pH-I think I love you,



But don't acid rain on my parade!



A basic lesson on pH and environmental impact and sustainability

ΒY

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ICE-5 SUMMER INSTITUTE

2010

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Lesson Title: <u>pH- I think I love you, but don't acid rain on my parade! A basic</u> lesson on pH and environmental impact and sustainability.

Lesson Narrative:

- In this lesson students will be **Engaged** by the teacher reading- *One Less Fish* by Kim Michelle Toft and Allan Sheather (1998).
 - (?)The students should be asked if they have ever seen tropical fish in real life.
 - (?) Students should be asked what importance the tropical fish play in the world.
 - (?) Students should be asked what would happen if all tropical fish disappeared.
 - Students will be asked to fill out a <u>K-W-L chart</u> for Acids, Bases, pH, Acid Rain Water cycle and Environmental Effects. <u>This is the first formative assessment which will guide instruction for the teacher</u>. Based on the information the students already know accurately, the teacher can proceed with instruction, spending less time on the known, and more time on the information students do not have in their schema. After assessing prior knowledge, the acid base lab will take place regardless of gaps in knowledge. Students will be gaining experience through the lab and teacher will use results of KWL assessment to ensure the knowledge gaps are addressed in class discussion after lab, power point presentation, and research on acid rain.
- The students will **Explore** by completing the Acid Base lab. The safety concerns will include: covering lab safety contracts and stressing the importance of following the lab procedure carefully, using safety goggles, and not performing any procedures not listed on the lab paper. The majority of the Learner Objectives will be achieved during the experiment since scientific method will be used.
- **Explain** will be addressed with a class discussion of the lab results. Acids will turn the cabbage juice indicator red, and the bases will turn the cabbage juice indicator blue. Students should be able to accurately predict the pH of other substances related to the ones tested in the lab. The students will do a formal lab write up using the Lab Write-Up Evaluation Form as a guide.
- **Explain** will also be addressed by the power point lecture over pH and the basic cycle of acid rain.
 - The second formative assessment will be in the form of a white boarding quiz. The process of making white boards involves taking a 4'x 8' of white shower board and cutting them into tiles that are 12" x 12" tiles for a writing surface. Edges are rounded over or sanded to prevent sharp edges. Low odor, dry erase markers are used to write the students answers to a question and holding it in front of the students' chest area to prevent other students from seeing the answers. Clean, old tube socks can be used as erasers. White boarding gives the teacher a quick method of assessing student

knowledge about a subject and all students are engaged, as compared to a simple question/answer format in which only a few students usually participate.

White boarding will be used to assess knowledge of pH after lab, class discussion, and power point on pH. Although white boarding can be used with larger boards for group activities, for this assessment, students will be using small, individual white boarding. If students do not have 80% accuracy, then students will have Buddy Study Session to review, and retest with white boards until all student are at 80% mastery.

• Elaborate/Extend:

The elaborate/extend will be accomplished through a **student research** on the computer and using the selected websites and selected book resources listed in the Additional Resources section. This is just a small sampling of available books and websites. The topics of research include: the background on acid rain as real world connection to importance of understanding the pH levels needed to sustain life on the planet. Once the research is completed, students will share their information and attempt to find any discrepancies in their information gathered.

The students will complete the **Lab of Growing Plants** in weak acid, strong acid water solutions. Students will be required to complete a full lab written report.

The Summative Assessment will provide the final assessment for this lesson plan and will be the evaluation of the students' written lab report. The students' reports should have basic knowledge of pH, acid rain impact on plant growth, and a link to the big idea of the negative impacts on sustainability for our planet.

Grade Level(s) Identified:

6th, 9th Grade Physical Science- or any grade with GLE's covering: pH, acid/base, or water cycle, with real world connections to environmental sustainability and ecological impacts due to acid rain.

Student Lerner Goals/Objectives- Connected to the GLE's (9th):

Strand 1: Properties and Principles of Matter and Energy

- a. 1.A.b Identify pure substances by their physical and chemical properties (i.e., color, luster/reflectivity, hardness, conductivity, density, pH, melting point, boiling point, specific heat, solubility, phase at room temperature, chemical reactivity)
- b. 1.B.a -Compare and contrast the properties of acidic, basic, and neutral solutions
- c. 1.G.a- Distinguish between physical and chemical changes in matter
- d. 1.2.A.d- Identify and evaluate advantages/disadvantages of using various sources of energy (e.g., wind, solar, geothermal, hydroelectric, biomass, fossil fuel) for human activity

Strand 7: Scientific Inquiry

- e. 7.1.A- Formulate testable questions and hypotheses
- f. 7.1.A-Analyzing an experiment, identify the components (i.e., independent variable, dependent variables, control of constants, multiple trials) and explain their importance to the design.
- g. 7.1.B- Make qualitative and quantitative observations using the appropriate senses, tools and equipment to gather data (e.g., microscopes, thermometers, analog and digital meters, computers, spring scales, balances, metric rulers, graduated cylinders)

- h. 7.1.C- Use quantitative and qualitative data as support for reasonable explanations (conclusions)
- i. 7.1.C-Identify the possible effects of errors in observations, measurements, and calculations, on the validity and reliability of data and resultant explanations (conclusions)
- j. 7.1.C-Analyze whether evidence (data) and scientific principles support proposed explanations (laws/principles, theories/models)
- k. 7.1.D- Communicate the procedures and results of investigations and explanations through: oral presentations, drawings and maps, data tables (allowing for the recording and analysis of data relevant to the experiment such as independent and dependent variables, multiple trials, beginning and ending times or temperatures, derived quantities),graphs (bar, single, and multiple line),equations and writings

Strand 8: Impact of Science, Technology and Human Activity

- I. 8.1.B.- Recognize the relationships linking technology and science (e.g., how technological problems may create a demand for new science knowledge, how new technologies make it possible for scientists to extend research and advance science)
- m. 8.3.B- Identify and evaluate the drawbacks (e.g., design constraints, unintended consequences, risks) and benefits of technological solutions to a given problem (e.g., use of alternative energies to reduce the use of carbon fuels, use of satellite communications to gather information)

Featured Scott Foresman's Textbook or other Text:

Prentiss Hall's Physical Science Concepts in Action by Wysession, Frank, and Yancopoulos

Academic Vocabulary Words:

acid, base, indicator, neutralization, salt, pH, buffer, electrolyte

Safety:

Safety contracts are reviewed with the students at the beginning school year, signed by the students and parent/guardian. Copies in English and Spanish are available at: <u>http://www.flinnsci.com/Sections/Safety/safety_contracts.asp</u> Review of these safety procedures takes place before each lab session. Students who are not following safety procedures do not continue with the lab.

Special considerations for this lab include:

- 1. Wearing safety goggles to prevent splashing of any liquids in eyes.
- 2. Precautions for glass safety.
- 3. Reminders to not eat or drink any of the food products.
- 4. Safety reminders for careful cutting with scissors.
- 5. Safety reminders for not mixing any of the samples.
- 6. Safety reminders for not performing any procedures that are not specified in the lab experiment.
- 7. Washing hands after all clean up is completed.

Bibliography of more information:

Additional Resources

Non-Fiction Books

- Acid Rain-Peggy J. Parks (2006). Good research material for upper elementary students on acid rain. Website links.
- Big Outdoors- Great Barrier Reef- Valerie Bodden (2010).
 Perfect for younger elementary students. Provides beautiful pictures, basic knowledge about reefs, and mentions what pollution does to the reef.
- Endangered Planet- David Burnie (2004).
 Great book for students to use for research. Great pictures, graphs, facts. Careers for environmental interest in each chapter and extensions for learning. Website links.
- Environmental Disasters: Vanishing Habitats and Species- Jane Walker (2005). Great link between acid rain, deforestation, and loss of species across the various biomes.
- Environmental Experiments About Water- by Thomas R. Rybolt and Robert C. Mebane. (1993) Excellent book that contains simple experiments covering such topics as: 1) Acid Rain, 2) Properties of Water, 3) Water Cycle, 4) Water Pollution, and 5) Water Purification. Book includes explanations for the results and extensions. Another book in this series is: Environmental Experiments about Life. It also has experiments about acid rain.
- Global Issues: Clean Air and Water-Cheryl Jakab (2007).
 Case studies of different global issues which could be used for problem solving discussions. Sustainable future is a central theme. Suggestions for students to save water and reduce pollution are included. Website links.
- 7. *The Great Barrier Reef: Using Graphs and Charts to Solve Word Problems* by Therese Shea(2007). Integration of science and math. Probably not appropriate for younger elementary students.
- 8. *Our Fragile Planet- Atmosphere, Air Pollution and Its Effects-* Dana Desonie, PhD. (2007) Excellent background information for Teachers and middle to upper grades. Website links.
- Reducing Air Pollution- Jen Green (2005).
 The book provides a great basic knowledge base for pollution, the consequences, and how to try to solve some of the problems.
- 10. What can we do about Pollution? –Suzanne Slade (2010). Great book for younger elementary age students. Website links.

Fiction Books

11. One Less Fish- Kim Michelle Toft and Allan Sheather (1998). Fiction Literature. Beautiful pictures of tropical fish are done in ink and dyes on silk. Downward progression of why the fish are disappearing due to fishing, pesticides, and other environmental problems. Great engagement book for a unit.

Teacher Resource

12. Project Wet K-12 Curriculum and Activity Guide (2002)- Great resource for all environmental subjects.

Video Resource

13. Video-*Planet in Peril (2007).* CNN anchor, Anderson Cooper along with other journalists and biologists tour 13 countries and discuss the issues.

Websites

- 14. <u>www.myfootprint.org</u>
- 15. <u>www.rprogress.org</u>
- 16. www.lerner.org/jnorth/
- 17. <u>www.csiro.au</u>
- 18. <u>www.Epa.gov</u>
- 19. http//site.videoproject.com/coral reefs/

great video on coral reefs online- free.

Engage:

- Read: One Less Fish
- <u>Formative assessment #1 K-W-L Chart</u> for Acids, Bases, pH, Acid Rain Water cycle and Environmental Effects

Explore:

• Acid- Base Lab

Explain:

- Class discussion of lab results and lecture of pH
- Formative assessment #2 White boarding- quiz over pH, acids, bases, water cycle for acid rain.

Elaborate/Extend:

• **Research** background on acid rain as real world connection to importance of understanding the pH levels needed to sustain life on the planet.

• Lab of Growing Plants in weak acid, strong acid water solutions Evaluate:

• Two well-developed formative assessments

 $ightarrow \frac{\#1- \text{K-W-L Chart to assess prior knowledge}}{\text{Momentum Results}}$ at beginning of unit. After assessing prior knowledge lab will take place regardless of gaps in knowledge. Students will be gaining experience through the lab and teacher will use results of KWL assessment to ensure the knowledge gaps are addressed in class discussion after lab, power point presentation, and research on acid rain

#2- White boarding to assess knowledge of pH after lab, class discussion, and power point on pH. If students do not have 80%

accuracy, then students will have Buddy Study Session to review, and retest with white boards.

• Summative assessment

Lab Report Write-up for Acid Watered Plant- see lab report grading rubric for point values.

Variety of DOK levels addressed in all assessments Complete answer key with point values



K_{now}	Want to Know	Learned



<u>**Background information**</u>: Cabbage juice acts as an indicator of acids and bases. If the substance you are testing turns the cabbage juice $RE\underline{D} = ACI\underline{D}$, and if the substance you are testing turns the cabbage juice <u>BLUE</u> = <u>BASE</u>.

<u>Hypothesis Statement:</u> Please make a hypothesis for each of the following substances you will be testing.

<u>If</u> cabbage juice indicates the pH of a substance by turning red for acids and blue for bases, <u>then:</u> mashed banana will turn the solution <u>red</u>, milk will turn the solution <u>red</u>, lemon juice will turn the solution <u>red</u>, baking soda will turn the solution <u>blue</u>, vinegar will turn the solution <u>red</u>, ammonia will turn the solution <u>blue</u>, and toothpaste will turn the solution <u>blue</u>.

Materials Needed:

GogglesCabbage juice indicatorplastic pipetteWaxed paper placemat sizepaper towelpencil scissors

Procedure:

1. Put goggles on.

2. Gather all needed materials.

3. Tear or cut paper towel into 8 strips + one for a mystery substance.

4. Label the strips with the names of the substances to be tested. (See hypothesis for each substance.)

5. Place a very small sample of each substance on the appropriate strip of paper towel.

6. Add 2 drops of cabbage juice indicator to the substance on the paper towel.

7. Record your results.

8. Clean up all work areas. Sanitize goggles and return to plastic tub.

Results:

Results:

TABLE 1 (title)

SUBSTANCE	ACID	BASE
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9. Mystery substance		

Analysis: Record all of results here and comment about what the pH will be based on the acid/base results.

Conclusion: (Restate your hypothesis, tell whether your data did or did not support your hypothesis, and **why**.) What surprised you about your results? What other experiments could you do now that you have the results of this experiment?



pH Effect on Plant Growth Adapted from Project Wet Question: How does water with an acid affect plant growth?

Student Hypothesis:

Materials Needed:

3 jars with lids 3 matching plant containers that have top open 1 type of seed (flower or vegetable) Cabbage juice indicator Potting soil Graduating cylinder Lemon juice pH paper

Procedure:

- 1. Prepare lemon juice water. Fill three jars with 100 ml. of water. Label one jar "strong acid", one "weak acid", one "plain water- control."
- 2. To first jar add 10 ml. lemon juice, and 1 ml. of lemon juice to the 2nd jar. Add nothing to the plain water. Place a lid on all three jars.
- 3. Measure the pH of each jar and write the results on the label for each jar.
- 4. Label the plant containers- "strong acid", "weak acid", "plain water".
- 5. Place the same amount of soil in each plant container.
- 6. Moisten all three containers with the same amount of tap water and plant seeds according to directions. Place the same number of seeds in each pot.
- 7. Place plants in sunny place or under plant growth light.
- 8. Check plants each day, making written observations every third day.

- 9. When soil is dry, water all three plants with water from appropriate number jar. Be careful to use the same amount for each plant. If you run out of water, repeat step # 1, #2, #3.
- 10. Record in results in table.

<u>Results</u>:

Date Watered (m/d/yr)	Amount Watered (ml)

Observations Date:	Plant watered with strong acid	Plant watered with weak acid	Plant watered with plain water- control
Height			
Number of leaves			
Color			
Other Observations			
Drawing or photograph			

<u>**Graph**</u>: Graph your data here with appropriate title, scales, key, x, y axis labels, and data points.



<u>Analysis:</u>					
	 <u> </u>			· · · · · · · · · · · · · · · · · · ·	
	 			<u> </u>	
	 	·			
Conclusion:	 				

Future Experimentation Ideas:

Lab Write-Up Evaluation Form Your lab write-ups must have the following components (parts) in order to be accepted. Failure to include all components will result in loss of points.

	5 pts	3 pts	0 pts
Name-DOK 1	Lab write-up has name on top right side of paper	Lab write-up has name, but not on top right side of paper	No Name
Hour- DOK 1	Lab write-up has hour on top right side of paper	Lab write-up has hour, but not on top right side of paper.	Lab write-up has no hour listed.
Lab Title- DOK 1	Lab write-up has title that explains what was tested or investigated	Lab write-up has title, but does not fit what was investigated	Lab write-up has no title.
Hypothesis- DOK 3	Lab write-up has if/then hypothesis that predicts the outcome of the experiment.	Lab write-up has hypothesis, but does not have if/then format or predicts the outcome of the experiment.	Lab write-up has no hypothesis.
Materials Needed-DOK 1	Lab write-up has all materials listed.	Lab write-up has some, but not all materials listed.	Lab write-up has no materials listed.
Procedure- DOK 4	Lab write-up has all the procedures listed, in the correct order, so someone else could repeat the experiment, even if they didn't see what was done.	Lab write-up has some procedures, but not in correct order, and are unclear as to what was done in the experiment.	Lab write-up has few or no steps listed, procedure not found.
Observations/Data Records DOK- 2	Lab write-up has all observations and these are recorded in the appropriate form of tables. All columns and rows are clearly labeled and have units of measure. Graphs are accurate and have the information from tables.	Lab write-up has some of the observations are found. Data not in tables or are missing labels and units of measure. No graphing of data where possible.	Lab write-up has few observations or none. No data tables or graphs.
Analysis-DOK 4	Lab write-up has clear statements about what was learned from the observation/data tables or what student thought happened in the experiment.	Lab write-up has unclear statements about what was learned or what student thought happened in experiment.	Lab write-up has no analysis of data or what student thought happened.
Conclusion-DOK 3	Lab write-up has clearly written, restated hypothesis statement, and whether data supports/does not support hypothesis.	Lab write-up has something about the hypothesis and data, but not well stated to understand the outcome of the experiment.	Lab write-up has no conclusion or does not correctly tell whether data supports/does not support hypothesis.
Neatness	Neatly written or typed. No erasure marks and in correct sequence order.	Some erasing evident or words crossed out. Some parts out of order.	Unable to read and not in appropriate sequential order.

"BINS

- 1) Acids will turn cabbage juice what color? Red (2 pts) DOK-1
- 2) Bases will turn cabbage juice what color? Blue (2pts) DOK-1
- 3) What do you get when you mix and acid and a base? A salt (2pts) DOK-1
- 4) What is the process called when you mix and acid and a base? Neutralization (2 pts) DOK-1
- 5) What is the pH of an acid? (0-7) (2pts) DOK-1
- 6) What is the pH of a base? (7-14) (2pts) DOK-1
- 7) What is the pH of distilled water? (7) (2pts) DOK-1
- 8) What is the pH of lemon juice? (2) (2pts) DOK-1
- 9) The following characteristics are for which substance: slippery, bitter taste, and the ability to cause color change in indicators. (bases) (2pts) DOK-1
- 10) What are the characteristics of acids? (Sour taste, react with metals) (2 pts) DOK-1
- 11) What are the two products of neutralization? (salt and water) (2 pts) DOK-1
- 12) Which substance is a proton acceptor? (bases) (1 pt) DOK-1
- 13) What ion is present in all common acid solutions? (H+) (1pt) DOK-1
- 14) Define buffer- (A solution that is resistant to large changes in pH) (4pts) DOK-1
- 15) Define electrolyte and explain why it is significant. (A substance that breaks apart into ions when it dissolves in water. Significance- It can conduct electric current.) (5pts) DOK-3

Final bonus points- 10 points- all must be correct to earn 10 points.

DOK 2-Classify each of the following as acid, base, or salt:

- 1. LiOH- (base)
- 2. H₂CO₃ (acid)
- 3. Ba(OH)₂ (base)
- 4. KCl— (salt)

TEACHER NOTES FOR POWER POINT

<u>Physical Properties of Acids and Bases</u>-pH is a physical property.

Comparísons

	ACIDS	BASES
Smell	Sharp	Sometímes no smell
Taste [*] Safety típ- never taste ín lab	Sour	Bítter
Feel	Not slippery- takes the oil off skin	Slíppery
pH	0~7	7~14

pH of Water is 7 (Neutral)

pH of stomach acid is 1 - HCl- hydrochloric acid

SECTION 2

Chemical Properties

A <u>chemical property</u> is a characteristic of matter that allows it to change to a different type of matter. This depends on what chemicals it is made of.

Chemical properties of acids and bases-

<u>Acids</u>- <u>corrosive</u> reacts with metals and damage living tissues. Ex- tomato on aluminum foil- holes in the foil.

<u>Bases</u>- also can also damage líving tíssue.

EX. ammonía can make skín tíssue bleed.

<u>Salts</u>- compounds of metal and non metal that are formed when acids and bases react or are combined.

EX. Sodium (metal) + Chloride (nonmetal) = NaCl or table salt.





RESEARCH FOR ACID RAIN

- Acid Rain-Peggy J. Parks (2006). Good research material on acid rain. Website links.
- Big Outdoors- Great Barrier Reef- Valerie Bodden (2010).
 Provides beautiful pictures, basic knowledge about reefs, and mentions what pollution does to the reef.
- Endangered Planet- David Burnie (2004).
 Great book for students to use for research. Great pictures, graphs, facts. Careers for environmental interest in each chapter and extensions for learning. Website links.
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- Global Issues: Clean Air and Water-Cheryl Jakab (2007).
 Case studies of different global issues which could be used for problem solving discussions. Sustainable future is a central theme. Suggestions for students to save water and reduce pollution are included. Website links.
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- Reducing Air Pollution Jen Green (2005).
 The book provides a great basic knowledge base for pollution, the consequences, and how to try to solve some of the problems.
- *9.* What can we do about Pollution? –Suzanne Slade (2010). Great book for general pollution information. Website links.

Websites to check out:

- 10. <u>www.myfootprint.org</u>
- 11. <u>www.rprogress.org</u>
- 12. www.lerner.org/jnorth/
- 13. www.csiro.au
- 14. www.Epa.gov

Your requirement is to write as many facts as you can about the following topics using the references given above. You may Google your own sources, but must give web addresses for the sites you use.

TOPICS-

- 1. What is acid rain?
- 2. What causes acid rain? Draw the cycle.
- 3. Over time how have the levels of acid rain changed?
- 4. What climate changes are being observed by scientists?
- 5. What specific biomes are affected by acid rain?
- 6. How is each biome affected- be specific.
- 7. How is plant life affected?
- 8. Find the levels of pH that plants can tolerate.
- 9. How is animal life affected?
- 10. Is this a natural phenomenon or manmade problem?
- 11. What is your footprint?
- 12. What can you do to reduce your footprint?
- 13. What can you personally do to decrease acid rain?
- 14. Find at least one experiment you would like to conduct on acid rain and write up the experiment as if you were going to do the experiment.
- 15. According to the sources, if we continue on the current rate of pollution, how long will we have a sustainable planet?

Once you have assembled your facts, you must write a written report on your findings to share with other scientists in the class. Be sure to listen carefully to other students reports and note any conflicts with information you have collected.