

The Impact of BSCS Biology

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One of the new science curriculums which has had a hard hitting impact on high school biology and to some extent college biology is the Biological Sciences Curriculum Study (BSCS) program. The program developed as a result of action by the Committee on Education of the American Institute of Biological Sciences. College and university biologists, together with science educators and many high school biology teachers, have sat together and developed a complete package of materials for high school biology. The funds for an operation of such a large scale have been provided primarily by the National Science Foundation.

SPECIAL FEATURES

The BSCS has attempted to provide the following in its program for high school biology:

1. An *investigative* approach to modern biology in contrast to a *descriptive* approach in former biology programs. Inquiry is the method by which knowledge about biology is acquired. Biology is an open-ended field of study, not a set of encyclopedic facts.
2. The BSCS has provided a pure science approach in response to major advances in molecular and cellular biology, population biology, genetics and metabolism. The books place an emphasis on these areas and de-emphasize contributions from nutrition, health, disease, conservation, and agriculture.
3. Molecular and cellular biology are emphasized much more than the organ and tissue level of biology.
4. The BSCS program has further stimulated the development of outdoor biology laboratories.
5. Laboratory work is more investigative and quantitative than the former programs. This program requires more lab space, equipment and supplies. Greater emphasis is placed on use of living materials than preserved specimens.
6. The BSCS program has attempted to take a fragmented, factual, compartmentalized field of biology and tie it together by emphasizing a theme approach.
7. The BSCS program provides a complete program for *all* biology students through such features as the *Special Materials* program, lab blocks, materials for gifted students, teachers' guides, technique films, pamphlet series and tests.
8. The BSCS curriculum has added discussions of evolution and human reproduction in its text material. Fifteen years ago we did not find much about this in biology books. There seems to be more acceptance by society for allowing this information to be taught.
9. The testing program has developed test items which examine the higher mental abilities of students such as comprehension, analysis, synthesis, application of facts, and the understanding of the methods of science, rather than the mere memorization of facts.

RESEARCH FINDINGS ABOUT BSCS BIOLOGY

Extensive studies about the BSCS biology program have been made by the BSCS [1]. Some findings which are relevant to the impact of the BSCS program are:

1. Average and above average students did well on achievement exams which measured the objectives of the BSCS program.
2. BSCS students scored significantly higher on the *BSCS Comprehensive Test* than did non-BSCS biology students. The non-BSCS students achieved significantly higher on the *Cooperative Biology Test* than the BSCS students.
3. Teacher salary, adequacy of laboratory, small class size, and proportion of the school's graduates going on to college showed a positive relationship with student achievement on the *BSCS Comprehensive Exam*.
4. The analysis of variables in BSCS student performance as measured by the *BSCS Comprehensive Final* indicated no significant differences in terms of rural-urban schools, size of schools, length of class periods, number of periods per week, per pupil expenditure and such teacher characteristics as age, years of experience and number of undergraduate and graduate hours in biology in the sample populations.

Blankenship [2] reported the attitudes of 55 teachers toward the BSCS program. These teachers were attending an institute which was preparing them for the BSCS programs. The results of a questionnaire study given to the teachers showed that teachers with three or less years of teaching experience had favorable attitudes toward BSCS program, those with three or more years experience reported unfavorable attitudes. Blankenship noted the unfavorable attitudes were not due to BSCS courses, but were unfavorable due to the lack of laboratory space, materials, references, equipment and supplies in their schools, the teacher's poor background in biology and the excessive work demanded by the extensive laboratory program.

A study of the "Effect of BSCS and Conventional Biology on Critical Thinking" was reported by Kenneth George [3]. George reported a study which compared students taking BSCS *Green*, *Yellow*, and *Blue Versions* respectively with students in non-BSCS control groups. The *Blue Version* group was the only one which showed a significant difference over the non-BSCS group on the *Watson-Glazer Test of Critical Thinking*. The study was limited in that there was only one class of *Blue Version* students.

The College Board Biology Exam reflected no significant differences between BSCS students and non-BSCS students. It is doubtful if College Board Exams will be set up exclusively for BSCS or non-BSCS students.

SUBJECTIVE EVALUATION

Recently an article by Ausubel [4] has created somewhat of a stir in biological education. Ausubel writes that the BSCS materials are "reasonably congruent with the content and methods of modern

biology, but, except for the *Green Version*, are psychologically and pedagogically unsound for the majority of tenth graders." Reasons for his statements are:

1. Students are being moved into high school with little prior preparation in science.
2. The *Blue Version* and the *Yellow Version* show a lack of concern with applications to familiar or practical problems in biology.
3. The books contain very highly sophisticated information. There is too much detailed biochemistry.
4. The thematic organization is poor. Some topics, particularly in the *Yellow* and *Blue Versions*, such as evolution, genetics, reproduction and ecology are treated as independent and unrelated ideas.
5. The *Blue* and *Yellow Versions* violate psychology of learning in that the student first encounters less familiar material, molecular and cellular biology, before he encounters more familiar material such as organisms, ecology, and mammalian physiology.

As a rebuttal to Ausubel, it is the opinion of this writer that students are ready for a molecular and cellular approach to biology in the tenth grade. Much biology in the elementary and junior high school is organismic in character and much human physiology is taught. In fact, physiology is offered at a very appropriate time in the student's physiological development. New courses, such as *Introductory Physical Science* are being developed which will introduce and strengthen children's thinking at the molecular level of science.

In developing the BSCS materials the writers realized that one simply cannot "add" information to texts, therefore much applied biology was excluded from BSCS materials. That information most relevant to the development of concepts, principles, and themes which give structure to biology was included. The structure idea is the foundation for most of the new science curricula. Thus it is assumed that effective biology teachers will add applications of basic concepts most relevant to their teaching approach. It is doubtful if future revision of BSCS will contain applied biology to a large extent, but perhaps biological problems related to conservation, agriculture, nutrition, medicine, and disease will be set up so students can approach them as inquiry, not as problems which have been already solved. If some themes were poorly developed, perhaps revisions of the text will clarify them. At least the theme idea is a much richer concept to apply than to continue writing texts which are encyclopedias of facts.

The tests published for the BSCS programs provide the stimulus in getting students to think! Opportunities to pass BSCS exams from rote memorization are negligible. Certainly BSCS tests reflect the testing of higher mental processes in students. This in itself is a major contribution of BSCS.

BSCS Biology may be sophisticated, but it was written to challenge

students. BSCS has also provided the *Special Materials* book for disadvantaged learners. It is the only NSF supported curriculum which has helped the slow learner.

THE FUTURE

BSCS Biology is different. It had to be in order to make an impact on American and International Biological Education. About 25 to 30% of students in American schools take BSCS Biology. Arnold Grobman, former director of BSCS, predicts that in five years about 75% of our students will take some kind of BSCS Biology. It is still too early to report accurately what BSCS Biology will have on introductory college biology courses. The Commission on Undergraduate Education in the Biological Sciences is carefully studying this problem as well as other innovations in the total college biology curriculum. There should be some published research reports on the impact of BSCS Biology on introductory college biology courses very soon.

BSCS Biology will also stimulate writers to develop new biology programs and this is a healthy approach. The biologist, biology teachers and science educators have developed and will continue to develop challenging programs for biology.

REFERENCES

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- [3] GEORGE, KENNETH. 1965. "The Effect of BSCS and Conventional Biology on Critical Thinking." *Journal of Research in Science Teaching*. 3: 293-299.
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ENGLAND INVESTIGATES PESTICIDE EFFECTS

A two-year investigation into the pesticide contamination of food has begun in Britain covering some 400 samples of foods in common use, in more than 200 areas.

Investigators will be looking for the presence of lead, arsenic and mercury residues, which would not be disclosed by biological tests. Eggs will especially be examined for the presence of mercury.

Bread, meat, fish, milk, fruit and vegetables in seven zones will also be included in the sampling.

Neither the Association of Public Analysts, who first proposed the inquiry in June 1965, nor the 200 local food and drug authorities believe there is cause for alarm. The aim is mainly to reassure the public about the food they buy. If, however, high levels of pesticide residues are found in samples, the authority concerned will be empowered to take immediate action.

The results of all the samples taken, after examination by gas-liquid chromatography and biological tests, will go to the Association of Public Analysts for a national report.