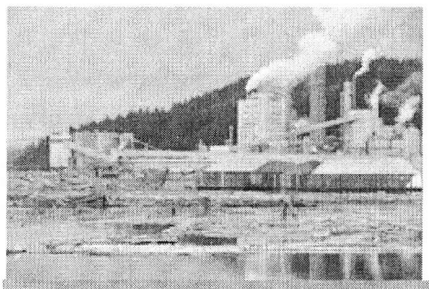
Name_____

Acid Rain Essay Writing Rubric

After reading the article "What is Acid Rain?" complete a 500 word essay/summary. Your essay must be original, not copied from a website or another person. Use proper grammar as you write your article (proper capitalization, punctuation, reflective thoughts, paragraph structure, etc.). The grading rubric is listed below. DO NOT plagiarize. This is an important writing assignment. I must see you perform some of your best written work in this class at this time. This assignment is due Feburary 24th at the beginning of class.

Description	No Effort	Little Effort	Some Effort	Average Effort	Above Average Effort	Maximum Effort
500 Words	≤ 300 Words 0	300-399 Words 6	400-449 Words 12	450-479 Words 18	480 – 499 Words 24	≥ 500 Words 30
Grammar	0	4	8	12	16	20
Relation to Topic/Article	0	4	8	12	16	20
					Total Points	

What is Acid Rain?



Additional Resources

- Clean Air Status and Trends Network (CASTNET) – CASTNET provides atmospheric data on the dry deposition component of total acid deposition, ground-level ozone and other forms of atmospheric pollution.
- National Atmospheric Deposition Program (NADP) – NADP is a network of over 100 federal, state and local government agencies, and private sector entities that collect data on acid deposition, as well as mercury deposition.
- EPA Clean Air Markets Data and Maps – Provides access to a variety of data associated with emissions trading programs, including trends in emissions and heat input, environmental assessment maps, data sets and reports on acid deposition, facility attributes and contacts, and other file downloads

"Acid rain" is a broad term referring to a mixture of wet and dry deposition (deposited material) from the atmosphere containing higher than normal amounts of nitric and sulfuric acids. The precursors, or chemical forerunners, of acid rain formation result from both natural sources, such as volcanoes and decaying vegetation, and man-made sources, primarily emissions of sulfur dioxide (SO_2) and nitrogen oxides (NO_x) resulting from fossil fuel combustion. In the United States, roughly 2/3 of all SO_2 and 1/4 of all NO_x come from electric power generation that relies on burning fossil fuels, like coal. Acid rain occurs when these gases react in the atmosphere with water, oxygen, and other chemicals to form various acidic compounds. The result is a mild solution of sulfuric acid and nitric acid. When sulfur dioxide and nitrogen oxides are released from power plants and other sources, prevailing winds blow these compounds across state and national borders, sometimes over hundreds of miles.

Wet Deposition

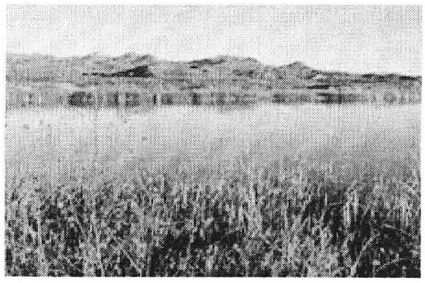
Wet deposition refers to acidic rain, fog, and snow. If the acid chemicals in the air are blown into areas where the weather is wet, the acids can fall to the ground in the form of rain, snow, fog, or mist. As this acidic water flows over and through the ground, it affects a variety of plants and animals. The strength of the effects depends on several factors, including how acidic the water is; the chemistry and buffering capacity of the soils involved; and the types of fish, trees, and other living things that rely on the water.

Dry Deposition

In areas where the weather is dry, the acid chemicals may become incorporated into dust or smoke and fall to the ground through dry deposition, sticking to the ground, buildings, homes, cars, and trees. Dry deposited gases and particles can be washed from these surfaces by rainstorms, leading to increased runoff. This runoff water makes the resulting mixture more acidic. About half of the acidity in the atmosphere falls back to earth through dry deposition.

Site: http://www.epa.gov/acidrain/what/index.html

Effects of Acid Rain



Acid rain causes acidification of lakes and streams and contributes to the damage of trees at high elevations (for example, red spruce trees above 2,000 feet) and many sensitive forest soils. In addition, acid rain accelerates the decay of building materials and paints, including irreplaceable buildings, statues, and sculptures that are part of our nation's cultural heritage. Prior to falling to the earth, sulfur dioxide (SO_2) and nitrogen oxide (NO_x) gases and their particulate matter derivatives—sulfates and nitrates—contribute to visibility degradation and harm public health.

Measuring Acid Rain

Acid rain is measured using a scale called "pH." The lower a substance's pH, the more acidic it is. See the pH page for more information.

Pure water has a pH of 7.0. However, normal rain is slightly acidic because carbon dioxide (CO2) dissolves into it forming weak carbonic acid, giving the resulting mixture a pH of approximately 5.6 at typical atmospheric concentrations of CO2. As of 2000, the most acidic rain falling in the U.S. has a pH of about 4.3.

Two networks, both supported by EPA, monitor acid rain's pH and the chemicals that cause acid rain. The National Atmospheric Deposition Program EXIT Disclaimer measures wet deposition and developed maps of rainfall pH (follow the link to the isopleth maps) and other important precipitation chemistry measurements.

The Clean Air Status and Trends Network (CASTNET) measures dry deposition. This EPA Web site features information about the data collected, the measuring sites, and the types of equipment used.

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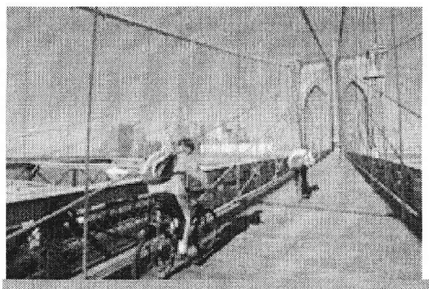
Reducing Acid Rain



What EPA Is Doing

Congress created the Acid Rain Program in Title IV of the 1990 Clean Air Act Amendments. The overall goal of the program is to achieve significant environmental and public health benefits through reductions in emissions of sulfur dioxide (SO_2) and nitrogen oxides (NO_x), the primary causes of acid rain. To achieve this goal at the lowest cost to the public, the program employs both traditional and innovative, market-based approaches for controlling air pollution. Specifically, the program seeks to limit, or "cap," SO_2 emissions from power plants at 8.95 million tons annually starting in 2010, authorizes those plants to trade SO_2 allowances, and reduces NO_x emission rates. In addition, the program encourages energy efficiency and pollution prevention.

There are several ways to reduce acid rain—more properly called acid deposition—ranging from societal changes to individual action. It is critical that acid deposition be reduced, not only in the United States and Canada, but also throughout the world to preserve the integrity of natural habitats, as well as to reduce damage to man-made structures.

EPA has taken steps to limit the amount of NO_x and SO_2 emitted into the atmosphere because they are the main contributors to acid deposition (for more information, see EPA's Acid Rain Program).

Additionally, individuals and society as a whole can participate in various efforts to help reduce acid deposition:

- Understand acid deposition's causes and effects
- Clean up smokestacks and exhaust pipes
- Use alternative energy sources
- Restore a damaged environment
- Look to the future
- Take action as individuals

Understand acid deposition's causes and effects

To understand acid deposition's causes and effects, and to track changes in the environment, scientists from EPA, state governments, and academia study acidification processes. They collect air and water samples and measure them for various characteristics such as pH and chemical composition, and research the effects of acid deposition on human-made materials such as marble and bronze. Finally, scientists work to understand the effects of sulfur dioxide (SO_2) and nitrogen oxides (NO_x)—the pollutants that cause acid deposition and contribute to particulate matter —on human health. See the acid rain effects section for more information.

Site: http://www.epa.gov/acidrain/what/index.html

To solve the acid rain problem, people need to understand how acid rain damages the environment. They also need to understand what changes could be made to the air pollution sources that cause the problem. The answers to these questions help leaders make better decisions about how to control air pollution and therefore, how to reduce—or even eliminate—acid rain. Because there are many solutions to the acid rain problem, leaders have a choice of which options or combination of options are best. The next section describes some of the steps that can be taken to tackle the acid deposition problem.

Clean up smokestacks and exhaust pipes

Almost all of the electricity that powers modern life comes from burning fossil fuels such as coal, natural gas, and oil. Acid deposition is caused by two pollutants that are released into the atmosphere when fossil fuels are burned: sulfur dioxide (SO_2) and nitrogen oxides (NO_x). Coal accounts for most U.S. SO_2 emissions and a large portion of NO_x emissions. Sulfur is present in coal as an impurity, and it reacts with air when the coal is burned to form SO_2. In contrast, NO_x is formed when any fossil fuel is burned.

There are several options for reducing SO_2 emissions, including using coal containing less sulfur, washing the coal, and using devices called "scrubbers" to chemically remove the SO_2 from the gases leaving the smokestack. Power plants can also switch fuels—for example, burning natural gas creates much less SO_2 than burning coal. Certain approaches will also have the additional benefit of reducing other pollutants such as mercury and carbon dioxide (CO_2). Understanding these "co-benefits" has become important in seeking cost-effective air pollution reduction strategies. Finally, power plants can use technologies that do not burn fossil fuels. Each of these options, however, has its own costs and benefits; there is no single universal solution.

Similar to scrubbers on power plants, catalytic converters reduce NO_x emissions from cars. These devices have been required for over 20 years in the United States, and it is important to keep them working properly. Recently, tailpipe restrictions were tightened to help curb NO_x emissions. EPA also continues to make, changes to gasoline that allow it to burn cleaner.

Use alternative energy sources

There are other sources of electricity besides fossil fuels. They include nuclear power, hydropower, wind energy, geothermal energy, and solar energy. Nuclear and hydropower are used most widely in the United States, while wind, solar, and geothermal energy have not yet been harnessed on a large enough scale to make them economically-feasible alternatives.

There are also alternative energies, such as natural gas, batteries, and fuel cells, available to power automobiles.

All sources of energy have environmental costs as well as benefits. Some types of energy are more expensive to produce than others, which means that not all Americans can afford all of them. Nuclear power, hydropower, and coal are the cheapest forms of energy today, but advancements in technologies and regulatory developments may change this in the future. All of these factors must be weighed when deciding which energy source to use today and which to invest in for tomorrow.

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Restore a damaged environment

Acid deposition penetrates deeply into the fabric of an ecosystem, changing the chemistry of the soil and streams and narrowing—sometimes to nothing—the space where certain plants and animals can survive. Because there are so many changes, it takes many years for ecosystems to recover from acid deposition, even after emissions are reduced and the rain pH is restored to normal. For example, while visibility might improve within days, and small or episodic chemical changes in streams improve within months, chronically acidified lakes, streams, forests, and soils can take years to decades, or even centuries (in the case of soils) to heal.

However, there are some things that people can do to bring back lakes and streams more quickly. Limestone or lime (a naturally occurring basic compound) can be added to acidic lakes to "cancel out" the acidity. This process, called liming, has been used extensively in Norway and Sweden but is not used very often in the United States Liming tends to be expensive, has to be done repeatedly to keep the water from returning to its acidic condition, and is considered a short-term remedy in only specific areas, rather than an effort to reduce or prevent pollution. Furthermore, it does not solve the broader problems of changes in soil chemistry and forest health in the watershed, and it does nothing to address visibility reductions, materials damage, and risk to human health. However, liming does often permit fish to remain in a lake, allowing the native population to survive in place until emissions reductions reduce the amount of acid deposition in the area.

Look to the future

As emissions from the largest known sources of acid deposition—power plants and automobiles—are reduced, EPA scientists and their colleagues must assess the reductions to make sure they are achieving the results that Congress anticipated when it created the Acid Rain Program in 1990. If these assessments show that acid deposition is still harming the environment, Congress may begin to consider additional ways to reduce emissions that cause acid deposition. It may consider additional emission reductions from sources that have already been controlled, or methods to reduce emissions from other sources. Congress may also focus on energy efficiency and alternative energy. Implementation of cost-effective mechanisms to reduce emissions and their impact on the environment will continue to evolve.

Take action as individuals

It may seem like there is not much that one individual can do to stop acid deposition. However, like many environmental problems, acid deposition is caused by the cumulative actions of millions of individual people. Therefore, each individual can also reduce their contribution to the problem and become part of the solution. Individuals can contribute directly by conserving energy, since energy production causes the largest portion of the acid deposition problem. For example, you can:

- Turn off lights, computers, and other appliances when you're not using them.
- Use energy-efficient appliances: lighting, air conditioners, heaters, refrigerators, washing machines, etc. For more information, see EPA's ENERGY STAR Program .
- Only use electric appliances when you need them.
- Keep your thermostat at 68°F in the winter and 72°F in the summer. You can turn it even lower in the winter and higher in the summer when you are away from home.
- Insulate your home as best you can.
- Carpool, use public transportation, or better yet, walk or bicycle whenever possible
- Buy vehicles with low NO_x emissions, and properly maintain your vehicle.
- Be well informed.

Site: http://www.epa.gov/acidrain/what/index.html