Lab: Chemical Reactions & Equations

FOR THE TEACHER

Summary
In this lab, students will observe a series of reactions, make observations, and then write balanced chemical equations to chemically describe what they observed.

Resource Type Lab
Grade Level Middle or high school

Objectives
By the end of this lesson, students should be able to
- recognize when a chemical change takes place.
- balance chemical equations.

Chemistry Topics
This lesson supports students' understanding of
- Balancing equations
- Chemical changes
- Observations

Time
Teacher Preparation: 45 minutes
Lesson: 90 minutes

Materials
- Hydrogen gas
- Ethanol
- Manganese dioxide
- Sodium
- Sodium hydrogen carbonate
- Water
- Copper(II) sulfate pentahydrate
- Copper metal
- Magnesium metal
- Zinc metal
- Steel wool
- Tongs
- Test tubes
- Spot plates
- Test tube racks
- Bunsen burners
- Pipets
- Wooden splints
- Test tube holders
- ~1.0-M solutions of...
  - Lead(II) nitrate
  - Potassium iodide
  - Hydrogen peroxide
  - Sodium carbonate
  - Copper(II) chloride
  - Calcium chloride
  - Hydrochloric acid
  - Ethanoic acid
Safety
- Always wear safety goggles when handling chemicals in the lab.
- Keep ethanol away from open flames as it is highly flammable.
- Always use caution around open flames. Keep flames away from flammable substances.
- When working with acids, if any solution gets on students' skin, they should immediately alert you and thoroughly flush their skin with water.
- Students should wash their hands thoroughly before leaving the lab.
- When students complete the lab, instruct them how to clean up their materials and dispose of any chemicals.

Teacher Notes
- This activity works really well!

FOR THE STUDENT
Student Activity Sheet: Chemical Reactions & Equations

Lesson
Purpose
To observe a collection of chemical reactions and write balanced chemical equations.

Procedure
DEMONS
1. Watch your teacher combust hydrogen. Record your observations.
2. Watch your teacher combust ethanol. Record your observations.
3. Watch your teacher add sodium to water. Record your observations.
4. Watch your teacher add lead(II) nitrate to potassium iodide solution. Record your observations.

LABS
1. Decomposition of a compound
   1. Using a pipet, add hydrogen peroxide solution to a test tube so it’s about 1 cm high. Place the test tube in the test tube rack.
   2. Light a wooden splint.
   3. Carefully add a small amount of manganese dioxide powder to the test tube and at the same time blow out the splint so that it is “glowing.” Wait 10 seconds and insert the glowing splint into the mouth of the test tube.
   4. When the reaction is complete, touch the outside of the test tube. Record your observations.

2. Reaction of a metal with an acid
   1. Using a pipet, fill one well of a spot plate with hydrochloric acid.
   2. Collect a small piece of magnesium metal and clean it with the steel wool.
   3. Place the metal in the acid. Record your observations.

3. Oxidation of a metal
   1. Take a small piece of copper metal and clean it with the steel wool.
   2. Using tongs, hold the copper in the flame of the Bunsen burner for about
45 seconds. Record your observations.

4. **Neutralization of an acid with a hydrogen carbonate**
   1. Using a pipet, add ethanoic acid solution to a test tube so it’s about 1 cm high. Place the test tube in the test tube rack.
   2. Light a wooden splint.
   3. Carefully add a small amount of sodium hydrogen carbonate powder to the test tube, wait 10 seconds and then insert the burning splint into to the mouth of the test tube. Record your observations.

5. **Displacement of one metal with another**
   1. Using a pipet, fill one well of a spot plate with the copper(II) chloride solution.
   2. Collect a small piece of zinc metal and place the metal in the solution.
   3. After two minutes, use the pipet to remove the solution from the well by “sucking” it out, but leave the zinc metal in the well. Record your observations.

6. **Precipitation reaction**
   1. Using a pipet, add a few drops of calcium chloride solution to a well on a spot plate.
   2. Add a few drops of sodium carbonate solution. Record your observations.

7. **Dehydration of a hydrated salt**
   1. Add hydrated copper(II) sulfate crystals to a test tube so it’s about 1 cm high.
   2. Using the blue flame of the Bunsen burner, heat the crystals strongly for about 1 minute.
   3. After heating wait another 2 minutes and then add a few drops of water to the test tube. Record your observations.

**Results**
Record your observations in the table below.

<table>
<thead>
<tr>
<th>DEMOS</th>
<th>OBSERVATIONS</th>
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<tbody>
<tr>
<td>1</td>
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<tr>
<td>2</td>
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<tr>
<td>3</td>
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<td>4</td>
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</tbody>
</table>
**Conclusion**

For each reaction, use the description to help you write a balanced chemical equation.

<table>
<thead>
<tr>
<th>DEMOS</th>
<th>DESCRIPTIONS to EQUATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hydrogen gas burns in oxygen gas to produce water</td>
</tr>
<tr>
<td>2</td>
<td>Ethanol (C$_2$H$_5$OH) burns in oxygen to produce carbon dioxide and water</td>
</tr>
<tr>
<td>3</td>
<td>Sodium metal reacts with water to produce sodium hydroxide and hydrogen gas</td>
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<td>4</td>
<td>When solutions of lead(II) nitrate and potassium iodide are mixed they will yield solid lead(II) iodide and a solution of potassium nitrate</td>
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<tr>
<td>1</td>
<td>Hydrogen peroxide solution will decompose to give water and oxygen gas</td>
</tr>
<tr>
<td>2</td>
<td>Magnesium metal reacts with hydrochloric acid to give magnesium chloride and hydrogen gas</td>
</tr>
<tr>
<td>3</td>
<td>Copper metal reacts with oxygen in the air to produce copper(II) oxide</td>
</tr>
<tr>
<td>4</td>
<td>Sodium hydrogen carbonate will react with ethanoic acid to produce sodium ethanoate, carbon dioxide and water</td>
</tr>
<tr>
<td>5</td>
<td>Zinc reacts with copper(II) chloride to give copper metal and a solution of zinc chloride</td>
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<tr>
<td>6</td>
<td>Mixing solutions of calcium chloride and sodium carbonate will lead to the formation of calcium carbonate and sodium chloride</td>
</tr>
<tr>
<td>7</td>
<td>Heating hydrated copper(II) sulfate will produce steam and leave behind anhydrous copper(II) sulfate</td>
</tr>
</tbody>
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