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Abstract. Some studies have been made showing the need for what is being done to develop an interesting junior high school science laboratory program. There are three basic types of experiments, individual student, student experiments done before the class, and teacher experiments done before the class, discussed and illustrated. Emphasis is placed on experiments performed by the students.

Many teachers who have taught junior high science, especially the seventh grade, have experienced the great enthusiasm the students have for science. They have an inquiring nature and are anxious to learn more about science. In a pilot study for his dissertation, Howard Prouse (3) discovered that at the State University of Iowa laboratory school seventh grade students regardless of socioeconomical background or ability preferred math and science to their other courses.

R. E. Yager (6) reports there has been an increase in science taught in the elementary school and that most junior high students have had a basic introduction to science by the time they start the seventh grade. With the new approaches to high school science courses, the junior high program is caught in the middle. At the State University of Iowa laboratory school studies (6) have been and are still being made in developing a unified junior high science program as a continuation of the elementary program and designed to give the student a general background in three years. (7) The writer is currently teaching the seventh grade course called Matter which consists primarily of chemistry and earth science.

New emphasis has been placed in the laboratory approach to the high school program (4) and has been shown (5) to be a means of increasing the interest of students in science. M .O. Pella (2) surveyed a number of science teachers and reported the function of high school laboratory activities as a means of securing information, determining cause and effect relationships, verifying certain factors of phenomena, applying what is known, developing skill, providing drill, helping pupils learn to use scientific procedures for solving problems, and carrying on individual research. There is no reason why the junior high experiments cannot be constructed along this line. Three basic types of experiments can be used: individual experiments; student

demonstrations; and teacher demonstrations, where the word demonstration signifies an experiment in front of a class with the class observing.

To illustrate these points a look at some of the experiments used in the seventh grade program would be in order. As part of the study of the nature of solutions, students investigate the freezing point deviation of one molar and one molal solutions in three steps. The first is the determination of the freezing point of benzene. Next the student is asked to make a one molar solution by weighing out 0.01 gram molecular weight of either carbon tetrachloride, benzoic acid or napthalene, putting the solute in a graduate and adding benzene to the 10 ml mark. The freezing point is obtained for the solution. Salt may be needed to lower the temperature sufficiently. The third step in the experiment asks the student to prepare a one molal solution by weighing out 0.01 gram molecular weight of the solute previously used and dissolve it in 10 grams of benzene. The freezing point of this solution is measured and the three values are compared.

When this experiment was performed by seventh graders they found the benzene froze around 5°C, the one molar solution between eight and thirteen degrees lower depending on the solute, and the one molal solution about four degrees lower. Since benzene was used instead of water only non-electrolytes could be used. This eliminated the problem of the activities of electrolytes which would increase the experimental error. Also in benzene there is a greater difference in freezing points of the solutions which is partially due to the nature of the solvent and partially to the fact that the amount of solvent can vary as much as 5 ml between the molar and molal solutions used. In water the difference in amount of solvent used is not great since one milliliter of water weighs approximately one gram. With water the experimental error is too great for seventh graders to detect a difference with normal laboratory equipment. This experiment brought about a visual realization of the effect of concentration on the freezing point specifically and colligative properties in general. Also, the difference between molarity and molality is illustrated.

There are times when materials to be used are too dangerous for the student to handle. This necessitates the use of a teacher-class experiment. Interest in this type of experiment can be generated by the use of a central theme in the form of a question. This approach was used in an experiment introducing the study elements and the behavior of groups in the periodic chart. The experiment consisted of investigating some of the properties

of three elements listed in Group IA, hydrogen, sodium, and potassium. The question investigated was, "Does hydrogen belong to the sodium family?" The experiment was conducted in three parts. The first was an examination of the physical structure of the free element and its reaction with water. The water is then tested with litmus paper. The second step was the testing of solutions of the hydroxides of these elements with litmus paper. Finally the solutions of the chlorides of the elements were tested with litmus paper. The students have no trouble seeing the similarity between sodium and potassium but that the hydrogen is different. The experiment posed the question, "Where does hydrogen belong in the periodic chart?" This became the theme for the rest of the study of groups in the periodic chart.

In student demonstrations a student usually does an experiment in front of the class in much the same way a teacher would run an experiment. This type of experiment is used when there is a shortage of materials and the chemicals are not overly dangerous. The student giving the demonstration gains not only from doing the experiment but also from explaining it to the class. One difficulty with this procedure is that the student doing the demonstrating is not experienced and the rest of the class has difficulties seeing the work and following the experiment. This year the seventh graders did a student demonstration a little differently. Working in pairs, each group was asked to prepare an assigned solution. Then each group tested the solution in turn to see if it conducted electricity. Each student handles the equipment and sees first hand what is going on. After the solutions had been tested, students were asked to make up solutions of their choosing. The one requirement was that the materials be checked by the teacher before mixing to make sure that they were safe to use. The class tried to predict whether the solution would conduct; then the students tested it. The students noticed that ions in ethyl alcohol did not seem to conduct electricity. One of the high school students (1) became interested in the conductivity of ions in non-aqueous solvents. Instead of using the 60 watt bulb used by the seventh graders he used bulbs of 15, 10 and 1/25 watts. He found that some of the solutions tested by the seventh graders did conduct electricity, but not sufficient to register on the 60 watt bulb.

The preceding experiments are illustrations of the different types of experiments being used in the junior high program. Most of the experiments used are the type the students do themselves. They fit in better with the objectives developed by Pella and are more popular with the students.

Literature Cited

1. Hickerson, Karl, 1964. Conductance in Non-aqueous Solutions. Iowa Junior Academy of Science. April 18, 1964.
2. Pella, M. O., 1961. Science Teacher. Sept. 1961. 29.
3. Prouse, Howard. Unpublished Ph.D. dissertation. State University of Iowa.
4. Stevenson, Andrew, 1963. Iowa Academy of Science. In Press.
5. Stevenson, Andrew, 1963. Iowa Sci. Teach. Journal vol. 1, no. 2, p. 7.
6. Yager, R. E., 1963. Sch. Sci. and Math. vol. 63, 719.
7. Yager, R. E., ed. 1964. Secondary Science Curriculum, University High School, State University of Iowa.

The Use of a Thermochemical Experiment in an Introductory Science Class

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Abstract. An experimental method for determining heat of neutralization, in introductory science classes, with simple laboratory equipment is described. Measured values for heat of neutralization determined by this method are compared with the literature values. The experimental method used offers a suitable means for the determination of heat of neutralization.

The purpose of this investigation was to determine a simple experimental method by which the heat of neutralization of various acids and bases can be determined by persons in introductory science classes.

In the study of energy relationships of reacting substances one often finds theory which is difficult and mathematics which is beyond the scope of the student in the introductory science class. Because of these problems, very little has been done to set forth a clear understanding of these relationships for the student with a limited scientific education.

The basic reaction of neutralization has been known for some time. The reaction may be represented by ionic equations:

$$HA \rightarrow H^+ + A^-$$

$$BOH \rightarrow OH^- + B^+$$

$$H_2O + B^+ + A^- + \text{Energy}$$

If at the beginning of the reaction the acid and base are highly ionized, the only chemical reaction is:

$$H^+ + OH^- \rightarrow H_2O$$

EQUIPMENT

Simple and inexpensive equipment was needed for these experiments. A triple beam balance accurate to 0.01 gram was used

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