Letters to the Editor

Dear Editor:

Charles L. Vigue, in his article "Murphy's Law and the Human Beta-Globin Gene" (*ABT*, *49*(2):76, February 1987) made a mistake that could lead to a great deal of confusion. In the caption to Figure 2 (p. 77) it is indicated that the nucleotide sequence is given for the Sense Strand of the Beta-Globin DNA molecule, when in fact it is the code of the non-sense (or anti-sense, or non-coding) strand. The sense strand is the part of the DNA molecule which acts as the template for the transcription of mRNA; the non-sense strand is the compliment of sense strand.

Dr. Vigue adapted this sequence from an article that appeared in the journal *Cell;* this journal, as well as others use the convention of indicating the non-sense strand when reporting the nucleotide sequence of a DNA molecule, especially when the amino acid sequence is reported with it. Reporting the non-sense strand is logical since its sequence would be the same as the mRNA transcribed from the sense strand except that T's would appear where there would be U's in the messenger.

Further confusion is brought about by the indication that the "termination codon at the end of the coding portion of the beta-globin mRNA" is TAA, since thymine does not occur in mRNA under usual circumstances.

I have found this article to be very informative and helpful and will definitely use it to teach the process of mRNA maturation as well as the consequences of various types of mutations, but I will have to take care to clarify the convention being used to present the gene code.

Douglas Happ
Buffalo, NY

Dear Editor:

The excellent undergraduate biology program described by Donald H. Ost (March 1987, p. 153) covers the essentials while maintaining flexibility for both teachers and students. The program is so well planned that I have to go to the introductory paragraphs to find a point that should be clarified. Since this point is often repeated without proper qualifications, it needs to be considered.

Ost said: ". . . , scientific 'facts' are constantly being modified." This was preceded by: "Biological knowledge is tentative. . . . There are no immutable facts." I know what Ost means, but these words are too flatfooted for students. More than 50 years ago I learned thousands of biological facts. Today most of those facts still stand; I believe most of them will continue to stand throughout time.

Knowing that all facts and ideas in science can be tested does not imply that all facts and ideas "are constantly being modified." They are modified only when evidence is found that forces a change. In well-established knowledge, change driven by new evidence is the exception, not the rule.

When considering the instability of scientific knowledge, one should recall the words of Einstein and Infeld (*The Evolution of Physics,* Simon and Schuster, NY 1951, pp. 158-159.): "To use a comparison, we could say that creating a new theory is not like destroying an old barn and erecting a skyscraper in its place. It is rather like climbing a mountain, gaining new and wider views, discovering unexpected connections between our starting point and its rich environment. But the point from which we started out still exists and can be seen, although it appears smaller and forms a tiny part of our broad view gained by the mastery of the obstacles on our adventurous way up." The old theories remain and function, but only within their boundaries which a broader theory has helped to establish.

An examination of dozens of established theories in biology shows them to be an essential part of biological knowledge, still functioning within their boundaries. The cellular theory of sexual reproduction, the germ theory of disease and the antigen-antibody theory are examples. Theories that have stood up under testing long enough to be included in general textbooks are seldom discarded. During testing, the range of applicability and the boundaries of these theories were in large part determined. New theories that give us a broader view have not destroyed the earlier theories. Rather the new theories help us see the range and limitations of the earlier theories.

Ralph W. Lewis
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East Lansing, MI

Dear Editor:

I am writing in reference to Don Igelsrud's April 1987 column on dissection and pithing.

The question of whether or not dissection is an appropriate means of instruction for biological education has now become an issue in the United States. Jennifer Graham, the young woman in California who attempted to avoid mandatory dissection without penalty, was not the first student to dissent, nor will she be the last. There is a growing tendency on the part of students to object, on principle, to dissecting and vivisecting animals, and to seek alternative means of satisfying those academic requirements which have normally involved the use of animals.

In the absence of appropriate counsel and encouragement from lecturers and instructors in biology, it seems likely that there are many more students in the country who have performed dissection because they felt themselves unable to come forward and express their doubts as Ms. Graham so boldly did.

As more students come to resist the notion that animals should be dissected or vivisected when the factual knowledge obtained thereby can be secured by other means, the teaching community will be faced with a challenge. Instructors and lecturers must come to terms with this trend, and indeed they must be willing to accommodate evolving standards of animal welfare and animal rights.

Isn't it time for those involved with biological education to adopt policies that guarantee students with sincere moral objections to dissection and vi-

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Note: Letters to the Editor do not necessarily reflect the views of the National Association of Biology Teachers, publisher of the *American Biology Teacher*.

bottomless; there is always something new to discover about the living world around us. Sometimes this aspect of biology seems daunting—there is so much to learn. But that is also what makes this science so exciting. No matter how bogged down I might get with mortgage applications and paint cans, it's nice to know that there'll always be new biological treasures waiting for me and my students.

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visection the opportunity to continue their work in the biological disciplines, and clarify what steps should be taken in the event that instructor and student cannot agree on a satisfactory alternative? Such policies would not guarantee that the values of the student will always prevail; but it would ensure that those values will at least be taken into account.

What is to be gained by denying students who might otherwise be attracted to the study of biology alternative means of satisfying those academic expectations currently associated with laboratory dissection and/or vivisection?

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Research Reviews

Dan Wivagg
Department Editor

The diversity of animals is illustrated by the diversity of their methods of obtaining food. This month's column reviews papers dealing with some unusual aspects of animal feeding.

Cannibalism

Meefe, G.K. & Crump, M.L. (1987) Possible growth and reproductive benefits of cannibalism in mosquitofish. *The American Naturalist, 129,* 203-212.

Cannibalism has been reported in many groups of animals. Starvation, overcrowding, behavior stress and availability of victims have all been suggested as factors that might lead to cannibalistic behavior in various animals. Meefe and Crump provide evidence that mosquitofish derive nutritional benefits from cannibalism, and thus nutrition is an additional factor in the evolution of cannibalism.

Meefe and Crump fed mosquitofish (*Gambusia affinis*) a diet of commercial fish food supplemented with meal prepared from a crustacean, an unrelated fish, or mosquitofish. Fish fed unsupplemented food served as a control group. The cannibalistic mosquitofish had a significantly higher reproductive index (a measure of both number of embryos produced and rate of embryo development) than controls and fish fed with other supplements. In a second experiment, cannibalistic fish had the highest dry weight. Thus mosquitofish, which are known to be cannibalistic in nature, derive nutritional benefits from cannibalism. It is presumed that the nutritional benefits are at least partly due to the fact that nutrients required by mosquitofish would be present in exactly the right proportions in other mosquitofish.

Plants Benefit from Being Eaten

Paige, K.N. & Whitham, T.G. (1987) Overcompensation in response to mammalian herbivory: The advantage of being eaten. *The American Naturalist, 129,* 407-416.

It is logical to assume that plants are harmed by the activities of herbivores. They lose energy and photosynthetic tissues, or their reproductive structures may be destroyed. And they may become more susceptible to pathogens. We tell our students about the many defenses plants have against herbivores . . . anatomical ones like thorns and chemical ones like poisons. But strange as it may seem, there appear to be benefits that plants derive from being eaten.

Paige and Whitham report on experiments with biennial scarlet gilia (*Ipomopsis aggregata*), a plant that grows in the mountains of the Western United States. The inflorescence of scarlet gilia is frequently browsed by mule deer and elk; in many cases, 95 percent of the aboveground biomass is consumed. Browsed plants are somehow stimulated and produce an average of four new inflorescences. Thus browsed plants are able to produce 2.4 times as many viable seeds as unbrowsed plants. Such an increase in fitness as a result of browsing is entirely unexpected. The mechanism for this overcompensation is not known, but will be an important topic for future studies. Perhaps this ability to overcompensate can be incorporated into crop plants.

Dan Wivagg is an assistant professor of biology at Baylor University. He holds a Ph.D. in Botany from the University of Texas at Austin and a B.A. in Zoology from the University of Massachusetts at Amherst. At Baylor, he is coordinator of the introductory biology lecture sequence and director of academic advisement in the biology department. He has taught high school biology, and has a long-standing interest in biology education at all levels. He serves as associate editor of *The American Biology Teacher* and as editor of *The Texas Biology Teacher,* the newsletter of the Texas Association of Biology Teachers. His address is: Department of Biology, Baylor University, Waco, TX 76798.