

Katherine Betrus  
The Effect of Acid Rain on the Germination of Seeds  
Topic: Ecology/Human Impact

**Time:** This lesson would take approximately three full class periods. The first period would serve as the time to set up the background on the lab and allow students to begin developing their experimental plan. The second class period would be to allow students to continue working on their experimental plan and set up their experiment. The third class period would give students the opportunity to analyze the results. In addition there is an extension activity involving the reading of a passage about acid rain and responding to text-based questions. This activity could be completed during the third class period or in an additional class period. In between the second and third class periods, there would be approximately 2-4 weeks where students would spend about 10 minutes every other class period taking data and recording it.

### **Materials/Resources**

Sulfuric Acid (diluted)  
Filter paper  
2 Petri Dishes (per student group)  
Graduated Cylinder/Pipettes  
Seeds (Vegetable)  
pH paper  
Lab Sheets

### **Physical Organization**

An area in the classroom will be needed for the seeds to germinate.

### **Objective**

- 1) Students will design an experiment to test the effect of acid rain on the germination of seeds.
- 2) Students will use their experimental design to construct an experiment.
- 3) Students will utilize the data from their experiment to explain their conclusion.
- 4) Students will read a passage on acid rain and respond to text-based questions.

### **NYS Standards**

MST 1: Students will use scientific inquiry to pose questions, seek answers, and develop solutions.

MST 4: Students will understand and apply scientific concepts, principles, and theories pertaining to the living environment.

### **Common Core Standards**

**RST.9-10.1:** Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

**RST.9-10.9:** Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.

**WHST.9-10.7:** Conduct short as well as more sustained research projects to answer a question

(including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.

**Town of Noville  
123 East Street  
Noville, NY 12345**

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July 1, 2012

Dr. Pat Smith  
Lab Manager  
Sunnyside Plant Laboratories  
456 Little Lane  
Bigtown, NY 16789

Dear Dr. Smith:

As per our phone conversation on June 2, 2012 the Town of Noville has contracted with your laboratory as part of the case *Valley View Farms vs. Easy Life Chemicals, Inc.* I am enclosing the major details of the case with this letter for your laboratory technicians to review.

It is the expectation of the town that your laboratory will perform the necessary tests to determine the outcome of this case. The contract that you agreed to states that you will notify us of the test results in 4-6 weeks. If at any point during the research your laboratory technicians have questions, please direct them to Ms. Betrus. Ms. Betrus is an outside consultant agreed on by both parties to be an objective resource should there be any issues with the research.

The Town of Noville chose Sunnyside Laboratories to complete the research in this case because of your sterling reputation for safety and accurate results. I look forward to reading your conclusion.

Sincerely,

Alex Porter  
Noville Town Attorney

Name \_\_\_\_\_

Due Date \_\_\_\_\_

Lab Partners: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

## **Acid Rain**

### **Background Information**

Acid rain is formed when the combustion of fossil fuels release gases containing nitrogen and sulfur compounds into the atmosphere.

### **Problem**

You are an employee of a laboratory. A town board has sent you the following case. A company would like to open in their town. The company carries out industrial processes that involve the burning of fossil fuels. The company would like to build their factory on property adjacent to a vegetable farm. The owner of the farm states that the factory would cause acid rain and the subsequent destruction of his crops. The company states that the gases released will have no effect on the farmer's crops.

Develop a plan to test the effect of acid rain on the germination of vegetable seeds. Depending on your results, the town board will decide whether to allow the factory to be built on the land or elsewhere. You will have access to the following materials: water, dilute sulfuric acid, filter paper, seeds, and Petri dishes. Your plan should include a hypothesis, procedure, and data table. The plan should mention how you will differentiate between experimental and control groups, as well as independent and dependent variables. Also, you must take into account safety procedures when completing your experiment. When complete, you should submit an advisory to the town, as to which course of action they should take.

**Plan**

Name: \_\_\_\_\_ Date: \_\_\_\_\_

Period: \_\_\_\_\_

Group Members: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Acid Rain Laboratory Experimental Design**

**Problem (What question are you trying to answer?):** \_\_\_\_\_  
\_\_\_\_\_

**Hypothesis:** \_\_\_\_\_  
\_\_\_\_\_

**Experimental & Control Groups (How many will be in each group & how will they be treated differently from each other?)**

Control Group	Experimental Group

**Variables**

**Independent Variable:** \_\_\_\_\_

**Dependent Variable:** \_\_\_\_\_

**Constants:** \_\_\_\_\_

**Safety (What guidelines should be followed?):**  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

**Materials:**

- ✓ On your own paper you will need to create a procedure, data table, data analysis, and conclusion to be handed in as part of your final grade for this experiment.

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A trade-off can occur when a decision is made. In a trade-off, one would consider less of one thing in order to gain more of another. During the case study we just completed, the town board was most likely was considering a trade-off. What trade-off do you think the town board was considering for the farmer vs. the factory?

1. Having read the passage about acid rain, do you think that not allowing factories to build near farm fields is the only solution to acid rain? Give evidence from the passage that describes alternative means of controlling acid rain.
2. Using evidence from the passage, refute the following claims made at the Noville Town Board meeting.
  - a. "Who cares about acid rain? I live in New York State, not California."
  - b. "I live near the town lake. It won't harm the fish so let's build the factory. The farmer can move."
  - c. "As long as there won't be any damage to the animals that live in the forest around the town, they should build the factory."
3. Refer to the last paragraph of the passage and your knowledge of natural selection.
  - Does the presence of a specific fungus on the roots of some trees give them an evolutionary advantage? Explain using evidence from the text.
  - In an area with severe acid rain, how would you expect the population of trees with fungi growing on their roots to change versus population of the trees without the fungi on their roots?