How Does Your Garden Grow? Investigating the "Magic Salt Crystal Garden"

Have you ever seen or grown a “Magic Salt Crystal Garden”? In this easy and popular activity table salt is mixed with water, ammonia, and laundry bluing. The resulting solution is poured over a porous solid that sits in a bowl. Food color is added. As if by magic, a beautiful “garden” of flowerlike crystals appears on the solid. In this Activity you will grow crystals and try to figure out how the garden crystals are different from ordinary salt crystals. You should also be able to figure out what each component of the solution contributes to the process.

Try This

You will need table salt, magnifying glass, white coffee filters, ruler, scissors, 5 small paper clips, 7 plastic or paper 8–10-oz. cups (if taller than 7 cm, trim to a height of 5–7 cm), water, measuring spoons or small graduated cylinders, household ammonia solution, laundry bluing, stirring rod or spoon, paper towels, and forceps. Water-soluble marker(s) are optional.

1. Sprinkle a few crystals (grains) of table salt on a clean surface. Examine them with a magnifying glass. Describe the crystals. How are they alike or different?
2. From a coffee filter, cut a pie-shaped wedge, 8–10 cm long and 12 cm at the wide end (1/4 of a 4-cup filter). Roll the wedge into a cone so that at the base the edges overlap by no more than 0.5 cm. Fasten the bottom edges with a small paper clip. The cone does not have to stay closed at the top, but it should stand upright when placed in one of the cups (pointed end up) and should not touch the walls. (If necessary, unroll the cone and cut off some paper to make it fit inside the cup.) Repeat to make a total of six paper cones. Optional: Use a water-soluble marker to draw a line around the circumference of five of the cones about 2 cm from the base, using different colors for segments of each line, if you wish.
3. Remove cones from cups and set them aside. Pour water into one of the empty cups until it is about 1–1.5 cm deep. Measure and record the volume of water in the cup by pouring it into a graduated cylinder or measuring spoon(s), then discard the water. Dry the cup with a paper towel.
4. Number the cups 1–7. In cups 1–5 and 7, mix approximately the volume of solution recorded in step 3 with the composition (by volume) listed below. Leave cup 6 empty. You may assume the volumes are additive. (For example, if the volume in step 3 was 6 teaspoons (t.), use 2 t. of salt and 4 t. of water in cup 1.) Stir each solution well. The salt may not dissolve completely. Observe and describe each solution.
   - Cup 1. 1 part salt, 2 parts water
   - Cup 2. 1 part salt, 2 parts water, 1 part household ammonia solution
   - Cup 3 and 7. 1 part salt, 2 parts water, 1 part laundry bluing
   - Cup 4. 1 part salt, 2 parts water, 1 part household ammonia solution, 1 part laundry bluing
   - Cup 5. 2 parts water, 1 part household ammonia solution, 1 part laundry bluing
5. Find a well-ventilated shelf, window sill, table top, or other stable surface, where the cups can be left for a few days without being disturbed. Cover the surface with paper towels to protect it from solutions or crystals that may climb out of the cups. Place cups 1–5 on the surface. Carefully place one of the marked paper cones in each cup, pointed end up, so that the cone stands on the bottom of the cup without touching the walls. What happens?
6. Stand the remaining unmarked cone in empty cup 6. Very slowly and carefully, pour the contents of cup 7 over the cone in cup 6. Wet the entire surface of the cone. If the cone falls over, use forceps to return it to an upright position. Carefully place cup 6 on the paper towels with cups 1–5. Cup 7 may be reused or placed in the trash.
7. Without moving the cups, make observations about 15 minutes later. Has there been any change? Record observations hourly for the rest of the day (or for as long as possible). Check the cones the following day, and daily thereafter until crystals form on some or all of them.
8. Use a magnifying glass to examine the crystals deposited on the cones. Compare these with the salt crystals in step 1. If time permits, leave the cups undisturbed for 2–3 days and continue to observe them daily. When your observations are complete, use forceps (not bare hands!) to remove the paper cones from the cups. Any remaining solutions can be poured down the sink. If you like, you can stand the cones upright on labeled paper towels to dry, and keep them for display. Otherwise, cups, cones, and crystals are safe to place in the trash.

Questions

1. Based on your observations, what do you think is the purpose of each ingredient in the salt crystal garden solution? Comment on the suggestion in some crystal garden “recipes” that use of ammonia is optional.
2. Chemically, what is laundry bluing? How is it used in laundering clothing? Does it have any other household uses?

Information from the World Wide Web (accessed March 2000)
Welcome to Bradley Products/Mrs. Stewart’s Bluing. http://www.mrstewart.com/

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