



Air Quality Introduction

In 1969, humans landed on the moon and looked back at the “blue marble” that we know as Earth. The vastness of the oceans was evident, as was the thin layer—the atmosphere—which supports life, as we know it. The next year was the first Earth Day, which was the year of the formation of the U.S. Environmental Protection Agency and the passage of the Clean Air Act of 1970. The air pollutants of greatest concern (criteria pollutants) were defined; they included ozone, carbon monoxide, particles, sulfur dioxide, nitrogen oxide, and lead. Michigan, however, was ahead of the federal government and had established an Air Pollution Control Commission in 1965. Michigan rules were formulated in 1967 to address some of the more severe air pollution problems and permits were required for new sources of air pollution. Michigan has been a leader in recognizing the importance of air toxics, going well beyond federal government programs. It wasn’t until 1990 that federal air permits became mandated and air toxics were more fully addressed at a national level.

Now many decades after Michigan’s bold move to address air quality, have we made progress on our air pollution issues? Do we understand the workings of the thin layer of the blue marble better? Can we learn from the past to prevent problems in the future? Can individuals help to ensure clean air?

A series of lessons in the MEECS Air Quality Unit have been developed to answer eight key questions:

- What is in the air?
- Why should we be concerned about air quality?
- What are the sources of air pollution?
- How can we measure air quality?
- How can we tell what the quality of the air is today?
- What has been done about air pollution?
- What can we do about air pollution?
- How can our actions impact the world?

The lessons in the unit consist of a core set of activities with enhancements and extensions focusing primarily on outdoor air quality. There are a variety of activities for the classroom, computer laboratory, and the outdoors. The activities are aligned to the Michigan Grade Level Content Expectations in Science and Social Studies. Environmental education principles are also addressed.

The unit was designed using the following “Enduring Understandings”:

Upon completion of the unit, students will understand that:

1. Air pollution has both natural and human causes.
2. Small amounts of certain gases or particles are enough to cause air pollution.
3. Some air pollutants are directly emitted from a source and others form in the atmosphere.
4. Health effects of air pollution mainly involve the respiratory and cardiovascular systems, and certain groups of people are more at risk.
5. There are ways to find out about the daily air quality in your area.
6. Air quality in Michigan varies throughout the year and throughout the state.
7. Environmental regulations have helped to improve air quality over the past 40 years.
8. Air pollution problems can be local, regional, and global.
9. Individual actions can make a significant difference in protecting the quality of our air.

This Michigan standards-based curriculum is dedicated to future adults so they can make wise and informed decisions about the air quality issues they now face and that they will face in the future. Choices made today can help prevent another “silent spring”—the wake-up call for environmental awareness.

Air Quality Overview

Essential Questions	Core Lesson
<p>1 How does a burning candle illustrate air pollution? What are the reactants and products of burning? What can happen to the air when fuel, leaves, and trees are burned?</p>	<p>1. What Gets into the Air?—Students make observations and interpretations about a burning candle to help them understand air pollution (i.e., combustion activities).</p>
<p>2 What types of pollutants are in the air and what are their health effects? What is asthma and how does air pollution aggravate the problem? What are local, regional, and global air issues?</p>	<p>2. Why Should We Be Concerned About Air Quality?—By performing a play, students examine common air pollutants, how they are formed, and their health and ecosystem effects. This lesson also includes an extension that provides students with an opportunity to do in-depth research.</p>
<p>3 What are the sources of air pollutants? What are the relative amounts of pollutants from these sources?</p>	<p>3. What Are the Sources of Air Pollution?—Students examine the sources of air pollutants (point, mobile, area, natural) using charts of actual data for Michigan. The concept of an airshed is developed. An enhancement lesson simulates training for air quality regulators.</p>
<p>4 What types of things pollute the air and how can we detect them? How can we monitor particle pollution and ozone levels in our community?</p>	<p>4. How Can We Monitor Air Quality?—Students learn about gases and particles that make up the air and explore different ways to monitor pollutants. In an enhancement lesson, they develop skills in biomonitoring.</p>
<p>5 What can the Air Quality Index (AQI) and the UV index tell us about conditions outdoors? Why are they important to your health?</p>	<p>5. How Can We Tell What the Quality of the Air Is Today?—In this lesson, the Internet is used as a resource for students to access daily (and hourly) information about air quality and levels of ultraviolet radiation from the sun.</p>
<p>6 How has the problem of air pollution affected us over time? How have the present day controls influenced the air quality in Michigan?</p>	<p>6. What Has Been Done About Air Pollution?—Students explore the role of regulations in influencing air quality decisions as they look at trends in air pollution. They analyze changes in levels of pollutants and draw conclusions about air pollution levels. Acid deposition is presented as a case study. In an enhancement lesson, they study the design of air pollution control devices and select air pollution control equipment to reduce air emissions.</p>
<p>7 What should be done about the high levels of ozone in areas of Michigan? How can individuals make a difference in solving air quality issues?</p>	<p>7. What Can We Do About Air Pollution?—Students examine how public policy decisions are made and practice solving problems that require choices. Nonattainment of ozone standards in Michigan is explored. An enhancement lesson on decision-making involving the choice of vehicles is on the MEECS Air Quality CD.</p>
<p>8 What is global climate change and what is its cause? What are the trends in Michigan’s climate? How could climate change affect Michigan’s environment? What actions can we take to mitigate global climate change?</p>	<p>8. How Can Our Actions Impact the World?—Students explore the ramifications of global climate change for Michigan, as well as individual actions that can decrease greenhouse gas (GHG) emissions. Climate patterns in Michigan are evaluated using graphing, interpreting, and analyzing skills.</p>

Enhancements/Extensions

- 1** - Background Lesson: *What Is in the Atmosphere?*
- Reading and PowerPoint on the *Atmosphere* (CD)
 - Readings on *Burning Waste* and *Wildfires* (CD)
 - *Burning Questions at Home* Student Activity
 - Explore fire as a forest management tool.
 - Do lessons based on Faraday's candle observations.
 - Make models of the Earth's atmosphere.

- 2** - Extension: *Investigating An Air Quality Issue* (CD)
- Readings on *Health Effects* and *Asthma* (CD)
 - Reading and activities on *Indoor Air* (CD)
 - Readings and activities on *Radon* (CD)
 - Use EPA's *Tools for Schools* to evaluate indoor air quality
 - Join EPA's *Clean School Bus USA* Program.

- 3** - Enhancement Lesson: *Smoke School* (CD)
- Maps of air pollution sources from EPA's *AirData* (CD)
 - Air quality in National Parks (CD)
 - Readings on *Air Toxics* (CD)
 - Use the EPA *Where You Live* web site to find local emission sources.

- 4** - Enhancement Lesson: *Biomonitoring for Lichens and Milkweeds* (CD)
- PowerPoint on *Meteorology* (CD)
 - Readings on *Ozone*, *Particle Pollution*, and *Haze* (CD)
 - Monitor acid precipitation, carbon monoxide, and radon.
 - Create a "Particle Reference Library."
 - Design other types of particle monitoring devices.

- 5** - PowerPoint on *Air Pollution in Michigan* (CD)
- Readings on the *Air Quality Index* (CD)
 - Readings on the *Ozone Layer* and *UV Index* (CD)
 - *Ozone and Particle Pollution Episodes* PowerPoints (CD)
 - Explore the AQI in other areas of the country.
 - Become an EPA *Sunwise* school.
 - Sign up for *EnviroFlash* to receive daily air quality information.

- 6** - Enhancement Lesson: *How Does Industry Control Air Pollution?* (CD)
- Timelines of air pollution history (CD)
 - Readings and PowerPoints on *Acid Rain* (CD)
 - Emission trends charts (CD)
 - Obtain air permits from MDEQ
 - Invite industry representatives to discuss air pollution control.

- 7** - Enhancement Lesson: *How Do Transportation Choices Influence Air Quality?* (WebQuest on CD)
- Readings on *Ozone Nonattainment* (CD)
 - Readings on *Ways to Reduce Ozone* (CD)
 - Readings on *Particle Pollution* (CD)
 - Play *Smog City* (CD)
 - Engage students in *Project A.I.R.E.* activities. (CD)
 - Organize a meeting to address particle pollution nonattainment.

- 8** - *Climate at a Glance* PowerPoint (CD)
- *Michigan* and *National Greenhouse Gas Inventories* (CD)
 - Readings on *Global Warming* and *Climate Change* (CD)
 - Explore the energy balance, ecosystem, political, and economic aspects of global climate change.

Michigan Grade Level Content Expectations

Grade 6-7 Science:

- Describe the effect humans and other organisms have on the balance of the natural world. **S.RS.06.17**
- Explain how mass is conserved as it changes from state to state in a closed system. **P.CM.06.12**
- Illustrate structure of molecules using models or drawings. **P.PM.07.23**
- Describe the origins of pollution in the atmosphere, geosphere, and hydrosphere and how pollution impacts habitats, climatic change, threatens or endangers species. **E.ES.07.42**

HS Earth Science:

- Explain how carbon moves through the Earth system and how it may benefit or harm society. **E2.3D**

HS Biology:

- Examine the negative impact of human activities. **B3.4C**

HS Chemistry:

- Balance simple chemical equations applying the conservation of matter. **C5.2A**
- Distinguish between chemical and physical changes in terms of the reactants and products. **C5.2B**

Grade 6-8 Social Studies:

- Describe the environmental effects of human action on the atmosphere, biosphere, lithosphere and hydrosphere.
6 - G5.1.1, 7 - G5.1.1

Grade 6-7 Science:

- Describe the effect humans and other organisms have on the balance of the natural world. **S.RS.06.17**
- Describe the origins of pollution in the atmosphere, geosphere, and hydrosphere and how pollution impacts habitats, climatic change, threatens or endangers species. **E.ES.07.42**

HS Earth Science:

- Explain how the impact of human activities on the environment can be understood through the analysis of interactions between the four Earth systems. **E2.4B**

HS Biology:

- Examine the negative impact of human activities. **B3.4C**

Grade 6-8 Social Studies:

- Describe the environmental effects of human action on the atmosphere, biosphere, lithosphere and hydrosphere.
6 - G5.1.1, 7 - G5.1.1

Grade 6-7 Science:

- Analyze information from data tables and graphs to answer scientific questions. **S.IA.06.11**
- Describe the origins of pollution in the atmosphere, geosphere, and hydrosphere and how pollution impacts habitats, climatic change, threatens or endangers species. **E.ES.07.42**

Grade 6-8 Social Studies:

- Describe the environmental effects of human action on the atmosphere, biosphere, lithosphere and hydrosphere.
6 - G5.1.1, 7 - G5.1.1

HS Social Studies:

- Read and interpret data in tables and graphs. **P2.2**

Grade 6-7 Science:

- Describe how human beings are part of the ecosystem of the Earth and that human activity can purposefully, or accidentally, alter the balance in ecosystems. **L.EC.06.41**
- Describe the origins of pollution in the atmosphere, geosphere, and hydrosphere and how pollution impacts habitats, climatic change, threatens or endangers species. **E.ES.07.42**
- Describe the atmosphere as a mixture of gases. **E.FE.07.12**

HS Earth Science:

- Conduct scientific investigations using appropriate tools and techniques. **E1.1C**

Grade 6-8 Social Studies:

- Describe the environmental effects of human action on the atmosphere, biosphere, lithosphere and hydrosphere.
6 - G5.1.1, 7 - G5.1.1

Grade 6-7 Science:

- Describe the origins of pollution in the atmosphere, geosphere, and hydrosphere and how pollution impacts habitats, climatic change, threatens or endangers species. **E.ES.07.42**
- Describe the atmosphere as a mixture of gases. **E.FE.07.12**

HS Biology:

- Examine the negative impact of human activities. **B3.4C**

Grade 6-7 Science:

- Describe how science and technology have advanced because of the contributions of many people throughout history and across cultures. **S.RS.06.19**
- Describe the origins of pollution in the atmosphere, geosphere, and hydrosphere and how pollution impacts habitats, climatic change, threatens or endangers species. **E.ES.07.42**

HS Earth Science:

- Analyze how science and society interact from a historical, political, economic, or social perspective. **E1.2k**

HS Chemistry:

- Predict products of an acid-based neutralization. **C5.7B**
- Explain why sulfur oxides and nitrogen oxides contribute to acid rain. **C5.7H**

6**Grade 6-8 Social Studies:**

- Use historical perspective to analyze global issues faced by humans long ago and today. **6 - H1.4.3**
- Explain that communities are affected positively or negatively by changes in technology. **6 - G2.2.2**
- Explain the challenges to governments and the cooperation needed to address international issues in the Western Hemisphere. **6 - C4.3.2**
- Explain why and how historians use eras and periods as constructs to organize and explain human activities over time. **7 - H1.1.1**
- Identify the role of the individual in history and the significance of one person's ideas. **7 - H1.2.6**
- Explain how governments address national issues and form policies, and how the policies may not be consistent with those of other countries. **7 - C4.3.1**

Grade 6-7 Science:

- Design solutions to problems using technology. **S.RS.06.16**
- Describe the origins of pollution in the atmosphere, geosphere, and hydrosphere and how pollution impacts habitats, climatic change, threatens or endangers species. **E.ES.07.42**

HS Earth Science:

- Critique solutions to problems, given criteria and scientific constraints. **E1.2f**
- Identify scientific tradeoffs in design decisions and choose among alternative solutions (e.g. best management practices, resource quantity and quality trade-offs). **E1.2g**

Grade 6-8 Social Studies:

- Explain that communities are affected positively or negatively by changes in technology. **6 - G2.2.2**
- Explain the challenges to governments and the cooperation needed to address international issues in the Western Hemisphere. **6 - C4.3.2**
- Clearly state an issue as a question or public policy, trace the origins of the issue, analyze various perspectives, and generate and evaluate alternate resolutions. **6 - P3.1.1, 7 - P3.1.1, 8-P3.1.1, P3.1**
- Conduct research on contemporary global topics and issues, compose persuasive essays, and develop a plan for action. **7 - G6.1.1**

7**HS Social Studies:**

- Identify and research various viewpoints on significant public policy issues. **C 6.1.1**
- Address a public issue by suggesting alternative solutions or courses of action, evaluating the consequences of each, and proposing an action to address the issue or resolve the problem. **C 6.1.4**
- Participate in a real or simulated public hearing or debate and evaluate the role of deliberative public discussions in civic life. **C 6.2.10**

Grade 6-7 Science:

- Analyze information from data tables and graphs to answer scientific questions. **S.IA.06.11**
- Describe how human beings are part of the ecosystem of the Earth and that human activity can purposefully, or accidentally, alter the balance in ecosystems. **L.EC.06.41**
- Describe the origins of pollution in the atmosphere, geosphere, and hydrosphere and how pollution impacts habitats, climatic change, threatens or endangers species. **E.ES.07.42**
- Compare and contrast the difference and relationship between weather and climate. **E.ES.07.71**
- Describe how different weather occurs due to the constant motion of the atmosphere from the energy of the sun reaching the surface of the earth. **E.ES.07.72**

HS Earth Science:

- Explain how carbon moves through the Earth system and how it may benefit or harm society. **E2.3D**
- Explain how the impact of human activities on the environment can be understood through the analysis of interactions between the four Earth systems. **E2.4B**
- Explain the natural mechanism of the greenhouse effect, including comparisons of the major greenhouse gases. **E5.4A**
- Describe natural mechanisms that could result in significant changes in climate. **E5.4B**
- Analyze the empirical relationship between the emission of carbon dioxide, atmospheric carbon dioxide levels, and the average global temperature over the past 150 years. **E5.4C**

8**HS Biology:**

- Describe the greenhouse effect and list possible causes. **B3.4D**
- List the possible causes and consequences of global warming. **B3.4E**

Grade 6-8 Social Studies:

- Describe the environmental effects of human action on the atmosphere, biosphere, lithosphere and hydrosphere. **6 - G5.1.1, 7 - G5.1.1**

Air Quality Master Materials List

Lesson 1. What Gets into the Air?	
<p>Reproducible Materials</p> <p><i>per class</i></p> <ul style="list-style-type: none"> • <i>Danger in a Cave</i> (teacher resource) • <i>Models of Atoms</i> (transparency master, cut) • <i>Models of Molecules: Reactants</i> (transparency master) • <i>Models of Molecules: Products</i> (transparency master) <p><i>per small group</i></p> <ul style="list-style-type: none"> • molecular models (make your own using <i>Models of Atoms</i> student resource or use purchased kits) <p><i>per student</i></p> <ul style="list-style-type: none"> • <i>Burning Questions</i> (student activity) • <i>Candles and Air Pollution</i> (student activity) • <i>Burning Questions at Home</i> (home activity) 	<p>Materials in MEECS kit</p> <p><i>per class</i></p> <ul style="list-style-type: none"> • MEECS Air Quality CD (teacher resources, lessons, extensions, student readings) <p><i>per student</i></p> <ul style="list-style-type: none"> • MDEQ pamphlet <i>Burning Household Waste</i> (on MEECS Air Quality CD) <p>To be supplied by teacher</p> <p><i>per class</i></p> <ul style="list-style-type: none"> • clear 2-L pop bottle • spray bottle with water • dust, talcum powder • aromatic substances such as onion, lemon, apple, vanilla extract • air freshener • 3-4 tea candles or a pillar candle for demonstrations (the candles must fit under the 500-mL beaker) • 500-mL beaker for demonstrations • matches • overhead projector • 100 mL limewater (calcium hydroxide saturated, 1.0g/100 mL) • bottle cap to hold limewater • straw • cobalt chloride paper <p><i>per small group</i></p> <ul style="list-style-type: none"> • small tea or pillar candle • aluminum foil or pie pan • 500-mL beaker • envelope, if paper models are used • scissors, if paper models are used <p><i>per student</i></p> <ul style="list-style-type: none"> • safety glasses

Lesson 2. Why Should We Be Concerned About Air Quality?

Reproducible Materials

per class

- *Effects of Common Air Pollutants* (teacher resource)
- *Indoor Air Pollution* (teacher resource)
- *Air Pollutants* (answer key)
- *Categories of Air Pollutants* (transparency master)
- *The Asthma Story* (answer key)

per small group

- individual pollutant strips cut from *Air Pollutants* (student activity)
- *Is There a Connection Between Air Pollution and Asthma?* maps (student resource)

per student

- *One Breath at a Time: The Play* (student resource)
- *The Asthma Story* (student resource)
- *The Asthma Story* (student activity)
- *Air Pollution and Health* (student assessment)

Materials in MEECS kit

per class

- MEECS Air Quality CD (teacher resources, student readings, fact sheets, posters)
- *Effects of Common Air Pollutants* poster
- *Air Pollution Can Trigger Asthma* poster

To be supplied by teacher

per small group

- large sheet of paper (11 x 17 inches or larger)

per student

- straws or coffee stirrers
- costumes or materials for name tags

Lesson 3. What Are the Sources of Air Pollution?

Reproducible Materials

per class

- *Air Pollution Sources* (transparency master)
- *Name That Source* (answer key)
- *Percentage of Air Emissions in Michigan by Source Type* (transparency master)
- *Michigan Air Toxics* (transparency master)
- *Estimate of Mercury Air Emissions in Michigan* (transparency master)
- *Great Lakes Airshed* (transparency master)
- *What Causes the Most Pollution?* (answer key)

per student

- *Looking for Air Pollution* (student activity)
- *Name That Source* (student resource)
- *Name That Source* (student activity)
- *What Causes the Most Pollution?* (student activity)

Materials in MEECS kit

per class

- MEECS Air Quality CD (teacher resources, maps, enhancement lessons, student readings, PowerPoints)
- Air Quality Unit Poster

To be supplied by the teacher

per class

- Clear 2-L pop bottle with pollutants from Lesson 1
- pan of water

Lesson 4. How Can We Monitor Air Quality?

Reproducible materials

per class

- *Great Lakes Airshed* (map from Lesson 3)
- *Ozone Monitors in Michigan* (transparency master)
- *Particle Pollution (PM_{2.5}) Monitoring Network* (transparency master)
- *Types of Particle Pollution* (transparency master)
- *Particles in the Air* (transparency master)

per small group

- particle counting grid (transparency)
- *What's in the Air?* (student resource)
- *How Can We Monitor Air Pollution?* (student activity)

Materials in MEECS kit

per class

- MEECS Air Quality CD (teacher resources, lesson support materials, PowerPoints, student readings)

per student

- color conversion chart (Schoenbein Scale)

To be supplied by the teacher

per class

- 1 air freshener spray bottle or other odor source (lemon, onion)
- fan
- hole punch
- stapler
- spray bottle with water

per small group

- thermometer (different kind for each group)
- 4" x 6" white index card
- clear adhesive tape
- ruler
- scissors
- string (about 24"/monitor)
- microscope or magnifiers
- ozone paper
- plastic bag

Materials to make ozone paper

- 250 mL beaker
- corn starch
- potassium iodide
- distilled water
- stirring rod
- hot plate
- small paint brush
- glass plate
- filter paper
- safety glasses

Lesson 5. How Can We Tell What the Quality of the Air Is Today?

Reproducible materials

per class

- *Accessing Air Quality Data from MDEQ and U.S. EPA* (teacher resource)
- *Interpreting the AQI* (answer key)
- *Interpreting the UV Index* (answer key)
- *Patterns of Particle Pollution and Ozone* (answer key)
- *Particle Episode January 31 – February 6, 2005* (teacher resource)
- *National Ambient Air Quality Standards* (teacher resource)

per student

- *The Air Quality Index* (student resource)
- *What Is your AQI?* (student activity)
- *Patterns of Particle Pollution and Ozone* (student activity)
- *Exploring the AQI* (student assessment)

optional or extension materials:

- *Interpreting the AQI* (student activity)
- *Patterns of Particle Pollution and Ozone* (student resource)*
- *Tracking the AQI* (student activity)
- *Weather Conditions and the Ozone Air Quality Index (AQI) for an Ozone Episode* (student resource)*
- *The AQI and Weather* (student activity)
- *The Ozone Layer and the UV Index* (student resource)
- *Tracking the UV Index* (student activity)
- *Interpreting the UV Index* (student activity)

*Resources if Internet access is not available.

Materials in MEECS kit

per class

- MEECS Air Quality CD (teacher resources, student readings, PowerPoints, AQI calculator, tables, AQI Fact Book)
- Air Pollution—Michigan PowerPoint on the MEECS Air Quality CD

To be supplied by the teacher

per class

- construction paper (green, yellow, orange, red, purple)
- computers with Internet access, PowerPoint projection system

Lesson 6. What Has Been Done About Air Pollution?

Reproducible materials

per class

- *An Introduction to Air Pollution History* (teacher resource)
- *Regulation of Air Pollution* (transparency master)
- *Michigan Stationary Source Emission Trends* (transparency master)
- *Cap and Trade Game* (teacher resource)
- *Is the Acid Rain Program Working?* (transparency master)

per small group

- *Cap and Trade Cards* (student activity)
- *Acid Rain Game* (student activity)

per student

- *Winds of Change* (student resource)
- *Acid Deposition* (student resource)
- *The Saga of Thomas J. Midgley, Jr.* (student assessment)

Materials in MEECS kit

per class

- MEECS Air Quality CD (teacher resources, enhancement lesson, student readings, PowerPoints, charts, maps, data)

To be supplied by the teacher

per small group

- one die for *Acid Rain Game*

Optional:

- red cabbage
- water
- rain water or melted snow
- vinegar
- baking soda
- pennies older than 1983

Lesson 7. What Can We Do About Air Pollution?

Reproducible materials

per class

- *Letter from U.S. EPA to Governor Granholm, April 15, 2004* (teacher resource)
- *Nonattainment Areas 8-hour Ozone Standard* (transparency master)
- *8-hour Ozone Nonattainment, 2004* (transparency master)
- *Role Card Examples* (student resource)
- *Particle Pollution Nonattainment Areas, 2010* (teacher resource)

per small group

- *What's the Problem?* (student activity)
- *Measures to Meet Ozone Air Quality Standards* (student resource)
- *Evaluation of the Plan* (optional student activity)
- *Ozone Action Day Tips* (student resource)

per student or small group (optional)

- *Particle Pollution* (student resource)
- *EPA Designates Seven Michigan Counties As PM_{2.5} Nonattainment Areas* (student resource)

Materials in MEECS kit

per class

- MEECS Air Quality CD (teacher resources, enhancement lessons, student readings, PowerPoints, charts, maps, data)

Lesson 8. How Can Our Actions Impact the World?

Reproducible materials

per class

- *A Simplistic View of Climate Change* (transparency master)
- *A More Realistic View of Climate Change* (transparency master)
- *Carbon Dioxide Concentrations* (transparency master)
- *Global Temperature Changes* (transparency master)
- *Climate at a Glance* (answer key)
- *Michigan Climate Change* (answer key)
- *Michigan Climate Example* (transparency master)
- *Distribution of Michigan Greenhouse Gas Emissions by Economic Sector, 2002* (transparency master)
- *Distribution of Michigan Greenhouse Gases by Gas Type, 2002* (transparency master)
- *Ten Easy Ways to Cool Global Warming* (teacher resource)

per small group

- *Climate Change and Michigan* (student resource)

per student

- *Climate at a Glance* (student activity)
- *Michigan Climate Change* (student activity)
- *Silent Spring Revisited* (student assessment)

Materials in MEECS kit

per class

- MEECS Air Quality CD (teacher resources, PowerPoints, student readings, Global Warming Wheel Card, Science Activities, data sheet, Keeling Curve chart)

To be supplied by the teacher

per class

- safety glasses
- 2 1-gallon plastic freezer bags
- 2 thermometers
- source of CO₂ (vinegar and baking soda)
- 100-mL beaker or cup
- heat lamp or sunlight
- computers with Internet access

per student

- index card

Michigan Grade Level Content Expectations Correlation for Air Quality Unit

X- Addresses/Supports

	1. What Gets into the Air?	2. Why Should We Be Concerned About Air Quality	3. What Are the Sources of Air Pollution?	4. How Can We Monitor Air Quality?	5. How Can We Tell What the Quality of the Air Is Today?	6. What Has Been Done About Air Pollution?	7. What Can We Do About Air Pollution?	8. How Can Our Actions Impact the World?
Grade 6-7 Science	E.E.S.07.42 Describe the origins of pollution in the atmosphere, geosphere, and hydrosphere and how pollution impacts habitats, climatic change, threatens or endangers species.	X	X	X	X	X	X	X
	E.E.S.07.71 Compare and contrast the difference and relationship between weather and climate.							X
	E.E.S.07.72 Describe how different weather occurs due to the constant motion of the atmosphere from the energy of the sun reaching the surface of the earth.							X
	E.FE.07.12 Describe the atmosphere as a mixture of gases.				X			
	L.EC.06.41 Describe how human beings are part of the ecosystem of the Earth and that human activity can purposefully, or accidentally, alter the balance in ecosystems.				X			X
	P.CM.06.12 Explain how mass is conserved as it changes from state to state in a closed system.	X						
	P.PM.07.23 Illustrate structure of molecules using models or drawings.	X						
	S.IA.06.11 Analyze information from data tables and graphs to answer scientific questions.			X				X
	S.RS.06.16 Design solutions to problems using technology.							X
	S.RS.06.17 Describe the effect humans and other organisms have on the balance of the natural world.	X	X					
	S.RS.06.19 Describe how science and technology have advanced because of the contributions of many people throughout history and across cultures.						X	
	E1.1C Conduct scientific investigations using appropriate tools and techniques.				X			
	E1.2f Critique solutions to problems, given criteria and scientific constraints.							X
	E1.2g Identify scientific tradeoffs in design decisions and choose among alternative solutions (e.g. best management practices, resource quantity and quality trade-offs).							X
E1.2k Analyze how science and society interact from a historical, political, economic, or social perspective.						X		
E2.3D Explain how carbon moves through the Earth system and how it may benefit or harm society.	X							
E2.4B Explain how the impact of human activities on the environment can be understood through the analysis of interactions between the four Earth systems.		X						
E5.4A Explain the natural mechanism of the greenhouse effect, including comparisons of the major greenhouse gases.								
E5.4B Describe natural mechanisms that could result in significant changes in climate.								
E5.4C Analyze the empirical relationship between the emission of carbon dioxide, atmospheric carbon dioxide levels, and the average global temperature over the past 150 years.								
								X
SCIENCE								
HS Earth Science								

Michigan Grade Level Content Expectations (Continued) Correlation for Air Quality Unit X- Addresses/Supports		Lesson 1	Lesson 2	Lesson 3	Lesson 4	Lesson 5	Lesson 6	Lesson 7	Lesson 8
SCIENCE	B3.4C Examine the negative impact of human activities.	X	X			X			
	B3.4D Describe the greenhouse effect and list possible causes.								X
	B3.4E List the possible causes and consequences of global warming.								X
	C5.2A Balance simple chemical equations applying the conservation of matter.	X							
	C5.2B Distinguish between chemical and physical changes in terms of the reactants and products.	X							
	C5.7B Predict products of an acid-based neutralization.							X	
	C5.7H Explain why sulfur oxides and nitrogen oxides contribute to acid rain.							X	
SOCIAL STUDIES	6 - C4.3.2 Explain the challenges to governments and the cooperation needed to address international issues in the Western Hemisphere.						X	X	
	6 - G2.2.2 Explain that communities are affected positively or negatively by changes in technology.						X	X	
	6 - G5.1.1, 7 - G5.1.1 Describe the environmental effects of human action on the atmosphere, biosphere, lithosphere and hydrosphere.	X	X	X	X				X
	6 - H1.4.3 Use historical perspective to analyze global issues faced by humans long ago and today.							X	
	6 - P3.1.1, 7 - P3.1.1, 8-P3.1.1, P3.1 Clearly state an issue as a question or public policy, trace the origins of the issue, analyze various perspectives, and generate and evaluate alternate resolutions.								X
	7 - H1.1.1 Explain why and how historians use eras and periods as constructs to organize and explain human activities over time.							X	
	7 - H1.2.6 Identify the role of the individual in history and the significance of one person's ideas.							X	
	7 - C4.3.1 Explain how governments address national issues and form policies, and how the policies may not be consistent with those of other countries.							X	
	7 - G6.1.1 Conduct research on contemporary global topics and issues, compose persuasive essays, and develop a plan for action.								X
	C 6.1.1 Identify and research various viewpoints on significant public policy issues.								
HS Social Studies	C 6.1.4 Address a public issue by suggesting alternative solutions or courses of action, evaluating the consequences of each, and proposing an action to address the issue or resolve the problem.								X
	C 6.2.10 Participate in a real or simulated public hearing or debate and evaluate the role of deliberative public discussions in civic life.								X
	P2.2 Read and interpret data in tables and graphs.			X					