Virtual Lab: Where in the U.S. is acid rain most severe?

Acid rain is any type of precipitation that is more acidic than normal rain. Normal rainfall is slightly acidic due to dissolved carbon dioxide that is picked up in the atmosphere. Normal rainfall has an approximate pH of 5.6. Because organisms have adapted to the slightly acidic nature of normal rain, it is not an environmental problem.

The primary cause of acid rain is air pollution from burning fossil fuels. Pollution from coal burning in coal-fired electric power plants contains chemicals such as sulfur dioxide (SO_2) and nitrogen oxides (NO_x). Nitrogen oxides are also produced from the emissions of vehicles such as cars, trucks, and buses. These chemicals react with water, oxygen, and other chemicals in the atmosphere to form mild solutions of sulfuric acid and nitric acid. The pollution is often released high into the atmosphere, increasing the time that it stays in the air. The longer the pollution is in the air, the greater the chances that the pollutants will form acid rain. When rainwater, snow, fog, and other forms of precipitation containing the acids fall to Earth, acid rain occurs.

Acid rain is an environmental problem that can damage or destroy aquatic life, forests, crops, and buildings, as well as pose a threat to human health by causing respiratory disorders, for example. Because pollution is carried by wind currents, these pollutants can travel hundreds of miles before falling to the ground as acid rain.

Acidity is measured on the pH scale. The pH scale ranges from 0 to 14 with pH 7 being neutral. A pH less than 7 is acidic; a pH greater than 7 is basic. Each whole pH value below 7 is ten times more acidic than the next higher value. So, pH 5 is ten times more acidic than pH 6 and 100 times more acidic than pH 7. This is important because slight differences in pH represent large differences in the degree of acidity.

Acid rain can vary in acidity from mildly acidic to highly acidic. In this Virtual Lab, you will examine the average pH of rainwater samples from each of the 48 contiguous states and compare them to the emissions of sulfur dioxide in those states.

Objectives:

·Define acid rain and describe its causes.

·Test the pH of rainwater samples and plot the information on a map of the United States.

·Describe the relationship between the occurrences of acid rain and sulfur dioxide emissions in the United States.

Procedure:

1. Click a Test Tube Holder to select a set of test tubes to test.

2. Click a Test Tube to test the pH of the water sample.

3. Enter the state's pH value into the map. To do this, click a state, then click the color in the legend that corresponds to the state's pH value.

4. Repeat steps 1-3 for all the states' rainwater samples.

5. When you have completed the pH Map, click the SO_2 button to compare the pH of the rainwater to sulfur dioxide emissions in the United States.

6. Complete the Journal questions.

Journal Questions:

1. What is acid rain? How is it formed?

2. How does acid rain affect the environment? Besides the effect on the environment, does acid rain has any other harmful effects?

3. What two air pollutants are associated with the formation of acid rain? What are the sources of these air pollutants?

4. According to your pH test result, where in the U.S. is acid rain most severe?

5. Sulphur dioxide is the main air pollutant associated with acid rain. Which state in the U.S. release the most sulphur dioxide annually?

6. Based on your analysis, is there a relationship between a state's sulphur dioxide emissions and the average pH of its rain water?

7. How might you explain the fact that Vermont and New Hampshire, states with very low sulphur dioxide emission, experience acid levels that are among the most severe in the country?

8. Discuss at least three possible ways to reduce acid rain.