

## **Global Change Teaching Unit**

By David Rowe

### **Target Grade and Subject:**

I plan to implement the teaching unit on global change in my *Sky and Sea* class. Sky and Sea is a class that covers one semester of oceanography and one semester of meteorology. Sky and Sea is an elective class that is offered to sophomores, juniors and seniors.

### **Unit Overview:**

My plan is to use the unit on global change in conjunction with a unit on climate and climate change. My goal is to make global change real and understandable for my students. I want my students to see that global changes are occurring both globally and locally and that these changes are measurable. The five investigations that will be included in the teaching unit would include:

- Ice off dates as related to seasonal and annual temperatures
- Investigating factors that affect the pH of rain water
- Exploring the effects of increasing atmospheric levels of Carbon Dioxide and Ozone in the atmosphere (The FACE project)
- How to cool global warming and
- The identification and eradication of exotic and invasive species

### **Teaching and Learning Objectives**

Upon the completion of this unit the students will be able to:

- Relate the length of time that lakes are frozen to ice off dates to global warming.
- Show ice off data graphically using an Excel program.
- Identify factors that alter the pH of a rain event.
- Collect and test water samples from a rain event.
- Determine the source of potential pollution from various rain events.
- Predict the response of forest ecosystems to increased levels of CO<sub>2</sub> and O<sub>3</sub>.
- Identify factors that are related to plant growth.
- Calculate their annual greenhouse gas emissions.
- Manipulate data to determine which factors contribute the most to their annual greenhouse gas emissions.
- Identify easy ways to reduce greenhouse gas emissions.
- Identify exotic species common to our area.
- Compare and contrast different eradication methods for invasive species.
- Explain why exotic species can become invasive.

### **Michigan Content Benchmarks Addressed**

There are many Michigan content standards that will be reinforced in this unit. Some of them would be:

- All students will be able to construct and reflect on scientific knowledge.
- Students will design and conduct investigations using appropriate methodology and technology.
- Students will explain how parts of an ecosystem are related and how they interact.
- Students will investigate and explain how communities of living things change over a period of time.
- Students will describe how materials cycle through an ecosystem and get reused in the environment.
- Students will analyze how humans and the environment interact.
- Apply knowledge, ideas, and issues from reading to personal life.
- Investigate problems using resources such as the internet.

- Identify and describe variations in patterns.
- Make inferences and predictions using data.
- Identify relationships between numbers.
- Explain global issues and events.
- Conduct investigations.

### **Overall Unit Assessment**

The unit on global change will be assessed through the completion of the activities outlined in each of the sub-units. Students will reflect upon new knowledge, answer questions, conduct research and visually display and interpret data.

### **Activity 1: An Investigation of Ice Off Dates and Seasonal and Annual Temperatures**

#### **Introduction:**

One of the best ways to monitor global change is to collect and analyze long-term data to see if any trends are emerging.

#### **Limitations:**

With this approach you may see a change over time, however, because of multiple variables it may be difficult to determine the cause of the change.

#### **Question:**

When graphing data from local and regional sources, do these data indicate that the Upper Midwest is experiencing global change as related to the amount of time that ice is on the water?

#### **Hypothesis:**

The length of time that ice remains on local lakes will show that the climate of the Upper Midwest is slowly warming.

#### **The Investigation:**

The investigation will begin by having students perform a case study by using the data from the “tice.ecoed.net” web site. Students will start the case study by looking at data collected over the last 160 years. The data was collected at Lake Mendota, which is located in Dane County, which is found in Southern Wisconsin.

The information that was collected on Lake Mendota focuses on:

- The date that Lake Mendota freezes over each year
- The date that ice leaves Lake Mendota
- The length of time that Lake Mendota is frozen each year

The ecological question that was posed by the by the “ecoed website” was: Is there evidence for global warming in long term data on changes in dates of ice cover in three Wisconsin lakes. Using this data, the students will use an Excel program and construct a line chart that shows ice duration vs. year for Lake Mendota. Upon completion of the graph, students will answer the following questions:

- 1) Was there a noticeable trend shown in the number of days ice was on the lake?
- 2) Specifically, what was the trend that was seen in the graph?
- 3) What factors do you think would affect the length of time ice was on the lake?

### **Local Applications:**

After completing the case study of Lake Mendota, I would like to focus the attention of the students on local applications, specifically:

- Historically, when has the weighted tire fallen through the ice on Sunday Lake in Wakefield, Michigan? The dates for the “tire sink” contest can be found in Appendix A.
- After graphing the information on the timing of “ice out” on Sunday Lake in Wakefield, Michigan, I would like the students to graph the ice out data for Lake Gogebic. This data can be found in Appendix B.

### **Data Collection:**

The data that will be used for this investigation will come from a variety of sources. Internet sources that I plan to use will include:

- [www.topozone.com/map](http://www.topozone.com/map)
- [www.tiee.ecoed.net](http://www.tiee.ecoed.net) (This supplies the Lake Mendota information.)
- [www.crh.noaa.gov/mqt](http://www.crh.noaa.gov/mqt)

Information will also be supplied by:

- Robin Turner – meteorologist, National Weather Service, Marquette
- The Ironwood Daily Globe: Ironwood, Michigan
- U. S. Forest Service Field Office, Bergland, Michigan and or the Ottawa National Forest Headquarters, Ironwood, Michigan.
- Carol Lillar, Wakefield Chamber of Commerce
- Jack Haskins, resident of Lake Gogebic

### **Appendix A**

Tire sink contest information from Sunday Lake in Wakefield, Michigan.

Although the tire sink has been going on for decades, the group sponsoring the contest has changed and there is no archive of information about the tire sink prior to 1995.

History:

- 1995 – April 29
- 1996 – May 9
- 1997 – April 26
- 1998 – April 5
- 1999 – April 14
- 2000 – March 26
- 2001 – April 21
- 2002 – April 17
- 2003 – April 22
- 2004 - April 18
- 2005 – April 10

## **Appendix B**

Ice out dates for Lake Gogebic.

Jack Haskins, a local resident that has kept track since 1941, supplied ice out dates for Lake Gogebic.

1941 – April 14	1979 – May 3
1942 – April 22	1980 – April 22
1943 – May 1	1981 – April 13
1944 – April 30	1982 – April 13
1945 – March 26	1983 – May 2
1946 – April 7	1984 – April 25
1947 – May 6	1985 – April 21
1948 – April 21	1986 – April 12
1949 – April 21	1987 – April 14
1950 – May 14	1988 – April 22
1951 – May 7	1989 – May 1
1952 – April 27	1990 – April 23
1953 – April 22	1991 – April 20
1954 – April 22	1992 – May 1
1955 – April 18	1993 – May 6
1956 – May 2	1994 – April 24
1957 – April 24	1995 – April 20
1958 – April 19	1996 – May 18
1959 – April 24	1997 – May 12
1960 – April 23	1998 – April 9
1961 – April 21	1999 – April 15
1962 – April 26	2000 – April 7
1963 – April 16	2001 – April 28
1964 – April 26	2002 – April 20
1965 - May 5	2003 – April 28
1966 – April 28	2004 – April 19
1967 – April 20	
1968 – April 12	
1969 – April 25	
1970 – April 26	
1971 – April 23	
1972 – May 10	
1973 – April 20	
1974 – April 29	
1975 – May 3	
1976 – April 17	
1977 – April 17	
1978 – April 30	

## Activity 2: Investigating Factors that Affect the pH of Rainwater

### Background Information:

Recall that “natural rain” is slightly acidic. As water falls through the atmosphere it mixes with CO<sub>2</sub> and forms a weak acid called carbonic acid. The pH of this “natural” rainwater typically has a pH of 5.6 to 5.0 although the pH can even be lower. Acid rain is formed when human activities cause the pH of natural rain to decrease and become more acidic.

Acid deposition from the atmosphere comes in two forms, dry deposition and wet deposition. Dry deposition accounts for 40% of the acid deposition and is in the form of particles. Wet deposition is created when pollutants mix with various types of precipitation such as rain or snow.

Because of the two types of deposition, (wet and dry) a given rain event can result in rainwater with varying pHs. Because dry deposition may settle on the leaves of trees, when it rains the rain contains both the acid from the atmosphere and the acid from the dry deposition, making the rain under deciduous trees more acidic than the rain in a field.

Similarly, coniferous trees are even better at filtering dry deposition from the air than deciduous trees, so this same rain may be more acidic in a coniferous forest than a deciduous forest.

### 30 Second Review:

Rainfall from a storm was collected from three different sites. The pH was measured and is indicated as follows:

Site of collection	pH
a) Site 1	5.4
b) Site 2	5.3
c) Site 3	5.1

Given the information above, predict the location of the collection site given that following information: One sample came from a deciduous forest, one sample came from an open field and one sample came from a coniferous forest.

Site of collection	pH	Predicted site of collection
a) Site 1	5.4	_____
b) Site 2	5.3	_____
c) Site 3	5.1	_____

Answers should be:

- Site 1: open field
- Site 2: deciduous forest
- Site 3: coniferous forest

In addition to the location of the deposition, (field, forest etc.) the direction that the prevailing winds were coming from for 1 to 2 days prior to the rain event determines how acidic the pH of the rain may be.

Using the *Density Map of Sulfur Dioxide Emissions* found at: <http://nadp.sws.ulc.edu> and the *Hydrogen Ion Concentration as pH from measurements made at the Central Analytical Laboratory* (also found at <http://nadp.sws.ulc.edu>) answer the following questions given that you are in Bessemer, Michigan.

### Questions:

- 1) Why do you think that Ontonagon and Marquette counties are considered high emissions areas? Hint – you need to tell me what types of industry could be causing the pollution. Note that the date is 1997. Answers might include, mining pollution or emissions from industrial power plants in White Pine and Marquette.
- 2) Which rain event would produce the most acidic rainfall on Gogebic county and why? A rain that occurred after two days of wind from the west or a rain that occurred after two days of wind

from the south east? Answers might include; the rain that occurred after the wind from the southeast.

- 3) Specifically, if our prevailing winds have been out of the southeast, where is our atmospheric pollution coming from? (List large cities that would be close enough to our location to affect us.) Answers might include; Chicago, Milwaukee

If our prevailing winds have been out of the southwest, where is our atmospheric pollution coming from? Answers might include: the Twin Cities

Investigation:

Collect water samples from various rain events. Collect the samples in different locations or conditions: in an open area, under deciduous trees and under conifer trees. Keep track of the location where the sample was collected and which direction the air was coming from for 1 to two days prior to the rain. Collect three samples of rain from air that originated from different areas.

Have students:

- Test the pH of each sample. You will need a digital pH meter that measures in tenths.
- Note the location where each sample was collected.
- Note the location where the air originated.

Rain Sample

Date of rain: \_\_\_\_\_

Direction of prevailing wind for the two days prior to the rain: \_\_\_\_\_

pH of rain collected in the open area or field: \_\_\_\_\_

pH of rain collected under deciduous trees: \_\_\_\_\_

pH of rain collected under coniferous trees: \_\_\_\_\_

After the students test the three rain samples, they should be given three samples of rain from another storm. The students should test the pH of each sample and based on the results the students should predict where the sample was collected. The students should also predict which direction the prevailing wind was from for the day prior to the storm.

Rain Sample

	PH	Predicted collection site
Sample A:	_____	_____
Sample B:	_____	_____
Sample C:	_____	_____

Based on the above information, the prevailing wind for the day or two before the storm was out of the: \_\_\_\_\_

Questions for Analysis:

- 1) What was it about the pH of the samples that helped you predict where they were collected? Be specific and describe each sample.
- 2) What was it about the pH of the three samples that helped you predict the direction of the prevailing wind for the days prior to the rain event?
- 3) When North East Wisconsin and Michigan's Upper Peninsula experience acid rain, what metropolitan areas are most likely responsible? Be specific and list at least three large metropolitan areas.

### **Activity 3: Exploring Effects of Increasing Atmospheric Levels of CO<sub>2</sub> and O<sub>3</sub> in the Atmosphere**

#### Background:

There are many gases including water vapor that are considered “greenhouse gases.” Without these gases, the Earth would be very cold and would not support life, as we know it. This tells us that our problem with global warming isn’t the green house effect; rather, the problem is that human activities are altering the composition of the atmosphere and increasing the greenhouse effect.

The greenhouse gases that humans are directly or indirectly increasing are:

CO<sub>2</sub> : 70%

Nitrous Oxide: 7%

Methane: 23%

Greenhouse Gases = 100%

With the most prevalent greenhouse gas, Carbon dioxide, burning fossil fuels creates 75% and 25 % is being formed by changes in land use. An example of this is the burning and clearing of forests for farms or cities.

Since pre-industrial times, the composition of green house gases and pollutants in the atmosphere has been altered. Our global atmospheric concentrations of Carbon Dioxide have risen by nearly 30% and the rate of increase is skyrocketing. Our current level of CO<sub>2</sub> is 370 ppm and we are currently increasing the atmospheric concentration by between 4 and 5 ppm per year! That means that we are increasing our current CO<sub>2</sub> levels by approximately 1.2% per year!

To put this into a historical perspective, although the earth has experienced higher levels of CO<sub>2</sub> in the atmosphere, the Law Dome Ice Cores indicate that the Earth hasn’t experienced CO<sub>2</sub> levels this high at any point in the past 420,000 years. (420,000 years ago the atmospheric levels of CO<sub>2</sub> were at 299 ppm.)

Similar to the problems associated with increasing levels of greenhouse gases, emissions of oxidized nitrogen (NO<sub>x</sub>) and other volatile organic compounds have increased the concentrations of ground level ozone (O<sub>3</sub>) by approximately 36% since the industrial revolution.

In the stratosphere O<sub>2</sub> is changed to ozone by ultraviolet light and this “good Ozone” helps protect the Earth from dangerous UV light. At ground level, NO<sub>x</sub> and volatile organic compounds produced by motor vehicles and industry are changed by sunlight into ozone. Although ozone in the stratosphere is necessary for life on the surface of Earth, ground level ozone is dangerous because it is so reactive. Ground level ozone will react with biological membranes, plant or animal, and have negative effects.

#### Effects of “Bad” Ozone

##### Human Health

- Coughing, irritated membranes in the nose, throat and lung damage.
- Especially susceptible are those with preexisting conditions such as asthma.

##### The Environment

- Plant tissues are damaged to the extent that the leaves may turn yellow and or black.
- Some plant species die and others are stressed and are more vulnerable to disease, insects or weather extremes.

Given the negative effects of increasing levels of CO<sub>2</sub> and ozone, is there a way to predict what may happen in the future as CO<sub>2</sub> and O<sub>3</sub> levels in the atmosphere continue to rise.

#### The FACE Project (<http://aspenface.mtu.edu/>)

The Aspen FACE (Free-Air Carbon Dioxide Enrichment) Experiment is a study that is looking at the effects of increasing tropospheric (ground level) ozone and carbon dioxide levels on northern forest ecosystems. The FACE study has been ongoing since 1997 and it consists of 12, 30-meter rings that allow researchers to control and monitor the concentrations of CO<sub>2</sub> and O<sub>3</sub>. Each ring consists of a

series of vertical vent pipes constructed out of PVC pipe. These pipes release CO<sub>2</sub>, O<sub>3</sub> or normal air into the ring.

Within the ring are sensors that detect the concentrations of these gases and a computer controlled system uses signal feed back technology to adjust the gas release each second to maintain the target concentrations. The test rings are divided into quadrants where half of each ring contains different genetic varieties of aspen, 25% of each ring contains a mixture of aspen and maple and 25% contains aspen and birch.

#### Thought Question:

Why do you think that aspen, birch and maple were selected as species to be tested? Try to identify at least two reasons:

*Answers might include the prevalence of these species in this area or that these species are of great economic importance.*

#### Designing the Experiment

The Rhinelander, Wisconsin site has 12 rings and 4 different treatments where there are 3 of each treatment as shown below.

Ambient Control (Blow air on the trees):

ppm CO<sub>2</sub> = 360

ppb O<sub>3</sub> = 32

Elevated CO<sub>2</sub>

ppm CO<sub>2</sub> = 560

ppb O<sub>3</sub> = 32

Elevated O<sub>3</sub>

ppm CO<sub>2</sub> = 360

ppb O<sub>3</sub> = 56

Elevated CO<sub>2</sub> and O<sub>3</sub>

ppm CO<sub>2</sub> = 560

ppb O<sub>3</sub> = 56

#### Pre-investigation Questions:

- 1) What is the formula for photosynthesis?  
$$6\text{CO}_2 + 6\text{H}_2\text{O} + \text{Light energy} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$$
- 2) Through the process of photosynthesis, what raw materials are being taken in by the plant?  
Answer: Carbon dioxide and water
- 3) Through the process of photosynthesis, what raw materials are being produced by the plant?  
Answer: Glucose (C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>) and oxygen
- 4) What effect would you think elevated CO<sub>2</sub> levels would have on plant growth?

Why do you think that elevated CO<sub>2</sub> levels will have this effect?

- 5) What effect would you think elevated ozone levels would have on plant growth?

Why do you think that elevated ozone levels will have on plant growth?

### The Investigation:

Using the FACE website (<http://aspenface.mtu.edu/>) answer the following questions by selecting the “results” icon.

- Hint – Recall that when answering your questions, you should compare the experimental group to the control group.

### Photosynthesis

1) What happens to the rate of photosynthesis when trees are exposed to:

- Elevated levels of CO<sub>2</sub>:
- Elevated levels of ozone (O<sub>3</sub>):
- Elevated levels of CO<sub>2</sub> and O<sub>3</sub>:

2) Of the tree species that are being tested, which tree species appears to be the **most** affected by increased levels of O<sub>3</sub>?

3) Of the tree species that are being tested, which tree species appears to be the **least** affected by changes in the CO<sub>2</sub> and O<sub>3</sub> levels?

### Leaf Response

- 1) Briefly describe the effects on leaves with increased levels of O<sub>3</sub>.
- 2) Which tree species appears to be tolerant of increased levels of O<sub>3</sub>?

### Tree Growth Response

In terms of tree growth, how did the following variables affect the growth rate of the various types of **aspen**?

- Elevated CO<sub>2</sub>:
- Elevated O<sub>3</sub>:
- Elevated CO<sub>2</sub> and O<sub>3</sub>:

### Pest Interactions

What effect would increased O<sub>3</sub> have on:

- Leaf rust:
- Number of aphids:
- Number of natural enemies:
  - o Why do you think that the number of natural enemies actually decreased?

### Elevated CO<sub>2</sub> and O<sub>3</sub>

The growth rate of the trees in the elevated CO<sub>2</sub> and O<sub>3</sub> ring was not statistically above the control group but it is rising. It seems that the sensitive genotypes are dying out and those genotypes that remain, are doing well.

### Question:

- 1) What is it called when, (according to Darwin), the species that are most adapted to their environment are the most likely to survive?      *A: Natural Selection*
- 2) What effect would having O<sub>3</sub> sensitive species die out do to the species diversity of a forest?
- 3) Would the change in species diversity in question 2 be good or bad and why?

Putting This Together:

What are the effects of increasing atmospheric levels of CO2 and O3?

CO2 Effects:

Photosynthesis:

Growth rate of plants:

Efficiency of water use: Hint – If the stomata of the leaves (pores that allow CO2 to enter the leaves) are not open as long because of increased levels of CO2, what will happen to the amount of water lost through the leaves? (Transpiration)

O3 Effects

Photosynthesis:

Growth rate of plants:

Leaf dieback and mortality:

Of the tree species that were tested, which tree species seems most vulnerable to increased levels of O3?\_

\_\_\_\_\_ Which tree species seems the least vulnerable? \_\_\_\_\_

For Further Thought:

In the elevated CO2 ring the growth response is 26% above the control group. The soil temperature is lower because of a dense canopy and there are fewer under story species due to increased shade. There is also less water used because the stomata do not have to stay open as long due to increased CO2 levels.

Question:

Would increased growth always be good? Why or why not?

What do you think happens to the strength of a tree or board when the tree grows fast?

**Activity 4: How To Cool Global Warming**

Using the website, [www.fueleconomy.gov](http://www.fueleconomy.gov), use the mpg estimates to determine the average gas mileage for *each* of the vehicles in your household. If you can't find your vehicle, make your best guess or choose a similar vehicle.

Gas Mileage for:

Vehicle 1: Make: \_\_\_\_\_ Model: \_\_\_\_\_ Year: \_\_\_\_\_ MPG: \_\_\_\_\_

Vehicle 2: Make: \_\_\_\_\_ Model: \_\_\_\_\_ Year: \_\_\_\_\_ MPG: \_\_\_\_\_

Vehicle 3: Make: \_\_\_\_\_ Model: \_\_\_\_\_ Year: \_\_\_\_\_ MPG: \_\_\_\_\_

Go to the *Gas Mileage Tips* section of the website and answer the following questions:

- 1) How can you drive more efficiently:
- 2) How can you keep your car in shape?
- 3) How can you plan and combine trips?
- 4) How much would you save by buying a more efficient vehicle? For example, going from 20 mpg to 30 mpg vehicle and driving 15,000 miles would save you \_\_\_\_\_ Dollars/year. How much would this save you over 4 years?

Using the website, [www.americanforests.org/resources/ccc/index.php](http://www.americanforests.org/resources/ccc/index.php), click on *Climate Change Calculator* and either use actual data from your utility bills or use averages to determine how much carbon dioxide your household produces annually.

- 1) How much carbon dioxide does your household produce annually? \_\_\_\_\_
- 2) How many trees would be needed to remove the carbon dioxide produced by your household annually? \_\_\_\_\_
- 3) Manipulate the numbers that you input into the climate change calculator to see how small changes in lifestyle can make big changes in your emissions.

Using the website,

<http://yosemite.epa.gov/oar/globalwarming.nsf/webprintview/ResourceCenterToolsGHGCalculator.htm> or Google “EPA’s Personal Greenhouse Gas Calculator” complete the following activity for your household or family:

- 1) What are your total emissions?
- 2) How can you and your family reduce these emissions?
- 3) What would a vehicle that gets 5 mpg more do to your total emissions?
- 4) What would replacing 5, 60 watt bulbs with 13-watt compact fluorescent bulbs do to your emissions?

Complete all areas.

Using the website, <http://www.greenhouse.gov.au/gwci/ten.html>, from the Australian Greenhouse Office, identify ten easy ways to cool global warming.

Answers will include:

- 1) Walk, cycle or use public transport.
- 2) Use compact fluorescent lights
- 3) Purchase the highest energy efficiency star rating appliances.
- 4) Insulate your home and save on heating and cooling costs. Add insulation to electric hot water units.
- 5) Cut hot water consumption by washing clothes in cold water and by fitting a water-efficient showerhead.
- 6) Replace an electric hot water service with solar or high-efficiency gas.
- 7) Support renewable energy.
- 8) Service your car regularly and, when buying a new car, choose one that is fuel-efficient.
- 9) Rate the energy efficiency of your new home design
- 10) Plant, protect and conserve existing trees and shrubs.

### **Activity 5: The Identification and Removal of Exotic and Invasive Species**

#### **Background:**

Recall that an invasive species is a non-native species that is reproducing in a new ecosystem and crowding out or destroying native species. Because non-native species typically have few or no natural predators in their new “home” they often have a competitive advantage that allows them to become very common and they often disrupt food webs.

Warm Up:

Try to identify and describe 4 exotic and invasive species found in our area: Try to identify two plants and two animals.

Plant 1: \_\_\_\_\_

- What does this plant look like?
- How did this plant get here?
- How is this plant spread?
- Why is this plant a problem?

Plant 2: \_\_\_\_\_

- What does this plant look like?
- How did this plant get here?
- How is this plant spread?
- Why is this plant a problem?

Animal 1: \_\_\_\_\_

- What does this animal look like?
- How did this animal get here?
- How does this animal move from one location to another?
- Why is this animal a problem?

Animal 2: \_\_\_\_\_

- What does this animal look like?
- How did this animal get here?
- How does this animal move from one location to another?
- Why is this animal a problem?

After completing the “warm up activity” to the best of your ability, use any of the following websites to finish your descriptions in the warm up. After completing the 4 warm ups, use the same procedure to describe two additional invasive plants and two additional animals.

[www.invasivespecies.org/resources/](http://www.invasivespecies.org/resources/)

[www.invasivespecies.gov](http://www.invasivespecies.gov)

[www.dnr.wi.gov/invasives/fact/buckthorn\\_com.htm](http://www.dnr.wi.gov/invasives/fact/buckthorn_com.htm)

[www.dnr.state.mn.us/invasives/terrestrialplants/woody/commonbuckthorn.html](http://www.dnr.state.mn.us/invasives/terrestrialplants/woody/commonbuckthorn.html)

Plant 3: \_\_\_\_\_

- What does this plant look like?
- How did this plant get here?
- How is this plant spread?
- Why is this plant a problem?

Plant 4: \_\_\_\_\_

- What does this plant look like?
- How did this plant get here?
- How is this plant spread?
- Why is this plant a problem?

Animal 3: \_\_\_\_\_

- What does this animal look like?
- How did this animal get here?
- How does this animal move from one location to another?
- Why is this animal a problem?

Animal 4: \_\_\_\_\_

- What does this animal look like?
- How did this animal get here?
- How does this animal move from one location to another?
- Why is this animal a problem?

Question:

Are there any organisms that are listed as invasive that were a surprise to you? Which ones?

## **Buckthorn: A Case Study**

Background:

Common buckthorn is an invasive species that is quite common in our area. Buckthorn was imported from Europe and is used as an ornamental tree in yards or as a hedge. Buckthorn produces many berries that are eaten by birds, which allows the seeds to be dispersed. In many areas buckthorn has become the dominant under story species and has crowded out many native species that are important to the local food webs.

Activity 1:

Use the two websites listed below to learn more about buckthorn and how it is eradicated.

[www.dnr.state.wi.us.org/land/er/invasive/factsheets/buckthorns/index.html](http://www.dnr.state.wi.us.org/land/er/invasive/factsheets/buckthorns/index.html)

[www.dnr.state.mn.us/invasives/terrestrialplants/woody/buckthorne/index.html](http://www.dnr.state.mn.us/invasives/terrestrialplants/woody/buckthorne/index.html)

Questions:

- 1) What does buckthorn look like?
- 2) What color are ripe buckthorn berries?
- 3) Draw a buckthorn leaf showing the vein arrangement.
  
- 4) What is (are) the most common methods of removing buckthorn?

Activity 2

You will be working in groups of 4 or 5 students. Each group will be assigned a 20-foot by 20 foot “test plot.” Each group will need to:

- 1) Identify all species of trees and shrubs in the test area.
- 2) Count the number of individuals of each species.
- 3) Determine the percentage of individuals that are buckthorn.
- 4) Make an educated guess as to how the buckthorn arrived at this location.

Activity 3: Buckthorn Eradication

Student groups will choose different methods of removing buckthorn from their test plots. In subsequent years the previous test plots will be assessed to determine the success of the different types of eradication.

### Follow Up Questions

- 1) Which method of buckthorn removal did you choose?
- 2) When looking at buckthorn removal sites from previous years, was there any buckthorn there?  
If there was buckthorn, how much was there?  
Was this new buckthorn or buckthorn that “came back?” How could you tell?  
If the buckthorn came back, what could be done to prevent its reemergence in the future?
- 3) Why is it important to eliminate exotic and invasive species such as buckthorn from an area?

### References

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