## National Congress on Science Education

of the

## National Science Teachers Association

# Focus Group Resource Guide

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NSTA

# The National Congress on Science Education
# 2005 Focus Group Resource Guide

Enclosed is a series of resource materials identified by the NCSE Planning Committee. Please read these papers prior to the meeting and **bring your copy with you to the meeting**.

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# The Challenge of the **Evolution** Debate

Prepared by Steve Rich, Congress Committee and District V Director
Co-facilitators: Ken Heydrick, Science Teachers Association of Texas and
Joyce Tugel, NSTA Director, Professional Development

## Overview

How can we stay true to science without offending the belief structures of those on the other side of the evolution debate? Examine varying beliefs and the resources available to design an intelligent response.

## Discussion Questions

1. How can we stay true to science without offending the belief structures of those on the other side of the evolution debate?
2. What are the belief systems of those who oppose the teaching of Evolution?
3. How should science teachers respond to those who believe in "intelligent design"?
4. What further steps should NSTA take to assist teachers & school systems in their reponse to the same?

## Bibliography

**Teachers, Scientists Vow to Fight Challenge to Evolution**
**Creationists Seek Curriculum Change; Kan. Education Hearings Open Today**
Washington Post, Thursday, May 5, 2005
By Peter Slevin
http://www.washingtonpost.com/wp-dyn/content/article/2005/05/04/AR2005050402022.html
TOPEKA, Kan., May 4 -- Alarmed by proposals to change how evolution is taught, scientists and teachers are mobilizing to fight back, asserting that educational standards are being threatened by what they consider a stealth campaign to return creationism to public schools. This week's battle is focused on Kansas, where State Board of Education hearings begin Thursday on evolution and intelligent design, a carefully marketed theory that challenges accepted understandings of Earth's origins in favor of the idea that a creator played a guiding role….

At the national level, Sen. Rick Santorum (R-Pa.) demonstrated political savvy envied by scientists when he proposed an addition to the No Child Left Behind education bill in 2001: "Where biological evolution is taught, the curriculum should help students to understand why this subject generates so much continuing controversy, and should prepare the students to be informed participants in public discussions." "When it was first introduced, we didn't really understand it. He did it at the eleventh hour, and we didn't know it was coming," said Jodi L. Peterson, legislative director of the National Science Teachers Association. Her group and others mobilized to quash it, but the language remained in the bill's nonbinding conference report.

**Now evolving in biology classes: a testier climate. Some science teachers say they're encountering fresh resistance to the topic of evolution - and it's coming from their students.**
The Christian Science Monitor, May 3, 2005
By G. Jeffrey MacDonald
http://www.csmonitor.com/2005/0503/p01s04-legn.html?s=hns
Nearly 30 years of teaching evolution in Kansas has taught Brad Williamson to expect resistance, but even this veteran of the trenches now has his work cut out for him when students raise their hands. That's because critics of Charles Darwin's theory of natural selection are equipping families with books, DVDs, and a list of "10 questions to ask your biology teacher."

The intent is to plant seeds of doubt in the minds of students as to the veracity of Darwin's theory of evolution. The result is a climate that makes biology class tougher to teach. Some teachers say class time is now wasted on questions that are not science-based. Others say the increasingly charged atmosphere has simply forced them to work harder to find ways to skirt controversy…

…an informal survey released in April from the National Science Teachers Association found that 31 percent of the 1,050 respondents said they feel pressure to include "creationism, intelligent design, or other nonscientific alternatives to evolution in their science classroom."

These findings confirm the experience of Gerry Wheeler, the group's executive director, who says that about half the teachers he talks to tell him they feel ideological pressure when they teach evolution. And according to the survey, while 20 percent of the teachers say the pressure comes from parents, 22 percent say it comes primarily from students.

**'Call to arms' on evolution**
By Dan Vergano and Greg Toppo, USA TODAY
March 24, 2005
http://www.usatoday.com/news/education/2005-03-23-evolution_x.htm
Nearly one-third of science teachers who participated in a national survey say they feel pressured to include creationism-related ideas in the classroom.

And an alarmed science establishment is striking back in defense of teaching evolution.

"I write to you now because of a growing threat to the teaching of science," National Academy of Sciences chief Bruce Alberts says in a letter to colleagues March 4. He calls on academy members "to confront the increasing challenges to the teaching of evolution in public schools." The nation's top scientists belong to the congressionally chartered academy.

Albert's plea comes as the National Science Teachers Association prepares to release the survey at the group's meeting March 31. "Teachers are under attack all the time and need more support from scientists," he says.

**Design for Living**
The New York Times, February 7, 2005
Op-Ed Contributor: By Michael J. Behe
http://query.nytimes.com/gst/abstract.html?res=F70713FD355F0C748CDDAB0894DD404482
(only abstract…I can provide full article)
Bethlehem, Pa. — IN the wake of the recent lawsuits over the teaching of Darwinian evolution, there has been a rush to debate the merits of the rival theory of intelligent design. As one of the scientists who have proposed design as an explanation for biological systems, I have found widespread confusion about what intelligent design is and what it is not.

First, what it isn't: the theory of intelligent design is not a religiously based idea, even though devout people opposed to the teaching of evolution cite it in their arguments. For example, a critic recently caricatured intelligent design as the belief that if evolution occurred at all it could never be explained by Darwinian natural selection and could only have been directed at every stage by an omniscient creator. That's misleading. Intelligent design proponents do question whether random mutation and natural selection completely explain the deep structure of life. But they do not doubt that evolution occurred. And intelligent design itself says nothing about the religious concept of a creator.

**'Intelligent Design'**
The New York Times, February 12, 2005
Letter to the Editor: By Bruce Alberts
http://www.nytimes.com/2005/02/12/opinion/l12science.html
In "Design for Living" (Op-Ed, Feb. 7), Michael J. Behe quoted me, recalling how I discovered that "the chemistry that makes life possible is much more elaborate and sophisticated than anything we students had ever considered" some 40 years ago. Dr. Behe then paraphrases my 1998 remarks that "the entire cell can be viewed as a factory with an elaborate network of interlocking assembly lines, each of which is composed of a set of large protein machines."

That I was unaware of the complexity of living things as a student should not be surprising. In fact, the majestic chemistry of life should be astounding to everyone. But these facts should not be misrepresented as support for the idea that life's molecular complexity is a result of "intelligent design." To the contrary, modern scientific views of the molecular organization of life are entirely consistent with spontaneous variation and natural selection driving a powerful evolutionary process.

**Evolution Takes A Back Seat In U.S. Classes**
The New York Times, February 1, 2005
By CORNELIA DEAN 1716 words
Late Edition - Final , Section F , Page 1 , Column 1
http://query.nytimes.com/gst/abstract.html?res=F40A14FE395F0C728CDDAB0894DD404482
(abstract only, I can provide full article)
Dr. John Frandsen, a retired zoologist, was at a dinner for teachers in Birmingham, Ala., recently when he met a young woman who had just begun work as a biology teacher in a small school district in the state. Their conversation turned to ... "She confided that she simply ignored...

**Doubting Rationalist: 'Intelligent Design' Proponent Phillip Johnson, and How He Came to Be**
Washington Post, Sunday, May 15, 2005
http://www.washingtonpost.com/wp-dyn/content/article/2005/05/14/AR2005051401222_pf.html

"I suppose you think creation is all about unguided material processes, don't you? Well, I don't have the slightest trouble accepting microevolution as the cause behind the adaptation of the peppered moth and the growth of finches' beaks. But I don't see that evolutionists have any cause for jubilation there.

NSTA National Science Teachers Association

## NSTA Position Statement

# The Teaching of Evolution

## Introduction

The National Science Teachers Association (NSTA) strongly supports the position that evolution is a major unifying concept in science and should be included in the K–12 science education frameworks and curricula. Furthermore, if evolution is not taught, students will not achieve the level of scientific literacy they need. This position is consistent with that of the National Academies, the American Association for the Advancement of Science (AAAS), and many other scientific and educational organizations.

NSTA also recognizes that evolution has not been emphasized in science curricula in a manner commensurate to its importance because of official policies, intimidation of science teachers, the general public's misunderstanding of evolutionary theory, and a century of controversy. In addition, teachers are being pressured to introduce creationism, “creation science,” and other nonscientific views, which are intended to weaken or eliminate the teaching of evolution.

## Declarations

**Within this context, NSTA recommends that**

- Science curricula, state science standards, and teachers should emphasize evolution in a manner commensurate with its importance as a unifying concept in science and its overall explanatory power.
- Science teachers should not advocate any religious interpretations of nature and should be nonjudgmental about the personal beliefs of students.
- Policy makers and administrators should not mandate policies requiring the teaching of “creation science” or related concepts, such as so-called “intelligent design,” “abrupt appearance,” and “arguments against evolution.” Administrators also should support teachers against pressure to promote nonscientific views or to diminish or eliminate the study of evolution.
- Administrators and school boards should provide support to teachers as they review, adopt, and implement curricula that emphasize evolution. This should include professional development to assist teachers in teaching evolution in a comprehensive and professional manner.

- Parental and community involvement in establishing the goals of science education and the curriculum development process should be encouraged and nurtured in our democratic society. However, the professional responsibility of science teachers and curriculum specialists to provide students with quality science education should not be compromised by censorship, pseudoscience, inconsistencies, faulty scholarship, or unconstitutional mandates.
- Science textbooks shall emphasize evolution as a unifying concept. Publishers should not be required or volunteer to include disclaimers in textbooks that distort or misrepresent the methodology of science and the current body of knowledge concerning the nature and study of evolution.

*--Adopted by the*
*NSTA Board of Directors*
*July 2003*

**NSTA offers the following background information:**

**The Nature of Science and Scientific Theories**

Science is a method of explaining the natural world. It assumes that anything that can be observed or measured is amenable to scientific investigation. Science also assumes that the universe operates according to regularities that can be discovered and understood through scientific investigations. The testing of various explanations of natural phenomena for their consistency with empirical data is an essential part of the methodology of science. Explanations that are not consistent with empirical evidence or cannot be tested empirically are not a part of science. As a result, explanations of natural phenomena that are not based on evidence but on myths, personal beliefs, religious values, and superstitions are not scientific. Furthermore, because science is limited to explaining natural phenomena through the use of empirical evidence, it cannot provide religious or ultimate explanations.

The most important scientific explanations are called “theories.” In ordinary speech, “theory” is often used to mean “guess” or “hunch,” whereas in scientific terminology, a theory is a set of universal statements that explain some aspect of the natural world. Theories are powerful tools. Scientists seek to develop theories that

- are firmly grounded in and based upon evidence;
- are logically consistent with other well-established principles;
- explain more than rival theories; and
- have the potential to lead to new knowledge.

The body of scientific knowledge changes as new observations and discoveries are made. Theories and other explanations change. New theories emerge, and other theories are modified or discarded. Throughout this process, theories are formulated and tested on the basis of evidence, internal consistency, and their explanatory power.

## Evolution as a Unifying Concept

Evolution in the broadest sense can be defined as the idea that the universe has a history: that change through time has taken place. If we look today at the galaxies, stars, the planet Earth, and the life on planet Earth, we see that things today are different from what they were in the past: galaxies, stars, planets, and life forms have evolved. Biological evolution refers to the scientific theory that living things share ancestors from which they have diverged; it is called "descent with modification." There is abundant and consistent evidence from astronomy, physics, biochemistry, geochronology, geology, biology, anthropology, and other sciences that evolution has taken place.

As such, evolution is a unifying concept for science. The *National Science Education Standards* recognizes that conceptual schemes such as evolution "unify science disciplines and provide students with powerful ideas to help them understand the natural world" (p. 104) and recommends evolution as one such scheme. In addition, *Benchmarks for Science Literacy* from AAAS's Project 2061, as well as other national calls for science reform, all name evolution as a unifying concept because of its importance across the disciplines of science. Scientific disciplines with a historical component, such as astronomy, geology, biology, and anthropology, cannot be taught with integrity if evolution is not emphasized.

There is no longer a debate among scientists about whether evolution has taken place. There is considerable debate about how evolution has taken place: What are the processes and mechanisms producing change, and what has happened specifically during the history of the universe? Scientists often disagree about their explanations. In any science, disagreements are subject to rules of evaluation. Scientific conclusions are tested by experiment and observation, and evolution, as with any aspect of theoretical science, is continually open to and subject to experimental and observational testing.

The importance of evolution is summarized as follows in the National Academy of Sciences publication *Teaching about Evolution and the Nature of Science:* "Few other ideas in science have had such a far-reaching impact on our thinking about ourselves and how we relate to the world" (p. 21).

## Creationism and Other Non-Scientific Views

The *National Science Education Standards* note that, "[e]xplanations of how the natural world changes based on myths, personal beliefs, religious values, mystical inspiration, superstition, or authority may be personally useful and socially relevant, but they are not scientific" (p. 201). Because science limits itself to natural explanations and not religious or ultimate ones, science teachers should neither advocate any religious interpretation of nature nor assert that religious interpretations of nature are not possible.

The word "creationism" has many meanings. In its broadest meaning, creationism is the idea that the universe is the consequence of something transcendent. Thus to Christians, Jews, and Muslims, God created; to the Navajo, the Hero Twins created; for Hindu Shaivites, the universe comes to exist as Shiva dances. In a narrower sense, "creationism" has come to mean "special creation": the doctrine that the universe and all that is in it was created by God in essentially its present form, at one time. The most common variety of special creationism asserts that

- the Earth is very young;
- life was created by God;
- life appeared suddenly;
- kinds of organisms have not changed since the creation; and
- different life forms were designed to function in particular settings.

This version of special creation is derived from a literal interpretation of Biblical Genesis. It is a specific, sectarian religious belief that is not held by all religious people. Many Christians and Jews believe that God created through the process of evolution. Pope John Paul II, for example, issued a statement in 1996 that reiterated the Catholic position that God created and affirmed that the evidence for evolution from many scientific fields is very strong.

"Creation science" is a religious effort to support special creationism through methods of science. Teachers are often pressured to include it or other related nonscientific views such as "abrupt appearance theory," "initial complexity theory," "arguments against evolution," or "intelligent design theory" when they teach evolution. Scientific creationist claims have been discredited by the available scientific evidence. They have no empirical power to explain the natural world and its diverse phenomena. Instead, creationists seek out supposed anomalies among many existing theories and accepted facts. Furthermore, "creation science" claims do not lead to new discoveries of scientific knowledge.

**Legal Issues**

Several judicial decisions have ruled on issues associated with the teaching of evolution and the imposition of mandates that "creation science" be taught when evolution is taught. The First Amendment of the Constitution requires that public institutions such as schools be religiously neutral; because "creation science" asserts a specific, sectarian religious view, it cannot be advocated in the public schools.

When Arkansas passed a law requiring "equal time" for "creation science" and evolution, the law was challenged in Federal District Court. Opponents of the bill included the religious leaders of the United Methodist, Episcopalian, Roman Catholic, African Methodist Episcopal, Presbyterian, and Southern Baptist churches, along with several educational organizations. After a full trial, the judge ruled that "creation science" did not qualify as a scientific theory (*McLean v. Arkansas Board of Education*, 529 F. Supp. 1255 [ED Ark. 1982]).

Louisiana's equal time law was challenged in court, and eventually reached the Supreme Court. In *Edwards v. Aguillard* [482 U.S. 578 (1987)], the court determined that "creation science" was inherently a religious idea and to mandate or advocate it in the public schools would be unconstitutional. Other court decisions have upheld the right of a district to require that a teacher teach evolution and not teach "creation science" (*Webster v. New Lennox School District #122*, 917 F.2d 1003 [7th Cir. 1990]; *Peloza v. Capistrano Unified School District*, 37 F.3d 517 [9th Cir. 1994]).

Some legislators and policy makers continue attempts to distort the teaching of evolution through mandates that would require teachers to teach evolution as "only a theory" or that require a textbook or lesson on evolution to be preceded by a disclaimer. Regardless of the legal status of these mandates, they are bad educational policy. Such policies have the effect of intimidating teachers, which may result in the de-emphasis or omission of evolution. As a consequence, the public will only be further confused about the nature of scientific theories. Furthermore, if students learn less about evolution, science literacy itself will suffer.

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# EVOLUTION: IS THERE A MISSING LINK?

*By Anne Tweed, NSTA President 2004–2005*

"Almost 80 years after the Scopes trial, the debate over the teaching of evolution continues to rage. There is no easy resolution—it is a complex topic with profound scientific, religious, educational, and legal implications. How can a student or parent understand this issue, which is such a vital part of (science) education?"

These are the introductory words on the back cover of Eugenie C. Scott's latest book, *Evolution vs. Creationism* (2004). If you have been reading major newspapers, magazines, and other media, this issue has been featured prominently during recent months. New strategies by anti-evolution groups have complicated the issue. Initially centered around the openly religious ideas of "creationism," groups are now using more covertly religious-based tactics by advocating for so-called "intelligent design" and "weaknesses of evolution" to be taught alongside evolution in science classrooms.

Did you know that it is illegal for science teachers to teach creation science? Eight major court decisions relate to this issue. Because by law, science teachers cannot advocate religion, schools must not teach as scientific fact or theory any religious doctrine, including "creationism."

As for intelligent design and other nonscientifically based ideas, quite frankly, they just don't cut it. As science educators, we look to the scientific community to investigate, research, test, validate, and debate science. In a nutshell, "no attempt to discredit the concept of evolution has proved successful." (Moore 2004)

So was Darwin wrong, as a recent *National Geographic* article (Quammen 2004) asked? Emphatically, the answer is no! So does the theory of evolution contain a missing link? Also emphatically, no! What is missing is the education of students, parents, and policy makers about the theory of evolution and why it is considered a central unifying theme of science.

What are the implications for science teachers? All science teachers—not just biology teachers—need to understand both evolutionary theory and the social issues related to its teaching. To assist teachers, the National Academy of Sciences (NAS) has published three reports that provide needed background information. Descriptions of these reports and a summary of the academy's efforts to deal with the challenges to teaching evolution are summarized in a recent article in *Cell Biology Education*. (Alberts and Labov 2004)

Teachers need to educate themselves about not only the scientific evidence for the theory of evolution, but also strategies to address the issues that have arisen in our society. In his recent " 'Call to Arms' on Evolution" article in *USA Today*, NAS President Bruce Alberts notes that members of the academy stand ready to help teachers deal with these issues in their state and school district.

Science teachers need to be prepared to respond clearly to parent and community questions about this issue and help to educate them. Strategically, teachers must take an offensive position and serve as advocates for evolutionary theory. What is "missing" is an adult population that understands the scientific concepts that form the basis for evolution. Most adults were never taught about evolution in school. Clearly, this lack of understanding has resulted in misconceptions about the theory and the scientific evidence that supports it.

In addition to the NAS resources, NSTA offers resources that teachers can provide to parents and policy makers to clarify the theory and the legal issues related to the teaching of evolution. These can be found at *www.nsta.org/evresources,* which includes links to the NSTA Press book *Evolution in Perspective* and the association's position statement on the teaching of evolution. The National Center for Science Education (*www.ncseweb.org*) is also a good source for this information.

One of the most common misconceptions related to this controversy is confusion about the definition of a scientific theory. In common usage, "theory" may be a prediction, hunch, guess, or explanation based on opinion. These "theories" are not, however, the same as scientific theories. A theory in science is not just a hunch!

What is also "missing" is a clear understanding of the terms *fact, hypothesis, theory,* and *belief.* As a high school biology teacher for almost 30 years, I found it important to provide students with a clear understanding of these terms. I presented students with 25 different statements and then asked them to determine which statements were facts, theories, and hypotheses and which were beliefs. The speed of light, for example, is a scientific fact that can be measured again and again with the same result. A hypothesis is a prediction statement that is based on prior observations that can be tested experimentally. And a scientific theory is a well-substantiated explanation of some aspect of the natural world that can incorporate facts, laws, inferences, and tested hypotheses.

Beliefs, on the other hand, are opinions and do not require any evidence or scientific data. They are based on societal norms, religious teachings, and ethics. Beliefs and actions define a person's character.

As a teacher, I believe that all students can learn. This belief, while not based entirely on scientific fact, is foundational to my philosophy of education. Students' religious beliefs similarly do not require evidence to support them. As a science teacher, I will not challenge a student's belief system, nor will I allow other students to promote or advocate for their religious beliefs in a science class. It is essential, however, that I teach the science behind the theory of evolution because evolution is the central organizing principle that biologists use to understand the world.

We not only need students to be scientifically astute, we also need the greater population, including parents, school board members, policy makers, and so many others, to understand the nature of science and what it tells us about our world. And whose job is it to educate our society about scientific theories and evolution specifically? Science teachers, of course! So as professional science educators, we must be advocates for science literacy and the teaching of evolution.

And what is my recommendation to administrators, legislators, and reporters? If you want to know about scientific theories, ask a science teacher!

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# *The Challenge of Reviving* ***Elementary Science***

Prepared by Vanessa Westbrook, Congress Committee
Co-facilitators: Vanessa Westbrook, Past President, Science Teachers Association of Texas and Paul Drummond, President-Elect, Michigan Science Teachers Association

## Overview

How should we focus on rebuilding elementary science in schools? Reading and mathematic assessment has strongly influenced what is currently taught in elementary schools. What should be done to insure science is actually being taught at the elementary level?

## Discussion Questions

1. How should we focus on rebuilding elementary science in schools? Reading and mathematic assessment has strongly influenced what is currently taught in elementary schools. What should be done to insure science is actually being taught at the elementary level?
2. The following questions are designed to lead the discussion and work of the focus group:
3. What are some consequences for the K-12 science program if elementary science is not in place?
4. What are some ways to support more acquisition of content knowledge for elementary educators?
5. What steps can be taken to encourage more experience-based science instruction in elementary classrooms?
6. What roles should chapters and affiliated groups play in designing and providing professional development for elementary educators?

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# *The Challenge of **Supporting** First and Second Career **New Teachers***

Prepared by John Olson, Congress Committee
Co-facilitators: John Olson, President, Minnesota Science Teachers Association and
Bambi Bailey, Faculty Advisor, Midwestern State University Student Chapter

## Overview

People become science teachers through many pathways including college graduation, master's programs, and alternative licensure. How do we help them become effective teachers during their early years?

## Discussion Questions

1. How are the needs of new teachers different for persons who enter teaching from: traditional college programs, adult learning programs and alternative licensure programs?
2. What preparation should new and second career teachers have to be effective teachers of science? What current programs are effective? What aspects of preparation are lacking?
3. What support should be provided by the science education community to teachers in their early years?

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http://www.nsta.org/main/news/stories/journal_archive_date_list.php?category_ID=88&issue_ID=843

- First Year 101
- Sink or Swim

*Education Leadership* May 2005 focuses on Supporting New Teachers. www.ascd.org.

# *The Challenge of Bridging the* ***Achievement Gap***

Prepared by Joe Moore, Congress Committee and Past President, AMSE
Co-facilitators: Bobby Jeanpierre, NSTA Director, Multicultural/Equity in Science Education and Deborah O'Gorman, President, Nevada State Science Teachers Association

## Overview

In science education an achievement gap exists between various subgroups based upon factors such as gender, race, ethnicity, ESL, and social economic status. What strategies can be used to help reduce these gaps?

## Discussion Questions

1. What factors contribute to today's achievement gap?
2. How do you predict recent immigration trends might affect the achievement gap?
3. How can we shape our curriculum and instruction practices in science to address the achievement gap?
4. What is the role of professional organizations in closing the achievement gap?

# *The Challenge of* ***Assessment*** *in 2007/08*

Prepared by Nancy Bennett, Congress Committee
Co-facilitators: Nancy Bennett, Past President, New Jersey Science Teachers Association and Mary Lightbody, Past President, Science Education Council of Ohio

## Overview

For the first time NCLB calls for states to test students in science once a year in each of three grade spans—3–5, 6–9, and 10–12 in 2007/08. How should science teacher organizations shape the response to the challenge?

## Discussion Questions

1. How should science teacher organizations shape the response to the challenge of the 2007/08 NCLB science assessment?
2. How should teachers prepare students for state assessments without "throwing out" quality inquiry instruction?

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# Will States Be Ready to Implement Science Assessments by 2007?

*By Anne Tweed, NSTA President*

The gauntlet has been thrown down, and the challenge is on: Will states be ready to implement science assessments in 2007–2008 as required by the No Child Left Behind (NCLB) Act? At this stage, it is a race too close to call.

The Education Commission of the States reports that every state is making progress in writing grade-level standards in science. But when it comes to developing science assessments, five states and the District of Columbia are not even close to meeting the goal, and another seven states are only partially on track to have their assessments ready. The bottom line is that most state departments of education have a long way to go to develop high-quality assessments that are aligned with challenging state standards.

What does this mean for elementary teachers who teach mathematics, reading and writing, *and* science?

Before we consider assessments, we must look at this issue: First and foremost, students need to be given the opportunity to learn science at all grade levels. This sounds simple, but it hasn't been happening: Elementary teachers have largely focused instruction on math and reading in the effort to meet current assessment targets. A recent report prepared by Horizon Research, Inc., states that students are averaging only about 25 minutes of science a day in a self-contained elementary classroom. A logical response by school districts preparing for the science assessments is to first make certain that science is being taught.

To ensure that science is being taught, many districts are employing science specialists. A specialist with a science background can plan and present inquiry lessons that align with the grade-level expectations, as well as plan and work with the classroom teacher to provide more science in the regular classroom.

Another way of ensuring that science is being taught is to use science as the integrating context for learning math and language arts. This strategy has proven successful in El Centro, California, and is being adopted by other districts as well.

It takes time for students to understand science concepts and learn problem-solving skills. Teachers also need time: time for planning high-quality science lessons, as well as time for students to make sense of their learning. Ultimately, these goals can best be accomplished by teachers who are as prepared and qualified to teach science as they are to teach reading.

Taking this a step further, what is really needed in many districts is an integrated approach to literacy and science. After all, science standards and assessments require students to be good readers and writers: How many times are students asked to describe, compare, explain, analyze, and evaluate what they have studied? Students need to be sufficiently literate to demonstrate their understanding of science concepts.

Furthermore, *all* science teachers should know how to integrate literacy and science, not just elementary teachers. Large-scale state assessments frequently contain nonfiction readings in science, and students are asked to state the main ideas of these readings and to infer from what they have read. Helping students strengthen these skills can result in improved performance on science *and* reading assessments.

Developing large-scale state assessments that measure both science knowledge and science understanding can be challenging even for assessment specialists. And teachers are not trained to design and develop valid and reliable assessment instruments that can give students practice for the 2007 tests. What teachers *can* do is provide students with opportunities to design and conduct their own experiments, which will help them become better problem solvers. They also will gain experience with analyzing data in charts and graphs and making inferences from the results.

The jury is still out on the question of what makes a good science assessment. What is certain is that teachers can provide students with learning experiences that focus on rigorous, meaningful content. They can challenge students to learn science concepts in depth and help them do it in ways that enable students to understand what they are learning. And they can ensure that the classroom environment is one in which all students can learn.

In preparation for the upcoming NCLB-mandated science assessments, the NSTA area and national conventions have included strands on assessment. These professional development opportunities will support teachers as they prepare for science assessments.

Teachers are already doing a terrific job teaching accurate science content. Now they must prepare students to demonstrate both science knowledge and conceptual understanding on state-level assessments. Clearly, planning plus preparation will yield a positive outcome, which is what we all want!

To find out more about the connections between science and literacy, check out the new NSTA Press® title *Crossing Borders in Literacy and Science Instruction* (see http://store.nsta.org). ●