

Inspiring the Next Generation of Innovators

Students, Parents and Educators Speak Up
about Science Education

National Findings on Science Education from Speak Up 2007



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EXECUTIVE SUMMARY

Today's leading technological thinkers assert that our nation's people must achieve basic STEM literacy (science, technology, engineering, and math) if we expect to solve the greatest challenges of the 21st century. While some of today's students will be producers of scientific knowledge, it's likely that the majority will be knowledge consumers. As democratic decision-makers, all consumers will have an important supporting role in the advancement of science, which will include taking-up new technologies, funding research, and critically assessing the validity of new assertions. Solving 21st century problems will be a collective responsibility.

Today's students, however, see learning science largely as a means to high school graduation. Less than 40 percent see learning science as important for making informed decisions in the future. This perspective might be an outcome of how students are learning science, as curricula are still largely focused on the memorization of facts. Educators and researchers argue that inquiry methods are essential for the development of scientific literacy, yet just one fourth of teachers say they're using these methods. But all is not lost. Students report they are open to learning science and pursuing STEM careers—intrigued by opportunities to participate in hands-on, group-oriented, “fun” experiences, as well as by opportunities to meet with professionals and use professional-level tools. Students are most motivated to learn science when they *do* authentic science rather than focus only on the knowledge science has already produced.

Methods

This report presents the findings from Project Tomorrow's 2007 Speak Up Survey, informing international discussions about how to improve science learning in the 21st century through an exploration of student, teacher, parent, and school leader attitudes about science education. Project Tomorrow administered its survey in all 50 United States, the District of Columbia, American Department of Defense Schools, Canada, Mexico, and Australia. The top participating states included: Texas, California, Arizona, Illinois, Alabama, Maryland, North Carolina, Pennsylvania, Florida, and Michigan.

Project Tomorrow surveyed 319,223 K-12 students, 25,544 teachers, 19,726 parents, and 3,263 school leaders. Respondents were from 3,729 schools and 867 districts. Ninety-seven percent were from public schools; three percent were from private schools. School locations were 32 percent urban, 40 percent suburban, and 29 percent rural. Forty-three percent of the schools were Title I eligible, and 29 percent had a more than 50 percent minority population attending.

In addition to data, this report includes quotes from student and teacher replies to open-ended questions about their especially interesting or fun learning experiences in science and math. As appropriate, the quotes were edited for spelling, grammar, and length. Project Tomorrow also included quotes from its “Innovators’ Road Trip” program, which were from evaluations written by student and parent participants, grades 9-12, who attend high school in Orange County, California.

Highlights from Project Tomorrow’s 2007 Speak Up Survey

- Fifty-seven percent of K-12 school administrators gave a passing grade to their school for preparing students for jobs of the future, but only 47 percent of teachers and 43 percent of parents agreed. Among middle and high school students who assessed themselves as advanced tech-users, only 23 percent indicated that their schools were preparing them well.
- While inquiry-based curricula are seen as one means for students to achieve scientific literacy, in 2007 only 25 percent of science teachers used such curricula in their classrooms. Today’s students will be expected to collaboratively tackle 21st century problems, yet only 16 percent of teachers reported they are assigning projects that help students develop problem-solving skills.
- Students report that their especially fun or interesting learning experiences using science and math have been hands-on and group-oriented.
- When asked about the essential features of their imagined ultimate science classroom, the leading answer for students in grades K-2 and in grades 9-12 was “teachers excited about science.” Students in grades 3-5 were more interested in “fun experiments” (69 percent). Other highly essential features for students in grades 3-12 were “real tools” (standard lab and technology-based tools) and being able to do “real research,” including online research on computers.
- Teachers reported that the 21st century tools having the greatest potential to increase student achievement in science specifically are: (1) animations to help students visualize difficult concepts; (2) interactive simulations to practice scientific expertise; (3) standard lab tools and apparatus (such as microscopes and Bunsen burners). If they were to consider integrating the tools into their science instruction, the factors most influencing them would be available funding and the cost of the tools. After funding, “best practices” most influence school leaders to improve science education.
- Most students who participated in the Project Tomorrow Speak Up 2007 survey are open to pursuing a job or career in a STEM field. Thirty-two percent of middle school students and 38 percent of high school students reported they are somewhat or very interested in STEM jobs or careers. Twenty-one percent more students in grades 6-12 indicated “maybe” they are interested in a STEM career. College scholarships, conversational interactions with professionals, visits to STEM companies, using tools professionals use, and hands-on learning opportunities have potential to further students’ interest.

Science education in the 21st century: Blending fact-learning with inquiry-based methods to prepare students for varying roles in meeting global challenges

In Project Tomorrow's Speak Up 2007 national survey, most adults agreed that improving science education should be a national priority. School leaders agreed most frequently (84 percent), followed by parents (71 percent) and teachers (69 percent). What it means to "improve science education," however, is a subject of emerging international understanding. Science curricula have traditionally included basic preparation in the three sciences: chemistry, biology, and physics. Science professionals have heavily influenced the design of these curricula, which focus largely on science fact-learning and memorization, to ensure that students develop a foundation to pursue science degrees (Osborne and Dillon, 2008).

Some STEM professionals, academics, and technology thinkers assert that preparing students to solve 21st century problems will require a far different strategy. Science education must—now more than ever—expand to help students as they prepare for their role as consumers of scientific knowledge. In addition to students actually doing authentic science, in which they ask their own questions and answer them using a variety of scientific methods, students must also learn about science – its "big ideas," range of methods, fundamental practices and relevance to everyday life. This is especially true for future nonscientists, who are arguably the majority of today's students (Reinhold, 1990). It is also true for future scientists who are increasingly specialized in their fields. Specialization requires scientists to properly evaluate knowledge generated in fields outside of their focus (Osborne, 2007).

What makes a good knowledge consumer? Wellcome Trust, an independent charity funding new curriculum development in the United Kingdom, contends that scientific literacy is essential to participation in a 21st century democracy:

Scientifically literate citizens should be able to understand the important ideas of science and their impact on our environment and culture, so that they can appreciate why these ideas are valued. They should be able to evaluate sources of information and assess risk and probability both in order...to make personal decisions, and to take part in democratic discussions. They should also be able to respond critically to media reports of science, and hold and argue an opinion on issues with a science component.

21st century STEM careers: What global problems are today's students preparing to address?

In February 2008, the US National Academy of Engineering released the Grand Challenges for Engineers in the next half century, as determined by an international group including 18 of today's leading technology thinkers.

The leaders asserted that STEM education must help today's students prepare to be *both consumers and producers of knowledge* in conquering old and new threats to personal and public health. Among other things, today's students will work to:

- Make solar energy economical
- Provide energy from fusion
- Provide access to clean water
- Reverse engineer the brain
- Advance personalized learning
- Develop carbon sequestration methods
- Restore and improve urban infrastructure
- Engineer the tools of scientific discovery
- Advance health informatics
- Prevent nuclear terror
- Engineer better medicines
- Enhance virtual reality
- Manage the nitrogen cycle
- Secure cyberspace

More information:
www.engineeringchallenges.org

And they should have the foundation to acquire further scientific knowledge throughout their lifetimes.

The US National Academy of Engineering likewise states that engineers and educators, among others,

“Jobs in the 21st century, even those outside STEM fields, will increasingly demand a technologically literate workforce. All students must have basic STEM literacy in order to be full and active participants in our increasingly technology-based democracy.”

United States National Science Board
October 2007

must “encourage and promote improved STEM education in the schools and enhanced flow of technical information to the public at large—conveying not just the facts of science and engineering, but also an appreciation of the ways that scientists and engineers acquire the knowledge and tools required to meet society’s needs.” Securing funding and political support for the advancement and adoption of new technologies is necessary for addressing the challenges citizens face in the 21st century. According to the United States National Science Board, this will require public understanding of how science, technology, engineering, and math together inform our knowledge of the material world. They will also need to understand that there is no absolute certainty.

Inquiry-based curricula, designed to put students in self-directed situations to learn *about* science, is increasingly seen by academics and educators as one means to scientific literacy for the 21st century. The Center for Inquiry-Based

Learning at Duke University explains, “In [inquiry-based learning] situations, students take the initiative to observe and question phenomena; pose explanations of what they see; devise and conduct tests to support or contradict their theories; analyze data; draw conclusions from experimental data; design and build models; or any combination of these.” Yet take-up of inquiry-based learning methods has been slow, partially because conventional structures have not yet adjusted to accommodate the practice. “The inquiry approach, while lauded by educators, is still not prevalent in the classroom. This may be the result of multiple factors, such as amount of classroom time, lack of effective means for students to conduct independent investigations, the difficulty of incorporating abstract concepts with inquiry, and lack of teacher expertise and experience” (Kubicek, 2005).

Project Tomorrow’s Speak Up 2007 survey results provide timely insight into these and other discussions about how to improve science education. The results contribute to the public understanding of the skills that students, parents, teachers, and school leaders across the United States report are essential for meeting 21st century challenges, with specific insights about how their science education contributes to their ability to attain those skills. The results also help explain how students and their parents experience science education, what sort of learning methods they seek and their interest in STEM careers. Teachers’ results indicate how they are facilitating science learning, including whether they are employing inquiry-based methods, and their perceived barriers to the implementation of inquiry-based curricula. School leaders (e.g., school and district administrators) report their perspectives about technology use and what influences them to improve science education.

Science education in 2007: Students experience limited connections to skills needed to meet 21st century challenges.

Students' least important reasons for learning science: informed decision-making, problem solving

Students in grades 6-12 understand they need skills that position them to be good consumers of STEM knowledge in the 21st century. They indicated that the five most important skills for their success include the ability to learn new things, creativity, knowing how to use technology effectively, communication skills, and ability to work with people all over the world. Though still strongly supported, the sixth most important skill set was problem-solving and critical thinking (62 percent).

Yet students did not see a connection between learning science and attaining these skills. Only 38 percent thought learning science would help them to make informed decisions in the future, and just 40 percent saw it as a means to developing problem-solving and critical thinking skills. Twelve percent of students said learning science is not important for their future. For most, learning science is important simply because it is required. They need to learn science, or at least earn science credits, in order to graduate from high school (57 percent) and get into college (56 percent).

Among parents of students in grades K-12, the most important reason for their children to have a good understanding of science is for problem solving and critical thinking. Only 36 percent of parents thought so, however. About one quarter of parents indicated that a good understanding of science is needed for their children to be successful.

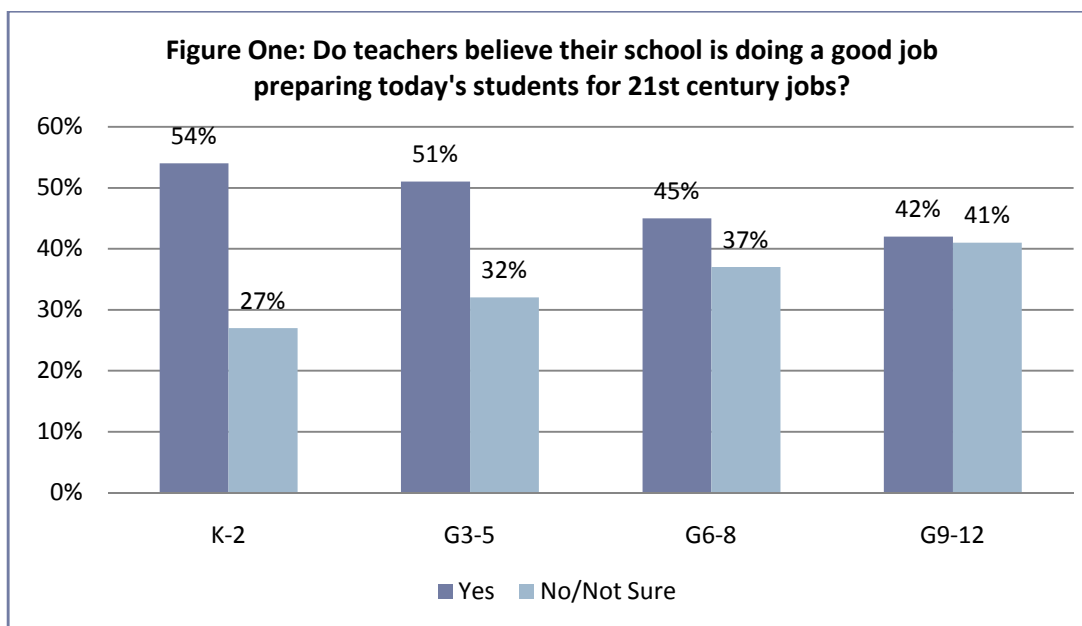
Less than half of students, teachers, and parents reported their school was preparing students for 21st century jobs.

While 57 percent of K-12 school administrators gave a passing grade to their school for preparing students for jobs of the future, only 47 percent of teachers and 43 percent of parents agreed. Teachers with students closer to professional life were less likely than teachers of younger students to report that their school was doing a good job of preparing students for 21st century jobs, as is illustrated in Figure One on page six.

Teachers and students who assessed themselves as “advanced” tech-users were least likely to indicate their schools were doing a good job, compared to “average” and “beginner-level” users. Advanced-level teachers were two times as likely as other teachers to say their schools were not preparing students for future jobs. Among the self-assessed “advanced” middle and high school students, only 23 percent indicated that their schools were preparing them well.

“We must prepare students for jobs that are not yet in existence. To do this, the most important thing they can learn is to *think*. Of absolute necessity are classes that include open-ended questioning, creativity, and problem-solving . . . These all lead to deeper and more complex ways of thinking.”

Female special education teacher
Los Lunas Middle School
Los Lunas, New Mexico



One in four science teachers use inquiry-based investigations to guide student learning.

Doing a “good job” of preparing students for future jobs may require helping students achieve scientific literacy. As described earlier, inquiry-based curricula are seen as one means for students to learn about science. In 2007, however, only 25 percent of science teachers used such curricula in their classrooms. Today’s students will be expected to collectively tackle 21st century problems, yet only 16 percent of teachers reported they are assigning projects that help students develop problem-solving skills.

Teachers’ most-used strategies for teaching science vary by grade level. Hands-on activities were the most frequently employed strategy among teachers of elementary (grades K-5) and middle school (grades 6-8) students. Elementary school teachers also frequently used inquiry-based investigations and

“I love labs in science. It is not like taking notes, which is really boring for me. [Labs] get me understanding more because I can be active. I think that many like to be active to learn.”

Girl, eighth grade
Notre Dame Preparatory School
Towson, Maryland

kit-based materials. Lecturing was not among the top five strategies primarily used by elementary school teachers.

In contrast, middle school teachers’ second and third most-used strategies were lecturing and “making it relevant.” They also frequently employed inquiry-based investigations and demonstration lessons. High school teachers most frequently lectured, and then employed hands-on activities and “making science relevant.”

The strategies teachers use also vary by their technological capabilities. Teachers who assessed themselves as “advanced” are far more likely to explore scientific concepts using multimedia, interactive simulations, and probeware¹ than those who assessed

¹ Prevailing views of using probeware in science assume that students use electronic sensors and computing technologies to collect, visualize, analyze and present data.

themselves as “average” or “beginner-level” users (47 percent compared to 29 percent and 17 percent, respectively). Eleven percent of the advanced group is using probeware in the classroom to facilitate the collection, visualization, analysis, and presentation of scientific data, but only five percent of the average-level users and two percent of beginner-level users are doing the same.

K-12 teachers reported that the barriers to further incorporating inquiry-based methods into their classroom are lack of time (23 percent), inadequate equipment or materials (16 percent), lack of funding to purchase materials (14 percent), pressure to conform to “prescribed” curriculum (12 percent), district and/or school focus on state science assessments (11 percent), and inadequate space to conduct scientific investigations (10 percent).

Students have few opportunities to use technology for school work in the easily-accessible, highly-interactive and customized ways they use it outside of school, but teachers are open to change.

While school administrators aim to protect young people with firewalls and filters, students report that the tools are blocking Web sites they need for learning. In 2007, this was high school students’ number one obstacle to using technology at their schools (53 percent). For middle school students, two obstacles tied for the greatest barrier (39 percent each): “there are rules against using technology at school” and “teachers limit technology use.” It’s likely that when students face obstacles to using technology at school, they also face obstacles to inquiry-based learning opportunities which can include online research, visualizations, and games.

Students reported that other major obstacles to using technology at school are not being able to access email accounts and slow Internet access. Perhaps these are the reasons why just 34 percent of teachers communicate with students via email. Teachers are certainly online; just not with students. Ninety percent of teachers, parents, and school leaders use email to communicate with one another about school.

“Students need to understand what they are learning, not just apply rote knowledge. In order to facilitate this learning, games and technology must be utilized.”

Female math teacher
Marine View Middle School
Huntington Beach, California

Students’ increased access to mobile computing devices might now mean that the instruments in their backpacks and pockets—not to mention their high-speed Internet at home (which 90 percent of them have, according to parents)—are far more useful to them for learning and communicating than the tools at school. Sixty-five percent

of students in grades 9-12 said their school could make it easier for them to work electronically by allowing them to use their own laptop, cell phone, or other mobile device. Sixty-six percent of school leaders and 51 percent of teachers said the most significant benefit of incorporating such devices into instruction would be to increase student engagement in school and learning.

Games could also increase student engagement, according to 65 percent of teachers. Outside of school, 64 percent of students in grades K-12 regularly play online or electronics-based games. Besides winning, students reported that they like to play because of the competition with their peers (48 percent). Middle and high school students indicated that they like finding ways to be successful at the games (46

percent) and the high level of interactivity (44 percent). About half reported that the value of gaming technologies for learning is that games make it easier to understand difficult concepts and would engage them more in the subject. Fifty-six percent of students in grades K-2 reported that gaming would help them learn more about a subject.

Just 11 percent of K-12 teachers reported they are incorporating gaming into their instruction, but over half said they would be interested in learning more about integrating gaming technologies into the classroom. Forty-six percent said they would also be interested in professional development to help them bring gaming into their practices. Without differentiation by gender, subject taught, or years of experience, teachers thought games could address different learning styles (65 percent), focus on student-centered learning (47 percent), and develop problem-solving and critical thinking skills (40 percent).

“Learning games that provide an opportunity to explore topics and receive instant feedback, as well as do so in an entertaining and fun manner, could increase student productivity in the classroom, especially for those who struggle with learning from direct instruction techniques. I would like to see an increase in well developed math and science educational games that can be implemented in classroom settings, as well as open up possibilities for personal study or homework.”

Male math teacher
Mountain View Youth Development Center
Charleston, Maine

Students reported their most interesting science-learning experiences are hands-on and group-oriented.

Just two percent of teachers indicated that a barrier to teaching inquiry-based science is lack of student interest. In an open-ended question, Project Tomorrow asked students in grades 3-12 to describe an especially interesting or favorite learning experience in science or math. Some students suggested that science can be inherently interesting, but a large number reported that their science and math curricula—as employed in their learning environments—are often not. A large portion of K-12 students who have experienced hands-on, tangible activities and group-oriented learning methods in STEM subjects found them to be the most interesting. For some, having a choice between individually-oriented learning, such as working on a research-project on a computer over time, or working in groups was best. Students also communicated that, in their preferred situations, learning is fun.

“My all-time favorite science project was from last year. My teacher let us go into groups and we had to build a bridge out of toothpicks. But he made it challenging because he made it as if we were real builders.”

Girl, ninth grade
Melbourne Senior High School
Melbourne, Florida

“I liked it when I did a project on some of the animals from Florida. I was able to work alone and on the computer. I love projects about studying animals and their natural habitat. I would like to tell about how much fun it is to either work in groups or [alone].”

Girl, sixth grade
Lewis Carroll Elementary School - Brevard County, Florida

“Last year in Geometry, our final project was to build a scale model of an actual house. This project was different from the same old boring posterboard and essay projects that we’re always doing and allowed me to use my creativity.”

Boy, 11th grade
Eleanor Roosevelt High School - Greenbelt, Maryland

“My favorite science activity was when we experimented with water and corks. I like it because it is not hard-core learning that stresses me out; I can just play with things and learn at my own pace while interacting with my group members.”

Girl, fifth grade
Newport Coast Elementary School - Newport Beach, California

Additionally, middle and high school students frequently mentioned their most interesting learning experiences involved using interactive and advanced technology tools and engaging in activities with real-world relevance. Other interesting experiences included teaching other students, learning outside of their normal environment, such as having class time outdoors, or doing something unusual inside their classrooms, such as moving around. Students also appreciated when science and math teachers worked together to assign one creative project that employed skills from—and earned credit for—both courses.

Students in grades 3-5 placed a lot of value on fun activities, particularly when the activities yielded unexpected results, such as a battery and two wires lighting up a light bulb. Activities that gave them a sense of accomplishment, and especially new activities they had never done before, such as “dissecting owl pellets,” were favorites. This age group persistently said that their most fun activities were also the most academically challenging.

“Excited teachers,” “fun experiments,” and “real” tools and experiences might boost students’ interest and achievement in science.

Essential features of students’ “ultimate science classroom” overlap with the experiences they said were most fun or interesting in their 2007 science learning. The most essential feature among students in grades K-2 and in grades 9-12 was “teachers excited about science.” Of all the choices, “excited teachers” was also the factor K-12 parents indicated would have the greatest impact on improving their children’s science education. In fact, almost half of students in grades K-2 who reported they did not like science said if “teachers made it fun” their interest would

For science and math learning, challenging activities are also the most fun.

Many students in grades three to five clearly like a challenge, especially when the “hard” task involved creativity and inquiry.

“My favorite lesson is when the science teacher taught us how to make some pennies clean. What makes it my favorite is that it is very challenging and it uses many thinking [skills].

Boy, fourth grade
Armstrong G. Elementary Intl. Studies
Chicago, Illinois

“[I liked] the activity where we had to make up and solve our own math problems. It’s my favorite because it challenges me. Making sure I don’t give myself easy problems is really hard.”

Boy, third grade
Windsor Hills Elementary School
Baltimore, Maryland

“My favorite [science] activity would probably be this year when . . . we had to see if we could light a light bulb using a D-cell [battery], mini light bulb, and two wires. We actually could but it was very difficult. You had to be very creative.”

Girl, fourth grade
Roy O. Andersen Elementary
Newport Beach, California

“My favorite is a science project called [Biome in a Box—ecology]. This is my favorite because I get to challenge my brain.”

Girl, fifth grade
Pasteur Elementary School
Chicago, Illinois

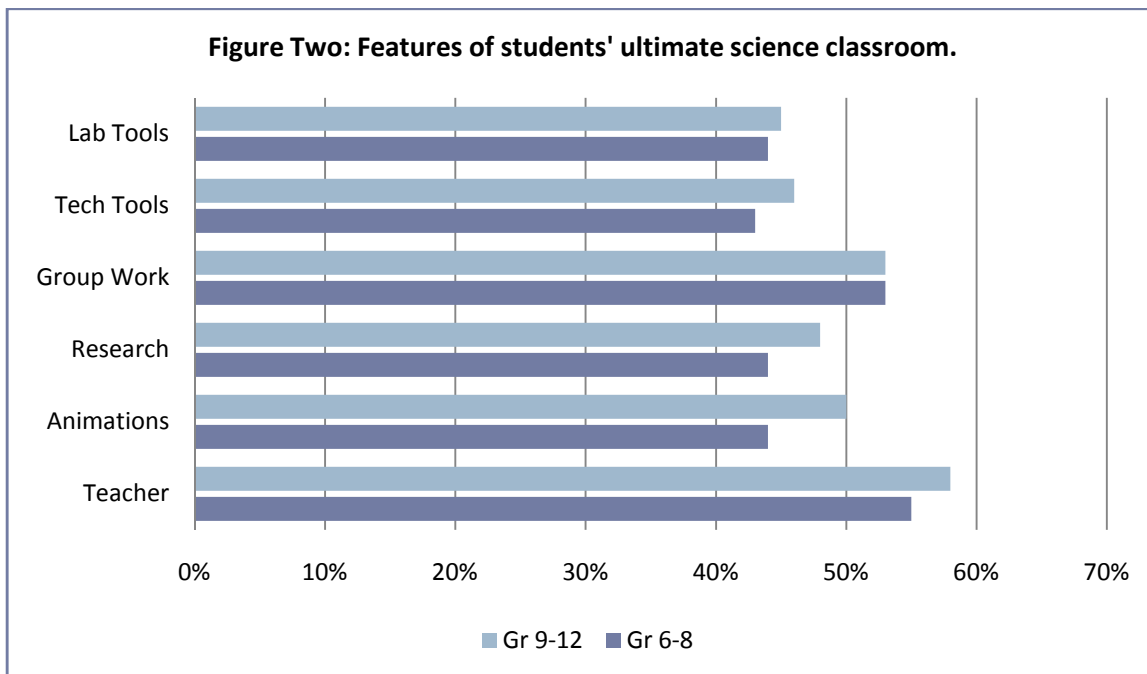
increase. Students in grades 3-5 were far more interested in “fun experiments” (69 percent), however. “Excited teachers” were the fifth highest answer for this age cohort (41 percent).

“Working with other students on projects” was the second most important feature for middle and high school students (53 percent) and third most important for students in grades 3-5 (44 percent). Only 30 percent of parents thought the ability to work in groups was important, however. It’s possible that group work is a more valuable approach for 21st century learners, who are able to call on one another easily via online communication. Since they are expected to work collaboratively as consumers and producers of scientific knowledge in the 21st century, working well in groups is likely to be an important skill.

Just one in five students said “reading the science textbook” was essential for their “ultimate science classroom.” Students who reported that science is not important to their future were more likely than other students to report that reading a textbook is essential (32 percent of high school students; 35 percent of middle school students).

Students seek fewer poster-board projects and more “real” tools that professionals use.

Other highly essential features of the “ultimate science classroom” for students in grades 3-12 were “real tools” (standard lab and technology-based tools) and being able to do “real research,” including online research on computers. For middle and high school students, animations for visualizing difficult concepts and interactive simulation tools were also important, as illustrated in Figure Two.



As described earlier, middle and high school students frequently mentioned that their most interesting learning experiences in science and math courses involved using interactive and advanced technology tools and engaging in activities with real-world relevance. They urged educators to make learning more

interesting by “ditching” the poster-board projects and embracing the varying technologies and professional-level tools available for learning, including standard lab equipment such as microscopes, visualization and animation software, and computers and the Internet for online research. The students’ remarks further reinforce their idea that using “real tools” would be an essential part of an ultimate science classroom.

“Last year in geometry, our final project was to build a scale model of an actual house. This project was different from the same old boring poster board and essay projects that we're always doing and allowed me to use my creativity.”

Boy, 11th grade - Eleanor Roosevelt High School - Greenbelt, Maryland

“In my chemistry honors class we were assigned an online research paper. This was very interesting because it allowed us to utilize the Internet and to discover how chemistry is used every day, whether it be in the kitchen or in medicine.”

Girl, 10th grade -Florida Virtual School

“In math, we are using a new program called Geometer's SketchPad® [a mathematics visualization software application]. I like it because it is using our laptops and extends math past the textbook and paper.”

Girl, 10th grade - Notre Dame Preparatory School - Towson, Maryland

“I like working hands-on in a science setting where we have telescopes and advanced technology to help us in what we are studying. I feel that this helps us really understand what we are learning. I also feel that this will help us enjoy science more.”

Girl, seventh grade
Cardinal Pacelli Elementary School
Cincinnati, Ohio

Students in all grades K-12, along with their teachers, indicated that laptops are the *most* essential tool needed in their imagined “ultimate school.” Likewise, school leaders indicated laptops were the tool with the greatest potential for increasing student achievement and success. Parents ranked laptops eighth, however, when Project Tomorrow asked where they would invest their school’s technology funds to boost student achievement.

Parents would invest in students’ access to online databases for research (53 percent), which was the second choice among students, teachers, and school leaders for their “ultimate school.” Parents would equally commit financial resources to “online access to classroom materials, lectures, and resources.” Perhaps asserting that more information is key to their ability to co-facilitate their children’s learning at home, parents would next invest to streamline families’ communication with teachers (45 percent). This includes portals that provide parents with information about their children’s attendance, grades, and school calendars (48 percent).

Teachers reported that if integrating 21st century tools or strategies into their classrooms they would be most influenced by funding availability, followed by ease of integration into the classroom.

In addition to selecting tools essential for an ultimate school, teachers chose which 21st century tools have the greatest potential to increase student achievement in science specifically. Their top three tools overlapped with students’ ideas: (1) animations to help students visualize difficult concepts;

(2) interactive simulations to practice scientific expertise; (3) standard lab tools and apparatus (such as microscopes and Bunsen burners). The responses were the same despite teachers’ years of experience and self-assessed technological ability, although more advanced users sensed the tools—even standard lab tools—would be useful in increasing achievement than beginner users.

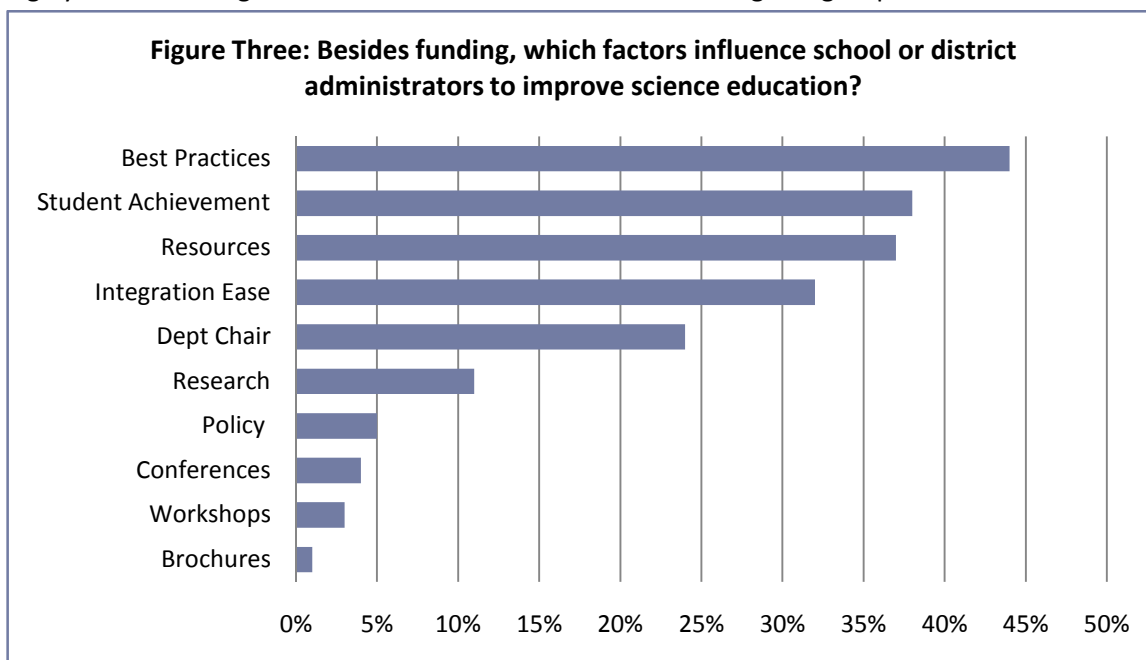
21 st century tool	Advanced-level	Average-level	Beginner-level
Animations	51%	43%	38%
Simulations	50%	40%	32%
Standard tools	42%	36%	27%
Projection systems	39%	28%	20%
Interactive whiteboards	38%	28%	21%

If considering integrating 21st century tools into their science instruction, the factor most influencing them would be available funding and the cost of the tools (27 percent). Twenty-four percent responded “ease of integration into the classroom,” 15 percent responded “research or best practices” and 14 percent responded “demonstrated improvements in student achievement.” Fourteen percent also said they would consider the supporting curricular resources such as teaching guides, lesson plans, and Web sites.

“Science is becoming *highly* technological. Look into today's careers and provide us with the tools, space, time and money we *need* (not what we think is fun—what we truly need) to prepare these kids for high-tech jobs.”

Female K-2 multiple subject teacher
Crestview Elementary - New Boston, Texas

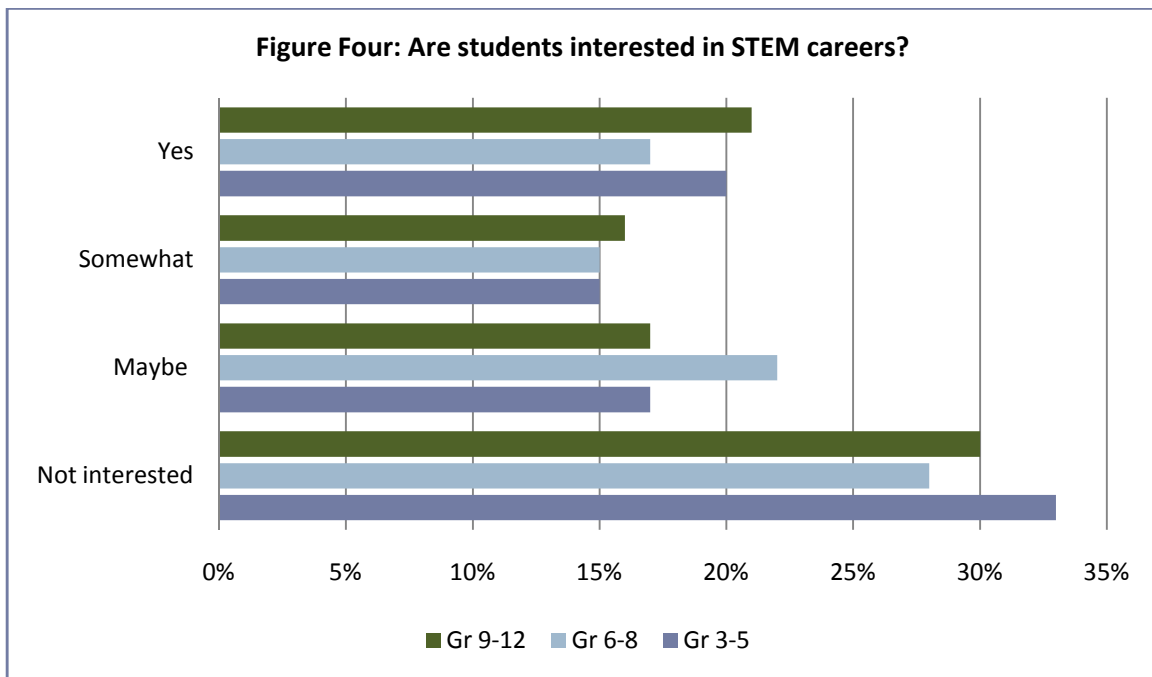
Fifty-eight percent of school leaders indicated that funding is the factor most influencing their plans to improve science education. School leaders also indicated that best practices (44 percent), demonstrated improvements in student achievement (38 percent) and resources to support curriculum (37 percent) are highly influential. Figure Three illustrates the factors influencing this group.



Students are open to STEM careers, and would be further interested given increased interaction with professionals and their tools.

Efforts to increase students’ interest in learning science are partially inspired by the global desire for more students to pursue STEM careers. It’s useful to know if specific methods or incentives might encourage students more than others. Figure Four illustrates that most students who participated in the Project Tomorrow Speak Up 2007 survey are open to pursuing a job or career in a STEM field.

Thirty-two percent of middle school students and 38 percent of high school students reported they are somewhat or very interested in STEM jobs or careers. Twenty-one percent more students in grades 6-12 indicated “maybe” they are interested in a STEM career. In the same age cohort, 47 percent of students reported that learning science is important because they “might want a job that uses science.” More than half of students in grades 3-5 indicated they might want such a job.



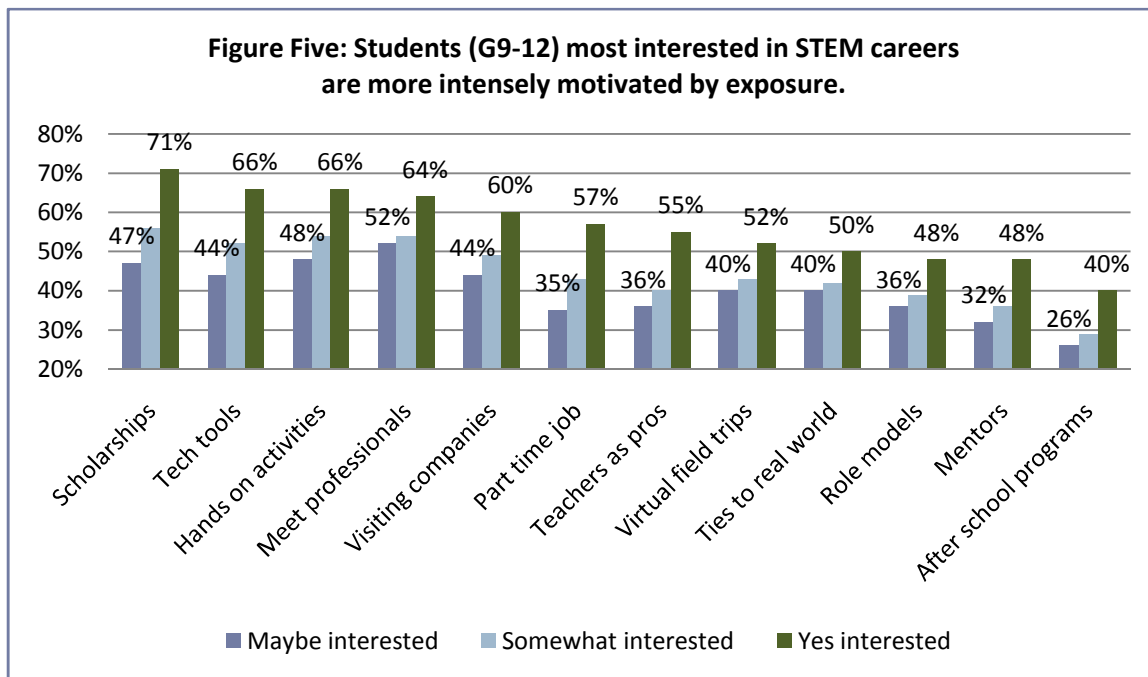
Parents, too, are open to STEM careers for their children. More than half of parents said they are likely to encourage their children to pursue a job in a STEM field. Seventy-one percent said their willingness to recommend the STEM field depended on their children’s interest in the subjects.

Just 12 percent of students indicated they wouldn’t pursue a STEM career because STEM subjects are “not interesting.” Only four percent of students in grades 3-8 and three percent of those in grades 9-12 indicated that STEM subjects are “too hard” to be of career interest.

Scholarships, hands-on activities, and exposure to professionals and tools professionals use will stimulate students’ interest in STEM careers.

Despite their level of interest in STEM jobs or careers, students indicated that similar strategies would be among the top-five most likely to boost their motivation to pursue a STEM field: college scholarships, using tools professionals use, hands-on learning opportunities, conversational interactions with professionals, and visits to STEM companies. Figure Five illustrates that the students who were more interested in STEM careers are likely to be more intensely motivated to pursue a STEM career when exposed to the various strategies, and that—among the top five strategies—some are likely to be more effective than others depending on the level of interest. It’s possible the differences are related to how committed the students are to the idea of pursuing STEM fields and/or how much they sense they need to learn about STEM fields before they pursue them further.

Students who indicated they were “yes” or “somewhat” interested in STEM careers, for example, reported they would be most motivated by scholarships, while students who were “maybe” interested preferred talking with professionals. Using professionals’ tools was the second most-motivating factor among the students who said “yes, interested” but fourth for students who said they were “somewhat” or “maybe” interested in STEM careers. Among the “somewhat” and “maybe” interested students, hands-on activities were the second most-motivating.



Conversational interaction with STEM professionals; visits to STEM companies

Just five percent of teachers surveyed indicated that they introduced students to science professionals as an instructional strategy. Yet when Project Tomorrow asked about factors that would increase their interest in STEM careers, middle and high school students clearly indicated that interactions with professionals and professionals' job environments would be highly influential. Three out of the students' top five responses sought direct exposure to professional-level STEM activities and tools, among them, "talking to career professionals about their jobs" (40 percent) and "visiting companies or places where science, technology, engineering or math are used daily" (35 percent). Virtual field trips were slightly less influential than the real visits, appealing to one third of the students.

Gaining exposure to STEM careers via one-time visits and conversational interactions edged out exposure through employment and programmatic experiences. Twenty-eight percent reported a part-time job in the field would increase their interest in STEM fields, although 58 percent of students who said "yes" they were interested in pursuing a STEM career were interested in a part-time job. One quarter indicated that after-school programs would be influential.

Using tools professionals use

Students reported their desire to use professionals' tools. Thirty-eight percent of students indicated that their interest in STEM careers could be improved if they had opportunities to "use advanced technology, laboratory devices, or professional tools." Recall, students also indicated that using professional-level tools in their science learning environments would be a major factor influencing their interest in learning science.

College scholarships

Scholarships to college for studying STEM subjects would be a real incentive to pursue a STEM career for 38 percent of students. Thirty-one percent of parents said scholarships would influence them to recommend a STEM career to their child.

Students take advantage of "Innovators' Road Trips" to interact with STEM professionals

Putting the Speak Up 2007 findings into practice, Project Tomorrow has been piloting "Innovators' Road Trips" near the organization's home in Orange County, California. The Road Trips are a unique opportunity for high school students to gain a first hand, behind the scenes perspective on careers in the high tech industry through specially structured tours, lab visits and meetings with company and university engineers, technologists and scientists.

Evaluating the 2008 visits to Western Digital, Emulex, and the University of California at Irvine School of Information and Computer Sciences, one student said, "It left a bigger impact on me than I believed it would. I think that engineering is a type of job that will be beneficial to me in the future." Another wrote that the experience "told me to keep an open mind about careers in technology."

Parents of two participants wrote, "It definitely gave our sons a good [perspective] in considering their career options for the future. Our sons are looking forward to the next opportunity to visit and explore the real workplace again."

STEM professionals were equally ecstatic about the opportunity to interact with tomorrow's scientists. Communicating their passion for science, they sensed, is an important way to bring more bright minds into STEM fields.

CEO of Project Tomorrow, Julie Evans, said, "'The 'Innovators' Road Trip' is a win-win for students and business professionals. It gives students the opportunity to ask professionals real questions about their career and career pathway; while providing professionals the opportunity to learn how to promote their profession to students."

“One science thing that I did that was fun was DNA electrophoresis. This project was a smartly applied lesson because it showed a real world use of what we were learning about.”

Boy, 10th grade
Fairfax County Public Schools
Virginia

Hands-on learning opportunities

Thirty-six percent of students reported that hands-on learning opportunities would increase their interest in pursuing a STEM career. Among high school students, this was the most important strategy. Additionally, more than 30 percent of students said their interest would increase with classroom instruction that ties academic material to real world problems.

From Posters to Probeware: Science Education for 21st Century Learners

For today’s students, science is in nearly all of the objects and ideas that surround them (Osborne, 2007). It’s in their handheld communication devices, on countless television series featuring forensics, in the games, computer programs, and networking Web sites they spend hours mastering, and in many of the political and moral dilemmas of our time, including the debates about global warming and embryonic stem cell research. Yet in their schools most young people experience science as the memorization and repetition of facts, often culminating in the anything-but-interactive, yet very familiar, poster board projects. As one student put it, “[You] solve a [problem], tell how you did it, and put it all on a poster. Ewww.” Students are motivated and interested in science when they get to do hands-on, group-oriented learning, but their opportunities to do so are few.

We expect that students will be able to use 21st century tools to solve 21st century problems, and that all will have a role in doing so as citizens of a democracy. The Project Tomorrow Speak Up 2007 findings make clear, however, that while students take science courses and use technology, there is hardly a marriage of the two. Students want to use the technology available to them at home and in their backpacks, but are restricted from doing so at school. Instead they use the schools’ equipment, which is not likely to be as up-to-date and high speed. They long to do “real research” using “real tools.” They hope, somewhat, for the latest animations and visualization software—even probeware for electronic measurement. Yet they’re more focused on what many would consider to be simpler goals, such as improving their access to computers and the Internet to learn science and other subjects. Furthermore, students are open to STEM careers, but sense they need a lot more information about what it is that STEM professionals *do*. The practice of authentic science is something to which they’re simply not well exposed.

School leaders and teachers indicated that when making decisions about improving science education in their schools and classrooms, funding availability is their foremost concern. In today’s political and economic climate, it would be easy for educators and others to dismiss any potential for change as very difficult; perhaps not possible. Yet it is this very barrier that might bring about the most creative ideas for moving toward learning environments where students can achieve scientific literacy. If students’ home access to technology is better than their in-school access, and STEM companies are willing to host

students, how can we take advantage of these opportunities while still enabling students to access to guidance from teachers? With “ease of integration into the classroom” being another major consideration for teachers, in what ways might we adjust conventional school structures (such as class periods, or “seat time”) to accommodate the learning methods necessary for achieving STEM literacy?

In answering these and other questions, the challenge before educators, as well as business and policy leaders, is to take seriously the attitudes of students regarding their experience with science learning, as well as their ideas about what would motivate them to decide to learn science and participate as a consumer and/or producer of science outputs in the 21st century. Learning is something that *students* do, encouraged and assisted by adults, rather than something adults do—or “deliver”—to students. As humans, and citizens of a democracy, young people choose whether they will learn. Therefore, their motivation must be a central focus. Any strategies for “improving science education” must be aware of this reality, lest they fail to achieve their desired goals.

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Appendix

Students Speak Up about their favorite science and math lessons Selected quotes from Speak Up 2006

Students report they like doing new activities...

My favorite project we did this year is inventions. I liked it because we got to use more of our imagination in doing something that will help or community, ourselves or someone else.

5th grade girl, Pasteur Elementary School, City of Chicago School Dist 299, IL

My favorite science lesson is doing the experiments and discovering new things.

5th grade girl, Thomas Jefferson Elementary, Baltimore City Public Schools, MD

My favorite project is this year when we dissected owl pellets. I have never dissected anything at all in my life, so when I found out that we would be dissecting owl pellets, I was very excited.

5th grade girl, Bridge Elementary School, City of Chicago School Dist 299, IL

My favorite science project is the M&M investigation. It is my favorite because it helps me on solving problems and how to investigate.

4th grade girl, Aldridge Elementary School, City of Chicago School Dist 299, IL

My favorite science project is the "Eco System" last year. It was about a week project. It is my favorite because it was the first time I had done a long project.

5th grade girl, Newport Coast Elementary, Newport-Mesa Unified, CA

I like last year's science fair because I got to see things explode and I got to see things I never thought exist[ed].

5th grade boy, Bouchet Elementary Math & Science Academy, City of Chicago School Dist 299, IL

The "New And Improved" project because we had to use our imaginations to do this project. We had to use our imagination by making up an invention that we think is going to appear in the future.

5th grade girl, Govans Elementary, Baltimore City Public Schools, MD

My favorite science project is to do chemicals. It's my favorite because, I like to mix things and see what they form.

4th grade girl, Solomon Elementary School, City of Chicago School Dist 299, IL

I like science it's really cool you could use tools that you have not seen before or used.

5th grade girl, Reilly Elementary School, City of Chicago School Dist 299, IL

My favorite subject is science because I learn new things and I like to learn.

3rd grade boy, Alcott Elementary School, City of Chicago School Dist 299, IL

Students report that science is fun, challenging and unexpected results...

I think science is my favorite project because it helps me learn more then parents and teachers do.

5th grade girl, Haley Elementary Academy, City of Chicago School Dist 299, IL

I like [the] airplane experiment in science because you can see what you did wrong if the airplane doesn't go far enough, and you can hang out with all of your friends. It's a really fun experiment to do in science.

5th grade girl, Harbor View Elementary, Newport-Mesa Unified, CA

My favorite lesson is when the science teacher taught us how to make some pennies clean. What makes it my favorite is that it is very challenging and it uses my thinking.

4th grade boy, Armstrong G Elementary Int'l Studies, City of Chicago School Dist 299, IL

My favorite science lesson was preparing for the science fair. I did a project on the solar system. Just making the planets was really good for me because my parents made me do it all alone. It was hard but they told me that I could do it and I did.

4th grade boy, Cecil Elementary, Baltimore City Public Schools, MD

..when we touched liver, hearts, lungs, and brains from a pig. I liked it because it was cool and squishy

5th grade girl, Bridge Elementary School, City of Chicago School Dist 299, IL

Last year we had a biochemist come in teach us how to mix properly added chemicals and substances. It was fun because we all thought it would be boring but when he mixed two chemicals foam started to come out of the beaker and smelled like oranges

7th grade boy, Herbert C. Hoover Middle School, Brevard County School District, FL

I liked the science lesson when we made ice cream to show how you can freeze a liquid and it will become a solid. I liked this because it was fun making the ice cream, and also fun to eat it!

4th grade girl, Andersen (Roy O.) Elementary, Newport-Mesa Unified, CA

My favorite project from last year was about batteries because it was cool seeing it light up in my hands.

5th grade boy, Haines Elementary School, City of Chicago School Dist 299, IL

Students' favorite science lessons are interactive and hands-on....

I liked last year's ecosystem and dissecting the owl pellets. I liked dissecting owl pellets because you got to see what the owl ate. The reason I liked the ecosystem was because I liked planting, feeding and caring for stuff.

5th grade girl, Newport Elementary, Newport-Mesa Unified, CA

Stomp Rocket Lab. It was a fun way of physically understanding physics and put the idea into concrete terms. It was different because it was hands on, outdoors, and something different.

11th grade girl, Eau Gallie High School, Brevard County School District, FL

It was last year in fourth grade we did a science project about plant cells and we had to make them with clay. It is my favorite because you can have fun with working with science and you don't even know your doing science because you have to much fun.

5th grade boy, Taylor Elementary School, City of Chicago School Dist 299, IL

This year we built rollercoasters. It was a hands-on project, it was fun, and it was a mixture of math and science. We need more hands on activities because you do learn from them and they make learning much more fun.

6th grade girl, Columbia Elementary School, Brevard County School District, FL

Something fun that we did in science was acting like we were bears and we tried to see who would survive the best. It was my favorite because we got to go outside and got to run around. I would tell my school to listen to the children's ideas of they want to do.

6th grade boy, Cardinal Pacelli Elementary School, Archdiocese of Cincinnati, OH

Well in science biology we do experiments online and it's cool. It shows you instead of reading it to you. Start using online activities!

9th grade boy, Miami Sunset Senior High School, Dade County School District, FL

My favorite science lesson is when we used a microscope to see a plant cell. ..I [had] never done before but I realized how cool it was!

5th grade boy, Armstrong G Elementary Int'l Studies, City of Chicago School Dist 299, IL

My favorite science lesson that we did was when we were learning about using the magnifying glasses measuring things with rulers.

3rd grade girl, Cecil Elementary, Baltimore City Public Schools, MD

We once did a Biology lab by breeding fruit flies and determining which genes were passed [on]. I enjoyed it because it was a hands-on experience.

12th grade girl, Notre Dame Preparatory School, MD

The experiment about sublimation was interesting to me. We used dry ice to see what sublimation was. To make other science activities as fun and interesting as this one, they should have experiments using things that aren't seen everyday.

8th grade girl, Robert C. Fisler, Fullerton Elementary, CA

In physics, we learned about circuits with interactive lessons that were really fun and easy to use. They helped me understand the lessons better. I think if they used that type of lesson again, it would be really fun!

12th grade girl, Florida Virtual High School, Florida Virtual School, FL

For science this year we were put into groups and we had to come up with lyrics to a song based on a real song (example, YMCA). We had to include science terms like atoms, neutrons, protons, and everything having to do with an atom and then we had to explain what each was while singing it to a good tune. I thought it was interesting and a very good way to understand what each part was. It was my favorite because making up songs helps me learn a subject well.

8th grade girl, Cardinal Pacelli Elementary School, Archdiocese of Cincinnati, OH

My favorite project was this year when we had to turn a solid into a liquid into a gas -with a candle, a spoon and ice water. It is my favorite because I never had an experience like this.

5th grade girl, Govans Elementary, Baltimore City Public Schools, MD

My favorite project was when we rubbed the balloon on our hair and it stuck to some of the objects. It was my favorite project because it was fun and funny and really, really cool.

4th grade boy, Newport Coast Elementary, Newport-Mesa Unified, CA

My favorite science project was last year and it was about habitats. The project involved making a certain habitat out of a shoe box. I liked this project because it involved artwork and science.

4th grade boy, Bridge Elementary School, City of Chicago School Dist 299, IL

My favorite science project is when we had to feel the dirt and how it changed when water was splashed on it. What the difference is how you feel the dirt and I love to feel the dirt and play in it.

5th grade boy, Medfield Heights Elementary, Baltimore City Public Schools, MD

My favorite thing is a project that I did last year and it was about Saturn. It was my favorite because I [had] chance to teach someone about what I know about Saturn.

4th grade girl, Armstrong G Elementary Int'l Studies, City of Chicago School Dist 299, IL

Science is already great the way it is. Kids like science because it has a lot of hands on activities and that makes us want to learn more. Math could be more interesting if we did more hands on work.

6th grade girl, Columbia Elementary School, Brevard County School District, FL

I like taking the nature walk. When we took our nature walk we were studying about leaves. For example we were talking about living and non living things.

5th grade girl, James Mosher Elementary, Baltimore City Public Schools, MD

I took Biology last year and one of the things that I remembered very well where we had to grow our own bacteria and fungus and then examine them under a microscope, and I thought it was really cool because learning became truly interactive.

9th grade girl, Florida Virtual High School, Florida Virtual School, FL

In science two years ago we did skits relating to what we learned in class and I thought that was really fun to make a skit and to watch the others. It was also a fun way to learn about real life situations relating to science.

7th grade girl, Notre Dame Preparatory School, MD

Last year in science class we got to dissect a frog, I thought it was a good lesson because we got to finally have a hands on experience. I would like to do more hands on experiences in class.

7th grade girl, Cardinal Pacelli Elementary School, Archdiocese of Cincinnati, OH

Right now in science we are about to launch our rockets we have been working on. This is really cool because it's like a hands-on project. This was different because like we actually got to build it ourselves and it was really, really, really cool

6th grade girl, Briar Meadow Charter, Houston ISD, TX

Students' favorite science lessons encourage exploration...

A science activity that I did this year was quite interesting. I had to keep a log of my family's water use, thinking of everything that used any water. I also had to keep a list of my personal use. I liked it because it involved me in the assignment.

12th grade girl, Florida Virtual High School, Florida Virtual School, FL

I enjoyed making a balloon powered race car for science. This project was especially interesting because we get to be creative and find the best way to make our race car work. I would tell my school that they should have a structured, but yet creative project or lesson so that everyone can find their interests.

7th grade girl, Herbert C. Hoover Middle School, Brevard County School District, FL

This year, we used a USB microscope called the Proscope that let us look closely at objects in science. This is different because we were able to explore on our own rather than be forced to stay within certain boundaries for experiment. If our school let us explore a little more freely in math and science rather than follow set lessons, maybe students would be more apt to listen.

7th grade boy, Robert C. Fidler, Fullerton Elementary, CA

I am currently working on a science research project called the effects of magnetism on electrostatics. I like it because I chose the project and control how I do it.

7th grade boy, Herbert C. Hoover Middle School, Brevard County School District, FL

Drawing the blueprints of my dream house (Geometry). It was fun because I had been imagining this house in my head and it was fun to be able to put on paper. I would tell them to make their lesson short and sweet, like that one because the human brain can absorb so much.

12th grade girl, Florida Virtual High School, Florida Virtual School, FL

I got to make a presentation to teach the rest of my class. I got to teach my classmates and they liked it. Students teaching students would help everyone learn

10th grade boy, Eau Gallie High School, Brevard County School District, FL

My favorite project from last year was the Inquiry project. It is different from other projects because we got to choose what our topic was, and that is why I love it so much.

4th grade girl, Armstrong G Elementary Int'l Studies, City of Chicago School Dist 299, IL

I designed a theme park using Newton's three laws and other physics terms.

6th grade girl, Tropical Elementary School, Brevard County School District, FL

I made a boat out of straws and tape. I wanted to see how many beans it could hold before it sank. I liked it because I got to build things and test out what I built. I think that my school should have more activities where we can make things.

7th grade boy, Poe Middle, Fairfax County Public Schools, VA

Last year in Geometry, our final project was to build a scale model of an actual house. This project was different from the same old boring poster board and essay projects that we're always doing and allowed me to use my creativity.

11th grade boy, Eleanor Roosevelt High School, Prince George's County Public Schools, MD

My freshman year of highschool my teacher gave us a project in which we had to develop our own solar powered car. It was my favorite project because we were able to break the common classroom atmosphere and spend time developing something that was our own.

11th grade boy, Melbourne Senior High School, Brevard County School District, FL

I did a science project this year and it was a waterwheel. It was fun because I got to design it and build it.

8th grade girl, Florida Virtual Middle School, Florida Virtual School, FL

Students report they like to work in groups...

I guess it would have to be the one about biomes that were doing right now. It would be my favorite because it is something I can work with friends.

5th grade girl, Pasteur Elementary School, City of Chicago School Dist 299, IL

My favorite thing was making a space ship. It is my favorite because we got to build it... we were in groups making the space ship and because we each brought a thing to make the space ship.

4th grade girl, Solomon Elementary School, City of Chicago School Dist 299, IL

A favorite science activity I did a while ago was creating a volcano in a group project. Learning how to do new things with fellow classmates is fun and motivational. It makes the students want to put more effort into it and work on the project than individual work.

9th grade boy, High Point High, Prince Georges County Public Schools, MD

I like it when we go into little math groups and so it is easier to learn from your mistakes and the other kids can help you with your problems in math.

6th grade girl, Lewis Carroll Elementary School, Brevard County School District, FL

My favorite activity was when we dissected a frog in 6th grade. I liked how we could see the actual frog not a picture of one. Lessons are fun when you get to work in groups and see actual live things, like animals in science.

7th grade boy, Cardinal Pacelli Elementary School, Archdiocese of Cincinnati, OH

Students' favorite science and math lessons incorporate technology...

I like working hands on in a science setting where we have telescopes and advanced technology to help us in what we are studying. I feel that this helps us really understand what we are learning. I also feel that this will help us enjoy science more.

7th grade girl, Cardinal Pacelli Elementary School, Archdiocese of Cincinnati, OH

My favorite activity was in my science class when we were able to use probes that were hooked up to a computer enabling us as students to measure the acidity of certain chemical. We were also given clues to help us figure out which chemical it was. This was interesting because we were able to work in groups and brainstorm on a puzzle that was mind boggling. It was an interactive assignment that required critical thinking and allowed us to learn while we were having fun.

12th grade girl, Miami Central Senior High School, Dade County School District, FL

A science lesson I did last year that was especially interesting to me was learning about the periodic table through interactive software. What was different about it was that it was online and that the students could interact with it. I would like to tell my school to make the Internet projects more interactive to get the same feel as my favorite activity.

9th grade girl, Notre Dame Preparatory School, MD

In science I like to go to the science lab because you get to work with instruments. I like to work with math because sometimes you get to work with fun activities.

4th grade girl, Airport Elementary, Weslaco ISD, TX

Last year I liked the inquiry project... because we got to use technology for our research.

4th grade girl, Armstrong G Elementary Int'l Studies, City of Chicago School Dist 299, IL

In math, we are using a new program called Geometer's SketchPad I like it because it is using our laptops and extends math past the textbook and paper.

10th grade girl, Notre Dame Preparatory School, MD

I enjoyed making charts and PowerPoint presentations for Science and Math projects. These are my favorite subjects, I liked being creative while doing the assignments. I would like to tell my school that having a variety of creative assignments helps to keep learning fun and interesting.

11th grade girl, Florida Virtual High School, Florida Virtual School, FL

I had to create a PowerPoint on an element of my choice in chemistry this year. I chose Carbon. It was especially fun and interesting for me because I enjoyed making the PowerPoint. I love being creative and being able to add creativity to my project was fun.

10th grade girl, Notre Dame Preparatory School, MD

An interesting project would be our science song about atoms and elements. It's my favorite because it was fun and creative unlike all the other boring projects. Let us use laptops to help us with our research

8th grade girl, Cardinal Pacelli Elementary School, Archdiocese of Cincinnati, OH

I really liked doing GeoSketch it is a really good way to figure out rules of Geometry without having a teacher just tell you. It reinforces the concepts.

10th grade girl, Notre Dame Preparatory School, MD

In my anatomy class we frequently do web activities that allow us to see how parts of the body such as muscles, bones, and organs function.

12th grade girl, Notre Dame Preparatory School, MD

We took online tests and quizzes. We also learned lots of things by researching and actually experiencing lots of different things. I don't like to make keynotes, but I love to take photos and make movies out of them, or make music out of garage band.

7th grade girl, Robert C. Fidler, Fullerton Elementary, CA

Students' favorite science lessons are relevant to the world around them...

Last year I had to design a house that was self-sufficient on energy. We had to apply what we learned about energy use of products and apply to a real life situation. I would tell them to make it apply to a real life situation, like we did.

12th grade boy, Melbourne Senior High School, Brevard County School District, FL

My favorite science lesson when we were working on living creatures. These projects make me feel more interested in the world, what is happening in the world and about all kinds of germs.

5th grade girl, Reilly Elementary School, City of Chicago School Dist 299, IL

To make everything interesting to students you should do things with the students that interest them. My favorite thing to do is be hands on because I learn everything much better.

12th grade girl, Space Coast Junior/Senior High School, Brevard County School District, FL

I did a project on an illness for my anatomy class- the most fun part was researching the disease and learning more about the disease. I think all math and science projects can be interesting if they can be applied to real life situations in any way.

11th grade girl, Notre Dame Preparatory School, MD

In biology, we went around the school & took samples from surfaces [and] grew the bacteria in a Petri dish. It helped us get a better view of biology in our lives, which can be hard because bacteria [are] so small. Also, we got to walk around & be creative about where our samples came from. We need more interactive, hands-on activities, especially for chemistry. Chemistry is really hard because you can't even see what you're learning.

10th grade girl, Notre Dame Preparatory School, MD

I had to do an assignment in math about how CDs work, which was easily the most enjoyable and entertaining assignment recently, because it gave me a chance to find out how something that I use every day works. I'd like to tell my school that the assignments like that are the most fun assignments out of all of the ones given to me, because it teaches me about something relating to the subject, but it also makes it fun, in that I learn about how something that I use every day works.

9th grade boy, Florida Virtual High School, Florida Virtual School, FL

I liked this project when we learning about the solar system. I choose to do a model over [an] essay. I made a model of the solar system using Styrofoam balls. The reason why this is my favorite project is because I love making models.

6th grade girl, Sherwood Elementary School, Brevard County School District, FL

A project that I have done this year was a science project that tested what types of material could create snowflakes using Styrofoam cups and dry ice. It was different because the predictions made were very close to the outcomes.

11th grade girl, Eleanor Roosevelt High School, Prince George`s County Public Schools, MD

A science or math lesson that I have done that was especially fun or interesting to me was when I got to make lollipops in Chemistry. The thing that was different about this lesson was that it showed how science can be used in every day life for something,

12th grade girl, Eleanor Roosevelt High School, Prince George`s County Public Schools, MD

I enjoyed making a food commercial in science using the steps of advertising to persuade people to buy the item. It was really fun to film and act it out. I would like to do more things like this in the future

6th grade girl, Cardinal Pacelli Elementary School, Archdiocese of Cincinnati, OH

One Science thing that I did that was fun was DNA electrophoresis. This project was a smartly applied lesson because it showed a real world use of what we were learning about.

10th grade boy, Louise Archer Elementary School, Fairfax County Public Schools, VA

The project itself is not the important part. What is important in ANY subject, and almost always not a part of any of them, is relevance to our lives and our futures. MAKE THEM RELEVANT!

11th grade girl, Florida Virtual High School, Florida Virtual School, FL

Students' favorite science lessons encourage career exploration...

My favorite subject in school is science because it's cool how people experiment on liquids. People like to figure out to make new medicine for people all around the USA. When I grow up I want to be a scientist.

5th grade girl, Gray Elementary School, City of Chicago School Dist 299, IL

I had to interview an engineer for my engineering class. At first, I didn't want to do it, but the person I interviewed was in chemical engineering, my field of choice. I ended up learning valuable information for my own academic future.

12th grade boy, Miami-Dade Virtual School, Dade County School District, FL

Last year I did a rocketry project for my physical science test. I always have enjoyed using rockets and studying rocketry science and learning how to build these crafts. I would like to do something like this for a job. I want to be an aerospace engineer.

9th grade boy, Palo Verde High School, Clark County School District, NV

About Project Tomorrow's Speak Up Initiative

Speak Up is a national initiative of Project Tomorrow (formerly known as NetDay), the nation's leading education nonprofit organization dedicated to ensuring that today's students are well prepared to be tomorrow's innovators, leaders and engaged citizens of the world. Since fall 2003, the annual Speak Up project has collected and reported on the views of over 1.2 million K-12 students, teachers, administrators and parents representing over 14,000 schools in all 50 states. The Speak Up data represents the **largest collection** of authentic, unfiltered stakeholder input on education, technology, 21st century skills, schools of the future and science instruction. Education, business and policy leaders report using the data regularly to inform federal, state and local education programs. For additional information, visit www.tomorrow.org.

About PASCO scientific

PASCO scientific, the sponsor of this report, is a leading developer of innovative, technology-based solutions for hands-on science. PASCO's team of over 165 includes former and current teachers, educational researchers, instructional designers and engineers. Throughout its more than 40-year history, PASCO has focused exclusively on science education—designing, developing and supporting better ways of teaching and learning science. Teachers and students in more than 100 countries throughout the world use PASCO solutions. For additional information, visit <http://www.pasco.com/>.

About the author

Kim Farris-Berg, who authored this report using data analysis conducted by Project Tomorrow, is an independent consultant working with a variety of clients to involve students as co-creators of education policy and practice. She integrates authentic student voices with current major discussions about how to improve K-12 and higher education. Most recently, Farris-Berg is working to develop online facilitated user networks where young people document their experiences and ideas.



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