

Teaching Unit: Atmosphere and Air Pollution

By Denise Akom

Target: Grade Level 7/8

Unit Overview

This unit is required by the Michigan Curriculum Standards and Benchmarks. At the completion of this unit students should be able to describe the characteristics of the atmosphere and how humans alter it. In this unit students will have opportunities to take and examine field samples of pollutants in the atmosphere. Students will be able to describe the major sources of common air pollutants and how these pollutants affect human health and ecosystem effects.

Sources

Air Quality, Curriculum for Middle School Science and Social Studies. (2005). Michigan Environmental Education Curriculum Support. Michigan Department of Environmental Quality.

Activities for the Changing Earth System. Earth Systems Education Middle School and High School Activities. (1993). Produced by Ohio State University under NSF.

Teaching About Climate Change, Cool Schools Tackle Global Warming. (2001) Editors, Tim Grant and Gail Littlejohn. New Society Publishers.

Great Lakes Instructional Materials for the Changing Earth System. (1995) Editors Heidi Miller and Amy Sheaffer. The Ohio State University, Ohio Sea Grant Publications.

Preparing for a Changing Climate, The Potential Consequences of Climate Variability and Change. Great Lakes Overview. (Oct. 2000) Edited by Peter J. Sousounis and Jeanne M. Biasanz for the U. S. Global Change Research Program.

Teaching and Learning Objectives

Students will be able to:

1. Discuss the composition of the Earth's atmosphere. (SCI.L.V.3.MS.2) (M.N.FL.08.11)
2. Describe the layers of the atmosphere. (SCI.L.V.3.MS.2)
3. Describe the major types of air pollution. (SCI.III.5.MS.6)
4. Name the major causes of air pollution. (SS.II.2. MS.4)
5. Explain how air pollution can affect human health. (EL.R.CM.08.04) (SCI.II.1.MS.1)
6. Explain how air pollution can be reduced. (EL.R.CM.08.04) (SCI.II.1.MS.1)

Michigan Curriculum Standards and Benchmarks for this unit.

- Describe the composition and characteristics of the atmosphere (SCI.L.V.3.MS.2)
- Describe ways in which humans alter the environment (SCI.III.5.MS.6)
- Explain how humans modify the environment and describe some of the possible consequences of those modifications (SS.II.2. MS.4)
- Use sources of information in support of scientific investigations (SCI.I.1.MS.2)
- Evaluate the strengths and weaknesses of claims, arguments, or data (SCI.II.1.MS.1)
- Generate scientific questions about the world based on observation (SCI.I.1.MS.1)

- Solve problems involving ratio units, such as mph, dollars per pound, or persons per sq.mile (M.N.FL.08.11)
- Analyze organizational patterns including chronological sequence, compare/contrast, and cause/effect (EL.R.IT.08.02)
- Apply significant knowledge from grade-level science, social studies, and mathematics texts (EL.R.CM.08.04)

Procedure

Lesson One – Defining the Atmosphere

Duration- 45-50 minutes, classroom.

Supplies: per person - meter stick, metric ruler, a strip of paper 62 cm / 30cm.

Lesson Overview – Define atmosphere, composition and layers. Student should take notes. Have students make a scale model of the layers of the atmosphere, identifying characteristics of the layers for homework. Scale for drawing 2cm = 10 km. Measurements should be completed for class ends. Labeling should be done for homework.

Resource: Windows to the Universe, retrieved August 27, 2006.

<http://www.windows.ucar.edu/tour/link=/earth/Atmosphere/layers.html>

Objectives:

Students will be able to:

Describe the layers of the atmosphere.

Describe the characteristics of the layers.

Lesson Two - Counting to a Billion (see appendix)

Duration: 45-50 minutes, classroom, groups of 4.

Supplies: triple beam balance, 5lb bag of grass seed, 20 empty 2 liter bottles for display (can use just one but the impact is not as great), calculators.

Lesson Overview- Students will use grass seed as a way to understand the large numbers used in describing the composition of the atmosphere. Copies of *A Seedy PPB, Count to a Billion*.

Objectives:

Students will be able to:

Define how many grass seeds are needed to fill a 2 liter bottle and how many bottles of grass seed are needed to equal a million seeds and a billion seeds.

Lesson Three - Atmosphere Composition

Duration: 45-50 minute period, classroom.

Supplies: per class- Set of 3 different colors of types of objects (marbles, beans, beads or candy) with ratios of 78:21:1. Box for the objects, apple or onion, layers of the atmosphere master.

Per student- graph paper, *Layers of the Atmosphere* (student activity).

Lesson Overview- *What Is in the Atmosphere?* Air Quality Background Lesson 1, page 19, Air Quality Curriculum for Middle School Science and Social Studies, Michigan Environmental Education Curriculum Support, Michigan Department of Environmental Quality.

Objectives:

Students will be able to:

Describe the composition of air.

Describe the differences between air and atmosphere.

Lesson Four - Air Quality

Duration – Two 45-50 minute periods, (+ homework activity)- classroom.

Why Should We Be Concerned About Air Quality? Air Quality Lesson 2
Michigan Environmental Education Curriculum Support

Lesson Overview-**Objectives**

Students will be able to:

1. List the common air pollutants and cite their major sources.
2. Describe the human health and ecosystem effects of polluted air.

Lesson Five- Ozone and Milkweed Leaves (see appendix)

Duration – one 45-50 minute period, (+homework) – classroom.

Supplies

Milkweed leaves (leaves can be collected during the growing season and frozen)

Hand lens

Pictures of leaves with ozone damage

Map of sample locations

Ozone action alerts for the area, including air temperature and wind speed.

Lesson Overview: this introductory lesson will have students examine ozone damage on milkweed leaves and plot on local map origin of samples. Ozone is a odorless and colorless gas, students will be able to see the damage on the leaves.

Objectives:

- Students will learn about air pollution and its effects on plants.
- Students will learn how to study plant samples for the effects of ozone.
- Students will correlate milkweed leaf damage to geographic areas and look at the human activity in the area.
- Students will look at the effects of temperature in the process of ozone formation.

Overall Unit Assessment

Lesson 1 - Scale drawing of the layers of the atmosphere including characteristics of each layer.

Lesson 2- Completion of student activity worksheet – *A Seedy PPB Count to a Billion*

Lesson 3 – student worksheet - *Layers of the Atmosphere*

Lesson 4 – Student worksheet, *Air Pollution and Health*. Have students prepare a poster about the effects of one of the air pollutants.

Lesson 5 - Completion of *Milkweed Investigation*.

A Seedy PPB, Count to a Billion!

Name _____ hr _____

by Denise Akom

Objective: Working in groups of 4, you will determine how many 2 liter bottles filled with grass seeds are needed to equal 1 billion grass seeds.

Materials

Per group

One - ¼ sheet of paper (to put seeds on for scale)

Grass seed

Triple beam balance

Per class – One 2-liter bottle filled with grass seed, with mass of grass seed determined.

Prediction

How many 2-liter bottles of grass seed are needed to hold a **million** seeds? _____

How many 2-liter bottles of grass seed are needed to hold a **billion** seeds? _____

Procedure

1. Find the mass of the ¼ sheet of paper to the nearest 10 of a gram.

Record the mass _____g

2. Put a small amount of seed on the table. Count out 250 seeds (counting by 2's or five's and record slash marks for sets of 10). Put seeds on ¼ sheet and find the mass of the paper and the seeds. Record _____g

3. Determine the mass of the seeds by subtracting the mass of the ¼ sheet from your total in #2.

Mass of seeds only _____g

4. Record the mass for each of your group members.

Mass of seeds only _____g

Mass of seeds only _____g

Mass of seeds only _____g

Add all four samples

Total _____g

5. Find the average mass of 250 seeds.

Average mass _____g

6. Calculate how many seeds you need for a gram of seeds. _____seeds/gram

7. From the board, record the mass of the filled 2-liter bottle. _____g

(The mass of the bottle has been subtracted.)

8. Calculate how many seeds are in the 2-liter bottle. _____seeds

9. Calculate how many 2-liter bottles of seed are needed for a million seeds _____# of bottles.

10. Calculate how many 2-liter bottles of seed are needed for a billion seeds _____# of bottles.

11. Why is this a good method of counting a billion seeds? _____

12. In what other situations might you use this method? _____

Milkweed Investigation

By Greg Lewis, Denise Akom, Linda Mussio

Middle School (7-8)

Time 45-50 minutes- classroom

Lesson Overview: This introductory less will have students examine ozone damage on milkweed leaves.

Objectives: Students will

- Learn about air pollution and its effects on plants.
- Learn how to study plant samples for the effects of ozone.
- Will correlate milkweed leaf damage to geographic areas and look at the human activity in the area.
- Will look at the effects of temperature in the process of ozone formation.

Question: How does ozone affect plants?

Teacher Resources:

Ozone, 1987. In *Diagnosing injury to Eastern Forest Trees*, eds. Skelly, J.M. et. Al. the Pennsylvania State University, College of Agricultural Sciences, University Park, PA, pp.2-10.

Krupa, S.V., A.E.G. Tonneijck, & W. J. Manning. 1998. Ozone. In *Recognition of air pollution injury to vegetation: A pictorial atlas*, ed. R.B. Flager. Air & Waste Management Association, Pittsburgh, PA, pp. 2-1 to 22-28.

Web sources with pictures of ozone damage cane be found at:

<http://www.ces.ncsu.edu/depts/pp/notes/Ozone/ozone.html>

Ozone biomonitoring: <http://www.fiaozone.net/index.html>

Wisconsin Milkweed Monitoring Network

<http://dnr.state.wi.us/org/caer/ce/eeek/earth/field/milkweed/slideShowIndex.html>

USDA Ozone Effects on Plants <http://ars.usda.gov/Main/docs.htm?docid=8453>

EPS Air Now

<http://cfpub.epa.gov/airnow/index.cfm?action=airnow.archives&RegionID=0>

Going Further

Students can determine the leaf area suing graph paper to determine more closely the percent of damage to each leaf.

Students can collect different species leaf samples and check for ozone damage.

Can keep preserved samples for students to examine in the future.

Lone-term data can be developed using milkweed monitoring on a yearly basis.

Materials:

Milkweed leaves

Hand lens

Pictures of ozone damage

Map of sample locations

Milkweed Investigation

Name _____ hr. _____

The purpose of this investigation is to examine the effects of ozone on milkweed leaves. After reading about the different types of milkweed leaf damage and viewing photos of damaged leaves, you will determine if milkweed leaves show signs of ozone damage.

Materials: milkweed leaf samples, hand lens. Milkweed photos.

Procedure: Look at each sample leaf and determine the percent of the leaf that is damaged. Rank the sample and record information on the data table. Use Ozone injury scale.

Ozone Injury scale (0-3)

0 – no damage

1 – very little damage (1-15%)

2 – significant damage (16 – 50%)

3 – severe ozone injury (more than 50%)

Sample location	# of leaves collected	Damage ranking	Describe leaf damage
School yard			
US 12 roadside			
Farm field			
Backyard			
City			

Conclusion

What is are necessary for ozone formation? _____

Which samples displayed the most damage? _____

What conditions did the most damaged sample experience? _____

What is an Ozone Action Day? _____