STEM Education, Science Literacy and the Innovation Workforce in America:

2012 Analysis and Insights from the Bayer Facts of Science Education Surveys

1995 - 2011

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About Bayer Corporation and

Making Science Make Sense®

Bayer Corporation, headquartered in Pittsburgh, is a subsidiary of Bayer AG, an international health care, nutrition and high-tech materials group based in Leverkusen, Germany. As an inventor company, it sets trends in research-intensive areas. The company's products and services are designed to benefit people and improve their quality of life. The Corporation is committed to the principles of sustainable development and to its role as a socially and ethically responsible corporate citizen. Economy, ecology and social responsibility are corporate policy objectives of equal rank. In North America, Bayer had 2011 net sales of EUR 8,177 million ($11,366 million) and employed 15,800 at year-end. For more information, go to www.bayerus.com.

Making Science Make Sense® (MSMS) is Bayer’s company-wide initiative that advances science literacy through hands-on, inquiry-based science education, employee volunteerism and a public education campaign. Currently, 12 Bayer sites around the U.S. operate local MSMS programs, which together represent a national volunteer corps of more than 1,000 employees. For more information, go to www.bayerus.com/msms.
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Bayer invites national science and education experts, as well as elected local, state and national officials to utilize the findings in this report. They, and others, including the media, may reproduce this document, either in whole or in part, with proper credit given to Bayer.
Executive Summary
In 1995, Bayer Corporation launched its Presidential award-winning Making Science Make Sense® science literacy initiative. Since then, the three hallmarks of the initiative have and continue to be the company's support of employee volunteerism in local schools, hands-on, inquiry-based science teaching and learning, and a national public awareness campaign led by Dr. Mae C. Jemison that is designed to educate Americans about the importance of science, science education and science literacy for all U.S. citizens.

From the outset, a key element of the public education campaign has been the Bayer Facts of Science Education surveys. Just as other national polls tap into American opinions about politics, the Bayer Facts surveys have taken the pulse of America's attitudes over the last 15 years about timely issues related to science and technology, science education, science literacy and more recently STEM (science, technology, engineering and mathematics) diversity and underrepresentation. The surveys have polled various audiences, including the nation's Ph.D. scientists and science teachers; Fortune 1000 STEM company CEOs, corporate human resources directors and other business leaders; and deans of colleges and universities, as well as parents, students and the general public. In doing so, the research has examined virtually every phase of the STEM continuum from elementary school through undergraduate/graduate education and the STEM workplace.

This report summarizes the 15 years of Bayer Facts public opinion research. In compiling this document, Bayer has identified key intersections of thought, belief and concern among diverse stakeholders. The important trends that emerged are instructive and can be utilized by those who help set and oversee U.S. STEM education policy.

**15 Universal Beliefs**
An analysis of all the Bayer Facts of Science Education surveys reveals some universal beliefs.

#1: Science literacy is critical for all Americans young and old, scientist or non-scientist.

#2: U.S. global economic leadership and competitiveness are intrinsically linked to a robust science and technology innovation pipeline and workforce.

#3: America’s future STEM leadership is dependent on the country’s ability to recruit and retain more women, African-Americans, Hispanics and American Indians (underrepresented minorities) in STEM fields.

#4: Improving science education for all students – especially girls and underrepresented minorities (URMs) – should be a national priority and begin at the earliest possible elementary school level since that’s where the STEM workforce truly begins.

#5: Science interest and ability are color-blind and gender-neutral: from an early age, boys and girls of all races and ethnic backgrounds are interested in science.

#6: Parents and teachers are critically important to nurturing children’s science interest, even if they themselves are not scientists or don’t have all the answers.

#7: In elementary school, science should be the “4th R” and given the same emphasis as reading, writing and mathematics.

#8: A hands-on, minds-on approach to science education is the best way for students to learn science and build crucial science literacy skills, such as critical thinking, problem solving and the ability to work in teams.

#9: The nation’s colleges and universities should revitalize pre-service teacher education in science.

#10: The nation’s in-service teachers should be given the tools and ongoing professional development required to be the best science teachers they can be.

#11: Students and teachers benefit from having direct access to scientists and engineers on a regular basis in the classroom.

#12: America’s leading research colleges and universities should rethink how they define academic success when it comes to undergraduate STEM students.

#13: For corporate America, STEM workforce diversity benefits the corporate bottom line by bringing a range of thought, skills and problem solving to the table.

#14: America’s STEM industries and communities need to more effectively communicate with all of today’s students about a range of issues including job opportunities and the fact that they are wanted and needed in these jobs.

#15: It will take a village to improve science education in this country and all stakeholders have a responsibility and a role to play.
**Bayer Facts of Science Education Surveys: The Stakeholders**

**Bayer Facts XV: A View from the Gatekeepers: STEM**
Department Chairs at America’s Top 200 Research Universities on Female and Underrepresented Minority Undergraduate STEM Students
(International Communications Research, Inc., Media, PA., 2011)
**Audience Polled:** 413 STEM department chairs at the nation's top 200 research universities and those that produce high numbers of female, African-American, Hispanic and American Indian STEM graduates

**Bayer Facts XIV: Female and Minority Chemists and Chemical Engineers Speak about Diversity and Underrepresentation in STEM**
(Campos Inc, Pittsburgh, PA, 2010)
**Audience Polled:** 1,226 working female and minority chemists and chemical engineers

**Bayer Facts XIII: Fortune 1000 STEM Executives on STEM Education, STEM Diversity and U.S. Competitiveness**
(International Communications Research, Inc., Media, PA, 2008)
**Audience Polled:** 100 Fortune 1000 STEM company CEOs and other C-suite executives

**Bayer Facts XII: CEOs on STEM Diversity: The Need, The Seed, The Feed**
(International Communications Research, Inc., Media, PA, 2006)
**Audience Polled:** 100 emerging STEM company CEOs and other C-suite executives

**Bayer Facts XI: American Parents Speak Out About Their Children and Science**
(Market Research Institute, Inc., Merriam, KS, 2005)
**Audience Polled:** 1,500 American parents who have at least one boy and one girl between the ages of five and 18 living at home

**Bayer Facts X: Are the Nation's Colleges and Universities Adequately Preparing Elementary Schoolteachers of Tomorrow to Teach Science?**
**Audience Polled:** 250 college/university deans of education and 1,000 new K-5 schoolteachers (those with three to five years of experience)

**Bayer Facts IX: Americans’ Views on the Role of Science & Technology in U.S. National Defense**
**Audience Polled:** 1,004 Americans age 18 and over

**Bayer Facts VIII: U.S. College Students Look Ahead Post-September 11**
(Gallup Inc., Princeton, NJ, 2002)
**Audience Polled:** 1,000 full-time college students attending four-year colleges

**Bayer Facts VII: The State of America’s New Workforce**
(Market Research Institute, Inc., Merriam, KS, 2001)
**Audience Polled:** 701 new U.S. workforce employees and 400 managers who supervise such new employees

**Bayer Facts VI: Americans’ Views on Science, Technology, Education and the Future**
(Gallup Inc. Princeton, NJ, 2000)
**Audience Polled:** 1,003 Americans age 18 and over

**Bayer Facts V: U.S. Science Teachers Speak**
(Market Research Institute, Inc., Merriam, KS, 1999)
**Audience Polled:** 1,712 U.S. K-12 science teachers who are members of the National Science Teachers Association

**Bayer Facts IV: Scientists on Science for the 21st Century**
(Roper Starch, New York, NY, 1998)
**Audience Polled:** 1,435 male and female Ph.D. scientists who are members of the American Association for the Advancement of Science

**Bayer Facts III: A U.S. Student Report Card on Science Education**
**Audience Polled:** 1,016 students ages 10 to 17

**Bayer Facts II: Today’s Students and Tomorrow’s Workplace: An Assessment of What Business Will Need and What Schools Can Provide**
(Research Communications, Inc., Dedham, MA, 1996)
**Audience Polled:** 301 elementary school principals and 300 human resource directors

**Bayer Facts I: Elementary School Parents and Teachers on Science Education**
(Research Communications, Inc., Dedham, MA, 1995)
**Audience Polled:** 1,004 elementary school teachers and 1,000 parents
United States’ STEM Pipeline and Workforce: Implications for U.S. Global Innovation and Competitiveness

Strong STEM Pipeline = Strong U.S. Economy and Sustained Global Leadership

According to the U.S. Department of Commerce report STEM: Good Jobs Now and for the Future (2011), “over the past 10 years, growth in STEM jobs was three times as fast as growth in non-STEM jobs. STEM workers are also less likely to experience joblessness than their non-STEM counterparts. Science, technology, engineering and mathematics workers play a key role in the sustained growth and stability of the U.S. economy, and are a critical component to helping the U.S. win the future.”

Similarly, one very clear message has emerged from the Bayer Facts of Science Education surveys: America’s economic and global leadership has been and is intricately linked with the inventions, innovations and discoveries made by a strong U.S. STEM workforce.

However, many of the stakeholders polled also are quick to point out that the U.S. cannot rest on its laurels if it is to maintain its lead in the world. In fact, they believe our nation’s leadership position is threatened by other countries that are making considerable investments in their own STEM infrastructures and education systems.

Thoughts on U.S. Global Leadership in STEM

<table>
<thead>
<tr>
<th></th>
<th>New Employees</th>
<th>Managers of New Employees</th>
<th>Emerging STEM Company CEOs</th>
<th>Fortune 1000 STEM Company CEOs</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. Global STEM Leader Next 25 Years</td>
<td>81 percent</td>
<td>78 percent</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>U.S. Leadership Challenged by Other Countries/ Shortage of U.S. STEM Talent</td>
<td>88 percent</td>
<td>88 percent</td>
<td>78 percent</td>
<td>95 percent</td>
</tr>
<tr>
<td>U.S./U.S. Students Face Increased Competition for STEM Jobs Globally</td>
<td>84 percent</td>
<td>85 percent</td>
<td>57 percent</td>
<td>68 percent</td>
</tr>
</tbody>
</table>
While many stakeholders recognize the opportunities created by STEM, they have concerns about whether or not we are fully developing our STEM pipeline.

**OPPORTUNITY**

America's success in the global economy will depend upon its having a world-class workforce with the skills necessary to meet the challenges of an ever-changing workplace (90 percent of Americans in *Bayer Facts VI*).

The country’s emphasis on national security post-9/11 will create new job opportunities in science and technology for today’s students (75 percent of Americans in *Bayer Facts IX*).

U.S. scientists expect the pace of discovery to accelerate and believe the impact of those discoveries on society, as well as new understandings and new applications of science to health, medicine and technology, will be greater in the next 100 years (75 percent of Ph.D. scientists in *Bayer Facts IV*).

Science and technology has been important in establishing America’s influence in the world (93 percent of Americans in *Bayer Facts VI*).

**CONCERN**

U.S. 12th graders’ poor performance on the Trends in International Math and Science Study (TIMSS) may negatively impact the nation’s future economic prosperity (90 percent of Americans in *Bayer Facts IX*).

Today’s students may not have the math and science skills necessary to produce the science excellence required for homeland security and economic leadership in the 21st century (90 percent of Americans in *Bayer Facts IX*).

The next generation of college students will need stronger pre-college math and science education (72 percent of U.S. college students in *Bayer Facts VIII*).

Science and technology-related jobs may shift to other countries whose citizens have stronger science literacy skills (75 percent of Americans in *Bayer Facts VI*).

**STEM Education = A National Priority**

Almost all Americans (90 percent in *Bayer Facts IX*) and *Fortune* 1000 STEM company CEOs (98 percent) believe pre-college STEM education should be a national priority for our schools and our country.

Our country needs more scientists, engineers and innovators, to be sure. And the more diverse talent pool we can draw from, the better. But, it goes beyond those working directly in STEM fields. We also need government and business decision-makers who understand science and all its implications. We need citizens who similarly understand science. We need more journalists to accurately report on scientific developments. And we need more gifted teachers to advance science literacy and curiosity. There is much to be done. Working together, we can change the future in bright, imaginative ways.

Greg Babe
President and CEO,
Bayer Corporation
Hats Off to Science Literacy

In the *Bayer Facts* surveys, science literacy has been defined as a general knowledge of science, math and technology in order to understand information, think critically and solve problems. Almost without exception, science literacy is recognized as being critically important for all Americans, young and old alike, regardless of whether or not they choose to pursue a STEM or non-STEM career.

**Stakeholders On Science Literacy**

<table>
<thead>
<tr>
<th>Stakeholders</th>
<th>Statement</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>K-12 Science Teachers</td>
<td>It is important for adults to be science literate</td>
<td>100 percent</td>
</tr>
<tr>
<td>Ph.D. Scientists</td>
<td>It is very important for adults today to be science literate</td>
<td>99 percent</td>
</tr>
<tr>
<td>Principals</td>
<td>Science literacy is important today for entry level jobs</td>
<td>98 percent</td>
</tr>
<tr>
<td>Parents</td>
<td>Science literacy is important for workers not employed in science and engineering fields</td>
<td>98 percent</td>
</tr>
<tr>
<td>Female and Minority Chemists and Chemical Engineers</td>
<td>It is important for Americans, both STEM professionals and non-STEM professionals alike, to be science literate in today’s world</td>
<td>96 percent</td>
</tr>
<tr>
<td>Human Resource Directors</td>
<td>Science literacy is important today for entry level jobs</td>
<td>90 percent</td>
</tr>
<tr>
<td>Americans (<em>Bayer Facts VI</em>)</td>
<td>Most entry-level jobs in the next decade will require a basic level of science literacy</td>
<td>83 percent</td>
</tr>
<tr>
<td>Ph.D. Scientists</td>
<td>Most entry-level jobs in the future will require science literacy</td>
<td>80 percent</td>
</tr>
<tr>
<td>College Students</td>
<td>Science literacy is important for college students given their career plans</td>
<td>74 percent</td>
</tr>
<tr>
<td>New Employees</td>
<td>Science literacy is important for success in today’s workplace</td>
<td>74 percent</td>
</tr>
<tr>
<td>Americans (<em>Bayer Facts IX</em>)</td>
<td>It is more important for today’s students to be science literate than it was before 9/11</td>
<td>72 percent</td>
</tr>
<tr>
<td>Managers of New Employees</td>
<td>Science literacy is important for success in today’s workplace</td>
<td>68 percent</td>
</tr>
</tbody>
</table>
**Fully Tapping America’s Talent Pool: Achieving STEM Diversity**

**Why STEM Diversity?**

Today, both the quantity and quality of America’s STEM workforce are at risk, according to many indications. As the country’s demographic patterns shift, minority populations grow and significant numbers of the STEM workforce retire, we can no longer rely solely on the traditional STEM worker – largely male and Caucasian – to fill our current and future workforce needs.

While women, African-Americans, American Indians and Hispanics have made gains in certain STEM fields, compared with Caucasian and Asian males they remain sorely underrepresented in STEM overall. According to recent U.S. Department of Commerce reports (ESA Issue Brief 04-11 and 05-11), women make up half the population, but only 25 percent or less of the STEM workforce, depending on field. Underrepresented minorities fare even worse. They comprise 30 percent of the population, yet only 14 percent of the STEM workforce.

Those gaps are large and, given current demographic trends, clearly unsustainable if the U.S. is to continue to pioneer the scientific and technological advances that make global leadership possible.

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**Awareness and Concern over Underrepresentation in STEM**

STEM diversity and underrepresentation have been the focus of the most recent *Bayer Facts Surveys XI – XV* which explore these dual issues in order to better understand the roots of underrepresentation and uncover ways to bring more talented American women and URMs to the STEM table. The good news – there is some broad consensus on the issues. Across the board, stakeholders believe diversity in STEM is one solution to sustaining long-term U.S. economic competitiveness and innovation, while maintaining a talented workforce pool.

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**Thoughts on STEM Underrepresentation**

<table>
<thead>
<tr>
<th>Awareness</th>
<th>Parents</th>
<th>Emerging STEM Company CEOs</th>
<th>Fortune 1000 STEM Company CEOs</th>
<th>Female and Underrepresented Minority Chemists and Chemical Engineers</th>
<th>STEM Department Chairs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underrep in Industry/Company</td>
<td>66%</td>
<td>65%</td>
<td>89%</td>
<td>63%</td>
<td>–</td>
</tr>
<tr>
<td>Underrep in Company</td>
<td>56%</td>
<td>36%</td>
<td>83%</td>
<td>63%</td>
<td>–</td>
</tr>
<tr>
<td>Underrep a Manpower Concern</td>
<td>47%</td>
<td>–</td>
<td>–</td>
<td>63%</td>
<td>96%</td>
</tr>
</tbody>
</table>

*NOTE: Of those who say underrepresentation exists in their company.*
The Benefits of a Diverse STEM Workforce: Industry Perspective

Overwhelmingly, senior executives at the nation’s Fortune 1000 (92 percent) and emerging STEM companies (74 percent) believe diversity enhances their companies’ success.

How Does Diversity Contribute to a Company’s Success?*

<table>
<thead>
<tr>
<th></th>
<th>Fortune 1000 STEM CEOs</th>
<th>Emerging STEM Company CEOs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increases different ideas/perspectives/skills</td>
<td>41 percent</td>
<td>25 percent</td>
</tr>
<tr>
<td>Improves ability to compete in U.S. and global markets</td>
<td>39 percent</td>
<td>14 percent</td>
</tr>
<tr>
<td>Allows for greater creativity/more innovation/new ideas</td>
<td>26 percent</td>
<td>—</td>
</tr>
<tr>
<td>Results in better solutions/decision making/client communication</td>
<td>14 percent</td>
<td>9 percent</td>
</tr>
<tr>
<td>Expands hiring/resource pool</td>
<td>12 percent</td>
<td>4 percent</td>
</tr>
<tr>
<td>Enables company to attract a diverse workforce/shows company is open to minorities and women</td>
<td>11 percent</td>
<td>—</td>
</tr>
<tr>
<td>Fosters a healthy work atmosphere/workplace reflects American demographics</td>
<td>10 percent</td>
<td>4 percent</td>
</tr>
<tr>
<td>Results in better/different products</td>
<td>8 percent</td>
<td>—</td>
</tr>
</tbody>
</table>

*NOTE: Executives could offer more than one response.

Underrepresentation in STEM

Despite the top executives’ recognition of the benefits of diversity, underrepresentation still exists. Female and URM chemists and chemical engineers (77 percent) believe significant numbers of women and underrepresented minorities are missing from the U.S. STEM workforce today because they were not identified, encouraged or nurtured to pursue STEM studies early on.

And they don’t think much has changed, particularly when it comes to the job the U.S. pre-college education system is doing to engage girls and URMs in STEM education.

Leading Causes of Underrepresentation in STEM*

- Lack of quality science and math education programs in poorer school districts (75 percent)
- The existence of stereotypes that say STEM isn’t for girls and minorities (66 percent)
- Financial issues related to the cost of education (53 percent)
- The failure of those in the STEM industries to communicate to women and minorities that they are wanted and needed in STEM (51 percent)

*According to female and URM chemists and chemical engineers in Bayer Facts XIV.

Report Card for Pre-College STEM Education*

<table>
<thead>
<tr>
<th>Engaging Girls</th>
<th>D+</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engaging Underrepresented Minorities</td>
<td>D</td>
</tr>
</tbody>
</table>

*Source: Bayer Facts of Science Education XIV

*NOTE: All “Report Card” grades that appear in this document are the result of a re-evaluation of data using one consistent scale from the College Board. In some cases, there are small differences from grades originally reported in individual survey executive summaries.
Bias in STEM: A Timeline

By all accounts, most STEM fields have long been the domain of men. In fact, in past years stereotypes have been a barrier difficult to overcome for many women and URMs who have gone on to become professional chemists and chemical engineers, according to those surveyed in Bayer Facts XIV. A number of other surveys also have detected bias.

Some women and URMs report they were encouraged less in science class. Bayer Facts XIV

Bias and lack of opportunity take center stage as the leading workplace barriers for women and URMS. Bayer Facts XIV

K-12 Education

Childhood

Parents are more optimistic about their sons than their daughters when it comes to science. Bayer Facts XI

College

Inappropriate discouragement of women and URMs in pursuing STEM studies is alive and well on campus. Bayer Facts XIV and XV

The Bayer Facts surveys confirm something I’ve long known – that interest in science is genderless and colorless. All children have an innate interest in science and the world around them. But for many children, that interest hits roadblocks along the academic system that is still not blind to gender or color. These roadblocks have nothing to do with intellect, innate ability or talent. On the contrary, they are the kinds of larger, external socio-cultural and economic forces that students have no control over. As students, they cannot change the fact that they do not have access to quality science and math education in their schools. But adults can. And we must.

Dr. Mae C. Jemison, astronaut, medical doctor, chemical engineer and Bayer’s longtime Making Science Make Sense® spokesperson.
C-level executives at both large, established STEM companies and smaller, emerging ones agree on a variety of STEM diversity issues. They share concern over the country's continuing global leadership in science and technology, recognize the benefits of a diverse workforce and acknowledge corporate America's role in helping women and minorities succeed in STEM fields.

However, when it comes to addressing their concern, a pattern emerges that demonstrates fewer executives of the smaller STEM companies are proactive in helping to increase the numbers of women and URM STEM professionals.

| Does Your Company Participate in Employee Volunteer Programs Aimed at Girls and Minority Students? | Fortune 1000 STEM Company Executives | Yes - 87 percent | Emerging STEM Company Executives | Yes - 37 percent |
| Does Your Company Effectively Communicate the Myriad STEM Job Opportunities to Today's Students? | Yes - 54 percent | Yes - 32 percent |
| Does Your Company Actively Recruit Women and Minorities for STEM Positions? | Yes - 71 percent | Yes - 18 percent |
It Begins at the Beginning: Developing Childhood Interest in Science

Scientists’ Perspective

Two Bayer Facts surveys questioned professional scientists and engineers about their experiences growing up, in school and in the workplace. Both surveys found that for those who go on to become professionals, interest in science begins early – before age 11. That means they were ripe for science learning in elementary school.

When is Interest in Science Sparked?

<table>
<thead>
<tr>
<th>Activity</th>
<th>Female and Minority Chemists/Chemical Engineers</th>
<th>Ph.D. Scientists</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interest Develops Before Age 11</td>
<td>59 percent</td>
<td>61 percent</td>
</tr>
<tr>
<td>Interest Develops After Age 11</td>
<td>40 percent</td>
<td>37 percent</td>
</tr>
</tbody>
</table>

In both surveys, the scientists and engineers were asked to identify the most important activities and individuals that contributed to stimulating their interest in science. School science classes, teachers and parents came out on top.

Important Influences in Nurturing/Sustaining Interest in Science*

<table>
<thead>
<tr>
<th>Activity</th>
<th>Female and Minority Chemists/Chemical Engineers</th>
<th>Ph.D. Scientists</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TOP ACTIVITIES</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>School Science Classes</td>
<td>84 percent</td>
<td>82 percent</td>
</tr>
<tr>
<td>Visits to Science Museums</td>
<td>63 percent</td>
<td>76 percent</td>
</tr>
<tr>
<td>Science in Media</td>
<td>62 percent</td>
<td>78 percent</td>
</tr>
<tr>
<td>Science Field Experiences</td>
<td>56 percent</td>
<td>61 percent</td>
</tr>
<tr>
<td>Science Toys/Equipment</td>
<td>53 percent</td>
<td>81 percent</td>
</tr>
<tr>
<td>Science Experiments at Home</td>
<td>44 percent</td>
<td>69 percent</td>
</tr>
</tbody>
</table>

| **INFLUENTIAL INDIVIDUALS**       |                                               |                  |
| Science Teachers                 | 70 percent (Elementary School) 88 percent (High School) | 71 percent (Elementary School) 91 percent (High School) |
| Mother                           | 46 percent (Elementary School) 47 percent (High School) | 60 percent (Elementary School) 58 percent (High School) |
| Father                           | 54 percent (Elementary School) 53 percent (High School) | 68 percent (Elementary School) 65 percent (High School) |
| Professional Scientists          | 26 percent (Elementary School) 38 percent (High School) | 23 percent (Elementary School) 36 percent (High School) |
| Other Relatives/Adults           | 26 percent (Elementary School) 25 percent (High School) | 33 percent (Elementary School) 35 percent (High School) |
| Non-Science Teachers             | 21 percent (Elementary School) 28 percent (High School) | 28 percent (Elementary School) 35 percent (High School) |

*NOTE: Multiple responses allowed.
Parents’ Perspective

Clearly parents are integral to fostering their children’s love of science, but just how involved are they in their children’s science education?

<table>
<thead>
<tr>
<th>Activity Done at Least Once a Week</th>
<th>Sons</th>
<th>Daughters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Encourage them to do well in school</td>
<td>95 percent</td>
<td>96 percent</td>
</tr>
<tr>
<td>Emphasize science is an important subject to learn</td>
<td>70 percent</td>
<td>63 percent</td>
</tr>
<tr>
<td>Teach science informally at home</td>
<td>42 percent</td>
<td>42 percent</td>
</tr>
<tr>
<td>Assist them with science homework/school projects</td>
<td>42 percent</td>
<td>39 percent</td>
</tr>
<tr>
<td>Encourage them to learn science through books</td>
<td>41 percent</td>
<td>36 percent</td>
</tr>
<tr>
<td>Encourage them to learn science hands-on</td>
<td>37 percent</td>
<td>31 percent</td>
</tr>
</tbody>
</table>

And how confident are parents in their sons’ and daughters’ abilities to succeed in science and math? While overall they are equally confident about their children, they appear more optimistic about their sons’ interest and future opportunities in STEM fields than they are about their daughters’.

<table>
<thead>
<tr>
<th>Parents on Their Children and Science and Math</th>
<th>Sons</th>
<th>Daughters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feel very confident about their children's ability to succeed in science and math in school</td>
<td>75 percent</td>
<td>73 percent</td>
</tr>
<tr>
<td>Believe their children are very interested in science, math or engineering</td>
<td>52 percent</td>
<td>28 percent</td>
</tr>
<tr>
<td>Report their children have expressed interest in continuing to study or have a career in science, math or engineering</td>
<td>63 percent</td>
<td>42 percent</td>
</tr>
<tr>
<td>Are very confident about their children’s ability to succeed in science and engineering careers</td>
<td>69 percent</td>
<td>57 percent</td>
</tr>
<tr>
<td>View science and engineering careers as very desirable for their children</td>
<td>65 percent</td>
<td>41 percent</td>
</tr>
<tr>
<td>Have given a science-related gift in the past year to their children</td>
<td>64 percent</td>
<td>47 percent</td>
</tr>
</tbody>
</table>

What do parents perceive as their children’s biggest obstacles to learning science and math?

<table>
<thead>
<tr>
<th>Top Challenges</th>
<th>Sons</th>
<th>Daughters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science classes are boring or uninteresting</td>
<td>51 percent</td>
<td>58 percent</td>
</tr>
<tr>
<td>Teachers who are poorly qualified to teach science</td>
<td>47 percent</td>
<td>57 percent</td>
</tr>
<tr>
<td>Few good science role models or mentors for them</td>
<td>45 percent</td>
<td>56 percent</td>
</tr>
<tr>
<td>Science is a difficult subject to learn</td>
<td>43 percent</td>
<td>54 percent</td>
</tr>
</tbody>
</table>

It’s Unanimous: 
Educational Foundation in Science and Math
Should Start Early

Elementary schools should focus their resources to ensure all students receive an education that allows them to develop their potential in science whether or not they are likely to go on to science careers (95 percent of Ph.D. scientists).

In order to eliminate underrepresentation it is important that girls and minorities receive a strong science and math education beginning in elementary school (96 percent of emerging STEM company executives; 98 percent of Fortune 1000 STEM executives).

Students should receive their STEM education foundation in elementary school, specifically kindergarten through the fifth grade (85 percent of STEM department chairs).
Kids’ Perspective

In 1997, the Bayer Facts III asked American students, ages 10 to 17, how they, themselves, felt about science. Their answers help to dispel some long-held myths about kids and science.

Kids Shatter Science Education Myths*

**MYTH #1:** Kids hate taking science in school these days.
**REALITY:** Not! Half—50 percent—of 10-17 year olds put science... at the top or near the top of their list...of favorite subjects.

**MYTH #2:** Kids think that science is dull and boring.
**REALITY:** Not! 42 percent of 10-17 year olds say science is the subject they are most curious about.

**MYTH #3:** Kids think science class doesn’t relate to the real world.
**REALITY:** Not! 94 percent of 10-17 year olds say that science isn’t just in the classroom, it’s part of everyday life in the world around you.

**MYTH #4:** Kids think learning science is mostly about memorizing facts.
**REALITY:** Not! 89 percent of 10-17 year olds say science lets them be very creative. And 89 percent also say the best way they can learn science is to observe things and do experiments themselves.

**MYTH #5:** Kids grow up believing that science is more for boys and not for girls.
**REALITY:** Not! 89 percent of all 10-17 year olds say “no” – science is NOT more for boys than girls.

**MYTH #6:** Kids think science is for nerds.
**REALITY:** Not! 93 percent of all 10-17 year olds say “no” – science is NOT for nerds. In fact, of all subjects, science ranked the coolest.

**MYTH #7:** Most kids are turned off to science in school.
**REALITY:** Not! When 10-17 year olds were asked for positive and negative things about science, things they like best about science won hands down (91 percent) over things they don’t like about science (32 percent).


“in science, when you’re doing a project, you have to think about what you are doing. in other classes they are telling you what to do. in science, they don’t. you have to do IT on your own.”  
Maureen, Age 11

“I think it’s more fun because it gets you thinking about things, and it could help solve other problems... you can use a strategy.”  
Andrea, Age 13
The State of K-12 Science Education: Yesterday, Today and Tomorrow

Recipe for Success: Science should be Fourth “R” and “Hands-On”

Virtually all stakeholders believe that in elementary school science should be given the same or greater priority as reading, writing and mathematics and taught using hands-on, inquiry-based methods. These methods emphasize experimentation, observation, problem solving, team working and critical thinking. In other words, learning science the way scientists do science... by doing it.

<table>
<thead>
<tr>
<th>Survey Group</th>
<th>Science = 4th R in Elementary School</th>
<th>Science Taught with a Hands-on Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principals</td>
<td>75 percent</td>
<td>99 percent</td>
</tr>
<tr>
<td>Human Resource Directors</td>
<td>76 percent</td>
<td>94 percent</td>
</tr>
<tr>
<td>Students</td>
<td>--</td>
<td>89 percent</td>
</tr>
<tr>
<td>Ph.D. Scientists</td>
<td>75 percent</td>
<td>--</td>
</tr>
<tr>
<td>Americans</td>
<td>64 percent</td>
<td>86 percent</td>
</tr>
<tr>
<td>New Employees</td>
<td>84 percent</td>
<td>88 percent</td>
</tr>
<tr>
<td>Managers of New Employees</td>
<td>70 percent</td>
<td>93 percent</td>
</tr>
<tr>
<td>Deans of Schools of Education</td>
<td>77 percent</td>
<td>95 percent</td>
</tr>
<tr>
<td>New Elementary School Teachers</td>
<td>53 percent</td>
<td>93 percent</td>
</tr>
<tr>
<td>Parents</td>
<td>84 percent</td>
<td>87 percent</td>
</tr>
<tr>
<td>Female and Minority Chemists and Chemical Engineers</td>
<td>88 percent</td>
<td>46 percent</td>
</tr>
</tbody>
</table>

Unfortunately, many stakeholders believe elementary and secondary science education has and continues to miss the mark.

When only one or two percent of children score on the advanced levels on the National Assessment of Educational Progress (NAEP), the next generation will not be ready to be world-class inventors, doctors and engineers.

- U.S. Secretary of Education Arne Duncan on the release of the NAEP Science Report Card (January 2011)

Report Card on U.S. Pre-College Science Education

<table>
<thead>
<tr>
<th></th>
<th>Elementary School</th>
<th>Middle School</th>
<th>High School</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ph.D. Scientists</td>
<td>C-</td>
<td>--</td>
<td>C</td>
</tr>
<tr>
<td>New Elementary School Teachers</td>
<td>B-</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Parents</td>
<td>B-</td>
<td>B-</td>
<td>C+</td>
</tr>
<tr>
<td>New Employees</td>
<td>B</td>
<td>B</td>
<td>C</td>
</tr>
<tr>
<td>Managers of New Employees</td>
<td>C</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>Emerging STEM Company CEOs</td>
<td>C-</td>
<td>C-</td>
<td>C-</td>
</tr>
<tr>
<td>Fortune 1000 STEM CEOs*</td>
<td>C</td>
<td>C</td>
<td>C</td>
</tr>
<tr>
<td>Female and Minority Chemists and Chemical Engineers</td>
<td>D+</td>
<td>--</td>
<td>D+</td>
</tr>
</tbody>
</table>

*NOTE: Grade includes both pre-college and college.

Is Science Getting the Short Shrift?

And their feelings are justified, particularly about elementary school where, according to a number of reports, science is consistently given short shrift. In the Bayer Facts X survey, elementary school teachers, regardless of region of the country or type of school they teach in, report:

- They are three times more likely to teach English (95 percent) and math (93 percent) every day than they are to teach science (35 percent); and, 29 percent say they only teach science twice a week or less.
- Science (25 percent) and Social Studies (60 percent) are the subjects they emphasize least in their schools.
Today’s K-12 Teachers: Are They Prepared to Teach Science?

Science Teaching Preparedness: Teachers Speak

Over the years, the Bayer Facts surveys have repeatedly gone back to the science education source: teachers. The Bayer Facts I and X each polled elementary school teachers, asking them to assess their own science literacy levels and science instruction abilities. These are important questions. After all, how can we expect students to achieve in science if their teachers don’t feel prepared to teach it?

Elementary School Teachers on Science Teaching

<table>
<thead>
<tr>
<th>Question</th>
<th>Bayer Facts I</th>
<th>Bayer Facts X</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do They Consider Themselves “Very Science Literate?” Few do.</td>
<td>36 percent “Yes”</td>
<td>29 percent “Yes”</td>
</tr>
<tr>
<td>Do They Feel “Very Qualified” to Teach Science as Compared to other Subjects? Not So Much.</td>
<td>English (86 percent) Math (81 percent) Social Studies (71 percent) Science (56 percent)</td>
<td>English (85 percent) Math (87 percent) Social Studies (66 percent) Science (61 percent)</td>
</tr>
<tr>
<td>Are They “Very Confident” that Their Elementary School Students are Receiving a Good Science Education? Half Are, Half Aren’t.</td>
<td>53 percent “Yes”</td>
<td>44 percent “Yes”</td>
</tr>
<tr>
<td>Are They “Very Comfortable” Answering Students’ Science Questions? For the Most Part, Yes.</td>
<td>62 percent “Yes”</td>
<td>57 percent “Yes”</td>
</tr>
</tbody>
</table>

Nation’s K-12 Science Teachers Issue Call to Nation’s Scientists and Engineers

Teachers derive benefits from working with scientists on science curricula and professional development. Those who have experienced this type of STEM industry volunteer program say it:

- bolstered their motivation and enthusiasm for teaching the subject (92 percent)
- helped them better understand science content (90 percent)
- improved their teaching of science content (87 percent)

Many teachers who have not had access to professional scientists say they would like to. They believe the experience would:

- help them better understand science content (78 percent)
- improve their teaching of science content (72 percent)
- bolster their motivation and enthusiasm for teaching science (78 percent)

Source: Bayer Facts of Science Education V (1999)
In 2003, the Bayer Facts IX survey found nearly half of Americans (46 percent) believe that U.S. colleges are not adequately preparing the teachers of tomorrow to teach elementary school science. The following year’s survey delved into that issue more closely. Deans of schools of education at leading U.S. colleges and new elementary school teachers who recently graduated from those colleges were asked to weigh in on the quality of pre-service elementary teacher preparation.

What did the survey find? Overall, deans are much more positive than teachers about their institutions’ performance in all areas of teacher preparation, including science.

“(In college), they focus heavily on reading and writing because they know that this is what the schools place heavy emphasis on. Now math is starting to get more of an emphasis. As for science, they suggest that you teach it twice a week, but if you don’t get to it, well that’s okay, too.”

Claudine
New Elementary School Teacher
New York, NY

When it comes to exposure and practical training for pre-service teachers in hands-on, inquiry-based science instructional methods, once again, the deans are far more positive than teachers about their institutions’ performance.

<table>
<thead>
<tr>
<th>Report Card on Pre-Service Content and Hands-On Training Preparation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>New Elementary School Teachers</strong></td>
</tr>
<tr>
<td>English</td>
</tr>
<tr>
<td>Math</td>
</tr>
<tr>
<td>Science</td>
</tr>
<tr>
<td>Social Studies</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Report Card on Hands-On Teaching Preparation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>New Elementary School Teachers</strong></td>
</tr>
<tr>
<td>EXPOSURE to Hands-On, Inquiry-Based Science Teaching</td>
</tr>
<tr>
<td>PRACTICAL TRAINING in Hands-On, Inquiry-Based Science Teaching</td>
</tr>
</tbody>
</table>

Quality Counts

The Bayer Facts X survey provides substantial evidence that the quality of pre-service science education training for elementary school teachers is critical. Those who assign an “A” or “B” to their pre-service science preparation are much more positive about many aspects of science education than those who assign lower grades. For example, they are more likely to:

- teach science every day (39 percent versus 31 percent)
- feel very qualified to teach science (72 percent versus 46 percent)
- feel very comfortable answering student questions about science (64 percent versus 47 percent)
- feel very confident that their students are getting a good science education (53 percent versus 32 percent)
- call themselves very science literate (36 percent versus 18 percent)
- say their pre-service training provided excellent to good exposure and practical training in hands-on methods (90 percent versus 59 percent and 85 percent versus 47 percent, respectively)
- feel qualified to teach science using hands-on, inquiry-based methods (97 percent versus 75 percent)
America’s Higher Education System: Is the STEM Pipeline Losing Talented Students?

Graduation Trends

Good news emerges from the 2012 National Science Foundation (NSF) Science and Engineering Indicators which reports women and men are now earning undergraduate STEM degrees equally. However, more men than women earn bachelor’s degrees in engineering, computer science and physics, while more women earn degrees in biological, agricultural and social sciences, and psychology.

For URMs, while the total number of science and engineering bachelor’s degrees and the total number of bachelor’s degrees in specific science and engineering disciplines has increased since 2000, the numbers are still low.

Is STEM Diversity a Priority for U.S. Colleges and Universities?

There is fairly widespread recognition of the importance of STEM diversity at the highest level on college campuses. Still, few American research universities have adopted formal STEM diversity programs that have specific recruitment, retention and evaluation goals.

Underrepresentation Needs to be Addressed by Highest Institutional Leadership

“A campus-wide commitment to inclusiveness provides the best environment for planting the seeds for diversity. This should be articulated by university leaders both in the university mission and in everyday affairs. Leadership is essential at all levels of academia – the faculty, department chairs, deans, provosts, chancellors and presidents, and even regents and trustees – for programs to work, that is, to increase the participation of underrepresented minorities in a significant way.”

Expanding Underrepresented Minority Participation: America’s Science and Technology Talent at the Crossroads
The National Academies (2011)

Source: Bayer Facts of Science Education XV

Importance of STEM Diversity to Institution

Yes 84%
No 11%
Don’t know/NA 5%
Recruitment and Retention of Female and URM STEM Students

While only one-third of the chairs report having formal STEM diversity initiatives, many more (66 percent) report that informal programs do exist at their institutions. Just how effective do the chairs think these programs are in recruiting and retaining female and URM STEM students?

The nation’s end-users of STEM talent are less optimistic about the higher education system’s efforts to engage and nurture female and URM students.

STEM department chairs agree, with more than one-third (37 percent) giving their institution a grade of “C” and below for retaining and graduating URM undergraduate STEM students. They are more positive about their female and majority students, giving their institution a “B” for these two student groups.

Key Characteristics of College STEM Diversity Programs*

The STEM department chairs cite a number of key elements of successful programs.

Report Card  
Effectiveness of STEM Diversity Programs

<table>
<thead>
<tr>
<th>Recruitment</th>
<th>Retention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>URM</td>
</tr>
<tr>
<td>B-</td>
<td>C+</td>
</tr>
</tbody>
</table>

Report Card  
Higher Education and STEM Training

<table>
<thead>
<tr>
<th>Minority Students</th>
<th>Female Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emerging STEM Company CEOs</td>
<td>C+</td>
</tr>
<tr>
<td>Fortune 1000 STEM Company CEOs</td>
<td>C+</td>
</tr>
<tr>
<td>Female And URM Chemists And Chemical Engineers</td>
<td>C+</td>
</tr>
</tbody>
</table>

- An early-career African-American female scientist

“There were certain communications barriers I had to overcome in graduate school. The expectations that I wouldn’t do well and that I needed to be three times as good as everyone else. I had a lot of self doubt. In order to build my confidence I had to build social relationships and gain the trust of my peers. Many women and minorities don’t survive because of the social aspect.”

Key Characteristics of College STEM Diversity Programs*

The STEM department chairs cite a number of key elements of successful programs.

<table>
<thead>
<tr>
<th>Recruitment Programs</th>
<th>Retention Programs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summer hands-on STEM programs (80 percent)</td>
<td>Faculty mentors (78 percent)</td>
</tr>
<tr>
<td>High school outreach programs with academic information and career counseling (77 percent)</td>
<td>Academic support including study groups, tutors and other support (74 percent)</td>
</tr>
<tr>
<td>Financial resources such as scholarships and paid internships (66 percent)</td>
<td>Peer support networks (74 percent)</td>
</tr>
<tr>
<td>Outreach programs with female/URM STEM majors working with high school students (58 percent)</td>
<td>Undergraduate research opportunities for juniors and seniors (73 percent)</td>
</tr>
<tr>
<td>Outreach programs that develop feeder systems of female/URM students directly to college (55 percent)</td>
<td>Undergraduate research opportunities for freshmen and sophomores (62 percent)</td>
</tr>
<tr>
<td>Social integration programs that support the transition to campus life (61 percent)</td>
<td>Social integration programs that support the transition to campus life (61 percent)</td>
</tr>
<tr>
<td>Provision of adequate financial aid (60 percent)</td>
<td>Provision of adequate financial aid (60 percent)</td>
</tr>
<tr>
<td>Professional development activities for juniors and seniors such as conferences, networking and research presentations (59 percent)</td>
<td>Professional development activities for juniors and seniors such as conferences, networking and research presentations (59 percent)</td>
</tr>
<tr>
<td>Undergraduate summer STEM programs targeting women and URMs (51 percent)</td>
<td>Undergraduate summer STEM programs targeting women and URMs (51 percent)</td>
</tr>
</tbody>
</table>

Source: Bayer Facts of Science Education XV

*NOTE: According to STEM department chairs who report recruitment and retention programs; multiple responses were allowed.
Impact of Introductory Level College STEM Courses on the STEM Pipeline

The National Academies' report Expanding Underrepresented Minority Participation: America's Science and Technology Talent at the Crossroads (2011) examines URM participation in STEM at every education level. In the report, the academic approach traditionally used by colleges and universities to teach introductory STEM courses comes under the microscope. In particular, the use of rigorous instructional methods often designed to weed students out of STEM early is called into question. The Bayer Facts XV asked college STEM department chairs to share their views about the pros and cons of this method, including the impact they believe it has on undergraduate students.

Introductory “Weeding Out” STEM College Courses

More STEM department chairs believe the approach is harmful than beneficial because it may drive significant numbers of potentially successful students out of STEM. They also believe this approach has more of an impact on URM and female students than on majority students.

Effect of Introductory “Weeding Out” STEM College Courses

Source: Bayer Facts of Science Education XV

Should Introductory Instructional Approaches be Changed?

In an effort to retain more students, including female and URMs in STEM, the department chairs reject the notion that these traditional approaches be adjusted. Instead, to retain students most believe their STEM departments need to significantly increase the academic support they provide to students. They cite mentoring, tutoring, informal faculty engagement and professional networking opportunities as the kind of support they believe will retain more students in STEM.

Change Introductory Instructional Methods

Source: Bayer Facts of Science Education XV

Increase Academic Support

Low Awareness of STEM Educational Barriers Faced by Women and URMs

Bayer Facts XIV and XV found major disconnects between the barriers female and URM STEM undergraduates face in pursuit of their STEM studies and the barriers college STEM department chairs perceive these students as facing.

The female and URM chemists and chemical engineers in Bayer Facts XIV readily shared a variety of barriers they faced as undergraduates, with lack of role models, low self-confidence and financial concerns topping the list.

Source: Bayer Facts of Science Education XV
While STEM department chairs acknowledge challenges exist for women, particularly persistent stereotyping and a lack of role models, more than one-quarter report that women do not face any significant barriers.

For their URM students, it’s a different story. The chairs admit that challenges do exist for these students. The chief barrier is limited access to quality pre-college science and math education. A lack of role models also is identified as an issue.

Of particular interest is the fact that while the chairs say stereotypes are an obstacle for their female students, they don’t recognize stereotyping as a problem for their African-American, Hispanic and American Indian students.

**Significant Barriers to Undergraduate STEM Education**

<table>
<thead>
<tr>
<th>Female and URM Chemists and Chemical Engineers on their Barriers</th>
<th>STEM Department Chairs on Barriers for URMs</th>
<th>STEM Department Chairs on Barriers for Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>* Lack of role models (35 percent)</td>
<td>* Limited quality pre-college science and math education (32 percent)</td>
<td>* Do not know of any/there are not any significant barriers (26 percent)</td>
</tr>
<tr>
<td>* Lack of mentors (34 percent)</td>
<td>* Lack of role models (17 percent)</td>
<td>* Stereotypes exist that say STEM isn’t for girls/URMs (13 percent)</td>
</tr>
<tr>
<td>* Lack of confidence/self-doubt (33 percent)</td>
<td>* Do not know of any/there are not any significant barriers (12 percent)</td>
<td>* Lack of role models (13 percent)</td>
</tr>
<tr>
<td>* Financial issues (32 percent)</td>
<td>* Their cultural background doesn’t value science/pursuit of science (10 percent)</td>
<td>* Limited quality pre-college science and math education (12 percent)</td>
</tr>
<tr>
<td>* Failure of STEM industries to communicate (31 percent)</td>
<td>* Financial issues relating to the cost of education (8 percent)</td>
<td>* Lack of confidence/self-doubt (9 percent)</td>
</tr>
<tr>
<td>* Sense of isolation (31 percent)</td>
<td>* Stereotypes exist that say STEM isn’t for girls/URMs (3 percent)</td>
<td>* Financial issues relating to the cost of education (6 percent)</td>
</tr>
<tr>
<td>* Existence of stereotypes (29 percent)</td>
<td></td>
<td>* Their cultural background doesn’t value science/pursuit of science (5 percent)</td>
</tr>
<tr>
<td>* Lack of quality math and science education (17 percent)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**The Reality: Discouragement = Major Barrier**

Many women and URMs who have chosen to study STEM face another obstacle, as revealed by both *Bayer Facts XIV* and *XI* surveys. That obstacle is discouragement and the fact that many female and URM STEM students have and continue to be dissuaded from pursuing STEM studies and careers.

In the *Bayer Facts XIV* survey, most of the female and URM chemists and chemical engineers who said they were discouraged said it happened in college and was done by college professors.

Unfortunately, a majority of college STEM department chairs believe such discouragement of female and URM STEM students still occurs today. And, with eight in ten (83 percent) department chairs saying their faculty members play a role in counseling students out of STEM and six in ten (58 percent) that such counseling is a common practice in their departments, it appears the discouragement of female and URM STEM students continues today on college campuses.

**“At any point in your life, were you ever discouraged from pursuing your STEM studies or career?”**

40 percent of female and URM chemists and chemical engineers in *Bayer Facts XIV*

**“Do you believe such discouragement of female and URM STEM students still occurs today?”**

59 percent of college STEM department chairs in *Bayer Facts XV*
The STEM Workplace: Challenges and Opportunities from the Frontlines

Today’s STEM Workforce: Improving Communication with Today’s Students

In the *Bayer Facts of Science Education XI*, many parents were surprised to learn that, according to the National Science Foundation, seven in 10 Americans working in science or engineering today have a bachelor’s degree or less education. Like many Americans, they assumed that STEM fields require advanced degrees. Learning they do not prompted many parents to reassess their own beliefs about whether or not science and engineering offer realistic job opportunities for their children, leading the vast majority to conclude that they do.

Educating students about the myriad STEM job opportunities available to them is the purview of the country’s science and engineering communities, say parents. In short, the STEM industries must communicate with students more effectively – something the STEM CEOs at the nation’s largest and smallest STEM companies also acknowledge. They recognize they need to improve their communications to *all students* – especially girls and minorities – and let them know they are wanted and needed in the nation’s STEM fields.

The Employer’s View: Diversity and Hiring Challenges

Many CEOs of both large and small STEM companies extol the virtues of a diverse workplace and recognize how important it is for women and URMs to hold senior management positions, specifically to serve as role models and mentors for younger female and URM employees. Yet, as reported in Chapter II, the nation’s emerging STEM company executives have a lower awareness of underrepresentation as an issue for their companies than do Fortune 1000 STEM company executives. This lower awareness continues to be reflected in a number of questions about the recruitment and hiring practices their companies use to target women and URMs.

C-Suite on Recruiting and Hiring Women and URM STEM Workers

<table>
<thead>
<tr>
<th>Does your company have recruitment programs for women and URMs?</th>
<th>Fortune 1000 STEM CEOs</th>
<th>Emerging STEM Company CEOs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>71 percent YES</td>
<td>77 percent NO</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Are you frustrated by your company’s inability to hire women and URM STEM workers?</th>
<th>Fortune 1000 STEM CEOs</th>
<th>Emerging STEM Company CEOs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>50 percent YES</td>
<td>74 percent NO</td>
</tr>
</tbody>
</table>
Across the board, Fortune 1000 STEM CEOs assign a “C” to their organizations for the job they do promoting women and underrepresented minorities to senior positions, while the majority of their counterparts at small companies believe they do an excellent job ensuring women and URMs receive promotions, raises and recognition. - Bayer Facts XIII

Both groups of executives do acknowledge their companies face specific challenges in hiring women and URM STEM workers.

### Challenges Hiring Women and URM STEM Workers

<table>
<thead>
<tr>
<th>Fortune 1000 STEM CEOs</th>
<th>Emerging STEM Company CEOs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Limited number of women/minorities qualified for STEM positions (44 percent)</td>
<td>Limited number of women/minorities applying for STEM positions (45 percent)</td>
</tr>
<tr>
<td>Problems identifying/locating/recruiting qualified candidates (29 percent)</td>
<td>Limited number of women/minorities qualified for STEM positions (35 percent)</td>
</tr>
<tr>
<td>Difficulty attracting/retaining women and URMs due to company location (19 percent)</td>
<td>No challenges/problems (10 percent)</td>
</tr>
</tbody>
</table>

### The Employee’s View: Challenges and Opportunities to Workplace Success

Once hired, what is the recipe for workplace success? The Bayer Facts XIV asked today’s female and URM chemists and chemical engineers to share their thoughts and experiences about the challenges and opportunities facing them in achieving professional advancement.

#### TOP CHALLENGES
Managerial bias is a leading workplace barrier (40 percent)
- Company/organizational/institutional bias (38 percent)
- Lack of professional development (36 percent)
- Lack of promotion/advancement opportunities (35 percent)
- No/little access to networking opportunities (35 percent)

#### TOP OPPORTUNITIES
Creating professional relationships (61 percent)
- Achieving work/life balance (55 percent)
- Building networks within their organizations (40 percent)
- Having supportive management behind them (37 percent)
- Joining professional societies or networking groups (37 percent)

### The Bottom Line
The good news for the United States is that an overwhelming number of the Ph.D. scientists (95 percent) and female and minority chemists and chemical engineers polled (83 percent) say that given everything, if they had to do it over again, they would still choose a STEM career.

“Entrance positions are not a problem. But after the first 10 years of your career, women and minorities start losing ground with their peers. Small disadvantages and bias accumulate over time.”

- Mid-career American Indian female chemistry professor
It Takes a Village: Improving STEM Education and Strengthening the Workforce Pipeline

Who is Responsible?
American science teachers make it quite clear -- without the active support of teachers, school administrators and school boards, parents and other citizens, business and industry, and the scientific community, science education reform efforts will most likely fail. In the Bayer Facts XI, parents also believe a number of key stakeholders -- including themselves -- share responsibility for ensuring girls and URM students succeed in STEM subjects.

<table>
<thead>
<tr>
<th>Stakeholders</th>
<th>Parents Assign “Great Deal of Responsibility”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parents</td>
<td>70 percent</td>
</tr>
<tr>
<td>Women and Minorities Themselves</td>
<td>66 percent</td>
</tr>
<tr>
<td>Schools</td>
<td>53 percent</td>
</tr>
<tr>
<td>Science &amp; Engineering Communities</td>
<td>49 percent</td>
</tr>
<tr>
<td>Government</td>
<td>21 percent</td>
</tr>
</tbody>
</table>

Stakeholder Responsibilities
Fifteen years of research has revealed that virtually every stakeholder group has its own unique role to play to help improve STEM education, bring diversity to STEM classrooms and fields, and keep the country’s science and technology leadership strong.

Stakeholder “To-Do” Lists

Parents
- Encourage your children to do well in school
- Encourage your children to learn about science on their own through books and other materials
- Emphasize science as an important subject to learn
- Encourage your children to learn about science on their own through hands-on science experiences
- Assist your children with science homework or school science projects
- Teach your children informally about science at home
- Take your children to visit science museums, science centers, and zoos
- Participate in strengthening science education at your children’s school
- Encourage your children to consider and pursue STEM careers
- Be involved in your children’s science education
- Challenge your children with high expectations
**STEM Industries**

- Participate in programs that bring scientists into schools to help develop curricula, teach science to teachers and/or work directly with students on science topics and projects
- Develop or participate in programs that attract, encourage and retain girls’ and minority students’ interest in science and math in school
- Provide mentors, mentoring programs and role models
- Offer high school and college internship opportunities
- Encourage and support STEM organizations and programs that support women and minorities
- Get involved with elementary, middle and high school STEM education
- Understand that contact with scientists and/or engineers is an effective way to help students better appreciate science and engineering as careers
- Do a better job telling today’s students about the job opportunities in STEM fields.
- Recruit, hire and promote women and minorities for STEM jobs
- Create and support family-friendly policies and working environments

**Federal, State and Local Governments**

- Place a high priority on improving U.S. STEM education
- Offer scholarships, fellowships and financial aid
- Increase financial support for STEM education at all levels
- Support and fund STEM education programs for women and minorities
- Encourage and support STEM organizations and programs that support women and minorities
- Recruit, hire and promote women and minorities for STEM jobs

**Women and Underrepresented Minorities**

- Set high standards, work hard and never give up
- Develop self-confidence
- Serve as mentors and role models
- Build/take advantage of peer networks and support groups
- Don’t let anyone tell you you can’t
- Take the initiative and assert yourself
- Be open to.seek opportunities
K-12 Education System

- Encourage and support interest and passion in science
- Be proficient in science and science education
- Offer more hands-on science experiences
- Teach without bias
- Provide stronger K-12 science curriculum and classes
- Make science exciting, interesting and fun

Higher Education System

- Offer scholarships, fellowships and grants
- Provide mentors, mentoring programs and role models
- Hire and promote more women and minority science faculty
- Encourage, engage and be involved with students
- Provide internships
- Recruit and admit, actively, women and minorities
- Create, encourage and support student groups for women and minorities
In Conclusion

Taken together the *Bayer Facts of Science Education* surveys offer an important snapshot of American public opinion from varied quarters. The voices captured in this report confirm the vital role science and technology play in the nation’s past, present and future; serve to strengthen Bayer’s ongoing commitment to improving science education and science literacy for all Americans; and, demonstrate that there is still much work to be done to achieve these very critical goals.

Bayer Corporation wishes to acknowledge and thank a number of individuals and organizations that have proved critical to the success of the *Bayer Facts of Science Education* survey series.

Special thanks to our partners over the years who have offered assistance and expertise to the surveys, including the:

- National Science Foundation;
- National Science Resources Center;
- American Association for the Advancement of Science;
- National Science Teachers Association; and,
- American Chemical Society.

We offer heartfelt appreciation and thanks to our longtime national *Making Science Make Sense*® spokesperson, Dr. Mae C. Jemison, who has eloquently articulated the survey findings and passionately addressed these important issues.

Finally, we express thanks and gratitude to the *thousands of individuals* over the years who have taken the time to share their opinions and thoughts on these important issues. There would be no *Bayer Facts of Science Education* surveys without you.

Executive summaries of each survey are available by visiting Bayer’s website at [www.bayerus.com/msms](http://www.bayerus.com/msms).
Making Science Make Sense® (MSMS) is Bayer’s company-wide initiative that advances science literacy through hands-on, inquiry-based science education, employee volunteerism and a public education campaign. For more information, go to www.bayerus.com/msms.

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