The Structure of Matter: Atomic Structure

Unit I, Week 1, Day 4: The Power of Atoms

Content Standards

As a means to understanding the concepts:

National B.
- Students develop an understanding of the properties and changes of properties in matter;

California 3.
- Students know the structure of the atom and know it is composed of protons, neutrons, and electrons.

Prerequisites

Knowledge: Basic Atomic Structure
Skills: Metric Measurement

Materials

1. Hydrogen Peroxide – \( \text{H}_2\text{O}_2 \)
2. Potatoes
3. Empty Film Canisters with lids
4. Simple cheese grater
5. Paper Plates
6. Plastic Knives

Schedule

1. Partners: Experiment with an Exploding Element
2. Partners: Create a Lab Safety List.
3. Whole Class: Create Lab Safety Manuel
Exploding Element Lab

“Be careful with water. It contains Oxygen and Hydrogen!”
- Author Unknown

Websites
Information on Oxygen  http://chemlab.pc.maricopa.edu/periodic/O.html
Catalase  http://www.rcsb.org/pdb/molecules/pdb57_1.html

Pre-Reading

Individual Elements can occur by themselves and in combinations with other elements. Let’s look at some when they occur as globs of just their own atoms.

You have heard of the California Gold Rush in history class where miners found nuggets of pure gold just laying in a stream.

Gold is an element with the symbol Au.

Actually, most of the gold was in mixtures of other rock materials and hard to find and hard to extract.

Hydrogen occurs as a gas in stars.

Stars give off light through nuclear fusion, which means that they are burning certain elements.

In fact, Hydrogen is the most common fuel used to make starlight.
Most elements combine with other elements and oxygen does that too. Oxygen also binds to other atoms of oxygen like that found in air – \( \text{O}_2 \). It is a gas in that form.

The little 2 below (subscript) the \( \text{O} \) means there are two atoms of oxygen bonded together.

Hydrogen peroxide (\( \text{H}_2\text{O}_2 \)) is often used to wash cuts. It really is not a very good antibacterial wash but it foams up really well in a scrape and does not sting as bad as alcohol.

The little 2 subscript (below) the \( \text{H} \) means there are 2 atoms of hydrogen bonded to the 2 atoms of oxygen.
Why does it foam? The foam is actually Oxygen gas bubbles escaping as the hydrogen peroxide (\(H_2O_2\)) reacts chemically with a protein that is produced in living things, called Catalase. Catalase is also found in plants like potatoes.

\[
H_2O_2 + \text{Scrapped Knee} \rightarrow \text{Gives off } O_2
\]

\[
H_2O_2 + \text{Potato} \rightarrow \text{Gives off } O_2
\]

Scrapped knees are a bit messy so we will use potatoes in our experiment.

The action of the oxygen escaping from this reaction is what you are going to observe today. Oxygen is highly flammable and explosive. Most of the time it is attached to other elements but when the hydrogen peroxide reacts with Catalase the oxygen given off is fairly pure \(O_2\) gas.

**Materials**

- Hydrogen Peroxide (\(H_2O_2\)) – 20 mls
- Small Potato Pieces
- Empty Film Canister with lid
- Food Grater
- Paper Plates and plastic knives
- Stop Watches
Directions

1. If the potato is not cut up, cut it into about 1-centimeter (cm) cubes.

2. Put a potato cube into a film canister.

3. Pour enough hydrogen peroxide ($\text{H}_2\text{O}_2$) into the canister to cover the potato cube.

4. Quickly put the lid on the canister and stand back.

5. Time the experiment.

6. Record what you observed on the Lab Reflection Sheet.

7. **Note:** All canisters are not created equal. Some have very tight lids and others have very loose lids. Some work better than others. If yours is a dud try another canister. Also the potato must be freshly cut.

8. How much oxygen does it take? Estimate this as more or less for each trial.

9. Try it again and vary either the amount of potato or the amount of hydrogen peroxide. You might like to try grating the potato to create more surface area or cut it up into little bits or squash it.

10. Record the changes on the Lab Reflection Sheet.

11. Record your data. The rest of the Lab Reflection will be done as homework.

12. You can try this several times but just record the initial trial and your best modification.

13. Record what you observed.

14. After you finish clean up your lab area.

The next thing to do is analyze the safety hazards of your experiment in the Creating a Safety Manual Activity: Partners section below.
Lab Reflection Sheets

Date: ____________________

Name (s) ______________________________________________________________

A. Record Your Data

<table>
<thead>
<tr>
<th>Trial Number</th>
<th>Amount H₂O₂</th>
<th>Amount Potato</th>
<th>Condition of Potato</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

C. What Happened? Explain what you observed during the first Trial.

________________________________________________________________________

________________________________________________________________________

D. What Modification did you make to the original trial?

________________________________________________________________________

________________________________________________________________________

Then what happened?

________________________________________________________________________

________________________________________________________________________

E. What other modification could you do?

________________________________________________________________________

________________________________________________________________________

(FROM THIS SECTION TO BE DONE AS HOMEWORK)

F. What problems did you encounter? What kinds of things might cause errors in your data collection or in how you interpret the data?

________________________________________________________________________

________________________________________________________________________

G. What is your interpretation of the data?

________________________________________________________________________
Creating a Safety Manual, Activity: Lab Partners

1. Evaluate the experiment that you did today in terms of safety.

A. Identify the safety issues in the following areas:

   Workspace: ____________________________________________
   Sharps: (knife) ________________________________________
   Glass: ________________________________________________
   People: ________________________________________________
   Chemical Spills: ______________________________________

B. What 3 simple safety rules would you suggest?

   a. _______________________________________________________
   b. _______________________________________________________
   c. _______________________________________________________

C. How would you suggest that the class handle the following situations?

   Fire at a lab station _______________________________________
   Chemical Spill - Acid ______________________________________
   Chemical Spill - Base _____________________________________
   Chemical Spill – Unknown _________________________________
   Injury: Cut ______________________________________________
   Injury: Burn _____________________________________________
   Injury: Chemical _________________________________________
   Injury: Eyes ______________________________________________
   Explosion _______________________________________________
   Broken Glass ____________________________________________
Creating a Safety Manual, Activity (continued): Whole Class

This can be completed the next day.

2. As a Class combine the evaluations of all of the lab partners into one list.

3. Divide into 14 groups of students.

4. Each group will write a paragraph of the Lab Safety Manual.

5. Here are the sections that need to be written:

   A. Basic Safety Rules for Behavior in the Lab – Group 1

   B. Specific Lab Safety Rules

      1. Injuries

         a. Eyes - Group 2
         b. Cuts – Group 3
         c. Burns – Group 4
         d. Chemical exposure – Group 5

      2. Accidents, other than injury

         a. Chemical spills – Group 6
         b. Broken glass – Group 7
         c. Explosions – Group 8
         d. Fire – Group 9

   3. Safe Equipment handling – Group 10

   4. Safe Chemical handling – Group 11

   5. Safe Bunsen Burner handling – Group 12

   6. Safe sharps handling – Group 13

   7. Safe clothing to wear during a lab – Group 14

6. When the writing is done have a whole class discussion on the sections.

7. Rewrite as needed.