PLANTS AND SULFUR DIOXIDE

TOPIC:

Air Pollution

INTRODUCTION:

Sulfur dioxide is a major air pollutant. It is released into the atmosphere in smoke from factories and power plants. Sulfur dioxide causes respiratory problems in people, especially when concentrated in smogs. When carried high into the atmosphere it dissolves in water droplets, falling back to Earth as acid rain; this corrodes metals, damages building stone, acidifies lakes, rendering them lifeless, and kills trees. In this experiment you will investigate the effect sulfur dioxide has on different plants, seeing whether some plants are more resistant to the effects of sulfur dioxide than others. You will do this by seeing how the gas affects the growth of seedlings.

TIME NEEDED:

For each part

20 minutes to plant seeds
seeds should be left to grow for 2 weeks
45 minutes to set up experiment
10 minutes to check experiment after 30 minutes and after 24 hours

MATERIALS:

three varieties of seeds (obtainable from gardening store or nursery):
either mustard *or* cress seeds
either corn *or* cucumber seeds
barley, carrot, lettuce, *or* tomato seeds
4 small square containers (*e.g.*, aluminum foil dishes) approximately 15 cm x 15 cm and 5 cm deep
4 small, empty jars (*e.g.*, jelly or baby food jars) without lids
potting soil
4 clear plastic bags (large enough to fit one square container and one jar)
felt-tip marker
masking tape
4 twist ties
scale
sodium bisulfite ($NaHSO_3$) (approximately 15g)
stirring rod (*e.g.*, chopstick)
citric acid solution
water
teaspoon or spatula
250-ml beaker
100-ml measuring cylinder
rubber gloves
citric acid solution
self-adhesive labels

Safety Precautions

Please click on above link to view our safety guidelines.

PROCEDURE:

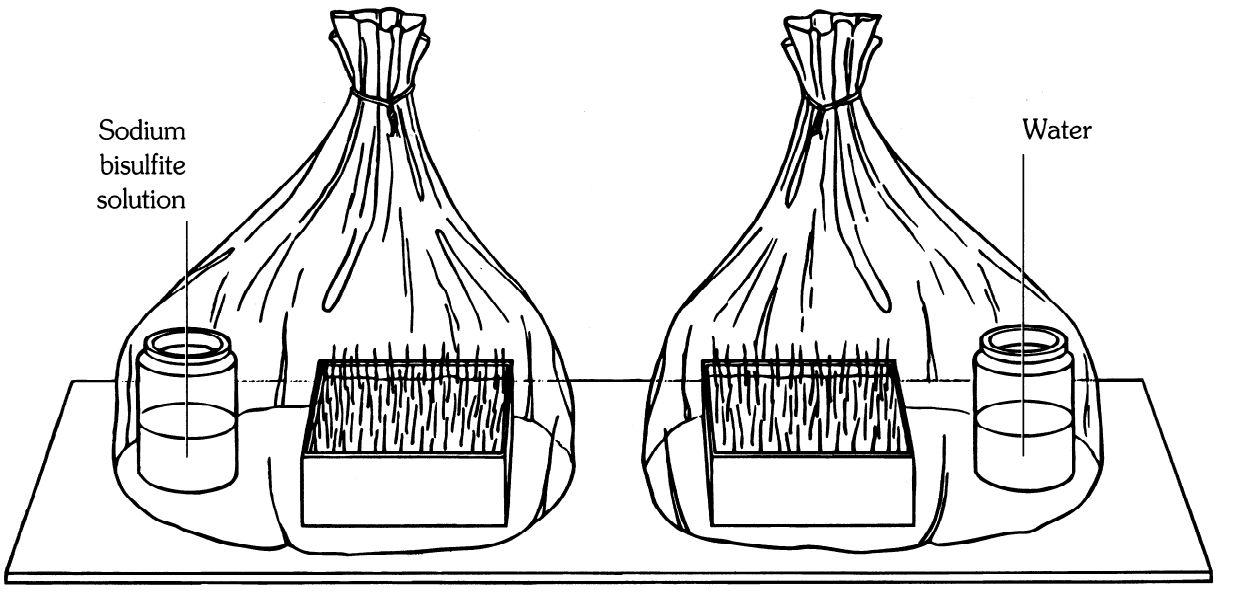
Part 1—Effect of sulfur dioxide on seedlings

Growing the seedlings

1. Half fill the two containers with potting soil. Carefully moisten the soil with water.
2. Sprinkle the mustard or cress seeds over the soil in both containers. Leave them for two weeks, moistening the soil if it dries out.

Investigating exposure to sulfur dioxide

3. Label the two containers "D" and "S". Record their appearance (in words, or using annotated drawings) in the column marked "Seedlings with damp air" (for container "D") and the column marked "Seedlings with sulfur dioxide" (for container "S") of the Data Table.
4. Put each container of seedlings in a plastic bag. Using the masking tape, label the bag with container "S": "Seedlings with sulfur dioxide." Label the bag with container "D": "Seedlings with damp air."
5. In a well-ventilated place, weigh 5 grams of sodium bisulfite using the scale; add the sodium bisulfite to the beaker.
6. Measure out 100 ml of water using the measuring cylinder. Add the water to the beaker and stir.
7. Put on the rubber gloves and half fill one jar with sodium bisulfite solution.
8. Add a few drops of citric acid solution to the jar (this increases sulfur dioxide production).
9. Place the jar in the bag marked "Seedlings with sulfur dioxide" and seal the bag with a twist tie.
10. Remove the rubber gloves.
11. Half fill the other jar with water.
12. Place the jar in the bag marked "Seedlings with damp air" and seal the bag with a twist tie.



Seedlings with sulfur dioxide Seedlings with damp air

13. Leave the bags for 30 minutes.
14. After 30 minutes (without opening the bags) look at the seedlings and record their appearance in the Data Table.
15. Leave the bags for 24 hours.
16. After 24 hours, look at the seedlings again and record their appearance in the Data Table.

DATA TABLE

Time	Seedlings with damp air	Seedlings with sulfur dioxide
At start		
After 30 minutes		
After 24 hours		

Part 2—Resistance of seedlings to the effect of sulfur dioxide

Growing the seedlings

1. Half fill the other two containers with potting soil. Carefully moisten the soil with water.
2. Label one container "A" and the other "B".
3. Sprinkle the corn or cucumber seeds over the soil in container A. Then sprinkle the barley, corn, lettuce, or tomato seeds over the soil in container B.
4. Leave the containers to grow for two weeks, moistening the soil if it dries out.

Comparing sensitivity to sulfur dioxide

5. After two weeks, record the appearance of both containers in the Data Table in the columns marked "Seedling A" (for container A) and "Seedling B" (for container B). Also, write the identities of seedlings A and B in the Data Table.
6. Put each container of seedlings in a plastic bag.
7. In a well-ventilated place, weigh 5 grams of sodium bisulfite using the scale; add the sodium bisulfite to the beaker.

8. Measure out 100 ml of water using the measuring cylinder. Add the water to the beaker and stir.
9. Put on the rubber gloves and half fill one jar with sodium bisulfite solution.
10. Add a few drops of citric acid solution to the jar.
11. Place the jar in the bag with container A and seal the bag with a twist tie.
12. Repeat steps 7 to 11 with container B.
13. Leave the bags for 30 minutes.
14. After 30 minutes (without opening the bags) look at the seedlings and record their appearance in the Data Table.
15. Leave the bags for 24 hours.
16. After 24 hours, look at the seedlings again and record their appearance in the Data Table.

DATA TABLE

Time	Seedling A	Seedling B
At start		
After 30 minutes		
After 24 hours		
Seedling A was:		
Seedling B was:		

ANALYSIS:

Part 1

1. What effect did the sulfur dioxide have on the seedlings after 30 minutes?
2. What effect did the sulfur dioxide have on the seedlings after 24 hours?
3. What had happened in the other bag after 30 minutes and 24 hours?
4. Why was water used instead of sodium bisulfite solution in one of the bags?
5. Find out which parts of the plant are affected by sulfur dioxide.
6. Do some research. How does sulfur dioxide affect humans?

Part 2

1. What effect did sulfur dioxide have on the "A" seedlings?
2. What effect did sulfur dioxide have on the "B" seedlings?
3. Why might this information be important to a farmer or horticulturalist growing crops near to factories or a coal-fired power plant?

OUR FINDINGS:

Click on above link to see what we found.

Our Findings

VI. POLLUTION PROJECTS

6.003 Plants and Sulfur Dioxide

Part 1

1. Results will vary.
2. Results will vary. However, after 24 hours the sulfur dioxide should be having a detrimental effect on the seedlings.
3. In the other bag the seedlings should appear normal and healthy after 30 minutes and 24 hours.
4. Water was used in the other bag as a control, to show the effect of enclosing the seedlings in a plastic bag in a moist atmosphere. If the seedlings remain normal after 24 hours then any effects observed in the other bag must be due to the effects of sulfur dioxide.
5. The best way to determine which parts of the plant are affected by sulfur dioxide is to take an affected seedling from those exposed to sulfur dioxide, and one from the control bag, and compare the leaves, stem, and roots of both.
6. Sulfur dioxide causes irritation in the upper respiratory tract (nose, trachea, bronchi) that can aggravate bronchitis and other respiratory diseases.

Part 2

1. Results will vary but these seedlings should be fairly resistant to the effects of sulfur dioxide.
2. Results will vary but these seedlings should be susceptible to the effects of sulfur dioxide.
3. The farmer or horticulturalist would be unwise to grow crops which are vulnerable to sulfur dioxide "fallout" from power plants or factories.

SPECIAL SAFETY NOTE TO EXPERIMENTERS

Each experiment includes a short list of special safety precautions that are relevant to that particular project. However, these do not include all of the basic safety precautions that are necessary whenever you are working on a scientific experiment. For this reason, it is absolutely necessary that you read, copy, and remain mindful of the General Safety Precautions that follow this note.

Experimental science can be dangerous, and good laboratory procedure always includes carefully following basic safety rules. Things can happen very quickly while you are performing an experiment. Things can spill, break, even catch fire. There will be no time after the fact to protect yourself. Always prepare for unexpected dangers by following basic safety guidelines the *entire* time you are performing the experiment, whether or not something seems dangerous to you at a given moment.

We have been quite sparing in prescribing safety precautions for the individual experiments. We made this choice for one reason: We want you to take very seriously every safety precaution that is printed in this book. If you see it written here, you can be sure that it is here because it is absolutely critical to your safety.

One further note—The book assumes that you will read the safety precautions that follow, as well as those at the head of each experiment you are preparing to perform, and that you will *remember* them. Except in rare instances, these precautions will not be repeated in the procedure itself. It is up to you to use your good judgment and pay attention when performing potentially dangerous parts of the procedure. Just because the book does not say BE CAREFUL WITH HOT LIQUIDS or DON'T CUT YOURSELF WITH THE KNIFE does not mean that you should be careless when simmering water or stripping an electrical wire. It does mean that when you see a special note to be careful, it is extremely important that you pay attention to it.

If you ever have a question about whether a procedure or material is dangerous, wait until you find out for sure that it is safe.

GENERAL SAFETY PRECAUTIONS

Accidents caused by carelessness, haste, insufficient knowledge, or taking unnecessary risks can be avoided by practicing safety procedures and being alert while conducting experiments. Be sure to check the experiments in this book for additional safety regulations and adult supervision requirements. If you will be working in a lab, do not work alone.

PREPARE:
—Clear all surfaces before beginning experiments
—Read the instructions before you start
—Know the hazards of the experiments and anticipate dangers

PROTECT YOURSELF:
—Follow the directions step-by-step; do only one experiment at a time
—Locate exits, fire blanket and extinguisher, master gas and electricity shut-offs, eye wash, and first-aid kit
—Make sure there is adequate ventilation
—Do not horseplay
—Wear an apron and goggles
—Do not wear contact lenses, open shoes, loose clothing, or loose hair
—Keep floor and work space neat, clean, and dry
—Clean up spills immediately
—Never eat, drink, or smoke in laboratory or work space
—Do not eat or drink any substances tested unless expressly permitted to do so by a knowledgeable adult

USE EQUIPMENT WITH CARE:
—Set up apparatus far from the edge of the desk
—Use knives and other sharp or pointed instruments with caution
—Pull plugs, not cords, when removing electrical plugs
—Don't use your mouth to pipette; use a suction bulb
—Clean glassware before and after use
—Check glassware for scratches, cracks, and sharp edges
—Clean up broken glassware immediately
—Do not use reflected sunlight to illuminate your microscope
—Do not touch metal conductors
—Use only low voltage and current materials such as lantern batteries
—Be careful when using stepstools, chairs, and ladders

USING CHEMICALS:
—Never taste or inhale chemicals
—Label all bottles and apparatus containing chemicals
—Read labels carefully
—Avoid chemical contact with skin and eyes (wear goggles, apron, and gloves)
—Do not touch chemical solutions
—Wash hands before and after using solutions
—Wipe up spills thoroughly

HEATING SUBSTANCES:
—Use goggles, apron, and gloves when boiling water
—Keep your face away from test tubes and beakers
—Never leave apparatus unattended
—Use safety tongs and heat-resistant mittens
—Turn off hot plates, bunsen burners, and gas when you are done
—Keep flammable substances away from heat
—Have fire extinguisher on hand

GOING ON FIELD TRIPS:
—Do not go on a field trip by yourself
—Tell a responsible adult where you are going and maintain that route
—Know the area and its potential hazards, such as poison plants, deep water, and rapids
—Dress for terrain and weather conditions (prepare for exposure to sun as well as to cold)
—Bring along a first-aid kit
—Do not drink water or eat plants found in the wild
—Use the buddy system; do not do outdoor experiments alone

FINISHING UP:
—Thoroughly clean your work area and glassware
—Be careful not to return chemicals or contaminated reagents to the wrong containers
—Don't dispose of materials in the sink unless instructed to do so
—Wash your hands
—Clean up all residue and put in proper containers for disposal
—Dispose of all chemicals according to all local, state, and federal laws

BE SAFETY CONSCIOUS AT ALL TIMES