

# Student Section

*This section contains samples  
of investigations developed by students  
to address the issues presented in  
the Copper Basin video.*

**I encourage you to work with your students to  
design their own investigations.**

# Will Plants Grow in Copper Basin Soil?

## Student Investigation 1

(Coordinates with Teacher Lesson 3)

In this activity we will study the effect of Copper Basin soil on the growth of plants. We will compare the growth of plants in simulated Copper basin soil to plants grown in other types of soil. We will also use compost or humus and local soil.

### **Problem:**

Will plants grow in simulated Copper Basin soil?

### **Materials:**

18 pine seeds	metric ruler
18 corn seeds	plant tray
6 small cups	local soil
simulated Copper Basin soil	
humus or compost	

### **Procedure:**

1. Predict the result when the seeds are planted in each type of soil. Record the predictions.
2. Construct tables in which to record your observations.
3. Fill the cups with soil as follows:
  - 2 cups with compost or humus
  - 2 cups with local soil, and
  - 2 cups with simulated Copper Basin soil.Punch small holes in the bottom of the cups for drainage. Label the cups.
4. Plant 4-5 corn seeds in each type of soil and 4-5 pine seeds in each type of soil. Plant seeds about 1 cm deep. Moisten the soil. Keep it moist for the next few days, but do not overwater it.
5. Put the labeled cups on a plant tray and store it in a warm place. Wash your hands when finished.
6. Observe the cups daily for the next several days. Record any observations. Once the plants begin to grow, record this date and measure the height of the plant each day. Record your observations.
7. At the end of the experiment determine the mean height for each seed that grew in each type of soil.
8. Dig up the seeds that did not grow. Record any observations that can be made such as appearance, color, or partial germination. Find the mass of each seed that did not germinate and record.

**Student Worksheet #1**  
**Will Plants Grow in Copper Basin Soil?**

**Predictions**

**Data Table**

**Observations**

**Analysis**

1. In which types of soils did the seeds germinate? \_\_\_\_\_
  - a. How many seeds germinated in each type of soil? \_\_\_\_\_
  - b. How did the heights and general appearance of the seedlings compare across soil types? \_\_\_\_\_
2. Explain changes observed in the seeds that did germinate? \_\_\_\_\_
3. How many seeds did not germinate in each type of soil? \_\_\_\_\_
4. Explain changes observed in the seeds that did not germinate. \_\_\_\_\_
5. Did the results of the experiment support your predictions? Why or why not? \_\_\_\_\_
6. What inferences can you make about the problems identified in the Copper Basin video? \_\_\_\_\_

# What Chemicals are Found in Copper Basin Soil?

## Investigation 2

(Coordinates with Teacher Lesson 3)

The soil used to reclaim the land that was destroyed by copper mining in Ducktown, Tennessee, contained minerals left from the roasting and smelting processes. The depleted soil apparently did not allow for reforestation of the area. In this lab we will analyze soil from the Copper Basin for its chemical content. The procedures focus on the chemicals needed for plant growth and those that might remain in the soil as a result of mining. The chemicals found in fertilizers are nitrogen, phosphorus, and potassium. Mining probably left behind some types of copper compounds and sulfides. We will also test local soil and humus for comparison. Later we can correlate these results with the observations from the previous investigation.

### **Problem**

Does the Copper Basin soil contain chemicals that will support the growth of plants?

### **Materials**

Chemical test kits for soil analysis                      soil samples

### **Procedure**

1. Read all cautions and safety procedures for each of the chemical tests. Follow the directions carefully when performing each of the chemical tests.
2. Construct a chart in which the results of each test can be easily recorded.
3. Perform the following soil tests;
  - pH
  - Phosphorus
  - Nitrogen
  - Potassium
  - Sulfide
  - Copper
4. Clean up your lab station and wash your hands.
5. Compare your results with those from other groups.

**Student Worksheet #2**  
**Will Chemicals are Found in Copper Basin Soil?**

**Data Table**

**Observations**

**Analysis**

1. What does the data reveal about the Copper Basin soil? \_\_\_\_\_  
\_\_\_\_\_
2. What chemicals may have inhibited the growth of plants in Copper Basin soil?  
\_\_\_\_\_
3. How do the results from the investigation, “Will plants grow in Copper Basin Soil?” support or refute the results of this investigation? \_\_\_\_\_  
\_\_\_\_\_
4. Based on this investigation, what are some possible solutions to the revegetation problems in the Copper Basin? \_\_\_\_\_  
\_\_\_\_\_
5. How does the evidence found in this investigation relate to the original list of issues and problems? \_\_\_\_\_  
\_\_\_\_\_

# How Does the Amount of Vegetation Affect Relative Humidity and Temperature?

## Investigation 3

(Coordinates with Teacher Lesson 4)

Organisms lose water faster in an atmosphere with lower humidity than in an atmosphere with higher humidity. The barren Copper Basin had much less vegetation than the forested area surrounding it. Two abiotic factors, temperature and relative humidity, might be very different in each area. We will measure and compare the temperature and relative humidity in three microenvironments at different heights and compare the results. We can use the results to predict if the barren land in the Copper Basin could have caused changes to the micro-climate in that area.

### **Problem**

Does the amount of plant life affect the relative humidity and temperature of an environment?

### **Materials**

3 watches/clocks/timers	3 screw top jars of 30-50 mL distilled water
3 metersticks	3 pieces of stiff cardboard for fanning
3 thermometers (dry)	3 shade devices
3 thermometers (with cotton sleeve over bulb end)	Table of Relative Humidity

### **Procedure**

1. Predict differences that will be found in the 3 different environments.
2. Divide the team into 3 pairs of students. Each pair will measure the temperature in one of the three environments at 0 cm, 10 cm, 90 cm, and 150 cm. The 3 environments are:
  - the woods (dense cover of plants)
  - the edge of the field (thicket or shrubby area), and
  - the middle of the soccer field (barren ground).
3. One person in each team should record the data. Teams should synchronize their timers. Write the synchronized times on a chart. All measurements should be made at the same times. Schedule at least 10 minutes between readings.
4. Wet the cotton sleeve of one thermometer with distilled water. This should be done before each reading.
5. Read both thermometers at the same time. Position the thermometers at least 2 minutes before a reading so that the temperature can stabilize. Use the shade device to shield the thermometer from the direct rays of the sun. Fan the thermometers with the stiff cardboard for 2 minutes, then read the 2 temperatures and record your readings. Repeat this procedure at each height.
6. Using your measurements and the relative humidity chart, determine the relative humidity. *Relative humidity* is the percent of water vapor actually in the air at any given temperature compared to the amount of water vapor the air could hold at that temperature.
7. Share results with the other teams.

**Student Worksheet #3**  
**How Does the Amount of Vegetation Affect**  
**Relative Humidity and Temperature?**

**Predictions**

**Data Table**

**Observations**

**Analysis**

1. At ground level, which environment is coolest and most humid? Which is warmest and least humid? \_\_\_\_\_  
\_\_\_\_\_
2. How do these two environments compare at the other heights with regard to temperature and humidity? \_\_\_\_\_  
\_\_\_\_\_
3. What differences in the 3 environments could account for the differences in humidity and temperature? \_\_\_\_\_  
\_\_\_\_\_
4. How do these differences show the interrelationship between abiotic and biotic factors? \_\_\_\_\_  
\_\_\_\_\_
5. How might these results explain the microclimatic changes that were observed in the Copper Basin? \_\_\_\_\_  
\_\_\_\_\_

# How Does Acid Rain Affect the Germination of Seeds?

## Investigation 4

(Coordinates with Teacher Lesson 5)

Acid rain is a big problem in the Copper Basin area. The local residents reported damage to the leaves of trees after periods of rainfall or fog. In this investigation, we will determine the effects of acidic conditions on plants. Because of the need for a controlled environment in the lab, we will examine the effect of pH on the germination of seeds.

### **Problem**

How does pH affect the germination of seeds?

### **Materials**

petri dishes	ruler
wax pencil	water solutions: pH 2, 3, 4, 5, 6, & 7
paper towel disks	(simulated rainwater)
scissors	seeds

### **Procedure**

1. Construct a table on which to record your observations.
2. Predict what will happen to seeds grown in solutions of differing pH. Record your predictions.
3. Cut disks of paper towel to fit the bottom of a petri dish. Place 4 paper towel disks in the bottom of each petri dish.
4. Dampen the disks with one of the pH solutions. Label the lid of the petri dish with this pH. Measure the lengths of the 5 seeds that are to be placed in this dish and record these measurements. Place the seeds in the petri dish and cover.
5. Repeat this procedure using the other pH solutions. There will be a total of 6 dishes.
6. Each day, remove the lids of the dishes. Measure the seeds and record your observations on a data table. If necessary, add appropriate solutions to keep the seeds moist.
7. On the last day share your results with other groups.
8. Construct a line graph of the averaged results.

**Student Worksheet #4**  
**How Does Acid Rain Affect the Germination of Seeds?**

**Predictions**

**Data Table**

**Observations**

(Graph your results on a separate sheet of graph paper.)

**Analysis**

1. What seems to be the optimum pH for germination? \_\_\_\_\_
2. Does any pH seem to inhibit the growth of seeds? Explain. \_\_\_\_\_  
\_\_\_\_\_
3. What impact might acid rain have on the growth of young plants in a forest or revegetated area? \_\_\_\_\_  
\_\_\_\_\_
4. How does the data help to explain issues or problems identified in the Copper Basin video? \_\_\_\_\_  
\_\_\_\_\_

# What Effect Does Fertilizer Have on the Growth of Plants?

## Investigation 5

(Coordinates with Teacher Lesson 6)

The nitrogen cycle is important for the growth of plants. Our chemical tests of the soil indicated a shortage of nitrogen in the Copper Basin soil. In this experiment we will show that adding fertilizer to the Copper Basin soil could improve its ability to grow plants.

### **Problem**

How does fertilizer affect the growth of plants in an ecosystem?

### **Materials**

small cups	ruler
1/8 teaspoon measures	nitrogen fertilizer
grass seeds	potting soil

### **Procedure**

1. Construct a table in which to record your observations.
2. Predict the effect of fertilizer on the growth of grass plants.
3. Fill 9 cups with potting soil. Add the same number of grass seeds to each cup (use at least 10 seeds/cup). Label the cups 1 – 9.
4. To cups 1–8, add amounts of fertilizer in increments of 1/8 teaspoon. Do not add fertilizer to cup 9. Place cups in a sunny location.
5. Observe the cups daily and observe any changes in the color of the grass. Measure and record the average height of the plants in each cup.

**Student Worksheet #5**  
**How Does Fertilizer Affect the Growth of Plants?**

**Predictions**

**Data Table**

**Observations**

**Analysis**

1. Describe any changes observed in the cups. Based on the results, what is the effect of fertilizer on the growth of plants? \_\_\_\_\_  
\_\_\_\_\_
2. How do these results relate to the problem identified in the Copper Basin video? \_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_
3. What may have depleted the Copper Basin soil of nitrogen? \_\_\_\_\_  
\_\_\_\_\_

# Evaluation

**The students and teacher should collaborate to design an appropriate assessment method.**

**My classes developed the following assessment and rubric.**

# Copper Basin Study

Working with your team, choose a way to present all the findings related to the Copper Basin problems and issues. The presentation must include all data that has been collected and its relationship to the Copper Basin problems must be clear. Possible solutions to problems that were suggested and tested in the investigations must also be included.

## **Must have list**

Data summary  
How collected data relates to overall problem  
Conclusions from all tests and investigations  
Proposed solutions  
Whole group participation

## **Project Ideas**

Report  
Video  
Brochure  
Skit  
Poster presentation  
Informational Booklet  
Oral presentation  
Computer presentation

## RUBRIC FOR PRESENTATION

	<b>INFORMATION</b>	<b>EXPLANATION</b>	<b>INFERENCES AND CONCLUSIONS WITH SUPPORT</b>	<b>LEVEL OF UNDERSTANDING</b>
<b>4</b>	Complete	Thorough and concise	Logical progression supported by data	Full
<b>3</b>	Most	Mostly correct	Acceptable, some support	Good
<b>2</b>	Some	Basically correct	Acceptable, weak support	Basic
<b>1</b>	Minimal	Ambiguous	Lacks logical progression, lacks support	Some