CHEMISTRY

The Crystal Tree

The Crystal Tree

NGSS

2-PS1-4; MS-PS1-2; MS-PS1-6

Objective

The student will understand the role of capillary action on water uptake in plants and trees in addition to how concepts like evaporation and saturation can affect solutions.

The student will be able to develop a crystallized cardboard structure, (a tree, in this case). Students will also be able to provide an explanation for why salt remains on the skin after sweating (recrystallization), similar to the crystallization process they will observe with the cardboard structure.

Vocabulary

Capillary Action: The tendency of a liquid to rise into narrow tubes or spaces.

Saturation: The point at which a solution of a substance can dissolve no more of that substance and additional amounts of the substance will appear as a separate phase.

Evaporation: The changing of a liquid to its gaseous state.

Re-crystallization: An important technique to purify solids.

Background

The solution mixed in the bowl at the beginning of this experiment is supersaturated with bluing and salt. When the cardboard tree is placed into the supersaturated solution, the liquid begins moving up the cutouts as a result of capillary action. This continues to occur until the cardboard is saturated with liquid solution. Over time, the water and ammonia in the solution will evaporate and only the bluing and salt will remain, visible as a crystalline precipitate...or the “crystals” you see on your tree or other cardboard cut-out.

Materials

For trees:

(Per student)

- Sturdy cardstock/thin cardboard or cereal box (enough to trace two trees approximately 6x4cm)
- Tree pattern (copy Figure 1)
- Scissors
- Food coloring
- Plastic bowl

For the Crystallization:

(Per student)

- Polystyrene bowl
- Plastic spoon
- Tablespoon (to measure)
- 1 tbsp. salt
- 1 tbsp. laundry bluing
- 1/2 tbsp. Ammonia

Procedure

1. Introduce the concepts of capillary action, solutions, saturation and super-saturation, and re-crystallization. Bring along a completed tree to pique students' interest.
2. Have each student trace two trees onto the cardboard then cut along the black lines shown in Figure 1, forming a slot at the top half of one tree and the bottom half of the other. ***Students can make any design they want with the cardboard, it does not have to be a tree for the exercise!***

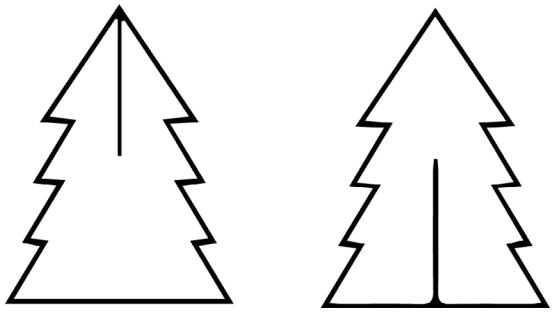

Figure 1. Tree pattern.

3. Slide the two slots together; creating a three-dimensional structure that can stand on its own.
4. Add drops of food coloring to the edges of the cardboard - these will color the crystals later.
5. Distribute a bowl to each student, and have them mix the following with a spoon:
    a. 1 tbsp. water
    b. 1 tbsp. bluing
    c. 1 tbsp. salt
    d. ½ tbsp. ammonia
6. Stand the cardboard tree in the middle of the bowl. Explain to the students that crystals will develop over the next 10-12 hours. Reshow the pre-constructed example tree and review the concepts of saturation, super saturation, and evaporation. This is also a great place to explain capillary action to students, expressing that the rise in fluid from root to tip up the tree will extend the color and salts out the upper edges of the tree, forming crystals. This is similar to the process of trees moving water from their roots through an inner tube, called the xylem, to their outer leaves.

Tips for Home:

- Advise students to keep their projects in a warm place to keep the crystals growing at a fast rate. This should take half a day to complete, so remind students that they will have to wait for the finished product.
- Increased air circulation will allow for increased evaporation and faster crystal growth.

Guiding Questions

- Why do you think it would be important for scientists to recrystallize certain solids?
- How could saturation play a role in making kool-aid?
- What ways is capillary action observed in our every day lives (e.g. paper towel and water touching one end of it)?

Career/Future Application

Crystallization is a major topic in chemistry. Students who really enjoy the process of creating and precipitating a solution may consider a related career using chemistry. Chemists are an an important part of diverse fields, such as food processing and

development, pharmaceutical development, materials manufacturing, energy science, and environmental ecology.

Sources

http://youngzeus.blogspot.com/2010/03/grow.html

https://www.phase-trans.msm.cam.ac.uk/2002/crystal/a.html

https://www.mt.com/us/en/home/applications/L1_AutoChem_Applications/L2_Crystallization.html