

## ED 5641 / FW 5641 Global Change Teacher Institute: Teaching Unit

By Steve Spahn, Chassell High School  
Submitted: July 29, 2006

### UNIT OVERVIEW

This unit will involve a total of 5 days of instruction involving three separate classes. One day of instruction will be with the 7<sup>th</sup> grade math class, three days will be with the 8<sup>th</sup> grade science class, and one day will be with the 9<sup>th</sup> grade science class.

### **Target Grades/Subject Areas**

**Math Class** – The basic theme of the class period will be relating increasing global temperatures to ice loss on Greenland. The students will calculate predicted volumetric losses of ice that will happen on Greenland as the overall global temperature increases. They will then compare this volume of ice to a thickness over familiar regions, like the area of Lake Superior, the state of California, etc. This connects to the curriculum with our percents and decimals unit, as there will be use of percents in determining the loss of ice over time. The lesson will also serve as a good review of areas and volumes. By doing this lesson I hope to show the students that very small increases in overall global temperatures will result in huge amounts of ice loss in the colder regions of the world.

**Science 8** – The 8<sup>th</sup> grade science students will have three lessons with regard to Global Change at two different times of the year. During the insects segment of our life science section of the curriculum on animals, the students will set up pit fall traps in the forested area behind the school, and will see what type of life forms they can collect. They will compare their specimens to known forms of invasive species. As an additional task with this lesson, the students will use GPS systems when placing their own cups, and then they will again use GPS systems to locate a pit fall trap of a different group on the collection day.

The other two class periods will involve the plants with seeds segment of our life science section of the curriculum on plants. The students will plant seeds, and as the plants begin to grow they will expose the plants to increased levels of carbon dioxide over several weeks to see what sort of effect that will have on their development. The rest of this two period segment will involve a short learning session on global warming where we will create a high concentration of carbon dioxide in one bag, and compare the air temperature to a bag with a concentration of atmospheric carbon dioxide with the use some heat lamps, vinegar, baking soda and thermometers.

These lessons tie in with the life science section of the 8<sup>th</sup> grade curriculum in two parts of the year. On these three days I hope to show the students that invasive species do exist in our area, and also to show them carbon dioxide is a good thing, but too much of it is having a bad effect on our world by causing global warming. I do not want them to see increased growth of a plant, if we can get that to happen, and go away from the lesson thinking we should pump as much carbon dioxide into the atmosphere as possible. I want them to see that it can have a detrimental effect. Also, even though increased levels of carbon dioxide can increase growth, that may not always seem like a good thing as rapid wood growth indicated by wide growth rings can result in ‘weaker’ wood.

**Science 9** – The 9<sup>th</sup> grade science students will have one lesson with regard to Global Change that will need to be conducted over two seasons of the year, fall and winter. The investigation will connect to the curriculum during the fresh water section of the earth science unit, and also during the acids/bases section of the chemistry and matter unit.

The basic plan will involve the collection and determination of the pH of rainwater in the fall, the collection and determination of pH of water from the Pike River in the fall, and the collection and

determination of the pH of snowfall in the winter. If possible we will compare the data collected with the direction from which the precipitation came. For this experiment, the students will locate the collection sites in the fall using GPS units, and when they put collection devices out in the winter they will use the GPS units to place the devices in the exact same place they were in the fall. They may also use the GPS units to find the collection devices in the winter if they get completely buried by the snow.

By conducting these experiments over the course of many years and documenting as much as possible the direction from which the precipitation came, I hope to show the students how our region is affected by what is going on around us.

## **REFERENCES**

### **Math 7**

Dixon, K. & Vahlenkamp, H., Arctic sea ice changes in gfdl r30 greenhouse scenario experiments, Geophysical Fluid Dynamics Laboratory, May 10, 2004, <http://www.gfdl.gov/~kd/KDwebpages/NHice.html#two>.

Hite, George, Lake Superior – Does Water In = Water Out?, George’s Eagle Harbor Web, April 1998, <http://www.eagleharborweb.net/>

Col, Jeananda, Area and Ranking, Enchanted Learning, 2001-2006. <http://www.EnchantedLearning.com>

Berenblit, Hanna, Volume of Earth’s Polar Ice Caps, The Physics Handbook™, 2000. <http://hypertextbook.com/facts/2000/HannaBerenblit.shtml>

Gore, Al. (2006). An Inconvenient Truth (p. 26-27). Emmaus, PA: Rodale Publishing.

### **Science 8**

Lilleskov, Erik. Personal Communication. July 17, 2006

Vail, Janet. Personal Communication. July 18, 2006

### **Science 9**

Burton, Andrew. Personal Communication. July 18, 2006

## **TEACHING AND LEARNING OBJECTIVES**

### **Math 7**

*The students will be able to:*

- 1) Translate a known volumetric measurement into an area with a calculated height.
- 2) Compare large volumes to something they are familiar with, like the size of Lake Superior.
- 3) Explain why small increases in global temperatures can have big impacts on the overall condition of the earth.

### **Science 8**

*Students will be able to:*

- 1) Explain why carbon dioxide is an important trace gas in our atmosphere because it is essential for plant growth which provides us with oxygen, food, and fiber.
- 2) Explain why excessive CO<sub>2</sub> can have a detrimental affect on our earth by increasing global warming.
- 3) Give examples of how humans have altered ecosystems through the introduction of invasive species.
- 4) Use scientific literature to determine whether or not an organism is an invasive species.
- 5) Use GPS units to identify specific locations around the school, given longitude and latitude information.

### **Science 9**

*Students will be able to:*

- 1) Determine proper locations for the collection of precipitation for pH analysis taking into account the reasons for the analysis.
- 2) Analyze pH data to describe reasons for the differences in values, if any, over time; taking into account weather patterns at the time of the collection.
- 3) Use GPS units to identify specific locations around the school, given longitude and latitude information.

## **MICHIGAN CONTENT BENCHMARKS ADDRESSED**

### **Math 7**

Numbers and Operations: Understand derived quantities

Algebra: Recognize when information given in a table, graph, or formula suggests a proportional or linear relationship.

### **Science 8**

Strand I: Construct New Scientific Knowledge (C)

Content Standard 1 – Students will ask questions that help them learn about the world; design and conduct investigations using appropriate methodology and technology; learn from books and other sources of information; communicate findings of investigations, using appropriate technology.

Benchmark 1 (MS): Generate scientific questions about the world based on observation.

Benchmark 2 (MS): Design and conduct scientific investigations.

Benchmark 3 (MS): Use tools and equipment appropriate to scientific investigations.

Benchmark 4 (MS): Use metric measurement devices to provide consistency in an investigation.

Benchmark 5 (MS): Use sources of information in support of scientific investigations.

Strand II: Reflecting on Scientific Knowledge (R)

Content Standard 1 – Students will analyze claims for their scientific merit and explain how scientists decide what constitutes scientific knowledge; show how science is related to other ways of knowing; show how science and technology affect our society; show how people of diverse cultures have contributed to and influenced developments in

science.

Benchmark 1 (MS): Evaluate the strengths and weaknesses of claims, arguments, or data.

Strand III: Organization of Living Things (LO)

Content Standard 2 – All students will use classification systems to describe groups of living things; compare and contrast differences in the life cycles of living things; investigate and explain how living things obtain and use energy; analyze how parts of living things are adapted to carry out specific functions.

Benchmark 3 (MS): Describe evidence that plants make and store food.

Strand III: Ecosystems (LEC)

Content Standard 5 – All students will explain how parts of an ecosystem are related and how they interact; explain how energy is distributed to living things in an ecosystem; investigate and explain how communities of living things change over a period of time; describe how materials cycle through an ecosystem and get reused in the environment; analyze how humans and the environment interact.

Benchmark 2 (MS): Describe how organisms acquire energy directly or indirectly from the sunlight.

Benchmark 5 (MS): Explain how humans use and benefit from plant and animal materials.

Benchmark 6 (MS): Describe ways in which humans alter the environment.

**Science 9**

Strand I: Construct New Scientific Knowledge (C)

Content Standard 1 - Students will ask questions that help them learn about the world; design and conduct investigations using appropriate methodology and technology; learn from books and other sources of information; communicate findings of investigations, using appropriate technology.

Benchmark 1 (MS): Generate scientific questions about the world based on observation.

Benchmark 2 (MS): Design and conduct scientific investigations.

Benchmark 3 (MS): Use tools and equipment appropriate to scientific investigations.

Strand II: Reflecting on Scientific Knowledge (R)

Content Standard 1 - Students will analyze claims for their scientific merit and explain how scientists decide what constitutes scientific knowledge; show how science is related to other ways of knowing; show how science and technology affect our society; show how people of diverse cultures have contributed to and influenced developments in science.

Benchmark 1 (MS): Evaluate the strengths and weaknesses of claims, arguments, or data.

Strand V: Hydrosphere

Content Standard 2 – All students will describe the characteristics of water and demonstrate where water is found on earth; how water moves; analyze the interaction of human activities with the hydrosphere.

Benchmark 2 (MS): Describe how surface water in Michigan reaches the ocean and returns.

Benchmark 4 (MS): Describe the origins of pollution in the hydrosphere.

Strand V: Atmosphere and Weather

Content Standard 3 – All students will investigate and describe what makes up weather and how it changes from day to day, season to season and over long periods of time; what causes different kinds of weather; analyze the relationships between human activities and the atmosphere.

Benchmark 1 (MS): Explain patterns of changing weather and how they are measured.

Benchmark 3 (MS): Explain the behavior of water in the atmosphere.

## **CLASSROOM/FIELD ACTIVITIES**

### **Math 7 – Greenland Ice Volume Loss compared to Global Temperature Increase** (1 class period)

**Material needed** – computer lab or a classroom with equipment (projector) to allow the whole class to see needed internet information, calculators.

**Introductory Discussion** – Discuss the concept of global warming to the students. I would ask the students various questions about global warming, trying to determine their level of knowledge. I would ask them if they know what it is, what causes it, if it is bad, etc. After this discussion, I would give them a short description of what causes global warming:

The Sun's energy enters the atmosphere and heats up the Earth. Some of that energy warms the Earth and then is re-radiated back into space in the form of infrared waves. Under normal conditions, a portion of the outgoing infrared radiation is naturally trapped by the atmosphere—and that is a good thing, because it keeps the temperature on Earth within comfortable bounds. The problem is that the atmosphere is being thickened by huge quantities of human-caused carbon dioxide and other greenhouse gases. And as it thickens, it traps a lot of the infrared radiation that would otherwise escape the atmosphere and continue out into space. As a result, the temperature of the Earth's atmosphere—and oceans—is getting dangerously warmer.

Then I would ask them what sort of effects this could have on the world, hoping that they would eventually say that it will cause the polar ice caps to melt. That will get us to the topic of Greenland. Total time: 10 minutes.

**Greenland** – I would discuss that Greenland is an island almost completely covered with ice. Then I would tell them the total calculated ice volume on Greenland is 714,984 cubic miles, and ask them if they think that number is exact. I would ask them some questions about how much that amount of ice would change if the earth warmed up one degree, and I would also make sure they know what a cubic mile is. I would have some topographic maps of the area they live in available for them to look at; showing them what a square mile is, hoping they understand that a cubic mile is a square mile one mile high. Total time: 8 minutes

**Area/Volume/Percent Review** – We will take some time to do some review calculations on area, volume, and percentage. They will be adept at taking a width and a length and multiplying them together to get an area, and then using a height to find volume. But I will give them some volumes, like the volume of the classroom, and have them calculate how high the room is knowing the floor area. Basically they will be doing a volume calculation in reverse. I will make sure they can do this, and also give them a review lesson, telling them to keep their units consistent so they are not multiplying an area in square inches by a height in feet. Total time: 6 minutes

### **Ice Loss vs. Temperature Increase**

At this time we will visit the graph on the website showing the percentage of ice loss as time goes on. As a class we will determine this information, but for the sake of this assignment, I will say that I determined it to be approximately a .55% volume loss per year. Also, as a class we will determine the increases in temperature as time goes on.

Again for the sake of this paper I will say that I determined it to be approximately .04 degrees Fahrenheit per year. This part of the assignment itself could be a lesson on determining rates, but for

now we will just find this information and use it for the objective at hand. So to find the volume of ice lost for an overall global temperature increase of .5 degrees Fahrenheit, I will ask the following questions:

1. If the overall temperature increase has been determined to be .04 degrees per year, how many years will it take to increase .5 degrees?

Hopefully they will be able to determine that we should divide .5 by .04 and get 12.5 years.

2. If the ice loss has been determined to be .55% per year, what percent ice loss will there be after 12.5 years?

If we have covered rates well enough, they should realize that we can find the ice loss by multiplying 12.5 years by .55 to get 6.88%

3. What volume of ice will be lost with a .5 degree increase in global temperature?

Hopefully the students will be able to know that they need to multiply .0688 and 714,984 together to get 49,191 cubic miles of ice.

4. How thick would 49,191 cubic miles of ice be if we had a surface the size of Lake Superior to put it all on? Lake Superior has a surface area of 31,700 square miles.

To find the answer here they would need to divide the overall volume of ice lost by the surface area available; 49,191 divided by 31,700. This would be a piece of ice 1.55 miles thick over an area the size of Lake Superior.

This would be a fairly heavy review of several topics; including rates, percents, area, and volume. There would also be some good lessons on interpreting graphs, and to determine the temperature increase per year along with the percent ice loss per year would involve drawing a rough line through the data, using a yardstick up against the projector screen or something along those lines. That process for two graphs with 7<sup>th</sup> graders could take some time. All students would be expected to write the whole process out and do the calculations listed above as we go through the information.

Total time: 20 minutes

### **Assignment/Homework**

Students will be given the following homework assignment.

1. How much ice would melt from Greenland if the overall temperature of the globe increased by 1 degree F? (The answer would be 98,382 cubic miles). What would be the thickness in feet of this ice if it could be spread over a surface the size of the entire United States? The surface area of the entire US is 3,537,411 square miles. To get the thickness in feet, multiply your answer in miles by 5280. (The answer is 147 feet)
2. We determined that if the overall temperature went up .5 degrees on the earth, 49,191 cubic miles of ice would melt on Greenland. What would be the thickness of this ice (in feet) if it was spread out over an area covering the state of California? The state of California has a surface area of 155,959 square miles. (The answer is 1665 feet)

## **Science 8 – Day One: Invasive Species Investigation** (3 class periods total)

**Materials needed** – GPS units, (at least one per group), 8 ounce plastic cups, microscopes.

**Introductory Discussion** - I would begin the lesson by asking the students if they know what an invasive species is. I would predict that they would say things like the sea lamprey and barnacles on ships, and possibly a few others. The main point of the discussion would be discussing the possible ways an invasive species could be brought into a region; Houghton County for example. We would try to bring the discussion around to pit fall traps, what they are and that we will be going outside to inspect pit fall traps. In order to make sure the lesson is completed in one hour, I will install five or six traps in various areas the previous day.

The students will use GPS units to find their assigned pit fall trap. They will learn how to use these tools at a previous time, but will get a quick review course on their use and especially their handling at this time in class. Total time: 15 minutes.

**Trip Outside to Pit Fall Traps** - We will go to each pit fall trap together as a class, hopefully with enough GPS units to allow each student to hold one and have a chance to see their progress toward their assigned trap. I will make sure that we have only four or five kids per pit fall trap, so each student should be able to use his or her own unit. I will pass out the GPS units to the group 1 members. When we get to their trap, we will simply pick it up, cover it, hand the GPS units to the group 2 members and move on. When all traps have been picked up, we will proceed back to the lab.

Total time: 15 minutes.

**Group Work: Trap Inspection** – Each students will document each organism in their trap, and determine the species of the organism using field guides at the school. Students may use microscopes to look at very small aspects of the organisms.

Total time: 15 minutes.

**Wrap Up Discussion** – Each group will tell the rest of the class what they found in their trap, and discuss any out of the ordinary findings. Total time: 9 minutes.

## **Science 8 – Days Two and Three: The Good and Bad of Carbon Dioxide**

**Materials needed** – 8 ounce plastic cups, (2 per students, and additional 1 to 2 dozen more), potting soil, seeds, Ziploc bags (large and small), several bottles of vinegar, baking soda, plastic tubing, two good quality thermometers, two heat lamps, Dixie cups, journals.

**Introduction** – In the spring of each year the 8<sup>th</sup> grade science class plant flowers or vegetables in clear 8 ounce cups. Each student gets two cups and plants whatever they would like within reason. The clear cups are used so that they can see the progress of the roots of their plants. To make sure everyone gets to grow a plant that they would like, we spend some time in class determining what everyone wants. I usually start by telling them what we have grown in the past and write those on the board. Almost always there is something on the board that interests them and so everyone is happy. I always tell them that they can bring in their own seeds if they would like and some do.

In this two day lesson, we will set up a project to determine the effects of increased levels of carbon dioxide on plants (the good of carbon dioxide) and we will do an experiment simulating global warming (the bad of carbon dioxide). As a part of the experiment involving the good side of carbon dioxide, when the kids do their planting we will make sure that we have at least an extra three or four sets of two, or better yet four plants of a fairly quick growing flower or vegetable that has a decent amount leaf

surface area. Looking back on what we have done in the past, I would say that pumpkins, cucumbers, and sunflowers are all plants that would be good candidates.

Even though this is a two-day lesson, the overall investigation of the good side of carbon dioxide will probably last more than a month, and most likely involve the equivalent of four or five class periods. It will involve approximately one and a half days of startup work and 5 minute (or less) segments of class time for the rest of the experiment. The description of the two day lesson that follows will be of teaching and learning that will be done so that the rest of the project can be done in 5 or less minutes per day.

### **Introductory Discussion (planting day)**

The students will most likely put their seeds in their cups right away at the beginning of the lesson on plants with seeds, and by the time their plants are growing, or at least the ones used for the experiment, it will be too late to discuss controlling variables. So on this day, the students will get a quick discussion on photosynthesis and a lesson on the project we will do exposing the plants to increased levels of carbon dioxide, and how we will need to be very careful as to how we handle those plants from the time the seed is put in the soil. So on this day I would start the class period with a description of how plants exist leading to the photosynthetic process. I would ask them a lot of questions as usual, and the whole purpose would be to reinforce the concept that plants need what we get rid of and give us what we need. I would put the equation for photosynthesis on the board, and after they see that carbon dioxide is very important to a plants development, I will describe the atmosphere and its components, and especially relate to them that carbon dioxide is a trace gas. I will start a discussion to get them to think about how a plant will do if it gets more carbon dioxide than what is available in the atmosphere. They should catch on to the idea that more carbon dioxide should help the rate of growth. After this task has been accomplished, I will describe to them the project we will do investigating increased levels of carbon dioxide exposure for a plant. I will need to explain to them that it is extremely important that before we plant the seeds we need to determine which plants will be involved in the study, and that we need to treat them exactly the same from planting time until we begin the extra carbon dioxide exposure. We will need to especially sure we water them with the same amount of water. I would actually take one of the plants and water it for the first time from a graduated cylinder to show the students what an appropriate amount of water is and then document that volume. After that, the students would plant the seeds for themselves and the ones for the experiment. Then we will begin the actual chapter on plants with seeds. So the time listed here is a part of the two day lesson that will happen probably around a week before the rest of the investigation described below. Total time: 20 minutes.

### **Carbon Dioxide Production**

When I come to school in the morning and see that the seeds for a particular species have begun to sprout, I will begin that particular science 8 class day with a quantity of baking soda and a bottle of vinegar, along with some small Ziploc bags at the front of the room. I will tell the kids that today is the day we will need to begin our carbon dioxide exposure experiment. I will take a small bag, put in a small amount of baking soda and follow that with the addition of the vinegar. I will quickly close the bag and show the students what happens. I will then break them up into groups of two or three and let them do the same thing. While they are experimenting, I will put the equation for what is going on in the bag on the board:



They will see that the gas they are forming inside the bag is carbon dioxide. At this point we will begin a discussion of how we can create this gas inside a Ziploc bag with our plants inside. Also, we will discuss other factors that could have an effect on the growth of the plant, like having excess vinegar in the bag. Ideally I could get them to determine through questions that they would probably want to have excess baking soda in the bag to use up all the vinegar, since the vinegar is an acid and somewhat irritating to us; maybe it will also be irritating to the plant. To avoid a large loss of carbon dioxide when closing the bag, I would try to get them to see that maybe we could put the Ziploc bag on it's side, put the plant in the bag with the right amount of baking soda, and then close the bag almost all the way around a tube through which the vinegar could be added. After we added the vinegar, we could simple pull out the tube and close the bag with negligible loss of carbon dioxide.

Since these 8<sup>th</sup> grade students would not be able to comprehend the stoichiometry of the equation, we would (as a class, through trial and error) determine the right amount of baking soda and vinegar to get a bag full of carbon dioxide with a plant inside where all the vinegar has been used up. I would have the students weigh out amounts of baking soda, and measure volumes of vinegar and eventually we would determine as a class the ratio we would need to fill the bag without it breaking at the seams. As an additional lesson, I would do the stoichiometry myself after class to make sure our trial and error was fairly close.

We would also review the other variables that we would need to be aware of, like sunlight, the amount of water they get and so on. Through a discussion like that we would eventually reinforce to the students that we would need to use two plants of the same species that were treated the same from the time the seeds were put in the ground. They would need to be watered the same, and put in the exact same lighting conditions. The only difference would be that one plant would grow in a bag of carbon dioxide and the other in the air of the classroom.

We would not actually put the plants in bags on this day, because I would want to check the stoichiometry to make sure we are not wasting too much material. At this point we would continue on with the chapter as originally planned. The time listed here is what would be used from the beginning of the hour to this point on our investigation.

Total time: 35 minutes

### **The next day**

We would come into the classroom this day with all our information obtained, and begin the exposure of the plants to carbon dioxide. We would measure out several of the needed volumes of baking soda in small Dixie type cups and keep them clean and dry so that we could create our carbon dioxide fairly quickly each day. We would keep the vinegar in the bottle and measure that out each day. Our work this day may take a little longer since they will need to familiarize themselves with the whole process of setting up a bag with a plant, baking soda, and then adding vinegar with a tube. Also, measuring the extra amounts of baking soda should take awhile and there will need to be extra documentation (see that section below) on this day.

Total time: 25 minutes

### **Bad Carbon Dioxide**

After we had begun our carbon dioxide exposure to some of the plants, I would get them back to their seats and set up another demonstration in front of the room. I would have two Ziploc bags on their sides each with a good quality thermometer set up off the side so that it is exposed only to the air in the bag. The only difference is I would put some baking soda and vinegar in one of the bags before closing them. They would then immediately be put under some heat lamps, and some volunteers would watch the

thermometers to compare measurements. Hopefully if the experiment goes as planned, the bag with the vinegar and baking soda will have a higher air temperature.

At this time I would start a discussion as to why we saw the difference, and lead them to see that the only difference in the air in each bag is the carbon dioxide. I would then go to the board and sketch a cross sectional view of the earth and its atmosphere and show them that some of the energy from the sun gets trapped, and the carbon dioxide increases the amount of heat that is trapped. The heat lamp is the sun and there is basically a good amount of global warming going on in the bag with more carbon dioxide. I would support this description with two of the charts from the Global Change Teacher Institute Disk, specifically the chart that shows how the carbon dioxide concentration in the atmosphere is going up over time and the chart that shows how the global temperatures are related to the levels of carbon dioxide in the atmosphere.

At this time the lesson on how carbon dioxide is beneficial (to plants and then to us) and how it can be harmful will be completed, so I would take some time to discuss what we did and how one compound can be both good and bad in certain ways.

Total time: 20 minutes.

### **Documentation/Assessment**

All students would be given a small journal to keep track of all aspects of the experiment, and then be required to write a lab report to summarize the whole project. Each day we will examine the plants and refill the bags as necessary. We may have some student's measure out several of the required volumes of baking soda in advance with some extra time here and there as we need them so that the monitoring process does not take up too much time on a given day. I would question the students as to how they could really do a good job of monitoring the plants. Hopefully they could determine that we could measure the height of the plants, the spread of the leaves, and make notes on the overall visual appearance of the plants to compare the growth of the one(s) in the bag with the growth of the one outside the bag. Maybe they would come up with some of their own ideas, like leaving some species of plants in bags until the end of the hour only, others until the end of the day, and still others all the time except to measure them and replace the carbon dioxide. We should have more than enough plants with which to change exposure for some of the plants.

The lab report will include a purpose, thorough description of the procedure and the results, and a conclusion.

### **Science 9 – pH Comparison of Rainwater, Snowfall, and Water in the Pike River** (1 class period)

**Materials needed** – GPS units, three rainfall collection units (each having a funnel covered with screen sitting in a jar), stakes to secure collection units, pH meter, rope, a clean bucket, a clean jar, and three buckets to collect snow.

**Introductory Discussion/Field Trip** – This activity will take more than one class period and for obvious reasons will need to be done over several months time. This lesson/activity will begin in the fall when we cover a chapter on freshwater in the earth science unit. We will most likely try to plan our trip outside to place the collection containers on a day where the forecast is looking like rain soon, that way our containers will not be out too long. On this day we will place three collection containers out in the open a fair distance from the Pike River so as to not be affected by runoff from trees or nearby vegetation. A collection container will simply be a funnel with a screen on it placed securely into a bottle or jar. The apparatus will be secured to prevent it from tipping. We will locate each collection apparatus using a GPS unit. When we feel like we have our sampling devices in good places, we will walk to the Pike River and take samples from water. We will take a sample directly from the middle of

the river using a bucket suspended from the bridge, and we will also take samples from the side of the river where the water is shallow and contains a lot of vegetation. When we have adequate samples, we will go back to the lab and analyze the pH of the river water, and document that data.

Total time: 40 minutes.

**After a good rain** – We will go out and collect our collection devices, bring them into the lab, and analyze for pH. Total time: 30 minutes

**Before a significant snowfall** – We will use GPS units to go out and place wide shallow buckets in the exact same places we had the collection devices for the rainfall. Also, we will most likely do this task when we are covering the section on acids, bases, and pH in our chemistry and matter unit.

Total time: 20 minutes

**After a significant snowfall** – We will go out and collect our snowfall collection devices, bring them into the lab, and analyze for pH. Depending on the amount of snowfall, we may need to use the GPS units to find our collection devices.

Total time: 30 minutes

**Analysis/Documentation** – After all the data has been collected, we will pull it all together and put it on the board. Each student will be required to keep track of all the data collected, including sample locations and pH measurements for all samples. They will also document the direction from which the precipitation came from so that we can determine reasons for potential differences in pH. We will discuss the data as a class, and try to determine the reasons for differences, if any. They will then do lab reports on the whole project, and the data will be compared to the same project data for years to come. The lab report will include a purpose, procedure, results, and conclusion.

### **OVERALL UNIT ASSESSMENT**

Assessments are described within each particular class section. Since there is only one day for math 7, three days for science 8, and one day for science 9, I would not test just over the material in these lessons, but when I do have a test, I will include some questions on the material presented in the respective lessons.

The specific assessment tools for these lessons are:

1. Homework Assignment – Math 7
2. Journal Reflections/data documentation on projects – Science 8 and Science 9
3. Lab Reports at the conclusion of projects – Science 8 and Science 9