

## TEACH EVOLUTION EFFECTIVELY

If you are looking for ideas that will help you to teach evolution, take a look at these two articles. They were published last year and offer specific suggestions for teaching evolution more effectively. The first one was by ENSI Co-Directors, **Craig E. Nelson**, with his article published in the special edition of the *McGill Journal of Education*, Spring 2007. The other, by **Jennifer Robbins and Pamela Roy**, was published in *The American Biology Teacher* for October 2007.

TEACHING EVOLUTION EFFECTIVELY: A CENTRAL DILEMMA AND ALTERNATIVE STRATEGIES  
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**ABSTRACT.** We will continue to have a public that is scientifically illiterate until we find ways to get faculty in post-secondary science classes to use effective pedagogical approaches. In this article, I present three scientifically and pedagogically valid strategies for helping students evaluate their initial understandings of evolution and to compare those understandings with more scientifically valid formulations. Adoption of such strategies in post-secondary teaching is central to more adequate preparation of future scientists, opinion leaders, and secondary school teachers.

The misunderstanding and misuse of science by our elected officials has become painfully public in recent years. At the very least, this underscores the lack of accurate scientific literacy in our society, and the failure of our educational system to meet that need. Our survival as an economically viable nation is at serious risk. Craig E. Nelson (one of the ENSI Co-Directors) vividly makes this point, with this crucial but seldom voiced observation: "... the mistaken assumption that all conflicting views deserve equal emphasis without regard to their validity is direct result of this failure." He then raises the challenge to our secondary and college science teachers to turn this around.

He recaps a failed approach: "Teach the science and ignore students' prior beliefs." He concludes with: Thus, the low levels of public understanding of evolution and of science generally are often matched with strong faculty reluctance to use educational approaches that research has shown to be most likely to lead to greater understanding and acceptance. The core to any escape from this dilemma is to recognize the difference between presenting creationist ideas as valid scientific alternatives and presenting them as alternative or misconceptions that need to be critically examined. A critical examination of creationism has been forcefully advocated by a recent president of the US National Academy of Sciences: "intelligent design should be taught in science classes, but not as the alternative to Darwinism.... It is through the careful analysis of why intelligent design is not science that students can perhaps best come to appreciate the nature of science itself" (Alberts, 2006, p. 741).

Nelson explores an even worse approach: "Two equal models." Here he states: Because college education has been so unsuccessful in producing graduates who are competent critical thinkers, ...much of the public and many politicians and journalists think that whenever there is a controversy both sides should be presented

as equally valid rather than as necessitating a consideration of comparative validity. But whenever alternatives are presented in science classes, we are *obliged* by the goals of both science and education to teach the students *how* to compare them on the bases of logic and evidence. A brief summary here of some relevant logical and evidential limits will make clear why any “two equivalent models” is the worst approach. [Italics added.]

[A fundamental flaw with Behe’s argument (in *Darwin’s Black Box*) for presenting creationism as scientifically valid] concerns its basic logic when advanced as science.

The appropriate logical conclusion when something appears to have no current scientific explanation is not that God or some other designing intelligence must have intervened. Rather, it is that no scientific explanation is *yet* apparent and that further study may be warranted. Science has a long and glorious record of finding natural explanations for things that seemed to be inexplicable.

[The second of two conclusions following from Behe’s arguments is that] ... the key task is to design effective educational interventions that circumvent the problems posed by a direct two-models approach, especially the psychological robustness of alternative conceptions in science as well as those of under-prepared teachers and a social and political climate that favors confusion on the scientific status of evolution. Further, this must be done in a way that respects, but does not necessarily support, a diverse array of religious beliefs among the students and teachers.

### **THREE ALTERNATIVE STRATEGIES FOR TEACHING EVOLUTION MORE EFFECTIVELY**

#### ***Strategy 1: Discuss selected misconceptions with only implicit reference to creationism.***

[Misconceptions included by Nelson were Thermodynamics and Organs of Extreme Perfection.]

[See the article in the *ABT* (Robbins and Roy, October 2007) on the effectiveness of assessing and discussing misconceptions, reviewed at <http://www.indiana.edu/~ensiweb/.....>]

#### ***Strategy 2: Make evolution and the nature of science central course themes.***

We conducted a series of institutes for high school biology teachers, put teacher-tested lessons and other resources on the web [ENSIWEB] and summarized key aspects of our approaches and their effects

Our premises, refined by working with the teachers, included:

- A clear understanding of the nature of science is an important outcome both on its own and as a way of understanding and defusing some of the controversy surrounding evolution.
- The nature of science should be a central organizing theme for the entire introductory biology course rather than a separate topic confined to just an introductory chapter or lesson.
- Evolution also should be made a central organizing theme for the entire introductory biology course rather than being largely restricted to one or two chapters or lessons that are easily dropped or condensed due to “lack of time.”
- Humans should be used repeatedly as central examples of the evidence

for evolution.

This combination helped the teachers understand the strength of the scientific support for evolution and the ways in which evolution was needed to make sense of all of biology. Comfort with their ability to explicitly counter creationist claims, should they arise either in or out of class, was quite important in encouraging many of the participating teachers to emphasize evolution.

*Strategy 3: More direct consideration of creationist claims*

CLOSING COMMENT

None of the strategies I advocate is a classic “two-models” or “teach the controversy” approach in the sense of treating any creationist models as valid scientifically. As noted in the introduction, I have found no creationist framework that can be rationally treated as equally valid. I hope that even those who are deeply opposed to explicitly presenting IDC or other creationist frameworks in public school science classes will find attractive some variant of the strategy (two) that makes evolution and the nature of science central course themes, ideally one that at least implicitly considers many creationist claims. Most of the high school teachers with whom we worked in summer institutes adopted some variant of this approach. However, I would suggest that teachers of post-secondary biology classes and of intensive, college-preparatory, secondary biology classes should seriously consider using at least some of the tactics summarized under strategy three. Although more evidence is certainly needed, it seems to me that only with these or similar tactics will pre-service teachers and future parents and opinion leaders be adequately prepared to address policy issues concerning evolution. Further, learning to explicitly compare and evaluate positions on controversial issues is a key advance in critical thinking ... one that is important for policy issues and for professional competency well beyond evolution.