Research Reviews

Jim Stewart
Department Editor

For the past two years, almost all of the Research Review articles have come from journals. As this second year of reviews draws to a close, I thought it would be appropriate to comment on some books that have reported on research in science education. All of the books deal either with theoretical issues on learning and problem solving, or report on the results of empirical studies. I have selected books that I think will be of interest to a wide range of biology teachers.

Novak, J. (1977). ***A Theory of Education.*** **124 Roberts Place, Ithaca, NY: Cornell University Press. $27.50.**

Although published nine years ago, this book is still current. Novak (who has often written for *ABT*) in many ways anticipated the current flood of research on learning in particular science content areas. More than anyone else, he has brought a cognitivist perspective to research in science education. This book is both enjoyable reading and provacative. He blends issues in learning theory (Ausubel) and philosophy of science (particularly Kuhn & Toulmin), with common sense in a way that should challenge each of us to think about our biology teaching.

Even though it is not a how-to book, with prescriptions for what to do on a day-to-day basis in the classroom, reflective teachers are likely to be able to construct their own prescriptions.

Gowin, D.B. & Novak, J. (1984). ***Learning How to Learn.*** **The Cambridge University Press, 32 East 57th Street, New York, NY 10022. (7.95).**

This book is a continuation of the themes set out in Novak's *A Theory of Education.* Melded from Novak's interest in a) concept learning, b) the importance of prior relevant knowledge on subsequent learning, and c) students as constructors rather than recipients of knowledge, and Gowin's writing on students' responsibility for their own learning, two techniques are presented for assisting learners to construct meaning and to better understand the nature of knowledge construction. The two techniques are concept mapping (developed by Novak and students at Cornell University) and VEE mapping (developed by Gowin at Cornell University).

Concept mapping is a technique that forces students to make explicit relationships among concepts. Thus, maps have the potential to promote meaningful learning. Vee mapping is a technique originally developed as a heuristic to analyze or "unpack" research reports. In the context of this book it is extended to encompass the analysis of labs or other events. Vee maps require students to think about knowledge generation, particularly the interaction between one's conceptions and theoretical commitments and the "methods" of science such as data gathering, data transforming, data interpretation.

In addition to describing the two mapping techniques, Gowin and Novak provide several illustrations of how they could be used in science classrooms. This book is aimed at classroom teachers, and is thus full of prescriptions for using maps in instruction.

Helm, H. & Novak, J. ***Proceedings of 1983 International Seminar on Misconceptions in Science and Mathematics.*** Available from Department of Education, Cornell University, 124 Roberts Pl., Ithaca, NY 14853 (approx. price: $15.00) or microfiche copies from ERIC, Ohio State University, 1200 Chambers Road, Columbus, OH 43212.

In these research reports I have written often about reports on student "misconceptions" or "alternate conceptions" in science. It has been my opinion that this research potentially can influence science instruction positively. This proceedings book brings together papers by leading alternate conceptions researchers, including reports of empirical research and those that are more philosophical/theoretical. It includes papers in the following categories:

Theoretical & Philosophical Issues
Instructional Issues
Research Methodological Issues
Historical & Epistemological Perspectives
Elementary School Science
Physics
Biology
Chemistry
Mathematics

While biology teachers may find many chapters interesting and rich in terms of their potential to influence teaching, the papers in biology may be most interesting. These include discussions of students' alternate conceptions of the human circulatory system, osmosis and photosynthesis. This book is a comfortable introduction to the whole topic of alternate conceptions.

Hunt, M. ***The Universe Within: 1982, A New Science Explores the Human Mind.*** **Simon & Schuster, 1230 Avenue of the Americas, New York, NY 10020.**

Much of the research we have reviewed in these pages has been on learning and problem solving, done within what I have called a cognitivist perspective. Underlying much of this research is a theoretical view of the human mind—information processing psychology. This psychological perspective, joined with the fields of artificial intelligence and linguistics, has led to a more or less unified discipline—cognitive science—concerned with language and knowledge acquisition and use, including specific concerns with problem solving. Hunt has written a popular account of the emergence and tenets of cognitive science that provides an excellent overview of the field.

The book is an informative blend of theory and empirical research that gets the reader actively involved. Hunt does a nice job of providing an historical perspective on the roots of cognitive science as well as the earlier beliefs about human thinking that cognitive science is a reaction to—behaviorism. His critique of behaviorism

Jim Stewart edits this *ABT* department. He is an associate professor in the Science Education area of the **School of Education, Department of Curriculum and Instruction at the University of Wisconsin-Madison, Madison, WI 53706.** Stewart is involved in research on learning and problem solving in genetics. He is also researching the use of microcomputers in biology, particularly in relation to genetics, at the high school and university levels.

is excellent. He also demonstrates that, while Piaget has greatly influenced current thinking about intellectual development and cognition, there is, as would be expected, more recent research that has caused changes in our understanding of development. These sections have significance for biology educators. Piagetian positions have had a virtual stranglehold on our thinking about how students learn biology and what biology they can learn. It is not that Piaget was not significant, or that his work doesn't continue to be valuable —he was and it is —but just as knowledge in the biological sciences is evolving, so it is in the social sciences. Just as a turn-of-the-century view of genetics has been modified with the newer view shaping current research and practice, it is true that psychology has changed—it is the newer psychology that should be influencing practice.

Hunt also has chapters on problem solving and creativity that are a synthesis of up-to-date research, much involving science content. While the book is not meant to be a handbook for teachers, there is, nevertheless, much in it that could allow reflective teachers to alter their instruction.

Walsh—Continued from page 300

dents want to give answers and get on with the exercise, and it takes a patient (and practiced) teacher to show how to use leading questions to mobilize a player who is stuck on a term. The language of negative feedback loops must have been a regular aspect of class for students to grasp the exercise in a reasonable amount of time. Even with regular exposure to feedback loops, we take a week to get proficient in the exercise. A major barrier to success in using this technique is the resistance that students have to a nonlecture format. It takes a while for some to take any exercise seriously that involves interacting with other students.

Given these problems, students come to enjoy the challenge of new sets of terms to deal with, as their positive comments on evaluations show. Many would like to use variations at different times during the year. One suggestion that I've received is to introduce the exercise earlier in the year and have students add significant terms to the deck as we cover new systems. Thus, the technique could serve as a focal point for integrating new knowledge. Perhaps as significant is the active role that students play in helping each other to learn.