

Dialogue

THE CHALLENGE TO TEACHERS

Teaching evolution presents special challenges to science teachers. Sources of support upon which teachers can draw include high-quality curricula, adequate preparation, exposure to information useful in documenting the evidence for evolution, and resources and contacts provided by professional associations.

One important source of support for teachers is to share problems and explore solutions with other teachers. The following vignette illustrates how a group of teachers—in this case, three biology teachers at a large public high school—can work together to solve problems and learn from each other.



It is the first week of classes at Central High School. As the bell rings for third period, Karen, the newest teacher on the faculty, walks into the teachers' lounge. She greets her colleagues, Barbara and Doug.

"How are your first few days going?" asks Doug.

"Fine," Karen replies. "The second-period Biology I class is full, but it'll be okay. By the way, Barbara, thanks for letting me see your syllabus for Bio I. But I wanted to ask you about teaching evolution—I didn't see it there."

"You didn't see it on my syllabus because it's not a separate topic," Barbara says. "I use evolution as a theme to tie the course together, so it comes into just about every unit. You'll see a section called 'History of Life' on the second page, and there's a section called 'Natural Selection.' But I don't treat evolution separately because it is related to almost every other topic in biology."¹

"Wait a minute, Barbara," Doug says. "Is that good advice for a new teacher?"

I mean, evolution is a controversial subject, and a lot of us just don't get around to teaching it. I don't. You do, but you're braver than most of us."

"It's not a matter of bravery, Doug," Barbara replies. "It's a matter of what needs to be taught if we want students to understand biology. Teaching biology without evolution would be like teaching civics and never mentioning the United States Constitution."

"But how can you be sure that evolution is all that important. Aren't there a lot of scientists who don't believe in evolution? Say it's too improbable?"

"The debate in science is over some of the details of how evolution occurred, not whether evolution happened or not. A lot of science and science education organizations have made statements about why it is important to teach evolution...."²

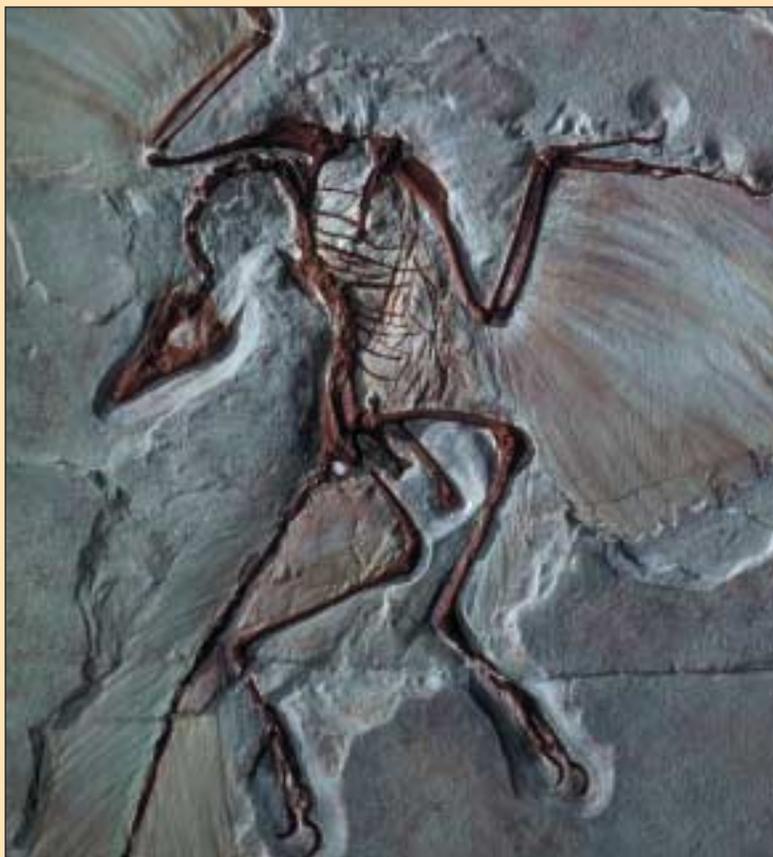
"I saw a news report when I was a student," Karen interjects, "about a school district or state that put a disclaimer against evolution in all their biology textbooks. It said that students didn't need to believe in evolution because it wasn't a fact, only a theory. The argument was that no one really knows how life began or how it evolved because no one was there to see it happen."³

"If I taught evolution, I'd sure teach it as a theory—not a fact," says Doug.

"Just like gravity," Barbara says.

"Now, Barbara, gravity is a fact, not a theory."

"Not in scientific terms. The fact is that things fall. The explanation for why things fall is the theory of gravitation. Our problem is definitions. You're using 'fact' and 'theory' the way we use them in everyday life, but we need to use them as scientists use them. In science, a 'fact' is an observation that has



A fossil of *Archaeopteryx*, a bird that lived about 150 million years ago and had many reptilian characteristics, was discovered in 1861 and helped support the hypothesis of evolution proposed by Charles Darwin in *The Origin of Species* two years earlier.

been made so many times that it's assumed to be okay. How facts are explained is where theories come in: theories are explanations of what we observe. One place where students get confused about evolution is that they think of 'theory' as meaning 'guess' or 'hunch.' But evolution isn't a hunch. It's a scientific explanation, and a very good one."

"But how good a theory is it?" asks Doug. "We don't know everything about evolution."

"That's true," says Karen. "A student in one of my classes at the university told me that there are big gaps in the fossil record. Do you know anything about that?"

"Well, there's *Archaeopteryx*," says Doug. "It's a fossil that has feathers like a bird but the skeleton of a small dinosaur. It's one of those missing links that's not missing any more."

"In fact, there are good transitional fossils between primitive fish and amphibians and between reptiles and mammals," Barbara says. "Our knowledge of fossil

intermediates is actually pretty good.⁴ And, Doug, it sounds like you know more about evolution than you're letting on. Why don't you teach it?"

"I don't want any trouble. Every time I teach evolution, I have a student announce that 'evolution is against his religion.'"

"But most of the major religious denominations have taken official positions that accept evolution," says Barbara. "One semester a friend of mine in the middle school started out her Life Science unit by having her students interview their ministers or priests or rabbis about their religion's views on evolution. She said that most of her students came back really surprised. 'Hey,' they said, 'evolution is okay.' It defused the controversy in her class."

"She didn't have Stanley in her class," says Doug.

"Who's Stanley?" asks Karen.

"The son of a school board member. Given his family's religious views, I'm sure he would not come back saying evolution was okay."

"That can be a hard situation," says Barbara. "But even if Stanley came back to class saying that his religion does not accept evolution, it could help a teacher show that there are many different religious views about evolution. That's the point: religious people can still accept evolution."

"Stanley will never believe in evolution."

"We talk about 'believing' in evolution, but that's not necessarily the right word. We accept evolution as the best scientific explanation for a lot of observations—about fossils and biochemistry and evolutionary changes we can actually see, like how bacteria become resistant to certain medicines. That's why people accepted the idea that the earth goes around the sun—because it accounted for many different observations that we make. In science, when a better explanation comes around, it replaces earlier ones."

"Does that mean that evolution will be replaced by a better theory some day?" asks Karen.

"It's not likely. Not all old theories are

replaced, and evolution has been tested and has a lot of evidence to support it. The point is that doing science requires being willing to refine our theories to be consistent with new information.”

“But there’s still Stanley,” says Doug. “He doesn’t even want to hear about evolution.”

“I had Stanley’s sister in AP biology one year,” Barbara replies. “She raised a fuss about evolution, and I told her that I wasn’t going to grade her on her opinion of evolution but on her knowledge of the facts and concepts. She seemed satisfied with that and actually got an A in the class.”

“I still think that if you teach evolution, it’s only fair to teach both.”

“What do you mean by both?” asks Barbara. “If you mean both evolution and creationism, what kind of creationism do you want to teach? Will you teach evolution and the Bible? What about other religions like Buddhism or the views of Native Americans? It’s hard to argue for ‘both’ when there are a whole lot more than two options.”

“I can’t teach a whole bunch of creation stories in my Bio class,” says Doug.

“That’s the point. We can’t add subjects to the science curriculum to be fair to groups that hold certain beliefs. Teaching ecology isn’t fair to the polluter, either. Biology is a science class, and what should be taught is science.”

“But isn’t there something called ‘creation science’?” asks Karen. “Can creationism be made scientific?”

“That’s an interesting story. ‘Creation science’ is the idea that scientific evidence can support a literal interpretation of Genesis—that the whole universe was created all at once about 10,000 years ago.”

“It doesn’t sound very likely.”

“It’s not. Scientists have looked at the arguments and have found they are not supported by verifiable data. Still, back in the early 1980s, some states passed laws requiring that ‘creation science’ be taught whenever evolution was taught. But the Supreme Court threw out ‘equal time’ laws,

saying that because creationism was inherently a religious and not a scientific idea, it couldn’t be presented as ‘truth’ in science classes in the public schools.”⁵

“Well, I’m willing to teach evolution,” says Karen, “and I’d like to try it your way, Barbara, as a theme that ties biology together. But I really don’t know enough about evolution to do it. Do you have any suggestions about where I can get information?”

“Sure, I’d be glad to share what I have. But an important part of teaching evolution has to do with explaining the nature of science. I’m trying out a demonstration after school today that I’m going to use with my Bio I class tomorrow. Why don’t you both come by and we can try it out?”

“Okay,” say Karen and Doug. “We’ll see you then.”



Barbara, Doug, and Karen’s discussion of evolution and the nature of science resumes following Chapter 2.

NOTES

1. The *National Science Education Standards* cite “evolution and equilibrium” as one of five central concepts that unify all of the sciences. (See www.nap.edu/readingroom/books/nse)
2. Appendix C contains statements from science and science education organizations that support the need to teach evolution.
3. In 1995, the Alabama board of education ordered that all biology textbooks in public schools carry inserts that read, in part, as follows: “This textbook discusses evolution, a controversial theory some scientists present as a scientific explanation for the origin of living things, such as plants, animals, and humans. No one was present when life first appeared on earth. Therefore, any statement about life’s origins should be considered theory, not fact.” Other districts have required similar disclaimers.
4. The book *From So Simple a Beginning: The Book of Evolution* by Philip Whitfield (New York: Macmillan, 1993) presents a well-illustrated overview of evolutionary history. *Evolution* by Monroe W. Strickberger (Boston: Jones and Bartlett, 2nd edition, 1995) is a thorough text written at the undergraduate level.
5. In the 1987 case *Edwards v. Aguillard*, the U.S. Supreme Court reaffirmed the 1982 decision of a federal district court that the teaching of “creation science” in public schools violates the First Amendment of the U.S. Constitution.