do you think that people would drive cars less frequently if they knew that fact? *Answers will vary.*
  - d) Is air pollution a good reason to rethink buying or driving a car? Why? *Answers will vary.*
  - e) How do you think air quality affects our population? *Answers will vary but may include ideas about causes to our health, such as increases in asthma, bronchitis and emphysema. Students might also note that air pollution affects nature.*
  - f) What could be done to improve air quality while still accepting the fact that America is a mobile society and people and goods must be transported from one place to another? *Answer: alternative fuel sources, buying locally, public transportation, etc*
  - g) What are some examples of alternative fuels that might be used to improve air quality? *Answers: ethanol, biodiesel, natural gas, propane, hydrogen.*

### Activity One: Where do Emissions Come From?

1. Show students **Reproducible #1 – Sources of World Emissions** on an overhead projector or interactive whiteboard. Give them a few minutes to look at each graph. Then, ask them the following questions:
  - a) In what sector are the greatest CO<sub>2</sub> emissions? *Answer: transportation*
  - b) In what sector are the least? *Answer: Commercial*
  - c) Which vehicle produces the most CO<sub>2</sub> emissions? *Answer: SUV*
  - d) Which vehicle produces the least? *Answer: bike/walk*
  - e) Why do you think the highest CO<sub>2</sub> emissions are in the transportation sector? *Answer: U.S. relies more on vehicles for transit than other countries do, don't utilize bicycles or walk as much, not as many modes of mass transit compared to other nations.*
2. Give students **Reproducible #2 – Alternative Fuel Sources**. Ask them to use a computer to find at least two advantages and disadvantages for each fuel source. Have them use the following site: <http://www.fueleconomy.gov/feg/current.shtml>
3. Ask students to each pick an alternative fuel from **Reproducible #2 – Alternative Fuel Sources**. During class and as homework that evening students should do additional research on their chosen fuel. Have them imagine that they are the owners of a company that distributes this fuel source and they need to sell their product to the 'green' consumer. Instruct them to construct a poster advertising their fuel. Their poster must include at least three facts, a catchy slogan and graphics to "hook" the customer.

4. The next day, have each student give a short presentation about their poster. They should present as though they are trying to sell their fuel to the class.

### **Wrap Up: *Air Quality Homework Assignment***

1. Review the major components of this lesson by reminding students what they learned about vehicle emissions and alternative fuel. Be sure to include the following questions:
  - a. What type of transportation releases the most pollution? *Answer: cars, trucks, etc.*
  - b. Which type releases the least? *Answer: Walking and biking.*
  - c. What are a few types of alternative fuels? *Answer: hydrogen, ethanol, biodiesel, wind, solar, etc.*
  - d. What are some ways to reduce emissions from transportation? *Answer: walk, bike, ride share, take public transportation, etc.*
2. Lead a discussion about switching to one of the new fuel sources the class learned about today. Ask students if they think switching their community (or the country at large) from fossil fuels to one of these fuel sources would be a viable option? Which one would they choose? Why?

### **CONCLUSION:**

In this lesson, students began to critically analyze where air pollution comes from and how a vehicle driven lifestyle contributes to environmental concerns and health issues. Students examined the causes and effects of emissions through graphs and charts. They also investigated the advantages and disadvantages of using a variety of different alternative fuel sources and the plausibility of implementing one of these fuels in their community to reduce fossil fuel emissions and the risks that accompany America's pollution heavy lifestyle. As a result of the activities in this lesson plan, students understand that air pollution is a worldwide problem but viable options exist to help combat the damage it causes.

### **LESSON PLAN CREDITS**

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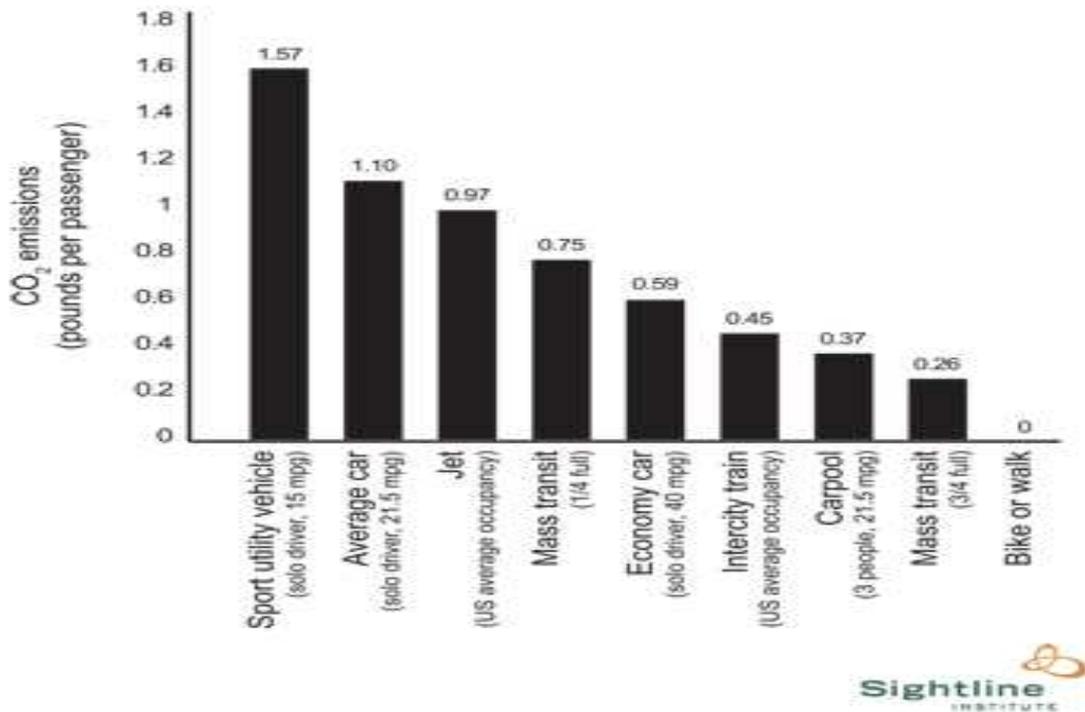
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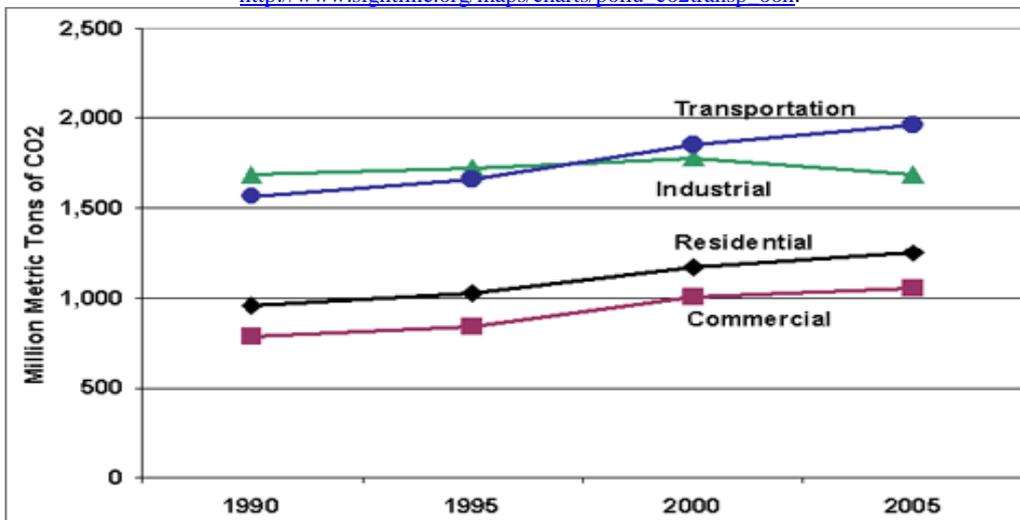
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## Sources of World Emissions



“CO<sub>2</sub> Emissions per mile traveled.” Photograph. The Sightline Institute. Retrieved May 2011 from [http://www.sightline.org/maps/charts/pollu\\_co2transp\\_ooh](http://www.sightline.org/maps/charts/pollu_co2transp_ooh).



“Emissions of Greenhouse Gases in the United States.” Energy Information Administration, Retrieved May 2011 from [http://www1.eere.energy.gov/vehiclesandfuels/facts/2007\\_fcvt\\_fotw464.html](http://www1.eere.energy.gov/vehiclesandfuels/facts/2007_fcvt_fotw464.html).

Name \_\_\_\_\_ Date \_\_\_\_\_

### Alternative Fuel Sources

Alternative Fuel Type	Advantages	Disadvantages

## Alternative Fuel Sources Answer Key

Alternative Fuel Type	Advantages	Disadvantages
<i>Solar Power</i>	<i>No Pollution, quiet, renewable, once installed energy is free, etc.</i>	<i>Can only be used during daylight hours, can be affect by bad weather, expensive to install, etc.</i>
<i>Wind Power</i>	<i>Inexpensive after installation, no pollution, etc.</i>	<i>Loud, expensive to install and upkeep, unsightly, take up a lot of space, dependent on weather, etc.</i>
<i>Ethanol</i>	<i>Can be used in normal cars, creates a larger market for farmers, etc.</i>	<i>Drives up the price of food, still uses fossil fuels, still creates emissions, etc.</i>
<i>Biodiesel</i>	<i>Recycles already used oil, free or very cheap after installation biodegradable, etc.</i>	<i>Must reconfigure engines to run on it, still produces emissions, etc.</i>
<i>Hydrogen</i>	<i>Renewable, no harmful emissions, etc.</i>	<i>Dangerously explosive, expensive, etc.</i>