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Science Education

CHEMICAL MAGIC EXPERIMENTS

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Explosions, color changes, mysterious fires and unusual reactions involving movement of liquids, solids and gases can create interest and provide entertainment, when used at science fairs, open house programs, parent-teacher organizations and service clubs.

The experiments described were used at the 1952 science fair held at the Mankato State Teachers College. They provided the principal entertainment feature of the fair.

Experiments performed at the science fair were repeated several times by each of the five students who gave the public performance. The chief "magician" was dressed in a tuxedo and top hat. He directed the work of the others. Experience showed that the demonstrator was effective if it was accompanied by entertaining and fantastic explanations. It was noted that these stories became more exaggerated with each performance as the demonstrators gained confidence and skill.

The experiments were conducted in the chemistry lecture room with spotlights fixed on the demonstration table. The room was darkened to make the experiments more striking and fires more visible.

Into a curiously shaped bottle water was run from the tap. But when the water was added to fourteen bottles lined up on the demonstration desk, liquids of many colors were produced. Prior to the demonstration, to each of these bottles there were added one or two cubic centimeters of either a dye, colored precipitate, indicator or concentrated colored solution. The experiments involved changing water to liquids resembling such things as tea, wine, orange juice, milk and many others.

As the chemical magic show progressed, candles standing on the demonstration table would light spontaneously. The wicks had previously been dipped in a solution made by mixing 3 cc of carbon disulfide with $\frac{1}{3}$ of its bulk of white phosphorus. The white phosphorus solution was also used in producing an explosion. A five grain tablet of potassium chlorate was moistened with the solution and allowed to stand for ten minutes. When touched by the magician with a meter stick a vigorous explosion resulted.

Water was frozen in the space of a minute by dissolving ammonium nitrate in water. This experiment was performed on the wet bottom of an inverted chalk box. A 400 cc beaker containing 100 grams of ammonium nitrate was placed on the box, 100 cc of water were added with vigorous stirring. The temperature quickly dropped to about ten

degrees below zero and the box was lifted by using the beaker as a handle.

The ammonia fountain proved an interesting demonstration. Failure of this experiment is most frequently due to insufficient ammonia in the dry flask. A slight innovation of the usual demonstration was made by inserting a medicine dropper filled with water into the upper flask. The experimenter merely pressed the bulb of the medicine dropper to start the fountain.

Since the room was darkened, demonstrations involving flames or fires were especially effective. A coil of platinum wire was suspended from a cardboard above methyl alcohol in a beaker. When the wire was heated with a flame and placed in position on the beaker it continued to glow for hours.

Cold fire produced probably the greatest audience reaction, when the demonstrator burned a solution containing equal volumes of carbon tetrachloride and carbon disulfide in the palm of his hand.

Solid alcohol was made by rapidly pouring together 20 cc of a saturated solution of calcium acetate and 100 cc of alcohol from one beaker to the other. The solidified material was used as the fuel in the next experiment.

A 1000 cc flask was half filled with water and made to boil using solid alcohol as the fuel. A wet rubber stopper was inserted into the flask as it was boiling, the flask removed from the flame and inverted. Cold water was then allowed to fall on the flask and as the flask was further cooled the boiling became more violent.

The demonstrator asked the audience for a handkerchief, which was quickly soaked in a solution of one part of alcohol and 6 parts of water. When lit, the handkerchief appeared to burn rapidly but came through the fire unharmed.

Changing wine to "water" by use of a colorless gas and a colored solution was an effective experiment. The gas used was SO_2 , generated in a beaker by using concentrated sulfuric acid and sodium sulfite. The liquid was a solution of potassium permanganate. When the beaker of gas was tipped so as to pour it into the bottle of potassium permanganate the color disappeared.

A few passes with the hand or the use of magic words can bring about a reaction in the so-called "clock" reaction. By using the proper quantities of ingredients the experimenter can time the reaction to the second. Two of these reactions are explained.

In the first experiment two colorless solutions are mixed and after 30 seconds a yellow color is produced, increasing in intensity. One solution is made by dissolving 1 gram of sodium arsenite in 50 cc of water, and adding 5.5 cc of glacial acetic acid to the resulting solution. The other solution is made by mixing 10 grams of photographers hypo (sodium hypo-sulfite) in 50 cc of water.

The other clock reaction was also performed with two solutions. One of these solutions was made by dissolving 4.5 g. of potassium iodate

in 1000 cc of water. The other solution was made by mixing .125 g. of sodium sulfite with $\frac{1}{2}$ gram of starch and a little water to make a paste. To the latter was added two cc of dilute sulfuric acid and then made up to about 100 cc. When the latter solution was added to the first in equal quantities, iodine colored the starch, the time depending on the relative quantities of the two solutions.

A liquid was stirred vigorously by invisible means. A magnetic motor stirrer was concealed under a small box. The experimenter held a beaker of water in his hand. He placed a small magnetic bar in the water. On placing the beaker on the box the water began to rotate vigorously.

Demonstrations involving smoke or obnoxious gases should be performed toward the close of a series of presentations. The first of these was the miniature volcano.

Powdered ammonium chromate served as the reactant for the miniature volcano. The material was heaped into a cone in the center of a porcelain crucible which was placed in the neck of a tall bottle. When ignited with a magnesium ribbon a miniature volcano erupted.

A few drops of water produced flames and smoke in the next experiment. Water was added from a medicine dropper to a small ball of excelsior into which one gram of sodium peroxide had been placed. The experiment was performed in an evaporating dish.

As the last series of experiments was being performed materials were slowly heating to produce Pharaoh's Serpent. In a small evaporating dish were placed 3 grams of parinitroacetanilide to which was added 1 cc of concentrated sulfuric acid. On heating for two or three minutes a "snake" suddenly came out in a cloud of smoke.

The American flag was made to show in the final experiment. A sheet of white paper on which details of the flag had been drawn was fastened to a board. The red stripes of the flag were drawn with ammonium thiocyanate, the blue with potassium ferrocyanide. When sprayed with ferric chloride solution the flag became visible.

The success of the chemical magic show depended largely on careful planning. Demonstrations were carefully rehearsed several times so that the performer had confidence in his ability to perform the experiment. He could then accompany the demonstration with an interesting and entertaining explanation.