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Adding Fizz to Your Science Classroom

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ADDING FIZZ TO YOUR SCIENCE CLASSROOM

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Have you found that your science classes just skip from unit to unit?
Do you want to get away from science lessons that stress vocabulary and memorization of facts?
Are you pondering how to get your students more involved in science?

These were some of the questions we thought about when we designed hands-on experiences in science for upper elementary students. According to the National Research Council in *Fulfilling the Promise, Biology Education in the Nation's Schools*, future curriculum goals for both elementary and secondary science teaching will emphasize hands-on exploration by the students, the development of skills in observation, comparison, measurement, questioning and understanding and the view of science education as a continuous, interrelated process rather than isolated units of study.

These goals are easily stated but not always easily implemented. In order to expose students to scientific methodology, we designed investigations in a manner which allowed students to logically record and interpret data. Students were to work in a classroom setting in the same way that a scientist would work in a laboratory. Our ultimate goal was for students to develop an understanding of scientific processes. Keeping these expectations in mind, science lessons were prepared using the following primary objectives:

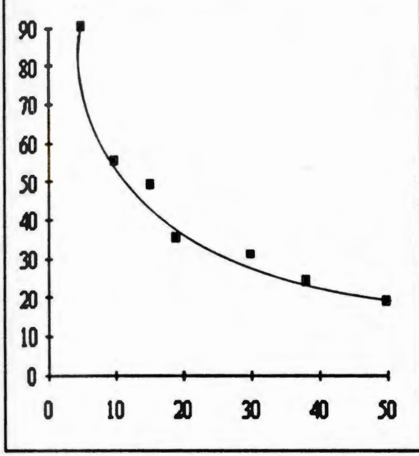
1. Students will collect and record data.
2. Students will construct a graph showing their results.
3. Students will use their graph to determine values of an unknown and to make predictions.

4. Students will be able to recognize and explain the effects of hidden variables (variables that should be held constant).

In addition to these primary objectives, we wanted all of our classroom investigations to utilize common, inexpensive materials which could be easily stored. Developing investigations that the students could handle with minimal teacher assistance and intervention was another important consideration.

Lab Notebook

One good way to help students learn the processes of science is for them to keep lab notebooks in which they record their lab experiences. The best time to begin a lab notebook is at the start of the year. We suggest using a three ring binder containing paper which is lined on one side and has graph paper on the other. Students organize the results from each lab experience as shown in Fig. 1.



TITLE
drawing of lab

Temperature (C)	Time (sec.)
50	19
38	24
30	31
19	35
15	49
10	55
5	90

conclusions

Figure 1: Science Lab Notebook Setup: Example of possible results obtained from plotting time vs. temperature for a dissolving Alka-Seltzer® tablet.

On the top part of the right hand page the student draws a picture of the experiment. The picture can show some of the materials used. It is intended to help the student better understand and remember the experiment.

The middle portion of the page contains the table or chart used to record the data. The chart should be set up in two columns, one for the manipulated variable and the other for the responding variable. We found it very important to give students time to make a chart before starting the investigation. In this way, the data was recorded directly into the lab notebook instead of on some scrap of paper toweling.

The bottom section is for the student's conclusions. The discussion could include thoughts relating to the prelab introduction, observations the student has made, predictions based on the results or the effects of hidden variables.

The left hand page is reserved for a graph of the results. The graph can be either a bar graph or a point/line graph; whichever is best suited for the data collected. Usually, the manipulated variable or the parameter which is being controlled and altered by the student is placed on the horizontal axis. The responding variable is marked on the vertical axis. Some time may be needed to discuss units for the graph and its sizing on the page. The graph should also have a title which explains the content of the graph.

This notebook can then be used for each experiment, and students will be able to look back through it to recall previous labs. As the year progresses, they will begin to understand the underlying methodology for scientific investigation. The students should also be able to proceed with less teacher assistance as they become familiar with the procedure.

Sample Investigation

The Question: Does the temperature of the water affect the rate at which an Alka-Seltzer® tablet dissolves?

Materials:
Alka-Seltzer® tablets (4 per group plus a few extra)
Thermometer (1 per group)
Containers such as peanut butter jars marked at about 250 ml
Hot, cold, and room temperature water
Clock with a second hand
Food coloring

Procedure: (completed in groups of 3 or 4 students)

1. Each student prepares a time vs. temperature table in his/her lab notebook. The chart and graph in Figure 1 show the expected results with seven different water temperatures. To limit costs and to allow the students

to complete the experiment in a reasonable time period, we recommend using only three water temperatures (hot tap about 50°C, room temperature and cold about 10°C). The student must decide what units of measurement will be used and how to design the table or chart.

2. Each group will need to decide when the Alka-Seltzer® tablet has completely dissolved. This point may be when they cannot see the tablet or when they cannot hear it fizzing anymore. A class demonstration, possibly using an overhead projector with an Alka-Seltzer® tablet in a shallow glass container, may be helpful in giving the students an idea of what to expect. It is important that the "endpoint" for a dissolving tablet is agreed upon before performing the actual experiment so that all students are consistent in recording their results.

3. Individual jobs for each trial should be assigned. Students can take turns being the tablet-dropper, timer, data-recorder and temperature-reader. Rotating these duties keeps everyone involved as well as ensures that everyone has been able to perform each task.

4. Students record the time it takes the Alka-Seltzer®s to dissolve in three different temperatures of water. Although Figure 1 shows seven data points, three temperatures (hot, room temperature, and cold) will be sufficient to make a fairly accurate graph. It is important that the same quantity of water be used for each trial. Before dropping the tablet into the water, the temperature must be read from the thermometer and recorded on the chart. The group then determines how long it takes the tablet to dissolve and the time (in seconds) is also recorded on the chart. This process is repeated using the same amount of water for different temperatures. We used a temperature range from 5°C (water that had been refrigerated) to 50°C (hot tap water). Water containing crushed ice did not give good results because the ice interfered with the dissolving of the tablet.

5. The students create a graph of their results. Students may need to be reminded to place the manipulated variable (temperature) on the horizontal axis and the responding variable (time) on the vertical axis. They can then plot the points according to their data and connect the points with the best curved line. (Fig.1)

6. Each group finally receives a colored water sample of an unknown temperature. This water is colored with food coloring to distinguish it from the other trials. The students must not use a thermometer for this trial. In our classroom, the students had to show their graph to the teacher and relinquish their thermometer before receiving the unknown sample.

7. The students record how long it takes the tablet to dissolve in the water sample of unknown temperature.

8. Using their graph, the students read what they would expect the temperature of the water to be, based upon how fast the tablet dissolved. At this point, we allowed them to check the temperature of the unknown with a thermometer to determine their accuracy.

9. The students write their conclusions in their notebook. This could include what they learned or how they felt about their experiment. A discussion of hidden variables is also appropriate for this section. For example: (a) the students could have broken one of their tablets, or (b) a tablet could have gotten wet and begun to dissolve prior to using it in the investigation, or (c) the students may not have been consistent in determining when the tablets were completely dissolved, or (d) they may have used different amounts of water for different trials, or (e) the water may have been swirling when the tablet was added. As you can see, the list of hidden variables goes on and on and on. Attempting to explain the results gives the student a chance to think about the procedure and to draw conclusions independently.

Notes

We used this investigation in a fifth-grade classroom after the students had been exposed to the concepts of charting and graphing. However, it could also be appropriate for junior and senior high school students. At the beginning of the year, this procedure could serve as a laboratory pretest in order to assess observation skills and the ability of students to appropriately record data and interpret the results.

Variations and expansions of this experiment could be designed. Here are five brief examples.

1. The effect of the percent of saturation could be observed by dissolving tablets in water containing different amounts of salt.

2. The effect of the percent of saturation could also be observed by dissolving tablets in varying amounts of water.

3. The effect of increasing the surface area could be investigated by breaking some tablets in half and crushing other tablets prior to dissolving them.

4. The rate of dissolving for different brands of antacid tablets could be compared.

5. The students could be asked to design their own experiment using Alka-Seltzer® tablets and materials within the classroom.

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