RESEARCH

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The Big Bang, the 'God Particle,' and You

New scientific discoveries often spark excitement—and controversy. Can you make sure every student is science literate while being sensitive to the religious and cultural beliefs in your community?

On July 4, European physicists announced they had amassed enough evidence to show that the elusive Higgs boson exists, capping a half century search involving thousands of scientists for what gives mass to matter.

It's not often that science stories get above-the-fold attention in the press. But this tiny subatomic particle made huge news, for it opens the door to understanding the creation of the universe. So fundamental is the Higgs boson to existence that a Nobel Prize winner had earlier dubbed it the "God particle." Little wonder, then, that scientists and students across the world tuned in for the announcement. Their reaction could be best described as giddy.

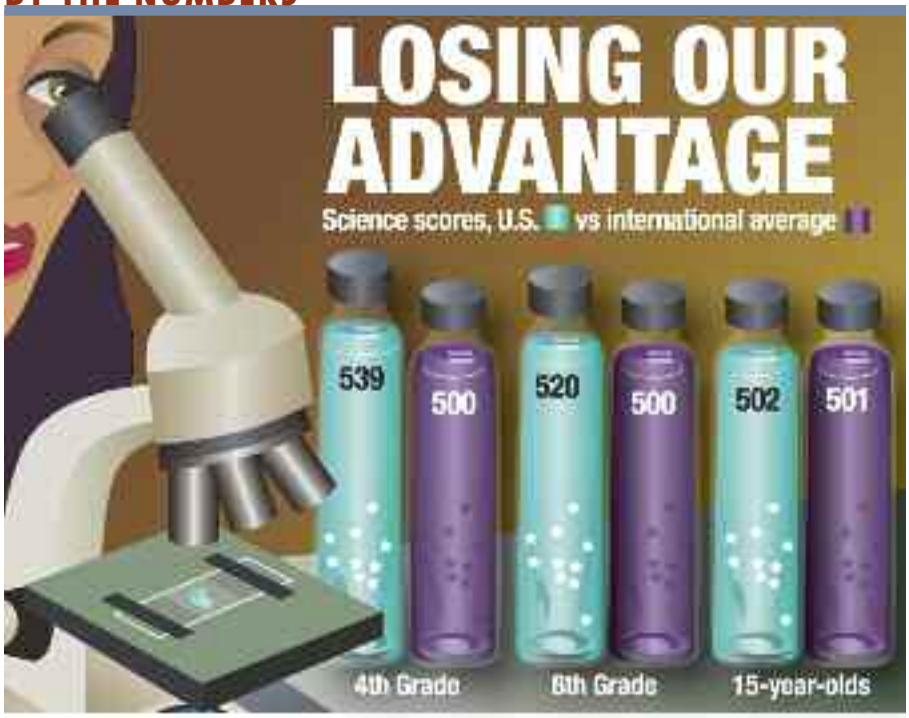
Discoveries like these are what make science so exciting. And it's this spirit of discovery and innovation that the study of science can convey to our students. The American public tends to agree. Voters responding to a recent survey by Achieve, Inc., ranked providing a world-class math and science education second only to getting the nation's fiscal house in order as key actions to keep the U.S. globally competitive. Science and math education ranked higher than lowering taxes and regulation on businesses, or investing in new technologies.

Even so, widespread support for science nationally can break down at the local level, as many school boards have seen. The benefit of community engagement in public education is often taken as a given. But school boards also have witnessed what can happen when the engaged community harbors competing values, particularly when those values are embedded in individual beliefs and faiths.

The science curriculum has been a frequent battleground for culture wars between the science community and those who believe evolution, geological time, and other concepts contradict tenets of their faith. Over the last several decades, certain groups have pushed to have other explanations for our origins included in the curriculum alongside the Big Bang and Darwin. Some of these attempts succeeded in a handful of states and districts.

Since the 1960s, however, the courts have consistently upheld challenges to these curricular rewrites, declaring that creationism and intelligent design are religious ideas, not science, and therefore in violation of the Establishment Clause. Still, many groups persist in their efforts to have their beliefs acknowledged in the science class-

BY THE NUMBERS



SOURCE: Center for Public Education

Art by Julie Ridge

room, frequently by casting suspicion on evolution and other basic science concepts as unproven theories.

Rather than confront unhappy constituents, many state and local policymakers have merely dodged the question. The Fordham Foundation is a conservative think tank that, among other things, advocates for rigorous academic standards in the nation's schools. In 2008, the foundation's reviewers gave state science standards an overall grade of "C." The No. 1 problem? They found most states undermine the topic of evolution, particularly the teaching of human evolution, with it often being "conspicuously missing" from the standards. This omission may gain some political points but, they argue, it leaves our students with a sizable gap in their understanding of science and places them at a real disadvantage compared to their international peers.

School leaders are left with a conundrum: How can public schools both show respect for individuals' beliefs and provide the science grounding all of our students need and deserve when those exigencies collide?

A 2005 Pew Research Center poll found that two-thirds of Americans think both evolution and creationism should be taught side by side, a seemingly good compromise position but one that troubles the science community for misconstruing what science is. The National Academies of Sciences (NAS) has weighed in on the controversy with its own recommendations. Stating the science community's consensus that "evolution is the central unifying theme of biology," NAS has set out to help educators address science while finding ways to be sensitive to the beliefs of students.

First and foremost, the American public needs to be educated about what a scientific theory is. In the lay, workaday world in which most of us operate, a "theory" is a hunch, an educated guess, where one is as good as another. In contrast, a theory in science circles must meet rigorous criteria. According to NAS, a scientific theory "refers to a comprehensive explanation of some aspect of nature that is supported by a vast body of evidence." It says that "the theory of evolution is supported by so many observations and confirming experiments that scientists are confident that the basic components of the theory will not be overturned by new evidence."

NAS cites examples of other scientific theories: the Earth orbits around the Sun (heliocentric theory), living things are made of cells (cell theory), matter is composed of atoms, and the Earth is divided into solid plates (theory of plate tectonics). To date, no one has launched a serious campaign to cast doubt on these theories. Evolution seems to have that singular distinction.

While the courts have prohibited the teaching of creationism or intelligent design in the science classroom, they have left the curriculum door open to teaching faith-based origin explanations in philosophy or comparative religion courses—an approach recommended by the American Association for the Advancement of Science as well as NAS.

Anything given the popular name "God particle" is bound to stir up the troops, and we should anticipate some pushback in how the Higgs boson will be presented in public schools. At the same time, we need to stay focused on what is important for students to know and do in science. At present, our fourth- and eighth-graders score above the international average in science (TIMSS 2009). But that advantage disappears when our 15-year-olds are asked to apply what they have learned (PISA 2009). Clearly, we have some work to do.

The public knows we need to raise science standards, which is half the battle. Twenty-six states are currently collaborating on developing common science standards. The framework that forms the basis for these "Next Generation Science Standards" emphasizes change and evolution as cross-cutting and core concepts. As the new standards roll out, state and local policymakers may face pressure from various groups as to how those key concepts will be presented. This is as it should be. Public schools are democratic institutions, and democracy can be messy. Not everyone will get what they want, but everyone will have a chance to be heard.

The Higgs boson was discovered by forcing trillions of collisions between protons. Out of these clashes came this tremendous contribution to what we know about the universe. So it can be when different communities collide over what we teach students. Rather than avoid the conflict, school leaders can use these occasions to reinforce their commitment to value every student and at the same time prepare them for a globally competitive world. That includes making sure every student is science literate. ■

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Learn more about teaching evolution

The National Academy of Sciences has compiled several resources related to teaching evolution: **www.nationalacademies.org/evolution**.

Project 2061 of the American Association for the Advancement of Science published a guide for teaching evolution called "Evolution on the Front Line." The guide can be downloaded from the Project 2061 website: **www.project2061.org/publications/guides/evolution.pdf**.

You can track progress on the next generation science standards at **www.nextgenscience.org**.