

STUDENTS ON STEM:

MORE HANDS-ON, REAL-WORLD EXPERIENCES

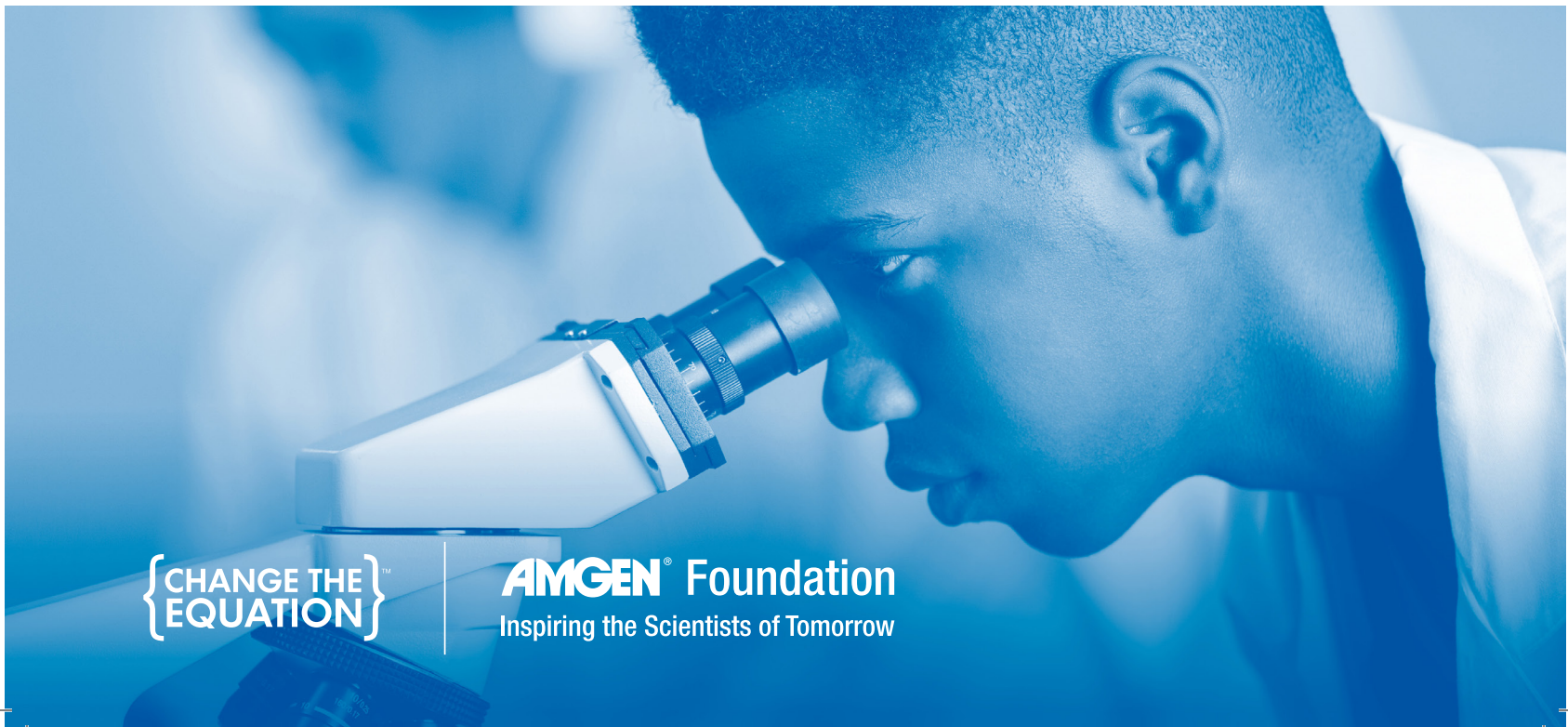
A new survey of American teenagers from the Amgen Foundation and Change the Equation offers real cause for optimism about the future of high school science and biology education in the United States. Teens generally like science—and biology in particular—and they grasp the importance of the field to people's lives. They know good biology teaching when they see it, and they would like the opportunity to do more engaging, hands-on science in school.

These attitudes present a significant opportunity to improve Americans' knowledge and skills in science, yet we are not taking full advantage of that opportunity. The survey suggests, among other things, that many teens lack access to engaging, real-world science experiences, which is limiting their chances to pursue science any further. These

findings are a call to action for anyone who is committed to inspiring the next generation of American scientists and innovators. Leaders in government, education, and industry need to support schools' and teachers' critical efforts to improve science teaching while enriching students' opportunities to experience science outside of school.

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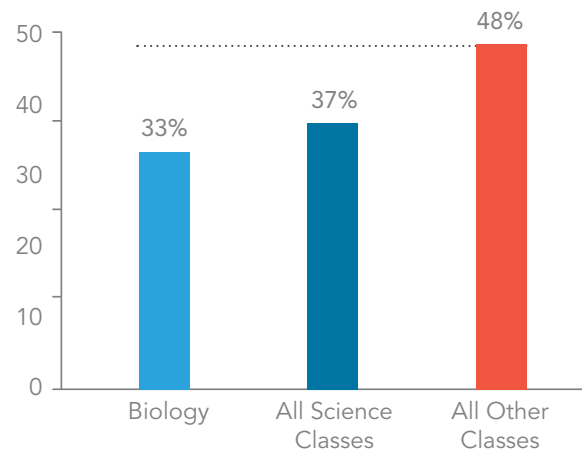
Teens overwhelmingly believe science is relevant and interesting, which makes them ripe for engagement in the subject. Yet we are not taking full advantage of this interest.

More than 8 in 10 teens (81 percent) are interested in science, with more than one in three (34 percent) extremely interested. Almost 3 out of 4 (73 percent) claim interest in biology in particular, with more than one in four (28 percent) extremely interested. A large majority says science is always changing (89 percent), has a big impact on people’s lives (86 percent), and has a lot of real-world applications (86 percent).

Yet teens generally rate their science classes below other classes. (See Figure 1.)

While teens’ overall interest in science and biology is encouraging, there is much room to strengthen it. In fact, roughly half (49%) of teens would sooner try out the latest smart phone than help a famous scientist run a biology experiment. Until few teens could pass up an opportunity to help a famous scientist, we know we still have work to do to capitalize on their interest.

Figure 1: Percentage of teens who report liking their classes “a lot”¹



Teens are savvy consumers of biology class, and they know that their classrooms aren’t giving them the classroom experiences that are most likely to engage them.

Fortunately, teens have a strong conception of what would engage them in biology class. Asked to rate the class tools that would make biology more interesting, they choose hands-on lab experiments, more field trips, projects that relate biology to real life, virtual experiments, and having the choice of what topics they would like to explore further. (See Figure 2.) Decades of research on science education validate much of what teens are saying.²

Yet the list of teaching strategies teens most often experience looks quite different.

Of the strategies teens prefer, only hands-on lab experiments rank among the teaching strategies students most commonly encounter. Teaching straight from the textbook, the second most common class tool, falls to the bottom of the list of what would engage teens the most. (See Figure 2.) Of course, teachers should not discard methods like class discussions or developing hypotheses simply because those methods do not make teens’ top five preferences. Both methods are indispensable tools for teaching science.

Yet teens clearly want more opportunities for real-world engagement in biology.

Figure 2: Comparison of how teens are taught biology versus how they would like to learn

Rank	Most used class tools (at least once a week)	Would make biology most interesting
1	Class discussions	Hands-on lab experiments
2	Teaching straight from the textbook	Field trips to learn about biology out of the classroom
3	Hands-on lab experiments	Projects that relate to the use of biology in real life
4	Learning about how people use biology in the real world	Simulated experiments or other activities virtually
5	Developing own hypotheses before experimenting	Choosing the specific topics you’d like to explore further

Science classes provide most teens their sole exposure to biology, and low-income teens are most dependent on schools for such experiences. Reforming how science is taught can give students the experiences that will most likely captivate them.

Teens who lack engaging, hands-on biology experiences in science classes in school are unlikely to have such experiences anywhere else. Only 33 percent of teens have ever been involved in a science club or group, either in or out of school. Low-income teens are much less likely than their higher-income peers to have been involved, and they are less likely to be aware of any extracurricular science offerings.³ (See Figures 3 and 4.)

Even among teens interested in biology careers, teachers and classes rank as high as parents and guardians as the biggest influences on career decisions. Eighty-six percent said a class influenced their potential career choices; 56 percent said the class was “very influential.” Teachers are just as influential (85 percent and 54 percent, respectively). Schools and teachers play a critical role in nurturing the next generation of scientists.

Figure 3: Percentage of teens who are involved in science group or club, in or out of school

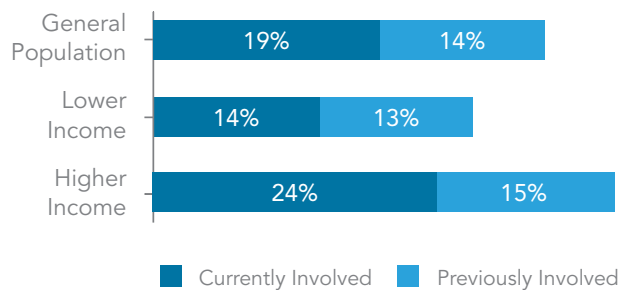
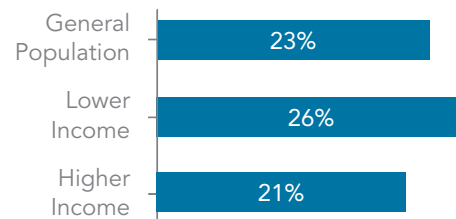


Figure 4: Percentage of teens who are unaware of science groups or clubs, in or out of school



More real-life exposure to science careers and professionals is also critical to teens, because they have few pathways to informed career decisions.

Even if schools made science classes more engaging, teens would still benefit from opportunities to learn about science careers. Ninety-four percent of teens say they know what they need to do to choose a career, and 97 percent of those teens say they are confident in their plans. All too often, however, that confidence fades after high school, when teens discover—sometimes too late—that they have not prepared themselves for career success.⁴

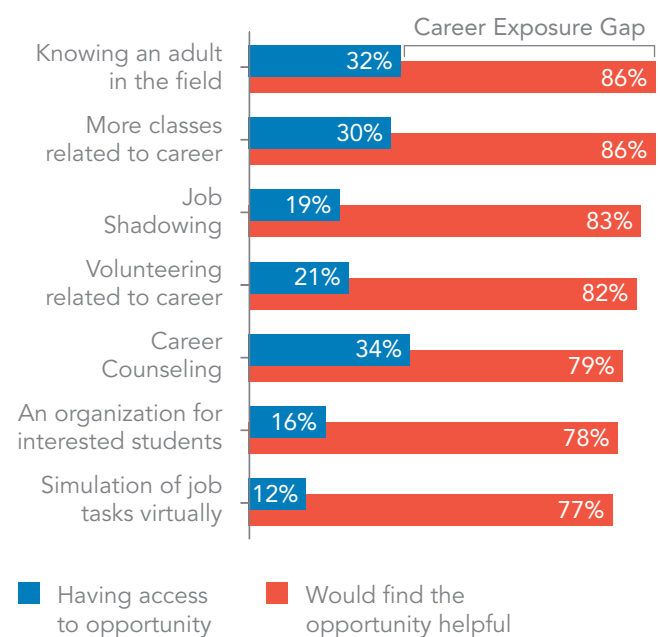
This mismatch between expectations and reality should come as no surprise. Few teens say they have access to the kinds of people and resources they believe would help them plan their steps towards a career. For example, 86 percent believe knowing an adult in their field of interest would be helpful, but only 32 percent actually know such an adult. (See Figure 5.) Even fewer, less than one in four, know someone with a job involving biology.

Low-income students have the fewest pathways to science careers.

- They are less likely than high-income students to:
- know someone who works in biology (19% vs. 25%)
 - be interested in biology (69% vs. 78%)
 - volunteer in a career area that interests them (18% vs. 24%)
 - get tested for career aptitude (23% vs. 29%)⁵

Such unequal access fuels broader social and economic inequities.

Figure 5: Teens want, but lack, career exploration opportunities:



SOLUTION:

Open up the pathways to science, both in and out of school

Teens know what good science education looks like, but they lack engaging learning opportunities, career guidance, and professional mentors. Science advocates in our schools, businesses, and communities can change that.

Teens need more engaging science teaching:

- States, districts, and schools have the opportunity to choose curricula and teaching materials that emphasize hands-on, inquiry-based science, and that make connections to teens' own lives and the world around them.
- As districts and schools adopt these new curricula, teachers deserve all the support they can get, including meaningful professional development and teaching materials to help them adopt more engaging methods.
- Valuable learning about science can happen both in and out of school. Teens need more access to engaging after-school or summer school science programs. (For examples of proven programs, see [Change the Equation's STEMworks database at changetheequation.org/stemworks](http://changetheequation.org/stemworks).)

Teens also need better career preparation pathways in science, both in and out of school. For example:

- Businesses and schools can work together to bring more science professionals into classrooms and identify more science mentors for high school students;
- Businesses can help schools and teachers integrate real-world, cutting-edge science. For example, the Amgen Biotech Experience provides teacher training, teaching materials, and research-grade lab equipment to give students hands-on exposure to the methods scientists use to create medicines through biotechnology.
- Schools and districts can join forces with employers to provide more career exposure opportunities in their career counseling efforts, from career fairs and informational interviews to internships in local labs.

American teens are ready to be inspired by science. We cannot squander that opportunity.

Methodology: The survey was commissioned by the Amgen Foundation and Change the Equation, and conducted by C+R Research Services, a national marketing research firm that specializes in youth attitudes and opinions. A representative sample of high school students ages 14 to 18 completed a total of 1,569 online surveys in November 2015. Researchers oversampled Black and Latino teens to ensure adequate representation. For the full methodology, visit changetheequation.org/students-on-stem.

1 The percentages for "All Science Classes" and "All Other Classes" represent average percentages calculated across the classes in each category.

2 See, for example, M. Suzanne Donovan and John D. Bransford, *How Students Learn: Science in the Classroom*, Washington, DC, National Academies Press, 2005. Not surprisingly, research on what works in science classrooms has long discredited "teaching straight from the textbook." It stresses establishing real-world contexts, giving students opportunities to formulate their own scientifically-testable questions, and helping them gather evidence and formulate explanations through actual engagement with the natural world. In addition, research on science education commonly supports connecting "classroom learning experiences in science" with students' own interests and experiences." (See *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*, Washington, DC, National Academies Press, 2012). Finally, see Nobel Laureate Carl Wieman's defense of simulated experiments: Carl Wieman, "Why Not Try a Scientific Approach to Science Education?" *Change Magazine*, September/October 2007, accessed April 7, 2016, <http://www.changemag.org/Archives/Back%20Issues/September-October%202007/full-scientific-approach.html>.

3 Differences between lower- and higher-income teens are significant at the 95 percent confidence level. "Higher income" students reported household income of \$50K or higher, while "lower income" students reported household income of \$49,999 or lower.

4 Surveys of high school students and recent graduates often reveal unrealistic career expectations or dashed hopes. In a 2011 survey, for example, the average high school student predicted that he or she would earn \$150,000 once established in a career—a figure nearly three times as high as median U.S. household income. (Charles Schwab, 2011 Teens & Money Survey Findings.) A 2014 survey of recent high school graduates found that, of those who did not go directly to college, fully 65 percent said they would have taken more challenging courses in school had they known about the expectations of the working world. Seventy-two percent of college students harbored the same regret. (Achieve, *Rising to the Challenge: Are High School Graduates Prepared for College and Work?*, November 2014.)

5 Differences are significant at the 95 percent confidence level.