Lab: Finding the Formula of Magnesium Oxide

FOR THE TEACHER

Summary
In this lab, students will recognize that oxygen has mass and that heating can involve and increase in mass as an element reacts to become an oxide. The lab also introduces the idea that the relative mass of elements in a compound is in the same proportion as the atoms in the chemical formula. Read more about this experiment in *Chemistry Solutions*.

Grade Level
High school

Objectives
By the end of this lesson, students should be able to
- determine the chemical formula from collected data.
- recognize they carried out a synthesis reaction.

Chemistry Topics
This lesson supports students’ understanding of
- Chemical formula
- Synthesis reaction
- Law of Definite Proportions

Time
Teacher Preparation: 30 minutes
Lesson: one class period

Materials
- Bottle cap crucibles (2)
- Nichrome wire
- Bunsen burner
- Tongs
- Magnesium ribbon
- Clay triangle
- Ring stand
- Balance
- Ruler
- Pencil

Safety
- Always wear safety goggles when handling chemicals in the lab.
- Always be aware of an open flame. Do not reach over it, tie back hair, and secure lose clothing.
- 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**
• To prepare the alternative crucibles, first heat the steel bottle caps over a Bunsen burner flame to remove the plastic insert. Allow to cool thoroughly before using.
• Extension: Magnesium reacts with nitrogen to form magnesium nitride (Mg$_3$N$_2$), which reacts with water to produce ammonia (changes moist red litmus paper to blue).

<table>
<thead>
<tr>
<th>Add the solid in the bottle caps to a vial. Place damp red litmus paper over its top.</th>
<th>Remove the paper and add boiling water to the vial. Replace the litmus paper.</th>
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</thead>
</table>

• A video of this experiment in its entirety, including the extension, can be viewed [here](#).

**FOR THE STUDENT**

**Student Activity Sheet: Finding the Formula of Magnesium Oxide**

**Lesson**

**Procedure**
1. Find the total mass of two bottle caps and 15 cm of nichrome wire. Record this mass as M$_1$.
2. Roll a 10 to 15 cm length of magnesium ribbon around a pencil and place the ribbon in one of the bottle caps.
3. Find the mass of the two bottle caps + nichrome wire + magnesium ribbon. Record this mass as M$_2$.
4. Set up a Bunsen burner and ring stand on a heat-proof mat. On the ring stand, place a clay triangle small enough to support the bottle cap "parcel."
5. Sandwich the magnesium between the two bottle caps (serrated edges together). Wrap the wire around the bottle caps to keep them together.
6. Place the bottle caps securely on the clay triangle.
7. Heat the bottle caps with a strong, nonluminous flame. When the magnesium ignites, you will be able to see the bright glow. Keep heating for five minutes or until you can no longer see a bright light between the bottle caps.
8. Switch off the Bunsen burner and allow the caps to cool (~ 5 minutes).
9. Find the mass of the bottle cap + nichrome wire + magnesium oxide. Record this mass as M$_3$.

**Data**

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<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>M1</strong></td>
<td>Bottle caps &amp; wire</td>
</tr>
<tr>
<td><strong>M2</strong></td>
<td>Bottle caps, wire &amp; Mg</td>
</tr>
<tr>
<td><strong>M3</strong></td>
<td>Bottle caps, wire &amp; product</td>
</tr>
</tbody>
</table>
Calculations
Calculate the mass of magnesium ribbon you used (M2 - M1)
Work out the mass of magnesium oxide produced (M3 - M1).
Calculate the molecular formula of magnesium oxide.

Use the graph to see the relationship between the mass of magnesium and the mass of magnesium oxide.

The Variation of the Mass of Magnesium Oxide with the Mass of Magnesium
The green line corresponds to the formula Mg₂O. The blue line corresponds to the formula MgO. The red line corresponds to the formula MgO₂.

Conclusion