PLANTING A CRYSTAL GARDEN

GRADES 3 - 5

SOUTHERN COMPANY

Energy to Serve Your World®

PLANTING A CRYSTAL GARDEN

SNC - Plant Farley

LESSON PLAN

Lesson Title: Planting a Crystal Garden

Lesson Description: Students conduct experiments by growing crystals out of magnesium sulfate solutions at different temperatures.

Grade Level: 3-5 (modify as needed for each grade level)

Subject Area(s): Physical Science, Earth Science

Objectives: Students will:
- gain an understanding of the concept crystalline structure and systems
- observe, record, and analyze factors that influence crystal formation
- grow crystals of magnesium sulfate
- observe a variety of crystal systems
- analyze data and communicate findings to others

Materials:
- specimen bowls or Petri dishes, 12 per student teamsmall rough surfaced rocks, 3 per student team
- small (8-10 mm) smooth, solid glass or plastic beads; 3 per student team
- hand lenses and/or stereomicroscopes, 1 per student team
- magnesium sulfate solution; enough to fill all the dishes of all student teams
- culture oven (110 -135° F)
- refrigerator (40 - 55° F)
- food coloring (optional)
- flashlights, 1 per student team
- thermometers, alcohol filled; 1 per team
- samples of various crystals (such as rock candy, halite, fluorite, quartz, etc.); try to have several different shapes of crystals
- pencils
- activity sheets

Correlations (NSES):
- Content Standard A - Science as Inquiry
  - develop abilities necessary to do science inquiry
  - develop understandings about scientific inquiry
- Content Standard B - Physical Science
  - develop an understanding of properties of objects and materials
  - develop an understanding of properties of earth materials
- Content Standard E – Science and Technology
  - develop abilities technological design
  - develop understanding about science and technology
- Content Standard F – Science in Personal and Social Perspectives
  - develop understanding of types of resources

Curriculum Integration:
- Environmental Science (natural resources)
- Mathematics (geometric shapes of crystals)

Process Skills:
- Observation
- Comparison
- Collection of data
- Measurement
- Research
- Inference
- Investigation/experimentation
- Interpretation of data
- Analysis of data
- Description of findings
- Communication of ideas

Background Information:
- Main ideas

  Principles related to crystalline structure such as:
  - relation to regular arrangement at atomic level
  - common external (geometric) shapes
  - special properties of crystals
  - are natural structures
  - are inorganic (not associated with life forms)

  Principles related to formation of crystals such as temperature, solution concentration, movement, etc.
- Secondary ideas
  - Uses of crystals in industry and technology
  - Gemstones

Teacher Activities:
- Assemble/organize all materials needed for activity. Set up the hot & cold water baths ahead of time.
- Check flashlights and stereomicrosopes to make certain they are working properly.
- Prepare a saturate solution of magnesium sulfate heptahydrate by dissolving 2 parts $MgSO4 \bullet 7H2O$ to 1 part water over heat. Stir the solution and do not allow it boil. Keep it hot.
- Present background material to students.
- Issue instructions on how to read a thermometer for this exercise.
- Depending on the size of the class, the teacher may wish to divide the class into teams or 2-4 students. Each student in the group should have a specific task is the exercise.
- Issue instructions to students regarding experiment.
- Distribute Activity Sheets to students and give instructions on how to complete them.
- Discuss safety issues. Stress importance of avoiding hot solutions, not breaking thermometers, avoiding getting magnesium sulfate solution in eyes, mouths, and noses.
- Dispense hot magnesium sulfate solution into dishes. Caution students again about getting burned by the hot solution.
- Monitor/assist students as needed during exercises.
- Move around to each team to assist and answer questions.
- If students wish to color their solutions, the teacher should place 2-3 drops of food coloring in the center of the dishes. Do not allow students to handle the food coloring.
- After students complete exercises and assemble back into a group, allow students to show their work and describe their observations. Inform students that they will make more observations at later times during the day and for several days in the future.
- After students have shared their work, engage students in post-activity discussion. Stress main points of lesson during discussion.
- Distribute a variety of crystal specimens to students.

Student Activities:

- Listen to background information given by teacher.
- Obtain all materials needed to complete the exercise (refer to Activity Sheet).
- Record preliminary data on Activity Sheets.
- Construct crystal growth experiment as directed.
- Observe results and record data over several days.
- Observe and compare other crystals to the ones grown.
- Interpret/analyze data and share it with other students.
- Participate in post-activity discussion.

Evaluation:

- Activity sheets
- Direct observation
- Oral reports from students

Extension/Enrichment:

- Have students utilize different types of solutions (e.g. alum, copper sulfate, etc.).
- Have students attempt to grown large, single crystals.
- Take a field trip to a geological/rock museum or even a jewelry store to observe specimens.
- Have students complete reports on crystals, minerals, or gemstones.
- Invite a geologist or "rock hound" to speak to the class.
- Have a crystal growing contest.
- Have the students make a "crystal collage" by gluing all the crystals on a board or placing them in Riker mounts.
- Engage students in a "Crystal Hunt" on the WWW.

Safety Considerations:

- Students and teachers must wear Z87 compliant goggles and lab aprons for this exercise.
- Do not allow students to pour the hot magnesium sulfate solution.
- Do not allow the culture oven temperature to exceed 135° F.
- Do not leave a hot plate or remaining hot magnesium sulfate solution in an area that students can access.
- Caution students to handle thermometers with care to prevent breakage. Do not use mercurial thermometers.
- Caution students about placing their hands in their mouths, eyes, or noses as the magnesium sulfate solution can be irritating.
- Some crystals may have sharp edges, especially if they break.
- Insist that students wash their hands after handling any chemicals or crystals.

GROWING A

ACTIVITY SHEET ONE

CRYSTAL GARDEN

(READ THIS ENTIRE SHEET BEFORE BEGINNING THE EXERCISE)

Introduction

We usually grow flowers or vegetables in a garden but today we are growing something different. We will be growing some pretty crystals instead.

You teacher has talked to you about what crystals are and told you about their shapes and how they grow. Follow the directions on this Activity Sheet and record your data carefully, as you will be called upon to discuss your findings to the rest of the class after the lab is completed. It will probably take several days of careful observation before you can get all the results you need.

Procedure

Obtain the following materials as directed by your instructor:

- 12 dishes
- a flashlight
- 3 small rocks
- 3 glass or plastic beads
- a hand lens and/or microscope
- samples of various crystals
- pencil
- wax or felt tip markers

- Listen to your teacher carefully as she tells you how to start the lab activity.

- Put on your goggles and lab aprons.

- Label your 12 dishes with a wax or felt tip marker by placing your team name on each of them.

- Place a single rock in three different dishes.

- Place a single bead in three different dishes.

- Place a small, single crystal of Epsom salt in three different dishes. The single crystal is called a seed crystal. This should leave you with three other dishes that are empty.

- Your teacher will pour enough Epsom salt solution in each dish. It will be very hot so be careful.

- Do not move the dishes at this time. While they cool, use your thermometer to measure the temperature of the air in the room where the crystals will grow, the air in the refrigerator, and the air in the culture oven. Record the temperatures in Table 1.

- Put the lids on your dishes and carefully place one set (a dish with a rock and solution, a dish with a bead and solution, and dish with a crystal and solution, and a dish with just solution) in the refrigerator as directed by your teacher. Examine the dishes carefully with the flashlight and record your observations in Table 1.

- Carefully place the next set (a dish with a rock and solution, a dish with a bead and solution, a dish with a crystal and solution, and a dish with just solution) in an area of the classroom or lab where they will be left undisturbed at room temperature for several days. Examine the dishes carefully with your flashlight and record your data in Table 1.

- Carefully place the remainder of the dishes in the refrigerator. Examine the dishes carefully using your flashlight and record your observations in Table 1. Then answer only questions 1-3 on the Activity Sheet.

- Observe the same specimens after 4 hours. Record your data in Table 2.
- Observe the same specimens once a day for the next three days. Record your data in Table 3.

- After the third day of observation, use tongs or tweezers to remove any crystals that have formed and lay them on a dry surface to air dry for 2 or more hours. You must wear goggles to perform this task. The crystals will be delicate and can break easily so handle them gently. Do not handle the specimens while they are still wet.

- After the crystals have had time to dry (2 hours), you may handle the crystals. Handle them gently as they will break easily. Use a hand lens to examine them. Compare your crystals to those grown by others in your class. Do not put your hands in your mouth or eyes while handling crystals. Wash your hands after handling crystals.

- Examine the crystals your teacher gives you. Compare them to the crystals you have grown. Look at the pictures of crystals on Activity Sheet 2. Compare your crystals to those on the sheet.

- Analyze your data and answer the remaining questions (starting with question umber 4) on the Activity Sheet .
- Present you findings to the class and compare your data with that of other students.

Questions:

1. Do you think that crystals will grow in all of your dishes? Why or why not?

2. Which dishes do think will grow the largest crystals? Why? Which do think will grow the most crystals? Why?

3. How do you think the temperatures of the dishes will affect the growth of the crystals?

Complete this table at the time you first put your dishes in their places (oven, refrigerator, room air). Use your hand lens and flashlight and describe what you see in the dishes in the empty squares in Table 1 below. Write down things such as if the objects in the dishes are visible, the color of the solution, if the light shines through the solution, etc. Be sure to write the temperature down at the spaces in this table.

Table 1 – Initial Observations

OBJECTS PLACED IN DISHES	DISHES IN OVEN TEMPERATURE_____ OBSERVATIONS	DISHES IN REFRIGERATOR TEMPERATURE_____ OBSERVATIONS	DISHES IN ROOM AIR TEMPERATURE_____ OBSERVATIONS
Rock			
Bead			
Single Small Crystal (seed crystal)			
No Object			

Complete this table about 4 hours after after filling out the last form. Write down what you see in the dishes in the spaces provided in Table 2. Be sure to write how the dishes may have changed since you viewed them last. Include things such as whether or not crystals are beginning to form and where in the dish they are forming.

Table 2 – Observations After 4 Hours

OBJECTS IN DISHES	DESCRIPTION OF DISHES IN OVEN	DESCRIPTION OF DISHES IN REFRIGERATOR	DESCRIPTION OF DISHES IN ROOM AIR
Rock			
Bead			
Single Small Crystal (seed)			
None			

Complete this table after days two and three. Write down what you see in the dishes and how things may have changed.

Table 3 – Observations on Days Two & Three

	DISHES WITH ROCK OBSERVATIONS	DISHES WITH BEAD OBSERVATIONS	DISHES WITH SMALL CRYSTAL OBSERVATIONS	DISHES WITH NO OBJECT OBSERVATIONS
Day 2 Dishes in Oven				
Day 2 Dishes in Refrigerator				
Day 2 Dishes in Room Air				
Day 3 Dishes in Oven				
Day 3 Dishes in Refrigerator				
Day 3 Dishes in Room Air				

Questions (continued):

4. Which of your dishes actually grew crystals?

5. Compare the information on Tables 1-3. Did temperature affect crystal growth? How?

6. Examine your crystals with a stereomicroscope or a hand lens. How would you describe the shape of your crystals? How many sides does each crystal have?

7. Did the crystals grow best on the rock, the bead, the small crystal or with nothing in the solution? Why do you think this is true?

8. Are all your crystals the same color? What color(s) are they?

9. Which dish produced the largest crystals? Which produced the smallest size crystals? Why do you think this happened?

10. Draw one of your crystals in the box below.

GROWING A

ACTIVITY SHEET TWO

CRYSTAL GARDEN

Some Pictures of Crystals Grown by Students. With practice and guidance from your teacher, you too can grow crystals such as the ones in these pictures.