

Making Chlorine

Student Worksheet

Name _____

Overview: If we don't have salt, we die. It's that simple. The chemical formula for salt is NaCl. Broken down, we have Na (sodium) and Cl (chlorine). Either one of these can be fatal in sufficient quantities. When chemically combined, these two deadly elements become table salt. What once could kill now keeps us alive. Isn't chemistry awesome?

What to Learn: You'll need to know that a sodium chloride, NaCl can split into sodium ions and chlorine ions in a decomposition reaction. The positive sodium ions are called cations, and the negatively charged sodium ions are called anions.

Materials

- 9V battery and clip
- carbon rod ([MSDS](#))
- 2 wires
- disposable cup
- salt, NaCl ([MSDS](#))
- water
- aluminum foil ([MSDS](#))
- litmus paper (optional)([MSDS](#))
- gloves
- goggles

Lab Time

1. Fill a disposable cup with water. Add enough salt to make a saturated solution (to the point where no more salt may be dissolved).
2. Take a piece of aluminum foil and wrap it over one side of the cup. Be sure it has plenty of contact with the salt water.
3. Connect the 9V battery to the battery clip. Connect the black wire from the battery to a regular black wire which has been stripped on its ends. Take the other end of the regular wire and place it up and over the aluminum foil on the cup.
4. Connect the red wire from the battery to a second regular wire which has been stripped at the ends. Take the other end of this regular wire and wrap it a few times around the carbon rod. Place the carbon rod into the salt water on the opposite side from the aluminum foil.
5. Observe! The bubbles forming on the foil are hydrogen bubbles. The bubbles on the carbon rod are chlorine gas. Make sure to open a window and don't breathe this toxic gas. It may start to smell like a swimming pool.
6. If you have litmus paper, use it to find out which pole is positive and which is negative. Hold it against the aluminum strip. If it turns blue, it means a negative pole. Red means positive.

7. Before you dispose of the solution, try this variation on the experiment: Remove the foil and hold a salt water-filled test tube (filled to the top with salt water and capped with a gloved thumb and submerged into the solution). Place the cathode wire into the tube and you'll see bubbles rising up into the tube. What type of gas is it? (Hint: wait until the tube is nearly full before removing it and using a match to test.)

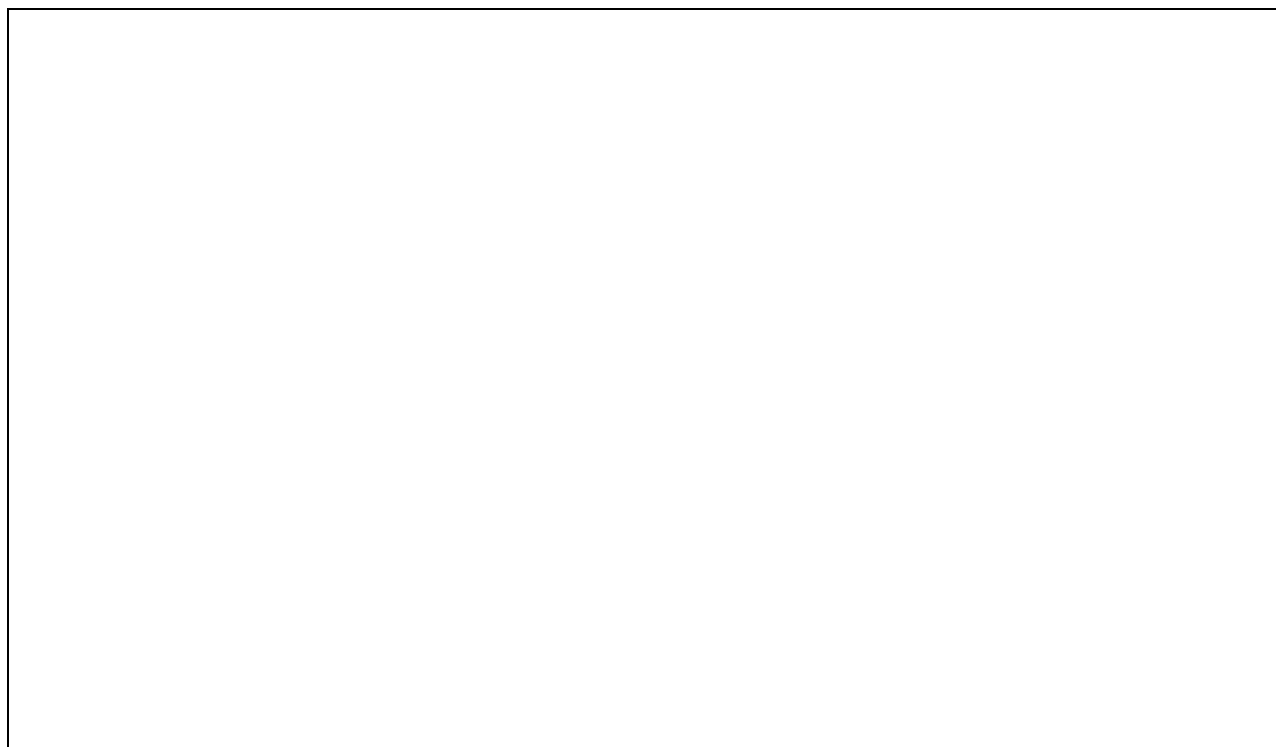
Cleanup: Clean everything thoroughly after you are finished with the lab. After cleaning with soap and water, rinse thoroughly. Chemists use the rule of “three” in cleaning glassware and tools. After washing, chemists rinse out all visible soap and then rinse three times more.

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

Disposal: 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 Chlorine Data Table

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



Exercises Answer the questions below:

1. What reaction did you observe once electricity was introduced into the salt water? What type of reaction was this?
2. How do you know which electrode was positive and which was negative?
3. Explain where the chlorine went from the start of the experiment until the end.
4. What is the difference between an anode and a cathode? Which was which?
5. What is the difference between an anion and a cation? Which was which?

Exercises

1. What reaction did you observe once electricity was introduced into the salt water? What type of reaction was this? ($\text{NaCl} \rightarrow \text{Na}^+ + \text{Cl}^-$. It is a decomposition reaction.)
2. How do you know which electrode was positive and which was negative? (Answers may vary. Students may use litmus paper to test for a negative pole, with paper turning blue when touching a negative pole and red with a positive pole. Or, students may simply follow the wires from the battery to determine which electrode is connected to the positive side of the battery, and which is connected to the negative side.)
3. Explain where the chlorine went from the start of the experiment until the end. (It started attached to sodium, as NaCl. Once an electrical charge was sent through the NaCl solution, the molecule decomposed to Na^+ and Cl^- ions. The negative Cl^- ions were attracted to the positive carbon rod and they combined to form chlorine gas, which bubbles out of the solution).
4. What is the difference between an anode and a cathode? Which was which? (An anode is a negatively charged electrode. A cathode is a positively charged electrode. The anode was the aluminum foil, and the cathode was the carbon rod.)
5. What is the difference between an anion and a cation? Which was which? (An anion is a negatively charged ion, while a cation is a positively charged ion. The chlorine was the anion and the sodium the cation).

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.