I Coping with the Creation/Evolution Controversy

Science can only be created by those who are thoroughly imbued with the aspiration towards truth and understanding. This source of feeling, however, springs from the sphere of religion.

—Physicist Albert Einstein, in
Science, Philosophy and Religion, a symposium (1941)

TEACHING SCIENCE is not easy. Students need to know many things about the world they live in—sometimes more than they want to learn. How the world works is what scientists are continually trying to find out. Their research has led to better materials, more abundant food, faster computers, and so on. But in gaining knowledge scientists have also challenged the way people think, which sometimes causes problems.

In the technologically developed part of the world, the scientific approach has become part of human experience. Other responses to the world—art, poetry, music, worship—are thousands of years older, but today young people without a grasp of science are culturally disadvantaged. And any country without a scientifically literate citizenry will soon find itself economically disadvantaged.

Good science teaching means more than conveying information about what scientists have learned. A more significant task is teaching the particular way scientists look at the world—a way not appreciated by everyone, even in a technologically advanced society.

Valid scientific conclusions are based on valid evidence. Students should learn how to evaluate evidence the way scientists are trained to do. Among other things, that means taking all relevant evidence into consideration while searching for still more evidence.

To teach with openness while upholding standards of scientific integrity does students a great favor. It also contributes to the health of science in our democracy, where basic research depends on continuing support from millions of taxpayers who aren't scientists. What is needed is not blind faith in science but understanding and a reasonable amount of public trust. To retain that trust, science must be taught without omitting important points, overstating its claims, or distorting the truth.

WARNING: A few critics have faulted this booklet for its incomplete presentation of evidence for evolution. Most high school teachers, however, correctly identify it as a supplement rather than a textbook.

The Science Teacher's Dilemma

Americans remain deeply divided in their beliefs about the origin and development of the human species, and a significant number care strongly enough about those beliefs to dispute how to teach the subject in school.

—Attorney and science historian Edward J. Larson, in
Trial and Error: The American Controversy over Evolution and Creation (1985)

BECAUSE SCIENTIFIC knowledge keeps growing, students must always be taught some things that were unknown when their parents went to school. The teacher's role becomes much more difficult if the whole scientific approach seems to run counter to values held by some parents. When that happens, teaching science in the public schools can be a risky business.

At the present time, the teaching of biological evolution in public schools is the subject of a major public controversy. To some extent the controversy arises from simple misunderstandings, but for some it represents a clash of opposing value systems. Science teachers who try to clear up the misunderstandings may feel quite vulnerable to criticism from both sides. In such circumstances, integrity in teaching requires courage as well as wisdom.

Biological evolution is often presented from a historical perspective, beginning with the early nineteenth-century concept of a static creation in which nothing had changed very much "since the beginning." Students are taught how that idea was gradually replaced by a picture of sweeping changes taking place over vast periods of time.

Why did most people eventually abandon the static view of "natural history" held by almost everyone well into the nineteenth century? The answer is that the accumulating geological evidence convinced scientists that the earth had had a very long history—a history of changes far greater than most had thought. None of the present forms of life had been on the earth all that time and many of the older forms had disappeared. Human beings seemed to be relative newcomers to a very ancient planet.

Science and religion were intertwined in the reading of that history in several ways. The static view of the world had been the prevailing way of interpreting both the physical data and the story of creation in the Bible. Yet the biblical picture—of an orderly creation by a dependable God—was one factor that had given impetus to the development of science.

A created world, which God had declared "good," had been deemed worthy of careful study by the pioneers of what was first called "natural philosophy." In a universe that "made sense" because its operations were overseen by a Supreme Intelligence, mathematical description and prediction were both possible and necessary. To quote Galileo, the Bible taught "how to go to heaven" but science described "how the heavens go."

Galileo Galilei (1564-1642), like Copernicus, Kepler, and other pioneers of science, was a sincere believer for whom the heavens declared the glory of God.

In the two centuries after Galileo, scientists described and predicted many things both in the heavens and on the earth. By the time Charles Darwin's *Origin of Species* appeared on the scene (1859), it was commonly believed that science could eventually explain everything.

Today it is commonly believed that science and biblical religion have always been at war with each other. That belief is not supported by historical investigation. Galileo, for example, was a devout believer in the Bible. Even in Darwin's day, many religious people accepted the evidence for great changes over

vast periods of geological time—without swerving from a firm faith that such changes were ultimately God's doing. They were able to separate the question of *when* new life-forms appeared from questions about *how* it happened.

The modern picture of how life changed over time was developed largely by geologists who believed in divine creation. The geologic column and the basic facts of fossil succession were established in science (and accepted by most theologians) by about 1840, some twenty years before Darwin proposed a mechanism to explain how such changes had taken place. [1]

Public interest in evolution has always been more complex than a simple clash between two conceptual frameworks, one scientific, the other religious. Further, the science taught in public schools is seldom at the cutting edge of research but rather is what is widely accepted, akin to what legal expert Edward J. Larson calls "public science." The compromise between scientific thought and public policy has its own history, in and out of the courts.

After the famous Scopes trial of 1925, evolution almost disappeared from American high school textbooks. It reappeared only after the Russians launched Sputnik in 1957. Sensing a need to upgrade science education, the federal government funded the Biological Sciences Curriculum Study. The three different high school biology texts produced by BSCS were integrated around evolutionary concepts. In several states, however, earlier laws against teaching evolution in public schools stayed in effect until the late 1960s.

Meanwhile, a movement was taking shape under the leadership of a few individuals with degrees in science whose interpretation of the Bible disallowed acceptance of an ancient earth. They wrote books containing ideas at variance with the main body of scientific thought but conforming to their own religious views. At first they were ignored by the scientific community, which saw nothing new in their criticisms of evolution. But their renewed version of early nineteenth-century science was in accord with the deeply rooted sentiments of many present-day religious fundamentalists.

Organizations sprang up endorsing the modern "young-earth" position known as "scientific creationism." Its followers began assaulting the teaching of evolution in every conceivable way. Activists introduced legislation, testified before state boards of education, threatened lawsuits, ran candidates for school boards, and put pressure on local schools and teachers. In response, small groups of scientists banded together in grassroots political organizations to defend evolution.

Tactics change from time to time. Unable to stop the teaching of evolution, believers in a young earth sought "balanced treatment" for their views, which they claimed were equally scientific. Early in 1982 a federal court ruling struck down an Arkansas balanced treatment act. Litigation over a Louisiana law worked its way up to the U.S. Supreme Court, where in 1987 "scientific creationism" was declared to be a religious view that should not be taught as science.

At the state and local level, political maneuvering continues, frequently focused on textbook selection. One anti-evolution strategy is based on the "establishment of religion" clause in the U.S. Constitution, which prohibits public institutions from favoring one religion over another. The claim is made that Christian children in public schools should be protected from the teaching of evolution. Why? Because evolution, when improperly taught, is seen by many as a doctrine of atheism or "the religion of secular humanism."

Debating whether evolution is "fact" or "theory" often obscures the factual nature of *evidence* and makes scientific theories sound like offhand guesses.

As an overall "explanatory principle," evolution remains a broad scientific and philosophical *inference*.

It has been well established (1) that the fossil record shows a succession of of life forms, and (2) that mutation and natural selection provide a plausible mechanism for the formation of new species (sometimes called *micro*-evolution). Other lines of evidence to be considered include the geographic distribution of plants and animals; similarities of "homologous" structures (human arm, bat wing, whale flipper); similarities in embryonic developmental patterns; the genetic makeup of populations; and now structural similarities in the genetic material itself. From the cumulated evidence biologists have inferred a general *macro*-evolutionary principle: "the genetic relatedness of all living things."

Many aspects of evolution are currently being studied by scientists who hold varying degrees of belief or disbelief in God. No matter how those investigations turn out, most scientists agree that a "creation science" based on an earth only a few thousand years old provides no theoretical basis sound enough to serve as a reasonable alternative.

Clearly, it is difficult to teach evolution—or even to avoid teaching it—without stepping into a controversy loaded with all kinds of implications: scientific, religious, philosophical, educational, political, and legal. Dogmatists at either extreme who insist that theirs is the only tenable position tend to make both sides seem unattractive.

Many intelligent people, however, who accept the evidence for an earth billions of years old and recognize that life-forms have changed drastically over much of that time, also take the Bible seriously and worship God as their Creator. Some (but not all) who affirm creation on religious grounds are able to envision *macro*-evolution as a possible explanation of how God has created new life-forms.

In other words, a broad middle ground exists in which creation and evolution are not seen as antagonists. With that middle ground in mind, a teacher need not "take sides" at all.

Some Classroom Guidelines

The extremity of creationist charges and claims is, to a degree, a reflection of corresponding extremities on the part of evolutionists themselves. Both extremes tend to fuel the fires of the other, and to find their worst fears realized.

—Conrad Hyers, in
The Meaning of Creation (1984)

MOST SCIENTISTS defend evolution because they regard it as a key biological concept. Probably most American citizens cherish creation as a basic biblical doctrine. Evolution and creation are often presented as polar opposites, so that if one interpretation holds, the other cannot. In a science classroom, head-on conflict is likely to erupt during almost any discussion of origins. When you as a teacher find yourself in that difficult situation, how should you respond? Here are some suggestions:

1. Use the opportunity. Although an *argument* over evolution with a know-it-all student can be counterproductive, a well-informed teacher can rescue the situation, turning it into a *discussion* that becomes a rewarding experience. Even students who come to class with blind spots in their view of biology can be shown how to ask critical questions, weigh probabilities, and separate facts from opinions. At the same time they can learn to recognize some of their own biases and those of others. If it doesn't get out of control, an energetic controversy can stir up greater interest in science as a whole.

2. Define the limits of discussion. Even the mention of evolution can trigger all sorts of images and issues in some people's minds. When old battles are fought again, old wounds are easily reopened. For more than a century,

evolution has been debated among scientists, philosophers, and theologians. They continue to wrestle with such questions as: How does evolution work? What does it explain? What does it fail to explain? What does it predict? Are there any reasonable alternatives? Could some as-yet-undiscovered mechanisms, biological laws, or rare cosmic events be integrated into the theory to make it more comprehensive in the future? How valid are evolutionary extrapolations from biology into other areas of thought?

Meanwhile, as we have seen, exactly what should be taught about evolution in public schools has become a legal question with political overtones. The subject is debated in legislatures and courtrooms, with media coverage often distorting the issues by focusing on extremes.

With so much going on at so many levels, it is hard to keep classroom discussions on a single level of responsible discourse. While you're trying to explore the limits of biological diversity at one level, someone may interject a biblical reference to "created kinds." The interpretation of scripture then gets mixed up with the interpretation of observations and experiments. Your task is to keep the discussion from roaming so widely that nothing is accomplished. Try to narrow the focus to a few clearly defined questions, but without ridiculing students who do introduce extraneous ideas.

3. Show respect for opposing views. Showing respect for a view one disagrees with means taking it seriously enough to try to put yourself in a proponent's shoes. Concentrate on the logical steps taken as students with different viewpoints interpret various kinds of evidence. Try to avoid making assumptions about motives, which are easily misjudged. The logical weight of an argument is what counts in scientific discussions, and a teacher should model the way a scientist might approach an unsolved problem. Typically, scientists pick apart their own ideas first, trying to anticipate any arguments that might be raised by others when their ideas are made public.

4. Consider the whole spectrum of opinion. Advocates of extreme positions tend to paint a win-or-lose, either/or picture. What some see as a con-

test between real science and a dangerous pseudoscience, others see as a defense of real religion against a blasphemous belief in "godless evolution" or "mere chance." Yet between those two extremes lies that broad middle ground where real science can coexist with real faith in God.

Portraying a disagreement as a clash between two warring camps is a common device for simplifying important issues. But to fortify one intellectual position against all others, and treat them as a single opposing force, is generally unrealistic. The cultivation of moderating positions is likely to be more productive but requires more effort. In fact even recognizing the existence of a moderating position demands the rethinking of one's own position. Nevertheless, continual rethinking is an important part of the way scientists operate.

5. Seek common ground. Suppose you find that class discussions of origins quickly gravitate toward polarizing positions. Then what do you do? It might be worthwhile to take up each position and let its adherents begin to work it out in detail. If that can be done without making students feel defensive, a kind of turning point may be reached—starting from either direction.

At such a point the "airtight logic" of an extreme position begins to break down, giving way to recognition that all is not so tidy. Thus, students who call themselves creationists may suddenly see that "creation scientists" cannot claim much knowledge of *how* God has created anything. Or they may see that *when* creative acts took place is still an open question among biblical scholars (Psalm 90, for example, which is attributed to Moses, speaks of differences in divine and human ways of reckoning time).

On the other hand, students who consider themselves evolutionists may see that explaining how things have *developed* may not tell us much about how they *began.* They may come to recognize that for any major transformation proposed on the basis of the fossil record, the mechanisms are far from understood. And even if we fully understood such mechanisms scientifically, the philosophical and religious questions of direction, design, meaning, and purpose would remain—beyond science.

In the end, proponents on both sides may come to agree on at least one (generally correct) point: it is easier to advocate a general position than it is to support it by detailed argument. One might say that extremists who oppose each other on nearly everything else do agree on one (generally incorrect) point. Both argue that no middle ground exists.

6. Watch your language. Terminology is a problem. For example, although *chance* has important philosophical implications in some usages, to a chemist a "chance collision of atoms" refers merely to a reaction that can be analyzed statistically. The word *sudden* may mean within a time-span of a microsecond to a physicist, of a few minutes to a bacterial geneticist, or of several hundred thousand years to a geologist.

The terms *evolution* and *creation* themselves cause much confusion. Astronomers use the term *evolution* to refer to the aging of stars and galaxies. In biology, it can mean small-scale changes within species, genera, and families; it can also mean a total change as large as from amoeba to human. Making such distinctions clear may be the most important classroom contribution of a well-informed science teacher.

Sometimes the scientific term *evolution* takes on the connotation of a world view recognizing *chance* (in the sense of happenstance or accident) as a kind of elemental driving force. Such a conviction, called by some *evolutionism,*

can function as a pseudoreligion. When *evolution* and *chance* are used in that sense, they could appropriately be spelled with a capital *E* or *C* (the way *God* is written with a capital *G*).

The word *creation* also has a broad range of meanings. Theists (including Christians, Jews, and Muslims) believe in God as both creator and sustainer of the universe; they view natural law as a reflection of God's wisdom and power. Atheists, on the other hand, believe that no creator exists and that natural law is autonomous and self-existent. Agnostics take no firm position on God's existence or on the "nature" of natural law. In between, many nineteenth-century scientists were deists, believing that God played no further role in the universe beyond initially winding it up like a clock.

All theists are creationists in that broad sense, and this includes many who are scientists with professional credentials and years of research experience. Where the scientific data are inconclusive, theists may express reservations about macro-evolution, especially since the biblical narrative seems to emphasize certain stages of divine creation. Hence such terms as *special creation, progressive creation,* and *theistic evolution* have been coined. In the heat of debate and in much popular writing, qualifying adjectives tend to drop off, leaving the erroneous impression that all creationists are united against all evolutionists.

7. Keep asking questions. Some students demand pat answers but most will appreciate openness. It is unnecessary (and in many circumstances unwise) for a teacher to "take sides" in class on the religious issue of Creator versus no-creator. But asking the right questions can help students identify such issues and distinguish science from *scientisms*—the philosophical positions that claim to be verified by science.

Many statements, whether made by scientists or theologians, cry out for someone to ask: What are you talking about? What do you mean? What's the evidence? How do you know? What assumptions are you making? What other conclusions make just as much sense—or more sense?

You might try some of these discussion-starters with your students, then develop your own examples:

—A leader in the creation science movement writes that "the truth of creation and the myth of evolution continue to be recognized by more and more people everywhere."

—Reporting on a cat-sized fossil primate from 18 million years ago, a popular science magazine concludes, "Other than the fact that it was one of the earliest apes on man's evolutionary line, little is known about *Proconsul africanus*."

—A television personality introduces a science program with the solemn words, "The Cosmos is all there is, there was, or ever will be."

—A Nobel prize-winning physicist includes in his book on the early history of the universe the statement that "the more the universe seems comprehensible, the more it also seems pointless."

—A newspaper account of a lecture on sexuality in primates reports an anthropologist's view that divorce, adultery, and promiscuity are inborn traits stemming from man's evolutionary past, "some 5 million years ago, when man came down out of the trees" (headline: PROMISCUOUS? BLAME IT ON APE FOREBEAR").

—An evangelist says of a fossil orangutan 16 million years old: "It is impossible to prove the age of anything concerning which we do not have reliable, intelligent, verbal, eye-witnesses."