# Carolina Workshop Resource

## Keep Calm and Chemistry On: Successful Lab Activities for the New Chemistry Teacher

# Carolina Kits 3D™: Mystery Chemical Reactions

**(catalog no. 840660)**

## Materials

Silver Nitrate, 0.1 M
Lead (II) Nitrate, 0.1 M
Potassium Iodide, 0.1 M
Copper (II) Sulfate, 0.1 M
4 Micropipets
Labels
Known Reaction Grid
Reaction Mat
Plastic Cup
Distilled or Deionized Water
Absorbent Paper Towel

## Objectives

- **Kit:** Perform 45 different microscale reactions and identify 8 unknown chemicals based on their reaction characteristics.
- **Workshop:** Perform 6 different microscale reactions and make observations of those reactions.

## Procedure

1. Label the 4 micropipets with the labels for $AgNO_3$, $Pb(NO_3)_2$, KI, and $CuSO_4$.
2. Place all 4 micropipets in the plastic cup and take them to the central materials station.
3. At the central materials station, fill each pipet (one at a time) with the chemical solution indicated on its label. Return each filled pipet to the plastic cup. Return to your work station.
4. On the known reaction grid, circle the names of the 4 chemicals used in this workshop—silver nitrate, copper (II) sulfate, potassium iodide, and lead (II) nitrate—on the top and side axes.
   a. Place the reaction mat transparency on top of the known reaction grid, so that the boxes line up.
5. Without touching the reaction mat with the pipet, place 1 drop of copper (II) sulfate in the middle of the reaction square that corresponds to its intersection with silver nitrate. Then, *without letting the pipet tip touch the drop of chemical you have already placed in the block*, add 1 drop of silver nitrate to that reaction square. Record your observations in the data table.
   a. React the remaining chemicals with each other in the columns and rows of reaction squares as the chemicals are listed. There will be a bit of jumping around on the reaction mat due to the pared-down nature of this workshop activity. Record your observations in the data table at right after each reaction.

### Data Table

| | sodium phosphate | iron (III) chloride | copper (II) sulfate | potassium iodide | lead (II) nitrate | sodium carbonate | silver nitrate | calcium chloride | sodium hydroxide |
|---|---|---|---|---|---|---|---|---|---|
| hydrochloric acid | | | | | | | | | |
| sodium hydroxide | | | | | | | | | |
| calcium chloride | | | | | | | | | |
| silver nitrate | | | | | | | | | |
| sodium carbonate | | | | | | | | | |
| lead (II) nitrate | | | | | | | | | |
| potassium iodide | | | | | | | | | |
| copper (II) sulfate | | | | | | | | | |
| iron (III) chloride | | | | | | | | | |

x = no visible reaction
ppt = precipitate
c = color change





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6. If you accidentally place a chemical in the wrong reaction square, use the corner of an absorbent paper towel to remove it.
7. After you have reacted all of the chemical pairs on the grid and recorded your data, lay a piece of absorbent paper towel flat across the entire reaction mat, and allow it to absorb all the chemicals. Discard the paper towel. Use an additional paper towel dampened with distilled or deionized water to clean the reaction mat.

## About the kit

Mystery Chemical Reactions presents students with the opportunity to first react, in pairs, 10 known compounds in solution. Students monitor the mixtures for signs of a chemical reaction and record their observations. Next, they use what they learned during that activity to determine the identity of 8 unknown chemicals. The kit is designed for a class of 30 students working in groups of 3.

840660 Mystery Chemical Reactions Kit

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# Carolina Kits 3D™: Balancing Chemical Equations

(catalog no. 840656)

## Objective

- Use models to help balance chemical equations and understand the law of conservation of mass. Minimize students' misconceptions about balancing equations by helping them to visualize the number of atoms participating in each side of a chemical reaction.

## Materials

Balancing Chemical Equations Kit (840656)
Dry-Erase Markers

## Procedure

1. Choose approximately 10 cubes each of 5 different colors and place them on your Balancing Equations Mat. Group the cubes by color. These cubes will represent different atoms; 1 color = 1 atom.
2. With a dry-erase marker, write the 5 cube colors in the "Color" column of the Tally Table on your mat.
3. Write the reactants and products of the equation from the equation list on the top of the Balancing Equations Mat.
4. Assign a different color to each atom in the equation. In the "Symbol" column of the Tally Table, write the symbol for the atom beside the assigned color from your groups of cubes.
5. Assemble the molecules according to the formulas based on the colors you assigned. **Note:** *The shape and arrangement of the molecules do not matter for this activity.*
6. Place the completed molecule into its box on the Balancing Equations Mat.
7. Count the number of each atom of each color on both sides of the arrow. In the Tally Table, record the number of atoms of each color on the left side and the right side of the equations.
8. If the number of atoms (cubes) of each color on each side of the equation is the same, then the equation is balanced. Skip to step 10.
9. If the number of atoms of each element is not the same on both sides, make additional molecules and add them to the appropriate box. Adjust your tally numbers to reflect the new number of atoms. Continue this process until the number of atoms on each side is the same.
10. Once the equation is balanced, write the total number of molecules in each box on the line above the box labeled "Coefficient."

**Balance the following equations using the mat and cubes:**

$\_\_\_\_\ Ca(OH)_2 + \_\_\_\_\ HCl \rightarrow \_\_\_\_\ CaCl_2 + \_\_\_\_\ H_2O$

$\_\_\_\_\ Na_2CO_3 + \_\_\_\_\ CaCl_2 \rightarrow \_\_\_\_\ CaCO_3 + \_\_\_\_\ NaCl$

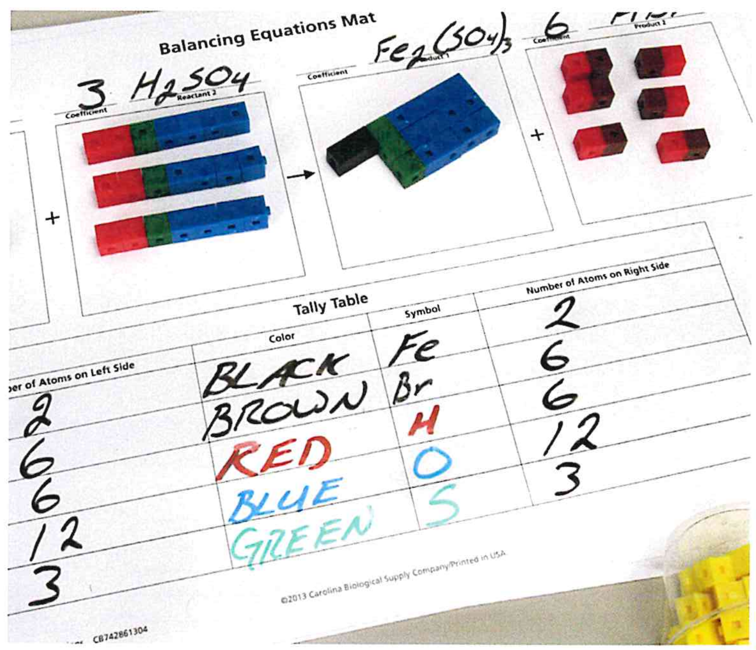
$\_\_\_\_\ CH_4 + \_\_\_\_\ O_2 \rightarrow \_\_\_\_\ CO_2 + \_\_\_\_\ H_2O$

$\_\_\_\_\ Mg + \_\_\_\_\ HCl \rightarrow \_\_\_\_\ MgCl_2 + \_\_\_\_\ H_2$

$\_\_\_\_\ HCl + \_\_\_\_\ NaOH \rightarrow \_\_\_\_\ NaCl + \_\_\_\_\ H_2O$

$\_\_\_\_\ Mg + \_\_\_\_\ Mn_2O_3 \rightarrow \_\_\_\_\ MgO + \_\_\_\_\ Mn$


## About the kit




Introduce and reinforce balancing chemical equations with this model-based kit. Students use colorful manipulatives and a unique Balancing Equations Mat to understand the law of conservation of mass and to visualize the number of atoms participating in each side of a chemical reaction. This activity also helps students understand the difference between coefficients and subscripts in chemical equations. Kit contains enough materials for 10 groups, pairs, or students working individually. Dry-erase markers and erasers are needed but not supplied.

If your students are ready to balance more challenging chemical equations, add the Carolina ChemKits®: Balancing Chemical Equations Expansion Pack (840675). It contains additional cubes for 10 teams (extra Balancing Equations Mats not included).

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# Carolina Kits 3D™: Petri Dish Electrolysis

**(catalog no. 840830)**

## Materials

Plastic Petri Dish
2 Connector Cords (with insulated alligator clips on both ends)
Pencil Lead
Graduated Cylinder, 25 mL
Spatula
Distilled or Deionized Water
Stirring Rod
Sheet of White Paper
Bogen Universal Indicator Solution (with pipet)
Sodium Sulfate
9-V Battery

## Objective

- To explore electrolysis and redox reactions

## Procedure

1. Place a piece of white paper under the petri dish. This will make it easier to see any color changes.
2. Fill the petri dish 3/4 full with distilled or DI water.
3. Place 20 drops of Bogen universal indicator in the graduated cylinder.
4. Use the spatula to sprinkle a pea-sized amount of sodium sulfate in the petri dish.
5. Mix with a stirring rod until the sodium sulfate is dissolved. Add additional Bogen indicator as necessary to bring the solution to a medium intensity color.
6. Break a piece of pencil lead into 2 equally sized pieces.
7. Clamp one end of the red connector cord to the 9-V battery's positive terminal. Clamp one end of the black connector cord to the 9-V battery's negative terminal. Carefully clamp one piece of the pencil lead to the other end of the red connector cord. Carefully clamp the other piece of the pencil lead to the other end of the black connector cord. The pencil leads serve as electrodes.
8. Predict what you think will happen when you put the pencil lead electrodes in the solution. Record your predictions above the data table.
9. Put the electrodes in the petri dish solution, keeping them as far apart as possible.
10. Record observations for two minutes (on back).
11. Keep the electrodes in the solution for approximately 1 minute, allowing the electric current to run. Observe any changes that occur. Record your observations in the data table.
12. Remove the electrodes from the solution. Rinse them with distilled water and carefully pat them dry with a paper towel.

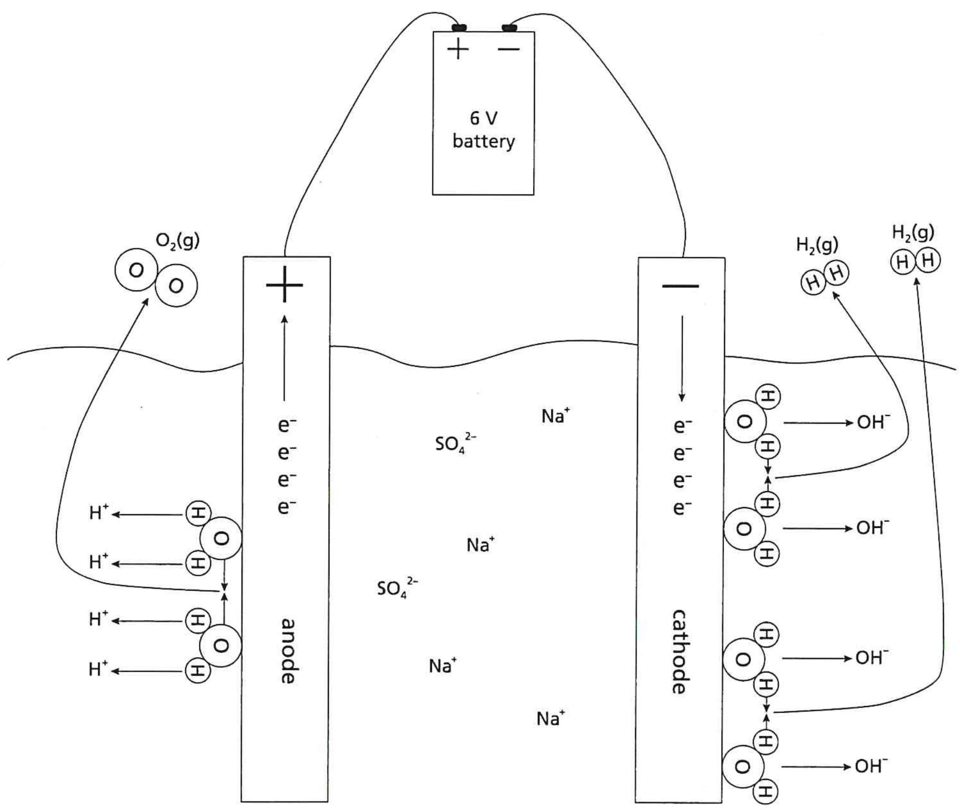
Predictions:

### Data Table

| Distilled Water and Sodium Sulfate | |
|---|---|
| Anode | Cathode |
| | |

Observations:

## Example Particle Level Explanation Diagram




**Anode**
$O_2$ gas produced
$H^+$ ions produced
Indicator turns pink (acidic)

**Cathode**
$H_2$ gas produced
$OH^-$ ions produced
Indicator turns purple (basic)

Carolina Workshop Resource

## Keep Calm and Chemistry On: Successful Lab Activities for the New Chemistry Teacher

# Carolina Kits 3D™: Kinetics of Elephant Toothpaste

**(catalog no. 840315)**

## Objective

- To demonstrate the use of a catalyst in the decomposition of hydrogen peroxide

## Prediction

On the basis of what you already know, describe and/or illustrate what you expect will happen during this demonstration.

## Procedure

1. Put on gloves and safety goggles.
2. Crush any lumps of potassium iodide (KI) into fine crystals with a spatula, and then weigh 1.5 g of it onto a weighing boat or filter paper.
3. Lay a large plastic garbage bag flat on a desk, table, or lab bench to protect the demonstration area. A large tray can also be used for this purpose.
4. Place the plastic bottle or large graduated cylinder in the middle of the demo area.
5. Measure 15 mL of 30% hydrogen peroxide into the bottle or cylinder.
6. Add 25 drops of dishwashing liquid to the hydrogen peroxide in the bottle or cylinder.
7. Swirl the bottle or cylinder to mix the liquid soap and peroxide.
8. **Optional:** Hold the bottle or cylinder at a 45° angle and add a few drops of red food coloring to it so that the coloring runs down the inside. Repeat with blue food coloring on the opposite side.
9. Quickly add the KI crystals to the bottle or cylinder and observe the oxygen gas as it forms bubbles in the soap, creating a plume of foam that is quickly expelled.
10. Test the foam for oxygen gas by igniting a wooden splint with a match and blowing out the flame, leaving a glowing ember. Quickly insert it into the foam at the bottle's mouth or cylinder's top. The glowing splint will burst back into flame. Blow it out and repeat again. You should be able to do this multiple times, showing that oxygen gas is being produced.

## Materials

Wooden Splints
Matches
Dishwashing Liquid
Hydrogen Peroxide, 30%
Potassium Iodide
Graduated Cylinder, 100 mL
Spatula
Safety Goggles
Gloves
Large Garbage Bag or Large Tray
Plastic Bottle or Large Graduated Cylinder (250 mL to 500 mL)
Red and Blue Food Coloring (optional)

## Particle level explanation

Use words and illustrations to explain what happened at a molecular level for the reaction that you observed. (Use back of paper if necessary.)

## Particle level explanation (continued)

## Big picture questions

1. This demo was done at room temperature. Describe the reaction if the catalyst was added to the soap and hydrogen peroxide in an ice water bath at 5° C and in a hot water bath at 55° C.

2. Draw a fully labeled energy diagram for the decomposition of hydrogen peroxide showing uncatalyzed and catalyzed reactions. Include the reactants; products; the energy of activation levels, $E_a$, for both reactions; and the overall change of energy, labeled $\Delta E_{rxn}$.

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# Carolina Kits 3D™: Beaker Freezer Kit

**(catalog no. 840378)**

## Objective

- Observe an extreme endothermic chemical reaction

## Activity

Extreme endothermic reaction (frozen beaker demonstration)

## Demonstration procedure

***Note: This demo will be performed by your presenter. Use the instructions below to do this demo in your classroom.***

1. Put on gloves and safety goggles.
2. Measure 32.0 g of barium hydroxide octahydrate into a 150-mL beaker.
3. Measure 11.0 g of ammonium chloride in a weigh boat.
4. To a wooden block, add water from a wash bottle to form a quarter-sized puddle (about 2.5 cm diameter) in the center of the block.
5. Add the 11.0 g of ammonium chloride to the barium hydroxide octahydrate in the 150-mL beaker.
6. Place the beaker in the center of the water on the block.
7. Holding the beaker steady with 1 hand, use your other hand to stir the 2 solids with a stirring rod.
8. The solids will become moist with the emission of ammonia gas. You may want to use a fume hood to exhaust the ammonia fumes.
9. In a few minutes, the water beneath the beaker will be frozen solid between the wood and beaker. The temperature in the beaker will be around –30° C.
10. Grasp the beaker and lift it. The bottom will be frozen so tightly to the block that the beaker will support the weight of the block as you lift the beaker.

## Materials

| | |
|---|---|
| Barium Hydroxide Octahydrate | Water |
| Ammonium Chloride | Weigh Boat |
| Beaker, 150 mL | Balance |
| Wooden Block | Safety Goggles |
| Stir Rod | Temperature-Resistant Gloves |
| Spatulas | Fume Hood (optional) |
| Wash Bottle | |