

Types of Chemical Reactions

Vanderbilt Student Volunteers for Science
Training Presentation

2018-2019 VINSE/VSVS Rural

Important!!!

- Please use this resource to reinforce your understanding of the lesson! Make sure you have read and understand the entire lesson prior to picking up the kit!
- We recommend that you work through the kit with your team prior to going into the classroom.
- This presentation does not contain the entire lesson – only selected experiments that may be difficult to visualize and/or understand.

Important Terms

- Discuss Physical and Chemical Changes
 - **A physical change** does not change the chemical properties of a substance.
 - No new substance is formed during a physical change.
 - **A chemical change** does change the chemical properties of a substance.
 - One or more new substances are formed in a chemical change.

Tell Students that chemical reactions can be classified into 5 types:

1. Combination
2. Single Replacement
3. Double Replacement
4. Decomposition
5. Combustion

Wear safety goggles for duration of experiment!!!

Single Replacement Reaction

Demonstration

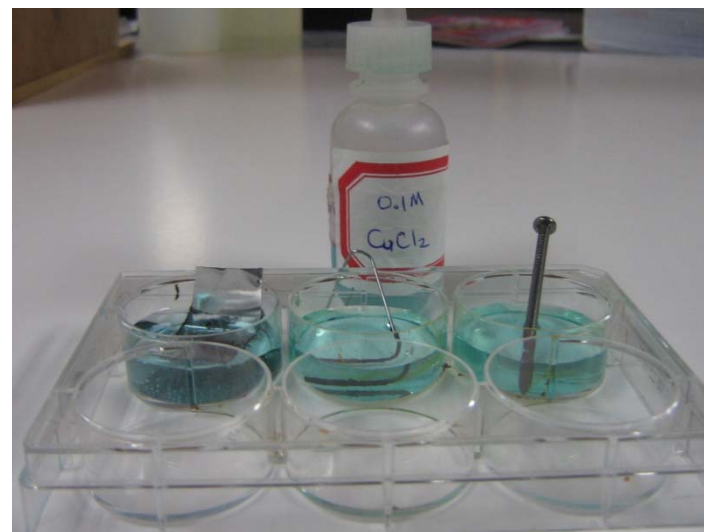
- Show students the jar containing silver nitrate solution.
- Tell the students that the solution contains silver ions and nitrate ions.
- Place the piece of copper wire into the jar.
- Tell the students that you will show them the jar again at the end of the lesson.

Single Replacement Reaction

Experiment

Tell students to use wells 1, 2 and 3:

1. Half fill wells 1, 2 and 3 with copper (II) chloride (blue solution).
2. Place one end of the aluminum strip (Al) into the solution in well 1.
3. Bend a paper clip (zinc coated, Zn) so that 1 wire forms an L-shape and place it into the solution in well 2.
4. Put 1 end of the nail (iron, Fe) into the solution in the 3rd well
5. Observe for 5 minutes.
6. Record results.

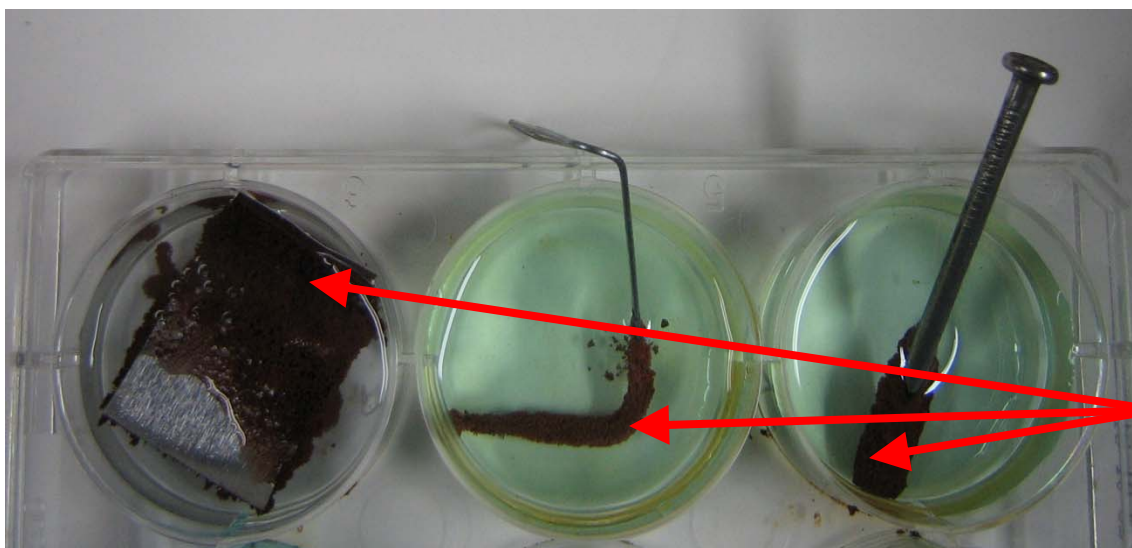


Aluminum, Zinc, and
Iron in Copper chloride

Single Replacement Reaction

Results

- A dark reddish-brown precipitate of copper metal deposits on the metals dipped in the solution.
- The copper color appears almost immediately on the nail. A black coating appears on the paper clip immediately and slowly (5 minutes) turns a copper color.
- The aluminum metal slowly gets a few dots of black coating on it and after 10 minutes has a reddish-brown copper coating.
- Tell students that the green-blue color eventually becomes colorless (after several hours).



Copper
formation on
elemental
metal

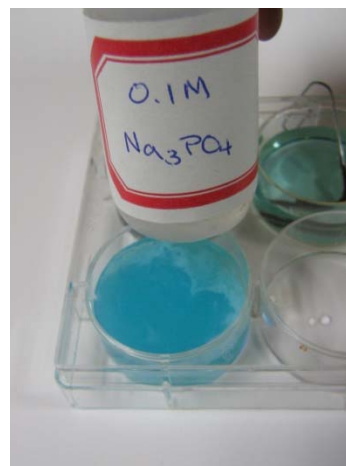
Double Replacement Reaction

Tell students to use well 4:

1. Squirt enough 0.1M copper (II) chloride solution so that the well is about $\frac{1}{4}$ filled.
2. Squirt the clear 0.1M sodium phosphate solution so that the well is now about half filled.
3. Observe the reaction and record the results.

Results

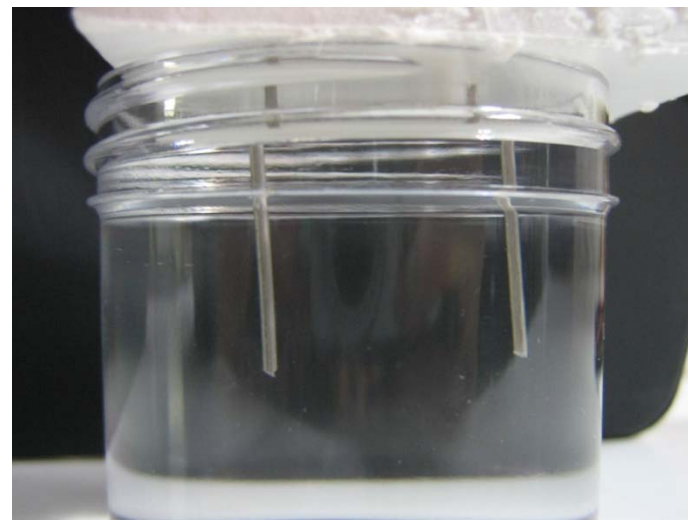
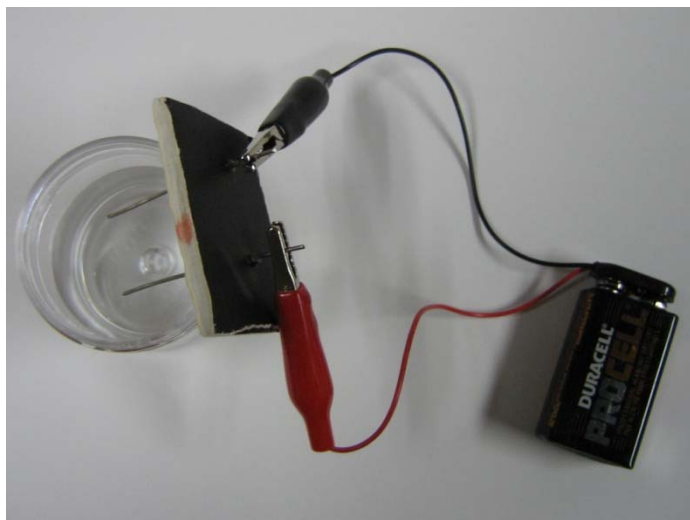
A pale blue precipitate forms (copper phosphate) with a clear solution (sodium chloride).



Copper chloride reacts with sodium phosphate to form precipitate

Decomposition Reaction – Electrolysis of Water (Demo)

1. Connect electrodes to battery. Attach alligator clips to nickel electrodes.
2. Submerge electrodes in distilled water.
Nothing!



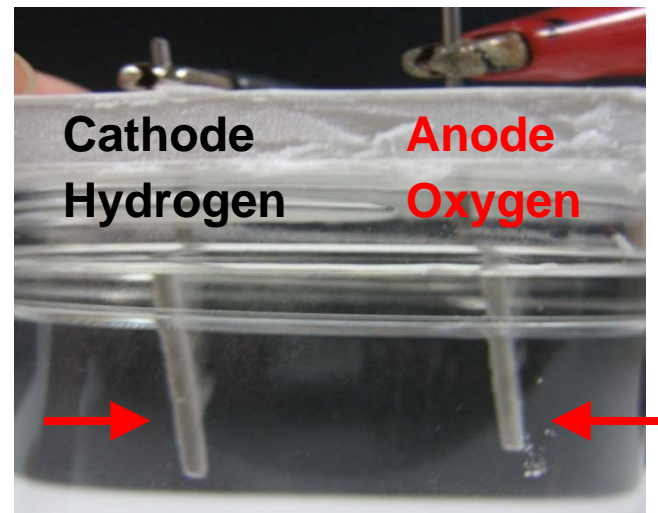
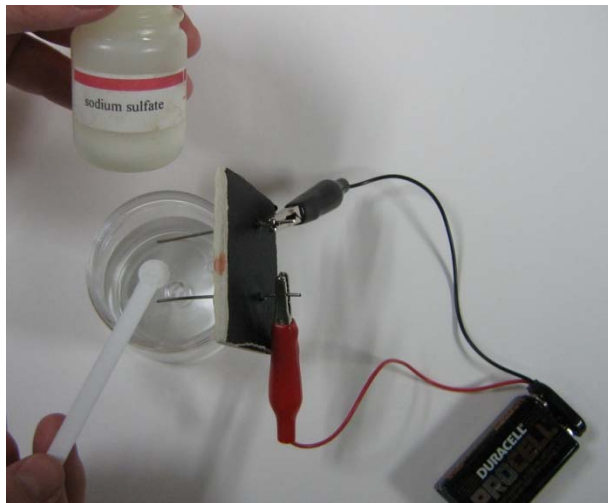
Distilled water can not conduct electricity → No reaction

Decomposition – Electrolysis of Water (Experiment for Students)

1. Add sodium sulfate to distilled water.
2. Submerge electrodes in solution.

Results

- Oxygen gas bubbles at positive electrode (anode) (red wire)
- Hydrogen gas bubbles at negative (cathode) (black wire)



Distilled water + sodium sulfate conducts electricity → Decomposition of water

Universal Indicator

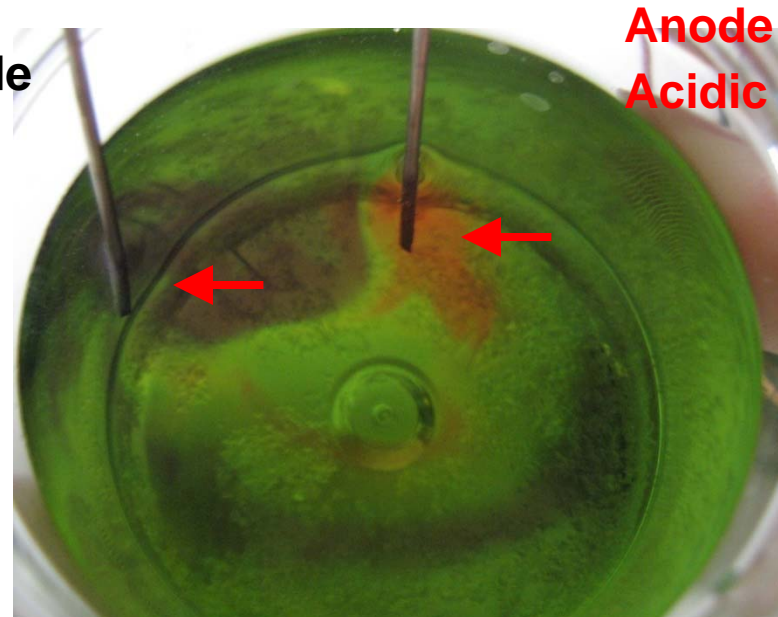
1. VSVS members will add enough drops of Universal Indicator to give a medium green solution. (Observations will not be possible if the solution is too dark, but can also be hard to see if the solution is not dark enough)
2. Replace the electrodes into the jar.
3. A purple color will develop at one electrode (the cathode) and a yellow to orange color will develop at the other (anode).
4. Tell students that the universal indicator is detecting changes in the acidity of the water.

Results

The water starts with a pH of neutral and is green colored. Its pH becomes acidic at the anode where oxygen is given off and hydrogen ions remain. The Universal Indicator turns red in acid. Its pH becomes basic at the cathode where hydrogen is given off and hydroxide ions remain. The Universal Indicator turns purple in basic solutions.



Cathode
Basic



Anode
Acidic

Clean Up

- Pour liquid contents of the well-plates & jars of distilled water into a sink before leaving the school. The used metal (nail, paper clip, aluminum) should be thrown away.
- Place the well-plates & jars back in the smaller plastic box & secure the lid.
- If no sink is available, be sure to secure the lids on the well-plates & jars & place them flat in the smaller plastic box. Make sure the plastic box lid is secure.
- *****The silver nitrate/copper solution may NOT be poured down the sink! Ensure that the vial is sealed and return it with its full contents.**