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Chemistry Demonstrations In Public

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tion in the major fields of knowledge, then provision should be made to include some training in the physical sciences for non-science majors.

CHEMISTRY DEMONSTRATIONS IN PUBLIC

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Chemistry open house programs serve a useful purpose in entertainment and education of the public by demonstrations and exhibits. When performed in the laboratory where it is possible to prepare adequately for a public showing with all the apparatus at one's disposal, many startling as well as commonplace experiments can be carried out.[1 2 3]

Is it possible to conveniently perform a series of interesting and entertaining experiments at public gatherings such as parent teachers organizations, service clubs and school assemblies? The experimenter is limited to apparatus and chemicals which he can conveniently take with him from the laboratory. Gas and water connections will not be available and demonstrations will likely have to be performed on a small table before an audience

No subject can be made to create so much interest or entertainment for a large group as chemistry because no subject lends itself so well to visual demonstration. Working with colored flames, solids, liquids and gases, the experimenter can easily hold the attention of his audience. The element of motion in which the demonstrator adds a reagent to a beaker, pours liquids, produces colored gases and smokes that rise and fall helps to sustain interest. The added mystery associated in the lay mind by a lack of understanding of chemistry makes a series of demonstrations as intriguing as the slight of hand performance of a magician. Curiosity is aroused by the pop of an explosion, formation of precipitates and effervescence of gases.

The experiments to be selected for a public performance must go to completion rapidly. Gases, liquids, solids and flames should be colored and should be visible at some distance from the demonstrator. Since a bunsen burner will not be available, reactions must be selected which require no heating or the relatively small amount of heat evolved by an alcohol lamp. Small volumes of solutions must be used since water connections will not be available. Demonstrations must be selected that require a small amount of chemical which can easily be carried about.

[1] Kindy, M. M., "A Successful Open-House Program," J. Chem. Educ. S, 2–46051, (1931)

[2] Billinger, R. D., "Open-House Programs," J. Chem. Educ. 11, 494–499, (1934)

[3] Vesconte, Amy Le, "A Plan for the Open House in Chemistry," J. Chem. Educ. 13, 72–73, (1936)

To successfully carry out a series of experiments before the public the performer must be certain that the demonstration will actually work. Many of the simplest experiments may fail to work as expected for one reason or another. Embarrassment can be avoided by repeating each experiment several times before attempting a public performance. Comments on the chemical significance of the reactions will likely appeal to the audience more than a stereotyped lecture. Careful preparation of these comments beforehand is essential because the explanation must be simple and untechnical; with the assumption that the audience knows little about the terminology of science.

Never should one attempt to set up the apparatus after the demonstration has begun. Everything must be in readiness. Apparatus should be carefully arranged on a table near the demonstration table so the demonstrator can quickly secure it without detracting from the experiment itself. It is well to place each piece of apparatus in the order in which it will be used, because nothing is more disconcerting to the observer than to watch someone hunt for a test tube which should have been in its place. An extinguisher should be accessible to safeguard against the danger of fire when flames are involved in the experiments. The experimenter must keep in mind that he is performing experiments for an audience, and that his demonstrations should be visible to everyone in the room. The performance should be made against a light colored background because it will bring out the color effects and make the apparatus more easily seen.

The experiments to be selected by the performer will depend somewhat on his interests and experience in demonstrating. Spectacular experiments have the greatest appeal, although many of the more common experiments in college and high school chemistry can be used in demonstrations before large groups. The list of experiments selected by the author and enumerated below have an eye appeal because of the element of motion, flames produced, of chemical actions which are visible. This list can be completed in half an hour. The apparatus necessary can be carried about in a small kit.

The first experiment selected is one which produces a substance that burns and gives a flame that can be used in subsequent experiments.

Five c. c. of a saturated solution of calcium acetate are placed in a 125 c. c. beaker. In another beaker of the same size are poured 100 c. c. of alcohol. Both solutions are held so that they are plainly seen and poured back and forth, producing a substance that solidifies in a few seconds. The solid alcohol may be inverted without spilling. It may be removed in small chunks on an asbestos mat and burned.

A demonstration on the balance, processes of burning and oxidation, can be shown in a striking experiment. Small porcelain crucible covers are inverted and placed on the pans of a 100 gram hand balance. These pans are made to balance by adding one gram of powdered magnesium to both sides. When one side is ignited by a match, the magnesium is seen to burn producing a white powder while the balance shows a gradual increase in weight on the burning pan. This experiment contradicts the common assumption that things which burn disappear. It shows forcefully that the burning is accompanied by an increase in weight due to the oxygen obtained from the air.

Water can be frozen in the space of a minute by merely dissolving ammonium nitrate in water. This experiment, suggested by Davison,[4] is performed on the bottom of an inverted chalk box. This surface is wet. A 400 c. c. beaker containing 100 grams of the ammonium nitrate is placed on the box. 100 c. c. of water are added to the beaker while stirring the solution with a horn spatula. In a few seconds the beaker will be frozen solidly to the box, which can be lifted by using the beaker as a handle.

A vigorous explosion has its place in a chemical demonstration. A solution is made by adding to 3 c. c. of carbon disulfide, one third of its bulk of white phosphorus. A five grain tablet of potassium chlorate is placed on an asbestos mat at a respectful distance from the experimenter. A spontaneous explosion follows in five or ten minutes after two or three drops of the solution are added. The action can be hurried by touching the tablet with a pointer after about three minutes.

The solution of phosphorus used above can be used in lighting candles. The wicks of several small candles are dipped in the solution and placed on the table. In a few minutes they will ignite spontaneously.

The relative proportion of carbon in various liquids can be demonstrated by burning each of them in a small casserole. Five c. c. of ether, ethyl alcohol, butyl alcohol and toluene are ignited with a match. The light colored flames over the ether and alcohol indicate a low percentage of carbon while the reddish flame over the butyl alcohol and the sooty flame over the toluene indicate the greater proportion of the element of carbon.

Pouring a visible gas from one test tube to another can be shown by using nitrogen dioxide. This gas is prepared by placing a penny in a large test tube and adding about five c. c. of concentrated nitric acid. In a moment or two dense fumes of nitrogen dioxide begin to ascend in the tube. If a few drops of ammonium hydroxide are then added a dense white cloud of solid ammonium nitrate fills the tube.

Color changes attending chemical reactions can be brought out by writing on yellow paper which has been sponged with ferric chloride. Using a brush dipped in potassium ferrocyanide, blue let-

[4] Davison, H. F., "A Collection of Chemical Lecture Experiments." The Chemical Catalog Company, Inc. New York City, 1926, p. 74.

ters are obtained; while one dipped in potassium thiocyanate gives red letters. The production of colored metallic sulfides by hydrogen sulfide in solutions of metallic ions also gives visual evidence of a chemical reaction. Burning solid alcohol generates sufficient heat to produce the gas hydrogen sulfide from the commercial product, Aitchtuess, in less than a minute. A small amount of the gas above solutions of lead nitrate, antimony chloride, cadmium nitrate and zinc nitrate quickly produces precipitates of black, orange, yellow and white sulfides.

The sight of flames seems to arouse the greatest interest in an audience. With the production of visible fire by unusual means this series of experiments may be brought to a close. Three c. c. of carbon disulfide are placed on a watch glass. A glass rod is heated slightly and held immediately above the liquid. The liquid catches fire; when blown out can be relit several times with the glass rod. In another experiment of a somewhat similar nature a ball of excelsior about five centimeters high is placed on an asbestos mat. Two grams of sodium peroxide are placed on top of the mass. When three drops of water are added, the excelsior bursts into a ball of fire.

The members of the audience generally agree that this group of demonstrations has proved very interesting. It is possible then to teach a few chemical truths and at the same time give the public a type of entertainment that it likes.

THE GENERAL SCIENCE WORKSHOP OF THE MANKATO STATE TEACHERS COLLEGE

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ABSTRACT

The junior and senior high school science teachers of south central Minnesota have for many years been organized for the purpose of exchanging ideas and discussing mutual problems. While they have found their four or five meetings a year very helpful, they have felt a growing need for longer and more concentrated periods of working together. As a result the Workshop at Mankato State Teachers College was established, a two weeks course followed by two or three conferences in the next school year.

Problems studied included (1) a restudy of the science curriculum of the junior and senior high school with the evaluation and distribution of units, (2) the scientific method, (3) the resources and industries of the community in relation to science, and (4) the various forms of visual aids. Special attention was given to the