Making Copper

Student Worksheet

Name_____

Overview: Although you don't get to turn lead into gold today, you do get to transform carbon into copper. Not bad for a day's work in the chemistry lab!

What to Learn: You should know that element 29, a metal called copper, conducts electricity well and can be used in experiments in electrochemistry.

Materials

- Carbon rod (MSDS)
- Copper sulfate ($CuSo_4$) (MSDS)
- Aluminum foil (MSDS)
- 9V battery with clip
- 2 wires, stripped at both ends
- Disposable cup
- Water
- Steel wool or iron filings (MSDS)

Lab Time

1. On a clean cup, fold a small piece of aluminum foil over one edge.
2. Using a piece of wire, connect the carbon rod to the negative side of the battery terminal. Wrap the wire around the carbon rod a few times to ensure it is firm.
3. Place the carbon rod on the other side from the aluminum foil, making sure the two do not come into contact.
4. Stretch out the second wire and connect it to the positive side of the terminal, then carefully fold it up and over the aluminum foil.
5. Fill the cup with water, making sure there is plenty of aluminum foil touching the water (at this point you may notice bubbles from the hydrogen and oxygen decomposing).
6. You will make a saturated solution of copper sulfate ($CuSO_4$) (**NOTE: copper sulfate is damaging to the environment. See proper disposal method below). Pour a measuring spoon of granulated copper sulfate in the water. Stir well. Continue adding a spoonful and stirring until no more crystals will go into solution. The solution is saturated when no more crystals will dissolve and there are undissolved crystals at the bottom of the cup. Cap the copper sulfate container and put it aside.
7. Observe! Look for copper, which will move toward the negative pole. If you are not sure which pole is negative, use litmus paper to press against each pole. The litmus paper will turn blue when in contact with a negative pole. Periodically pull up the carbon rod and observe. Look for gas bubbles.
8. When finished, disconnect the battery.

Clean up: Clean everything thoroughly after you are finished with the lab. After cleaning with soap and water, rinse thoroughly. Chemists use the rule of "three" in cleaning glassware and tools. Rinse three times, wash with soap, rinse three times.

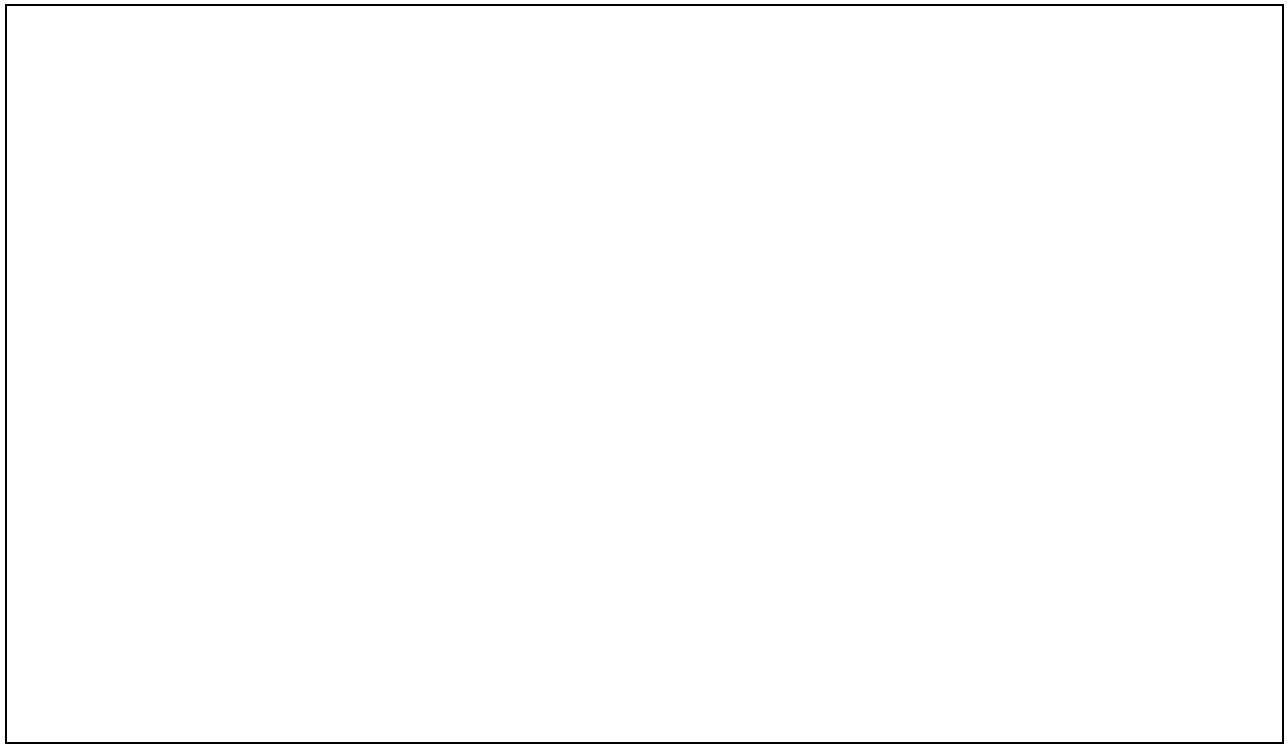
Wipe off the carbon rod to remove the copper. The aluminum goes in the trash, but the solution and solids at the bottom cannot. The liquid contains copper, a toxic heavy metal that needs proper disposal and safety precautions. Another chemical reaction needs to be performed to remove the heavy metal from the copper sulfate. Add a thumb-sized piece of steel wool or small spoonful of iron filings to the solution. The chemical reaction will pull out the copper out of the solution. The liquid can be washed down the drain. The solids cannot be washed down the drain, but they can be put in the trash. Use a little water to rinse the container free of the solids.

Place all chemicals, cleaned tools, and glassware in their respective storage places.

Dispose of all solid waste in the garbage. Liquids can be washed down the drain with running water. Let the water run awhile to ensure that they have been diluted and sent downstream.

Making Copper Data Table

Make a diagram of this experiment. Include the positive and negative terminals of the battery, wires, aluminum foil, carbon rod, copper ions, and oxygen bubbles. Indicate where positive and negative charges occur.



Exercises Answer the questions below:

1. Explain what the following chemical equation means: $CuSO_4 + H_2O \rightarrow Cu^{2+} + SO_4^{2-}$.

2. Where did the positive copper ions go once electricity was introduced into the solution? Why did this occur?

3. The following reaction took place by the aluminum foil: $6H_2O \rightarrow O_2 + 4H_3O^+ + 4e^-$ (water yields oxygen, hydronium, and electrons). What did you observe by this pole? Why did this occur?

4. Why was it necessary to be extra cautious when disposing of the copper sulfate solution?

Exercises

1. Explain what the following chemical equation means: $CuSO_4 + H_2O \rightarrow Cu^{2+} + SO_4^{2-}$. (Copper sulfate plus water yields a positive copper ion and a negative sulfate ion.)
2. Where did the positive copper ions go once electricity was introduced into the solution? Why did this occur? (They went to the carbon rod, because the positive copper ions were attracted to the negative charge of the carbon pole).
3. The following reaction took place by the aluminum foil: $6H_2O \rightarrow O_2 + 4H_3O^+ + 4e^-$ (water yields oxygen, hydronium, and electrons). What did you observe near the aluminum foil? Why did this occur? (The positively charged aluminum attracted electrons from the water molecule to form oxygen bubbles.)
4. Why was it necessary to be extra cautious when disposing of the copper sulfate solution? (Copper is a heavy metal that is damaging to the environment. It has to be pulled out of the solution and put in the trash before it is safe to dump the liquid down the drain.)

Closure: Before moving on, ask your students if they have any recommendations or unanswered questions that they can work out on their own. Brainstorming extension ideas is a great way to add more science studies to your class time.