GCC CHM 107LL
Applying the Scientific Method

In this lab you will learn to apply the Scientific Method by making observations, forming a hypothesis and experimentally testing your hypothesis. You will also learn the difference between qualitative and quantitative experimentation.

Background Information

The Scientific Method is a way of interpreting the results of experiments and observations in a logical manner. It can be applied to daily problems as well as the lab sciences. Essentially, it involves the steps outlined below.

1. Careful observation

Sometimes the Scientific Method begins by simply observing the world around you. For example, the owner of a greenhouse may observe that some plants are thriving while others are not. Other times experiments are conducted. These may be **qualitative** (observations are recorded) or **quantitative** (careful numerical measurements are recorded). Careful observation and data recording are important, since other scientists must be able to repeat your experiment with the same results before it is accepted within the scientific community.

2. Forming a hypothesis

The next step is to search the data for patterns. These may be obvious or may require computer programs for analysis. Scientists form a **hypothesis** (an educated guess) to attempt to explain their observations. Depending on the experiment, there may be more than one hypothesis and it is important not to let preconceived ideas limit the number of hypotheses formed. In the example above, the greenhouse owner may formulate several hypotheses, each dealing with a different factor such as temperature, light, food, water, etc.

3. Testing the hypothesis

One hypothesis must be tested at a time. All possible factors (called **variables**) must be considered, but only one is changed at a time (amount of water for example). The other variables (temperature, amount and type of food, amount of sunlight, etc.) must be kept the same or constant. Otherwise, the results would be impossible to interpret. Then the scientist records if the changed variable (water) affects the outcome.

4. Revising the hypothesis

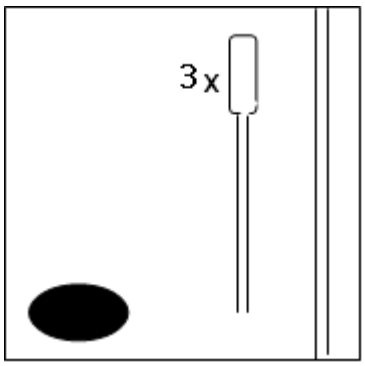
Sometimes, the hypothesis is either right or wrong. Other times, it may be slightly revised and retested. This "loop" of revision and retesting should continue until the hypothesis is refined. If, even one piece of data does not "fit" the hypothesis, further revision is necessary.

In this experiment, you will mix a 6% solution of hydrogen peroxide (H_2O_2) with a small package of yeast and observe and record the results. You will then formulate and test several hypotheses to explain these results. We will give you a hint that only the hydrogen peroxide is involved in the change you will see. The yeast just makes the change occur fast enough to observe in lab.

Procedure

1. Open the small package of yeast and pour approximately one half of it into a plastic baggy.

CAUTION: Hydrogen peroxide damages skin, eyes and clothes. Wash off any spills with plenty of water.



2. Fill three plastic pipets (large eyedropper, see diagram) as full as possible with the hydrogen peroxide solution. Carefully place them inside the bag. **At this point, you do not want the hydrogen peroxide solution and the yeast to come in contact with one another.** Your experimental setup should look like the diagram. Gently squeeze the bag to remove most of the air without allowing the hydrogen peroxide to contact the yeast. Seal the bag tightly.

3. Gently squeeze the pipets and force the hydrogen peroxide to come into contact with the yeast. Carefully observe the results and complete items #1 through #3 on the Report Sheet.

4. Once you have completed the design required by Report Sheet question #4, discuss it with your instructor. Your instructor will provide you the necessary equipment to test your hypothesis. (Note: your instructor may modify your design to make it simpler, ensure your safety, or remain within the limits of our lab's available equipment).

5. Using your experimental design, attempt to identify the gas formed in the baggy. Record your results on the Report Sheet, item #5.

Table of Common Gases

CH_4 = methane. Main component of natural gas, colorless, odorless, flammable, not toxic, used as fuel, potent greenhouse gas, produced by cows that eat lots of corn.

O_2 = oxygen gas. Colorless, odorless, tasteless, 21% of air, third most abundant element, will burn smoothly if ignited, is blue when liquefied.

H_2O = steam. Colorless, odorless, tasteless, non-flammable, steam is vaporized water, used in steam engines and turbines to generate electricity.

N_2 = nitrogen gas. Colorless, odorless, tasteless, mostly non-reactive or inert gas, 78% of air.

H_2 = hydrogen gas. Colorless, odorless, tasteless, highly flammable it sparks, pops and sputters when ignited, most abundant element in the universe, the lightest element, main sequence starts are mostly hydrogen.

CO_2 = carbon dioxide. Colorless, slightly acidic odor, called dry ice when solidified, non-flammable, used in some fire extinguishers, produced by burning fossil fuels, greenhouse gas, used in carbonated beverages, removes caffeine from coffee, used by plants in photosynthesis, acidifies the ocean by making carbonic acid.

CO = carbon monoxide. Colorless, odorless, tasteless, flammable, highly toxic, most common form of poisoning, major pollutant in urban areas, produced by internal combustion engines, used to make meat look red and fresh

H_2S = hydrogen sulfide. Colorless, toxic, flammable, smells like rotten eggs, occurs in volcanoes, natural gas, sewers, and swamps.

GCC CHM 107LL Report Name: _____

Applying the Scientific Method Partner: _____

1. Observations after adding the hydrogen peroxide to the yeast. (color, temperature, sound, state of matter like solid, liquid or gas, anything else you saw)

2. Assuming that the gas formed is produced from only the hydrogen peroxide, circle which of the following gases may be in the bag. (Hint: check the formula for hydrogen peroxide)

CH_4 O_2 H_2O N_2 H_2 CO_2 CO H_2S

3. Based upon your observations, form at least three hypotheses as to what happened in the plastic baggy. <u>At least one of your hypotheses must focus on the identity of the gas that formed.</u>

I.

II.

III.

4. Design an experiment to test your hypothesis regarding the identity of the gas formed in the baggy. Keep your design within the confines of equipment on the lab cart. <u>Discuss the experiment design with your instructor before trying it</u>.

Instructor's initials _____ indicating that your experiment is safe to try.

5. Observations as you try your experiment.

6. We think the gas formed in the bag is _____ gas.

7. (Circle one) This lab is: qualitative or quantitative

8. What else would need to be done before you could state with certainty the identity of the unknown gas? (Hint: review the discussion of the Scientific Method).

8. Name two greenhouse gases. _____and _____

10. The Hindenburg disaster of 1937 relates to today's lab. The Hindenburg was a German commercial passenger airship (Zeppelin), the largest flying machine ever built. Helium gas was initially selected for the lifting gas, but it was too expensive. What gas was used and what happened to the Hindenburg in 1937?