

# The Effects of Acid Rain on the Environment

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## INTRODUCTION

Getting students to the point where they actually want to learn is a problem with which today's teachers are plagued constantly. There are so many disruptions in the classroom until it is almost impossible to teach. The teacher must reteach many lessons due to student absences. All students are not present in the classroom at the same time for all lessons. Many of the students are pulled from the classroom for assemblies, pep rallies, field trips, special tutoring and other such events. These special pull-outs are important to the student and their achievement in the school setting.

Many students must attend special tutoring, such as for the Texas Assessment of Academic Skills (TAAS), at my school. These tutorial sessions are attended both on Saturday and during the week. (These are the students that the tutorial teacher has identified as being at risk). It is understandable that the schools are so concerned that the students achieve on this test because, if they do not pass it they will not receive a high school diploma. It does not matter if the student has a passing grade in all of their classes. They will simply get a certificate stating that they attended school for twelve years, if they do not pass the TAAS test.

This one test determines the number of academic achieving students that will petition to attend the school and/or remain in the school, the rating of the school, the amount of money a teacher receives as incentive pay, also, the amount of money given to the principal and superintendent in bonuses. The competition is so fierce that many school officials have been accused of cheating to ensure jobs for themselves and for an exemplary status for their school.

Since students are bored in their classrooms with the traditional class setting, teachers can no longer be a person to guide them through their lessons. These young people are demanding a big production. If teachers are to enter the new millennium with the students, they must perform each day to ensure that the student is interested with their subject matter and are paying attention to their instructions. This is essential if the educator expects to remain in education. **No exceptions!** This requires that the teacher become a writer, actor, director, musician, singer, choreographer, producer, and what-have-you for the "Big Event" (the lesson). Teachers today must be a little crazy in presentation but the facts must be accurate. Therefore, it is unthinkable for a teacher to prepare a lesson with just one discipline in mind. These lessons must be interdisciplinary. The lesson that I have proposed will be of that type. It includes science (chemistry, biology, botany, and environmental science) and mathematics.

I plan to teach my lesson to an environmental science class. The class will focus on the effect of acid rain on the environment using various edible plants. This lesson will be presented to these classes so they can become aware of the importance of pollution control. I'm excited about the prospect of this assignment. Students will reap the benefits of a lesson that is both hands-on and minds-on.

To complete this assignment each student will develop a time line indicating the important discoveries using acids and bases including *pH*, *equilibrium*, *neutralizations*, and *reactions*. They will compare the discoveries that were made in the time line to pollution and the fight to control this menace in the United States. Library research will be the first step. They will be guided through this phase. Technology must play an important part in the beginning, middle and end of this assignment.

Students will be presented with information on the edible plants they plan to use from research and their science teachers. This material will include information to help them study the structure and function of plants. Students will be expected to study the plants after simulating an environment that is similar to nature and completing the investigation that requires subjecting these plants to environments that are considered to be one of an acid rain nature. The computer will be used to keep all pertinent data, perform the necessary calculations, complete the graphics, perform titrations and so forth.

### **Student Activity # 1**

**Problem:** What are the effects of pH 1-6 on the growth of edible plants ?  
(The teacher can select plants that does not grow normally in acidic soil.)

**Hypothesis:** If we investigate the growth of these plants using various pH scales then we will discover that they will or will not grow best at these pH ranges.

<b>Materials:</b>	pH scale	solutions of water at different pH
	plant seeds	potting soil
	planter	light source
	ruler	daily log

**Procedure:**

1. Obtain the necessary equipment for the assignment.
2. Plant the seeds using the various pH solutions as the watering source.  
(Make certain that you sprinkle the watering solution on the entire plant twice a week.)
3. Measure the plants each day as they are developing.
4. Take pictures of your growing plants.
5. Record this information in your daily log.
6. Indicate your findings in the observation section.

- Observation:
1. The daily log of your observations.
  2. Display the pictures of the plants as they grew.
  3. Make a data table of your findings.
  3. Graph the growth of the plants on a daily/weekly basis.

Conclusion: What effect does acid rain have on plant growth?

## **BACKGROUND**

Water is a molecule that contains two parts hydrogen and one part oxygen. Water exists in this way most of the time. This is what one will normally find in the environment all the time. However, there are circumstances when one hydrogen atom will be broken away from the other part of the molecule and form a completely different substance. The new substance is a positive charged hydrogen ion and a negative charged OH ion. In solutions of this nature, if the hydrogen ions are larger in number than the hydroxides ions, then the substance is considered an acid. In the same sense, if the hydroxide ions are greater in number than the hydrogen ions then the substance is considered a base.

Scientists use a scale to determine the concentration of the acids and bases. This system is a scale of numbers are called the pH scale. On this scale the range of numbers are from one to fourteen. If the substance measures from a range of one to slightly under seven, then the substance is considered to be an acid. If the solution registers on the scale at seven, the substance will be considered to be a neutral substance. But, if the substance measures on the scale from slightly over seven to fourteen then the substance is considered to be base. The greater the number of hydrogen ions, the solution is an acid. (If a substance has a pH of three it is an acid but, if a substance has a pH of thirteen it is a base.)

It is a common fact that rain water is slightly acidic. It has a pH range normally from about 5.5 to 5.7. The pH has changed in many areas in recent years due to the increase in substances like carbon dioxide, sulfur dioxide, nitrogen dioxide combining with water and oxygen in the air to lower the pH. The release of sulfuric dioxide and nitrogen oxides into the atmosphere really lowers the pH of rainwater. When the pH lowers below the normal range then the normal rain takes on a different position. It becomes *acid rain*.

Acid rain is yet another problem which results from burning fossil fuels and is another reason why some people have suggested turning to other energy sources. Coal does not solve the problem because it contains sulfur, and when burned, releases sulfur dioxide. We must strive to invent devices that will help with the removal of pollutants from gases escaping to the atmosphere. Alternate energy sources, such as nuclear, solar, tidal, and wind power, do not release substances which cause acid rain into the atmosphere. Many people want to turn toward these sources, however, this still presents another problem for producers and consumers.

Acid rain harms both plants and animals. This is a global problem. At one time we considered this to be a problem of the urban areas, but we cannot boast to this any longer. The reason this is not so is due to economics. Many businesses are moving away from the urban areas to places where there is cheap labor. As these companies move, they carry their pollution with them. In many instances, these new places do not have rules and regulations to govern them as they pollute. These individuals move to the new place to save money and are still polluting the atmosphere in the process. They state that they are cutting corners. The sad part is that they are in the process of killing our food supply, in the name of making money. We are all at risk due to these polluters.

As the level of acidity increases the plant tissue is harmed. Acid rain damages plant tissue and interferes with photosynthesis and nitrogen fixation. Photosynthesis cannot occur as it normally should. This then gets to be a big problem. Man suffers a tremendous loss as a result of this. The food supply is damaged tremendously.

Greater acidity is lethal to a variety of organisms – plankton, eggs of fish and salamanders, frogs, and adult fish. Because many bacteria also die, the rate of decomposition decreases and organic material accumulates at the bottom of the lake. This then presents a problem for the fish that we eat. It then boils down to us and our food supply. We are affected when we eat the fish that are contaminated.

This is a problem that is much closer than one thinks. Scientists discovered animals that lived on this earth prior to existence of the dinosaurs were disappearing from the earth. These animals were amphibians. This startling discovery was made by David Bradford. Immediately other scientists were concerned with these findings and investigated. Biologists were alarmed and wanted to find out the cause of the dilemma. They had proposed many different things as a result of the disappearance. However, biologist John Harte discovered the culprit to be acid rain.

## **Student Activity #2**

**Problem:** What effect does acid rain have on the growth of animals? Fish, Isopods and worms will be used for this experiment.

**Hypothesis:**

<b>Materials:</b>	Aquarium	Neutral water
	Fish	Fish food
	Fishnet	Water – acid level of 4.0-6.5

- Procedure:
1. Students will obtain all equipment.
  2. Animals will be placed in water prepared with the pH of 4.0-6.5.
  3. Students will feed all the fish the same amount of food each day.
  4. Students will examine each container to determine what has happened to the fish on a daily basis.
  5. Students will determine which solution was best for the fish.
  6. This experiment will be conducted with Isopods and worms by changing the pH of the soil.
  7. Both the Isopods and the worms will be kept in soil at the designated pH. (The soil should be evaluated every two days.)

- Observation:
1. Keep a log book of your findings.
  2. Data tables, logs, and charts of your findings will be presented here.

Conclusion: Discuss the investigation by explaining the problems encountered when the organism came in contact with an environment that was a hazard to them.

Students must not forget that acid rain can cause havoc in the environment. Remember acid rain is a term for rain, snow or other precipitation that has been polluted by acids. The acids are produced when water vapor in the air reacts with chemical compounds given off by automobiles, factories, power plants and other sources that burn coal and oil. These chemical compounds consists chiefly of sulfur dioxide and nitrogen oxides, which form sulfuric acid and nitric acid when they react with water vapor.

Acid rain falls over large areas of eastern Northern America and Northwestern and Central Europe. It has polluted thousands of lakes rivers and streams, causing the death of fish and other aquatic life. Some scientists believe acid rain may also damage buildings, statues, crops, forest, and soil.

Acid rain can be reduced by limiting the amount of sulfur and nitrogen compounds released into the air. For example, several types of devices have been developed to remove these compounds from substances that pass through industrial smokestacks. Scientists have also found ways of decreasing the effects of acid rain. For instances, lime can be added to acidified lakes periodically. The lime helps temporarily restore the lakes by neutralizing the acid.

There has been a tremendous increase in the pollution of the lithosphere, hydrosphere, and atmosphere, due to acid rain. Do not just think that acid rain is only referring to a rainfall of acid that falls on the earth and burns into our environment. This is not truly the case. The rain that falls is not that deadly initially. It takes years for the acid to erode substances away. Acid rain is a slow silent destroyer. It is present but we cannot see the acid in it as it rains on us, nor can we feel it, as we cannot feel it as it destroys our atmosphere. Later we can readily see the damage performed by this polluter.

In fact, many may think the word rain is referring to a liquid substances only, but the rain may be dust, gas clouds, hail, fog, mist, and snow. Scientist has determined that the rain falling on the environment for the last few hundred years has been acidic. This has been determined from test that has been performed on the rain. All over the world scientists have performed tests on the rain to determined if it is an acid or not by using litmus paper. (Red litmus paper turns blue when dipped in a liquid that is a base. It remains red, when dipped in a liquid that is an acid. Blue litmus, turns red when dipped in a liquid that is an acid, but remains blue when dipped in a liquid that is a base.) Acid rain is defined as that with a pH below 5.6. The lower limit of natural acidity can drop to pH 5.1 to 5.5.

In order for one to measure the acidity and alkalinity of a substance, a pH (paper-Hydriion) scale is used. A pH scale ranges from zero to fourteen, with zero being the most acidic and fourteen being the most alkaline. The scale is logarithmic; therefore, pH-5 is ten times more acidic than pH-6, pH-3 is a thousand times more acidic than pH-6. When a substance has a pH of seven, it is considered to be neutral. Distilled water has a neutral pH.

Acid rain has revived much interest and controversy in recent years. Environmentalists from many countries are pondering what can be done to prevent acid rain from continuing in this same mode. We know we must stop polluting, but the question is what are we to do? This is a global problem. One thing is certain – our youth must get involved in trying to prevent acid polluting This is the only way we can hop to really stop this menace.

Acid rain has become an environmental concern of global importance within the last decade. This has occurred due to that damage to our forest areas, deterioration of statues and building materials, and loss to our aquatic ecosystem.

Environmental issues have been with us a long as the earth has in existence. Acid rain took the center stage in the 1980s. People all over the world started debating the problem. Everyone agreed that acid rain is harmful and does damage to our environment, but the steps to clean up what has been damaged is then the problem.

Today we must make certain that we do not wait until our food supply is destroyed, our buildings stumble and fall, our bridges and automobiles corrode, our roads are destroyed, and human heath is damaged, before we react to the situation. It is imperative that our youth take an interest and get involved in solving the problem of acid rain. When we get our young people involved we must allow them an opportunity to give an input into all aspects of the problem. Especially to solve the problem of who will pay for the cleanup. This has been a big debate for a very long time. Teaching our students about this problem is very necessary.

Environmentalists agree that a major cause of acid rain is sulfur dioxide emission from coal burning power plants. In the United States we have really big concerns with the acid rain dilemma. There are some states that receives a larger amount of acid rain, due to the polluting of other states. These states consider themselves as victims. They look upon other states as perpetrators of the acid problem. Then there are the called innocent bystanders. States in the Northeast regards themselves as victims. States in the Midwest are known as the perpetrator states. Cannon and other environmentalists believe that the polluter must pay principals.

Data obtained from for the Untied States indicates that there are ten states confided to be the major source of sulfur dioxide emission. These states are listed in the order of their emissions. From this list the top five are responsible for 34% of the nations total sulfur dioxide pollution. These sates are:

- |                 |                  |
|-----------------|------------------|
| 1. Ohio         | 6. Texas         |
| 2. Pennsylvania | 7. Kentucky      |
| 3. Indiana      | 8. Florida       |
| 4. Illinois     | 9. West Virginia |
| 5. Missouri     | 10. Tennessee    |

The Midwestern states seen as perpetrators of acid rain by those in the Northwest are:

1. West Virginia
2. Pennsylvania
3. Kentucky
4. Indiana
5. Ohio

West Virginia, Pennsylvania and Alabama shipped more power to other states than any of the states managed to generate on their own for all purposes. Their combined power exports exceeded the total power generated of all but three states. Many of the Idaho acid rain perpetrators states are serving as the nation's electricity "breadbasket," supplying power to other states.

The flip side of the coin is the fact that the United States and Great Britain are two of the largest polluters in the world. Usually, these polluters don't stop polluting because money is involved. They claim to pollute in the name of technology but in actuality, it is in the name money. This is a reason students must be taught at an early age to not pollute.

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Forest that was once healthy are dying or are already dead. Fishing holes are not stocked with healthy fish; face and body statues that once were admired for their beauty have become crumbly and weak with body parts missing. Even steel bridges and other expensive structures are deteriorating more rapidly than expected. These structures are in areas where airborne chemicals affect their surfaces when rain is acid enough to have a pit of 5.0. Most atmospheric chemist would call it acid rain. Forests, lakes, statues and structures of acid deposition can be viewed.

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NO<sub>x</sub> Nitrogen Oxide

SO<sub>x</sub> Sulfur Dioxide

SIp-State Implement

DOE-Department of Energy

The Precipitation is Naturally Acidic

Explores the fact that the atmosphere transports many air pollutants hundreds of miles away from its source of entry.