Growing Copper Crystals

Materials and Equipment:

- Preform and cap – one per student
- Preform racks – one per every 6 students or another holder for the preforms (test tubes)
- Copper II sulfate pentahydrate – medium crystals
- Non-iodized salt – one box – poured into several small containers (ex. plastic cups)
- Bright nails – 2" to 3" in length – two per student
- Steel wool – used to clean the nails
- Cotton pads (make-up removal pads), cotton balls, or coffee filters
- Plastic pitchers of water

Safety:

- Students should wear safety glasses when measuring and pouring chemicals.
- Copper sulfate is harmful if swallowed – if swallowed, provide water and call a physician.
- In case of contact with copper sulfate, rinse the skin with water.
- No food or drink should be allowed during this activity.

Teacher Notes/Background/Suggestions/Helpful Hints:

- Each student will set-up their own test tube but can share test tube racks.
- Cotton pads (makeup removal pads), cotton balls or coffee filters (filter paper) can be used to make the barrier layers.
- Cotton pads seem to work the best. Presoak them in water and cut with scissors to fit the preform.

- If using cotton balls, pull small pieces from a larger cotton ball. A separation between layers is needed but it should be a thin barrier layer.
- If using filter paper, cut disks the size of the interior diameter of the preform. The instructor may want to make these ahead of time as the students generally have difficulty making them. Or at least have some on hand for the students that are having trouble if they do it themselves.
- Set out labeled cups or beakers of copper sulfate and salt for the students to share in small groups.
- Students enjoy taking pictures each day if there is a means available.
- A hand lens or magnifier is useful for making observations during the activity.
- A single replacement reaction occurs in the preform. Iron (nail) is more reactive than copper so it will replace it in the solution forming pure copper crystals.
- $CuSO_4 + Fe \longrightarrow Cu + FeSO_4$
- The lab mimics the formation of pure mineral copper deposits in Earth's crust.
- Air pockets sometimes form in the test tube. Inserting and then removing a thin copper wire down the inside of the test tube will often release the trapped air.

Methodology Overview:

Students work individually to set up a single replacement reaction in a plastic test tube (preform). Observations are made daily and the students may take the copper crystals or entire set-up home

on Friday. The concepts of chemical reactions, elements and compounds and the relative reactivity of metals may be discussed as the reaction progresses.

Procedure:

1. Pour approximately 2 to 3 cm (about 1 inch) of copper sulfate crystals into a preform (test tube). Students can use a small spoon or spatula and a funnel can help prevent spills.
2. Add enough water to cover the copper sulfate.
3. Place a small piece of water-soaked cotton pad on top of the copper sulfate. A pencil or stirring rod can be used to push it into place.
4. Place approximately 1 to 2 cm (about ½ inch) of salt (sodium chloride) into the preform (test tube).
5. Cover the salt layer with water. Pour slowly and gently to avoid stirring or mixing the layers.
6. Add another small piece of wet cotton pad as a barrier layer.
7. Place two or three nails on top of the second barrier. Clean the iron nails with steel wool first.
8. Add water to cover the nails.
9. Place the cap on the preform. Write student initials on the cap or preform with a permanent marker.
10. Place the racks with the preforms in an area where they will not be disturbed.
11. Make observations every day. Make labeled drawings or take pictures.
12. On the final day students may take their preforms home.
13. If the students want to take the copper that formed out of the preform they may do so.
    a. Slowly pour the contents of the preform into a plastic cup or beaker.
    b. Carefully separate the copper from the other solids using a spoon or some type of probe.
    c. Remove the copper from the cup using a spoon. Gently rinse the copper with water using an eyedropper or disposable pipette.
    d. Place the copper on a paper towel to dry.