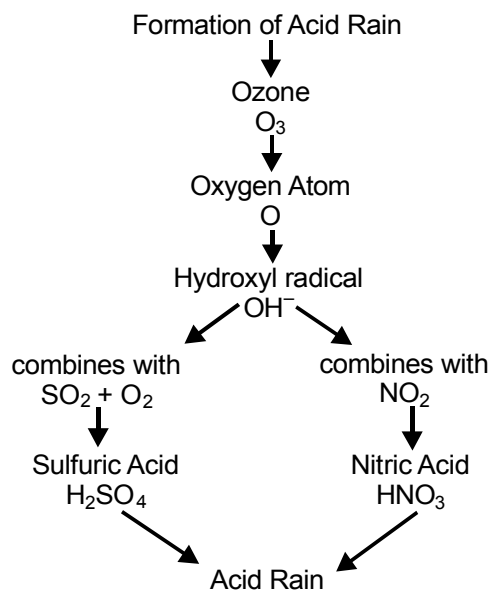


## Seed Germination

### Examining the Effects of Acid Rain

One of the major concerns in environmental science is acid precipitation resulting from pollutants in the atmosphere. This pollution can harm plants, kill fish and other animals, and cause damage to buildings and statues. The majority of this pollution comes from the burning of fossil fuels from both automobiles and industry. The burning of fossil fuels results in emission of sulfur dioxide and nitrogen oxides. We refer to these oxides as  $\text{SO}_x$  and  $\text{NO}_x$  [pronounced “socks and knocks”]. These oxides combine with water to form nitric acid and sulfuric acid that is contained in the precipitation that falls to earth.



Normal rain has a pH of 5.6. Acid rain has a pH that ranges from 5.5 to 2.4. When acid rain accumulates in lakes and rivers it lowers the pH of the run-off water. This affects forests by killing trees and many other plants. It also kills fish and aquatic life as the acid accumulates in the lakes and ponds.

You will be working in a group of 3-4 students. Your group will design an experiment to investigate the effects of acids with varying pH on the germination of pea seeds. If seeds cannot germinate, then of course the plants will not grow. The investigation is limited to the materials provided by the teacher unless the teacher agrees to the use of different materials. The design of your experiment must be reasonable, and **the procedure must have the approval of your teacher**. There is a two-week time limitation on the experiment.

As your team begins to design this experiment, keep the following questions in mind.

- A. How many acids of varying pH will you use in your experimental design?
- B. How many seeds will you use per container?

- C. Which variables serve as controls for your experimental design?
- D. What volume of acid you will use to promote germination?
- E. At what time intervals will you check the seeds for their progress?
- F. What sort of data will you collect at each time interval?
- G. How will you design your data table? How will you graph your data? What is your independent variable? What is your dependent variable?

### PURPOSE

The purpose this investigation to examine the effects of acid rain on seed germination.

### MATERIALS

Petri dishes, 10 ea	paper towels
ruler	graduated cylinders 10 mL
syringes 10 cc	access to balance
goggles	lab aprons
latex gloves	graph paper
permanent maker	scissors
tweezers	package of pea seeds
acids and a base at the following pH: 2.0 3.0, 4.0, 5.0, 6.0, 7.0, 8.0	

#### Safety Alert

1. Goggles, aprons and gloves must be worn.
2. **These solutions contain acids. These solutions are irritants and can damage clothing. Avoid skin/eye contact; do not ingest. Immediately run water over any skin that the liquid comes in contact with. Continue to flush the affected area for 10 minutes. Notify your teacher immediately.**
3. Scissors are sharp; handle with care.

# 3 *Seed Germination*

## **PROCEDURE**

1. Write a paragraph concerning the impact of acid rain on the environment on your student answer page.
2. Formulate a hypothesis for your experimental design and record it on your student answer page. Use an “if, then” format and address the effect varying pH has on seed germination.
3. Outline a procedure to test your hypothesis and write it down on the student answer sheet.
4. Design a data table to record the measurements that will be taken as you execute your experimental design. Put this on the student answer sheet.
5. Obtain your teacher’s approval before proceeding with your experiment.
6. For the next seven class days, record your measurements in your data table.
7. At the end of this investigation graph your data and analyze any trends that you find. Make sure your graph is properly constructed, paying special attention to your independent and dependent variables.
8. Write a conclusion for this experiment. Remember, a well written conclusion explains why the results occurred as opposed to restating those results.
9. Answer the conclusion questions on the student answer page.

Name \_\_\_\_\_

Period \_\_\_\_\_

# Seed Germination

## Examining the Effects of Acid Rain

### IMPACT PARAGRAPH

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### HYPOTHESIS

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### PROCEDURE

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# 3 *Seed Germination*

## **ANALYSIS**

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This space is provided for your data tables and graphs.

## **CONCLUSION**

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This area is provided for your conclusion.

## CONCLUSION QUESTIONS

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1. What is the optimal pH for the germination of pea seeds based on the data you collected?
2. What is the relationship between the pH of the solution used and seed germination?
3. Why does altering the pH of a seed's environment during germination have an effect on the germination of seeds and their metabolism and thus growth rate?
4. How might acid rain have an impact on crops and the economy?
5. What action should be taken to end acid rain pollution? What governmental intervention is necessary to implement your action? What impact will your action have on industry? What impact will your action have on agriculture?
6. Evaluate your experiment. Include in your evaluation sources of errors, and recommend improvements for your experiment should you be asked to repeat it.