

Using Real-Time Data: pH and Rainfall

Time: 1-2 class periods

National Benchmarks: Benchmarks 5A: Diversity of Life; 5D Interdependence of Life; 5E: Flow of Matter and Energy; 9B:Symbolic Relationships; 9D:Uncertainty; 12B:Computation and Estimation; 12D:Communication Skills; 12E:Critical-Response Skills.

National Science Content Standards: *Science as Inquiry: A; Life Science: C:* Biological Evolution; The Interdependence of Organisms; Matter, Energy, and Organization in Living Systems; *Science and Technology: E:* Abilities of Technological Design; Understandings about Science and Technology; *Science in Personal and Social Perspectives: F:* Population Growth; Natural Resources: Environmental Quality; Natural and Human-induced Hazards; Science and Technology in Local, National, and Global Challenges

New York State Standards: 1, 2, 4, 5, 6, 7

Objective: Students will know how to retrieve data from a real-time data website, be able to explain and pose questions about the relationship between pH and rainfall data from two locations on the Hudson River.

Lesson Outline:

1. Students retrieve data from the HR-ECOS website according to worksheet instructions.
2. Students use the data to discuss the relationship between pH and rainfall.
3. Students test local water sources for pH before and after a rainstorm and compare their data with HR-ECOS data.

Materials: Computers with internet access (either at home or at school); pH meter or test kits; rain gauge or online access to rainfall amounts

Engagement: Ask students to think about how scientists know about the pollution or rainfall on any given day. Discussions about weather are generally easier because students have a significant level of familiarity with daily meteorological observations (snow days, etc). The Cary Institute has a long term environmental monitoring program (http://www.ecostudies.org/emp_purp.html) which has been running for twenty-one years, collecting rainfall and temperature information as well as air, stream, and precipitation chemistry. This information helps inform local and national environmental managers and policy makers about pollutants such as ground level ozone and acid rain. For example, from this record, we can see that sulfur dioxide has declined from 8.1 kg/ha in 1988 to 2.2 kg/ha in 2007 as a result of technological improvements in response to the Clean Air Act Amendment of 1990. Sulfur dioxide is one of the two main components of acid rain (nitrogen oxide is the other).

Explore 1: During this lesson, students will become familiar with data from the HR-ECOS (Hudson River Environmental Conditions Observing System) website, but do not need access to computers in class if they have access at home, or if you complete the extension questions as a class. Students should all receive a copy of the “pH and rainfall” worksheet which guides them through the investigation.

Explore 2: Students should test a local water body for pH before and after a rainfall event. If a trip to a local water body is impossible, samples can be brought into the classroom for analysis.

Explain: The Hudson River basin has a lot of limestone bedrock, which has a naturally high (alkaline) pH and is therefore well buffered. However, much of the rainfall in the region is acidic, with the average pH of rainfall around 5.0. With the buffering capacity of the bedrock, the Hudson tends to range between 7.5 and 8.0. After a long period without rain, the pH tends to increase, generally due to the decreasing levels of carbon dioxide as photosynthesis occurs. Rainfall usually decreases the pH of the river, but time of year, amount of rainfall, and previous rainfall patterns all have an impact.

On a daily basis, pH will first increase during daylight hours due to the photosynthesis of plants and phytoplankton. As the sun goes down, pH decreases as carbon dioxide levels increase throughout the night as a result of respiration. Other factors can influence pH, however, such as clouds that block the sun's radiation, decreasing the photosynthetic rates of the plants and reducing the increase in pH. Tides can also influence pH, and a low tide can allow more sunlight to reach submerged plants, increasing their photosynthetic rates.

Extend: Students can download data for other times of year or other locations along the Hudson River to compare results.

Evaluate: Collect student worksheets.