

Air Pollution Unit Overview

Target grade and subject: 6th grade science

Duration of unit: 5 days, plus assessment



Purpose of unit:

The goal of this unit is to introduce the topic of air pollution and how it impacts human life. Students learn how our air is polluted, the elements that make up our atmosphere and the various concentrations of gases. Students then learn about several common sources of air pollution and how they, even as kids, contribute to air pollution. Students also learn about asthma and how air pollution aggravates the problem. Finally, students participate in a computer activity to learn how air quality is measured and can be improved.

Students learn basic chemistry terms in sixth grade and routinely discuss “air”, but have no knowledge about what air is and how it is impacted by human activities. This unit will make an excellent addition to my current matter unit, enhancing the lessons already taught and bringing in a new, environmental dimension. Additionally, it meets the content benchmarks that have been difficult for us to teach and students to learn. It is my goal that students become more environmentally aware and sensitive to how human actions impact our natural world.

Michigan Content Benchmarks Addressed:

- Explain how humans modify the environment and describe some of the possible consequences of those modifications (SS.II.2.MS.4).
- Generate scientific questions about the world based on observation (SCI.I.1.MS.1).
- Describe the composition and characteristics of the atmosphere (SCI.V.3.MS.2).
- Design and conduct scientific investigations (SCI.I.1.MS.2).
- Describe health effects of polluted air (SCI.V.3.MS.4).
- Describe ways in which humans alter the environment (SCI.III.5.MS.6).
- Use sources of information in support of scientific investigations (SCI.I.1.MS.5).

References Used:

Air Pollution Can Trigger Asthma Poster, 2003. Published by Wisconsin Environmental Health Association. PUB CE-7004-03.

Air Quality Lesson Plans; Michigan Environmental Education Curriculum Support, DEQ, 2005; Lesson 1-4; pg. 1-135.

Effects of Common Air Pollutants Poster; EPA. EPA-452/F-04-001

EXPOLRE our Natural World: A Biodiversity Atlas of the Lake Huron to Lake Eric Corridor; 2002. Project edited by Mary Kehoe Smith and Bob Weir. U.S. Environmental Protection Agency Great Lakes National Program Office to the Wildlife Habitat Council, pg.112-118.

Global Warming Wheel Card Classroom Activity Kit, 2000. EPA.
Van Nostrand's Science Encyclopedia; 1999. John Wiley & Sons Inc. pg. 211-213.

GLOBE Science and Education Program, 2004. The Globe Program UCAR/CSU.

www.epa.gov/globalwarming

www.airnow.gov

Day 1 – What Gets into the Air?

Overview: An investigation that shows how combustion activities contribute to air pollution.

Investigation question: Does the process of burning contribute to air pollution?

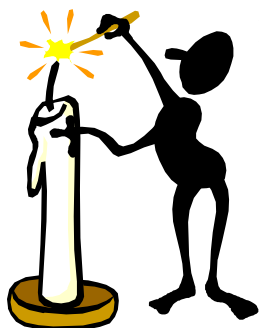
Hypothesis: Students are expected to respond that burning does not contribute to air pollution since it only releases gases. Gases are not a solid and do not pollute.

Content standards:

- Explain how humans modify the environment and describe some of the possible consequences of those modifications (SS.II.2.MS.4).
- Generate scientific questions about the world based on observation (SCL.I.1.MS.1).
- Describe the composition and characteristics of the atmosphere (SCI.V.3.MS.2).
- Design and conduct scientific investigations (SCL.I.1.MS.2).

Background Information:

Human activities contribute to the pollution our atmosphere. Significant amounts of pollution are due to the burning of fossil fuels to generate power. The process of burning releases gases and solid pollution into our atmosphere. Water is a natural byproduct of combustion.



Design of investigation:

1. Begin with a class discussion about air pollution and the kinds of activities people do that create air pollution. Record responses on a board or large sheet of paper. Generate as many ideas as possible. Allow students to see this list throughout the lesson and lab activities.
2. Pass out student worksheet “Burning Questions” and explain the procedure to the students. Review safety procedures with students.
3. Working in small groups or with partners, students will observe an unlit candle and make observations and draw the candle on the lab sheet.

4. Next, they light the candle and specifically observe and pollutants they see. Record results and draw candle.
5. Students then extinguish the candle and record observations and draw the candle.
6. As a class, discuss:
 - a. Reactants/Products: Allow students to cut out and manipulate paper models of atoms. Students will discover that wax (methane) and oxygen produce carbon dioxide and water.
 - b. Model the burning candle again and place a glass beaker at the top of the flame. Students should observe that 'soot' (solid pollution) is also released during burning.
 - c. Demo – Place some talcum powder in the bottom of a glass beaker. Burn the candle and extinguish it by placing the beaker over the flame. The powder should stick to the sides of the beaker showing that water is released during the burning process.
 - d. As a whole class, generate a list of machines that have an engine to 'burn' fossil fuels to generate power. Encourage kids to think of things that they use. Examples: lawn mower, quad, dirt bikes, etc.
 - e. Allow students to make the Global Warming Wheel Card and assess how they can reduce carbon dioxide emissions.
7. Allow students time to reflect in their daily journals about how burning contributes to air pollution.
8. Extension activity- "Burning Questions at Home" worksheet. Students identify fuel burning sources at home.



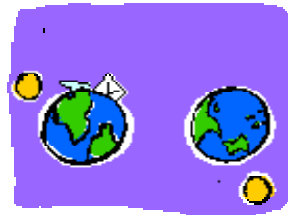
Sources and websites:

[Air Quality Lesson Plans](#); Michigan Environmental Education Curriculum Support, DEQ, 2005; Lesson 1; pg. 1-16.

Global Warming Wheel Card Classroom Activity Kit, 2000. EPA.

www.epa.gov/globalwarming

6th Grade Science
Day 2 – What is in the atmosphere?
What are the sources of pollution?



Overview: An investigation that shows the composition of gases in our atmosphere and the sources of pollution.

Investigation question: What are the layers of the atmosphere and how are the layers affected by pollution?

Hypothesis: Students are expected to respond that the atmosphere is made up of one single layer of just oxygen and that pollution is spread evenly throughout it.

Content standards:

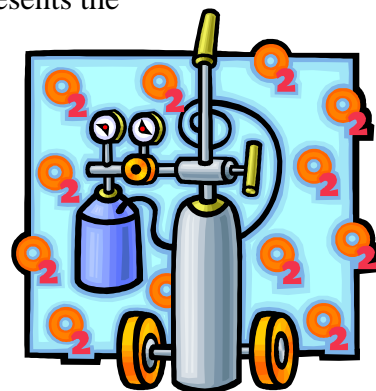
- Explain how humans modify the environment and describe some of the possible consequences of those modifications (SS.II.2.MS.4).
- Describe the ways in which humans alter the environment (SCI.III.5.MS.6).
- Describe the composition and characteristics of the atmosphere (SCI.V.3.MS.2).

Background Information:

Human beings are dependent on a mixture of oxygen, carbon dioxide and water vapor in the atmosphere around us. Without these substances, life would not exist. The atmosphere refers to the layers of air that surround the Earth while air is an invisible mixture of gases surrounding Earth. Air is composed of many different types of gases, but also contains liquids and solid particles. The layer of atmosphere directly above the Earth is the troposphere. This layer supports all of our weather. The stratosphere, directly above the troposphere, is composed of ‘good ozone’ and shields the Earth from harmful radiation. Air pollution comes from a variety of sources and travels freely around the Earth. Scientists classify air pollution into five categories; point or stationary sources, such as factories or power plants, mobile sources, specifically motor vehicles and engines, area sources, which includes livestock and home pollution, natural sources, such as volcanoes and fires, and wet and dry deposition, or solid particulates.

Design of investigation:

1. Before class, the teacher should set up a canister that represents the concentrations of molecules in our atmosphere. Use a variety of materials, such as beads, coins, marbles, candy, etc. place 78 same colored objects in the box to represent nitrogen, 21 same colored objects in the box to represent oxygen and 1 object of a third color to represent all of the different gases in the atmosphere.
2. Go around the room, allowing students draw out an individual item and record the color in a classroom data chart. When all objects have been drawn from the box, add up numbers of each color and convert to percentages. Use an overhead transparency to identify the



layers of the atmosphere.

3. In small groups, have students fold a piece of paper lengthwise. In the left column, the groups should list places/objects that pollute our air. Allow a few minutes of work time.
4. Using the overhead transparency “Air Pollution Sources”, review with the class how scientists have classified air pollution. Discuss the examples in each category. Allow each group time to classify their list in the right column.
5. As a closing activity, discuss with students ways that humans can improve air quality. Spray a little air freshener or perfume in the corner of the class and allow students to observe how it moves throughout the room. Allow students to predict is the entire bottle/can was sprayed in area. Encourage students to hypothesize how humans can improve air quality without necessarily eliminating air pollution.
6. Allow students time to reflect in their daily journals about the composition of our atmosphere and sources of air pollution.

Sources and websites:

[Air Quality Lesson Plans](#); Michigan Environmental Education Curriculum Support, DEQ, 2005; Lesson 1 and 3; pgs. 19-27; 59-79.

EXPOLRE our Natural World: A Biodiversity Atlas of the Lake Huron to Lake Eric Corridor; 2002. Project edited by Mary Kehoe Smith and Bob Weir. U.S. Environmental Protection Agency Great Lakes National Program Office to the Wildlife Habitat Council, pg.112-118.

6th Grade Science

Day 3 – Asthma and Air Pollution

Overview: An investigation that explains what asthma is and how air pollution can aggravate the problem.

Investigation question: What is asthma and how can air pollution aggravate the problem?

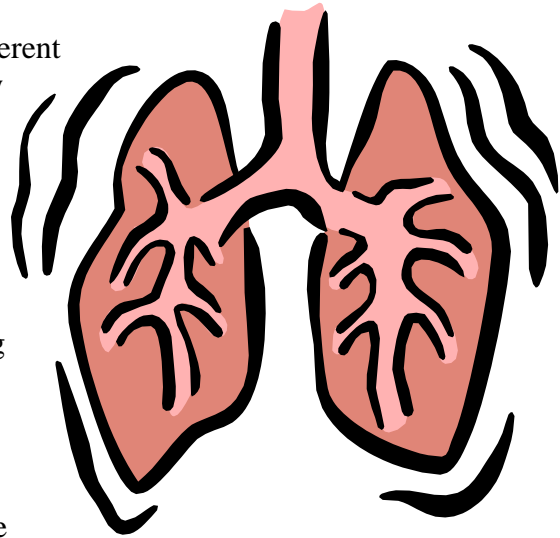
Hypothesis: Students are expected to respond that they are not sure what asthma is or how air pollution effects it.

Content standards:

- Explain how humans modify the environment and describe some of the possible consequences of those modifications (SS.II.2.MS.4).
- Describe the health effects of polluted air (SCI.V.3.MS.4).
- Describe the ways in which humans alter the environment (SCI.III.5.MS.6).
- Design and conduct scientific investigations (SCI.I.1.MS.2).

Background Information:

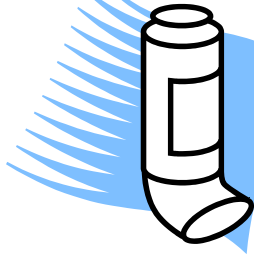
Asthma is a chronic disease of the lungs with different degrees of severity. While some people may only experience mild symptoms, ranging from a cough and tightening of the chest, others experience severe symptoms that restrict air flow and can become life threatening. During an asthma attack, the bronchial tubes react to some trigger and become inflamed and swollen. The muscles around the airways constrict, making breathing difficult. Additional mucus is also formed, enhancing the problem.



Design of investigation:

1. Begin the lesson by looking up “asthma” in the Science Encyclopedia, giving students a few minutes to read the captions and pictures. Also have students raise their hand if they or someone they know has asthma.
2. Show students the chart showing Asthma Prevalence in Michigan among High School Students in 2003, specifically discussing how roughly 20% of our population is affected by asthma.
3. Read the article called “The Asthma Story” aloud using the poster showing how air pollution can trigger asthma. Encourage students with asthma to describe how an asthma attack feels. Using coffee stirrers or drinking straws, have students breathe through just the straw for a few minutes, experiencing diminished lung capacity.

4. Distribute copies of “Air Pollution and Health” worksheet as well as make an overhead transparency. Complete the chart as a class discussing how human health can be affected from various air pollutants.



Continue looking at the overhead transparency map, which shows emissions distribution in 1999 and the asthma hospitalization rate for children. Discuss patterns and allow students to make predictions about other states as well as different years.

5. Allow students time to reflect in their daily journals about asthma and how air pollution affects asthma.
6. As an extension activity, allow students to complete the asthma story questions or interview someone with asthma, describing their experiences.

Sources and websites:

Air Pollution Can Trigger Asthma Poster, 2003. Published by Wisconsin Environmental Health Association. PUB CE-7004-03.

Air Quality Lesson Plans; Michigan Environmental Education Curriculum Support, DEQ, 2005; Lesson 2; pg.29-39;50-58.

Effects of Common Air Pollutants Poster; EPA. EPA-452/F-04-001

Van Nostrand’s Science Encyclopedia; 1999. John Wiley & Sons Inc. pg. 211-213

6th Grade Science

Days 4& 5 - Ozone in Your Backyard

Overview: An investigation of air quality index levels and patterns in the Midwest region of the United States.

Investigation question: Is there bad ozone where I live?

Hypothesis: Students are expected to respond that ozone is not a problem in their life and does not affect them.

Content standards:

- Generate scientific questions about the world based on observation (SCI.I.1.MS.1).
- Design and conduct scientific investigations (SCI.I.1.MS.2).
- Use sources of information in support of scientific investigations (SCI.I.1.MS.5).



Background Information:

Introduce the activity by asking students about their prior knowledge of ozone. Show students overhead with the diagram of the Earth and the layers of the atmosphere. Explain that there is more than one level of ozone, the stratosphere is good ozone and protects us from UV radiation while ozone created in the troposphere is man made and can be hazardous to plants and animals. Show and discuss the transparencies and explain what causes ozone. Explain that ozone is measured in a relative way by the air quality index. Using the AQI, students will focus on the patterns of bad ozone in the Midwest region.

Show students the transparency of the global image of the Earth and the ozone distribution. Explain the key to the map using your classroom poster of air quality index. Ask a few practice questions such as what is the air quality in a few locations. Explain that we will be going to the computer lab to collect data on ozone conditions in our area.

Design of investigation:

7. Pass out student worksheet and explain the procedure to the students.
8. Students go to the www.airnow.gov website.
9. Using a pre-selected month and year, students will create a table of data. The data points are: date and peak ozone concentration measured by the AQI color over a selected city.
10. Data will be graphed in a bar graph. Students will need to use correct labels and title and be able to identify dependent and independent variables.
11. Groups will hang their graph according to year, make data comparisons and participate in a classroom discussion.

Discussion Questions:

1. Do we have a problem with ozone in our backyard?
2. Is your hypothesis correct or incorrect? What do you think now?
3. What do you think we happen if we looked at a different month? Day of the week?
4. Do seasons make a difference in the amount of ozone in our area?
5. What generalizations can you make about the amount of ozone in our area over the past few years? Can you identify any patterns?
6. What predictions can you make for our future?
7. Does ozone affect your health?
8. What can you do to reduce ozone days in our area?

Anticipated Conclusions:

1. The number of days with elevated ozone activity in our area has increased over time.
 2. The warmer the weather, the more ozone that is created.
 3. Students will predict that our area will see an increase in the number of ozone action days.
12. Students will work independently to answer the questions about ozone in their backyard. (Located on the student worksheet.)
13. After students have learned about the Air Quality Index, select a student who will check the website each day and set the poster to the correct setting for each day.
14. Allow students time to reflect in their daily journals about how air quality is measured and ozone action days.

Sources and websites:

[Air Quality Lesson Plans](#); Michigan Environmental Education Curriculum Support, DEQ, 2005; Lesson 4; pg. 101, 104, 115-116.

www.airnow.gov

Name _____
Date _____

Ozone in My Backyard Student Response sheet

Question: Is there bad ozone in my backyard?

Hypothesis: _____

Procedure:

1. Go into the internet to: www.airnow.gov
2. Click on the tab labeled "ozone"
3. To the right of the map click on "map archives"
4. The window above the map should say "Midwest" click on "go"
5. Now use the drop down menu and select our state.
6. Set the window to the month of July of the year your group was assigned.
7. Click on the window for July 1 to view the map on the full screen. The first map shows the progression of ozone throughout the day. The second map on the page shows the peak ozone for that day. We will be using the peak ozone for the day to record our data today. Find where we are located on the map and record the date and ozone conditions for that day (using the color code) in the table below.
8. Go back to the whole month of maps and click on the next day of the month and repeat the recording procedure.



Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday

When you have finished recording your data for the entire month begin working on your graph.

Read through the following information and the AQI chart:

10 Steps you can Take on Ozone Action Days to help reduce your contribution to ozone formation. (<http://www.epa.gov/ARDR5/naags/o3info.htm>)

Travel Tips

1. Limit driving. Defer errands or share a ride. For short trips, walk or ride a bike.
2. If you drive, avoid excessive idling or jack-rabbit starts.
3. Take transit. Ride the bus or train to work, school or shopping
4. Don't refuel on an Ozone Action Day. If you must refuel do so after 7 pm.
5. Avoid using gasoline powered equipment, such as outboard motors and off-road vehicles.

Home Tips

1. Defer mowing your lawn until late evening or the next day. Also avoid using other gasoline-powered garden equipment.
2. Postpone using oil-based paints, solvents, or varnishes.
3. Use electric starter or charcoal chimney rather than lighter fluid.
4. Defer using household consumer products that release fumes or evaporate easily.
5. Conserve energy to reduce energy needed from power plants.

Air Quality Index Colors and Health Statements

Color	Descriptor	Health statement
Green	Good	None
Yellow	Moderate	People who are unusually sensitive to air pollution should consider limiting prolonged outdoor exertion.
Orange	Unhealthy for sensitive groups	Active children and adults, and people with lung disease, such as asthma, should reduce prolonged or heavy outdoor exertion.
Red	Unhealthy	Active children and adults and people with respiratory disease, such as asthma should avoid all outdoor exertion; everyone else, especially children, should reduce prolonged outdoor exertion.
Purple	Very Unhealthy	Active children and adults, and people with respiratory disease, such as asthma should avoid all outdoor exertion; everyone else especially children should limit outdoor exertion.
Maroon	Hazardous	Everyone should avoid ALL outdoor exertion

Name _____
Date: _____

Investigation conclusions and reflection



1. Is there bad ozone in your backyard? _____
2. Was your hypothesis correct? _____
3. When the AQI color wheel is green what does that mean?

4. How many days in the month of July were green? _____
5. When the AQI color wheel is yellow what does that mean?

6. How many days in the month of July were yellow? _____
7. If you had asthma what would the yellow mean to you?

8. How many days in the month of July were red? _____
9. When the AQI color wheel is red what does that mean?

10. Would a day that is indicated as red be a good day to cut the grass with a push mower? Explain why or why not.

11. What is an ozone action day?

12. Using your new knowledge and the information provided create an ozone awareness poster.

6th Grade Science

Air Pollution Assessment

Overview: An evaluation activity assessing student knowledge about air pollution.

Investigation question: Can the concepts of air pollution, the sources of air pollution, how it impacts human health and how it is measured be combined into a concept map?

Hypothesis: Students are expected to create a basic concept map. Many students will probably forget to include 'connecting' words on the lines or provide examples.

Content standards:

- Explain how humans modify the environment and describe some of the possible consequences of those modifications (SS.II.2.MS.4).
- Generate scientific questions about the world based on observation (SCI.I.1.MS.1).
- Describe the composition and characteristics of the atmosphere (SCI.V.3.MS.2).
- Describe the ways in which humans alter the environment (SCI.III.5.MS.6).
- Describe the health effects of polluted air (SCI.V.3.MS.4).



Background Information:

Air pollution is a large, evolving problem. While our atmosphere is composed of 78% nitrogen, 21% oxygen and 1% other gases; a small amount of pollution has a significant affect on the air we breathe and consequently, human health. Human lifestyles, especially in the United States, have drastically increased the amount of air pollution since all combustion engines emit carbon dioxide. Scientists have classified the six largest contributors of air pollution as point sources, mobile sources, natural sources, area sources and wet and dry deposition. Additionally, factory and power plant smokestacks release large amounts of sulfur dioxide and nitrogen oxides which contribute to acid rain. Polluting our atmosphere comes with a great impact on human health. Asthma, a lung disease that causes the bronchial tubes to contract and restrict air flow, is aggravated by air pollution. Almost 20% of our population suffers from asthma.

Our Earth is protected from harmful radiation by ozone molecules found in the stratosphere. Unfortunately, ozone molecules are harmful if present in the troposphere layer. Ozone is created when nitrogen oxides combine with VOC in the presence of sunlight. This gas is very unstable and breaks down within a few hours, but is harmful humans. The good news is that the quality of air can be measured and improved. Scientists use the Air Quality Index (AQI) to measure the amount of ozone present in a certain area. Warnings are provided when necessary to reduce exposure to ozone. Ozone production can be limited by decreasing the use of combustion engines, especially on hot days.

Humans have the ability to alter the air that we breathe. It is through our activities and lifestyle choices that decisions are made about the kinds and amount of pollution that we will tolerate. Every person's actions directly impact our atmosphere.

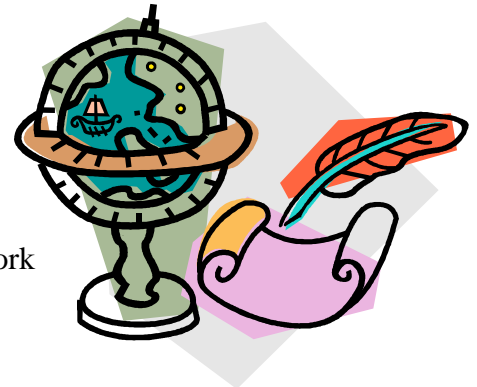
Design of investigation:

Give students a blank sheet of white paper. As a whole class, make a list of the key words that were used learning about air pollution. Keep this list visible, either on the board or overhead projector. Sample words include: air pollution, atmosphere, nitrogen, oxygen, solid particles, gases, carbon dioxide, sulfur dioxide, nitrogen oxide, troposphere, stratosphere, mobile sources (cars and trucks), point sources (factories, smokestacks), asthma, greenhouse gases, global warming, acid rain, ozone, ozone days, AQI, etc. Be sure to include important words that students forgot and eliminate too many words. Distribute the concept map rubric and identify what is expected.

Begin with the concept of air pollution in the middle of the paper. If students haven't created concept maps before, complete a sample map together. Remind students to write connecting words on the lines so that each statement makes sense. Also, encourage students to include several examples about each topic and their own personal experiences. Students might include information about asthma, an asthma attack, 'seeing' air pollution at a park or observing smokestacks.

After students have revised their rough draft, provide time to complete a final copy. This might be a good extension or homework activity. Students could also complete this activity on the computer program Inspiration.

Allow students to evaluate their own map on rubric before the teacher completes the evaluation. Students should share their work with their classmates as well as display their map.



Sources and websites:

[Air Quality Lesson Plans](#); Michigan Environmental Education Curriculum Support, DEQ, 2005; Lesson 1-4; pg. 1-135.

Air Pollution Concept Map Rubric

Map Maker: _____

Each category is worth 5 points.



Concepts

All required idea words used on the map? _____

Concepts are explained correctly? _____

Examples/personal experience included? _____

'Connecting' words used on each line? _____

Words on lines make sense? _____

Appearance

Lines do not cross? _____

Used entire sheet of paper? _____

Words spelled correctly? _____

Total

40

Extra Credit

Pictures added to explain ideas _____

Appropriate amount of color _____

Border around map _____

Total & Extra Credit

Teacher Comments:

