

ones, and the biology teacher must decide which of these structures or combinations thereof he will use.

But there seem to be missing links between the choice of content structure and the education of the students. One of these important links is the structuring of an effective learning sequence that will be as compatible as possible with the structure of content.

Where does this structuring begin? First, the teacher needs to define learning and education. According to Bloom, "Learning may be conceived of as change, due to experience, in the student's way of thinking, feeling and acting. Thus conceived, education may be regarded as a system of learning experiences which bring about certain desirable changes in students." (1) If the teacher accepts these conceptions of learning and education, then he needs to carefully determine what these desired changes are in terms of the content structures chosen. In other words, the teacher needs to be clear about the educational objectives or goals for which he is striving.

Once these desired behavioral changes are clearly in mind then the best available instructional strategy for achieving these changes should be employed whether it be lecture, discussion, self instructional programmed learning, still picture, film, or closed circuit television. Too often, the teacher is media (stimulus) oriented rather than learner (response) oriented. The selection and utilization of the learning experience should be in terms of the behavioral changes desired in the learner.

However, determining objectives and establishing selected learning environments is not enough. There is another link which is equally important. The teacher must determine the effectiveness of these learning environments by testing the learner in terms of the desired behavioral changes. If the results of the tests so

indicate, instructional strategies should be revised, tested and revised until the best results possible are obtained with the available time and accessible instructional resources. This testing should not prematurely judge the instructional designs but neither should it be delayed to such an extent that errors are repeated and eventually institutionalized.

The remarks of Dr. Robert M. Gagné in the summary of his article in *NABT News and Views* are particularly pertinent to the above discussion, "Many findings of research on human behavior can be adduced to provide a systematic basis for modern curriculum design in mathematics and science. Increased emphasis on the logical structure of content, de-emphasis on mere verbalizing, provision of practice in strategies of problem solving and broad coverage of science processes, are all trends which in one manner or another, may be expected to improve learning and retention, and perhaps even more importantly, to increase the generalizability of the knowledge acquired by the student. The research psychologist is inclined to believe that there are additional implications of the study of behavior which are equally well established, but which are not as generally represented in curriculum development efforts. Among the most important are the defining of behavioral objectives, the specification of means and modes of instruction, and the assessment of learning outcomes. All of these aims together need to be served in the building of improved science education." (2)

1. Bloom, Benjamin S. "Testing Cognitive Ability and Achievement" in *Handbook of Research on Teaching*, N.S. Gage, Ed., Chapter 8, page 386.
2. Gagné, Robert M. "Some Psychological Factors in Science Curriculum Design," *News and Views of NABT*, Vol. VIII, No. 3, December, 1964 page 6.

Photo Tips for Biologists

● Clarence M. Flaten, Assistant Editor

Your photo editor recently called for pictures showing young biologists at work in the laboratory. The prints we received in response to this call were largely disappointing. Most of the prints, while technically good, either pictured the youngsters looking directly into the camera or failed to show

what they were doing. The result—no usable pictures!

To illustrate these points your editor has taken two series of pictures which demonstrate the difference between snapshots and pictures that show interested young biologists at work in the laboratory.

Series A



Fig. 1. Snapshot of a young biologist. At the moment he is watching the business of taking the picture. Mother may like this shot, but it is not satisfactory for the journal.



Fig. 2. A second picture has the youngster looking into the aquarium. This is an improvement over shot 1, but the interest seems only superficial. Also a minor objection is the position of the chin behind the top edge of the aquarium. This appears to dissect the chin.

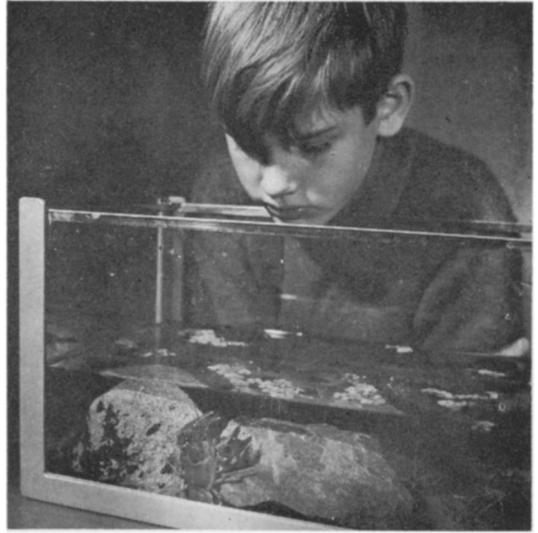


Fig. 3. There is a further improvement in this picture which is analyzed as follows:
a. A higher camera angle raises the chin into a position above the edge of the aquarium.
b. The interest in the young biologist seems more intense and real.
c. Life in the aquarium is more clearly shown. This life gives the youngster something to look at.

Series B



Fig. 1. The usual snapshot type of picture. There is wonderful potential material here for a picture.



Fig. 2. Give the boys a microscope and something to do and look at and there is genuine interest immediately. This is a medium distance shot made with the camera slightly above the petri dish level to show the duckweed.



Fig. 3. To get the picture, the camera is brought in closer on the boys and lowered slightly to place more emphasis on the boy's faces and expressions. Close-ups often add interest as well as show additional subject detail.

Book Reviews

All unsigned reviews were made by Editor.

Human Biology

THE BODY, Alan E. Nourse, 200 pp., Time-Life Science Library, New York, 1966.

This volume in a remarkable series concerns the human body, and written as it is by a physician, has a distinctly medical flavor. Also, as usual, the illustrations are superb. There is a great deal of attention to anatomy with the treatments of muscles, bones, and the heart in fine detail. The digestive system is charted as some gigantic monopoly game. The last "picture essay" is on medical education.

From this, the flavor of the book is apparent. It is medically oriented, splendid illustrations in full color, with some attention to cellular biology, but with chief emphasis on an interestingly written account of the human body and some of its aberrations.

LABORATORY MANUAL OF STRUCTURE AND FUNCTION IN MAN, Stanley W. Jacob and Clarice Ashworth Francone, 219 pp., \$3.50, W. B. Saunders Company, Philadelphia, 1966.

This anatomy and physiology laboratory manual by Jacob and Francone, with its neat design and compact format, appears at first

glance to be an abridged or limited effort. However, a closer scrutiny reveals that they have included a wide range of exercises and activities suitable for shorter courses as well as longer ones. There are seventeen chapters organized principally on the basis of the organ systems, except for a few on the usual generalizations of cytology and histology and fluids and electrolytes. Each chapter is then subdivided into one to twelve discrete laboratory activities—some being true "experiments," others being what could be more accurately termed supervised study sessions. For example, the chapter on skin has one exercise whereas the chapters on the circulatory and nervous systems have ten and twelve exercises, respectively. While some instructors would consider it lamentable that certain "experiments" are performed mainly with the aid of reference texts, charts, preserved specimens, and models, they should be reminded that there are eighty-five "experiments" to choose among. Moreover, certain schools will not be equipped to perform all the exercises with all their variations and can make good use of the activities not requiring elaborate equipment or extraordinary materials. Admittedly, this laudable feature of the book might be a drawback to those institutions with much modern equipment and new facilities; they would require a publication with more and greater emphasis on technical procedures.