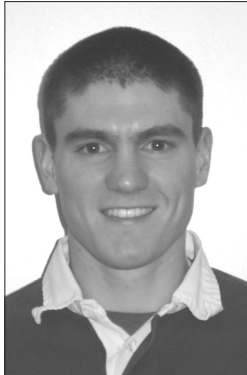


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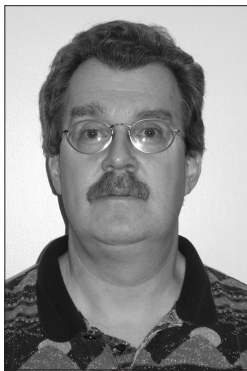
The Teaching of Evolution in Public School: A Case Study Analysis

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A Case Study Analysis



Timothy R. Johnson



Karl Giberson

Some of the more aggressive critics of evolution charge that it is being taught in America's public schools in a way that undermines traditional religious values and promotes atheistic naturalism. We examine this claim in some detail by looking carefully at the public school curriculum in one city. Research involved investigation of language used in the textbooks and mandated curricular goals, as well as extensive interviews of a number of teachers in elementary, middle, and high schools. Our research indicates that there is no basis for this claim.

As readers of this journal are fully aware, the teaching of evolution in public schools remains as controversial as ever within American culture. Claims are made by critics that evolution is, at best, an inadequate scientific speculation being taught as fact and, at worst, an extension of philosophical naturalism/atheism. Some charge that evolution comes disguised as science and is smuggled into public schools, where it serves to undermine traditional religious belief. More strident foes of evolution even argue that evolution is taught in such a way that it undermines morality and values in general and is a contributor to rising levels of crime, juvenile delinquency, homo-sexuality, and so forth. Lerner writes:

Such believers hold, moreover, that teaching the biological relationship of humans to other animals inevitably undermines any possible moral or eth-

ical teaching. If, they argue, humans are "only animals" they will "act like animals" (whatever that means). Teaching evolution thus leads to such broadly diverse social phenomena as atheism, communism, socialism, nazism, inflation, homosexuality, women's liberation, sex education, teenage sex, abortion, pornography, family breakdown, school shootings, crime, alcoholism, and drug addiction, to name a few.¹

Phillip Johnson, for example, one of the most strident critics of evolution today and no stranger to this journal, has suggested the following:

... the intellectual elite in America believe that God is dead. In consequence they think that reason starts with the assumption that nature is all there is and that a mindless evolutionary process absolutely must be our true creator. The common people aren't so sure of that, and some of them are very sure that God is alive.²

The purpose of this paper is to investigate the role that evolution plays in the curriculum of the Quincy, Massachusetts, public school system. Quincy was selected partly for practical reasons, and partly because we believe that its demographics suggest that it is not likely to be a school system where evolution is "soft-pedaled" in any way or unduly influenced by any significant local anti-evolutionary constituencies.

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Through a combination of interviews and examination of textbooks and other curricular materials, we have developed an analysis of the extent to which evolution is taught in Grades K-12 and of the particular strategies used by the various instructors. We have not been able, of course, to examine exhaustively the entirety of the curricular materials nor talk at length with every teacher. We do believe, however, that we have done enough so that our conclusions are representative and accurately reflect the general circumstances surrounding the teaching of evolution in the public schools of Quincy, Massachusetts.

Demographics

Located on the south shore of Boston, the city of Quincy is a largely blue-collar community; the population numbers about 88,000 with a significant minority of Asians, around 16,000.³ There are twelve elementary schools, five middle schools, and two high schools. The city is predominantly Roman Catholic and contains very few non-Christian religious communities. The population that would identify themselves as "evangelical" is also very small.

We approached this problem from the bottom up, starting with an examination of curricular material used in the elementary schools, followed by discussions with the elementary school teachers. Next we looked at the middle school curriculum and talked to the teachers in the middle school. We finished with a more careful analysis of the high school science curriculum and some broadly based interviews with high school teachers who focus primarily on biology, and thus have to deal with the challenges of teaching evolution.

This paper reports on the result of our study and provides a useful window into a topic of great importance and controversy. It also offers the reader a chance to compare the charges of the critics of evolution with a particular slice of our public education system.

Quincy Public Schools "Design for Learning"

The Quincy Public School System seeks to develop persons who stand out as "self-fulfilling individuals, citizens, and workers in a world that empowers all peoples to enrich their lives and the lives of others."⁴ The goal of the faculty is to educate children in an environment most conducive to learning and to produce life-long learners. The final product should be people who will contribute significantly to society.

The curriculum development staff for learning in science and technology articulate a specific rationale for science. They write:

The study of science as an intellectual and social endeavor—the application of human intelligence to

figuring out how the world works—should have a prominent place in any curriculum that has science literacy as one of its aims.

Acquiring scientific knowledge about how the world works does not necessarily lead to an understanding of how science itself works, and neither does knowledge of philosophy and sociology of science alone lead to a scientific understanding of the world. The challenge for educators is to weave these different aspects of science together so that they reinforce one another.⁵

Elementary Schools

Quincy Public Schools Elementary Learning Standards

The science standards for Quincy elementary schools seek to provide children with scientific knowledge and a way of learning that will serve as a firm foundation for more complex material that will come in the middle and high schools. The learning process is naturally progressive and instruction builds continually on earlier material. As students advance, foundational knowledge is reinforced and supports more difficult material. While the curriculum contains traditional facts and theories, the main goal is to instill a desire for learning. Students are encouraged to solve problems and make decisions based on what they know—to master, in an introductory way, the "scientific method."

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The curriculum for the elementary and middle schools was developed over four years, starting in 1997 with summer workshops. Instructors met during the summer, after school, and on Saturdays. Past rationale was examined and benchmarks were developed for a new curriculum. Special attention was given to the vocabulary of the new curriculum to insure that learning standards were clear and logical.⁶

Learning standards in the Science and Technology/Engineering Curriculum Framework are outlined clearly and organized within the appropriate domains of science, which include earth science, life science, and physical science. Standards also are broken down by grade level. For instance, children in grades K-2 are expected to observe

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and describe familiar objects and events by identifying details, similarities, and differences. They are to make predictions based on their past experiences with particular materials or objects; suggest and describe ideas; and describe how, why, and what would happen if these objects were placed in different situations. Later students will apply this knowledge in understanding more difficult material. For example, after observing that the moon looks a little different every day, but the same again every four weeks, children can dig deeper and learn reasons why this happens. Eventually students will come to learn about the rotation of the earth and the all-important numbers 23.5, 186,000, and 93,000,000. They will know what makes light reflect off the moon, why the same side of the moon always faces the earth, whether the moon is rising or falling, and what it will look like the next day.

There are no specific texts assigned for science in the elementary schools. Teachers are free to use sources they deem appropriate. For example, an experienced teacher at Beechwood Knoll elementary school uses a text titled *Cell Wars* by Dr. Fran Balkwill to provide an interesting way for her students to learn about the cells of the human body.⁷ Other teachers share materials or use resources such as the Internet, library, or other information providers.

In the elementary schools, the word evolution is not even mentioned because the elementary level is considered too early for children to dig into complex scientific topics. Many children have never encountered any science, and that is taken into account when presenting unfamiliar material. One elementary school principal also suggests that parents would not be comfortable with evolution being taught.

Middle School

Evolution enters Quincy classrooms in the middle school (grades 6–8). Like the elementary schools, the middle schools have no prescribed texts, freeing (or forcing) teachers to choose their own instructional materials, which often includes popular textbooks. The teachers, however, do have a curriculum framework and year-end “expectations guide.” Our research was done with the help of the principal and science teachers from

the seventh and eighth grades at Atlantic Middle School, which is typical of the other Quincy middle schools.

The middle school curriculum builds on the foundations laid in the earlier grades. Teachers are expected to follow the curriculum framework. Middle school students, e.g., continue to learn more about the cell and how cells work together to form a living organism. Students study specialized tissues, organs, and systems. Teachers demonstrate how these systems work together to ensure the successful functioning of the organism. Teachers also are expected to show how organisms interact in ecosystems, which are described as changing over time in response to physical conditions or interactions among organisms. Changes may be the result of predictable succession or the result of catastrophes, e.g., volcanic eruption or ice storms.

The year-end expectations are clearly outlined, listing all of the questions students should be able to answer within each particular domain of science after completing each grade level. Sixth grade students are to understand concepts about ecology, ecosystems, and organisms; the characteristics of living things and cells; and the classification of living things. For example, students must be able to state three basic concepts of cell theory, introduce phases of mitosis, and give examples of single cell and multicellular organisms. Evolution is not formally introduced, mainly because students do not yet have adequate background knowledge.

All this changes when students reach the seventh grade, where 38% of the science year-end expectations are directly related to evolution.⁸ Atlantic Middle School uses a set of colorful and current texts by Prentice Hall called *Science Explorer*. Evolutionary subject matter is found within “Cells and Heredity” in a chapter titled “Changes Over Time.” This chapter introduces Charles Darwin, the fossil record, and various proposed evidences for evolution.

Science Explorer surveys much of evolution but does not discuss human evolution, suggesting only that organisms change over time. Even when comparing early stages of development, the text avoids comparing other species to humans. For example, it says: “Turtles (left), chickens (center), and rats (right) look similar during the earliest

stages of development. These similarities provide evidence that these three animals evolved from a common ancestor."⁹

The text gives the age of the earth as 4.6 billion years, backed up with supporting evidence. There is no suggestion that the earth was the result of a random event. It says:

The formation of the Earth marks the beginning of Precambrian Time. The first living things, which were bacteria, appeared in seas 3.5 billion years ago. Algae and fungi evolved 1 billion years ago. The earliest animals appeared 600 million years ago.¹⁰

While incompatible with young-earth creationist interpretations of Genesis, the text makes no explicit reference to religious beliefs that have been challenged by these conclusions.

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In addition to the text, teachers are free to use additional sources of information. One seventh grade science teacher told us, "I don't cover much more than what is in the book, except a few days with the *Dawn of Man* video produced by The Learning Channel."¹¹ This is one teacher's attempt to expose the students to human evolution before they encounter it in higher grades. The Learning Channel describes the *Dawn of Man* as follows:

Five million years ago began the greatest story of all: how we came to be. Scene by scene, the astonishing drama of our history unfolds. Witness gripping reenactments of turning points in human prehistory like the invasion of Neanderthal Europe by our African ancestors. Experience the pain, fear, love and joy of early man in an extraordinary and unforgettable adventure that leads to a deeper understanding of ourselves as human beings.¹²

Having been produced for a different audience than public school students, and one for whom grand and controversial claims are less likely to be challenged, the presentation of the *Dawn of Man* is less restrained and more likely to upset students.

In the eighth grade, students begin to study living things in depth with less material on evolution. Students are expected, however, to be able to explain the theories of cell origin. The curriculum includes an introduction to heredity and reproduction, which asks the student, for example, to define genetics, explain the significance of

dominant and recessive genes, and explain how variations in offspring can result from the same two parents, which leads to variation in populations of the same species. According to one teacher, "The point in the eighth grade is to continue to introduce them to basic terminology without confusing them so that they will be able to go further with it in grade nine."¹³

Since seventh grade is where the student first encounters evolution and receives a foundation which will be expanded on in high school, it is critical to note how the information is presented, particularly concerning the *mechanism* for the evolutionary process, which is generally understood apart from the supposed *reality* of the evolutionary process. Phillip Johnson says:

Given that only a small minority of Americans believe the central finding of biology—"that human beings (and all the other species) have slowly evolved by natural processes from a succession of more ancient beings with no divine intervention needed along the way"—how should our educational system deal with this important instance of disagreement between the experts and the people?

One way would be to treat the doubts of the people with respect, to bring them out in the open and to deal with them rationally. The opposite way is to tell the people that all doubts about naturalistic evolution are inherently absurd, that they should believe in the orthodox theory because the experts agree that it is correct, and that their silly misgivings will be allowed no hearing in public education.

American educators have chosen the second path ...¹⁴

It is important to note that the curriculum in Quincy (and we suspect elsewhere) focuses primarily on evolutionary *change over time* and not on proposed *mechanisms* for the evolutionary process. This is a theme that we have observed at every grade level, particularly at the high school level where the instruction of evolution is more focused. This is a critical distinction that must be maintained to properly assess any possible philosophical or theological implications of the presentation of evolution.

High School

Evolution within the Text

Most of our research was conducted at the high school level where the teaching of evolution is concentrated. Six different textbooks are used in North Quincy's High School biology classes, each of them corresponding to different levels of biology instruction, with college bound students taking advanced courses. The information in the textbooks, however, is very similar; advanced biology courses simply move at a faster rate.

We began by assessing the textbooks, noting comparisons and differences, the language used in each, various

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rhetorical emphases and so on. One thing was immediately apparent: the texts simply do not, at least in any overt way, describe life as the result of mindless natural forces, an issue that many critics of evolution like Phillip Johnson believe is at the heart of the problem in teaching evolution in public schools in America. Johnson, for example, has stated:

I don't know what new theories the future may bring, but I think I know where the revolution will start. It will start with the realization that life is not the product of mindless natural forces. Life was designed.¹⁵

Regarding the origin of life, the textbooks indicate restraint in their claims. One textbook states:

While scientists cannot disprove the hypothesis that life originated naturally and spontaneously little is known about what actually happened. Many different scenarios seem possible, and several contradictory ones have solid support from experiments.¹⁶

The teachers at North Quincy High School present alternative scenarios and some even include, as a part of regular class discussion, the possibility that life is a creation of God!

One veteran biology and anthropology teacher believes that there is room for creation to play a role in the origin of life as evolution is taught in the classroom; she presents creation as a possible mechanism for the origin of life. She notes that, in her eighteen years as head of the science department, there have been absolutely no complaints from parents concerning the subject. In fact, parents are often happy with the way the material is presented.¹⁷

On the origin of life, the other textbooks continue to use the same sort of restrained rhetoric. One textbook states: "How these elements present in the atmosphere could have formed simple organic compounds important to life is a challenging scientific puzzle."¹⁸ One biology teacher, unconcerned about the uncertainty in the text, states simply, "My goal is to get children to think."¹⁹ Regardless of students' religious backgrounds, this teacher wants them to think critically about the information in the text and form their own ideas after learning as much of the science as they can. Neither here

nor elsewhere, did we encounter any teachers to whom it seemed of critical importance that students jump blindly onto the evolutionary bandwagon.

As for the specific information in the text itself, the authors leave enough room for religious students to continue in their belief that God was actively involved throughout the evolutionary process, although such a belief is not explicitly mentioned. All of the science high school textbooks used in Quincy provide introductions to Charles Darwin. Johnson and Raven write:

When the Beagle sailed on December 27, 1831, most scientists and nonscientists thought that each species was a divine creation, unchanging and existing as it was originally created ... But scientists had begun to appreciate that traditional views of divine creation could not explain the kinds and distributions of fossils that had been found. Some scientists tried to explain their observations by changing traditional explanations of creation while others (including Darwin's own grandfather) proposed various mechanisms to explain how evolution occurs.²⁰

The text goes on to show that Darwin not only made observations but also provided a mechanism—natural selection—by which he thought that the whole process worked. Familiar, if questionable, examples are used, such as short-necked giraffes die and long-necked giraffes prosper.

One text describes Darwin's evidence as "compelling" and accepted by biologists around the world.²¹ Most scientists agree, says the text, that "all organisms living today evolved from earlier, simpler life forms."²²

The real controversy, however, does not lie primarily within evolutionary theory itself, given that evolution in its simplest form is being defined simply as "change over time." The real controversy lies in the mechanism of *how* evolution occurs. These particular textbooks refrain from taking this controversial issue head on, opting instead for generalizations. For example, one textbook states:

Evolution theory is the foundation on which the rest of biological science is built. In fact, the biologist Theodore

Dobzhansky once wrote that nothing in biology makes sense except in the light of evolution. Much research in genetics, ecology, and medicine is based on evolutionary theory.²³

Another textbook states: "Evolution is a fact, organisms have changed over time."²⁴

One twelve-year veteran teacher makes the same distinction as well, agreeing with Dobzhansky that evolution is the most important theory in biology. He says: "It is a unifying theory that ties together all aspects of biology."²⁵ He recalls a classroom incident when a student from a fundamentalist background attempted to provoke a confrontation by stating: "I hope you're not going to teach evolution." With a smile, the teacher effectively defused the situation by replying, "I hope you're not going to learn science."²⁶ We suspect that such personal and idiosyncratic strategies are in use in almost every classroom where evolution is taught.

One text acknowledges "because most fossil skeletons are far from complete, these scientists must make inferences from subtle clues."²⁷ In general, the texts are doing their best to provide scientific information and insight into the *process* of science, and taking care not to communicate unsupported material as fact.

Freedom of Teachers within the Classroom

As in the middle schools, the high school teachers have considerable autonomy in the classroom, exercising control over both the depth of coverage and how material is presented. Mary Young says that in her eighteen years as science department head, she recalls only one teacher opting not to present creation as a possible mechanism for evolution. It is her judgment that teachers, at least those at North Quincy High School, demonstrate considerable sensitivity in how evolution is presented to students with religious backgrounds. She says:

Science teachers also need to respect the religious faith of their pupils and ought not to bridle when parents and clergymen (and other teachers) explain to children that what they're learning in science class is not the whole story. Educating children, after all, entails a lot more than ensuring that they learn science. The school curriculum, too, includes more than science. If it neglects the powerful role of religious faith in human history and contemporary culture, it is not doing a good job of educating its students.²⁸

This is exactly why creation and religion are touched upon in Quincy High Schools; faculty seek to offer students a complete, well-rounded education, devoid of distracting and unnecessary controversy.

Young believes that there needs to be more communication within America's churches about how Christians should interpret evolutionary theory. In Young's class-

room, evolution is taught in a way that does not exclude God. "God could have used evolution or the big bang, maybe that is the way He 'created.'"²⁹ Again, evolution is not taught dogmatically.

Other teachers use creative ways to get students to think about evolution and the origin of life. Steve Brenner has been teaching biology at North Quincy High School for twenty-eight years and enjoys covering the subject of evolution because it opens doors to students' creative ideas. Brenner challenges his students to write papers defending their view of evolution, creation, or another theory. Students are given a week to research and explore a particular theory regarding the origin of life. At the end of the week, they present papers detailing their research and conclusions.

Teachers demonstrate considerable sensitivity in how evolution is presented to students with religious backgrounds.

Brenner encourages a healthy skepticism among his students, encouraging them to avoid simply accepting everything they read. His students must think for themselves. Brenner seeks to give students as much science as he can without forcing them to accept theories that cannot be proven as fact. He says: "I've observed Carl Sagan presenting certain aspects of evolution as fact; this shouldn't be done."³⁰ Brenner also discusses creation as a theory in his classroom.

Not all teachers are quite so willing to include discussion of creation in their classrooms, yet they are sensitive to their students' backgrounds. One teacher makes a careful distinction between a theory and a belief, which he believes is critical. He says: "A theory arises as a result of huge amounts of data that almost always point to a specific solution. Creationism is not a theory, it is a belief."³¹ With regard to the mechanism for evolution, he offers a number of different possibilities and, although he excludes creation, he is self-consciously careful not to give evolution a purposeless or meaningless tone.

Catherine Smith, head of the science department at Quincy's other high school has been teaching for over thirty-three years. Smith is a graduate of a Catholic college and believes in God, but she does not believe it is necessary to present creation within her classes as a possible explanation for the origin of life. "Evolution is not a belief system, it is a theory," she suggests, which is why "special attention is given to evolution in the classroom and creation is not addressed."³² Smith recalls but one concern from an outside source in all her years as a teacher regarding the way in which evolution was being presented. One

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of her students brought up evolution in a Sunday school class, and Smith received a call from the minister shortly after. He was simply interested in the way evolution was being taught and was satisfied by the response he received.

Conclusion

The Quincy public school system, like that of any city of comparable size or larger, has a diverse group of teachers with different methods of teaching and views on what is important in the classroom. We could find no evidence that public school teachers in Quincy are exacerbating tensions with students and parents in the way that evolution is presented; indeed, most of them are expending energy in minimizing such tensions.

Our experience suggests to us that Quincy public school teachers are appropriately sensitive to the religious backgrounds of their students. We find no support for Phillip Johnson's charge, in *Defeating Darwinism by Opening Minds*, that American educators have chosen to "tell the people that all doubts about naturalistic evolution are inherently absurd ... and that their silly misgivings will be allowed no hearing in public education."³³ Our research within the Quincy public school system indicates exactly the opposite, and we suspect that this inference could be extended to the majority of public school systems in America. Johnson argues further that evolution is taught throughout the United States as a meaningless and purposeless process, leaving no room for God or religion, which is contrary to the faith of almost all Americans. This is simply not true in Quincy, Massachusetts. Neither the texts nor the teachers give the impression that "a mindless evolutionary process absolutely must be our true creator."³⁴ Most teachers are even content for their students to understand evolution as a possible explanation for "how God created."

The subject of evolution in public schools will continue to be controversial and will need careful attention. However, some of the critics of evolution, particularly Phillip Johnson, have adopted a hyperbolic, aggressive rhetoric suggesting that American educators are engaged in some sort of gigantic conspiracy to undermine traditional religion. If, as our research suggests, this strident claim

simply is not true, then it would appear that the conservative critics of evolution are fighting an imaginary foe. This is unfortunate. ★

Notes

- ¹L. S. Lerner, *Good Science, Bad Science: Teaching Evolution in the States* (The Thomas B. Fordham Foundation, Sept. 2000).
- ²P. E. Johnson, *Defeating Darwinism by Opening Minds* (Downers Grove, IL: InterVarsity Press, 1997), 22.
- ³Internet Source: <http://www.quincyonline.com/>
- ⁴Curriculum Development Committee, "Design for Learning: Science," (curriculum standards, Quincy, MA, 2000), iv.
- ⁵*Ibid.*, viii.
- ⁶Dr. J. Ditullio, interview by T. R. Johnson, Quincy, MA, March 2001.
- ⁷F. Balkwill, *Cell Wars* (Minneapolis: Carolrhoda Books, Inc., 1990).
- ⁸Curriculum Development Committee, "Design for Learning: Science," A-14.
- ⁹D. Cronkite, *Science Explorer* (Upper Saddle River, NJ: Prentice Hall, Inc., 2000), 161.
- ¹⁰*Ibid.*, 156.
- ¹¹D. Glynn, personal email, May 2001.
- ¹²Internet Source: <http://shopping.discovery.com/product/1115-1411-175190.html>
- ¹³D. Glynn, interview by T. R. Johnson, Quincy, MA, March 2001.
- ¹⁴Johnson, *Defeating Darwinism by Opening Minds*, 49.
- ¹⁵*Ibid.*, 67.
- ¹⁶G. B. Johnson and R. H. Raven, *Biology: Principles and Explorations* (Austin: Holt, Rinehart, & Winston, Inc., 2001), 257.
- ¹⁷M. Young, interview by T. R. Johnson, North Quincy High School, Quincy, MA, April 2001.
- ¹⁸A. Towle, *Modern Biology* (Austin: Holt, Rinehart, and Winston, Inc., 1989), 209.
- ¹⁹S. Brenner, interview by T. R. Johnson, North Quincy High School, Quincy, MA, April 2001.
- ²⁰G. B. Johnson and R. H. Raven, *Biology: Principles and Explorations*, 277.
- ²¹G. B. Johnson, *Biology: Visualizing Life* (Austin, TX: Holt, Rinehart, and Winston, Inc., 1998), 173.
- ²²G. B. Johnson and R. H. Raven, *Biology: Principles and Explorations*, 283.
- ²³K. R. Miller and J. Levine, *Biology*, 5th ed. (Upper Saddle River, NJ: Prentice Hall, Inc., 2000), 305.
- ²⁴*Ibid.*
- ²⁵R. Whitehouse, interview by T. R. Johnson, North Quincy High School, Quincy, MA, April 2001.
- ²⁶*Ibid.*
- ²⁷A. Towle, *Modern Biology*, 255.
- ²⁸L. S. Lerner, *Good Science, Bad Science: Teaching Evolution in the States*, Sept. 2000.
- ²⁹M. Young, interview.
- ³⁰S. Brenner, interview.
- ³¹R. Whitehouse, interview.
- ³²C. Smith, interview by T. R. Johnson, Quincy High School, Quincy, MA, May 2001.
- ³³Johnson, *Defeating Darwinism by Opening Minds*, 49.
- ³⁴*Ibid.*, 22.

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