

# Global Climate Change Unit

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## Unit Overview

This unit is intended to introduce 8<sup>th</sup> graders, in an integrated science class, to the effects of elevated ozone levels. The goal is for students to understand what is ozone, why is elevated ground level ozone a concern, how to recognize the impact of ozone on plants and most importantly to study local environmental conditions & indicators that relate to climate change (in this case recognize that human factors have an affect on climate change).

## References

See end of document for reference list.

## Teaching & Learning Objectives

*Students will be able to:*

1. Define new terms related to atmosphere, climate, climate change and global warming.
2. Recognize the difference between atmospheric and ground level ozone.
3. Identify healthy milkweed plants and damaged plants.
4. Make a site map of their school grounds.
5. Observe milkweed plants in their natural setting and study samples in the classroom.
6. Create a global warming wheel and determine their personal carbon dioxide emissions.
7. Collect data for analysis using internet carbon counters.
8. Make informed consumer choices and identify conservation measures that they can implement to reduce global warming.
9. Contact local legislators about environmental issues.

## Benchmarks (State of Michigan)

Science Benchmarks

Atmosphere and Weather - Investigate and describe what makes up weather and how it changes from day to day, from season to season and over long periods of time

EAW.V.3.h.1: Explain how interactions of the atmosphere, hydrosphere and geosphere create climates and how climates change over time.

EAW.V.3.m.1 Explain patterns of changing weather and how they are measured.

EAW.V.3.m.4 Describe health effects of polluted air.

EAW.V.3.h.4 Explain the impact of human activities on the atmosphere and explain ways that individuals and society can reduce pollution.

Geosphere – All students will describe the Earth’s surface.

EG.V.1.m.1 Describe and identify surface features using maps.

Constructing New Scientific Knowledge - Communicate findings of investigations using appropriate technology.

Reflecting on Scientific Knowledge - Students will show how science and technology affect our society.

Social Studies Benchmarks:

Strand II, Geographical Perspectives, Human/Environment Interactions: All students will describe, compare and explain the locations and characteristics of ecosystems, resources, human adaptation, environmental impact and the interrelationships among them.

Strand IV, Individual and Household Choices.

Strand VI, Public Discourse and Decision Making.

Mathematics Benchmarks:

Standard II, Measurement, Compare attributes of an object with a standard unit.

Standard III, Inference and Prediction, Students draw defensible inferences about unknown outcomes, make predictions, etc.  
Standard II, Geometry & Patterns, Construct familiar shapes...sketch and draw two and three dimensional shapes.

### **Five Day Teaching Unit Overview**

The teaching unit that I have prepared will include the following: a short EPA video on global change, an internet activity, outdoor fieldwork, map making, a lab/classroom activity, creating a manipulative, homework & conducting a survey, using a website calculator and student suggestions to reduce impact/emissions. The unit was designed to have students considering evidence of local environmental issues and what they can do about these issues.

### **Assessment**

Student work will be checked, reviewed and discussed on a daily basis.

Day #1 – check student notes, complete internet study accurately

Day #2 – participate in school site exploration, create a map of the school site on graph paper and be able to identify milkweed plant

Day #3 – recognize healthy vs damaged milkweed plants/leaves, complete milkweed investigation lab sheet

Day #4 – create a global warming wheel, take notes from EPA info, survey family regarding carbon dioxide emissions

Day #5 – share data from survey, run internet carbon counters, prepare a summary paragraph and list of suggestions to reduce carbon dioxide emissions.

### **Procedure**

#### **Day #1**

Introduction to Global Change.

Show EPA video “Climate Change, Wildlife & Wildlands” (12 minutes).

Internet Study Activity, How Does Lake Michigan Affect Ozone Formation? (see end of document for activity worksheet)

This student activity will provide an overview of terms and concepts as well as a documented area of concern with regard to ozone levels.

#### **Day #2**

School site exploration and map project. The objective is to get students outdoors to observe the environment and develop skills to recognize signs of pollution and local land use. Each student will create a site map, on graph paper, of the school grounds. The maps must include land use of adjacent property and topographical features. We will identify and examine milkweed plants and collect leaf samples. \*Optional assignment, students may bring in milkweed leaf samples from home.

#### **Day #3**

Milkweed Investigation. Students will examine milkweed leaves collected from the school site as well as teacher provided leaf samples. They will complete the lab sheet (see Day #3 Activity at end of document for activity worksheet). The objective is to determine, on the local level, does the school site suffer from ozone pollution? View internet pictures of damaged milkweed leaves and other possible indicator plant species. Look at FACE site pictures of leaf damage from elevated ozone exposure.

#### **Day #4**

Global Warming Wheel. Read and take notes on carbon dioxide emissions and global warming issues from the EPA information in “Global Warming Wheel Card Classroom Activity Kit”. Kit available from EPA, see references for ordering information. Create a Global warming wheel manipulative. Discuss habits and the cost of generating carbon dioxide in daily lives. Gather family data on carbon dioxide emissions and use/habits.

#### **Day #5**

Carbon Counters. Share family data from Global Warming Wheel categories. Use carbon counter internet sites to calculate emissions based on family data. Write a summary of family use, carbon counter numbers and suggestions to be implemented to reduce carbon dioxide emissions. Visit government website to find out about carbon dioxide/pollution in the Great Lakes Region and to contact a legislator about environmental concerns.

#### **References**

“Climate Change, Wildlife and Wildlands”, EPA video, from A Toolkit for Teachers and Interpreters, 2005.

Global Warming and the Great Lakes Region information, solutions and contacts.

[www.ucsusa.org/greatlakes/glchallengeaction.html](http://www.ucsusa.org/greatlakes/glchallengeaction.html)

What you can do: 101 Tips

[www.earthfuture.com/stormyweather](http://www.earthfuture.com/stormyweather)

How to reduce carbon dioxide emissions

[www.climatecrisis.net/takeaction/whatyoucando](http://www.climatecrisis.net/takeaction/whatyoucando)

Carbon counters on the internet:

[www.climatecrisis.net/takeaction/carboncounter](http://www.climatecrisis.net/takeaction/carboncounter)

[www.safeclimate.net/calculator](http://www.safeclimate.net/calculator)

[www.carboncounter.org](http://www.carboncounter.org)

[www.pbs.org/wgbh/warming/carbon](http://www.pbs.org/wgbh/warming/carbon)

Carbon dioxide & ozone research study site, images of plant leaves [www.aspenface.mtu.edu](http://www.aspenface.mtu.edu)

Fact sheets and global warming info, including Global Warming Wheel Activity Packet (document #EPA-430-K-0-007 November 2000)

[www.epa.gov/globalwarming/publications/outreach/index.html](http://www.epa.gov/globalwarming/publications/outreach/index.html)

Reference books for teacher use:

Gore, Al. An Inconvenient Truth. Emmaus, PA. Rodale Publishing, 2006.

Concepts and Challenges in Earth Science. Globe Fearon Educational Publisher, New Jersey, 1998. pages 211-262 and 263-278.

Day #1 Activity Credit:

“How Does Lake Michigan Affect Ozone Formation”, Created by Sara Busken, Carolyn Grapentine and Rebecca Heckman at MTU, July 2006, used with permission.

\*Optional Information and Resources:

Local groups to contact for information and volunteer opportunities:

River Raisin Watershed, local water stewardship information and projects

[www.riverraisin.org](http://www.riverraisin.org)

Hidden Lake Gardens, MSU botanical research station

[www.hiddenlakegardens.msu.edu](http://www.hiddenlakegardens.msu.edu)

Stubnitz Environmental Education Center, environmental programs and activities

[www.seec.lisd.k12.mi.us/about/about.html](http://www.seec.lisd.k12.mi.us/about/about.html)

## **Day #1 Activity: Ozone Group Work**

Names \_\_\_\_\_ Date \_\_\_\_\_

**Question.** *Do you think Western Michigan has an ozone problem?*

**Your Hypothesis:**

### **Procedure for background information:**

1. Go to [www.epa.gov/airnow/](http://www.epa.gov/airnow/)
2. In the far right corner choose *Ozone* found under *Air Quality Basics*.
3. Read about good and bad ozone.
4. Answer these questions.
  - a. Where is the good ozone located and what is its function?
  
  - b. What depletes the good ozone?
  
  - c. Where is the bad ozone located and what creates it?
  
  - d. What are some (at least three) of the health problems associated with bad ozone? (Hint you may need to go to *Ozone and your health* found lower on that page then choose *How can ground-level ozone affect your health*)
    - 1
    - 2
    - 3

Scroll down to the Air Quality Index color chart. Write down a one-word descriptor of each color code (I've given the one for green ☺)

Green= good

Yellow=

Orange=

Red=

Purple=

After answering this question go back air now home page (found on top)

5. In the far left corner choose *Ozone*, then chose *Ozone Now* found under *National overview*  
What is the current ozone reading for our area? \_\_\_\_\_ (Use color code on right side)

### **Data Collection:**

6. Choose *Map Archives* found on the lower right
7. Click on map of Michigan, chose Month *June* Year *2003* and region *Midwest* click *ozone* box (the days of the month may take a moment to load)

8. Click on the 23<sup>rd</sup>. The top map will indicate the time of day and the progression of ozone forming in the Midwest.
  - a. Where are the worst areas?
  - b. Are we one of them?
  - c. What time of day seems to be the worst?
  - d. If I told you that the major pollutants were formed in Gary and Chicago, infer which way the wind was blowing.
  - e. List three factors that you believe to influence bad ozone formation?
    - 1.
    - 2.
    - 3.
9. Click *back*, you should now be looking at the month of June again. Note bad ozone trends during this month.
10. Create line graph of the peak ozone level and daily high temperatures (data supplied) for the month of June 2003.

**Conclusion:**

What is the formula for ozone formation?

Why do you think the ozone levels increase over Lake Michigan?

Review your original hypothesis. What changes would you make in your statement?

Review July & August 2003, 2004 and 2005.

Speculate on the weather conditions in the summer of 2004 and 2005

2004:

2005:

NAME \_\_\_\_\_

**Day #3 Activity: Milkweed Investigation**

The purpose of this investigation is to examine the effects of ozone on milkweed leaves.

After reading about different types of milkweed leaf damage and viewing photos of damaged leaves, you will determine if milkweed leaves show signs of ozone damage.

Write your prediction, which sample location will show the most evidence of ozone damage?

\_\_\_\_\_

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

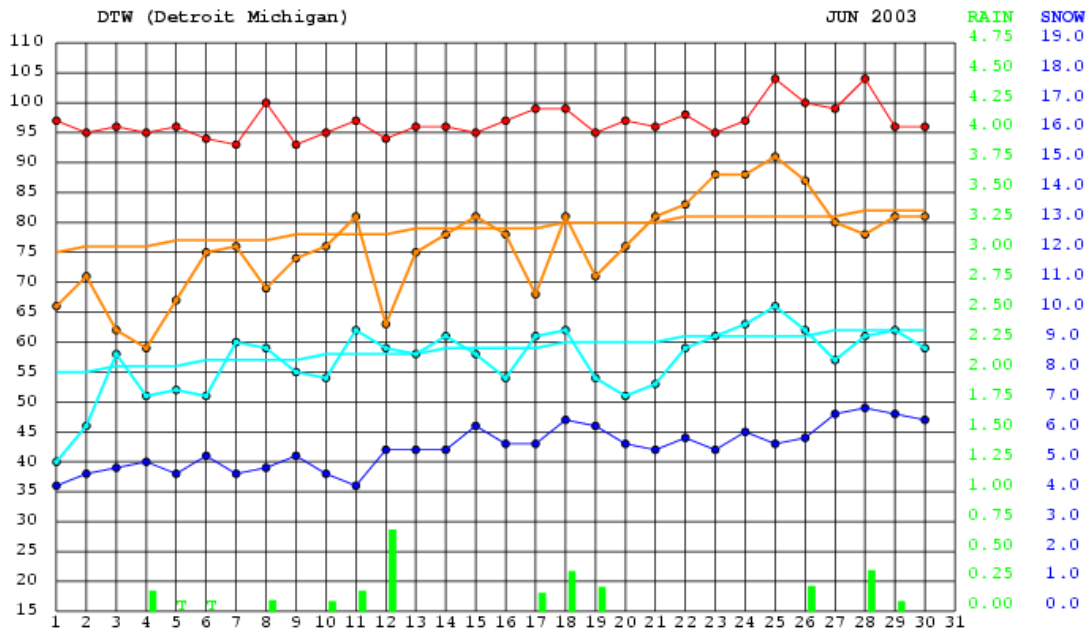
Procedure: Look at each sample leaf and determine the percent of the leaf that is damaged. Rank the sample and record info on data table.

Ozone injury rank scale (0-3),

- 0 = no ozone injury
- 1 = very little ozone injury (1-15%)
- 2 = significant ozone injury (16-50%)
- 3 = severe ozone injury (more than 50 %)

Sample Location	# of leaves collected	Damage rank	Describe leaf damage
Schoolyard			
US-12 roadside			
Farm field			
Backyard			
City			

Conclusion/Summary: Did your observations match your prediction? Explain \_\_\_\_\_  
What conditions are necessary for ozone formation? \_\_\_\_\_



TEMPERATURE AND PRECIPITATION DATA

Average High.....76.2	Monthly Normal.....79.0	Average Low.....57.0	Monthly Normal.....58.9
Average for Month...66.6	Monthly Normal.....69.0	Monthly HDD.....48	Monthly Normal HDD..41
Monthly CDD.....104	Monthly Normal CDD..145		
Monthly Precip.....2.50	Monthly Normal.....3.55	Yearly Norm Precip..15.96	
Monthly Snow.....0.0	Monthly Norm Snow...0	Yearly Norm Snow....	

GRAPH KEY	● Record High Temp	— Mean High Temp	— Mean Low Temp
	● Daily High Temp	● Daily Low Temp	● Record Low Temp