

TITLE: Just Plain Water

Overview: The purpose of this lesson is to solidify the concept of Acid Rain. Students will investigate the acidity of a natural water source, compile data, and draw conclusions based on their findings and knowledge of acidity levels.

National Geography Standards:

- Standard 14: (1) Human modifications of the physical environment in one place often lead to changes in other places.
- Standard 14: (2) Use of technology has changed the scale at which people can modify the physical environment.

Oregon Geography Content Standards:

- Standard 6.15: Explain how people have adapted to or changed the physical environment in the western hemisphere.

Connections to Common Core:

- Standard 6-8.RH.2: Determine the central ideas or information of a primary or secondary source; provide an accurate summary of the source distinct from prior knowledge or opinions.

Objectives:

- Students will be able to identify the acidity level of a natural water source using pH balance strips.
- Students will be able to define what can cause acid rain.
- Students will also be able to conclude the effects of a high/low acidity level in natural water sources.

Grade: 6TH

Time: (4) 60 minute lessons (Outdoor School)/ 1day field trip

Materials:

- Paper
- pencils
- pH Balance strips bought at a local pool supply store / amazon.com
- clipboards

- old blanket or sheet for sitting.
- natural water source
- Acid Rain –Students Site Reading: *What is Acid Rain? What Causes Acid Rain? Why is Acid Rain Harmful?* - (Appendices A – C)
- Acid Rain review reading (Appendices D-F)
- Station Test Worksheet (Appendix G).
- Acid Rain Assessment (Appendix H)
- Acid Rain Rubric (Appendix I)
- Wildlife species specific to local area/ outdoor school

Background: Water cycle, Fossil Fuels, Fresh Water / Salt Water Species, Acid Rain reading (covered in classroom with Appendices A – C)

Resource:

https://www3.epa.gov/acidrain/education/site_students/whatisacid.html

- Site used for original Acid Rain Appendices (A – F)

Preparation:

- You can have students practice testing the pH level in your classroom.
- Discussion about water safety is important prior to going on the field trip.
- Also, remind students and parents about field trip appropriate clothing.
- If possible, scout the area you are visiting before your students to mark or note your three stations moving down the river.

Procedures:

1. **Hook the lesson:** On the bus ride to the natural water source, have students identify which objects were on the road that use gasoline or diesel. Did they notice any odd smells on the trip? Can these items be harmful to the earth?
2. Once you're off the bus, have students get into groups of 3 or 4.
3. Give each group the following material sets: clipboard, pencil, water test strips, Station Test Worksheet (APPENDIX G). **Time:** 10 minutes
4. Introduce the lesson: "Today, you are going to test the pH Balance of the Willamette River (or nearby water source). You will take three samples from three different locations along the river. It is important that you pay attention to the people and space around you". **Time:** 5 minutes

5. **Task 1** - Take students to the first water station. One student from each group should form a line to take their sample.
6. Once the student has a sample, they take it back to their group, label the strip, and begin the Station Test Worksheet by answering the first question set.
7. Give students time to answer the question before moving on to the next station.
8. At the next station, a new set of students should be lining up to take a water sample. Once the student has the water sample, remind students to label the sample and answer the second question set.
9. Walk the class to the last sample station. A new set of students should be lining up to take the last sample. Have students take the strip back to their group and complete the process from steps 6 and 8. That will finish the last question set. **Time:** 60 minutes
10. Now that students have their data, they will need to compile it into a bar graph. Question 4 on the Station Test Worksheet provides the students with space to organize their data.
11. Assist students with discerning the colors on their test strips. **Time:** 15 minutes
12. Now that students have the data organized, introduce the review reading (Appendices A – C or D – F modifications) and the Acid Rain Assessment (Appendix H).
13. “Now that you have the data collected, you can review the ways that acid occurs and predict what would happen if acid levels become too high or too low. Also what it would take to maintain neutral pH levels in natural water systems”. **Time:** 5 minutes
14. **Task 2** – Give students the modified reading for their groups.
15. Instruct students to read the information before they begin their group writing section. (**Teacher note:** Students can also work in pairs to improve equal involvement.) **Time:** 15 minutes
16. Once students have had a chance to review the reading, give them the Acid Rain Assessment (Appendix H).
17. **Task 3** - Go over the writing assignment instructions with your students. Clarify any questions that they may have about the assessment.
18. While your students are writing, assist them with any questions they may have or need to think through the scenarios. **Time:** 30 Minutes
19. Have students share out their ideas once they are done writing. Work through each scenario even if the students didn't write about it. Make sure to cover the repercussions to their full event. If the pH is too high

- or low, it is harmful to the natural species that inhabit the water and the surrounding forests. It could also be harmful to humans, if acid rain (precipitation) actually occurs with a high enough acidity level.
20. Collect student papers to be graded based on the assessment rubric (Appendix I) which can be done in the classroom after the day's field trip or the outdoor activity.
 21. Before you leave the Willamette River (or nearby water source), please make sure that all materials are collected, or thrown away as needed.

Assessment:

Students will be expected to construct a response to one of the following prompts in their groups.

Prompt: Pick a number and write two paragraphs about the provided scenario.

Paragraph 1 should state how the levels could change. Paragraph 2 should state the outcomes from the changes.

1. Describe what would happen to the forests, wildlife and humans if the water became too acidic causing acid rain?
2. Explain what would happen to the forests, wildlife, and humans if the water became too basic.
3. Detail in what ways it would be possible to maintain neutral pH levels in our natural water systems.

Extensions and/or Adaptations:

Task 1:

- Analyze the pH levels of more than one naturally occurring water source if it is possible.
- This task can also be done in the classroom by having students bring in water sources from home. The teacher should also bring in water samples from various sources as well to add variety to student samples. The samples could be labeled anonymously. This would give students the opportunity to guess their water source.
- Students can research in the classroom or the computer lab possible causes for abnormal levels such as nearby factories, run offs, and watersheds.

Task 2:

- The literacy/ text portion of this lesson can be taught prior to the trip in the classroom. The modified readings can be used with SPED/ELL students that require adaptations. Original copies can also be used to modify for TAG as well.
- Matching the vocabulary with pictures to increase understanding.
- Students can perform a web-quest using the source site for the readings. Pre-determined questions can be used to guide the students through the readings.

Task 3:

- The assessment doesn't need to be done on site. It can be done in the classroom if preferred or necessary.
- The writing portion can be done individually, pairs, or groups as listed.
- If the class has had practice working in fish bowls, allowing the group to observe and listen to student ideas to the prompts. – A fish bowl is an exercise where a small group of students sit in a circle while being surrounded by the rest of the class. They discuss the topic at hand. Teacher helps to guide the discussion when it stalls. The outside group takes notes about the discussion/ or writes down questions that they have for the group at the end of the fishbowl.

Appendix A

What is Acid Rain?

Acid rain is rain that has been made **acidic** by certain pollutants in the air. Acid rain is a type of **acid deposition**, which can appear in many forms. Wet deposition is rain, sleet, snow, or fog that has become more acidic than normal. Dry deposition is another form of acid deposition, and this is when gases and dust particles become acidic. Both wet and dry deposition can be carried by the wind, sometimes for very long distances. Acid deposition in wet and dry forms falls on buildings, cars, and trees and can make lakes acidic. Acid deposition in dry form can be inhaled by people and can cause health problems in some people.



What is acidity?

Acidic and basic are two ways that we describe chemical compounds. Acidity is measured using a pH scale. A pH scale runs from zero (the most acidic) to 14 (the most **basic** or **alkaline**). A substance that is neither basic or acidic is called "neutral", and this has a pH of 7.

Appendix B

What Causes Acid Rain?

Sources of Acid Rain

Acid rain is caused by a chemical reaction that begins when compounds like sulfur dioxide and nitrogen oxides are released into the air. These substances can rise very high into the atmosphere, where they mix and react with water, oxygen, and other chemicals to form more acidic pollutants, known as acid rain. Sulfur dioxide and nitrogen oxides dissolve very easily in water and can be carried very far by the wind. As a result, the two compounds can travel long distances where they become part of the rain, sleet, snow, and fog that we experience on certain days.



Human activities are the main cause of acid rain. Over the past few decades, humans have released so many different chemicals into the air that they have changed the mix of gases in the atmosphere. Power plants release the majority of sulfur dioxide and much of the nitrogen oxides when they burn fossil fuels, such as coal, to produce electricity. In addition, the exhaust from cars, trucks, and buses releases nitrogen oxides and sulfur dioxide into the air. These pollutants cause acid rain.

Acid Rain is Caused by Reactions in the Environment

Nature depends on balance, and although some rain is naturally acidic, with a pH level of around 5.0, human activities have made it worse.

Normal precipitation—such as rain, sleet, or snow—reacts with alkaline chemicals, or non-acidic materials, that can be found in air, soils, bedrock, lakes, and streams. These reactions usually neutralize natural acids. However, if precipitation becomes too acidic, these materials may not be able to neutralize all of the acids. Over time, these neutralizing materials can be washed away by acid rain. Damage to crops, trees, lakes, rivers, and animals can result.

Appendix C

Why is Acid Rain Harmful?

Acid Rain Can Cause Health Problems in People

Air pollution like sulfur dioxide and nitrogen oxides can cause respiratory diseases, or can make these diseases worse. Respiratory diseases like [asthma](#) or chronic [bronchitis](#) make it hard for people to breathe. The pollution that causes acid rain can also create tiny particles. When these particles get into people's lungs, they can cause health problems, or can make existing health problems worse. Also, nitrogen oxides cause ground-level [ozone](#). This ground-level ozone causes respiratory problems, like [pneumonia](#) and [bronchitis](#), and can even cause permanent lung damage. The health effects that people have to worry about are not caused by the acid rain, but are caused when people breathe in these tiny particles or ozone. Swimming in an acidic lake or walking in an acidic puddle is no more harmful to people than swimming or walking in clean water.



Acid Rain Harms Forests

Acid rain can be extremely harmful to forests. Acid rain that seeps into the ground can dissolve nutrients, such as magnesium and calcium, that trees need to be healthy. Acid rain also causes [aluminum](#) to be released into the soil, which makes it difficult for trees to take up water. Trees that are located in mountainous regions at higher elevations, such as spruce or fir trees, are at greater risk because they are exposed to acidic clouds and fog, which contain greater amounts of acid than rain or snow. The acidic clouds and fog strip important nutrients from their leaves and needles. This loss of nutrients makes it easier for infections, insects, and cold weather to damage trees and forests.

Appendix C continued

Acid Rain Damages Lakes and Streams

Without pollution or acid rain, most lakes and streams would have a pH level near 6.5. Acid rain, however, has caused many lakes and streams in the northeast United States and certain other places to have much lower pH levels. In addition, aluminum that is released into the soil eventually ends up in lakes and streams. Unfortunately, this increase in acidity and aluminum levels can be deadly to aquatic wildlife, including [phytoplankton](#), mayflies, rainbow trout, small mouth bass, frogs, spotted salamanders, crayfish, and other creatures

that are part of the food web.



This problem can become much worse during heavy downpours of rain or when the snow begins to melt in the spring. These types of events are known as [episodic acidification](#).

Acid Rain Damages Buildings and Objects

Acid rain can also have a damaging effect on many objects, including buildings, statues, monuments, and cars. The chemicals found in acid rain can cause paint to peel and stone statues to begin to appear old and worn down, which reduces their value and beauty.

Review Reading - Appendix D

What is Acid Rain?

Acid rain is rain that has been made acidic by certain pollutants in the air.

Acid rain is a type of acid deposition, which can appear in many forms. **Wet deposition** is rain, sleet, snow, or fog that has become more acidic than normal. **Dry deposition** is another form of acid deposition, and this is when gases and dust particles become acidic. Both wet and dry deposition can be carried by the wind, sometimes for very long distances. Acid deposition in wet and dry forms falls on buildings, cars, and trees and can make lakes acidic. Acid deposition in dry form can be inhaled by people and can cause health problems in some people.

What is acidity?

Acidic and basic are two ways that we describe chemical compounds.

Acidity is measured using a pH scale. A pH scale runs from **zero** (*the most acidic*) to **14** (*the most basic* or alkaline). A substance that is neither basic or acidic is called "neutral", and this has a pH of 7.

Key Words:

Acid Rain: Rain that has a been made more acidic than normal.

Wet Deposition: Wet deposits that include rain, snow, hail and fog.

Dry Deposition: Dry deposits that are gases and dust particles that have been made more acidic.

Acidity: excessive acid quality

Acidic: a compound that has a less than a 7 on a pH scale.

Neutral: meaning that the water has no excessive characteristic of being too acidic or basic.

Review Reading - Appendix E

What Causes Acid Rain?

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Human activities are the main cause of acid rain. Over the past few decades, humans have released so many different chemicals into the air that they have changed the mix of gases in the atmosphere. Power plants release the majority of sulfur dioxide and much of the nitrogen oxides when they burn **fossil fuels**, such as coal, to produce electricity. In addition, the exhaust from cars, trucks, and buses releases nitrogen oxides and sulfur dioxide into the air. These pollutants cause acid rain.

Acid Rain is Caused by Reactions in the Environment

Nature depends on balance, and although some rain is naturally acidic, with a pH level of around 5.0, human activities have made it worse. Normal precipitation—such as rain, sleet, or snow—reacts with alkaline chemicals, or non-acidic materials, that can be found in air, soils, bedrock, lakes, and streams. These reactions usually neutralize natural acids. However, if precipitation becomes too acidic, these materials may not be able to neutralize all of the acids. Over time, these neutralizing materials can be

washed away by acid rain. Damage to crops, trees, lakes, rivers, and animals can result.

Key Words:

Compounds: A substance formed by two or more elements.

Acidic Pollutants: Chemicals that are excessively acidic and pollute the air/earth.

Fossil Fuels: Petroleum – oil, coal and natural gas that has been naturally made from ancient plants and animals.

Review Reading - Appendix F

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This problem can become much worse during heavy downpours of rain or when the snow begins to melt in the spring. These types of events are known as episodic acidification.

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Acid rain can also have a damaging effect on many objects, including buildings, statues, monuments, and cars. The chemicals found in acid rain can cause paint to peel and stone statues to begin to appear old and worn down, which reduces their value and beauty.

Key Words:

Asthma/Bronchitis: Respiratory or breathing disease.

Ozone: a layer of specific oxygen in the atmosphere that absorbs ultraviolet rays preventing them from reaching the surface of the earth.

Phytoplankton: a cluster/group of plants or plantlike organisms.

Group Names: _____ Date: _____

Station Test Worksheet (G)

Directions: Write the station number on each strip. Identify the acidity level of each station by matching the test strip to the Scale color gauge. The color indicates the level of acidity.

1. What color is the strip of Station 1? What is the acid level number based on the color? Based on the pH scale, describe the quality of the water.

2. What color is the strip of Station 2? What is the acid level number based on the color? Based on the pH scale, describe the quality of the water.

3. What color is the strip of Station 3? What is the acid level number based on the color? Based on the pH scale, describe the quality of the water.

4. Graph the levels for Station 1 -3 below?

14		
13		
12		
11		
10		
9		
8		
7		
6		
5		
4		
3		
2		
1		
0		

Station 1 Station 2 Station 3

If possible, circle the stations with the highest and lowest numbers.

Assessment Rubric – Appendix I

	Paragraph 1	Paragraph 2
3	It has been clearly detailed how the pH balance of a natural water source has been maintained or extremely altered to be acidic or overly basic based on human actions.	It has been clearly paraphrased from the reading and student conclusions how the changes to the water effects the local forests, wildlife, and humans.
2	It has been detailed that the natural water source has been maintained or changed by human actions.	It has been paraphrased from the reading how the changes to the water source effects the local forests, wildlife, and humans.
1	It has been simply explained that the natural water source has been maintained or changed by human actions.	Based solely on the reading, it has been described that the local forests, wildlife, and humans will be effected.
0	It has been stated that the natural water source has been maintained or altered.	Taken directly from the reading, it has been copied which forests, animals, and objects will be effected by acid rain regardless of location.