dumps and taking political action to clean them up. In addition, many have been looking into the state and federal laws about pollution and have been involved in contacting legislators and informing them of these "old" laws and requesting action on their behalf. Some students have been taking surveys from people about their feelings on family size and population control. As one can readily see, the class is actively involved in the entire environmental "scene." They are not only learning about ecologic principles as they affect man but they are living and working with this "new" ecology and are emotionally involved in the course.

The greatest aspect of the entire course is the breaking down of the academic barriers and having students from all fields of study work together in an endeavor to learn and find out more about their environment, and how each can contribute. This so-called interdisciplinary approach is working, and it can work if we use a model in which students can participate and give their insights into the problems and are willing to scratch heads together in order to develop a program that might work. We no longer can divorce ourselves from the other disciplines, but we must work, each of us, to bring together these vast fields of knowledge in order that mankind and the environment can benefit.

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A Study of the Needs of High School Biology Teachers

The knowledge explosion and the impact of the new curricula developed for high school biology instruction by national study groups, such as BSCS, have caused a scientific subject-matter content and competency lag for present-day high school teachers of biology.

In an effort to assist in updating the content background of biology teachers in the high schools, the departments of education and biology of Wagner College, with the aid of a faculty research grant, conducted a questionnaire survey of New York City biology teachers. The purpose of this teacher survey was to ascertain deficiency areas in biology background; to discover major interest areas within the biologic sciences; and to create a program for secondary school biology teachers to alleviate deficiencies and to update and expand the major interest areas.

The survey was accomplished by use of a questionnaire consisting of 245 content items organized into seven units. The content items closely paralleled the material covered in the New York State biology syllabus. The teachers were asked to judge each item on a three-scale rating: "high," "medium," "low." "High" indicated a desire for more in-depth information; "medium," for more general information; and "low," if no further information was sought.

The science department chairman of every New York City high school was contacted to determine the number of questionnaires that should be sent to each school. A total of 85 high schools participated, including local Staten Island private and parochial schools. 56 high schools responded—over 300 individual replies, for a return of 66%.

The results indicated that there were 95 items that had a cumulative "high" rating of 100 or more. ("100" out of approximately 300 possible "more in-depth information" ratings was an arbitrarily chosen number selected for inclusion of this item in the proposed program.) The areas of primary concern for the teachers as reflected by the questionnaire were within the realms of ecology, genetics, and evolution. In addition, recent information on certain aspects of human physiology and of cellular processes in both plants and animals was requested.

The survey reflects a concern shared by a large segment of our society for the great environmental crises that have recently come to light. Ecology, evolution, genetics, and certain aspects of physiology were rated "high," since they are intimately related to many of the problems created by our modern technology.

A program was devised to meet the needs as ascertained by the questionnaire. This proposal emphasizes selected aspects of biology content with an orientation towards current ecologic problems. For example, this program includes a study of the world population explosion, with an orientation based on reproductive physiology; and an analysis of the effects of air and water pollution on ecosystems, on organisms, and on cells, with respect to such processes as respiration and photosynthesis.

The program will provide a means for sustaining and intensifying interest from both an academic and a practical point of view. With this exposure, high school biology teachers should be better prepared to cope with the demands of today's biology courses and to keep abreast of the current knowledge explosion.

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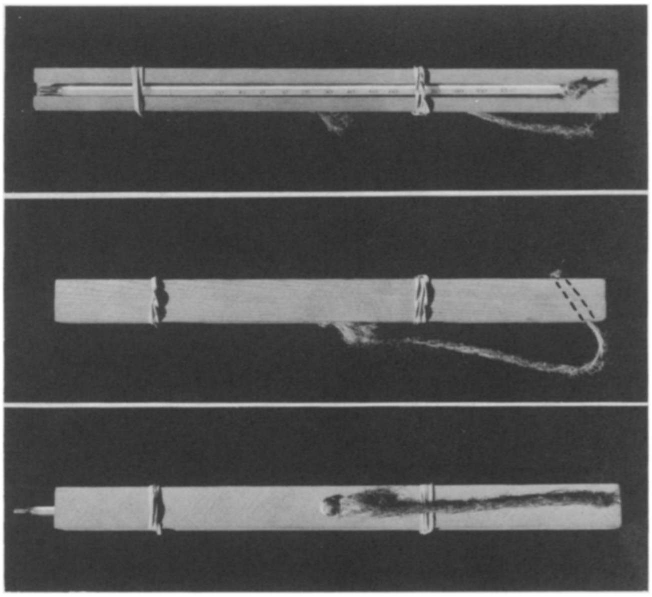
Guarding Your Thermometers

As part of an effort to develop a program in environmental education, an outdoor biology program for children in grades 4 to 6 was initiated at the University of California Botanical Garden, at Berkeley, during the past summer. A lesson on determination of thermal gradients was developed as part of that program. The purpose of this particular lesson was to show quantitatively the temperature differences that exist in different environments. The activity involved taking temperature measurements in various parts of the garden, and this meant that each student would be carrying his thermometer from place to place. The first class, of 17 students, broke three thermometers; the second class, of 20 students, broke two. The five thermometers were broken while being carried between study areas. The continued breakage of thermometers threatened to force cancellation of this highly successful activity. The children were not being careless; in fact, the opposite was probably true. High-quality centigrade thermometers were used, and the children seemed truly excited to be using high-quality equipment. Nevertheless, broken thermometers are both dangerous (broken glass and mercury) and costly to replace.

The problem demanded a solution, but a survey of biology supply houses proved to be fruitless. Manufactured thermometer safeguards were small, difficult to hold, and more expensive than the thermometers themselves. This problem led to the development of a thermometer guard (see fig.). The thermometer guard is a piece of wood 13 inches long, 1 inch wide, and 1 inch thick, made to accommodate a 12-inch thermometer. The thermometer rests in a groove at the top and is held in by rubber bands and a drawstring. The thermometer guard is easy to make, easy to carry, and tremendously successful in preventing thermometer breakage. After initiating the use of the thermometer guards in the thermal-gradient lesson, 71 students in the following four classes broke only one thermometer, and it was broken while the student was taking a measurement. Further testing is now in progress.

The thermometer guard for a 12-inch thermometer can be made by ripping a quarter-inch groove along the center of one side of a 13-inch piece of wood. A hole 3/16 to ¼ inch in diameter is next drilled at roughly 60° from the groove through to the opposite side. The hole should start ¾ inch in from the top and end ¼ inch from the bottom. The final step in the construction of the guard is a wooden plug which should fill the ¾-inch space between the hole and the end (optional).

Assembly takes only a few minutes, once the guard is constructed. A piece of string or twine is attached to the loop hole of the thermometer. The thermometer is laid in the groove and the string is threaded through the drilled hole. Pull the thermometer out about 2½ inches, pull the string taut, and attach it to the back of the thermometer guard with a thumbtack (a protrusion of 2½ inches should be adequate for most measurements). The last step is to place two strong rubber bands around both wood and thermometer, thus preventing the thermometer from falling out. When a temperature (other than that of the air) is desired, merely pull the thermometer out to its 2½-inch extent and take the measurement. At the conclusion of the reading, the thermometer can be drawn back into the guard and transported without fear of breakage.



Front, side, and rear views of the thermometer guard. Side view shows direction of bore for loop string.

Thermometers are a worthwhile addition to any science lesson, whether biology, physics, or chemistry. Temperature is one variable that is almost always important and at the same time easily measured. The possible tangents are innumerable. Math can be presented as a sensible and practical subject if interesting problems arise, while using thermometers, that only math can solve; for example, if using centigrade thermometers the students can use the conversion formula in order to get readings in Fahrenheit, which they can more readily understand. Equally important, the thermometer is one of the few pieces of scientific equipment that is small enough to be portable, and, if properly protected, it is inexpensive and safe enough to allow every student to have his own instrument.

Thermometer guards are only worth constructing, however, if relatively costly thermometers are used. It seems reasonable to want the highest degree of accuracy possible when conducting a lesson. More important, though: students given a quality instrument, one high in accuracy, are more likely to use greater care in measuring temperatures and calculating results. When presented with a poor piece of equipment, the student is likely to respond accordingly. The initial investment in acquiring quality thermometers and fitting each with a thermometer guard will be more than compensated for by years of profitable student use.

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