

at the science courses elementary education majors already take, we find that most take biology. So why is biology not the best taught subject in elementary schools?

This system of university science courses has placed the teacher hopefuls in large introductory biology classes that have at most one advantage: They are cost-effective for the science departments. Shelia Tobias (1990) showed that students were being turned off to science in these introductory classes. David Hestenes (Hestenes, Wells & Swackhamer 1992) discovered that students in introductory courses, despite passing paper and pencil tests, may excel in plug-and-chugging, but not in understanding.

Furthermore, this approach places teacher hopefuls in a subsystem to learn science from professors who get slight or no rewards in terms of tenure, promotion or recognition for excellent teaching. So the elementary education majors and their nonscience counterparts from other departments leave the class firm in their original misconceptions: that plants eat dirt, photosynthesis is a respiratory process, and oxygen turns into carbon dioxide in the lungs.

Where in the elementary education major's school career, beyond a methods course, do they see models of how hands-on science should be taught? Most large scale introductory science labs are laden with cookbook activities. The most successful student in the cooking classes is the one who can follow the directions, not present or solve problems. The sole interactions of the lab teammates are to "divide and conquer" to finish assignments within the allotted 60 minutes. The science curriculum in most introduction courses is the textbook which is lectured to them by a science professor.

With the wrong role models we ask teachers to teach science the way the scientists teach it. And, sadly, the elementary teachers do. They only repeat what they have seen in their science courses: plug and chug, memorize the formula, and answer the problems at the end of the chapter. So when we assign accountability for poor quality teaching, we must also look at the science departments' part in educating teachers.

The education of teachers must be a community effort. Lee Shulman (1987) has shown that content alone, or pedagogy alone, does not make effective teachers. If the knowledge of content were the only factor in making an

exemplary teacher, our research scientists would be our best teachers. But this is not true. If pedagogy were enough, the Sumerhill experience and the open classroom would have worked. But it couldn't stand alone.

What are some of the positive things that biology departments can do to help train elementary education majors? The biology departments need to reward their professors for quality science teaching so that there is equal status for a professor who wants to devote his or her career to teaching. Departments need to direct the science content towards understanding for nonscience majors classes, not the content we have always taught "just because it always was." The economic reality is that departments must rely on teaching assistants, but these people need to be trained and rewarded for pedagogy. Content-specific classes need to be provided for elementary education majors. And finally, the best biology students need to be advised to go into teaching, not the ones we whisper "will never make it as a biologist."

## References

- Hestenes, D., Wells, M. & Swackhamer, G. (1992). Force concept inventory. *The Physics Teacher*, 30, 141-166.
- Tobias, S. (1990). They're not dumb, they're different. Tucson, AZ: Research Corporation.
- Shulman, L.W. (1987). Knowledge and teaching: Foundation of the new reform. *Harvard Education Review*, 57(1), 1-22.

## Operation Physics Clarified

### Dear Editor:

Thank you for printing the letter by Anthony J. Husemann regarding Operation Physics in your May issue. Although we appreciate Mr. Husemann's enthusiastic opinion of Operation Physics, his letter contains two minor errors.

First, Operation Physics is a program of the American Institute of Physics, funded in part by the National Science Foundation. Although Mr. Husemann refers to AIP as "the National Science Foundation's American Institute of Physics," AIP is an independent scientific association and not a subsidiary or peripheral organization of the NSF.

Second, the American Institute of Physics has relocated, and our new

address is: Operation Physics, One Physics Ellipse, College Park, MD 20740-3843, (301) 209-3008, (301) 209-0839 (fax).

Donald F. Kirwan  
Project Director  
Operation Physics  
College Park, MD 20740-3843

## Animal Use Policy Sparks Debate

### Dear Editor:

I have just received the February, 1994 issue of *News & Views* and am delighted with the NABT Position Statement, "The Use of Animals in Biology Education" that appears on page 14. It is far superior to anything on that subject that has come out of NABT previously. I commend the Board of Directors and am glad to see the Statement published and made available for all who are interested.

It is not quite a perfect statement, however. Let's paraphrase the fourth paragraph using a history class that has a student in it who hates, actually detests, memorization of dates. She says to her teacher that she'd like a substitute for memorizing dates. After all, she says, the history teachers' "association encourages teachers to be sensitive to substantive student objections to memorization and to consider providing appropriate alternatives for those students."

The teacher replies that he feels that the memorization of dates is a fundamental part of his course and that the history teachers' association "acknowledges that no alternative can substitute for the actual experience of memorization and urges teachers to be aware of the limitations of alternatives."

I agree with the teacher. He has properly preferred, for sound pedagogical reasons, the sentence he selected from the fourth paragraph over the one selected by the student. I think the teacher finds the sentence selected by the student to be a contradiction and a meaningless sop to kids who don't like to memorize dates.

To jump to the bottom line: Leave the Statement as is. We live in a multicultural society and what we have is probably the best that can be obtained in that society.

Arnold Grobman  
168 Crown Bay, Suite 310  
Charlotte Amalie, VI 00802