Social Issues Serve As Unifying Theme In a Biology Course

MELBA JAMES
EDWARD SCHMIDT
THOMAS CONLEY

WOULD YOU BE WILLING to stop teaching biology for one month of the school year? At Parkway West Senior High School, in Ballwin, Mo., 21 days are spent discussing biologic aspects of social issues. In fact, the entire biology curriculum is constructed around controversial issues confronting our society. This article examines the rationale, methods, and results of using social issues in biology.

Initially, we were hesitant about eliminating some of the traditional factual material from our course. However, the onslaught of environmental and social problems made us aware of some real needs of our students and society. The communications media have been busy reporting not only environmental problems but also problems of drug abuse, old age, cancer, food choices, venereal disease, alcohol abuse, and so on. Our students are confronted with these realities several times a day, every day. We felt it important that the students be able to examine the biologic principles and to apply the scientific processes to their very real social problems.

We agree that a major goal of education is to produce informed citizens; but of what value is the factual knowledge of biology if it is just stored and forgotten? Rather, as Alexander Meiklejohn says, our final responsibility as scholars and teachers is not to the truth: it is to the people who need the truth. We believe it is our responsibility to society, now and in the future. This inevitably couples truths in science with social issues.

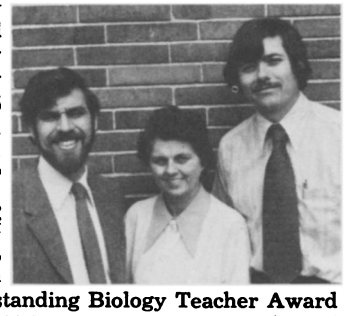
On the basis of these beliefs, we decided to structure our curriculum around social issues in order that the students would (i) become acquainted with some facts about the social issues of our civilization, (ii) use biologic information to reexamine the issues, and (iii) have a method of examining their views and suggested solutions.

What to Teach?

We desired to create a socially relevant and meaningful biology course and yet wanted a thorough course in general biology. Some 76% of our students will be enrolled in a college-biology program. Our first task was to identify the biology content and then align this content with social issues. We elected to begin the course with a study of ecology, so that we could do some field work. We continued with a study of the cellular processes, which all life forms have in common. This material was followed with studies of genetic continuity within a species, evolutionary forces, and embryologic development of organisms. Because students desire to dissect, we concluded with the classification and structure of plants and animals.

Criteria were established to select the specific concepts to be included in each of the broad content areas. The criteria were (i) the importance of the general understanding of biology, (ii) the ability to provide a laboratory experience that would enable the students to gather quantitative and qualitative data, and (iii) the existence of a social issue related to an understanding of the concept.

The accompanying table shows the selection and sequencing of the biologic content and the related social issue. The materials were grouped into 16 units, which we call "PAKs." Each of these was 11 days in length. The 16th PAK was an attempt to put the students into the normal situation that a citizen finds himself in when confronting a social issue: "What is its price?" We arranged a town-hall meeting for a mythical "New Bubbleton, Mo." The tax-



Melba James, Edward Schmidt, and Thomas Conley teach biology at Parkway West Senior High School, 75 Clayton Rd., Ballwin, Mo. 63011. Their paper was presented at the 1973 NABT convention. **James** *(pictured, center)*, a 1952 graduate of Southeast Missouri College, has her M.A.T. from Indiana University. She was the Outstanding Biology Teacher Award recipient for Missouri and NABT Region IV in 1964; chaired the committee that wrote Missouri's *Biology Curriculum Guide*; organized the Biology Association of Teachers in the St. Louis Area (an NABT affiliate); and has held NABT regional and convention chairmanships. **Schmidt** *(left)*, a 1966 graduate of Cardinal Glennon College, obtained his M.Ed. from the University of Missouri at St. Louis. He and Conley served on audiovisuals committees at the 1972 NSTA convention and the 1973 NABT convention. **Conley** *(right)* also is a Cardinal Glennon College graduate (1969). He taught in and directed an HDC-funded adult-education program before joining the Parkway West faculty. Exploration of the geology of the western United States is his chief extracurricular interest. All three authors are avid photographers and campers.

Selection and sequencing of biologic content and related social issues.

Biologic content	*Social issue*
1. Flow of matter and energy	1. Should solid refuse be disposed of in landfills?
2. Relationship of organisms to each other and their environment	2. Should we continue the use of pesticides to control agricultural pests?
3. Population growth and regulation	3. Should the human race be considered too populous?
4. Succession	4. Should man continue the use of strip mining?
5. Cellular structure and diffusion	5. Should abortions be allowed?
6. Foods and respiration	6. Should Americans question the nutrition of the foods they eat?
7. Cellular multiplication	7. Should drugs that cause chromosomal damage be allowed?
8. Synthesis of carbohydrates and proteins	8. Should food shortage be allowed to control the size of the human population?
9. Gamete formation	9. Should we allow the use of mutagenic agents?
10. Mendelian laws	10. Should geneticists be allowed to alter the genes of men?
11. Natural selection	11. Should the minority have rights over a majority when the minority's health is involved?
12. Reproduction	12. Should we allow venereal disease to eliminate behavioral deviants?
13. Development	13. Should society retain all congenitally defective persons at home?
14. Plants: classification and structure	14. Should we allow man's technologic progress to continue the destruction of natural plant life?
15. Animals: classification and structure	15. Should we be aware of how we determine when we die?
16. New Bubbleton's budget	16. Should biologic principles form the basis of a community's resolution of its social issues?

payer–students were present when the alderman–teacher presented the yearly budget. Each department had budget items that were related to one or more of the social issues discussed. The students were asked to discuss the pertinent points of the budget and then to vote on next year's taxes.

How PAK Materials Were Presented

The basic pattern we used in constructing the material sequence in a PAK is shown in the accompanying diagram. The social issue is put before the student. This usually is done through the use of transparencies, statistics, or a situation. The students are asked to take a stand on the issue and to share their ideas. Usually, additional information is then given, so as to cause the student to question his position. On succeeding days the student is exposed to related biologic ideas and given the opportunity to verify these ideas in the laboratory. The PAK is terminated with a reexamination of the issue and a quiz.

The sequence of PAK 2 is typical. It is as follows:

Day 1. The history of DDT's rise to fame and fall to disgrace is presented. The student's task is to identify the chemical being discussed. Following this, data are given concerning the robin population on the campus of the University of Wisconsin. The students are asked to interpret these data. Then the students look at some agricultural data from Peru, where both chemical and biologic controls are used. The students are asked to interpret these data. The class ends with a discussion of the means that should be used to control agricultural pests.

Day 2. The method of examining a population is introduced. This basically involves factors and determiners and how they affect population densities.

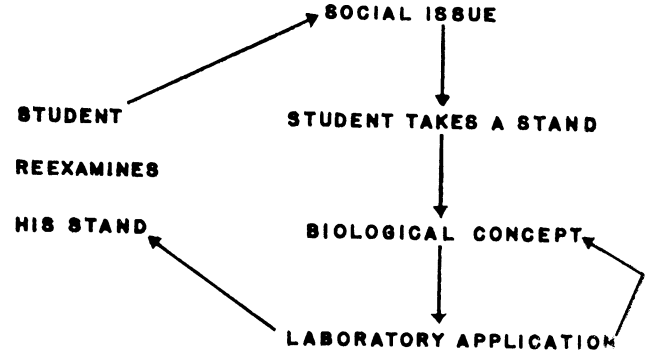
Day 3. A movie about the mallard duck is shown, and the students are asked to identify the factors, to say whether they are biotic or abiotic, to speculate on how they might affect the population density, and to identify the determiner through which they would act. The hour ends with a discussion of the students' impression of a population and its life habits.

Day 4. The students set up a lab, to study the effect of a biotic or an abiotic factor on the population density of yeast. Food is used as the biotic factor; temperature, as the abiotic factor.

Day 5. The data are collected and accumulated. The students analyze the lab, as a homework assignment.

Day 6. The labs are discussed, and the students discuss how pesticides fit into this information. The latter part of this hour is used to look at transparencies of the major biomes of the planet and thus to acquire some information about their abiotic conditions and the plants and animals that are characteristic of the biomes.

Day 7. The students have the task of enlarging their concept of a species. The first part of the lesson is designed to help the student formulate some inferences about the species concept and its place in



Schema used to develop each PAK.

taxonomy. The second part of the lesson uses the BSCS Inquiry Film *The Prairie Chicken.*

Day 8. The students visit a field that is partly mowed and partly unmowed. Which abiotic factors are most important in causing the differing vegetation? The students make sketches of the field. They are told about the different kinds of plants.

Day 9. We are back in the field, collecting data. Students work in groups to obtain a part of the data. Both abiotic and biotic data are collected.

Day 10. The field data are accumulated, and the students discuss possible explanations of the differences in vegetation. They are asked to suggest how the use of pesticides might affect this field.

Day 11. The content of the PAK is pulled together, from the framework established on the first day, and a quiz is given.

Students' Responses to the Program

How successful has been the inclusion of social issues in the biology curriculum? Last year we conducted two surveys of our students. One was an end-of-the-year general survey of attitudes; the other (conducted by Melba James and Ed Schmidt for presentation to the Missouri Science Academy) compared social-issues biology with traditional biology.

The general attitude survey of the students showed the following:

1. 97% thought the inclusion of social issues was great, and more than 50% wanted more of the social-issues lessons.

2. When students were asked to pick what they considered to be the three most important social issues and the three least important issues, the student's responses gave varying ratios of best–least importance; for example, drugs and mutations had 33 "best" for each "least" response, and overpopulation had 9 "best" for each "least." Only one of the 16 social issues was overwhelmingly rejected: the lesson on monocropping. (This lesson was altered this year to include the issue of strip mining as another example of land use and its effect on succession.)

3. In the section in which the students could express their opinions about the course, the bulk of the comments centered on the materials of the course and the usefulness of the course.

The second study was set up so as to be computer-scored and statistically analyzed. It surveyed the 10th-, 11th-, and 12th-graders who had taken biology or were taking biology. In all three grades, similar biologic concepts had been taught; in many cases even the same basic learning materials had been used. The major difference was the use of social issues as a unifying theme for the biologic concepts. An analysis-of-variance test showed four significant differences ($P < 0.01$) between those who took social-issues biology and those who did not: the social-issues biology students indicated that the course (i) was not frustrating, (ii) was easy, (iii) was such that they learned more in it than in any other academic course they had taken, and (iv) was such that they learned more than they had expected.

There have been other indications of success. The number of sections of advanced biology increased from one section to four sections. In addition, last year's students have been "public-relations personnel": when we returned to school last fall, preenrollment in biology had jumped by 100!

These findings have encouraged us to continue on this path of making biology a useful subject to help students to develop a greater understanding of social issues and to acquire skills for dealing with them.

Acknowledgment.—Our colleagues Elizabeth Rosenbaum and Victor Phillips, who teach biology, were participants in the development of the course; indeed, they might well have been listed as coauthors.

Human Traits . . . from p. 336

REFERENCES

BUFFON, G. L. LECLERC, COMTE DE. 1828. Addition à l'article des variétés dans la génération, et aux articles où il est question de la génération spontanée. In *Histoire générale des animaux: œuvre complète de Buffon.* Paris. Vol. 12, p. 366–404.

BULLOCH, W. 1938. *The history of bacteriology.* Oxford University Press, London.

CHAMBERLIN, T. C. 1965 [1890]. The method of multiple working hypotheses. *Science* 148:754.

CONANT, J. B. 1953. Pasteur's and Tyndall's study of spontaneous generation. In *Harvard case histories in experimental science,* ed. by Conant. Harvard University Press, Cambridge, Mass. Case 7.

COOPER, T. 1917. Needham, John Turberville. In *Dictionary of national biography.* Oxford University Press, London. Vol. 14, p. 157–159.

DARWIN, C. 1963 [1859]. *On the origin of species.* Aldine Press, Letchworth, England, p. 456.

GETZELS, J. W. 1964. Theories of learning and instruction. In *63rd Yearbook, National Society for the Study of Education.* University of Chicago Press, Chicago. Part 1, p. 251.

NEEDHAM, [J.] T. 1748. A summary of some late observations upon the generation, composition, and decomposition of animal and vegetable substances. *Philosophical Transactions of the Royal Society of London* 45:615.

PASTEUR, M. L. 1862. Mémoire sur les corpuscules organisés qui existent dan l'atmosphère: examen de la doctrine des générations spontanées. *Annales de Chimie et Physique* 64:66.

PLANCK, M. 1949. *Scientific autobiography and other papers.* Philosophical Library, New York. p. 33–34.

PLATT, J. R. 1964. Strong inference. *Science* 146:347.

SPALLANZANI, L. 1769. *Nouvelle recherches sur les découvertes microscopiques, et la génération des corps organisés.* Paris; 2 vol.

_____. 1776. *Opuscoli di fisica animale e vegetabile dell' abate Spallanzani.* Modena.