South Pasadena • Chemistry

Name_____
Period___ Date ___/___/___

What Happens When Chemicals Are Put Together?

The Natural History of Airs

Purpose

The purpose of this chemical investigation is to produce three gases or airs, observe their properties, and practice chemical tests that will allow us to identify one gas from another. These experiments are based on the work of Joseph Priestly from England.

Background

Joseph Priestly was a contemporary of Benjamin Franklin and met him during his visits to London. Although Priestly studied to become a minister, his scientific work led to many discoveries. We will examine some of the work he did with gases or as they called it, "airs."

Experiments on air in the eighteenth century posed challenges to the natural philosopher. Today we unhesitatingly regard air as a solution of gases and confidently understand the chemical and physical properties that distinguish one colorless gas from another. However, centuries ago there was considerable confusion. In Priestly's time air was subjected to only simple tests of appearance, odor, and solubility. Any differences could have been real or, depending on the purity of the samples, caused by contamination.

Modern gaseous elements and compounds were known as types of **air**: nitrous air (NO), phlogisticated air (N_2O), acid air (HCl), and reduced fixed air (CO). The "goodness" of air, a measure of it respirability, interested Priestly. In 1771, he noted the restoration of "injured" or depleted air by green plants. He wrote,

> *"The injury which is continually done to the atmosphere by the respiration of such a large number of animals… is, in part at least, repaired by the vegetable creation."*

This balance between animal and plant kingdoms is particularly relevant to our present environmental concerns over global warming and rainforest destruction.

Resource: `http://www.phmc.state.pa.us/bah/priestly/overview.asp?secid=31`

Apparatus

Team Materials	Shared Materials	Testing Materials
1 large test tube	vinegar	fresh limewater
1 rubber stopper	chalk	(don't shake limewater)
1 45-cm piece of tubing	swimming pool acid solution	matches
3 small test tubes with stoppers	mossy zinc	wood splints
1 test tube rack	hydrogen peroxide	
1 pneumatic trough	baker's yeast	

Procedure

1. Put on your goggles to protect your eyes. Assemble the **large** test tube, stopper, and tubing to make a "generator" as demonstrated in class. (The small test tubes are used to collect the gas samples.)
   Sketch the generator:

2. Use the "recipes" below to generate one gas. Use the pneumatic trough to collect three small tubes of the gas. Stopper each tube. Perform the three tests in Step 3 on your samples. Repeat the generating procedure with the other recipes and test the other gas samples.

Dephlogisticated air

Use a third of a test tube of hydrogen peroxide and a large pinch of dry baker's yeast

Fixed air

Use a third of a test tube of vinegar and a 2-cm piece of chalk (break up the chalk a little).

Inflammable air

Use a third of a test tube of swimming pool acid solution and a few small pieces of mossy zinc

3. Perform the three tests on the three samples of each air. The tests are performed as follows:

limewater test

Add about ¼ a tube of limewater to the sample. Stopper the tube and invert the tube several times to mix the air and the liquid. One sample causes a change in the limewater.

glowing splint test

Light a wooden splint and blow it out. Insert the glowing splint into the tube of air. One of the samples causes a change in the glowing splint.

burning splint test

Light a wooden splint. Insert the burning splint deep into the tube of air. One of the samples causes a "pop."

Data Table

Design a data table on another sheet of paper that will give you space to write your observations about the three tests for each of the three samples. Your observations will be about the change in the appearance of the limewater or an observation of the splint. If nothing happens, write "NR".

Questions

1. There are chemical symbols for each of the substances used in this activity. Write their symbols:

hydrogen peroxide	**vinegar**	**chalk**	**swimming pool acid**	**mossy zinc**

2. Write the modern chemical symbols and names of the three "airs".

Old Name	**dephlogisticated air**	**fixed air**	**inflammable air**
Modern Name			
Chemical Symbol			
Briefly describe the test that identifies this gas.			

3. Each recipe and each test involves a chemical reaction. On another sheet of paper, write the chemical equation for each reaction and classify each as double replacement, single replacement, synthesis, decomposition, or combustion. Each type is represented at least once in this lab. The wood splint can simply be written as "wood" and is primarily a hydrocarbon.