Science Bulletin

Volume 3 | Number 3 Article 3

11-1930

Carbon Dioxide: Experiments for General Science

O. B. Read
Iowa State Teachers College

SCIENCE BULLETIN

A Service Bulletin for Teachers of High School Science. Published Monthly by the Extension Division and Edited by the Department of Natural and Physical Science.

IOWA STATE TEACHERS COLLEGE
Cedar Falls, Iowa

VOLUME III NOVEMBER, 1930 No. 3

CARBON DIOXIDE
Experiments for General Science

It is quite generally thought that an elaborate equipment of test tubes, flasks, beakers, dishes and desks are needed for any experiment involving chemistry. There are, however, many simple and instructive experiments that may be tried with only common household apparatus.

Carbon dioxide is a very simple and easily prepared gas with which to begin a series of such chemical experiments. The many important uses to which it is put add interest to its study. The materials and apparatus needed for the experiments are simple, inexpensive, and easily prepared. Place in a glass tumbler a level teaspoonful of baking soda (NaHCO3, sodium bicarbonate). To this add a tablespoonful of vinegar, which is a dilute acid (CH3COOH, acetic acid). A violent foaming called effervescence will occur. Lower a glowing splinter into the gas above the foam and it will be immediately extinguished, thus showing the inability of the gas to support combustion.

Another experiment of a similar nature is to place a candle about three fourths of an inch long in the bottom of a tumbler and light it. Prepare another tumbler of carbon dioxide as directed above. When full, hold the second tumbler in a position to pour the gas into the one containing the lighted candle, being careful not to pour over any of the liquid. The candle will begin to flicker and soon be extinguished. This confirms the above conclusion that the gas will not support combustion and also adds the idea that it is heavier than air and may be poured like water. It is also noted that the gas has no color and no odor, the odor present in this case being due to the vinegar.

Owing to the fact that carbon dioxide is colorless and odorless its presence in small quantities is not easily detected excepting by chemical means. However, the following method of chemical detection is not difficult. Secure a piece of lime (CaO, calcium oxide) about the size of an English walnut, and put it in a cup containing about a half pint of water. Soon it will begin to slack and a small portion of it will dissolve. It should be stirred occasionally at first and covered. After a few hours it will cool and the liquid will become clear. This liquid is known as lime water (Ca (OH)2, calcium hydroxide). Place about two tablespoonfuls of the clear lime water in a tumbler. Prepare some carbon dioxide with soda and acid as described above, pour some of the gas into the tumbler containing the lime water, shake the tumbler and note the cloudiness produced. This is due to the lime water and carbon dioxide forming fine particles of insoluble calcium carbonate (CaCO3). This is known as the lime water test for carbon dioxide.

The test for the presence of carbon dioxide in the breath may be made as follows. Secure a straw or a paper tube such as is used at a soda fountain and blow the breath through a small quantity of clear lime water in a tumbler. The cloudiness produced is evidence of carbon dioxide in the breath.

The presence of carbon dioxide in the air about us may be detected by placing a couple of tablespoonfuls of fresh lime water in a shallow glass dish and leaving it exposed to the air for about thirty minutes. A white film or crust will form over the water which is a layer of calcium carbonate.

Another method of preparing carbon dioxide is to crush a piece of marble into fine bits and put som vinegar on it and test the gas arising from it by the lime water test described above.

An examination of one of the types of chemical fire extinguishers shows that its contents consist of a soda solution and an acid (H_2SO_4, sulfuric acid). By turning the extinguisher upside down the acid container is opened and the acid is spilled into the soda solution producing carbon dioxide. The formation of this gas produces pressure forcing the contents of the can out through the nozzle. This extinguishes the fire by covering it with a layer of incombustible gas and by scattering the liquid over the burning material.

It is not difficult to understand the purpose of soda and sour milk as used in baking. The lactic acid of the sour milk slowly reacts with the soda producing carbon dioxide. The bubbles of gas are prevented from escaping thus causing the dough or batter to rise. This would lead one to investigate whether soda is a constituent of baking powder. By placing a little baking powder in a cup with some water a gas is produced. By careful manipulation this gas may be poured into a cup of lime water which becomes cloudy showing that the gas is carbon dioxide. By examining the label on the baking powder can it is noted that soda is one of the main constituents. Another constituent is tartaric acid or a substance serving in that capacity. The purpose of the starch in baking powder is to keep the soda and acid apart and dry until they are brought into contact by the moisture in the dough.

From these experiments we learn that carbon dioxide is easily produced by the action of an acid on a carbonate; it is heavier than air and may be poured from one vessel to another; that it will not support combustion; that we exhale carbon dioxide constantly; that the gas is a common constituent of the air; and that it is an important agent in the baking process.

O. B. Read.

PLANT DISEASE

Agriculture — Biology

Many educated people do not realize that a plant may be diseased as truly as a human being; at least they have little conception of the nature and significance of plant disease. In an agricultural state such as Iowa this is an important question and scme time can very profitably be given to the study of plant disease either in the biology course or in the agriculture course. Enough instruction should be given so that the pupil will be conscious of plant diseases and be able to appreciate their economic significance. Diseased plants and plant material can be found easily in all parts of Iowa, so there should never be a lack of laboratory material for first-hand study.

What is a plant disease? We must not forget that plants are living organisms and that the same fundamental biological phenomena are found in plants as in animals, consequently one might expect that a plant disease and a human disease would have much in common. A plant disease may be defined as follows,—"A plant disease is any variation from the normal as expressed either by checking or interrupting the physiological activities, or by structural changes which may check development, cause abnormal formations or lead to premature death of a part or all of the individual." Plant disease has also been defined purely from the agricultural or commercial aspect in the following way,