

## Activity 3.1: What Makes Materials Different from Each Other?

How can we tell the difference between substances that look the same?

Different substances have different properties that can be used to identify them. Test Tubes X, Y, and Z are filled with gas. Can the properties of the gas in each test tube be used to tell whether the gases are the same or different?

### Question #1

What do you think might happen when a gas is exposed to a small flame? List as many possible results as you can think of.

## Investigate

Watch the demo to see what happens when a small flame is placed inside each of the test tubes. Watch the demo to see what happens when a glowing splint is placed inside each of the test tubes.

### Question # 2

Fill in the table to record your observations of what happened when a small flame or glowing flint was placed inside each test tube. If you want to see the demonstrations again, watch the following videos:

Test Tube	What happened when a small flame was placed in the test tube?	What happened when a glowing splint was placed in the test tube?
X		
Y		
Z		

### Question #3

Each test tube contained a gas. Was the gas in each test tube the same or different? Use evidence to support your answer.

### What are substances made of?

One way scientists learn about substances is by breaking them down chemically to see what types of atoms they are made of. One such technique is called *electrolysis*. You will now use electrolysis to separate water into its components. Follow the procedure outlined in the Water Electrolysis handout. Make sure to record your observations

### Question #4

When you have collected the gases, compare the amount of gas in the test tubes over each electrode.

### Question #5

Using the results of your observations from the testing gases demonstration at the beginning of the activity, predict what gas was collected in test tube X. Justify your prediction.

### Question #6

Using the results of your observations from the testing gases demonstration at the beginning of the activity, predict what gas was collected in test tube Y. Justify your prediction.

### Testing the gases

Continue to investigate by testing the gas in each tube to detect its properties. You will test both tubes with either a small flame or a glowing splint. Make sure to get your teacher's permission before proceeding. Then follow Steps 13, 14, and 15 in the chart.

### Question #7

Fill in the table to record what happened when a small flame or a glowing splint was placed inside each test tube.

Type of test	Gas from negative ( - ) terminal	Gas from positive ( + ) terminal
Small flame		
Glowing splint		

### Question #8

Use the results of the previous experiment to make a claim about which Test Tube(s) used in the demonstration (X, Y, and/or Z) contained a gas that could be a component of water. Be sure to support your claim with evidence.

You will further observe electrolysis performed by your teacher using a slightly different procedure. Notice the ratios of gases produced in this demonstration, as they will be more accurate than what you found. This will help you more accurately determine what gas ratios are for decomposition of water during electrolysis.

### What is water made of?

Different substances have different properties. Thus, properties can be used to identify substances. The table lists some substances that are commonly found in air, as well as some of their properties.

Substance	Boiling Point (°C)	Density (g/L)	Reaction with a glowing splint	Reaction with a small Flame
Oxygen	-183	1.429	Glowing splint becomes brighter or is reignited	Flame is brighter
Carbon dioxide	-78	1.977	Glowing splint is extinguished	Flame goes out
Water (vapor)	100	0.804	Glowing splint is extinguished	Flame goes out
Helium	-269	0.179	Glowing splint is extinguished	Flame goes out
Hydrogen	-259	0.089	"Pop" sound occurs	"Pop" sound occurs

### Question #10

Use the data in the table to determine the identities of the two gases that you found could be components of water. Provide evidence to support your claim.

**Question #11**

Compare the volumes of the two gases produced by electrolysis. What does their ratio tell you about the ratio of the atoms that make up a water?

**Question #12**

Water is often represented using the symbol  $H_2O$ . Based on your identification of the gases and their ratio, what do you think the symbols mean?

**Question #13**

Draw a model to show what you think water would look like if you could see the atoms that make it up.

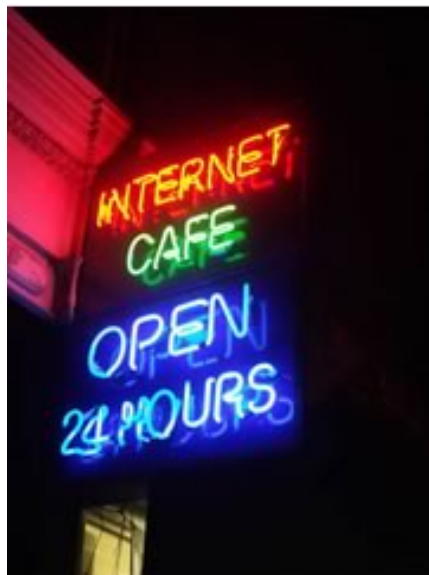
**Question #14**

For each of the gases produced by the electrolysis of water, draw what you think the gas would look like if you could see the atoms that make it up.

## What makes substances different?

You know that water is different from the two gases that resulted from electrolysis. What makes water different from other substances? What makes any substance different from others?

Neon signs are made from glass tubes that are filled with neon gas.



### Question #15

Neon gas is composed of many single neon (Ne) atoms. Draw a model to show what you think neon gas would look like if you could see the atoms that make it up.

Oxygen gas and ozone gas are both composed of oxygen atoms, but their properties are very different. Oxygen is a transparent gas that has no smell. It is essential to many life-forms on earth. Ozone is a pale blue gas with a distinctively strong smell. High concentrations of ozone can damage respiratory tissues in animals and plants.

### Question #16

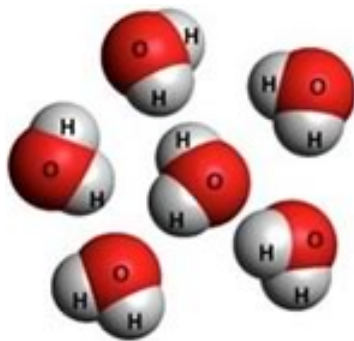
Oxygen gas ( $O_2$ ) is composed of two oxygen atoms; ozone gas ( $O_3$ ) is composed of three oxygen atoms.

What are some possible representations of oxygen gas and ozone gas?

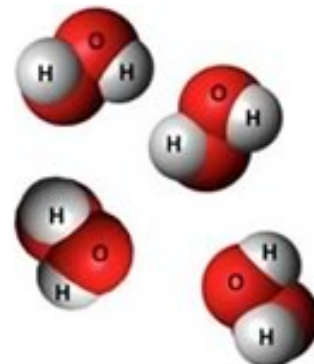
What do you think causes oxygen gas and ozone gas to have different properties?

Hydrogen peroxide is used in hair dye to bleach out the natural color of hair, usually in preparation for giving hair a new color.

Water molecules always consist of two hydrogen atoms and one oxygen atom ( $H_2O$ ). This chemical composition makes water different from other substances. Hydrogen peroxide also consists of hydrogen and oxygen, but in a different number--two atoms of



Molecules of water



Molecules of hydrogen peroxide

hydrogen and two atoms of oxygen. The figure below show the water and hydrogen peroxide molecules.

This table describes some properties of water and hydrogen peroxide.

Property	Water	Hydrogen Peroxide
Corrosive	NO	Yes
Boiling Point	100 Degrees C	150.2 Degrees C
Density	1.000g/cm <sup>3</sup>	1.135 g/cm <sup>3</sup>

**Question #17**

Why are water and hydrogen peroxide different substances even though they are both made up of hydrogen and oxygen atoms?

**Homework:** Reading for Activity 3.1 Molecules and Their Representations