

## How Do Our Actions Impact Indoor Air Quality and Beyond?

### **AUTHOR:**

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### **OVERVIEW:**

In this lesson, students will gain a better understanding of the risk factors that affect the quality of air at different levels. They will first investigate indoor air pollutants by conducting an air quality assessment right around them including the air they breathe, and continuing on to the air surrounding the Earth. They will also develop pollution prevention strategies for each level.

### **High School Content Standards (HSCS):**

- Examine the negative impact of human activities (B3.4C).
- Describe the greenhouse effect and list possible causes (B3.4D).
- List the possible causes and consequences of global warming (B3.4E).

### **OBJECTIVES:**

Students will be able to:

1. Identify and give examples of types of indoor and outdoor air pollution.
2. Conduct air quality risk assessment to identify factors that affect the quality of air at various levels— from the air them all the way to the air surrounding the Earth.
3. Understand that air quality can be the result of personal choices individuals make.
4. Describe the health impacts of indoor air pollutants.
5. List human activities that produce air pollutants.
6. Develop a pollution prevention strategy to reduce air pollutants.
7. Understand how air pollutants contribute to greenhouse gases.
8. Explain the link between greenhouse gases generated by human activities and global climate change.
9. Describe the greenhouse effect, global warming, and global climate change.

### **BACKGROUND INFORMATION:**

It is estimated that people spend over 90% of their time indoors. According to the Environmental Protection Agency indoor air pollution can cause a range of symptoms from allergic reactions to fatigue, and is one of the top threats to public health. Three significant sources of indoor pollution include tightly sealed buildings and heavily glued construction materials and furnishings, inadequate ventilation, and human-caused emissions from sources such as cosmetics and cigarette smoke.

**GRADE:** High School

**SUBJECT(S):** Science

**DURATION:** Several 50-minute sessions

**HSCSs:** B3.4C, B3.4D, B3.4E

### **MATERIALS:**

- Home\*A\*Syst, Indoor Air Quality Chapter 5 and Risk Assessment (Available at the Michigan Water Stewardship Program under Publications)
- Internet access
- Posterboard
- Markers
- Computers with PowerPoint installed

## **Air Pollutants**

Air pollutants are unwanted chemicals or other materials found in the air we breathe. They can occur indoors and outdoors, and can be produced naturally or as a result of human activity as well. Pollutants can harm the health of living organisms, the environment, and property. Many air pollutants occur as gases or vapors, but some are very tiny solid particles, such as dust, smoke, or soot.

## **Indoor Air Pollutants Are Not Always Easy to Detect**

Indoor air pollution consists of air pollutants that occur within buildings or other enclosed spaces, as opposed to those occurring in outdoor, or ambient air. Certain indoor air contaminants are at much higher levels than outdoors. Examples of indoor air pollutants include combustion products such as carbon monoxide, building materials such as asbestos, biological contaminants such as mold and pollen, household products and chemicals, radon, and methane.

It is not always easy to detect poor air quality. Although you can smell paint vapors and see smoke, many harmful pollutants, such as deadly carbon monoxide gas, are invisible and odorless. Common health problems, such as irritated eyes and nose, headaches, dizziness, tiredness, asthma, viral infections and respiratory diseases, may be due to substances in the air you breathe. Some serious effects of poor air quality, such as lung cancer, may take many years to develop. People react differently to contaminants depending on their age, sensitivity and health status, and the type and length of exposure. Indoor air pollutants are associated with high cancer risks. In the United States, radon is the second leading cause of lung cancer after smoking. It contributes to over 20,000 deaths per year.

## **Sources of Indoor Air Pollutants**

There are two main sources of indoor air pollutants: natural sources and area sources. Area sources are those whose emissions are spread over a wide area, such as those resulting from consumer products and fireplaces. These stationary sources can consist of many small sources of air pollution. Individually, they may not seem significant, but when combined, they may be a significant source of air pollution. Natural sources include emission sources not produced by humans, including biological and geological sources. Examples of biological sources include pollen, spores, and bacteria. An example of a geological source is radon.

## **Indoor Air Quality: Your Resource, Your Responsibility**

Clean air is a precious asset – fresh, full of oxygen, and without harmful pollutants. If you are like most people, you spend at least half of your life inside your home, where certain contaminants are at much higher levels than outdoors. The health risks from indoor air pollution can easily be overlooked and/or underestimated. Importantly, the U.S. EPA does not regulate indoor air quality like it does for outdoor air. The air in many modern American homes, however, may not be fit to breathe. It can be more polluted and dangerous to your health than outdoor air. If your home has poor air quality, it may be simply annoying or unpleasant, or it may lead to serious health problems.

## **Impact of Human Activities on Air Quality**

Greenhouse gases are atmospheric gases such as carbon dioxide, methane, chlorofluorocarbons, nitrous oxide, ozone, and water vapor that slow the passage of re-radiated heat through the Earth's atmosphere. The greenhouse effect is a natural effect where water vapor, carbon dioxide and other gases in the atmosphere trap heat and warm the Earth's surface. Human activities can add to naturally occurring greenhouse gases, which in turn lead to global warming. Global warming is the increase in

the temperature of the Earth's troposphere. Global warming has occurred in the past as a result of natural influences, but the term is most often used to occur as a result of increased emissions of greenhouse gases. Global climate change involves changes in long-term patterns including temperature, precipitation, circulation, and extreme weather. Climate refers to long-term patterns in the weather, for example, annual average temperature and rainfall. Climate change may be natural and also a result of human activity.

## **VOCABULARY**

Air pollutants, air pollution, air quality, air toxics, anthropogenic area sources, emissions, acute health effects, aerosol, asthma, biogenic sources, carbon monoxide, carcinogenic, chlorofluorocarbons, chronic health effects, combustion, dust, hazardous air pollutants, global warming, global climate change, greenhouse effect, greenhouse gases, human modifications of the ecosystem, indoor air pollution, hydrocarbons, lead, methane, particles or particulate matter, volatile organic compounds, micron, nitrogen oxide, parts per million, parts per billion, pollutants, pollution prevention, radon, sensitive groups, smoke, soot, source, stationary sources, ground-level ozone

## **PROCEDURE:**

### **WARM-UP (Anticipatory Set)**

- Review types of air pollution and their sources. How does each compromise air quality?
- Discuss ways to identify air pollutants. Can you see or smell all air pollutants?
- As part of a homework assignment to be completed prior to the start of this lesson, students should complete a series of air quality assessments in which they will brainstorm factors/pollutants which affect the quality of the air they breathe at each of the following levels: immediately around them, their home, school, city in which they live, state in which they live, entire United States, and Earth.
- Ask for volunteers to share the results of their pre-lesson homework assignment, in which they completed risk assessments of air at different levels. Which pollutants are caused by humans? Which occur naturally? How can you eliminate and/or decrease the impact of each pollutant? How does the air quality at one level affect the air quality at another level? Give examples.

## **ACTIVITY:**

- After completing the air quality risk assessment, students will conduct an extensive indoor air quality assessment of their home using the Home\*A\*Syst Indoor Air Quality Assessment. Create an inventory of indoor air pollutants in the home and categorize each pollutant based on whether it is naturally occurring or caused by humans. Research health effects of each pollutant, and determine what can be done to reduce or eliminate each pollutant identified.
- Conduct a similar assessment at school to determine what can be done to make sure the air is safe to breathe. Develop a report to present ideas to the school administration about recommendations you have to improve school air quality.
- Compare and contrast indoor air quality at home and school. Which air pollutants are found in one or both places? How does air quality at your home or school compare to that at the national

level? Do your actions generate air pollutants that contribute to ground-level ozone or an increased level of emissions of greenhouse gases?

- Conduct research on the Internet to identify resources and services in your community to help deal with indoor air pollutants. Create a “Community Resource Directory” and share it with your school, friends, family, and neighbors.
- From the results of their analysis of all the air quality factors that affect them, have students put together a PowerPoint presentation to share with other students, their families, and the community to share their findings.
- Some people suffer from a condition called Sick Building Syndrome, which produces symptoms of allergic reactions, headaches, fatigue, asthma, nervous system disorders, respiratory and sinus congestion. This syndrome is thought to be caused by indoor air pollutants. Certain indoor plants can absorb and remove volatile organic compounds (VOCs) from indoor air. NASA recommends one indoor plant for every 100 square feet of living space to improve indoor air quality. To optimally clean indoor pollution, 2- 4 medium sized plants are suggested. Research which specific types of plants can best filter indoor air, and calculate the number of square feet in our home and school to figure out the number of plants needed to best “scrub” your indoor air. Share the results with your family and your school.

### **Wrap Up (Closure)**

- Discuss how individual actions and choices can result in more far-reaching impacts on air quality. What would students be willing to change in order to improve their own air quality? The air quality for others?
- Were students surprised by all the sources that contributed to indoor air pollution?

### **ASSESSMENT OPTION:**

- Is air quality constant? Give examples of situations in which air quality can vary based on where someone is and what’s going on around them.
- Is the pollution immediately around you more significant than the pollution around you on a larger scale, for example, in your city or region? Why or why not?

### **ADAPTATIONS/EXTENSIONS/ENHANCEMENTS**

- Conduct Home\*A\*Syst Air Quality risk assessments with friends and neighbors to gauge their susceptibility to indoor air pollutants. Create action checklists for the high and medium risk identified. Write down the improvements they plan to make, and identify target dates for completing these plans.
- Ask students to interview members of their family to determine if they have experienced any short or long-term health affects which have resulted from poor indoor air quality. Try to pinpoint the causes of these health affects.
- Who has responsibility for monitoring air pollution at each level?

### **RESOURCES:**

Home Assessment System (Home\*A\*Syst) Air Quality , Chapter 5:  
Available at the Michigan Water Stewardship Program web site under Publications

**MEECS Air Quality Curriculum**

[http://www.michigan.gov/deq/0,1607,7-135-3307\\_3580\\_29678---,00.html](http://www.michigan.gov/deq/0,1607,7-135-3307_3580_29678---,00.html)

**National Green Week**

<http://www.nationalgreenweek.com/curricula/high-school-green-teams/air-quality-curricula.html>

**Green Education Foundation:**

<http://www.greeneducationfoundation.org/>

**O2 For You:**

<http://www.o2foryou.org/>

**Benefits of Indoor Plants:**

<http://www.extension.umn.edu/yardandgarden/ygbriefs/h110Indoorair.html>