GREATNESS STEMS FROM IOWANS

GOVERNOR'S STEM ADVISORY COUNCIL

2016-2017 Iowa STEM Evaluation Report

"Across Iowa, businesses, schools, developers and government are coming together to build a new home for innovation in America's heartland. We see that commitment in Iowa's education system and in the value that you place on creativity, adaptability and new ways of thinking . . . we admire what you guys have accomplished, and we want to be a part of it."

- Tim Cook, CEO, Apple Inc.

Source: PC Magazine: Apple commits $1.3B for Iowa data center
http://in.pcmag.com/news/116380/apple-commits-13b-for-iowa-data-center?utm_medium=email&utm_source=govdelivery

KEY INDICATORS

These indicators are provided by the external evaluation team consisting of UNI's Center for Social and Behavioral Research, ISU's Research Institute for Studies in Education, and UI's Iowa Testing Programs.

- The average proportions of students in 8th and 11th grade meeting mathematics proficiency on the Iowa Assessments **increased slightly across nearly all demographic groups,** including students who are female, African American, Hispanic, and/or with low income, from the period 2011–2013 to the period 2014–2016.

- In science achievement, the average percentages of proficient students in the 2014–2016 biennium period are **higher than the 2011–2013 biennium period** among 8th grade students.

- **More than 75% of all students statewide** indicated they were very interested or somewhat interested in science, technology, engineering, or in pursuing a STEM career in 2016–2017.

- In 2016, Iowa's average ACT score was 21.4 in mathematics and 22.3 in science, compared to 20.6 and 20.8 nationwide, respectively. **Average Iowa STEM score of 22.1 compared to 20.9 nationally.**

- The proportion of 2016 ACT test-takers interested in STEM increased by +3 percentage points among both males and females, and **+2 percentage points among students who are African-American and Hispanic**, compared to 2012.

- From 2012 to 2016, the number of students taking advanced placement courses in STEM–related subjects **increased from 4,968 to 6,537** (32% increase).

- There has been a 3% increase in STEM awards at Iowa's 2–year community colleges, an **18% increase at 4–year public, and a 7% increase at 4–year private (not–for-profit) colleges** and universities, respectively between the periods 2011–2012 to 2014–2015.

- There has been an **18% increase in STEM degrees awarded to females** at Iowa's 2–year community colleges, while the number of degrees awarded to males remained relatively stable between the periods 2011–2012 to 2014–2015.

- The number of **STEM-related degrees awarded to students who are African-American rose 16%** at 4–year public, and 94% at private, 4–year not–for-profit colleges and universities in Iowa since 2011–2012 maintaining stable at 2-4% of all degrees per year. Roughly the same proportions bear out for students who are Hispanic.

- **Iowa STEM occupations, at 17% of all Iowa jobs, are expected to grow 1.2% annually** from 2014 to 2024 compared to .9% annual growth across all occupations.

- These jobs pay mean salaries **$15,514 higher per year** ($57,357 in STEM versus $41,843 for all other).

- In 2015–2016, there were an estimated **12,444 vacancies in STEM jobs statewide**.

- Community college STEM diplomas, certificates and degrees to minority graduates increased 23% last year, **a 144% gain since 2011**.

STEM SCALE-UP 2016-17

A total of **1,674 educators** took part in scaling one of eleven world-class STEM programs in 2016–2017.

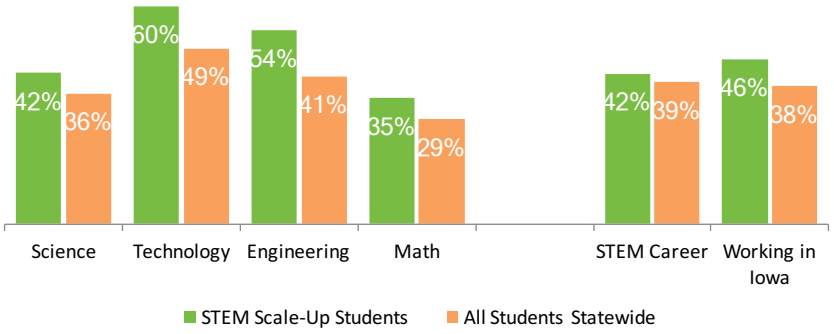
An estimated **74,038 preK–12 youth** participated in one or more Scale-Up programs in 2016–2017.

Since 2012, an estimated **462,778 preK–12 Iowans** have participated in Scale-Up.

70% of educators taking part in Scale-Up agreed or strongly agreed that they now have more confidence to teach STEM topics, and **74%** have increased their STEM knowledge.

Students who participated in Scale-Up were more interested in STEM subjects, STEM careers and working in Iowa after graduation than students statewide.

STUDENT INTEREST IN STEM

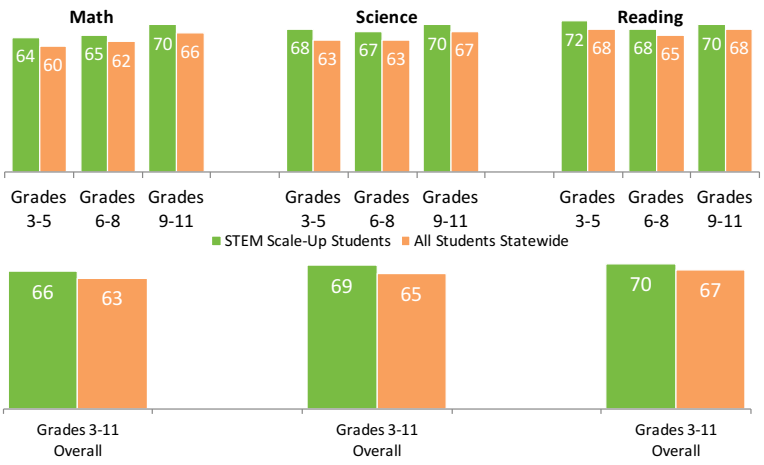


A higher proportion of students who participated in a Scale-Up Program said they were **"very interested" in all STEM-subjects** and in pursuing a STEM career compared to all students statewide.

STUDENT ACHIEVEMENT IN NATIONAL PERCENTILE RANK

STEM Scale-Up participants scored an average of 3 points higher in National Percentile Rank in math and reading, and 4 points higher in science, compared to all students statewide.

For minority students, the difference is greater: Scale-Up participants scored an average of 6 points higher in National Percentile Rank in math, 7 points higher in science and 6 points higher in reading compared to minority students who did not participate.

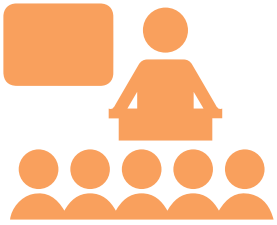


STEM BEST®

BUSINESSES ENGAGING STUDENTS & TEACHERS

Ten new STEM BEST partnerships were established in 2016–2017, involving 17 schools partnering with hundreds of employers.

Estimated dollars contributed by non-school partners collectively sums to more than **$1 million.**



Approximately **700** students participate in STEM BEST.

STEM BEST EXAMPLES

HOOVER HIGH SCHOOL: 92.5% of the 2016–17 STEM class are committed to post-secondary education, many on scholarship.

FORT MADISON HIGH SCHOOL: Students skype experts in a variety of fields across the United States and in several countries abroad, as part of independent studies ranging from developing gaming software, "how-to" online instructions for those who are preparing for surgery and repurposing old computers.

WAUKEE APEX: Past student participants have indicated the top takeaways of this program include growth in persistence, resilience, self-confidence, development of job-seeking package, networking skills and knowledge about future opportunities.

IT ACADEMY

A total of **6,846** Microsoft IT student certifications have been awarded. **(Totaled 607 in 2014, 1,922 in 2015, 2,492 in 2016)**

6 students this year earned Master Certifications (the top certification available in the program).

17 students qualified for Nationals in Word, Excel and PowerPoint (up from 6 last year).

150 high schools and community colleges are participating with 18 schools on the waiting list.

Teacher training for coding and computer science is rolling out, and new student certifications will be coming online for data science and IT Infrastructure as well as for coding and computer science.

TEACHER EXTERNSHIPS

IOWA STEM TEACHER EXTERNSHIPS
CONNECTING CLASS TO CAREER

Total Teacher Externships
2009 to 2017
421

Total Workplace Partners
2009 to 2017
134

Total approximate cost-share by workplace hosts from 2009 to 2017
$585,100
($171,050 this year)

2017 RESULTS:

Of 2017 employers surveyed, most monetized the value of an extern between $2,500 and $10,000.

Of 2017 employers surveyed, most cited as most valued outcomes:

- Elevated awareness of their business in the community
- Increased interest of the future workforce
- Establishment of school-business partnerships
- Workplace relevance brought to schools

Top reasons that 2017 teachers gave for participating include:

- Bringing real-world experiences into the classroom
- Building partnerships with employers
- Discovery of the "soft skills" students will need to succeed

STEM CHALLENGES AND OPPORTUNITIES

- In science achievement, the average percentage of proficient students in the 2014–2016 biennium period are lower than the 2011–2013 biennium period among 11th grade students.
- Proficiency in science on the Iowa Assessments has declined the most among students in the 11th grade who are African-American, from 60% in 2011–2013 to 49% in 2014–2016.
- ACT scores are an average of 5 points lower among students who are African-American, and an average of 3 points lower among students who are Hispanic, compared to their white counterparts.
- 2016 STEM career interests remain strongly gendered, with the top five two-year college majors for females in health–related fields (nursing, radiologic technology and physical therapy), animal sciences and veterinary medicine (pre–vet), while for males the top five majors were computer science and programming, mechanical engineering, computer software/media application, animal sciences and athletic training.
- The proportion of African-American, Hispanic and Asian students who are very interested in STEM careers is higher than the interest among white students in grades 3 and 4. Interest declines by 8% for white students through grade 11, while interest declines by 19% for African-American students and by 16% for Hispanic students.

STEM ENDORSEMENTS

Iowa's STEM teaching endorsements are now offered at five institutions: Drake University, Grand View University, Morningside College, St. Ambrose University and Buena Vista University. A number of other institutions are developing courses in preparation to offer the endorsement.

A total of 34 Iowa educators are now credentialed in STEM.

STEM PROFESSIONAL DEVELOPMENT*

The first-ever STEM Professional Development Palooza was offered to Iowa educators and teacher-preparers in July of 2017 at Waukee's Innovation and Learning Center.

Exemplary models for establishing school-business partnerships and STEM were showcased, each identified through a statewide competitive review process to find the best of Iowa.

"There's been a shift in my thinking."

"I'm chock-full of excitement!"

"My head is spinning, but in a good way."

"Life-changing."

78% of the participants said they would attend another STEM P.D. Palooza.

Beyond the Palooza, **78 different workshops across** Iowa's six STEM regions prepared almost **2,000 educators** to implement 11 Scale-Up programs in 2016–2017.

*Iowa STEM Professional Development "STEM Palooza" Evaluation,
Dr. Liz Hollingworth, Director, University of Iowa Center for Evaluation and Assessment. August 31, 2017.

STEM COMMUNICATIONS

SOCIAL MEDIA

Twitter: **2,780** followers
Up **22%** from last year

Facebook: **965** likes
Up **25%** from last year

Instagram: **185** followers
Up **27%** from last year

YouTube: **19,692** views
Up **66%** from last year

Newsletter: **6,321** readers
Up **50%** from last year

Other social media includes Pinterest and LinkedIn.

WEBSITE

www.IowaSTEM.gov

125,418 page views

28,243 new visitors

129 countries

50 states

421 Iowa cities

MEDIA COVERAGE

The STEM Career Awareness TV PSA ran more than **18,000** times across the state, generating **$555,000+** in value for commercial advertisement.

STEM career awareness billboards were placed in **18** rural and urban locations across Iowa, resulting in nearly five million impressions and more than **$23,000** in donated billboard space.

Total PR efforts resulted in **390** pieces of newspaper, television and radio outreach over the course of the year in local, statewide and national media coverage, appearing before **130 million** sets of eyes.

62% of media coverage included a specific STEM example/story in the state or spoke to STEM economic development, and **64%** of the coverage mentions the efforts of the Governor's STEM Advisory Council.

PUBLIC ATTITUDES AND AWARENESS OF STEM

More than half of Iowans (53%) had heard about 'improving math, technology, science and engineering education, and 49% had heard of STEM when used as a stand-alone acronym.

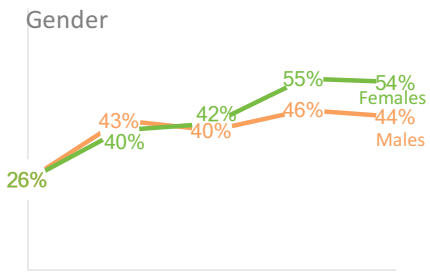
About half of Iowans see STEM as an economic development effort and half see STEM as an education effort.

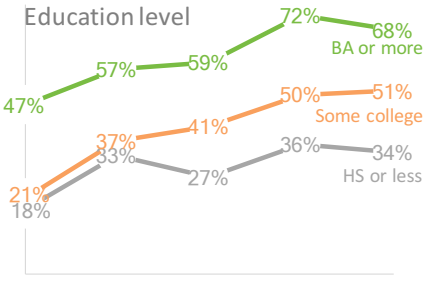
Nearly 9 out of 10 Iowans agreed or strongly agreed with the statement that there is an urgent need in Iowa for more resources to be put toward STEM education.

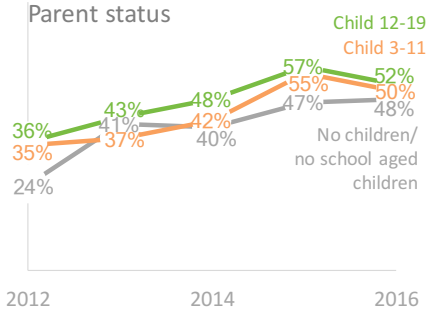
92% of Iowans agreed or strongly agreed that increased focus on STEM education in Iowa will improve the state economy.

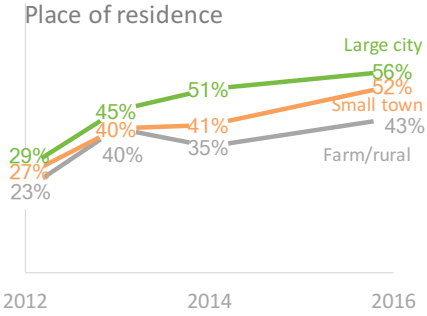
In 2016, 9 out of 10 Iowans thought STEM education should be a priority in their local school districts, but only 50% said it was a priority and another 20% didn't know.

Awareness of STEM has increased across all subgroups from 2012 to 2016.









IOWA'S STEM NETWORK

CORPORATE PARTNERS AND INVESTMENTS

$3.1 MIL

A total of **$3,169,738** in grants, corporate partner gifts and cost-sharing by other STEM partners was invested in Iowa STEM for 2016–2017.

$569K

44 corporate partners contributed **$569,727** to Iowa STEM in 2016–2017, a slight increase in private investments over 2015–2016. [Investors are listed at www.IowaSTEM.gov/corporate-partners.]

$959K

A total of **$959,984** in grants from the Iowa Department of Natural Resources, the National Governor's Association, the U.S. Department of Labor/Iowa Workforce Development and the National Science Foundation supported Iowa STEM in 2016–2017.

$1.6 MIL

Cost-sharing partners, including Strategic America, Regional Hub institutions, Teacher Externship workplace hosts, STEM BEST partners, and STEM Scale-Up program providers contributed **$1,640,027** to Iowa STEM in 2016–2017.

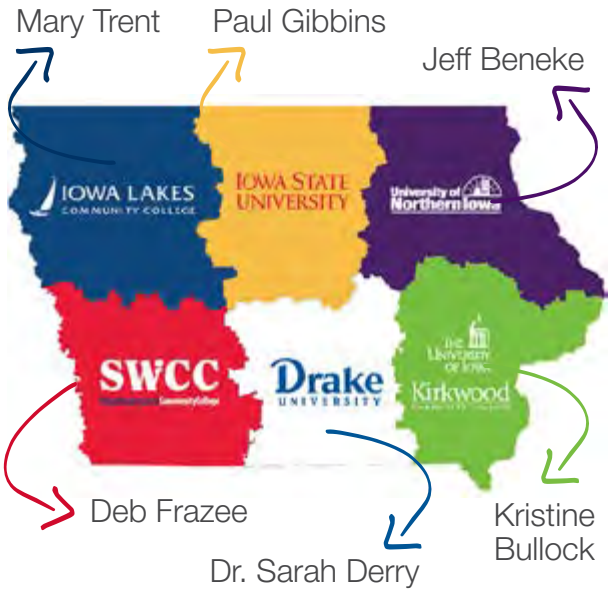
REGIONAL STEM

Regional STEM managers facilitated **11 exemplary STEM Scale-Up programs** that impacted **74,038 preK–12 youth** and their **1,674 educators** in 2016–2017.

Managers held a total of **37 community STEM Festivals** across Iowa, engaging about **16,725 Iowans** in 2016–2017.

Managers made a total of **569 new connections** with business, workforce development, economic development and formal/informal education leaders.

Collectively, Iowa's Regional STEM managers have **9,923** newsletter subscribers, **3,146** Twitter followers and **1,095** Facebook likes.



ACTIVE LEARNING COMMUNITY

337 Iowans representing 200 organizations now make up the STEM Active Learning Community Partners working group (Up from 280 and 140 last year, respectively).

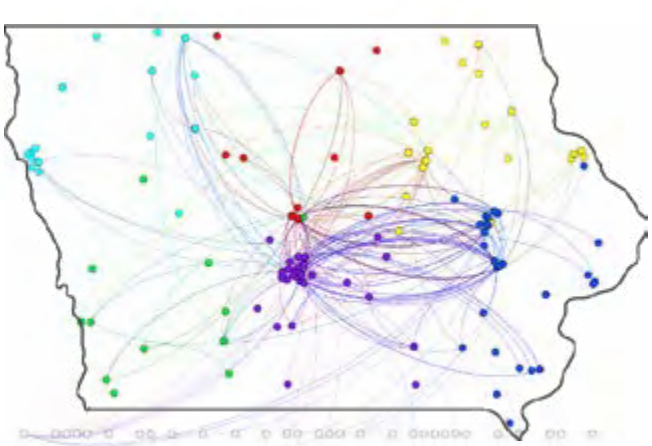
Partners include **after-school programs, museums, libraries, 4H, YMCAs** and other educators around the state.

87 STEM Scale-Up programs were awarded to Active Learning Community Partners in 2016–2017.

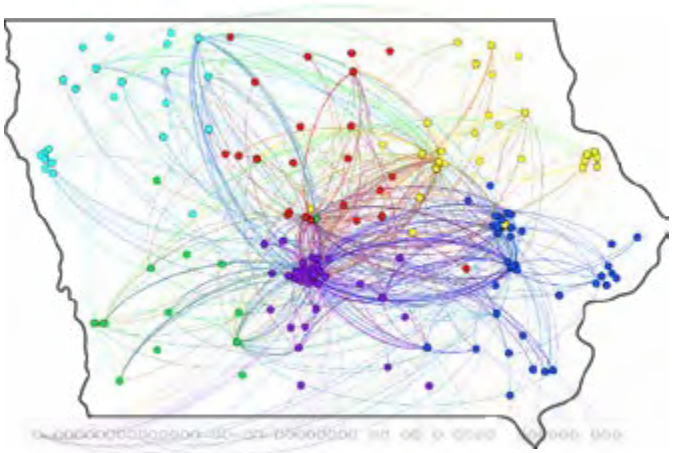
389 educators enjoyed professional development through the ALCP working group in 2016–2017 (up from 272 in 2015).

These **educator partners contributed** to regional STEM festivals, STEM Day at the Iowa State Fair, STEM Day at the Capitol, Dimensions of Success (DoS) trainings, and a slew of conferences in 2016-2017.

IOWA STEM PROFESSIONAL NETWORK GROWTH



2007–2011



2014–2015

The number of members of Iowa's STEM network grew **from 353 in the period 2007–2011 to 721 in 2014–2015**. And the connections between members grew **from 309 to 1057,** respectively.*

*Iowa Statewide STEM Initiative Process Evaluation—Social Network Analysis—Iowa's STEM Network: Reach, Growth, and Potential. Mari Kemis, Andres Lazaro Lopez, Elena Polush, Kathleen Gillon, Research Institute for Studies in Education, Iowa State University. National Science Foundation MSP-RETA award no. DRL-1238211

WHERE ARE THEY NOW?*

STEM evaluators have begun to examine K–12 participants' post-secondary pathways. This will become a prominent report component in years to come.

For a pilot study, a pool of 1,421 high school graduates who had participated in STEM Scale-Up were identified thanks to superintendent permissions.

A total of 168 of them responded to a survey. Sixty percent of that pool (100) were enrolled full time in college. Seventy-one of them declared a STEM major—more than four times the national percentage.

The most agreed-upon survey item was

"I would recommend the STEM program that I was in to other students if they are unsure about their career goals."

The top three words chosen by respondents to describe their STEM experience were **Challenging, Collaborative and Engaging.**

*Iowa STEM Council Scale-Up Program Participants' Postsecondary Trajectory, Dr. Liz Hollingworth, Director, University of Iowa Center for Evaluation and Assessment. June 30, 2017.

Iowa STEM Monitoring Project

2016-2017 Annual Report

Report No. 5.1
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Prepared for
Iowa Governor's STEM Advisory Council

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Executive Summary

The Iowa STEM Monitoring Project (ISMP) is a multi-faceted and collaborative effort that works in support of the Iowa Governor's STEM Advisory Council. ISMP partners include the University of Northern Iowa Center for Social and Behavioral Research, the Iowa State University Research Institute for Studies in Education, and Iowa Testing Programs at the University of Iowa. The purpose of the ISMP is to systematically collect a set of metrics and information sources used to examine changes regarding STEM education and workforce development in Iowa centered on the activities of the Iowa Governor's STEM Advisory Council. The ISMP is comprised of four components: 1) Iowa STEM Indicators; 2) the Statewide Survey of Public Attitudes Toward STEM; 3) a Statewide Student Interest Inventory; and 4) STEM Scale-Up program monitoring. Data for these four components come from publicly available data at the national and state levels; 1,800 Iowans who participated in a statewide survey; 730 Scale-Up educators who completed an educator survey; and 19,102 matched records from Scale-Up student participant lists.

Section 1. The Iowa STEM Indicators The Iowa STEM Indicators track publicly available data on a variety of STEM topics in education and workforce development. In 2016-2017, Iowa's STEM indicators were updated and reorganized across four primary areas of focus: 1) STEM achievement and interest among K-12 students, 2) STEM Preparation of K-12 students, 3) Post-secondary enrollment and training in STEM fields, and 4) STEM employment.

Select findings from the Iowa STEM Indicators are presented below.

<u>STEM achievement and interest among K-12 students</u>

Indicator 1: In *mathematics* achievement on the Iowa Assessments, the average percentages of proficient students in the 2014-2016 biennium period were higher than the 2011-2013 biennium period among 4th, 8th, and 11th grade students (increasing from 78% to 79% among 4th grade, 74% to 76% among 8th grade, and from 82% to 84% among 11th grade, respectively). Increases were also observed in *science* achievement on the Iowa Assessments among 8th grade students, from 76% in the 2011-2013 biennium to 84% in the 2014-2016 biennium, but not among 11th grade students (from 85% to 80%, respectively).

Indicator 2: There were both losses and gains in the percent of Iowa students in 4th and 8th grades scoring at or above proficient in *mathematics* on the National Assessment of Educational Progress (NAEP) from 2013 to 2015. In 2015, 44% of students in 4th grade and 37% of students in 8th grade scored at or above proficient, a net difference of -4% and +1% from 2013, respectively). There were small gains in the percent of Iowa students in 4th and 8th grades scoring at or above proficient in *science*. In 2015, 42% of students in 4th grade and 38% in 8th grade scored at or above proficient – both small increases from the previous administration of the NAEP *science* assessment in 2009 (4th grade) and 2011 (8th grade).

Indicator 3: Student interest in individual STEM topics or in pursuing STEM careers started high in 2012-2013, and has remained high through 2016-2017. This includes 39% of students who were *very interested,* and another 42% who reported they were *somewhat interested* in pursuing a STEM career across all grades combined from elementary, middle school, and into high school.

Indicator 4: Iowa students who took the ACT in 2016 achieved an average STEM score of 22.1, which was higher than the average STEM score nationally of 20.9. On average since 2012, about 23% of Iowa students who took the ACT met STEM benchmarks. While the percent meeting STEM benchmarks annually has remained essentially unchanged since 2012, a higher percentage of Iowa students consistently meet or exceed ACT STEM benchmarks compared to 20% nationally (23% of Iowa test-takers met STEM benchmarks in 2016 compared to 20% nationally).

Indicator 5: Overall, nearly half (49%) of students in the 2016 ACT-tested graduating class have an expressed and/or measured interest in pursuing STEM majors or occupations. Among minorities in the 2016 ACT-tested graduating class, 43% of Hispanic students and 52% of African American students have an expressed and/or measured interest in pursuing STEM majors or occupations.

Indicator 6: Among those that aspire to a four-year degree or more, the top five majors indicated by the 2016 ACT-tested graduating class with an expressed and/or measured interest in STEM were four specific to health and medical fields, followed by mechanical engineering. Among ACT-tested students who aspire to a two-year degree, the top five majors in 2016 for females with interest in STEM were in health-related fields (nursing, radiologic technology, and physical therapy), animal sciences, and veterinary medicine (pre-vet). For males with interest in STEM, the top five majors were computer science and programming, mechanical engineering, computer software / media application, animal sciences, and athletic training.

<u>STEM preparation of K-12 students</u>

Indicator 7: The percentage of underrepresented minority students in high school enrolled in STEM-subject courses has increased annually in the last five years. Enrollment by underrepresented minority students in *science* has increased by 3.3%, 2.4% in *technology*, .2% in *engineering*, 4.4% in *math*, and 4.8% in *health* since 2012-2013.

Indicator 8: From 2012 to 2016, the number of students taking Advanced Placement courses in STEM-related subjects increased from 4,968 to 6,537, as well as the number of students who qualified to receive college credit from these courses (from 3,197 in 2012 to 4,191 in 2016).

Indicator 9: In FY2016, a total of 47,907 unduplicated high school students jointly enrolled in community college courses, and increase of 9% from FY2015. The number of concurrent enrollment mathematics courses taken by high school students has increased each year, with over 8,500 courses taken in 2015-2016. The number of concurrent enrollment science courses taken has increased each year, with over 3,600 courses taken in 2015-2016.

Indicator 10: A total of 34 endorsements have been granted: 26 for 5-12 Engineering, four for K-8 STEM, two for 5-8 STEM, and two for K-12 STEM Specialist. Five Iowa colleges and universities currently offer the STEM endorsement—Buena Vista University, Drake University, Grandview University, Morningside College, and Saint Ambrose University.

STEM college completions

Indicator 11: In 2016, 4,236 students enrolled in Iowa's community colleges in degree fields categorized by career clusters in architecture and construction, information technology, and STEM. An additional 12,127 students were enrolled in health sciences. Overall, there were small fluctuations in the percent change of awards from Iowa's community colleges from 2011 to 2016, with awards among males increasing by 7%, and a small increase in awards among females (<1%). Notably in 2016, awards to minority graduates increased by 23% from the year prior, and 144% compared to 2011.

Indicator 12: From 2011-2012 to 2014-2015, there has been a 3% increase in STEM awards at Iowa's 2-year community colleges, an 18% increase at 4-year public, and a 7% increase at 4-year private (not-for-profit) colleges and universities, respectively. Males represent approximately 82% of degrees in STEM fields from Iowa's 2-year community colleges, and 69% of degrees in STEM fields from Iowa's 4-year, public universities. However, the number of females graduating with degrees in STEM fields at Iowa's 4-year public universities increased 14% from 2011-2012 to 2014-2015.

STEM employment

Indicator 13: On average in 2016, individuals in STEM occupations earned $7 more per hour and $15,500 more in annual salaries compared to all occupational groups. Specifically, STEM occupations earned $27.58 in average hourly wages in 2016 and $57,357 in mean salaries, compared to all occupations overall earning $20.12 in average hourly wages and $41,843 in mean salaries, respectively.

Indicator 14: In 2015-2016, there were an estimated 12,444 vacancies in STEM jobs statewide.

Section 2. Statewide Survey of Public Attitudes Toward STEM To assess change in public awareness and attitudes toward STEM, a statewide public survey of Iowans was conducted from June through September 2016.

In 2016, 49% of Iowans had heard of the acronym STEM. In contrast, only 26% of Iowans had heard of the acronym in 2012. This was a net increase of +8% from 2014, and nearly double that which was measured in 2012. Iowans who were female, and had some college education or a college degree were more likely than other groups to have awareness of STEM.

Respondents were also asked about groups and events promoting STEM in the state, as well as awareness of the slogan *Greatness STEMs from Iowans*. In 2016, an estimated 27% of Iowans had heard about the Governor's 2016 Future Ready Iowa Summit and a STEM academy or STEM school. Approximately one in five (21%) Iowans had heard of the Governor's STEM Advisory Council, STEM Day at the Iowa State Fair, or the I.O.W.A STEM Teacher Award. Fewer Iowans reported hearing about STEM Day at the Capitol (15%), or a STEM festival (10%). An estimated 16% of Iowans reported having heard the slogan *Greatness STEMs from Iowans* at the time of the public awareness survey in summer 2016.

In 2016, nine in ten Iowans (93%) said STEM education **should** be a priority in their local school district, but only 50% said STEM education actually **is** a priority and another 20% said they didn't know if STEM education was a priority in their local school district. Furthermore, eight in ten Iowans (80%) support (37% very supportive and 44% somewhat supportive*)* state efforts to devote resources and develop initiatives to promote STEM education in Iowa. Iowans were split about sixty to forty in their agreement with the statement "Overall, the quality of STEM education in Iowa is high." Over half of Iowans agreed (58%) or strongly agreed (3%) with this statement (35% disagreed or 2% strongly disagreed). By subject area, over half of Iowans rated the quality of science, technology, and math education in their community as *excellent* or *good*, but just under 40% rated engineering education this way.

Section 3. Statewide Student Interest Inventory Among all students statewide who completed an interest inventory when taking the Iowa Assessments in 2016-2017, interest in individual STEM subjects was highest among elementary students, followed by middle school and high school students, respectively. While interest in all subjects generally decreased with advancing grades, the proportion of all students statewide who were *very interested* in pursuing a STEM career remained close across grade groups, from 41% among grades 3rd through 5th, 40% among grades 6th through 8th, and 37% among grades 9th through 12th.

Section 4. Regional Scale-Up Program Monitoring As part of the Iowa STEM Monitoring Project, two sources of information were expected from all schools/organizations implementing a STEM Scale-Up program: 1) an educator survey, and 2) a student participant list.

Over 700 educators completed an educator survey, and they reported several important impacts as a result of implementing Scale-Up programs in 2016-2017. Educators in both formal and informal education settings reported that they gained skills and confidence in teaching STEM topics as a result of their participation in the Scale-Up programs. Most educators agreed or strongly agreed that they now have more confidence to teach STEM content (70%), have increased their knowledge of STEM topics (74%), are better prepared to answer students' STEM-related questions (65%), and have learned effective methods for teaching in STEM content areas (67%). Over two-thirds of the educators reported observing an increase in both student awareness (66%) and interest in STEM topics (71%), while almost 38% stated they observed increased student achievement in STEM areas.

In 2016-2017, Scale-Up student participants were approximately 48% female and 52% male. The distribution of participants by race/ethnicity was 84% White, 8% Hispanic, 3% African American, and 6% Other. On the Iowa Assessments, Scale-Up participants scored higher than students statewide, an average of +3 points higher in National Percentile Rank in *math*, +4 higher in *science*, and +3 higher in *reading*, respectively. Achievement scores by race/ethnicity showed that minority students who had participated in a Scale-Up program scored an average of +6 points higher in National Percentile Rank in math, and +7 points higher in science, compared to minority students who had not participated in a Scale-Up Program.

Conclusion The data compiled, collected, and synthesized for this report come from a variety of sources. Following the benchmarks established in 2012-2013, 2016-2017 showed small but measureable gains in some indicators and some losses in others. The ISMP will continue to follow these indicators, identify and/or refine other metrics of STEM progress, and strengthen relationships with other data partners in the state. Taken together, this report provides a picture of Iowa's STEM landscape, and how it is evolving following the targeted initiatives of the Iowa Governor's STEM Advisory Council to improve STEM education and workforce development surrounding STEM in Iowa.

Introduction

The Iowa STEM Monitoring Project (ISMP) is a multi-faceted and collaborative effort that works in support of the Iowa Governor's STEM Advisory Council. ISMP partners include the University of Northern Iowa (UNI) Center for Social and Behavioral Research (CSBR), the Iowa State University (ISU) Research Institute for Studies in Education (RISE), and Iowa Testing Programs (ITP) at the University of Iowa (UI). The purpose of the ISMP is to systematically collect a set of metrics and information sources used to examine changes regarding STEM education and workforce development in Iowa centered on the activities of the Iowa Governor's STEM Advisory Council.

As the project name and purpose implies, monitoring of the Advisory Council activities in Iowa includes tracking national, state, and program data, analyzing data for trends, and systematically tracking the STEM landscape in the state. The ISMP is comprised of four components: 1) The Iowa STEM Indicators, 2) Statewide Survey of Public Attitudes Toward STEM, 3) Statewide Student Interest Inventory, and 4) STEM Scale-Up Program Evaluation. The UNI CSBR coordinates all four ISMP components. Each ISMP partner has specific areas of responsibility with areas of overlap. This report summarizes the findings from 2016-2017 of the Iowa STEM Monitoring Project.

Section 1. Iowa STEM Indicators

The Iowa STEM Indicators track publicly available data at the national and state level. The purpose of the indicators is to provide annual benchmarks on a variety of STEM topics in education and economic development by systematically assessing the progress and condition of the state's STEM landscape. The indicators fulfill the need for benchmarks related to a variety of domains in the area of STEM education and workforce development.

In 2016-2017, Iowa's STEM indicators were updated and reorganized across four primary areas of focus: 1) STEM achievement and interest among K-12 students, 2) STEM Preparation of K-12 students, 3) STEM college completions, and 4) STEM employment. All indicators are reviewed each year for data quality and utility in providing useful benchmarks to the Council. In addition, new or updated indicators are explored as other data and data sources are identified or in response to targeted activities or policy interests by the Council. Several changes were made to the 18 indicators reported in past years (Table 1), and these updates are summarized in (Table 2).

When possible, the indicators are compared across demographic, geographic, and other characteristics of respondents. Data used to track Iowa's STEM indicators are publicly available and come from sources such as the Iowa Department of Education, the National Center for Education Statistics (NCES), Iowa Workforce Development (IWD), ACT, and Iowa Testing Programs. Each data source has its own dissemination schedule in the timing of data collection, analysis, and reporting, which does not always overlap with the timeline of this report. This variability limits the ability to report on all indicators at the same time annually.

Table 1. Indicators tracked for 2016-2017

Indicator (Reference number used in previous reports)	Data source	2012/13	2013/14	2014/15	2015/16	2016/17
STEM achievement and interest among K-12 students						
Iowa student achievement in mathematics and science (1)	Iowa Testing Programs	✓	✓	✓	✓	✓
Iowa student achievement on NAEP mathematics and science tests (2)	National Center for Education Statistics	✓	✓	✓	✓	✓
Number/Percentage of K-12 students interested in STEM topic areas (8)	Iowa Testing Programs	✓	✓	✓	✓	✓
Number of students taking the ACT and average scores in mathematics/science (3)	ACT	✓	✓	✓	✓	✓
Interest in STEM among ACT test-takers (5)	ACT		✓	✓	✓	✓
Top 5 majors among ACT test-takers with interest in STEM (7)	ACT		✓	✓	✓	✓
STEM Preparation of K-12 students						
Enrollment in STEM courses in high school (13)	Iowa Department of Education		✓	✓	✓	✓
Number of students taking STEM Advanced Placement tests and average scores (4)	College Board	✓	✓	✓	✓	✓
Concurrent and dual enrollment in STEM courses	Iowa Department of Education					✓
Number of current Iowa teachers with K-8 STEM endorsements, 5-8 STEM endorsements, and K-12 STEM specialist endorsements	Iowa Department of Education	*	*	*	*	✓
Post-secondary enrollment and training in STEM fields						
Community college degrees and certificates in STEM fields (14)	Iowa Department of Education	✓	✓	✓	✓	✓
College and university enrollment and degrees awarded in STEM fields (15)	Integrated Postsecondary Education Data System	✓	✓	✓	✓	✓
STEM employment						
Percent of Iowans in workforce employed in STEM occupations (16)	Iowa Workforce Development	✓	✓	✓	✓	✓
Job vacancy rates in STEM occupational areas (17)	Iowa Workforce Development	✓	✓	✓	✓	✓

* Indicator previously reported as number of current Iowa teachers with endorsement to teach STEM subjects.

Table 2. Summary of revisions to Iowa STEM Indicators, 2016-2017

2015/16 Indicator	2016/17 Indicator	Reason(s) for change
Educational aspirations of ACT test-takers with interest in STEM (6)		This indicator was discontinued because it was deemed to be of low utility to the Council toward informing future decisions.
Number of current Iowa teachers with licensure in STEM subjects (9)		This indicator was discontinued because Council activities do not directly target the teacher supply-demand pipeline at this time.
Number of current Iowa teachers with endorsement to teach STEM subjects (10)	Number of current Iowa teachers with K-8 STEM endorsements, 5-8 STEM endorsements, and K-12 STEM specialist endorsements	This indicator was revised to focus on STEM endorsement information only to better align with Council activities.
Number of beginning teachers recommended for licensure/endorsement in STEM subjects (11)		This indicator was discontinued because Council activities do not directly target the teacher supply-demand pipeline at this time.
Teacher retention in STEM subjects (12)		This indicator was discontinued because Council activities do not directly target teacher retention; other indicators of retention are being explored to better align with specific Council activities.
STEM workforce readiness (18)		This indicator was discontinued as other indicators of workforce readiness are being explored.
	Concurrent and dual enrollment in STEM-related courses	This indicator was added to better understand the role of concurrent and dual enrollment courses in the STEM preparation of secondary students.

Indicator 1: Iowa student achievement in *mathematics* and *science*

Data source

Iowa Testing Programs, The University of Iowa

This indicator tracks the proportion of Iowa students statewide who were proficient in *mathematics* and *science* on the Iowa Assessments. Data are reported in biennium periods. Biennium periods represent the average percentages of proficient students for the two school years represented, e.g., 2012-2014 represents the average of the 2012-2013 and 2013-2014 school years.

Key findings

- In *mathematics* achievement, the average percentages of proficient students in the 2014-2016 biennium period were higher than the 2011-2013 biennium period among 4th, 8th, and 11th grade students (Table 3). In the 2014-2016 biennium period, 84% of students in 11th grade were proficient in *mathematics*.
- From the 2011-2013 to the 2014-2016 biennium periods, the average proportions of students in 8th and 11th grade meeting *mathematics* proficiency increased slightly across nearly all demographic groups, including students who are female, African American, Hispanic, and/or with low income.
- In *science* achievement, the average percentages of proficient students in the 2014-2016 biennium period are higher than the 2011-2013 biennium period among 8th grade students, but lower among 11th grade students. In the 2014-2016 biennium period, 80% of students in 11th grade were proficient in *science* (Table 4).
- Overall, there are disparities in proficiency. The proportions of minority students, those of low socioeconomic status, and students with disabilities that exhibit proficiency are consistently lower than the overall rates. This is true in all biennium periods, all grade levels, and in both *mathematics* and *science*. Proficiency in *science* has declined the most among students in the 11th grade who are African American, from 60% in 2011-2013 to 49% in 2014-2016.

Table 3. Proportion of Iowa students statewide who are proficient in *mathematics*

Grade		2011-2013[1]	2012-2014	2013-2015	2014-2016	Trend since 2011-2013
4th	Overall	78%	79%	80%	79%	↑
	Male	78%	80%	81%	81%	↑
	Female	77%	78%	78%	78%	↑
	White	81%	83%	84%	84%	↑
	African American	48%	50%	50%	50%	↑
	Hispanic	65%	66%	65%	63%	↓
	Low income	66%	67%	68%	67%	↑
	Disability	45%	44%	45%	46%	↑
8th	Overall	74%	75%	76%	76%	↑
	Male	74%	74%	75%	75%	↑
	Female	74%	75%	77%	77%	↑
	White	78%	79%	80%	81%	↑
	African American	41%	42%	42%	41%	↔
	Hispanic	55%	56%	59%	60%	↑
	Low income	58%	59%	61%	61%	↑
	Disability	25%	27%	29%	28%	↑
11th	Overall	82%	83%	84%	84%	↑
	Male	82%	82%	83%	82%	↔
	Female	82%	83%	85%	84%	↑
	White	85%	86%	87%	87%	↑
	African American	53%	53%	55%	54%	↑
	Hispanic	65%	69%	71%	70%	↑
	Low income	67%	69%	71%	69%	↑
	Disability	42%	42%	43%	41%	↓

Source: Iowa Testing Programs, The University of Iowa

Retrieved from *The Annual Condition of Education*, Iowa Department of Education, 2016.
https://www.educateiowa.gov/sites/files/ed/documents/COE2016-rev%2007112017.pdf

1. Percentages for each biennium period represent average percentages of proficient students for the two school years represented, e.g., 2014-2016 represents the average of the 2014-15 and 2015-16 school years.

Table 4. Proportion of Iowa students statewide who are proficient in *science*

Grade		2011-2013[1]	2012-2014	2013-2015	2014-2016	Trend since 2011-2013
8th	Overall	76%	80%	84%	84%	↑
	Male	77%	80%	84%	84%	↑
	Female	74%	79%	84%	84%	↑
	White	80%	84%	87%	88%	↑
	African American	43%	49%	55%	54%	↑
	Hispanic	58%	64%	71%	72%	↑
	Low income	62%	67%	73%	73%	↑
	Disability	37%	44%	49%	49%	↑
11th	Overall	85%	82%	80%	80%	↓
	Male	84%	81%	79%	78%	↓
	Female	87%	84%	81%	81%	↓
	White	88%	85%	84%	83%	↓
	African American	60%	53%	49%	49%	↓
	Hispanic	71%	69%	64%	63%	↓
	Low income	73%	69%	65%	65%	↓
	Disability	49%	43%	38%	36%	↓

Source: Iowa Testing Programs, The University of Iowa

Retrieved from *The Annual Condition of Education*, Iowa Department of Education, 2016.
https://www.educateiowa.gov/sites/files/ed/documents/COE2016-rev%2007112017.pdf

1. Percentages for each biennium period represent average percentages of proficient students for the two school years represented, e.g., 2014-2016 represents the average of the 2014-15 and 2015-16 school years.

Indicator 2: Iowa student achievement on NAEP *mathematics* and *science* tests

Data source National Assessment of Educational Progress (NAEP), National Center for Education Statistics (NCES)

NAEP Assessments in *mathematics* have been administered to 4th, 8th, and 12th grades students in odd numbered years. Data from 2017 are not yet available. Results are published six months to a year after the assessment is complete. NAEP Assessments in *science* were administered in 2009, 2011 (8th grade only), and 2015.

A new NAEP assessment in *technology and engineering literacy (TEL)* was administered in 2014 to a national sample of eighth-grade students. The TEL assessed how well students apply technology and engineering principles to real life situations, and was computer-based. The TEL assessment will be given to eighth-graders across the nation in 2018. For more information, see http://nces.ed.gov/nationsreportcard/tel/

Key findings

- From 2013 to 2015, *mathematics* scores decreased slightly among 4th grade students overall, females, and males in 4th grade, though the difference was not statistically significant. While also not reaching statistical significance, 4th grade students who are African American had increased average scale scores by 4 points from 2013 to 2015 (Table 5), but are still below the 2009 and 2011 average scale scores for African American students.
- After not having changed from 2011 to 2013, the average scale scores in *mathematics* among 8th grade students increased by one point overall from 2013 to 2015.
- In addition, after having decreased by four points from 2011 to 2013, there was a four-point increase in average scale scores among 8th grade students who are Hispanic. However, students who are African American slipped again from 2013 to 2015. The differences do not reach statistical significance, but will be something to watch going forward.
- Since 2013, Iowa's national rank dropped one spot to 15th in the nation regarding 4th grade *mathematics* scores (compared to 14th in 2013). The national rank of 15th regarding 8th grade *mathematics* jumped ten spots from 2013.
- Less than half (44%) of 4th graders, and approximately one-third (36%) of 8th graders who took the NAEP mathematics test in 2015 scored well enough to be rated at or above proficient in *mathematics*.

- After not having administered the *science* assessment to 4th graders since 2009 and to 8th graders since 2011, the scores from the 2015 administration are now available (Table 6). In 2015, the average *science* score of fourth-grade and eight grade students in Iowa was higher than the average score nationwide (159 versus 153, respectively).
- *Science* scores increased for both 4th and 8th grade students among males, females, students who are African American and students who are Hispanic.
- While the *science* scores for male versus female students in 4th grade was not significantly different, male students in 8th grade had a 5-point higher average score compared to 8th grade female students (161 versus 157, respectively).
- While the scores increased among racial/ethnic subgroups, the gap between the *science* scores of African American or Hispanic students versus White students was not significantly different from that in 2009 (a 31-point and 27-point spread for 4th graders, and a 33-point and 26-point spread for 8th graders, respectively).
- Iowa ranks 11th nationally among 4th graders and 15th nationally among 8th graders in *science*.

Table 5. Iowa *Mathematics* scores on the National Assessment of Educational Progress

Grade	Variable		2009	2011	2013	2015	Trend since 2013
4th	Scale score (0-500)	All students	243	243	246*	243	↓
		Males	243	244	247*	244	↓
		Females	242	242	244*	243	↓
		African American	226	224	218	222	↑
		Hispanic	223	229	234	226	↓
	National rank[1]		19	20	14	15	↓
	Num. jurisdictions significantly higher than IA[2]		6	10	4	6	↓
	Percent at or above Proficient (>249)		41%	43%	48%*	44%	↓
	Percent at Advanced		5%	6%	9%*	9%	↔
8th	Scale score (0-500)	All students	284	285	285	286	↑
		Males	285	286	286	287	↑
		Females	284	284	284	285	↑
		African American	259	258	255	254	↓
		Hispanic	266	269	265	269	↑
	National rank		28	25	25	14	↑
	Num. jurisdictions significantly higher than IA		16	18	17	6	↑
	Percent at or above Proficient (>299)		34%	34%	36%	37%	↑
	Percent at Advanced (>333)		7%	8%	7%	9%	↑

*Significant at p< .05, 2013 versus 2011

Source: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), Mathematics Assessments

Retrieved from: http://nces.ed.gov/nationsreportcard/statecomparisons/
http://nces.ed.gov/nationsreportcard/naepdata/dataset.aspx

1. In 2009, national rank is out of 51 jurisdictions (50 states plus the District of Columbia). In 2011, 2013, and 2015, national rank is based out of 52 jurisdictions (50 states, the District of Columbia, and Department of Defense Education Activity).
2. A jurisdiction is defined as any government defined geographic area sampled in the NAEP assessment.

Table 6. Iowa *Science* scores on the National Assessment of Educational Progress[1]

Grade	Variable		2009	2011	2013	2015	Trend
4th	Scale score (0-300)	All students	157			159	↑
		Males	158			159	↑
		Females	157			159	↑
		African American	130			134	↑
		Hispanic	134			141	↑
	National rank[2]		11			11	↔
	Num. jurisdictions significantly higher than IA[3]		5			4	↑
	Percent at or above Proficient (>167)		41%			42%	↑
	Percent at Advanced (>224)		1%			1%	↔
8th	Scale score (0-300)	All students	156	157		159	↑
		Males	158	159		161	↑
		Females	154	155		157	↑
		African American	127	128		133	↑
		Hispanic	133	143		144	↑
	National rank		17	17		15	↑
	Num. jurisdictions significantly higher than IA		7	12		6	↑
	Percent at or above Proficient (>170)		35%	35%		38%	↑
	Percent at Advanced (>215)		1%	1%		1%	↔

Source: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), Science Assessments.

Retrieved from: http://nces.ed.gov/nationsreportcard/statecomparisons/
http://nces.ed.gov/nationsreportcard/naepdata/dataset.aspx

1. NAEP Assessments in science were administered in 2009, 2011 (8th grade only), and 2015; the science assessment was not administered to any grade in 2013.
2. In 2009, national rank is out of 51 jurisdictions (50 states plus the District of Columbia). In 2011 and 2015, national rank is based out of 52 jurisdictions (50 states, the District of Columbia, and Department of Defense Education Activity).
3. A jurisdiction is defined as any government defined geographic area sampled in the NAEP assessment.

Indicator 3: Number and percentage of students in grades 3-5, grades 6-8, and grades 9-12 interested in STEM topics and careers

Data source Iowa Assessments, Iowa Testing Programs, The University of Iowa

Key findings

- Among all students statewide, interest in individual STEM topics or in pursuing STEM careers started high in 2012-2013, and remained high through 2016-2017. Over 75% of all students statewide indicated they were *very interested* or *somewhat interested* in science, technology, engineering, or in pursuing a STEM career in 2016-2017 (Figure 1). Just under three-quarters (72%) said they were *very interested* or *somewhat interested* in math.
- In Figure 2, students who said they were *very interested* or *somewhat interested* were combined to compare changes in interest across the four STEM subjects and in STEM careers from 2012-2013 to 2016-2017 among all students statewide. Interest in the four STEM subjects is consistently highest among students in grades 3-5, followed by students in grades 6-8, and grades 9-12, respectively. However, interest in pursuing a STEM career is comparable across the grade groups, ranging from 79 to 83%.
- More information and other results from the interest inventory can be found in Section 3. Statewide Student Interest Inventory, Section 4.2 Report of Participant Information, and Appendix A.

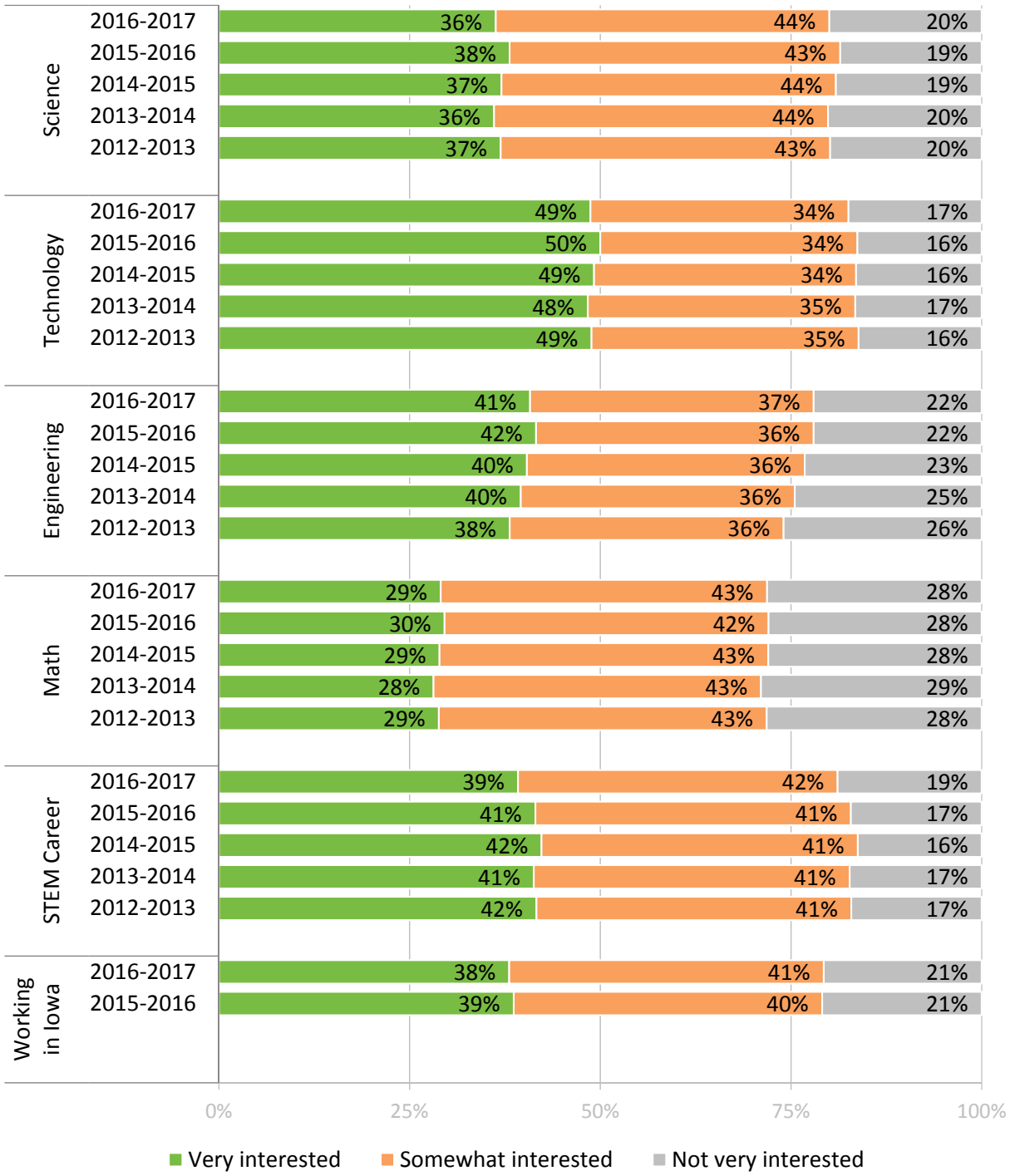


Figure 1. Statewide student interest in individual STEM topics, STEM careers, and working in Iowa 2012/13 to 2016/17

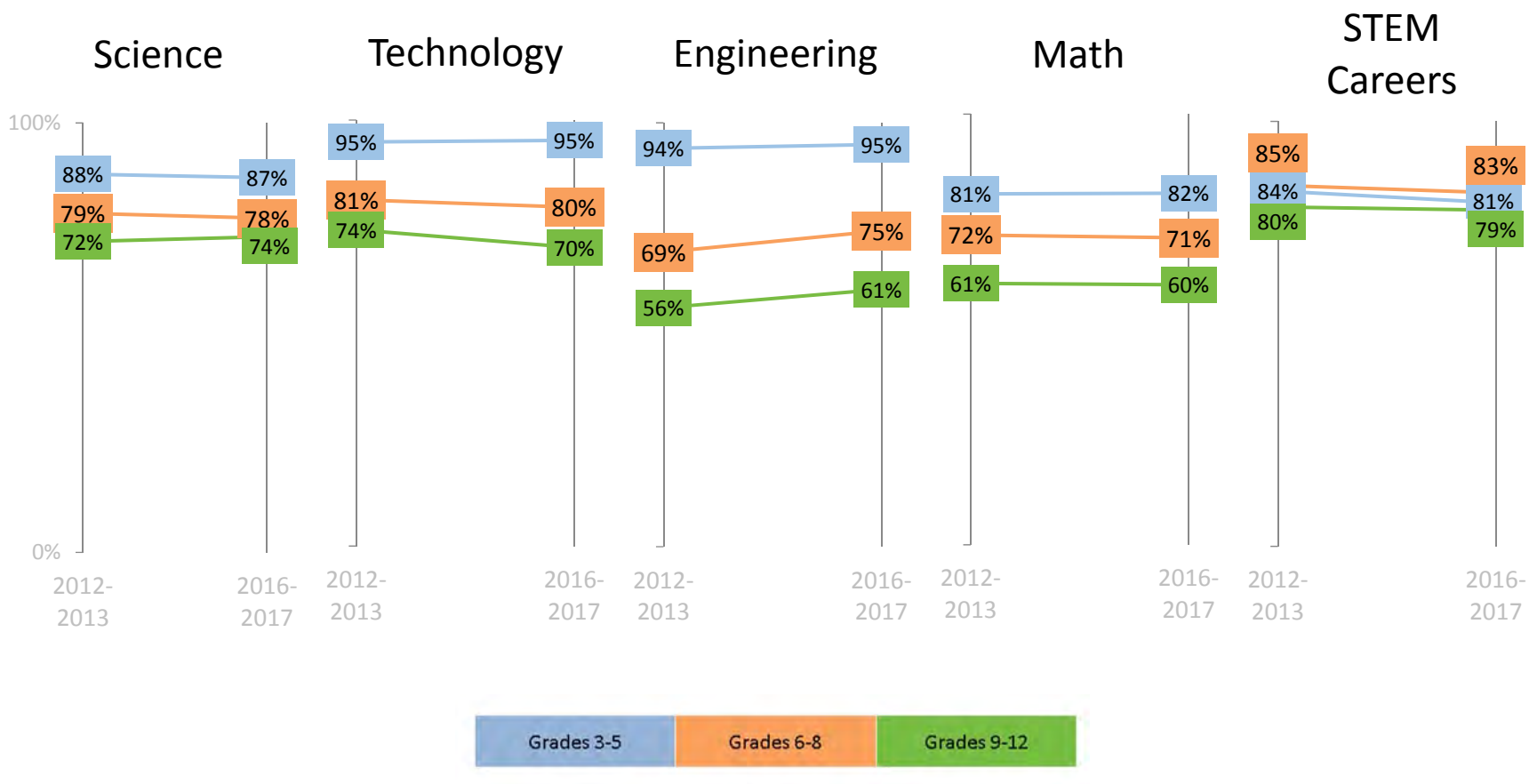


Figure 2. Proportion of all students statewide by grade group who said they were *very interested* or *somewhat interested* in STEM topics and STEM careers, 2012/13 to 2016/17

Indicator 4: Number of students taking the ACT and average scores in mathematics, science, and STEM

Data source ACT, Inc.

Math and *science* achievement on the ACT is reported by year reflecting the performance of graduating seniors in that year who took the ACT as a sophomore, junior, or senior and self-reported that they were scheduled to graduate in the respective year, e.g., 2016 reflects 2016 graduating seniors who took the ACT in the 10th, 11th, or 12th grade (which corresponds to 2013/14, 2014/15, and 2015/16 academic years, respectively). Trends are compared from 2012 (which would reflect students who took the ACT in 2009/10, 2010/11, or 2011/12) to 2016 (which reflects students who took the ACT during the last three of Council activities). Among Iowa's graduating class of 2016, 64% of students (n=23,132) took the ACT.

Key findings

- Average ACT scores of graduating seniors in *mathematics* and *science* have changed very little from 2012 to 2016 (Table 7). This is consistent with National trends and across demographic groups by gender and Hispanic ethnicity. In 2016, Iowa's average ACT score was 21.4 in *mathematics* and 22.3 in *science,* compared to 20.6 and 20.8 nationwide, respectively.

Disparities exist in average ACT scores by race/ethnicity with an average of 5 points lower among students who are African American, and an average of 3 points lower among students who are Hispanic compared to their White counterparts (Table 8).

- In 2016, 48% of graduating seniors who took the ACT met benchmarks for *mathematics*, and 46% met benchmarks for *science*. Comparing the graduating class of 2012 (the most recent year preceding the statewide STEM Scale-Up programs) to 2016, the proportion of Iowa ACT test-takers meeting benchmarks increased by eight percentage points for *science*, but decreased three percentage points for *mathematics*. (Figure 3)
- By gender, the proportion of males and females who met college readiness benchmarks in *science* increased between 2012 and 2016, from 45% to 53% among males, and 33% to 43% among females, respectively (Figure 3). However, the percent meeting college readiness benchmarks in *mathematics* decreased by one percentage point among males, and three percentage points among females between 2012 and 2016, respectively.
- Disparities exist among students by race/ethnicity with only 29% of Hispanic students and 18% of African American students meeting benchmarks in *mathematics,* compared with 52% of White students in 2016 (Figure 4). A similar trend exists for *science* benchmarks. A disparity also exists by race/ethnicity in the number of students who take the ACT. Of the over 23,100 students reflected in the 2016 data, approximately 1,300 (6%) were Hispanic and 600 (3%) were African American, respectively, compared to comprising 8% and 6% of the 15-19 year old statewide adolescent population (Table 8).

- Iowa students who took the ACT in 2016 achieved an average STEM score of 22.1, which was higher than the average STEM score nationally of 20.9. On average since 2012, about 23% of Iowa students who took the ACT met STEM benchmarks. While the percent meeting STEM benchmarks annually has remained essentially unchanged since 2012, a higher percentage of Iowa students consistently meet or exceed ACT STEM benchmarks compared to 20% nationally (23% of Iowa test-takers met STEM benchmarks in 2016 compared to 20% nationally).

Table 7. ACT scores and benchmarks for Iowa students, 2012-2016[1]

		2012	2013	2014	2015	2016	Trend since 2012
Overall	Number of students tested	23,119	22,526	22,931	22,675	23,132	↑
	Average ACT scores[2]						
	Composite	22.1	22.1	22.0	22.2	22.1	↔
	Math	21.7	21.6	21.4	21.5	21.4	↓
	Science	22.2	22.2	22.2	22.3	22.3	↑
	Percent meeting benchmarks[3]						
	Math	51%	50%	48%	48%	48%	↓
	Science	38%	46%	47%	48%	46%	↑
Males	Number of students tested	10,684	10,406	10,350	10,172	10,197	↓
	Average ACT scores						
	Composite	22.4	22.3	22.5	22.5	22.7	↑
	Math	22.5	22.3	22.3	22.4	22.4	↓
	Science	22.9	22.8	23.0	23.0	23.1	↑
	Percent meeting benchmarks						
	Math	57%	56%	55%	56%	56%	↓
	Science	45%	52%	54%	54%	53%	↑
Females	Number of students tested	12,380	12,091	11,937	11,816	11,899	↓
	Average ACT scores						
	Composite	21.9	21.9	22.0	22.1	22.0	↑
	Math	21.1	21.0	20.9	21.0	20.9	↓
	Science	21.7	21.7	21.8	22.0	22.0	↑
	Percent meeting benchmarks						
	Math	46%	45%	45%	44%	43%	↓
	Science	33%	42%	44%	45%	43%	↑

Source: ACT, Inc.
Retrieved from: www.act.org/newsroom/data

1. Year reflects performance of graduating seniors in that year who took the ACT as a sophomore, junior, or senior and self-reported that they were scheduled to graduate in the corresponding year, e.g., 2014 reflects 2014 graduating seniors who took the ACT in the 10th, 11th, or 12th grade.
2. Scores: Include both an overall Composite Score and individual test scores in four subject areas (English, Mathematics, Reading, Science) that range from 1 (low) to 36 (high). The Composite Score is the average of the four test scores, rounded to the nearest whole number.
3. College Readiness Benchmarks: the minimum score needed on an ACT subject-area test to indicate a 50% chance of obtaining a B or higher or about a 75% chance of obtaining a C or higher in the corresponding credit-bearing college courses. The benchmark scores, updated in August of 2013, for math and science were 22 and 23 respectively.

Table 8. ACT scores and benchmarks for Iowa students by student race/ethnicity, 2012-2016[1]

		2012	2013	2014	2015	2016	Trend since 2012
White	Number of students tested	19,515	18,712	18,475	18,084	18,121	↓
	Average ACT scores[2]						
	Composite	22.5	22.5	22.6	22.7	22.7	↑
	Math	22.0	21.9	21.9	22.0	21.9	↓
	Science	22.5	22.6	22.7	22.8	22.8	↑
	Percent meeting benchmarks[3]						
	Math	53%	53%	52%	52%	52%	↓
	Science	40%	49%	51%	52%	50%	↑
African American	Number of students tested	601	601	600	628	635	↑
	Average ACT scores[2]						
	Composite	17.6	17.3	17.4	17.9	17.9	↑
	Math	17.6	17.4	17.4	17.7	17.7	↑
	Science	18.1	17.8	17.5	18.3	18.4	↑
	Percent meeting benchmarks[3]						
	Math	17%	16%	16%	18%	18%	↑
	Science	12%	15%	14%	19%	15%	↑
Hispanic	Number of students tested	1,140	1,204	1,264	1,270	1,341	↑
	Average ACT scores[2]						
	Composite	19.3	19.1	19.5	19.7	19.8	↑
	Math	19.2	18.9	18.9	19.1	19.1	↓
	Science	19.8	19.4	19.8	20.1	20.3	↑
	Percent meeting benchmarks[3]						
	Math	30%	27%	26%	27%	29%	↓
	Science	21%	24%	26%	29%	29%	↑

Source: ACT, Inc.
Retrieved from: www.act.org/newsroom/data

1. Year reflects performance of graduating seniors in that year who took the ACT as a sophomore, junior, or senior and self-reported that they were scheduled to graduate in the corresponding year, e.g., 2014 reflects 2014 graduating seniors who took the ACT in the 10th, 11th, or 12th grade.
2. Scores: Include both an overall Composite Score and individual test scores in four subject areas (English, Mathematics, Reading, Science) that range from 1 (low) to 36 (high). The Composite Score is the average of the four test scores, rounded to the nearest whole number.
3. College Readiness Benchmarks: the minimum score needed on an ACT subject-area test to indicate a 50% chance of obtaining a B or higher or about a 75% chance of obtaining a C or higher in the corresponding credit-bearing college courses. The benchmark scores, updated in August of 2013, for math and science were 22 and 23 respectively.

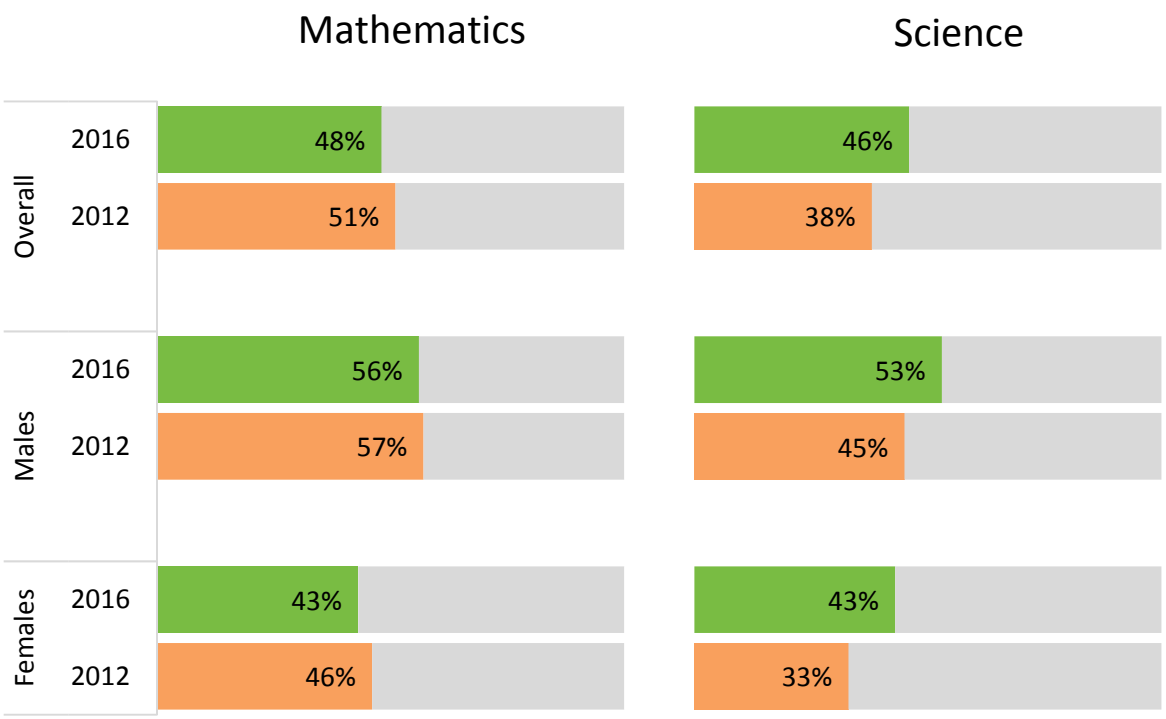


Figure 3. Percentage of Iowa graduating seniors meeting college readiness benchmarks in *mathematics* and *science* based on ACT scores by gender

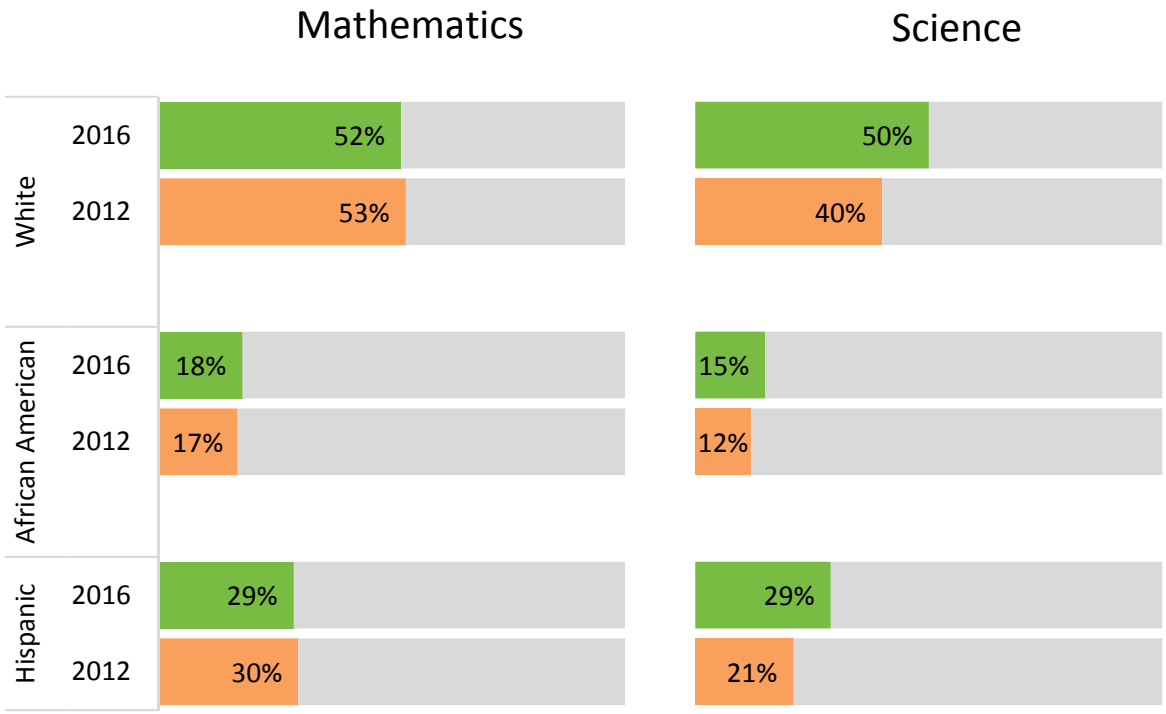


Figure 4. Percentage of Iowa graduating seniors meeting college readiness benchmarks in *mathematics* and *science* based on ACT scores by race/ethnicity

Indicator 5: Interest in STEM among ACT test-takers

Data source ACT, Inc.

This indicator uses an aggregated sample of students who have an expressed and/or measured interest in STEM content. A student who has an expressed interest in STEM is choosing a major or occupation that corresponds with STEM fields. A measured interest utilizes the ACT Interest Inventory, an inventory administered with the ACT that determines interest in different occupations and majors.

The four STEM areas categorized by ACT include: *science*, *computer science/math*, *medical and health*, and *engineering* and *technology*.

> *Science* includes majors and occupations in the traditional hard sciences, as well as sciences involving the management of natural resources. This also includes science education.
>
> *Computer science/math* includes majors and occupations in the computer sciences, as well as general and applied mathematics. This also includes mathematics education.
>
> *Engineering* and *technology* includes majors and occupations in engineering and engineering technologies.
>
> *Medical and health* includes majors and occupations in the health sciences and medical technologies.

Results for this indicator do not include students who have expressed and/or measured interest in other subject areas. Note that the ACT is not taken by all students in Iowa, and mostly by those who are college-bound. In 2016, the proportion of Iowa's graduating class who had taken the ACT was 64%.

Key findings

- Nearly half (49%) of students in the 2016 ACT-tested graduating class having an expressed and/or measured interest in pursuing STEM majors or occupations. (Table 9).
- Compared to the 2012 ACT-tested graduating class, the proportion of students interested in STEM in 2016 increased by +3 percentage points among females, and +2 percentage points among students who are African American.
- Among all students who have an expressed and/or measured interest in STEM, 41% are in the area of medical and health, 25% in science, 23% in technology/engineering, and 11% in computer science/math (Figure 5).
    - Compared to males who have interest in STEM more evenly distributed across individual STEM topic areas and where the greatest percentage of 38% is in the area of technology and engineering, 58% of female interest is in the area of medical and health.

- The distribution of interest in STEM topic areas among students who are African American or Hispanic mirrors the distribution across topic areas among all students combined.
    - For African American students, 26% have an expressed and/or measured interest in science, 20% in technology/engineering, 9% in computer science/math, and 44% in medical and health.
    - For Hispanic students, 22% have an expressed and/or measured interest in science, 22% in technology/engineering, 11% in computer science/math, and 46% in medical and health.

Table 9. Percentage of Iowa high school students who have taken the ACT with an expressed and/or measured interest in STEM-related topics, 2012 to 2016[1]

STEM Interest		2012	2013	2014	2015	2016	Trend since 2012
All STEM	All Students	48%	49%	49%	48%	49%	
	Male	52%	52%	54%	54%	55%	
	Female	45%	46%	46%	46%	48%	
	White	49%	49%	50%	50%	51%	
	African American	41%	43%	42%	41%	43%	
	Native American	52%	40%	47%	44%	52%	
	Hispanic	48%	49%	48%	47%	49%	
Science	All Students	25%	25%	24%	25%	25%	
	Male	24%	22%	23%	22%	22%	
	Female	26%	27%	26%	28%	28%	
	White	25%	25%	25%	25%	25%	
	African American	17%	15%	17%	15%	26%	
	Native American	20%	30%	15%	36%	13%	
	Hispanic	24%	22%	24%	20%	22%	
Technology and Engineering	All Students	22%	22%	22%	22%	23%	
	Male	37%	39%	37%	37%	38%	
	Female	7%	6%	7%	7%	8%	
	White	22%	22%	23%	23%	23%	
	African American	26%	22%	21%	24%	20%	
	Native American	28%	26%	19%	18%	13%	
	Hispanic	18%	23%	20%	22%	22%	
Computer Science/ Math	All Students	9%	10%	10%	10%	11%	
	Male	13%	14%	14%	15%	15%	
	Female	5%	5%	5%	6%	6%	
	White	9%	10%	10%	10%	11%	
	African American	7%	11%	10%	13%	9%	
	Native American	8%	4%	11%	4%	16%	
	Hispanic	9%	9%	8%	11%	11%	
Medical and Health	All Students	44%	43%	44%	42%	41%	
	Male	26%	25%	26%	25%	25%	
	Female	61%	61%	61%	59%	58%	
	White	43%	43%	43%	42%	41%	
	African American	49%	52%	53%	48%	44%	
	Native American	45%	39%	56%	43%	58%	
	Hispanic	49%	47%	47%	46%	46%	

Source: ACT, Inc.

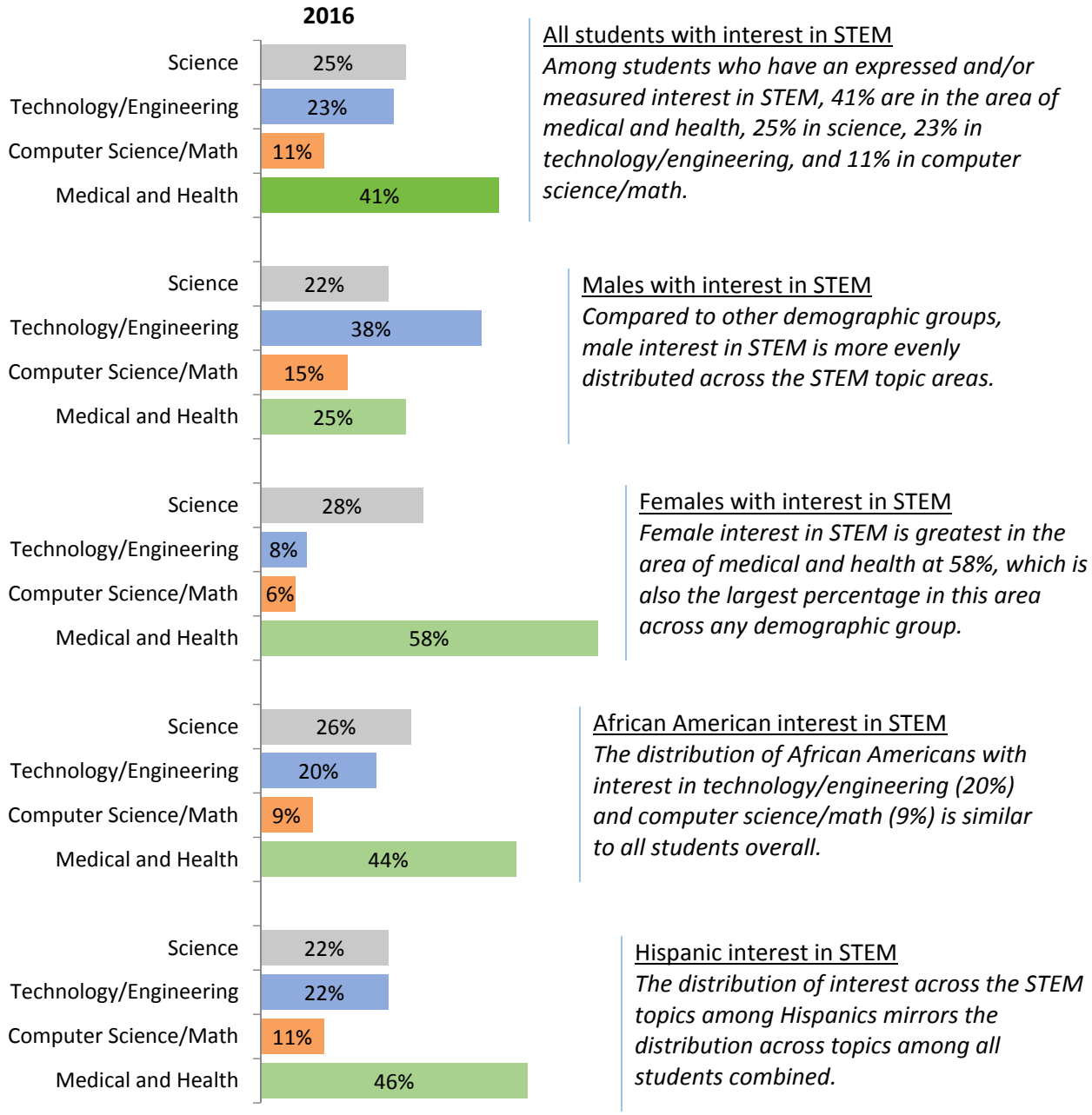


Figure 5. Percentage of Iowa high school students who took the ACT in 2016 who have expressed and/or measured interest in STEM-related topics

Indicator 6: Top 5 majors among ACT test-takers with interest in STEM

Data source ACT, Inc.

This indicator uses an aggregated sample of students who have an expressed and/or measured interest in STEM only. A student who has an expressed interest in STEM is choosing a major or occupation that corresponds with STEM fields. A measured interest utilizes the ACT interest inventory, an inventory delivered with the ACT that determines inherent interest in different occupations and majors. Results do not include students who have expressed and/or measured interest in alternative subject areas. Note that the ACT is not taken by all students in Iowa, and mostly by those who are college-bound. Among Iowa's graduating class of 2016, 64% of students (n=23,132) took the ACT.

Key findings

- Among those that aspire to a two-year degree, the top five majors for females in 2016 with interest in STEM were in health-related fields (nursing, medical radiologic technology, and physical therapy), animal sciences, and veterinary medicine (pre-vet). For males with interest in STEM, the top five majors were computer science and programming, mechanical engineering, computer software / media application, animal sciences, and athletic training.
- Among those that aspire to a four-year degree or more, the top five majors indicated by the 2016 ACT-tested graduating class with an expressed and/or measured interest in STEM were four specific to health and medical fields, followed by mechanical engineering (Table 10).

Table 10. Top 5 majors among ACT-tested graduating class in 2012 and 2016 who have expressed and/or measured interest in STEM and aspire to a two-year degree

Group	2012	2016
All Students	1. Nursing, Registered (B.S./R.N.) 2. Medical Radiologic Technology 3. Animal Sciences 4. Nursing, Practical/Vocational (LPN) 5. Emergency	1. Nursing, Registered (B.S./R.N.) 2. Medical Radiologic Technology 3. Animal Sciences 4. Computer Science & Programming 5. Mechanical Engineering
Males	1. Mechanical Engineering 2. Animal Sciences 3. Computer Software & Media Application 4. Emergency Medical Technology 5. Wildlife & Wildlands Management	1. Computer Science & Programming 2. Mechanical Engineering 3. Computer Software & Media Application 4. Animal Sciences 5. Athletic Training
Females	1. Nursing, Registered (B.S./R.N.) 2. Medical Radiologic Technology 3. Nursing, Practical/Vocational (LPN) 4. Animal Sciences 5. Veterinary Medicine (Pre-Vet)	1. Nursing, Registered (B.S. /R.N.) 2. Medical Radiologic Technology 3. Animal Sciences 4. Physical Therapy (Pre-Phys Therapy) 5. Veterinary Medicine (Pre-Vet)
White	1. Nursing, Registered (B.S. /R.N.) 2. Medicine (Pre-Medicine) 3. Physical Therapy (Pre-Phys Therapy) 4. Biology, General 5. Engineering (Pre-Engineering), Gen	1. Medical Radiologic Technology 2. Animal Sciences 3. Nursing, Registered (B.S./R.N.) 4. Mechanical Engineering 5. Computer Science & Programming
African American	1. Nursing, Registered (B.S./R.N.) 2. Nursing, Practical/Vocational (LPN) 3. Athletic Training 4. Computer & Information Sciences 5. Construction/Building Technology	1. Architectural Engineering 2. Automotive Engineering Technology 3. Bus/Mgmt Quantitative Methods, Gen 4. Computer Software & Media Application 5. Dentistry (Pre-Dentistry)
Hispanic/ Latino	1. Nursing, Registered (B.S./R.N.) 2. Automotive Engineering Technology 3. Emergency Medical Technology 4. Mechanical Engineering 5. Architectural Engineering	1. Athletic Training 2. Computer Science & Programming 3. Nursing, Registered (B.S./R.N.) 4. Architecture, General 5. Biology, General

Table 11. Top 5 majors among ACT-tested graduating class in 2012 and 2016 who have expressed and/or measured interest in STEM and aspire to a four-year degree or more

Group	2012	2016
All Students	1. Nursing, Registered (B.S./R.N.) 2. Medicine (Pre-Medicine) 3. Physical Therapy (Pre-Phys Therapy) 4. Athletic Training 5. Biology, General	1. Nursing, Registered (B.S./R.N.) 2. Medicine (Pre-Medicine) 3. Physical Therapy (Pre-Phys Therapy) 4. Athletic Training 5. Mechanical Engineering
Males	1. Medicine (Pre-Medicine) 2. Mechanical Engineering 3. Athletic Training 4. Engineering (Pre-Engineering), Gen 5. Computer Science & Programming	1. Mechanical Engineering 2. Computer Science & Programming 3. Medicine (Pre-Medicine) 4. Athletic Training 5. Engineering (Pre-Engineering)
Females	1. Nursing, Registered (B.S. /R.N.) 2. Medicine (Pre-Medicine) 3. Physical Therapy (Pre-Phys Therapy) 4. Biology, General 5. Pharmacy (Pre-Pharmacy)	1. Nursing, Registered (B.S./R.N.) 2. Medicine (Pre-Medicine) 3. Physical Therapy (Pre-Phys Therapy) 4. Biology, General 5. Animal Sciences
White	1. Nursing, Registered (B.S. /R.N.) 2. Medicine (Pre-Medicine) 3. Physical Therapy (Pre-Phys Therapy) 4. Athletic Training 5. Biology, General	1. Nursing, Registered (B.S./R.N.) 2. Medicine (Pre-Medicine) 3. Physical Therapy (Pre-Phys Therapy) 4. Athletic Training 5. Mechanical Engineering
African American	1. Nursing, Registered (B.S./R.N.) 2. Medicine (Pre-Medicine) 3. Athletic Training 4. Biochemistry & Biophysics 5. Computer Engineering	1. Medicine (Pre-Medicine) 2. Nursing, Registered (B.S./R.N.) 3. Biology, General 4. Aerospace/Aeronautical Engineering 5. Computer Science & Programming
Hispanic/ Latino	1. Medicine (Pre-Medicine) 2. Nursing, Registered (B.S. /R.N.) 3. Athletic Training 4. Biology, General 5. Physical Therapy (Pre-Phys Therapy)	1. Nursing, Registered (B.S./R.N.) 2. Medicine (Pre-Medicine) 3. Biology, General 4. Athletic Training 5. Computer Science & Programming

Indicator 7: Enrollment in STEM-related courses in high school

Data source Iowa Department of Education, Bureau of Information and Analysis Services, 2016

Indicator 6 investigates the opportunities available for Iowa students to take basic and advanced level STEM courses in high school.

Key findings

Table 12 provides the number of high school students statewide enrolled in each STEM-related subject area over a six-year period. Note that core mathematics and science enrollment increases and decreases, in contrast to elective course enrollment trends, likely reflect population shifts. An addendum to clarify these differences will be forthcoming.

- Compared to last year, student enrollment in STEM courses has increased in some subject-areas, and decreased in others. From 2015-2016 to 2016-2017, *science* courses showed a 1% decrease in enrollment, *technology* showed a 3% decline and *engineering* had a 10% decline in enrollment. The greatest percent increase in enrollment was in the *health* courses, which had an increase of 10%, from 364 students last year to 397 students this year. *Math* courses had the highest overall increase of 1,547 students, a 3% increase over last year.
- In addition, the trend in student enrollment in STEM-related courses since the Governor's STEM Advisory Council was established in 2011-2012 was compared to the two years prior to the establishment of the Council.
    - From 2009-2010 and 2010-2011, the number of high school students enrolled in *science* courses increased by less than 1%. Between 2011-2012 and 2016-2017, enrollment increased by 3%.
    - The number of students enrolled in *technology* courses has continued to decrease over time, by 12% from 2009-2010 to 2010-2011, and then another 12% decrease from 2011-2012 to 2016-2017.
    - Enrollment in *engineering*-related courses increased every year from 2009-2010 through 2014-2015. In 2015-2016, enrollment in *engineering* courses declined for the first time since 2009-2010, and decreased again in 2016-2017. From 2009-2010 to 2010-2011, the number of students enrolled in high school *engineering* courses increased by 20%. Since 2011-2012, that number increased by another 8% through 2015-2016, but then declined by 800 students (3%) in 2016-21017.
    - From 2009-2010 to 2010-2011, the number of Iowa high school students enrolled in *math* courses decreased by 1%. Conversely, between 2011-2012 and 2016-2017, the number of high school students enrolled in *math* classes increased by 17%.
    - The number of Iowa high school students enrolled in *health* courses decreased by 4% from 2009-2010 to 2010-2011. Since 2010-2011, enrollment in *health* courses has increased by 16%.

Table 12. Student enrollment in high school courses of STEM-related subject areas

	2009/10	2010/11	% Change 2009/10 -2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	% Change 2011/12 -2016/17
Science	72,428	72,114	<1%	73,150	73,633	73,996	74,178	75,997	75,195	3%
Male	49.4%	49.8%		49.5%	49.6%	49.7%	49.4%	49.2%	49.1%	
Female	50.6%	50.2%		50.5%	50.4%	50.3%	50.6%	50.8%	50.9%	
Technology	8,644	7,647	-12%	7,818	7,791	7,032	7,239	7,086	6,889	-12%
Male	65.5%	64.2%		66.9%	69.2%	71.1%	73.9%	72.8%	73.2%	
Female	34.5%	35.8%		33.1%	30.8%	28.9%	26.1%	27.2%	26.8%	
Engineering	5,327	6,386	20%	7,303	7,954	8,952	8,957	7,882	7,082	-3%
Male	84.9%	83.7%		84.1%	83.6%	83.5%	84.5%	83.6%	84.4%	
Female	15.1%	16.3%		15.9%	16.4%	16.5%	15.5%	16.4%	15.6%	
Math	47,481	46,934	-1%	47,563	49,602	51,210	50,894	54,163	55,710	17%
Male	49.3%	49.1%		49.3%	49.5%	49.5%	49.4%	49.1%	48.9%	
Female	50.7%	50.9%		50.7%	50.5%	50.5%	50.6%	50.9%	51.1%	
Health	289	278	-4%	343	412	373	296	364	397	16%
Male	31.1%	25.2%		26.2%	31.3%	31.6%	24.7%	21.4%	24.7%	
Female	68.9%	74.8%		73.8%	68.7%	68.4%	75.3%	78.6%	75.3%	

Source: Iowa Department of Education, Bureau of Information and Analysis Services, 2017

The percentage of underrepresented minority students enrolled in STEM-subject areas has increased annually in the last five years (Table 13). Enrollment by underrepresented minority students in *science* has increased by 3.3%, 2.4% in *technology*, .2% in *engineering*, 4.4% in *math*, and 4.8% in *health*.

Table 13. Percentage of students enrolled in STEM subject courses who are an underrepresented minority[1]

	2012/13	2013/14	2014/15	2015/16	2016/17
Science	15.1%	15.6%	16.5%	17.2%	18.4%
Technology	12.5%	13.2%	14.1%	14.3%	14.9%
Engineering	13.8%	14.3%	15.2%	13.5%	14.0%
Math	9.0%	9.5%	9.9%	12.0%	13.4%
Health	6.3%	5.1%	5.4%	4.7%	11.1%

1. Underrepresented minority students include Black or African American, Hispanic/Latino, American Indian or Alaska Native, and Native Hawaiian or other Pacific Islander, including:

Hispanic/Latino (A person of Cuban, Mexican, Puerto Rican, Cuban, South or Central American, or other Spanish culture or origin, regardless of race.)

American Indian or Alaska Native (A person having origins in any of the original peoples of North and South America, including Central America, and who maintains tribal affiliation or community attachment.)

Black or African American (A person having origins in any of the Black racial groups of Africa.)

Native Hawaiian or Other Pacific Islander (A person having origins in any of the original peoples of Hawaii, Guam, Samoa, or other Pacific Islands.)

Indicator 8: Number of students taking STEM-related Advanced Placement (AP) tests and average scores

Data source College Board

Key findings

- From 2012 to 2016, the number of students taking Advanced Placement courses in STEM-related subjects increased from 4,968 to 6,537, as well as the number of students who qualified to receive college credit from these courses (from 3,197 in 2012 to 4,191 in 2016).

	2012	2013	2014	2015	2016
Number receiving STEM-related college credit	3,197	3,461	3,753	3,976	4,191
Number taking AP STEM-related courses	4,968	5,355	5,600	6,067	6,537

- Comparing 2012 (the year immediately preceding statewide STEM Scale-Up programming) to 2016, the proportion of students scoring 3 or better on the AP exam increased in Biology, Computer Science A, and Statistics. However, the proportion decreased in Calculus AB/BC, Chemistry, and Environmental Science (Table 14).

Table 14. Percentage of Iowa high school students scoring 3 or higher on Advanced Placement exams in STEM-related topics[1]

	2012 % (n)	2013 % (n)	2014 % (n)	2015 % (n)	2016 % (n)	Trend since 2012
Biology	55% (588)	70% (735)	75% (877)	76% (866)	71% (745)	↑
Calculus AB	65% (889)	59% (821)	61% (872)	61% (863)	61% (887)	↓
Calculus BC	82% (245)	77% (290)	85% (311)	77% (298)	77% (396)	↓
Chemistry	56% (481)	58% (462)	55% (461)	55% (487)	53% (533)	↓
Computer Science A	77% (53)	80% (94)	83% (99)	87% (147)	77% (163)	↔
Environmental Science	66% (184)	56% (227)	54% (217)	52% (215)	52% (275)	↓
Physics B	73% (243)	71% (277)	69% (278)			
Physics 1				53% (301)	51% (283)	↓
Physics 2				58% (26)	87% (59)	↑
Physics C: Elec. & Magnet.	93% (25)	61% (27)	82% (31)	72% (32)	76% (22)	↓
Physics C: Mechanics	87% (78)	67% (79)	77% (89)	85% (148)	81% (110)	↓
Statistics	70% (411)	69% (449)	71% (518)	72% (569)	73% (718)	↑

Source: AP Program Participation and Performance Data, 2012-2016, College Board

Retrieved from: http://research.collegeboard.org/programs/ap/data

1. College-level Advanced Placement (AP) courses are available to Iowa high school students through College Board in 22 subject areas. Optional tests are included with the AP courses. Scores can range from 1 to 5, with 3 or better indicating that the student is qualified to receive college credit in that topic. Percentages reflect the proportion of test takers within each subject who scored 3 or higher on that subject exam.

Number in parentheses indicates the numerator in the proportion.

Indicator 9: Iowa concurrent enrollment in science and mathematics

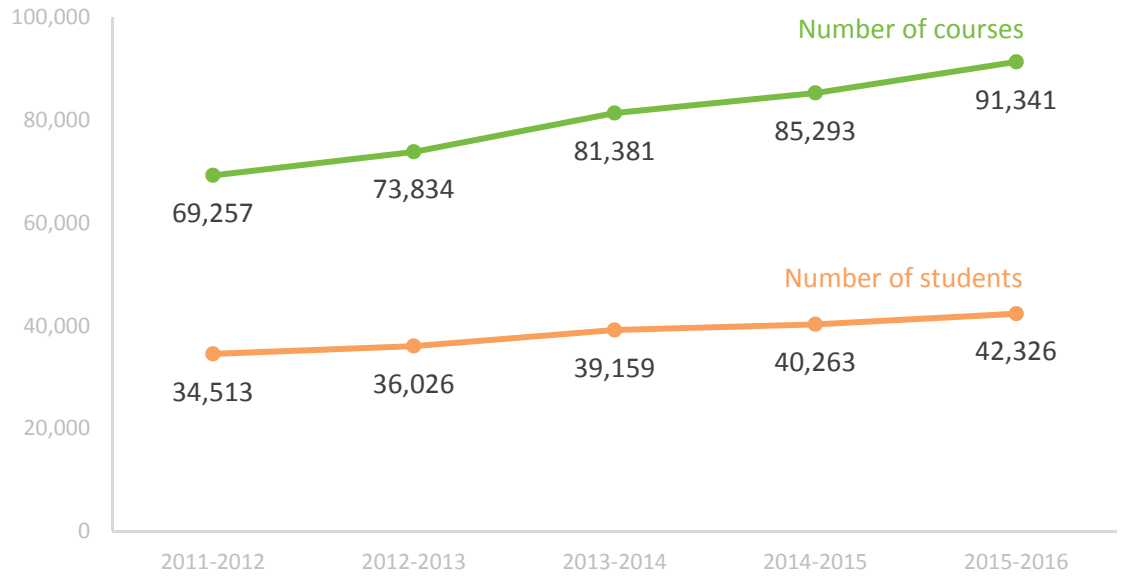
Data sources Annual Condition of Education Report 2016, Iowa Department of Education, July 2017, Joint Enrollment FY2016 Annual Report, Iowa Department of Education, and Metrics That Matter, Future Ready Iowa Alliance

This indicator tracks the concurrent enrollment and number of courses taken. The data are reported annually and compiled by the Iowa Department of Education for reporting of the Annual Condition of Education. Additional sources provide information about joint enrollment.

Concurrent enrollment courses are offered by community colleges through 28E agreements between school districts and community colleges. The two courses are designed slightly different. One , the courses are designed for both college and high school students for concurrent credit offered by community colleges. Two, the courses are designed for high school students offered by community colleges to bridge high school students to community college programs and typically provide coursework in science, technology, engineering, and mathematics (STEM) or other highly technical areas. The second kind of courses through 28E agreements between high school and community college are designed for career academy concurrent credit.

Key findings

- In FY2016, a total of 47,907 unduplicated high school students jointly enrolled in community college courses, and increase of 9% from FY2015.
- Thirty-one percent of all Iowa public high school students (grades nine through 12) jointly enrolled in community college courses in FY2016, averaging eight credit hours per student.
- Eighty-eight percent of joint enrollment is through concurrent enrollment, 8% through the Post-Secondary Enrollment Option (PSEO), and 4% through paid tuition.
- Figure 6 shows the past five-years of concurrent enrollment courses taken by Iowa public high school students and concurrent enrollment from 2011-2012 to 2015-2016. Concurrent enrollment has increased by 23%, and the number of courses taken has increased by 32% over that time.
- Each year, 80 to 99 percent of Iowa districts (only those districts that had a public high school) had concurrent enrollments. In general, an upward trend of districts with concurrent enrollment is reported in Table 15.
- Concurrent enrollments by grade are displayed in Table 16. In the last five years, about half of the concurrent enrollments were high school seniors. However, the proportion of students in lower grades that have taken concurrent enrollment courses has increased the past five years.
- Table 17 and Figure 7 show the concurrent enrollment courses taken in STEM-related subject areas. The highest percentages of courses taken were in career technical / vocational education.
- The number of concurrent enrollment mathematics courses taken by high school students has increased each year, with over 8,500 courses taken in 2015-2016. The number of concurrent enrollment science courses taken has increased each year, with over 3,600 courses taken in 2015-2016.



Source: Iowa Department of Education, Bureau of Information and Analysis, Student Reporting in Iowa, winter files.

Figure 6. Iowa concurrent enrollment and courses taken 2011-2012 to 2015-2016

Table 15. Iowa Districts with Concurrent Enrollment 2011-2012 to 2015-2016

Year	Total # of districts	Districts with high schools	Districts with concurrent enrollment	Percent of districts with high schools that had concurrent enrollment
2011-2012	351	320	311	97%
2012-2013	348	316	309	98%
2013-2014	346	314	310	99%
2014-2015	338	312	302	97%
2015-2016	336	310	304	98%

Source: Iowa Department of Education, Bureau of Information and Analysis, Student Reporting in Iowa, winter files.

Retrieved from *The Annual Condition of Education*, Iowa Department of Education, 2016.
https://www.educateiowa.gov/sites/files/ed/documents/COE2016-rev%2007112017.pdf

Table 16. Total number of Iowa school students taking concurrent enrollment courses 2011/12 to 2015/16

Year	9th Graders	10th Graders	11th Graders	12th Graders	Total Enrollment
2011-2012	2,199	3,941	11,596	16,777	34,513
2012-2013	2,403	4,365	11,962	17,296	36,026
2013-2014	2,748	5,056	12,858	18,497	39,159
2014-2015	3,013	5,421	13,204	18,625	40,263
2015-2016	3,414	6,039	13,668	19,205	42,326

Source: Iowa Department of Education, Bureau of Information and Analysis, Student Reporting in Iowa, winter files.

Retrieved from *The Annual Condition of Education*, Iowa Department of Education, 2016.
https://www.educateiowa.gov/sites/files/ed/documents/COE2016-rev%2007112017.pdf

Table 17. Iowa concurrent enrollment courses taken by STEM-related subject area 2013/14 to 2015/16

Subject Area	2013-2014		2014-2015		2015-2016	
Mathematics	8,200	(10%)	8,311	(10%)	8,570	(9%)
Science	3,163	(4%)	3,031	(4%)	3,624	(4%)
Career technical / Vocational education	28,904	(36%)	29,801	(35%)	31,553	(35%)
Other	8,926	(11%)	8,936	(10%)	9,637	(11%)
Total courses taken	81,381		85,293		91,341	

Source: Iowa Department of Education, Bureau of Information and Analysis, Student Reporting in Iowa, winter files.

Retrieved from *The Annual Condition of Education*, Iowa Department of Education, 2016.
https://www.educateiowa.gov/sites/files/ed/documents/COE2016-rev%2007112017.pdf

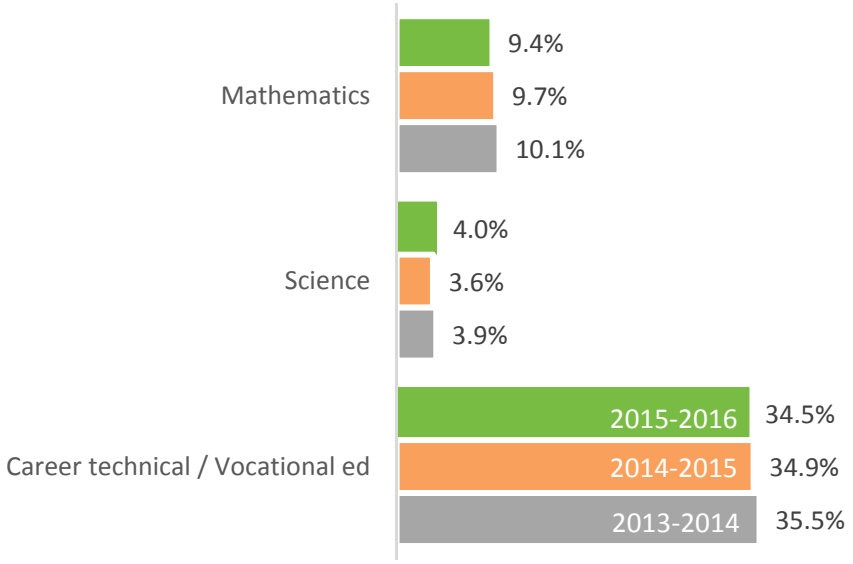


Figure 7. Percent of Iowa concurrent enrollment courses taken by STEM-related subject area, 2013/14 to 2015/16

Indicator 10: Number of current Iowa teachers with K-8 STEM endorsements, 5-8 STEM endorsements, and K-12 STEM specialist endorsements

Data source Basic Educational Data Survey (BEDS), Bureau of Information and Analysis Services, Iowa Department of Education

A collaborative effort of the Governor's STEM Advisory Council and the Board of Educational Examiners (BOEE) led to the development of a STEM endorsement available to teachers and teacher candidates. Three endorsements—K-8 STEM, 5-8 STEM, and K-12 STEM Specialist—authorize educators to teach science, mathematics, and integrated STEM courses in grades Kindergarten through eighth grade, fifth through eighth grade, or Kindergarten through twelfth grade. See Appendix B for a description of the authorization, program requirements, and content for each. Endorsement in 5-12 Engineering is also reported.

Key findings

The number of teachers in Iowa with a STEM endorsement is minimal (Table 18).

- A total of 34 endorsements have been granted: 26 for 5-12 Engineering, four for K-8 STEM, two for 5-8 STEM, and two for K-12 STEM Specialist. Given the specific requirements for these endorsements, that these are relatively new endorsement options, and the time necessary to complete the requirements, these numbers should continue to increase as more individuals complete the requirements necessary for endorsement in these STEM areas.
- Five Iowa colleges and universities currently offer the STEM endorsement—Buena Vista University, Drake University, Grandview University, Morningside College, and Saint Ambrose University (Table 19).
- All five offer endorsement in K-8 STEM and 5-8 STEM. Drake University also offers the K-12 STEM Specialist Endorsement.
- The University of Iowa offers a Master of Science in STEM Education and the University of Northern Iowa offers a Minor in STEM Education.

Table 18. Number of Iowa teachers with STEM endorsements, 2017

STEM Area Endorsement	Females	Males	2014	2015	2016	2017	Total
5-12 Engineering	10	16	1	5	8	15	26*
K-8 STEM	3	1	1	1	0	2	4
5-8 STEM	1	1	0	0	1	1	2
K-12 STEM Specialist	2	0	1	1	0	0	2

*Annual subtotals sum to 29 because conditional and standard licenses are counted separately. For example, if an educator received a conditional license in early 2016, and then added it to his/her standard license later in 2016, the annual count would show both for that person

Source: Iowa Department of Education, Bureau of Information and Analysis Services, Basic Educational Data Survey (BEDS), 2017

Table 19. Iowa colleges and universities with STEM endorsement programs in 2017

College/University	K-8 STEM Endorsement	5-8 STEM Endorsement	K-12 STEM Specialist Endorsement	Offers STEM Degree	Offers STEM Education Minor
Buena Vista University	X	X			
Drake University	X	X	X		
Grandview University	X	X			
Morningside College	X	X			
Saint Ambrose University	X	X			
University of Iowa				M.S. in STEM Education	
University of Northern Iowa					Minor in STEM Education

Source: Iowa Department of Education, Bureau of Information and Analysis Services, Basic Educational Data Survey (BEDS), 2017, and personal communication with BOEE staff

Note: Buena Vista University started offering STEM Endorsements1 in Fall of 2017 after receiving a $500,000 endowment to enhance their STEM program in January 2017,2 (personal communication with BVU staff). 1 http://www.bvu.edu/academics/programs/endorsements

2 http://www.bvu.edu/bv/family-association/detail.dot?id=031e9264-0e35-443e-8bbc-cd573bcae85c

Note: Loras College previously offered selected courses that met requirements for a STEM endorsement. Additionally Loras College has discontinued the M.A. Integrated STEM Education program and is not taking new students at this time. Future re-evaluation may lead to the program being reinstated (personal communication with Loras College staff).

Indicator 11: Community college awards in STEM fields

Data source Iowa Department of Education, Division of Community Colleges

Awards include diplomas, certificates, Associate's degrees, and "other" awards as identified and classified by the Iowa Department of Education Division of Community Colleges. The Iowa Department of Education classifies career and technical education programs into occupational "career clusters," following the National Career Clusters Framework. Four of these (architecture and construction, health sciences, information technology, and STEM) were tracked for the purposes of indicator 14.

Note there are differences in operational definitions of STEM awards/degrees depending on the data source. In addition, defining "STEM degrees" is a moving target, and may be more broad or narrow depending on the data source. Indicator 15 also includes information on STEM degrees from Iowa's community colleges using Classification of Instructional Programs (CIP) codes compared to awards as reported by career cluster here. STEM awards by career cluster will be more broad in definition. STEM degrees defined by CIP codes will be more specific.

Key findings

- In 2016, 4,236 students enrolled in Iowa's community colleges in degree fields categorized by career clusters in architecture and construction, information technology, and STEM. An additional 12,127 students were enrolled in health sciences (Table 20).
- When assessed by career cluster, enrollment in STEM fields has decreased 38% at Iowa's community colleges.
- Over 6,250 awards in STEM-related fields as categorized by career cluster were awarded by Iowa's community colleges in 2016 (Table 21). This is decrease of less than one percent from 2015 (a difference of 87 awards between 2015 and 2016), and a 4% increase since 2011.
- Overall, there were small fluctuations in the percent change of awards from Iowa's community colleges from 2011 to 2016, with awards among males increasing by 7%, and a small increase in awards among females (<1%). Notably in 2016, awards to minority graduates increased by 23% from the year prior, and 144% compared to 2011 (Figure 8).

Table 20. Community college enrollment by career cluster[1]

	2011	2012	2013	2014	2015	2016	% Change 2011 to 2016
Architecture and Construction	2,599	2,422	2,082	2,018	1,795	1,490	-43%
Information Technology	2,853	2,726	2,607	2,444	2,378	2,457	-14%
Science, Technology, Engineering, and Mathematics	882	495	245	221	261	289	-67%
Health Science	20,260	18,833	17,600	15,943	14,969	12,127	-40%
TOTAL	26,594	24,476	22,534	20,626	19,403	16,363	-38%

Source: Iowa Department of Education, Division of Community Colleges. (2016). *The annual condition of Iowa's community colleges: 2016*.

Retrieved from https://www.educateiowa.gov/document-type/condition-community-colleges

1. Definitions of Career Clusters can be obtained from http://www.careerclusters.org/

Table 21. Community college awards by career cluster[1,2]

	2011	2012	2013	2014	2015	2016	% Change 2011 to 2016
Architecture and Construction							
Total	792	679	566	625	852	764	-4%
Male[3]	752	652	521	537	771	708	-6%
Female	40	27	32	52	71	42	5%
White	534	479	326	528	693	580	9%
Minority	48	42	79	71	110	156	225%
Information Technology							
Total	405	551	490	409	513	573	41%
Male	316	418	374	308	419	442	40%
Female	89	133	113	101	89	129	45%
White	316	367	330	331	430	470	49%
Minority	26	34	61	51	56	72	177%
Science, Technology, Engineering, and Mathematics							
Total	107	88	78	56	104	116	8%
Male	67	43	45	36	58	96	43%
Female	40	45	22	20	42	17	-58%
White	74	49	53	39	69	88	19%
Minority	9	21	8	9	19	22	144%
Health Science							
Total	4,696	4,920	4,173	4,477	4,883	4,812	2%
Male	574	545	561	547	611	576	<1%
Female	4,122	4,375	3,584	3,930	4,250	4,118	<-1%
White	3,806	3,932	3,336	3,798	4,051	3,778	-1%
Minority	324	379	706	484	621	742	129%
TOTAL[4]	6,000	6,238	5,307	5,567	6,352	6,265	4%
Male	1,709	1,658	1,501	1,428	1,859	1,822	7%
Female	4,291	4,580	3,751	4,103	4,452	4,306	<1%
White	4,730	4,827	4,045	4,696	5,243	4,916	4%
Minority	407	476	854	615	806	992	144%

Source: Iowa Department of Education, Division of Community Colleges. (2016). *The annual condition of Iowa's community colleges: 2016*. Retrieved from https://www.educateiowa.gov/document-type/condition-community-colleges

1. Awards include diplomas, certificates, Associate's degrees, and "other" awards as identified and classified by the Iowa Department of Education Division of Community Colleges. The Iowa Department of Education classifies career and technical education programs into occupational "career clusters," following the National Career Clusters Framework.
2. Definitions of Career Clusters can be obtained from http://www.careerclusters.org/
3. Subgroup totals do not include students with unknown/unreported gender or race. Sums of subgroup data not equal to the total are due to missing data.
4. Methods revised in 2014/15 to include architecture and construction as a career cluster, in addition to the three career clusters (health sciences, information technology, and STEM) tracked in the 2012/13 and 2013/14 annual reports.

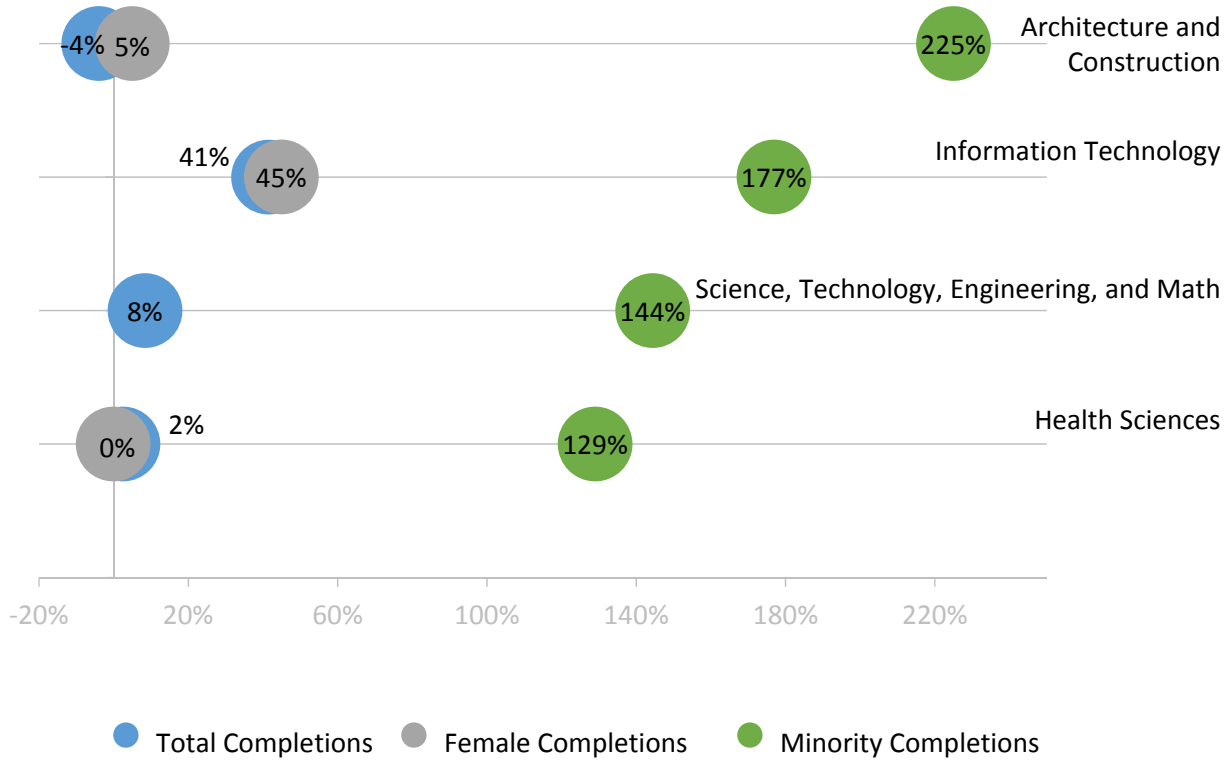


Figure 8. Percentage change in number of awards in STEM-related career clusters at community colleges, 2011 to 2016

Indicator 12: College and university enrollment and degrees in STEM fields

Data source Integrated Postsecondary Education Data System (IPEDS)

This indicator includes information on enrollment, bachelor's degrees, master's degrees, and doctoral degrees conferred by 4-year public universities, private non-profit colleges, and private for-profit colleges. Information on associate's degrees from Iowa's 2-year community colleges is also included here applying the same operational definition of STEM degrees and using the same data set as used to determine STEM degrees from Iowa's 4-year colleges and universities. This allows for better proportional comparisons by college type.

Note that the definition of what constitutes a "STEM degree" has evolved in the past five to ten years nationwide. The methods for the current annual report have been modified slightly from the 2012-2013 and 2013-2014 annual reports, but follow the methods used since 2014-2015. The same database (i.e., IPEDS) is used with a more precise definition of STEM degrees. The tables below utilize a basic analysis of IPEDS database using a composite of primary 2-digit Classification of Instructional Programs (CIP) code categories that reflect STEM, STEM-related, and health science degrees. This is a slight modification of a more specific, 6-digit, CIP code definition of STEM degrees that was developed to correspond with the standard occupational classification (SOC) codes used in tracking STEM workforce developed by the Standard Occupational Classification Policy Committee (SOCPC) for the Office of Management and Budget. Additional documentation on the STEM classification process and recommendations can be found at www.bls.gov/soc

Key findings

- From 2011-2012 to 2014-2015, there has been a 3% increase in STEM awards at Iowa's 2-year community colleges, an 18% increase at 4-year public, a 7% increase at 4-year private (not-for-profit) colleges and universities, respectively (Table 23).
- During the same time period, health science degrees have increased 4% at Iowa's 2-year and 4-year, public and private non-profit colleges and universities (Table 24).
- From 2011-2012 and 2014-2015, there has been an 18% increase in STEM degrees awarded to females at Iowa's 2-year community colleges (from 194 degrees in 2011-2012 to 229 degrees in 2014-2015), while the number of degrees awarded to males remained relatively stable (about 1,000 per year).
- Since 2011-2012, approximately 30% of the STEM and STEM-related degrees awarded by Iowa's 4-year public universities were conferred to females, compared to about 18% to females at Iowa's 2-year community colleges, and 40% at Iowa's 4-year, private not-for-profit colleges and universities.

- The number of STEM and STEM-related degrees awarded to students who are African American increased 59% at 2-year, 16% at 4-year public, and 94% at private, 4-year not-for profit colleges and universities in Iowa since 2011-2012. Despite the increase in the number of degrees, the proportions of degrees conferred upon African American students has remained stable at around 2-4% of all degrees per year.
- The number of STEM and STEM-related degrees awarded to students who are Hispanic increased 8% at 2-year, 64% at 4-year public, and 68% at private, 4-year not-for profit colleges and universities in Iowa since 2011-2012. Despite the increase in the number of degrees, the proportion of degrees awarded to Hispanic students has remained stable at around 2% of all degrees per year.

Table 22. Four-year institutions' fall enrollment, 2010 to 2014

STEM & STEM-Related (excludes Health Sciences)	2010	2012	2014	% change 2010 to 2014
4-year public universities				
Undergraduate	11,183	13,294	14,524	30%
Graduate/Professional	3,375	3,145	3,357	-1%
Subtotal	14,558	16,439	17,881	23%
Private, 4-year, not-for-profit				
Undergraduate	4,357	4,308	4,555	5%
Graduate/Professional	11	13	20	NR
Subtotal	4,368	4,321	4,575	5%
Total, non-profit	18,926	20,760	22,456	19%
Private, 4-year, for-profit[1]				
Undergraduate	205	139	73	-64%
Graduate/Professional	0	0	0	
Total, for-profit	205	139	73	-64%
Grand total	19,193	20,899	22,529	18%

Health Science Degrees	2010	2012	2014	% change 2010 to 2014
4-year public universities	960	962	990	3%
Private, 4-year, not-for-profit	0	0	0	
Private, 4-year, for-profit	0	0	0	

Source: National Center for Education Statistics, IPEDS Data Center, 2016

STEM & STEM related degrees include (2-digit CIP): Engineering (14), Biological Sciences/Life Sciences (26), Mathematics (27), Physical Sciences (40).

Health Science degrees include (6-digit CIP): Dentistry (51.0401), Medicine (51.1201).

NR – Not reported due to small counts.

1. On an annual basis, data is downloaded from IPEDS for the most recent year available and for all preceding years reported in the table. Of note, the counts for 2010 and 2012 decreased for undergraduate degrees from private, for-profit colleges and universities from what was reported in the 2014/15 report. This is a default database setting in IPEDS that uses the directory file for the most recent year for all years in the data query (Barbett, personal communication, January 2016). If a college or university closed or there was some characteristic that changed (e.g., a satellite campus in Iowa changed their address of record to their headquarter address in another state), it will not be listed in the directory for Iowa that generates the current year's data or in any preceding year's data that is downloaded using that directory file. This ensures that the directory of colleges and universities is consistent across all years in the table.

Table 23. Number of STEM and STEM-related degrees awarded by Iowa's 2-year and 4-year colleges and universities

STEM & STEM-Related (excludes Health Sciences)	2011/12	2013/14	2014/15	% change 2011/12 to 2014/15	% change 2013/14 to 2014/15
2-year community colleges					
Associate's degree	1,218	1,256	1,250	3%	0%
Subtotal	1,218	1,256	1,250	3%	0%
4-year public universities					
Bachelor's	2,987	3,564	3,809	28%	7%
Graduate/Professional	1,134	1,095	1,066	-6%	-3%
Subtotal	4,121	4,659	4,875	18%	5%
Private, 4-year, not-for-profit					
Associate's Degree	9	9	5	NR	NR
Bachelor's	1,366	1,333	1,438	5%	8%
Graduate/Professional	155	183	190	23%	4%
Subtotal	1,530	1,525	1,633	7%	7%
Total, non-profit	6,869	7,440	7,758	13%	4%
Private, 4-year, for-profit[1]					
Associate's Degree	620	404	304	-51%	-25%
Bachelor's	664	465	333	-50%	-28%
Graduate/Professional	190	214	227	19%	6%
Total, for-profit	1,474	1,083	864	-41%	-20%
Grand total	8,343	8,523	8,622	3%	1%

Source: National Center for Education Statistics, IPEDS Data Center

STEM & STEM related degrees include (2-digit CIP): Agriculture (01), Natural Resources (03), Architecture (04), Computer and Information Sciences (11), Engineering (14), Engineering Technologies (15), Biological Sciences (26), Mathematics and Statistics (27), and Physical Sciences (40).

NR – Not reported due to small counts.

1. On an annual basis, data is downloaded from IPEDS for the most recent year available and for all preceding years reported in the table. Of note, the counts for 2010 and 2012 decreased for undergraduate degrees from private, for-profit colleges and universities from what was reported in the 2014/15 report. This is a default database setting in IPEDS that uses the directory file for the most recent year for all years in the data query (Barbett, personal communication, January 2016). If a college or university closed or there was some characteristic that changed (e.g., a satellite campus in Iowa changed their address of record to their headquarter address in another state), it will not be listed in the directory for Iowa that generates the current year's data or in any preceding year's data that is downloaded using that directory file. This ensures that the directory of colleges and universities is consistent across all years in the table.

Table 24. Number of health science degrees awarded by Iowa's 2-year and 4-year colleges and universities

Health Science Degrees	2011/12	2013/14	2014/15	% change 2011/12 - 2014/15	% change 2013/14 – 2014/15
2-year community colleges					
Associate's degree	2,126	2,107	2,124	<-1%	1%
Subtotal	2,126	2,107	2,124	<-1%	1%
4-year public universities					
Bachelor's	432	546	472	9%	-17%
Graduate/Professional	934	914	883	-5%	-3%
Subtotal	1,366	1,460	1,355	-1%	-7%
Private, 4-year, not-for-profit[1]					
Associate's degree	291	292	291	0%	0%
Bachelor's	991	1,172	1,274	29%	9%
Graduate/Professional	1,607	1,548	1,613	0%	4%
Subtotal	2,889	3,012	3,178	10%	6%
Total, non-profit	6,381	6,579	6,657	4%	1%
Private, 4-year, for-profit[1]					
Associate's degree	1,267	1,378	1,492	18%	8%
Bachelor's	1,296	1,439	1,656	28%	15%
Graduate/Professional	333	503	729	119%	45%
Total, for-profit	2,896	3,320	3,877	34%	17%
Grant total	9,277	9,899	10,534	14%	6%

Source: National Center for Education Statistics, IPEDS Data Center

Degrees include (2-digit CIP): Health Science (51).

1. On an annual basis, data is downloaded from IPEDS for the most recent year available and for all preceding years reported in the table. Of note, the counts for 2010 and 2012 decreased for degrees from private, for-profit colleges and universities from what was reported in the 2014-2015 report. This is a default database setting in IPEDS that uses the directory file for the most recent year for all years in the data query (Barbett, personal communication, January 2016). If a college or university closed or there was some characteristic that changed (e.g., a satellite campus in Iowa changed their address of record to their headquarter address in another state), it will not be listed in the directory for Iowa that generates the current year's data or in any preceding year's data that is downloaded using that directory file. This ensures that the directory of colleges and universities is consistent across all years in the table.

Table 25. Gender distribution of STEM and STEM-related degrees awarded by Iowa's 2-year and 4-year colleges and universities

STEM & STEM-Related (excludes Health Sciences)	2011-2012 Associate's	Bachelor's	Graduate/ Professional	Subtotal	2014-2015 Associate's	Bachelor's	Graduate/ Professional	Subtotal	Percent change, 2011/12 to 2014/15
2-year community colleges	1,218			1,218	1,250			1,250	3%
Male	1,024			84%	1021			82%	0%
Female	194			16%	229			18%	18%
4-year public universities		2,987	1,134	4,121		3,809	1,066	4,875	18%
Male		2,037	768	68%		2,680	690	69%	20%
Female		950	366	32%		1,129	376	31%	14%
Private, 4-year, not-for-profit	9	1,366	155	1,530	5	1,438	190	1,633	7%
Male	6	737	121	56%	4	794	160	59%	11%
Female	3	629	34	44%	1	644	30	41%	1%
Private, 4-year, for-profit	620	664	190	1,474	304	333	227	864	-41%
Male	482	482	119	73%	217	230	139	68%	-46%
Female	138	182	71	27%	87	103	88	32%	-29%

Source: National Center for Education Statistics, IPEDS Data Center

STEM & STEM related degrees include (2-digit CIP): Agriculture (01), Natural Resources (03), Architecture (04), Computer and Information Sciences (11), Engineering (14), Engineering Technologies (15), Biological Sciences (26), Mathematics and Statistics (27), and Physical Sciences (40).

Table 26. Gender distribution of health science degrees awarded by Iowa's 2-year and 4-year colleges and universities

	2011-2012				2014-2015				Percent change, 2011/12 to 2014/15
Health science degrees	Associate's	Bachelor's	Graduate/ Professional	Subtotal	Associate's	Bachelor's	Graduate/ Professional	Subtotal	
2-year community colleges	2,126			2,126	2,124			2,124	0%
Male	227			11%	235			11%	4%
Female	1,899			89%	1,889			89%	-1%
4-year public universities		432	934	1,366		472	883	1,355	-1%
Male		46	298	25%		58	325	28%	11%
Female		386	636	75%		414	558	72%	-5%
Private, 4-year, not-for-profit	291	991	1,607	2,889	291	1,274	1,613	3,178	10%
Male	24	102	708	29%	32	144	669	27%	1%
Female	267	889	899	71%	259	1,130	944	73%	14%
Private, 4-year, for-profit	1,267	1,296	333	2,896	1,492	1,656	729	3,877	34%
Male	52	146	46	8%	482	212	85	20%	219%
Female	1,215	1,150	287	92%	1010	1,444	644	80%	17%

Source: National Center for Education Statistics, IPEDS Data Center

Degrees include (2-digit CIP): Health Science (51).

Table 27. Racial/ethnic distribution of STEM and STEM-related degrees awarded by Iowa's 2-year and 4-year colleges and universities

STEM & STEM-Related (excludes Health Sciences)	2011-2012 Associate's	Bachelor's	Graduate/ Professional	%	2014-2015 Associate's	Bachelor's	Graduate/ Professional	%	Percent change, 2011/12 to 2014/15
2-year community colleges									
White	1,002			82%	1,076			86%	7%
African American	17			1%	27			2%	59%
Hispanic	26			2%	28			2%	8%
Other	173			14%	119			10%	-31%
4-year public universities									
White		2,427	560	72%		2,952	487	71%	15%
African American		47	23	2%		55	26	2%	16%
Hispanic		77	18	2%		118	38	3%	64%
Other		436	533	24%		684	515	25%	24%
Private, 4-year, not-for-profit									
White	8	1,133	29	76%	4	1,130	28	71%	-1%
African American	1	29	4	2%	0	49	17	4%	94%
Hispanic	0	28	0	2%	0	47	0	3%	68%
Other	0	176	122	19%	1	212	145	22%	20%
Private, 4-year, for-profit									
White	218	116	6		195	197	90	56%	NR
African American	36	22	5		51	45	57	18%	NR
Hispanic	19	15	2		26	26	15	8%	NR
Other	347	511	177		32	65	65	19%	NR

NR – Percent change not reported due to inconsistencies in the 2011-2012 race/ethnicity data reported to IPEDS by private, 4-year, for-profit colleges and universities.

Source: National Center for Education Statistics, IPEDS Data Center

STEM & STEM related degrees include (2-digit CIP): Agriculture (01), Natural Resources (03), Architecture (04), Computer and Information Sciences (11), Engineering (14), Engineering Technologies (15), Biological Sciences (26), Mathematics and Statistics (27), and Physical Sciences (40).

Table 28. Racial/ethnic distribution of health science degrees awarded by Iowa's 2-year and 4-year colleges and universities

	2011-2012				2014-2015				Percent change, 2011/12 to 2014/15
Health Sciences	Associate's	Bachelor's	Graduate/ Professional	%	Associate's	Bachelor's	Graduate/ Professional	%	
2-year community colleges									
White	1,857			87%	1,810			85%	-3%
African American	45			2%	101			5%	124%
Hispanic	37			2%	58			3%	57%
Other	187			9%	155			7%	-17%
4-year public universities									
White		391	716	81%		403	658	78%	-4%
African American		6	26	2%		2	20	2%	-31%
Hispanic		7	18	2%		14	35	4%	96%
Other		28	174	15%		53	170	16%	10%
Private, 4-year, not-for-profit									
White	266	865	1,332	85%	265	1,125	1,328	86%	10%
African American	3	21	31	2%	8	43	49	3%	82%
Hispanic	3	16	52	2%	11	24	51	3%	21%
Other	19	89	192	10%	7	82	185	9%	-9%
Private, 4-year, for-profit									
White	310	131	23		875	1,008	299	56%	NR
African American	50	50	21		259	249	176	18%	NR
Hispanic	19	14	5		177	115	45	9%	NR
Other	888	1,101	284		181	284	209	17%	NR

NR – Percent change not reported due to inconsistencies in the 2011-2012 race/ethnicity data reported to IPEDS by private, 4-year, for-profit colleges and universities.

Source: National Center for Education Statistics, IPEDS Data Center

Degrees include (2-digit CIP): Health Science (51).

Indicator 13: Percentage of Iowans in workforce employed in STEM occupations

Data source Iowa Workforce Development

Key findings

For this indicator, data presented in the 2014-2015 Annual Report remain the most up to-date. Estimated and projected employment in STEM occupations for the 2014-2024 time period is expected later in 2016.

- Approximately 17% of Iowa's occupations are in STEM fields (Table 29).
- From 2014 to 2024, Iowa's STEM occupations are expected to grow 1.2% annually, compared to a 0.9% annual growth rate across all occupations (Table 30).
- On average in 2016, individuals in STEM occupations earned $27.58 in mean wages and $57,357 in mean salaries, compared to all occupations overall earning $20.12 in mean wages and $41,843 in mean salaries, respectively (Table 30).
- Among respondents to Iowa's 2016 Laborshed Study, 52% of respondents employed in a STEM field were female, and 48% were male. The larger proportion of females among respondents employed in STEM occupations is largely driven by including healthcare occupations as a STEM field. A larger proportion of females than males are employed in the STEM-related fields of life/physical/social science and healthcare occupations (Table 31).

Table 29. Percentage of Iowans in workforce employed in STEM occupations

Time period	Total STEM employment	Total employment (all occupations)	% STEM of all occupations
2008-2018	358,960	1,762,260	20%
2010-2020	267,765	1,717,020	16%
2012-2022	257,230	1,758,205	15%
2014-2024	298,510	1,795,100	17%

Table 30. Iowa estimated employment in STEM fields: Projections, growth, and salaries, 2014/24[1]

	2014 Estimated employment	2024 Projected employment	Annual growth rate	2016 Mean Wage ($)	2016 Mean Salary ($)
Management	27,160	28,795	.6%	$46.80	$97,337
Business & Financial Operations	40,620	45,140	1.1%	$31.69	$65,920
Computer & Mathematical	33,380	39,425	1.8%	$35.37	$73,557
Architecture & Engineering	14,030	15,185	0.8%	$32.29	$67,173
Life, Physical, & Social Science	9,715	10,685	1.0%	$25.59	$53,218
Healthcare Practitioners & Technical	80,135	92,395	1.5%	$36.96	$76,882
Healthcare Support	12,135	14,125	1.6%	$17.71	$36,841
Installation, Maintenance, & Repair	26,030	28,515	1.0%	$22.71	$47,228
Production	13,680	14,715	0.8%	$18.16	$37,763
Other[2]	41,625	46,515	0.8%	$24.39	$50,736
Total STEM Occupations	298,510	335,495	1.2%	$27.58	$57,357
Total All Occupations	1,795,100	1,949,240	0.9%	$20.12	$41,843

Source: Communications and Labor Market Information Division, Iowa Workforce Development

1. The acronym STEM, as used in this table, is a combined occupational group made-up of occupations from existing and/or established occupational groups adopted from the Office of Management and Budget's (OMB) Standard Occupational Classification (SOC) Manual. These occupations have a preponderance of tools and skills from Science, Technology, Engineering, and/or Mathematics. STEM occupations were defined using criteria by Iowa Workforce Development (IWD) and/or recommended by the SOC Policy Committee for OMB.
2. Other includes first-line supervisors of food preparation/servers, institutional/cafeteria cooks, graphic designers, postsecondary business/biological science/nursing teachers, animal breeders, first-line supervisors of farming/fishing/forestry workers, electricians, plumbers/pipefitters/steamfitters, and fire fighters.

Table 31. Distribution of males and females in STEM occupations, 2016

STEM Occupational Category[1]	% Male	% Female
Management	46%	54%
Business & financial	37%	63%
Computer & mathematical	67%	33%
Architecture & engineering	89%	11%
Life, physical, and social science	52%	48%
Healthcare practitioners and technical	18%	82%
Healthcare support	0%	100%
Installation, maintenance, & repair	98%	2%
Production	86%	14%
Other STEM[2]	67%	33%
TOTAL[3]	48%	52%

Source: Iowa Workforce Development Statewide Laborshed Survey (2016 Statewide Sample; n=3,906), Communications and Labor Market Information Division, Iowa Workforce Development

1. STEM occupations as used in this table are a combined occupational group using the Standard Occupational Classification Policy Committee (SOCPC) definition and additional criteria defined by Iowa Workforce Development. The Census STEM and STEM-related occupation code list is based on the recommendations of the SOC Policy Committee for the Office of Management and Budget (OMB). Additional documentation on the STEM classification process and recommendations can be found at www.bls.gov/soc.
2. Other includes, first-line supervisors of food preparation/servers,cooks, institution and cafeteria, first-line supervisors of construction trades and extraction workers,electricians, plumbers, pipefitters, and steamfitters and graphic designers.
3. The larger proportion of females in total in STEM occupations is largely driven by including healthcare occupations as a STEM field.

Indicator 14: Job vacancy rates in STEM occupational areas

Data source Iowa Workforce Assessment Survey, Iowa Workforce Development

The Workforce Needs Assessment Survey is conducted each year with employers in the state by Iowa Workforce Development to assess the demand and skills required for jobs in several sectors of the workforce.

Key findings

- In 2015-2016, there were an estimated 12,444 vacancies in STEM jobs statewide. (Table 32).

Table 32. Estimated job vacancy rates in STEM occupational areas[1]

	2011/12		2012/13		2014/15		2015/16	
Occupational Categories[2]	Vacancy Rate	Est. Vacancy	Vacancy Rate	Est. Vacancy	Vacancy Rate	Est. Vacancy	Vacancy Rate	Est. Vacancy
Architecture and Engineering	5%	815	3%	593	6%	1,047	5%	860
Community and Social Science	3%	699	2%	355	3%	720	6%	1,313
Computer and Mathematical science	3%	810	3%	752	6%	1,887	1%	435
Farming, Fishing, and Forestry	11%	588	3%	148	12%	683	16%	881
Healthcare Practitioner and Technical	4%	2,738	2%	1,837	3%	2,847	5%	4,128
Healthcare Support	8%	3,953	4%	1,678	3%	1,205	10%	4,672
Life, Physical, and Social Science	6%	659	1%	116	3%	355	1%	155
Total Estimated Vacancies		10,262		5,479		8,744		12,444

Source: Iowa Workforce Needs Assessment, Iowa Workforce Development, 2017

https://www.iowaworkforcedevelopment.gov/sites/search.iowaworkforcedevelopment.gov/files/documents/state_iowa_wna_2017_0.pdf

Vacancy data derived from the Iowa Workforce Development job bank, and reported in the Workforce Needs Assessment report for each respective year. Data may be limited for making longitudinal comparisons due to the changing number of employer websites that are indexed on the job bank in any given year. Numbers are also subject to changes in employers' job posting strategies. For example, over the course of three years, an employer may change their job-posting strategy and become more aggressive about posting and re-posting jobs, which would result in a big jump in the number of openings over the course of time.

Occupational Categories not included in this table are: Arts, Design, Entertainment, Sports, & Related; Building & Grounds Cleaning & Maintenance; Business & Financial Ops; Construction & Extraction; Education, Training, & Library; Food Preparation & Serving Related; Installation, Maintenance, & Repair; Legal; Management; Office & Administrative Support; Personal Care & Service; Production; Protective Service; Sales & Related; and Transportation & Material Moving.

Section 2: Statewide Survey of Public Attitudes Toward STEM

The 2016 Statewide Survey of Adult Attitudes toward STEM is a project that bridged two larger projects: the Iowa STEM Monitoring Project (UNI-CSBR_FY2015_01) and the Iowa STEM Education Evaluation (National Science Foundation, Award No. DRL-1238211). While the statewide survey is a shared activity between both projects, the purpose of the survey as it relates to each project is different.

The purpose of the ISMP is to systematically observe a series of defined metrics and information sources to examine changes regarding STEM education and economic development in Iowa centered on the activities of the Iowa Governor's STEM Advisory Council. Within the ISMP, the Statewide Survey of Adult Attitudes toward STEM serves to track changes in public perceptions related to STEM education and economic development in Iowa.

The purpose of the I-SEE is to build a collaborative statewide system to describe and evaluate the statewide STEM initiative for improvement and accountability. The long term goal of the project is to create a model demonstrating for stakeholders in Iowa and in other states how to build useful, accurate STEM evaluation systems. Within the I-SEE, the Statewide Survey of Adult Attitudes toward STEM serves as one activity to examine statewide cultural change related to STEM.

The UNI CSBR coordinates both the Iowa STEM Monitoring Project and the Iowa STEM Education Evaluation across the partner research centers and institutions for each project. This report summarizes the key findings from the 2016 Statewide Survey of Adult Attitudes toward STEM primarily as it relates to the Iowa STEM Monitoring Project – that is, as an indicator of STEM awareness and attitudes among the general population of adult Iowans.

Background and Methodology

To measure public awareness of and attitudes toward STEM in Iowa, the UNI Center for Social and Behavioral Research has conducted an annual statewide public survey of adult Iowans since 2012. The survey is funded by the Iowa Governor's STEM Advisory Council and the National Science Foundation (Award No. DRL-1238211). The survey instrument was first developed in 2012, and is reviewed and revised annually in consultation with the Council's Operations Team. Survey topics included:

1. Awareness of STEM
2. Attitudes toward STEM and the role of STEM in Iowa
3. Perceptions and attitudes about STEM education
4. Perceptions about strategies to improve STEM education
5. Parent perceptions of STEM education
6. Demographics

The complete survey instrument used for 2016 data collection can be found in Appendix C.

Population & Sampling Design

The 2016 Survey of Adult Attitudes toward STEM used a dual-frame random digit dial (DF-RDD) sample design that included both landline and cell phones. In addition, a targeted (landline list-assisted) oversample of two groups was included (African-American adults and Hispanic adults). All samples were obtained from Marketing Systems Group (MSG). Within-household selection for landline calls randomly selected an adult member of the household using a modified Kish procedure. Respondents were Iowans who were at least 18 years of age or older at the time of the interview. Interviews were completed from June 6, 2016 through September 20, 2016, and averaged 23 minutes in length. Interviews were conducted in both English and Spanish with computer-assisted telephone interviewing (CATI).

A total of 1,857 interviews were completed. This included 1,244 (67%) interviews from the cellular RDD sample, 203 (11%) interviews from the landline RDD sample, and 201 (11%) and 209 (11%) interviews from the listed landline numbers of likely households of Hispanic and African American adults, respectively. A total of 58 interviews were conducted in Spanish.

Response rates were calculated using the American Association for Public Opinion Research (AAPOR) RR3 calculation. The overall response rate was 21%. The response rate for the RDD landline was 19%, and the cell phone sample was 24%, respectively. The response rate for both the oversample of likely households of parents and African American and Hispanic adults was 17%. The overall cooperation rate (AAPOR CR3) was 58%. The cooperation rate for interviews completed via cell phone (76%) was higher than for landline (44%), and was 38% for the African American & Hispanic oversample groups.

Weighting & Precision of Estimates

This report focuses on findings from the 2016 statewide survey, but also includes some key comparisons to findings from previous survey years.

The data were weighted in order to obtain point estimates that are representative of the adult population of Iowans on key characteristics including gender, age, ethnicity, race, education, place of

residence, and cell-phone only versus other telephone households.[1] The post-stratification weights were computed with SAS (see www.sas.com). These weighted data help adjust for any areas of over- or underrepresentation in the sample and are used to generalize results to the statewide population of adult Iowans, thus we refer to respondents as "Iowans" throughout the report. The interviews from the probability sample (i.e. RDD) and the non-probability sample (i.e. oversample groups) were combined for analysis. Descriptive statistics, including frequencies and distributions were calculated for the total sample and for population subgroups including gender, education, parent status, and place of residence for select questions in the survey. Margin of sampling error taking into account the design effect is ±1.5% for the overall sample and as high as ±8.1% for the analyses using the smallest subgroups (Race subgroup: All other, including oversampling).

IBM SPSS Statistics 22 (see www.ibm.com/software/analytics/spss/) was used for initial data management and descriptive analysis, and SUDAAN v10.0 (see www.rti.org/sudaan) was used to estimate population estimates of responses. Analyses conducted in SUDAAN have been adjusted for the design effect[2] due to differential probabilities of selection, clustering and weighting. SUDAAN was also used for logistic regression to model some of the main findings of this study. Further explanation of this multivariate analysis (RLOGIST command in SUDAAN) can be found at www.rti.org/sudaan.

Unless otherwise noted, percentages reflect the "weighted percent" of survey respondents. Percentages in the tables and figures that follow were rounded to the nearest whole number, therefore percentage totals will range from 99% to 101% throughout the report. Unless otherwise noted, proportions reported in all charts and figures and all survey items described in the report are from cued responses (i.e., closed-ended questions).

[1] See Appendix D

[2] The Design Effect (DEFF) is a measure of estimated ratio between variances between cluster versus simple random sampling design in a weighted data analysis. See more information at www.rti.org/sudaan.

2016 Survey Results

Demographic characteristics of the survey sample can be found in Table 33.

Overall, respondents tended to be older and more educated than the general population of Iowans. Weighting uses standard Census metrics of the Iowa population of men and women applied to the full survey sample yielding an overall correction and adjustment in the final weights which were used to compensate for issues related to gender and possible under- or overrepresentation of certain demographic groups. This correction is observed in the side-by-side comparison of the unweighted and weighted distributions of respondents by demographic characteristics in Table 33.

Table 33. Demographic characteristics of respondents, 2016

	Sample size (n)	Unweighted %	Estimated % after weighting
Total Sample	1,857	--	--
Gender			
Men	896	48%	49%
Women	961	52%	51%
Age Group			
18-34	361	19%	30%
35-54	547	30%	32%
55 and older	949	51%	38%
Ethnicity			
Hispanic, Latino, or Spanish origin	155	8%	6%
Non-Hispanic	1,702	92%	94%
Race			
White	1,671	90%	93%
Black / African American	63	3%	2%
Other	123	7%	4%
Education			
High school graduate/GED or less	548	30%	39%
Some college or technical school	595	32%	32%
4-year undergraduate or graduate degree	714	38%	29%
Employment			
Employed for wages	952	51%	56%
Self-employed	181	10%	10%
Out of work / Unable to work	127	7%	8%
Student	49	3%	4%
Homemaker	72	4%	4%
Retired	475	26%	19%
Annual gross household income			
Less than $50,000	723	44%	46%
$50,000 to less than $100,000	560	34%	35%
$100,000 or More	351	22%	19%
Missing	223		
Place of residence			
Rural / Small town (<5,000 pop.)	863	48%	42%
Large town (5,000-<50,000 pop.)	507	28%	34%
Urban (>50,000 pop.)	442	24%	24%
Parent status			
Not a parent of a school aged child	1,298	70%	65%
Parent of 3-11 year old	252	14%	17%
Parent of 12-19 year old	307	17%	19%

Sums less than 1,857 due to respondents who answered 'Don't know' or 'Refused'; proportions greater than or less than 100% due to rounding.

STEM awareness

Awareness of STEM was asked in a variety of ways beginning with general questions about K-12 education and then shifting to more specific questions about the acronym STEM and improving science, technology, engineering, and mathematics education. Both cued (i.e., closed-ended) and uncued (i.e., open-ended) question formats were used. To gauge general awareness surrounding K-12 education, Iowans were asked how much they had heard about K-12 education in Iowa along with other broad topics in the state (Figure 9). Other topics included agriculture, healthcare, and water quality in Iowa. Respondents were asked to respond using a 3-point scale of *A lot*, *A little*, or *Nothing*. In 2016, approximately 45% of Iowans had heard *A little* and 27% had heard *A lot* about K-12 education in the past month. Relative to the other topics asked, K-12 education ranked third following agriculture and healthcare among Iowans who have heard something about these broad issues in the past month when the survey was fielded in July-September 2016.

AWARENESS OF K-12 EDUCATION IN IOWA IN THE PAST MONTH

About three-quarters of Iowans had heard something about K-12 education, in general, in the month preceding the survey (42% said A little, 34% said A lot).

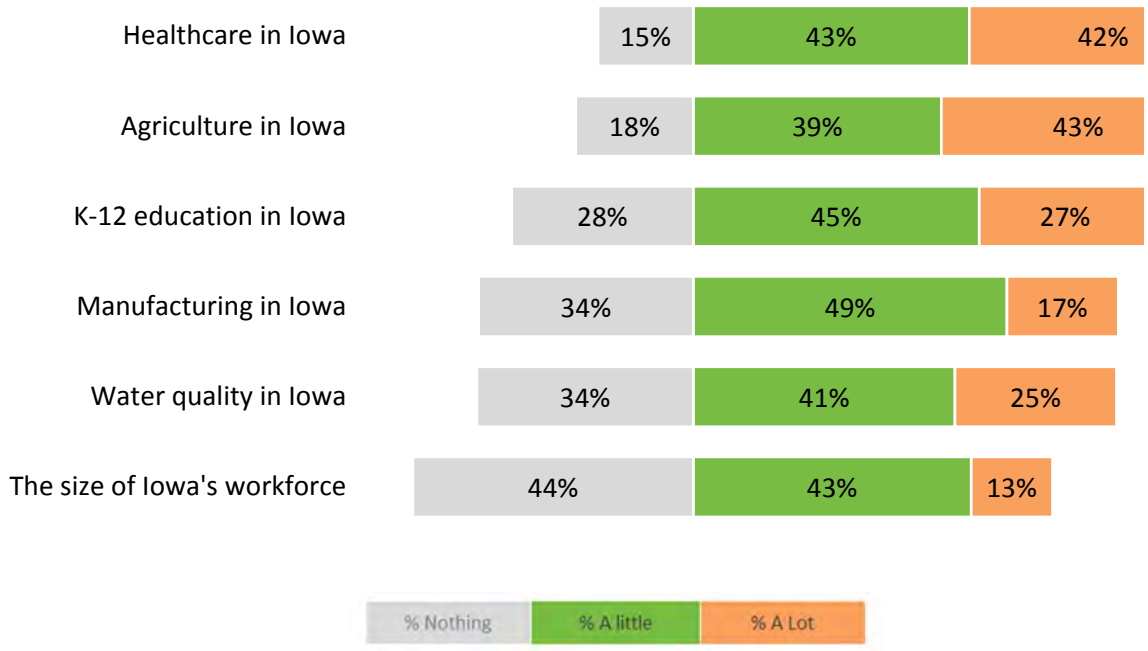


Figure 9. Please tell me how much you have heard about K-12 education in Iowa, if anything, in the past month.

Awareness of education topics was also assessed in a more specific, cued question about how much they had heard about "Improving math, technology, science, and engineering education"' in the past month. In 2016, 39% of Iowans said they had heard *A little* and 14% said they had heard *A lot* when education topics specific to STEM were described this way.

Prior to either using or defining the STEM acronym or asking structured questions about STEM education in the interview, respondents were asked an uncued, open-ended question to explore basic awareness and understanding of STEM when used as a stand-alone acronym. Responses were coded by the interviewer at the time of the interview into broad categories of common responses determined from prior years of the STEM survey.

About one in five of the uncued responses (21%) were an exact or close definition of STEM, and another 11% of responses described STEM as having something to do with education in general (Figure 10). Stem cells or stem cell research was referenced in 15% of responses. More than half (51%) of responses were *I don't know* or *Nothing* comes to mind regarding the acronym STEM.

UNCUED RECALL AND UNDERSTANDING OF STEM, 2016

Approximately one in five respondents described an exact or close definition of STEM.

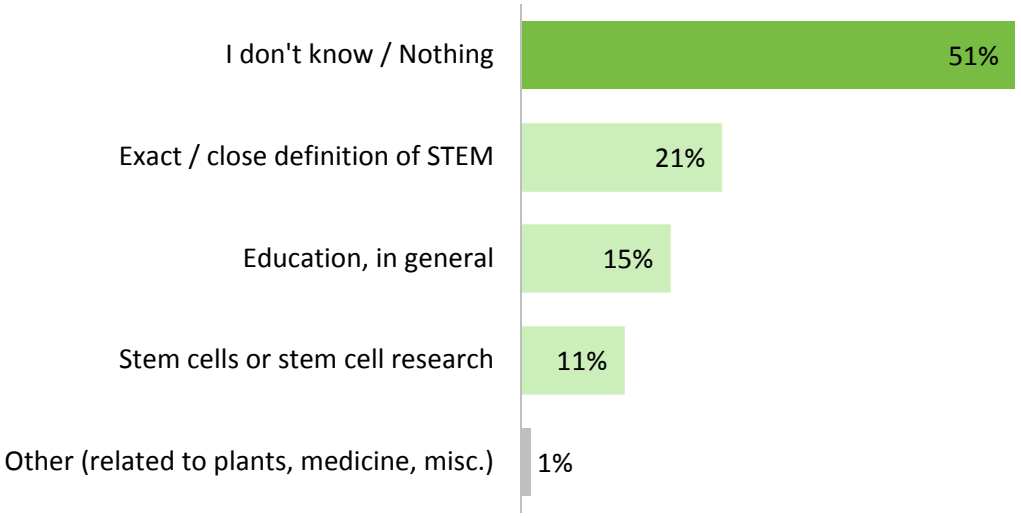


Figure 10. You may have heard about STEM education or STEM careers lately. What, if anything, comes to mind when you hear the letters S-T-E-M, or the word STEM?

To assess awareness of STEM specifically, Iowans were asked "STEM stands for 'science, technology, engineering, and mathematics.' Have you read, seen, or heard of this before?" Overall, three quarters of Iowans (72%) had heard something in the past month about K-12 education in general, and 53% reported that they had heard something about "improving math, science, technology, and engineering education" (Figure 11). When asked specifically about the STEM acronym, just under half (49%) of Iowans had read, seen, or heard of STEM.

49%

of Iowans overall have heard of STEM

STATEWIDE AWARENESS OF STEM, 2016

Over half of Iowans (53%) had heard about 'improving math, technology, science, and engineering education, and 49% had heard of STEM when used as a stand-alone acronym.

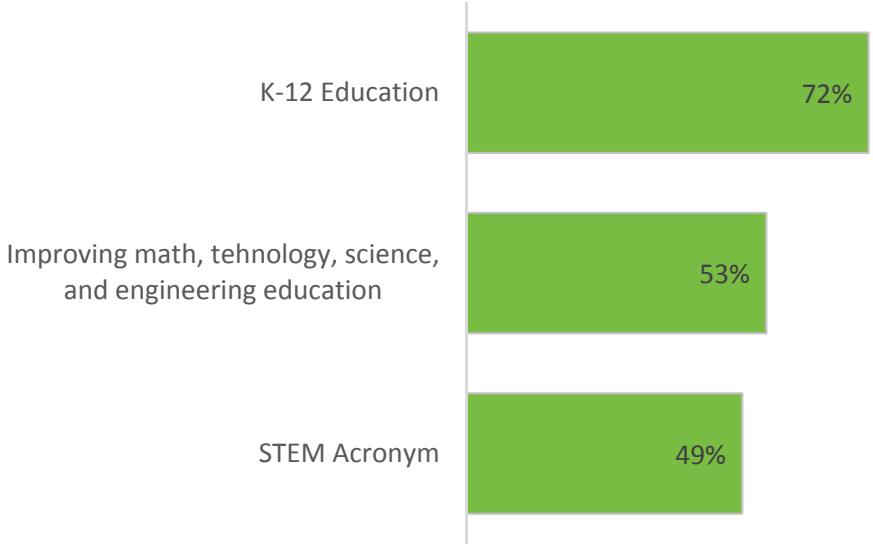


Figure 11. Proportion of Iowans with awareness of STEM

Chi-square tests of significance were used to compare awareness of STEM across select demographic variables. Subgroup analyses are useful for identifying which characteristics of Iowans may be associated with more or less awareness of STEM. Awareness of STEM by gender, education, parent status, and place of residence is presented in Figure 12.

AWARENESS OF STEM ACRONYM BY DEMOGRAPHIC CHARACTERISTICS

In 2016, a greater proportion of Iowans with some college education or more had awareness of STEM compared to Iowans with a high school education or less (p<.01). In addition, a greater proportion of Iowans living in an urban area (>50K) had awareness of STEM compared to Iowans living on a farm or in a rural area. There were no significant differences in awareness of STEM by gender or parent status.

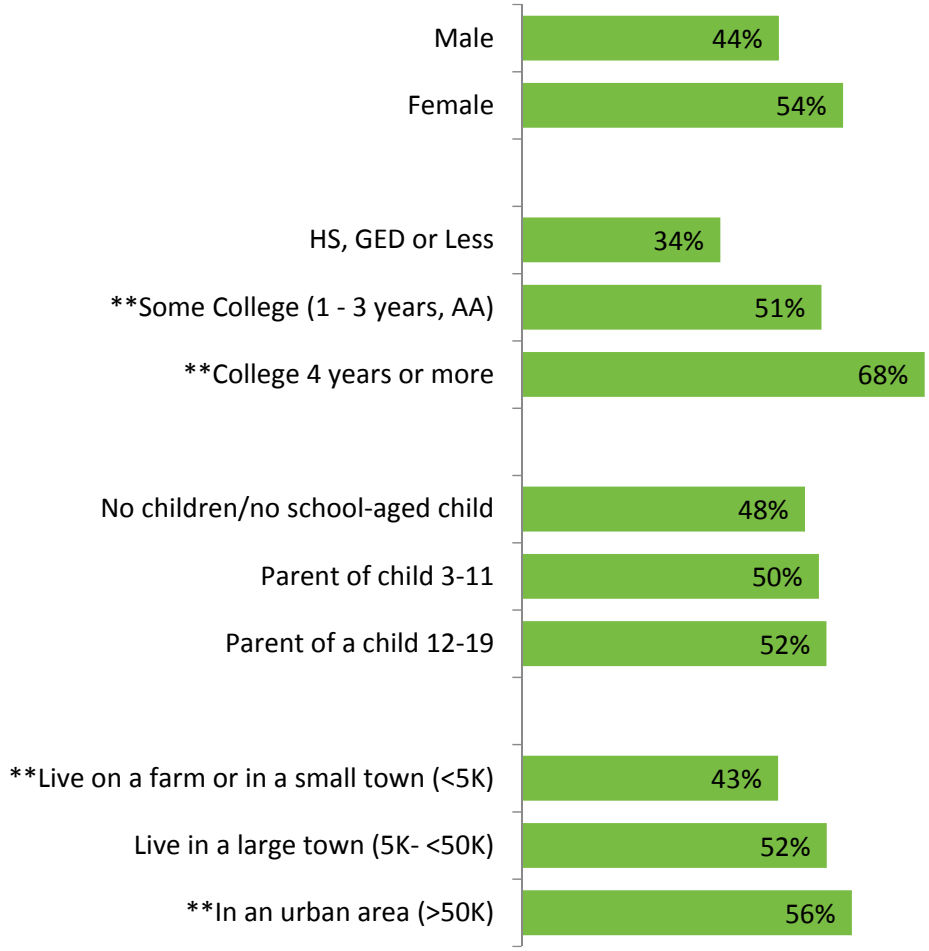


Figure 12. STEM stands for 'science, technology, engineering, and mathematics.' Have you heard of this before? (% Yes) **p< .01

Respondents who answered 'yes' (n=979) to having an awareness of STEM, were asked about specific sources of information where they may have read, seen, or heard about STEM education in the past 30 days (Figure 13). Among Iowans who had heard of STEM, about half (48%) reported seeing information about STEM education in the newspaper or a school or teacher. Other sources of information on STEM education included from television (41%), or a child or student (33%) (Note that categories were not mutually exclusive). There were no demographic differences in sources of information. For example, Iowans who were a parent of school-aged child were not different from the overall population of Iowans in their sources of information about STEM education. This was also true regardless of gender, education level, or urban versus rural location.

Sources of Information on STEM Education

Among Iowans who reported an awareness of STEM, 48% had read about STEM education in the newspaper in the past 30 days or heard about it from a school or teacher.

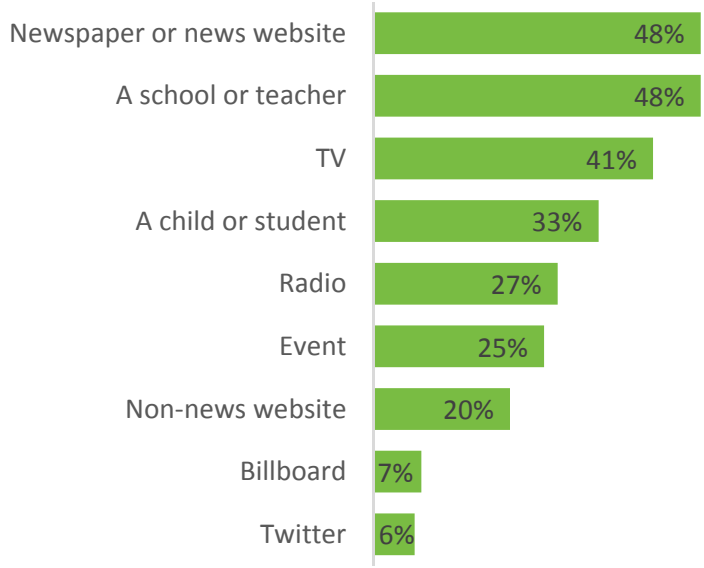


Figure 13. In the past 30 days, have you read, seen, or heard anything about STEM education from any of the following sources of information? (% Yes. Categories not mutually exclusive.)

In addition, awareness of statewide efforts to improve STEM education was assessed by asking respondents if they have read, seen, or heard anything about specific groups or events promoting STEM education and careers in Iowa or the phrase *Greatness STEMs from Iowans*. In the past year, an estimated 27% of Iowans had heard about the Governor's 2016 Future Ready Iowa Summit and a STEM academy or STEM school. Twenty-one percent (21%) of Iowans reported they had heard of the Governor's STEM Advisory Council, STEM Day at the Iowa State Fair, or the I.O.W.A STEM Teacher Award (Figure 14). Fewer Iowans reported hearing about STEM Day at the Capitol (15%), or a STEM festival (10%).

AWARENESS OF GROUPS AND EVENTS PROMOTING STEM EDUCATION AND CAREERS

In the past year, one in five Iowans had heard about STEM Day at the Iowa State Fair, and one in seven had heard of STEM day at the Capitol.

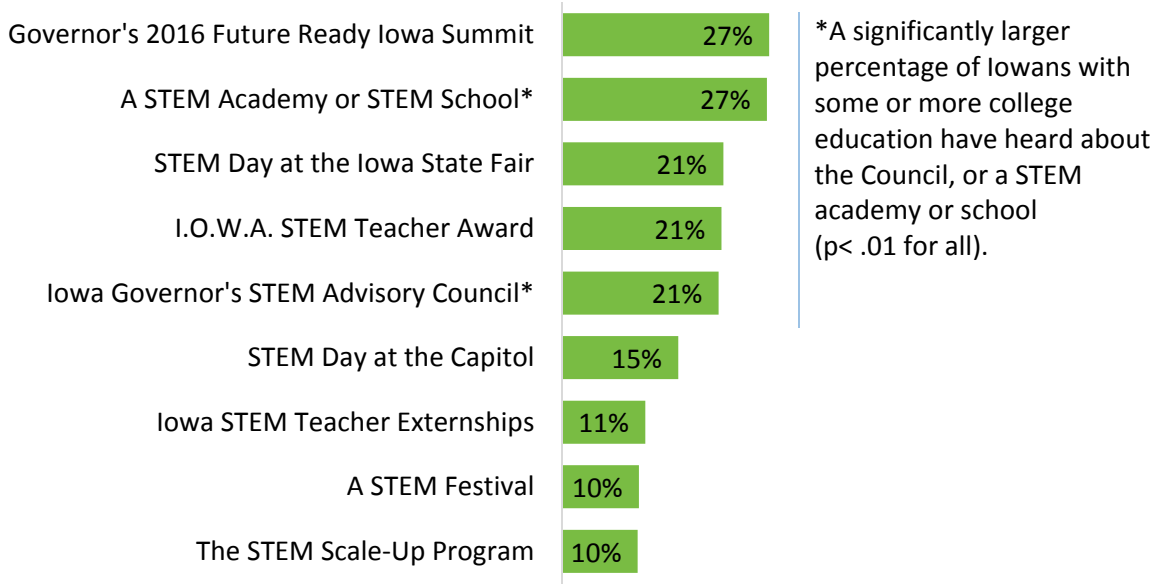


Figure 14. I'm going to read a short list of some groups promoting STEM education and careers. Please tell me how much you have heard, if anything, about each one in the past year. (% A lot/A little. Categories not mutually exclusive.)

In 2016, 16% of Iowans recognized the slogan *Greatness STEMs from Iowans.*

No respondents mentioned the slogan *Greatness STEMs from Iowans* when asked unprompted if they had read, seen, or heard any slogans or taglines about STEM. When specifically asked, 16% of Iowans recognized the slogan *Greatness STEMs from Iowans.* Of those who recognized this slogan (n=291), 18% reported seeing it on television, 15% from a newspaper or news website, 11% from the radio, and 9% from a school or teacher. For comparison, Iowans were also asked about two other slogans that to our knowledge have not been used in Iowa. Of these fabricated slogans, 7% said they had heard the slogan *Commit2STEM* and 12% said they had heard *Iowa's future demands STEM*. While these proportions are less than the primary slogan being assessed, the confidence intervals overlap which suggests *Greatness STEMs from Iowans* is no more recognizable than slogans that have not been used in Iowa.

Multivariate analysis of awareness of STEM

Multivariable logistic regression analysis was conducted on the main outcome variable of awareness of STEM. The purpose of this analysis was to estimate the effect of demographic and geographic factors on awareness of STEM. Odds ratios were computed and are a measure of association between a demographic or geographic factor and awareness of STEM. The odds ratio is a number that represents the odds that an outcome will occur given a particular attribute of the factor. For example, in this analysis, if the odds ratio is 1.45 for women on awareness of STEM, this means that women are almost one and one-half times (1.45 times) as likely as men to have awareness of STEM. Odds ratios above one indicate higher likelihood and odds ratios below one indicate lower likelihood. Confidence intervals (95%) are also reported for each odds ratio.[3] A 95% confidence interval means that if the same population of adult Iowans was sampled on multiple occasions and interval estimates were made each time, the resulting intervals would include the true population value approximately 95% of the time. It is important to remember that caution should be used in generalizing findings where confidence intervals are wide.

Factors included in the logistic regression model were gender, age, education, race, household income, place of residence, and parent status. The complete set of tables with SUDAAN outputs and representation of these findings can be found in Appendix D

The logistic regression model focused on respondents who reported having an awareness of STEM (an estimated 49% of adult Iowans). The overall model was significant at $p < .001$.

After controlling for other factors, gender, age-group, and education level were statistically significant predictors of awareness of STEM in 2016. Iowans who were female, and had some college education or a college degree were more likely than other groups to have awareness of STEM. Specifically, the model predicting awareness of STEM found that:

- The odds ratio for women was 1.52 [CI: 1.15, 2.01].
- The odds ratio for Iowans with some college was 1.87 [CI: 1.33, 2.63], and for Iowans with four or more years of college, the odds ratio was 3.86 [CI: 2.71, 5.50].
- The odds ratio for those aged 35 to 54 years old was 0.67 [CI: 0.46, 0.98] compared to adults 18 to 34 years old.

These findings suggest that Iowans with a college education are significantly more likely to have awareness of STEM compared to those without any college education. This is especially true for those with four or more years of college, who are 4 times more likely to have awareness of STEM compared to those without any college education.

[3] When making inferences from a sample to the population, a confidence interval gives an estimated range of values which is likely to include the unknown population parameter of interest. A population parameter is a fixed value for a variable, such as the mean or variance, in the population. The confidence interval contains this parameter plus or minus a margin of sampling error, that is, the amount the value is expected to vary if different samples were drawn from the population.

Attitudes toward STEM and the role of STEM in Iowa

Public attitudes toward STEM and views about the role of STEM in Iowa were assessed with a series of statements. The statements reflected attitudes about the importance of STEM, STEM's role in economic development, broadening participation in STEM, and barriers to public support of STEM. Response options utilized a 5-point scale of *strongly disagree, disagree, neither disagree or agree, agree,* or *strongly agree.* A large majority of Iowans had positive attitudes toward the importance of STEM to the state, and most Iowans agree or strongly agree with statements that reflect the role of STEM in Iowa's economic and workforce development (Figure 15). In an effort to gauge the public perception of STEM efforts as an economic development initiative versus an education initiative, Iowans were asked their level of agreement with the statement "The push for STEM is more about filling open jobs than making sure students are taught about specific STEM concepts in school." Just over half of Iowans (49%) agreed or strongly agreed with this statement, and 48% disagreed or strongly disagreed (4% neither agreed nor disagreed). This reflects that Iowans are almost evenly divided in their views about the push for STEM as an economic development versus education effort.

ATTITUDES ON THE IMPORTANCE OF STEM

Most Iowans agree that increased focus on STEM education in Iowa will improve the state economy (68% agree/ 24% strongly agree), and that more companies would move to Iowa if workers had a reputation for great science and math skills (64% agree/ 21% strongly agree).

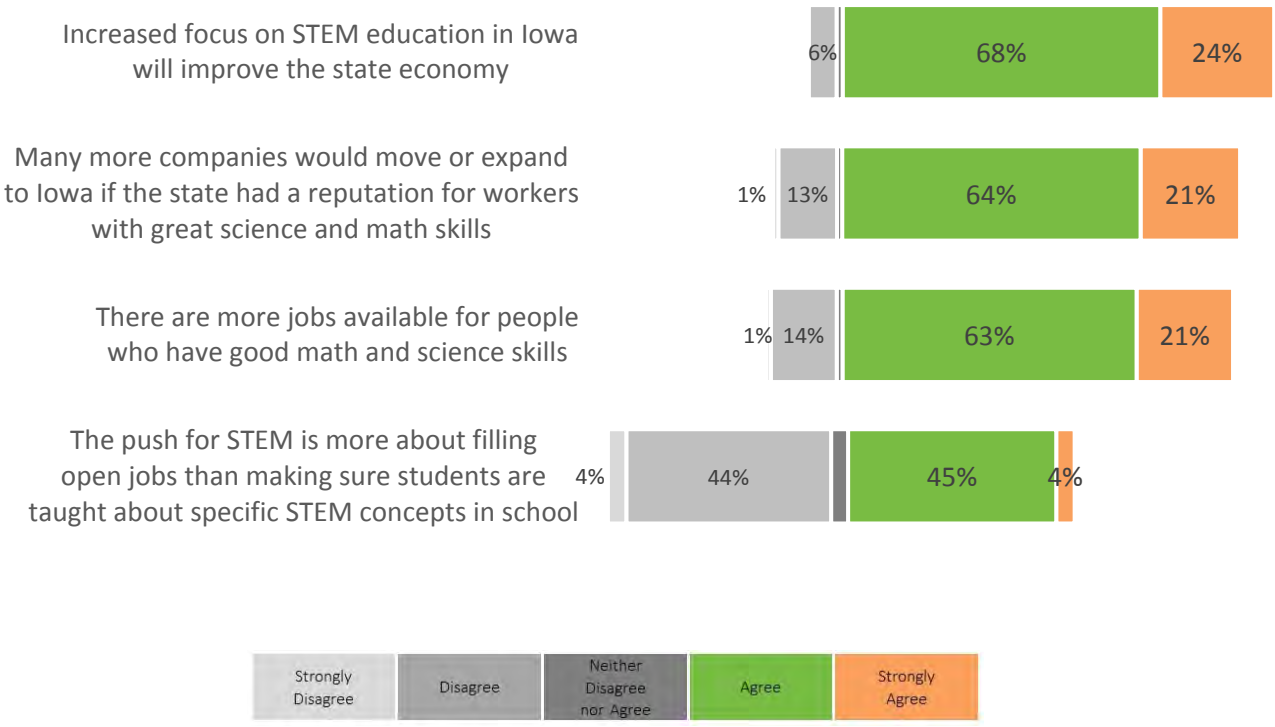


Figure 15. Public attitudes about the importance of STEM

The survey also asked Iowans' perceptions about the STEM workforce in Iowa. In 2016, eight in ten Iowans (82%) thought there were not enough skilled workers to fill STEM jobs in Iowa, another 14% thought there was just the right number, 4% thought there was more than enough. In addition, most Iowans agreed or strongly agreed with statements of support for efforts to broaden participation in STEM for women, Hispanics and African Americans. Nearly eight in ten Iowans agreed that progress was being made to increase STEM jobs for women (69% agreed and 10% strongly agreed) (Figure 16). A majority also agreed with statements about increasing participation among Hispanics (56% agreed and 3% strongly agreed) and African Americans (62% agreed and 3% strongly agreed) in STEM jobs.

ATTITUDES TOWARD RESOURCES AND WORKFORCE DEVELOPMENT IN STEM

A majority of Iowans strongly agreed or agreed that progress is being made to increase the number of STEM jobs for women, Hispanics, and African Americans.

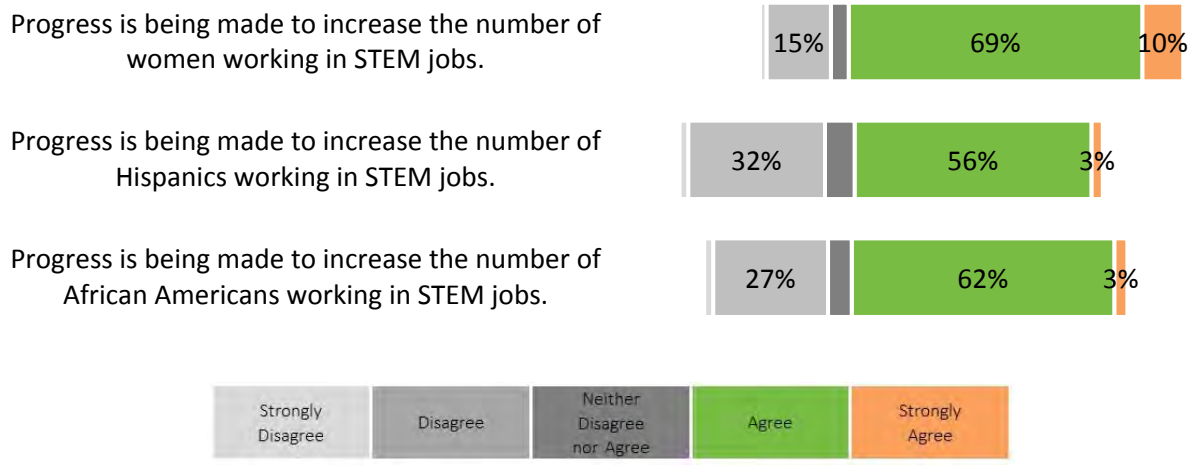


Figure 16. Attitudes toward broadening participation in the STEM workforce

Perceptions about STEM being “too hard” or “too specialized” may be a barrier for some Iowans in their support of STEM. Three-quarters (74% agreed or strongly agreed) of Iowans agreed that more people would choose a STEM job if it didn’t seem so hard, and 41% agreed science, technology, and engineering are too specialized for most people to understand it (Figure 17).

PERCEPTIONS THAT MAY HINDER SUPPORT FOR STEM

Almost half of Iowans disagreed (48% disagreed and 9% strongly disagreed) that STEM is “too specialized,” but these perceptions may still be barriers for 4 out of 10 residents in the state.

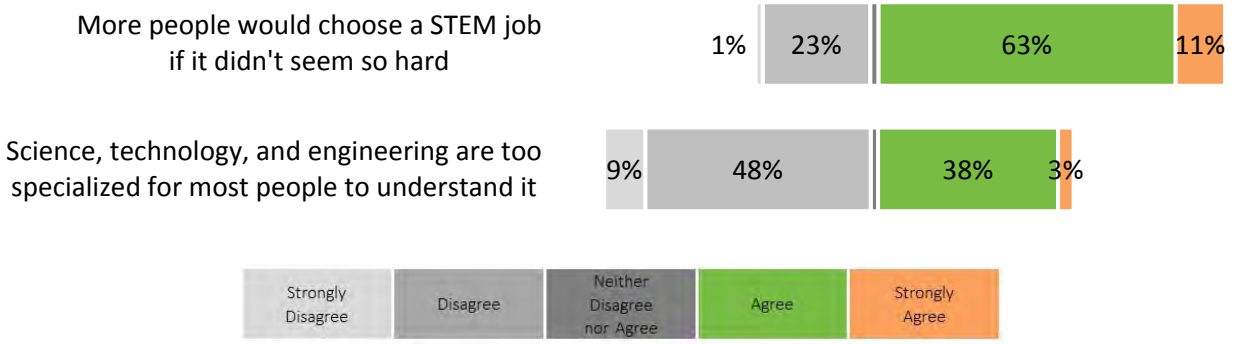


Figure 17. Perceptions among Iowans that may hinder support for STEM

Perceptions about STEM education

The statewide survey also assessed perceptions about STEM education in Iowa. Questions centered on support for STEM education, perceptions of science and math achievement, and opinions about how well schools in their community are teaching STEM subjects. The survey also assessed views on the importance of STEM education and perceived barriers to it.

In 2016, nine in ten Iowans (93%) said STEM education **should** be a priority in their local school district, but only 50% said STEM education actually **is** a priority and another 20% said they didn't know if STEM education was a priority in their local school district. Furthermore, eight in ten Iowans (80%) support (37% very supportive and 44% somewhat supportive*)* state efforts to devote resources and develop initiatives to promote STEM education in Iowa. Notably, there were no subgroup differences in these views by any demographic characteristics. That is, views on the priority of STEM education and the support for state efforts towards STEM education did not differ by gender, education level, parent status, or urban or rural place or residence. In addition, nearly nine in ten Iowans agreed (69% agreed and 20% strongly agreed) with the statement that there is an urgent need in Iowa for more resource to be put toward STEM education.

*In 2016, nine in ten Iowans thought STEM education **should** be a priority in their local school districts, but only 50% say it actually **was** a priority and another 20% **didn't know**.*

Iowans were split about sixty to forty in their agreement with the statement "Overall, the quality of STEM education in Iowa is high." Over half of Iowans agreed (58%) or strongly agreed (3%) with this statement, but 35% disagreed or strongly disagreed (2%). This view also did not differ by gender, education level, parent status, or urban or rural place of residence. In response to the question "How well do you think schools in your community are teaching STEM subjects?," over half of Iowans said teaching in science, technology, and math is *excellent* or *good* in their community, but only 40% rated engineering education this way (Figure 18).

Opinions on the role of visual arts, music, or drama on STEM performance was also assessed with an agree/disagree statement. In response to the statement, "Training in visual arts, music, or drama improves performance in STEM," 82% of Iowans agree/strongly agree versus 16% who disagree/strongly disagree. Notably there were several significant differences by demographic subgroup. This included a significantly greater proportion of women versus men ($p < .01$), and individuals with some or more college versus none ($p < .01$) who agreed or strongly agreed with this statement compared to those who did not within each subgroup. Similar to opinions about the quality of education in STEM subjects, over half of Iowans rated the quality of music and art education as *excellent* or *good* as well (62% agreement for music and 56% for art, respectively).

Perceptions of Quality of Education

Over half of Iowans rated the quality of science, technology, and math education in their community as 'Excellent' or 'Good,' while only 40% of Iowans rated the quality of engineering education in their community that way.

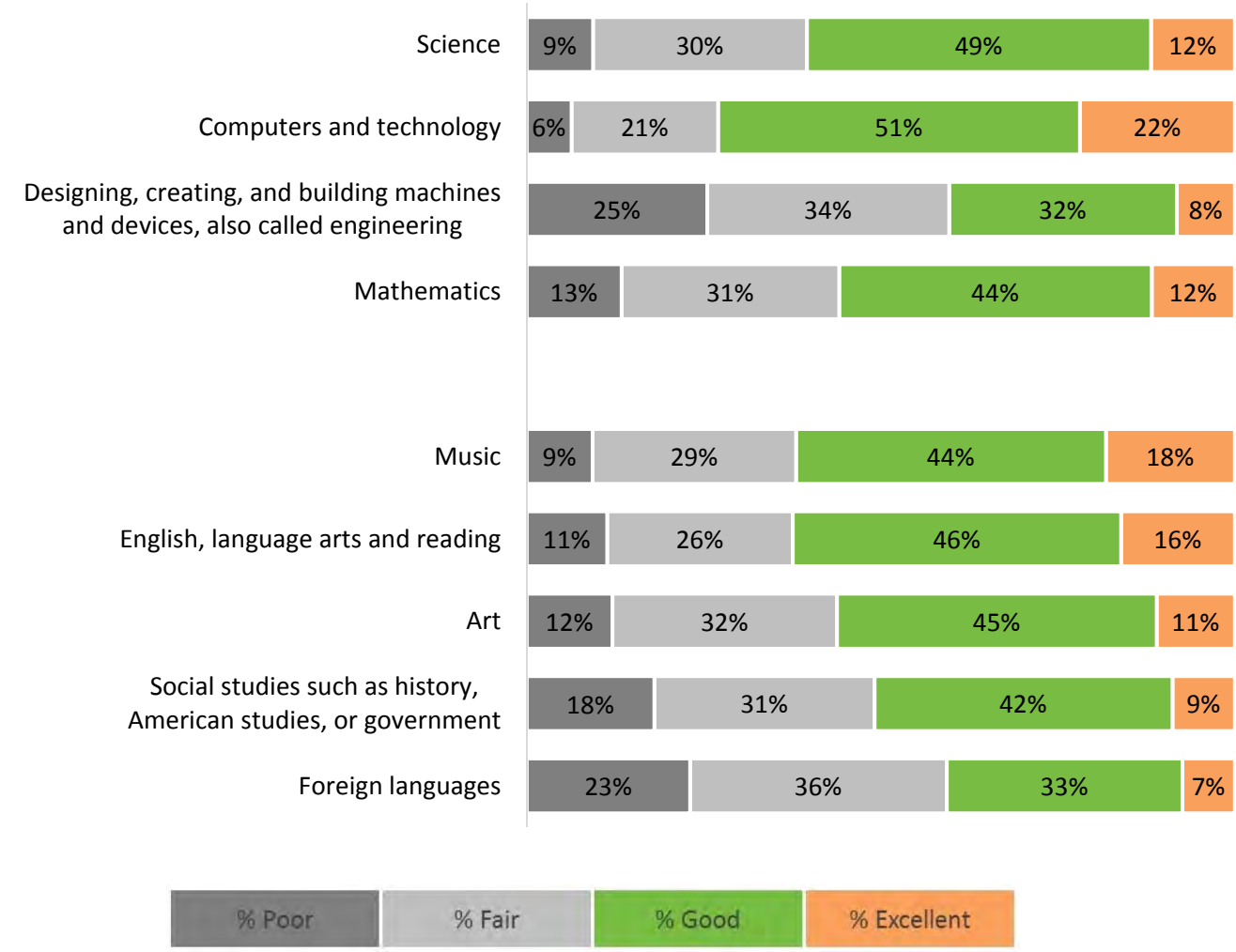


Figure 18. How well do you think the schools in your community are teaching each of the following subjects?

Attitudes about STEM education were assessed in a series of statements on the importance of STEM education, teacher and student preparation, and broadening participation among students in STEM. Response options again utilized a 5-point scale of *strongly disagree, disagree, neither disagree or agree, agree,* or *strongly agree.*

ATTITUDES ABOUT STEM EDUCATION

Over three-quarters of Iowans agreed or strongly agreed that Iowa colleges and universities are doing a good job preparing STEM teachers (76% agreed or strongly agreed) and preparing students for careers in STEM fields (83% agreed or strongly agreed).

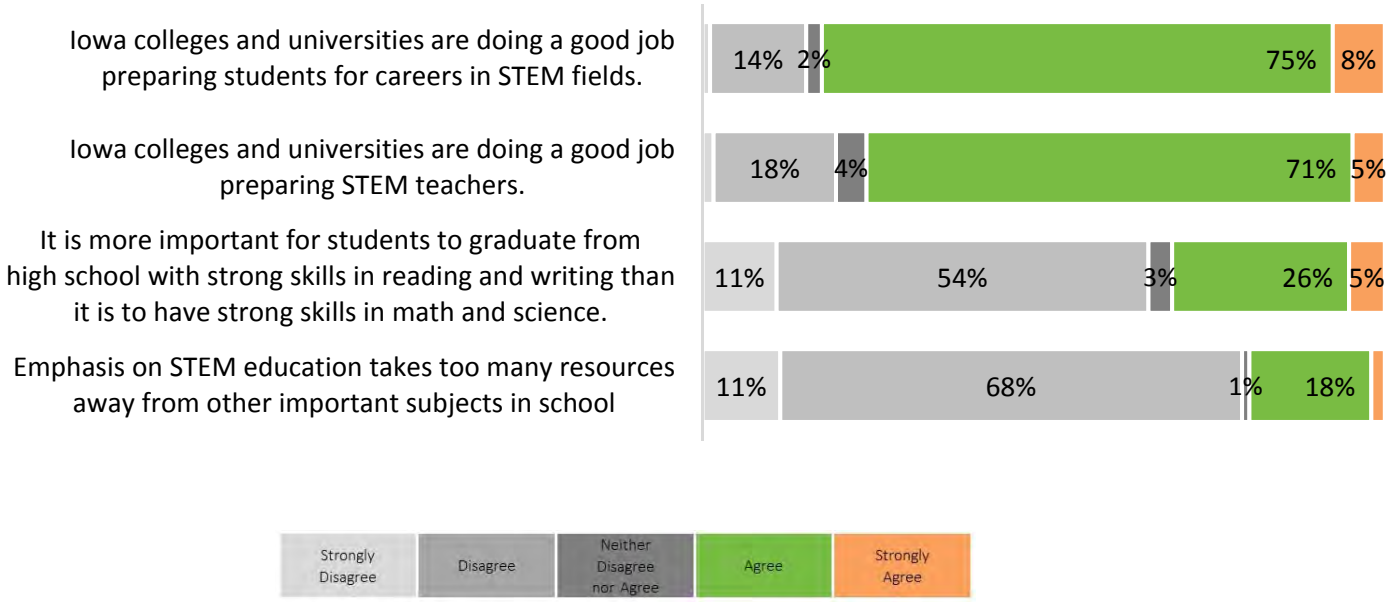


Figure 19. Attitudes about STEM education

Parent perceptions of STEM education

The preceding sections in this report presented results of the survey for Iowans overall. In this section, subgroup differences by parent status are described and results from a battery of questions asked only of parents are presented. Only results where there were significant differences between parents and Iowans overall are highlighted below. For questions where no significant differences were found, the awareness, attitudes, and perceptions of parents mirrored the general population of Iowans.

Notably, parents did not differ from the overall population of Iowans in their awareness of the STEM acronym, STEM slogans, the STEM Council or STEM events (e.g., a STEM festival, STEM summit, STEM school, or STEM Day at the state fair), or in the sources of information where they may have read, seen or heard about STEM education. In addition, parents did not differ from the overall population of Iowans in their attitudes about STEM's role in Iowa's economy, efforts surrounding underrepresented minorities in STEM fields, or in their support of state efforts to promote STEM education in Iowa.

The survey asked parents about their child's interest in individual STEM topics using a scale of *a lot of interest, some interest,* or *little or no interest.* There were no differences in how parents of a younger child versus parents of an older child perceived their child's interest across STEM topics. More parents perceived their child to have *a lot of interest* in computers and technology compared to the other STEM topic areas (Figure 20).

PARENT PERCEPTION OF THEIR CHILD'S INTEREST IN STEM

Over half of parents (67%) said their child had a lot of interest in technology. Fewer than half said their child had a lot of interest in science (48%), math (38%), or engineering (38%)

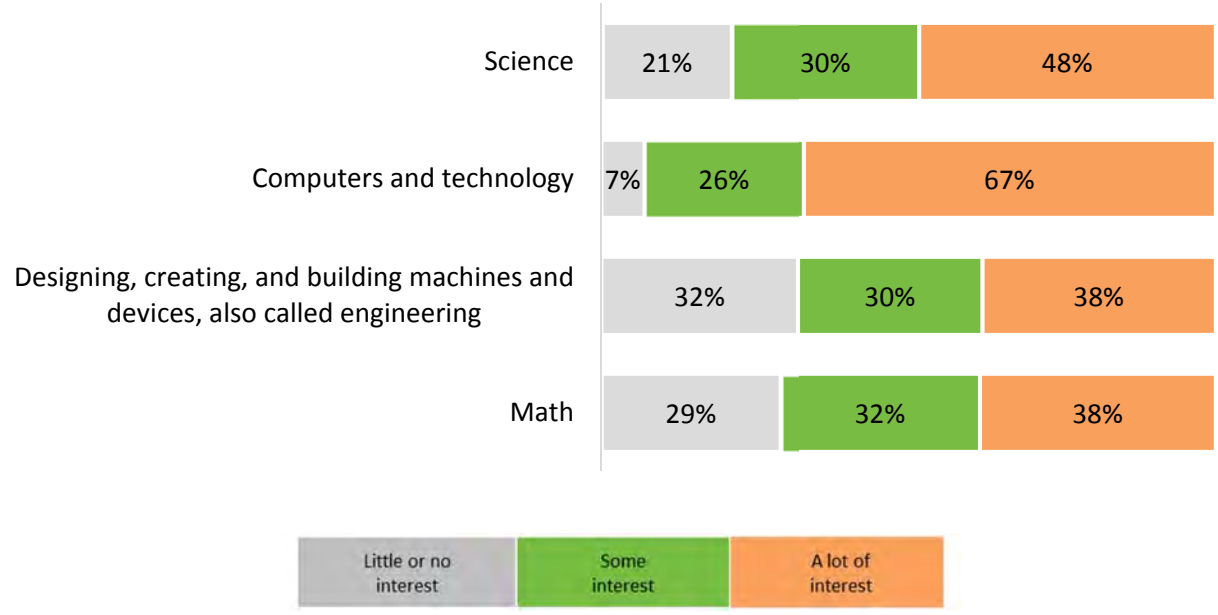


Figure 20. In general, how much interest, if any does this child show in STEM subjects?

No differences were found by parent type when asked to rate how well schools in their community were teaching STEM subjects. That is, parent views of the quality of schools in their community in teaching STEM subjects mirrored the overall statewide population described earlier in this report. Parents were also asked their perceptions of how well their child is doing in STEM subjects. Response options were excellent, above average, average, below average, or not assessed yet. When asked how well their child is doing in STEM subjects, over half of parents said their child was doing above average or excellent in science (51%), technology (61%), or math (54%) (Figure 21). For parents whose child was getting instruction in engineering, 43% of parents reported their child to be doing above average or excellent in engineering, another 41% said their child was about average in their achievement in engineering subjects.

PARENT PERCEPTIONS OF THEIR CHILD'S ACHIEVEMENT IN STEM

Over half of parents said their child was doing above average or excellent in science (51%), technology (61%), or math (54%). For parents whose child was getting engineering instruction, almost half said this about engineering (43%).

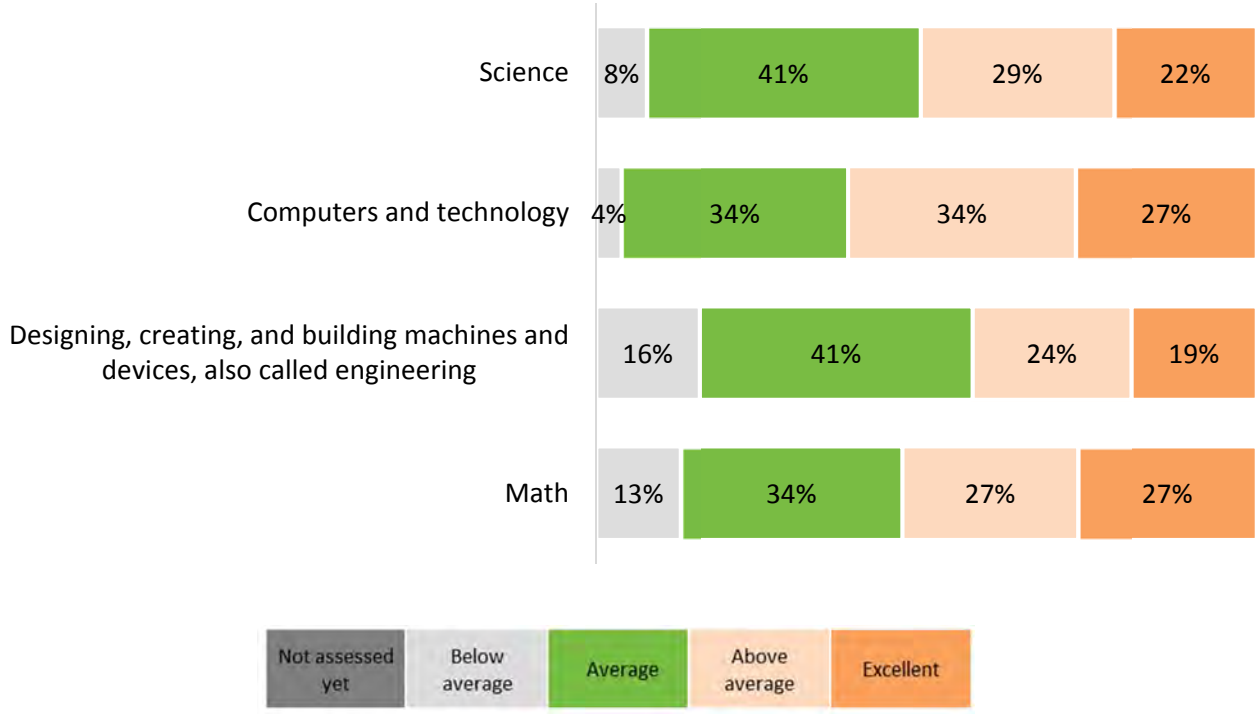


Figure 21. In general, how much interest, if any does this child show in the following subjects?

The survey also examined parent attitudes regarding the importance of their child's achievement in individual STEM-subjects relative to other subjects. In addition, the survey asked parents of an older child, 12-19 years old, about the importance of advanced skills in science, technology, engineering, or math for their child. Response options for importance included very important, important, somewhat important, or not important at all. There was no difference by parent type (i.e., parent of an older versus younger child) in their attitudes about the importance of doing well in STEM subjects. Approximately nine in ten parents said it was very important or important to them that their child does well in science (87%), technology (97%), or math (95%) (Figure 22). Slightly fewer – about eight in ten - parents said the same about engineering (82%).

IMPORTANCE OF STEM EDUCATION AMONG PARENTS

A greater proportion of Iowans who are parents of a school-aged child said doing well in math, reading, or technology was "very important" or "important" to them compared to science, engineering, or social studies. In addition, a greater proportion of parents of an older child rated advanced technology or math skills as "very important" or "important" compared to advanced skills in science or engineering.

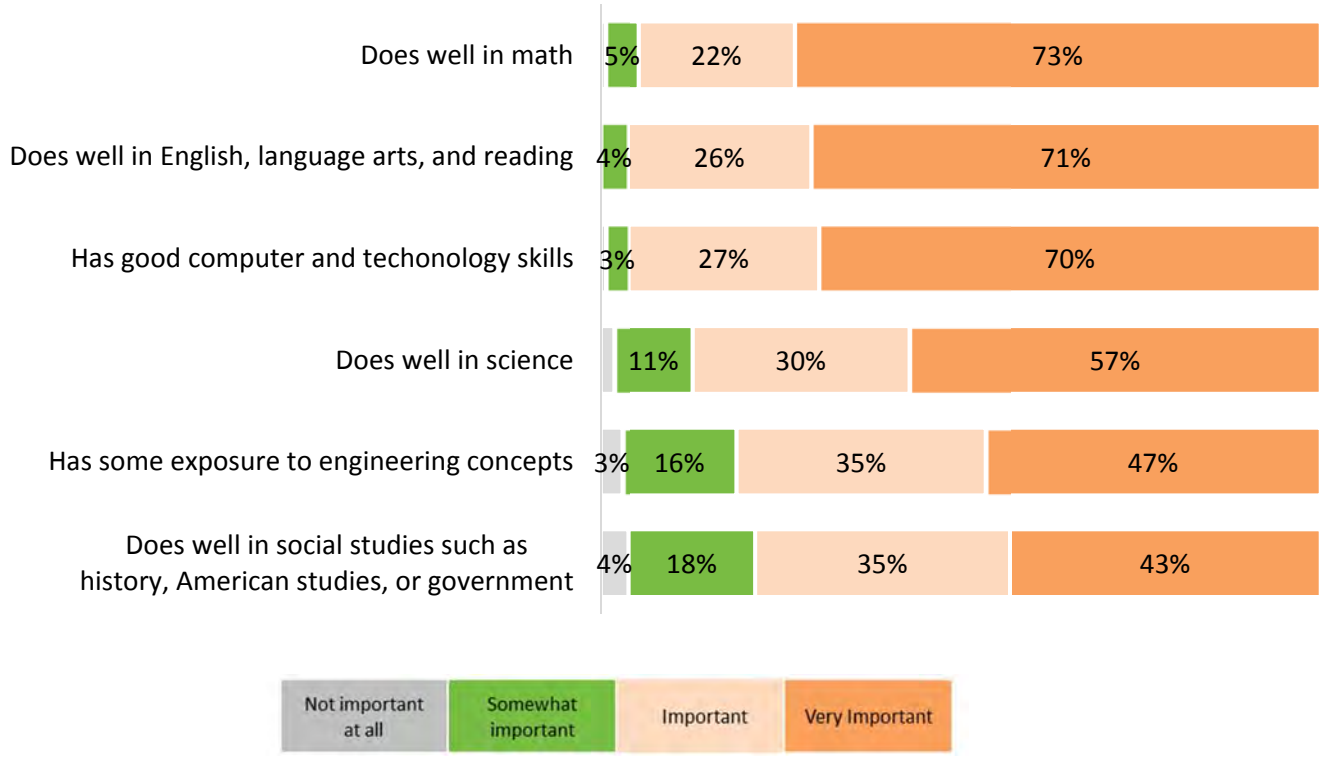


Figure 22. How important is it to you that your child does well in STEM subjects? (Asked of all parents of a school-aged child)

Finally, Iowans who were parents of an older child 12 to 19 years olds were asked what their child was most likely to do after graduation, the likelihood that their child will pursue a career in a STEM field, and how prepared they felt their child was to study science, technology, engineering, or math in college. Over half (58%) said their child was most likely to attend a 4-year college or university, and 23% said their child would likely attend a 2-year college. Furthermore, an estimated 40% of parents of a child 12-19 years old said their child was very likely, and another 37% their child is somewhat likely to pursue a career in a STEM-related field. A majority of parents felt their older child was somewhat prepared or very prepared to study science, technology, engineering, or math in college; however, more parents responded moderately that their child was only somewhat prepared to study science (52%), technology (48%), engineering (38%), or mathematics (45%) compared to those who responded very prepared or not at all prepared (Figure 23). Notably, 49% of parents of an older child said their child was not at all prepared to study engineering.

PARENT PERCEPTIONS OF THEIR OLDER CHILD'S PREPAREDNESS TO STUDY STEM IN COLLEGE

About half of parents of a child 12-19 years old said their child was only somewhat prepared to study science (52%), technology (48%), or math (45%) in college. However, 49% said their child was not at all prepared to study engineering; while one in five said their child was not prepared in science, technology, or math.

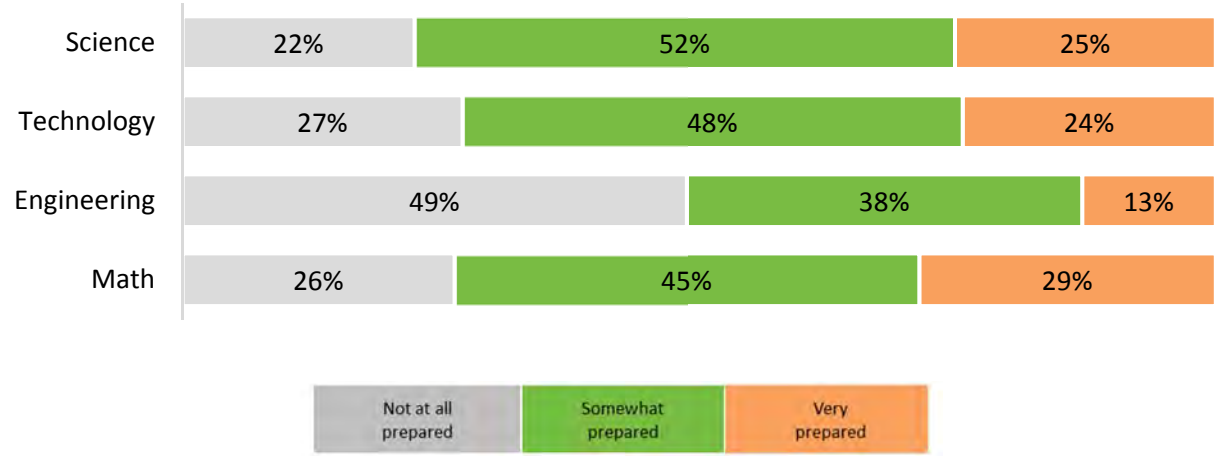


Figure 23. How prepared do you feel your child is to study STEM in college?

Trends in Perceptions and Attitudes toward STEM from 2012 to 2015

This section highlights select trends in the statewide survey of adult Iowans toward STEM over the past four years of the survey.

Increased awareness of STEM

The 2016 Survey of Adult Iowans showed increased awareness of STEM compared to previous survey years. In 2016, approximately half (49%) of Iowans had heard of the acronym STEM. Awareness was 10% higher since 2014, and nearly double that which was measured in 2012 in the first year of the survey (Figure 24). Awareness of STEM has increased from 2012 to 2016 across all subgroups (Figure 25).

INCREASE IN STEM AWARENESS AMONG IOWANS FROM 2012 TO 2016

Iowans who have read, seen, or heard about STEM has nearly doubled since 2012, from 26% in the first year of the survey to 49% in 2016.

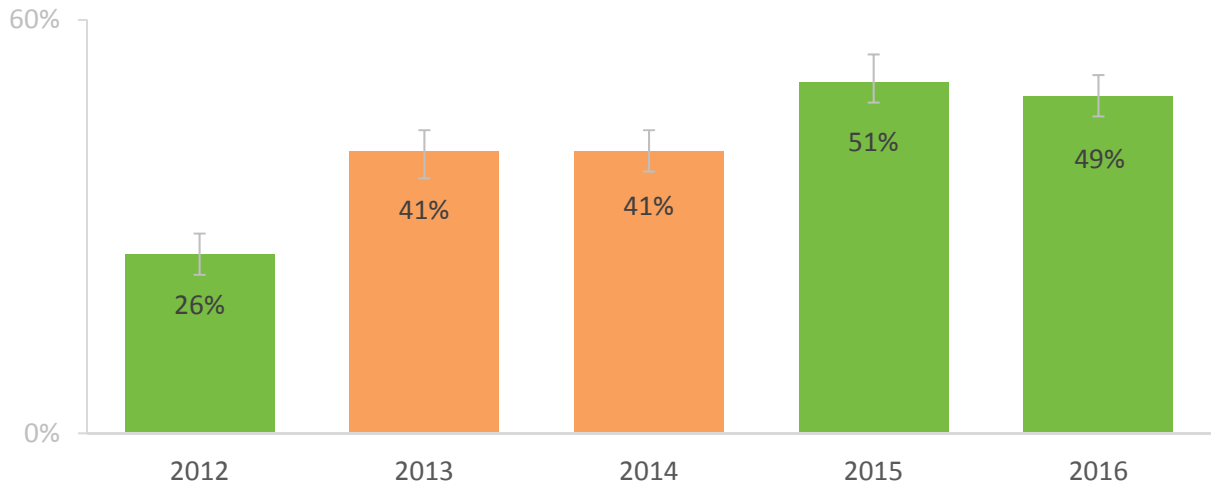


Figure 24. Statewide increase in STEM awareness, 2012 to 2016

HAVE YOU READ, SEEN, OR HEARD OF STEM? 2012 TO 2016

Awareness of STEM has increased from 2012 to 2016 across all subgroups.

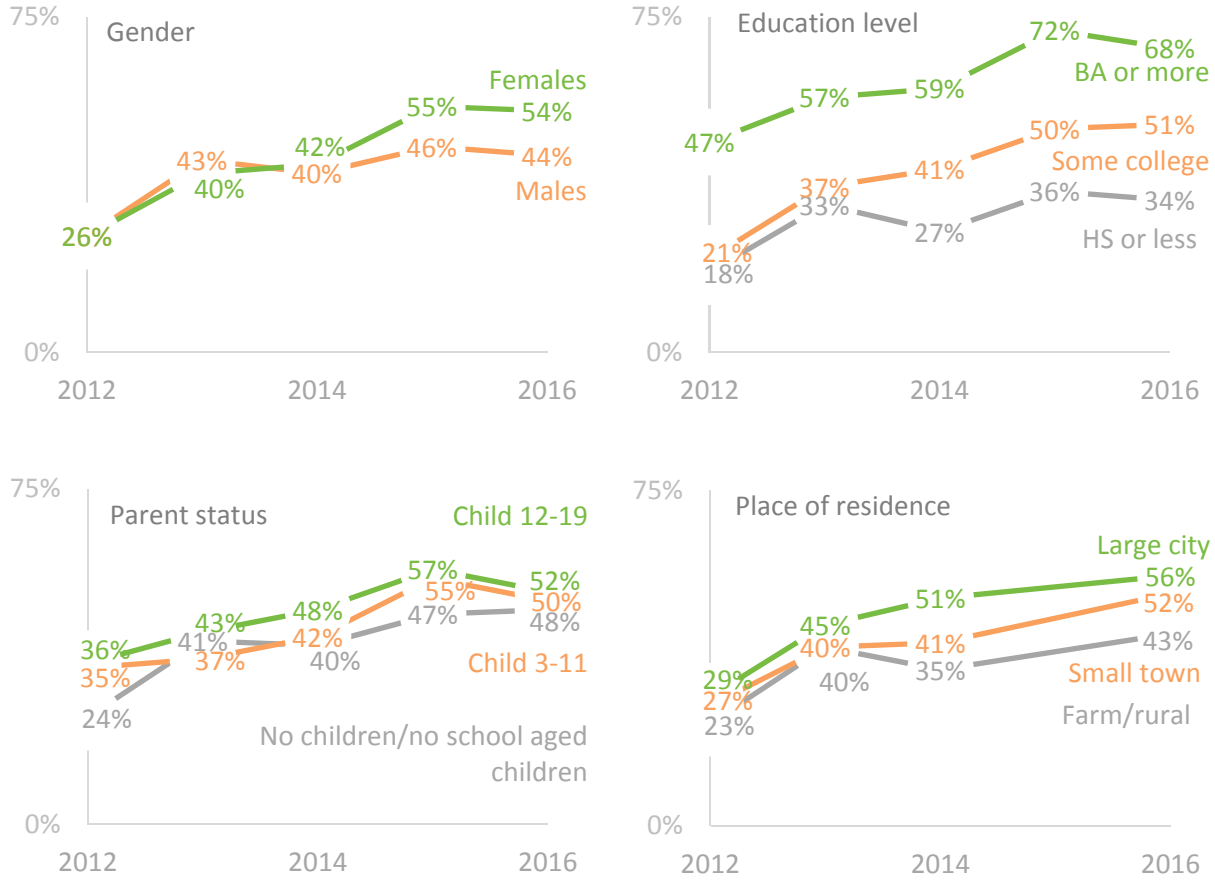


Figure 25. Increase in STEM awareness among all demographic subgroups, 2012-2016

All six STEM regions showed a modest increase in STEM awareness from 2014 to 2016. It is important to note that the findings in these five regions were statistically non-significant because the confidence intervals overlapped for each respective year's point estimate. In addition, there were no significant differences across regions in 2014 or 2016. As a reminder, the point estimate and 95% confidence intervals sets forth the upper and lower range of the "true" percentage in the population, so even though a trend upward or downward may be observed when comparing regions from one year to the next or with each other, the increase or decrease does not reach statistical significance when the 95% confidence intervals overlap.

INCREASE IN STEM AWARENESS BY STEM REGION FROM 2014 TO 2016

Awareness of STEM increased significantly in the past year in the Southwest STEM region of Iowa, from 32% in 2015 to 42% in 2016 (p< .01). Awareness of STEM in the other five regions did not significantly increase or decrease during the same one-year time period.

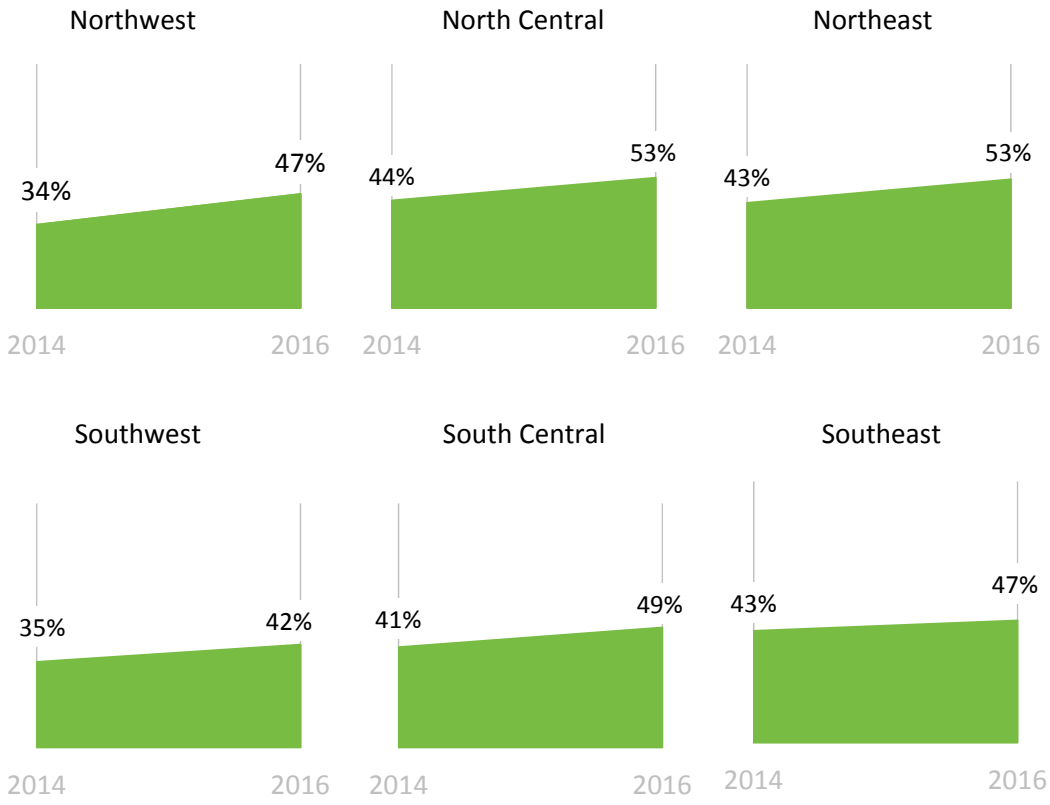


Figure 26. Awareness of STEM by STEM region, 2014 to 2016

Overall support for STEM efforts remains high

8 in 10 Iowans are *very supportive* or *somewhat supportive* of efforts to devote resources and develop initiatives to promote STEM education in Iowa (Figure 27). Response options included: *Very opposed, Somewhat opposed, Neither, Somewhat supportive, Very supportive*.

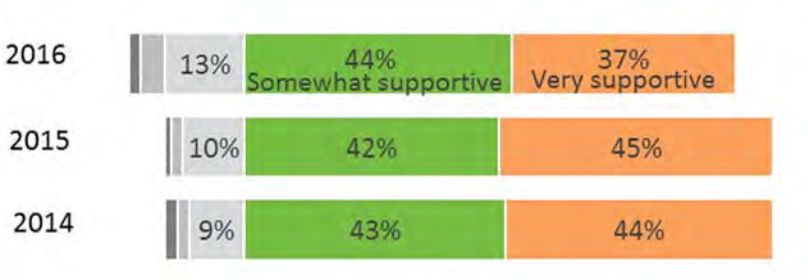


Figure 27. Overall, to what degree do you support or oppose state efforts to devote resources and develop initiatives to promote STEM education in Iowa?

Changes in attitudes about STEM's role in Iowa

From 2014 to 2016, there were no significant differences in the proportions of Iowans who responded they *strongly agree* or *agree* in their attitudes about STEM's role in Iowa's economic development (Table 34)

Table 34. Trends in attitudes toward STEM, 2012 to 2016

	2012	2013	2014	2015	2016
Many more companies would move or expand to Iowa if the state had a reputation for workers with great science and math skills.	76%	90%	87%	88%	85%
Increased focus on STEM education in Iowa will improve the state economy.	86%	89%	90%	89%	92%

Percentages in table combine the proportion of Iowans who responded *strongly agree* or *agree*.

Changes in perceptions about STEM education

From 2015 to 2016, there were no significant differences in the proportions of Iowans who responded they *strongly agree* or *agree* in their perceptions about STEM education in Iowa.

Table 35. Changes in perceptions about STEM education, 2012 to 2016

	2012	2013	2014	2015	2016
Overall, the quality of STEM education in Iowa is high	65%	58%	59%	58%	61%
Iowa colleges and universities are doing a good job preparing STEM teachers.	79%	73%	71%	76%	76%
Iowa colleges and universities are doing a good job preparing students for careers in STEM fields.	83%	80%	82%	85%	83%

Percentages in table combine the proportion of Iowans who responded *strongly agree* or *agree*.

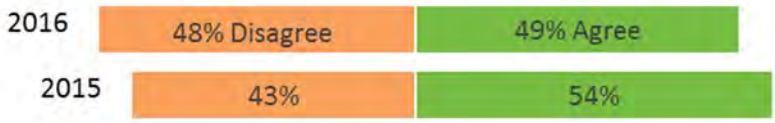
Perceptions on workforce development

Iowans continue to perceive a need for both a STEM education and STEM workforce, and view STEM efforts as supporting both

82% said there is not enough skilled workers in Iowa to fill STEM jobs (4% said more than enough, and 14% said just right)

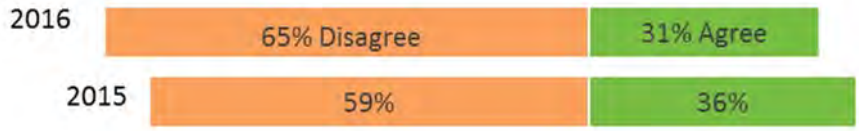
+5% Shift towards a more balanced distribution of Iowans who view STEM efforts as workforce development versus STEM education

The push for STEM is more about filling open jobs than making sure students are taught about STEM concepts in school



+6% Shift towards attitudes that reflect the value of science and math education as important as reading and writing

It is more important for students to graduate from high school with strong skills in reading and writing than it is to have strong skills in math and science



Section 3. Statewide Student Interest Inventory

Data source Iowa Assessments, Iowa Testing Programs, The University of Iowa

Methods Iowa Assessments are standardized tests taken annually by nearly every student in grades 3 through 11 in the state of Iowa. Since 2012-2013, an 8-item interest inventory has been added to the Iowa Assessments. In January 2016, an additional item was added at the request of the Council. Schools have the option to administer the inventory to their students. The Interest Inventory was developed in part to serve as a data source for both the Iowa STEM Indicators (See Indicator 8), and as a way to compare students who participate in Scale-Up Programs with all students statewide (See Section 4.2 Report of Participant Information).

Two versions of the inventory were created with variations in question wording and response options to accommodate different grade levels (Table 36). Response options for grades third through fifth were *I like it a lot, It's okay*, or *I don't like it very much* for items one to seven, and *I would like it a lot, It would be okay*, or *I would not like it very much* for items eight and nine, respectively. Response options for grades six through twelve were *Very interested, Somewhat interested*, or *Not very interested* for all items.

For 2016-2017, among the 351,355 students in Iowa who took the Iowa Assessments, 202,041 also completed the Interest Inventory (58% participation rate) (Table 37). Item frequencies for each of the interest inventory questions can be found in Appendix H.

Table 36. Statewide Student Interest Inventory

Grades 3rd-5th	Grades 6th-12th
1. How much do you like to create and build things?	1. How interested are you in designing, creating, and building machines and devices (also called engineering)?
2. How much do you like math?	2. How interested are you in math?
3. How much do you like science?	3. How interested are you in science?
4. How much do you like art?	4. How interested are you in art?
5. How much do you like reading?	5. How interested are you in English and language arts?
6. How much do you like using computers and technology?	6. How interested are you in computers and technology?
7. How much do you like social studies?	7. How interested are you in social studies (such as history, American studies, or government)?
8. When you grow up, how much would you like to have a job where you use science, computers, or math?	8. As an adult, how interested would you be in having a job that uses skills in science, technology, math, or engineering?
9. When you grow up, how much would you like to have a job in Iowa?[1]	9. How interested are you in living in Iowa after you graduate and go to work?[1]

Table 37. Summary of Statewide Student Interest Inventory participation

	2012/13	2013/14	2014/15	2015/16	2016/17
Number of all students statewide who took the Iowa Assessments[1]	342,494	346,774	346,914	350,270	351,355
Interest Inventory participation among all students statewide (participation rate)	241,957 (71%)	174,184 (50%)	215,134 (62%)	199,416 (57%)	202,041 (58%)

1. Iowa Assessments are standardized tests taken annually by nearly every student in grades 3 through 11 in the state of Iowa. Since 2012-2013, the Interest Inventory has been added to the Iowa Assessments. Schools have the option to administer the inventory with their students.

Key findings

- While these small changes should be interpreted cautiously, the proportion of all students statewide who said they were "very interested" in individual STEM topics, in pursuing a STEM career, or working in Iowa has decreased by a few tenths from 2015-2016 to 2016-2017.

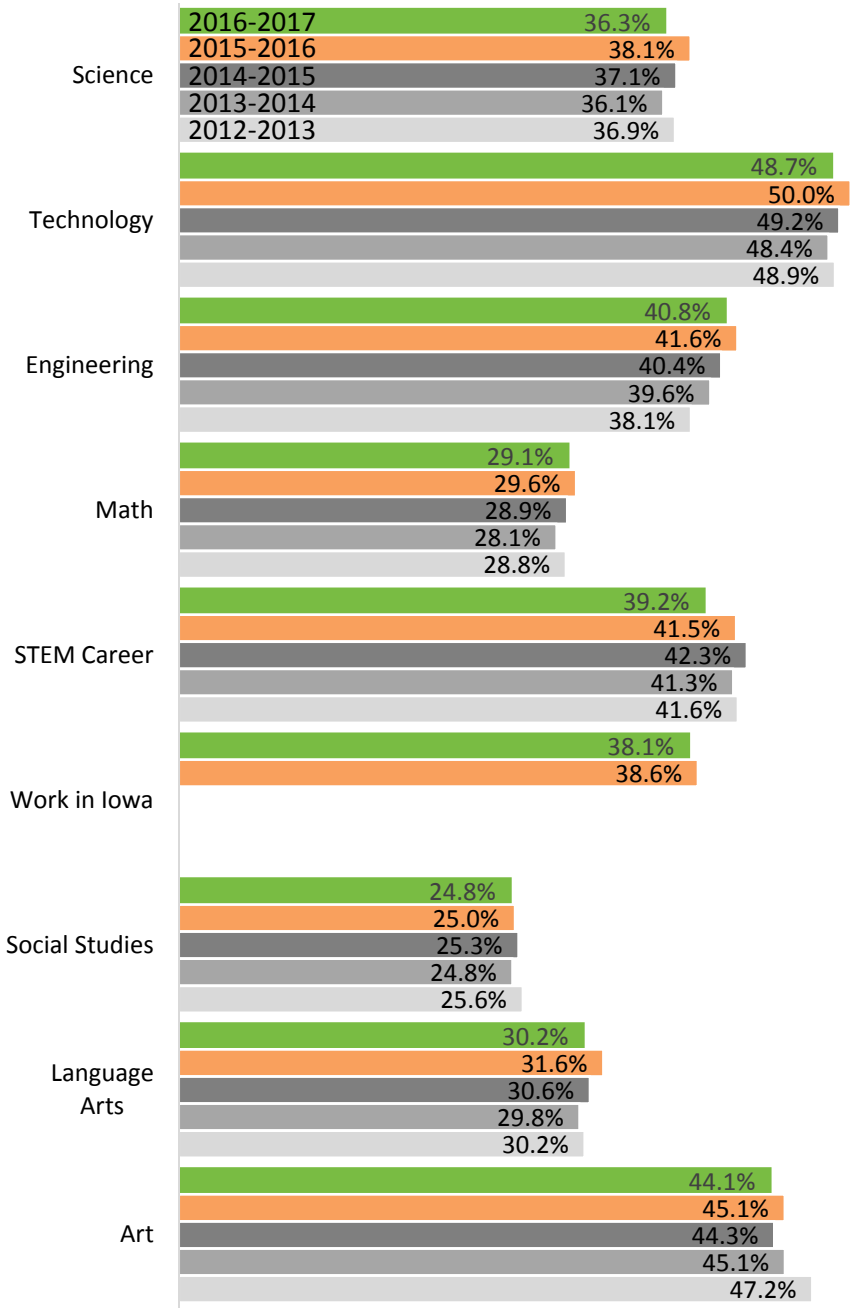


Figure 28. Proportion of all students statewide who were *very interested* by subject area

Key findings (cont'd)

- Among all students statewide who took the Iowa Assessments in 2016-2017, interest in individual STEM subjects is highest among elementary students, followed by middle school and high school students, respectively (Figure 29).
- While interest in all subjects decreases as students' progress through school, the proportion of all students statewide who are *very interested* in pursuing a STEM career remains close across grade groups, from 41% among grades 3rd through 5th, 40% among grades 6th through eighth, and 37% among grades 9th through 12th.

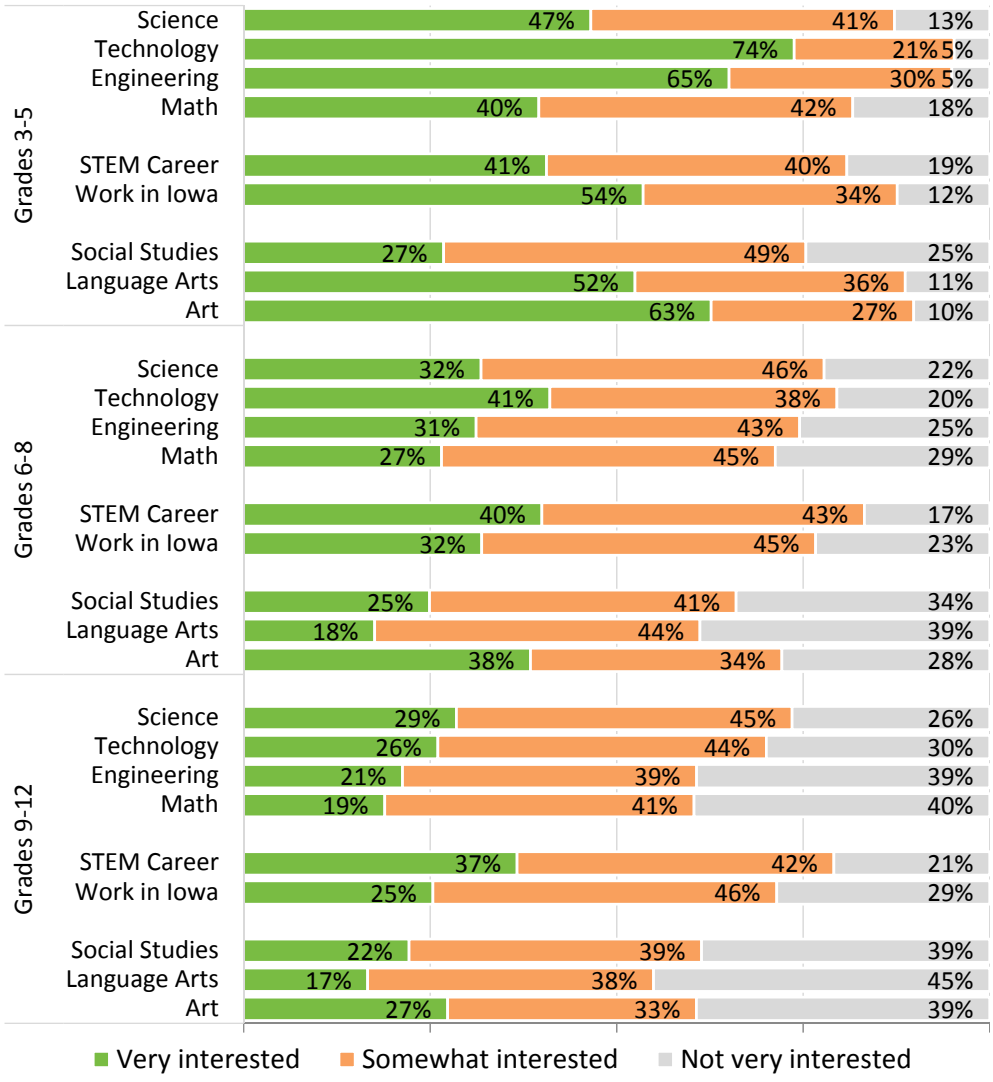


Figure 29. Statewide Student Interest Inventory for all students statewide by grade group, 2016-2017 (n=202,041)

Key findings (cont'd)

- Among all students statewide by gender, female interest in a STEM career has a steady rate of decline from an average of about 36% of females in grades 3-5 who indicated they were *very interested* in STEM, to 31% of females in grades 6-8, and 29% of females in grades 9-11. Male interest remains fairly stable from 46% in grades 3-5, 49% in grades 6-8, and 44% in grades 9-11. The pattern follows results from 2014-2015. (See appendix A for figures reflecting Interest Inventory by gender and race/ethnicity).
- Both male and female interest in individual STEM subject areas decline with advancing grade levels. There is very little difference between males and females in their interest in science and math in any grade. However, the gender interest gap widens with advancing grades in the subject areas of computers and technology, and engineering
    - The proportion of students who are *very interested* in science is similar between males and females: 50% of males and 51% of females in grade 3 compared to 29% of males and females in grade 11, respectively.
    - In math, there is a similar trend of decline for both genders with little difference between them in any grade: 44% of males and 38% of females are *very interested* in grade 3 compared to 19% of males and 15% of females in grade 11, respectively.
    - In computers and technology, the gap in grade 5 is -14 percentage points (79% of males versus 65% of females), in grade 8 is -29 percentage points (47% of males versus 18% of females), and -25 percentage points in grade 11 (37% males versus 12% of females) between the proportions of males and females who are *very interested.*
    - In engineering, the gap in grade 5 is -8 percentage points (67% of males versus 59% of females), in grade 8 is -30 percentage points (42% of males versus 12% of females), and -26 percentage points in grade 11 (32% males versus 6% of females) between the proportions of males and females who are *very interested.*
- The proportion of students who are *very interested* STEM careers is actually higher among students who are African American, Hispanic, or Asian compared to White in grades 3 and 4. Interest among students who are Asian did not decline for Asian students and -8 percentage points for White students between grade 3 and 11. In contrast, the proportion of African American students who are *very interested* starts high at 51% in grade 3 but declines to 32% in grade 11 (a net loss of -19), and drops from 49% among Hispanic students in grade 3 to 33% in grade 11 (-16 net loss).

Students who said they were *very interested* in a STEM career scored higher in math and science achievement on the Iowa Assessments compared to students who were *not very interested*. This is true for all students statewide regardless of gender or race/ethnicity.

Section 4.1 Educator Survey

Data source Educator Survey, Iowa STEM Monitoring Project
Provided by Research Institute for Studies in Education, Iowa State University

Key findings

The Educator Survey is collected annually from teachers and others who implement Scale-Up programs in their schools and organizations. In 2016-2017, data were collected across all six STEM regions of the state and for 11 Scale-Up programs (New programs in 2016-2017 are noted by *):

- Curriculum for Agricultural Science Education (CASE) – Introduction to Agriculture, Food and Natural Resources (AFNR)
- Curriculum for Agricultural Science Education (CASE) – Natural Resources and Ecology (NRE)
- Engineering is Elementary (EiE)
- FIRST Robotics Competition*
- HyperStream
- Making STEM Connections*
- Power Teaching Math*
- Project Lead the Way (PLTW): Introduction to Computer Science*
- Project Lead the Way (PLTW): Principles of Biomedical Science
- Science Education for Public Understanding Program (SEPUP)*
- Spatial-Temporal (ST) Math

Scale-Up Program Awards

Four hundred and ninety-nine (499) Scale-Up program awards were made in 2016-2017. One thousand six hundred seventy-four educators (1,674) from 298 Iowa schools and 54 organizations were awarded Scale-Up programs (Table 38). This represents an increase of 263 educators (19%) from 2015-2016, and an overall increase of 846 educators (102%) since 2013-2014. There were 34 first-time awardees and 259 repeat awardees. Seventy (70) of those were awarded another opportunity to implement a program they had implemented in a previous year.

Table 38. Number of educators awarded 2016-2017 Scale-Up programs by region

	Total	Number by STEM Region					
Scale-Up Program	**n**	**NW**	**NC**	**NE**	**SW**	**SC**	**SE**
Total	**1,674**	**244**	**250**	**306**	**375**	**245**	**254**
CASE – AFNR	5	0	2	1	0	1	1
CASE – NRE	24	3	2	2	9	7	1
Engineering is Elementary	355	72	90	34	33	78	48
FIRST Robotics Competition	25	3	1	7	0	7	7
HyperStream	73	7	23	10	22	5	6
Making STEM Connections	577	118	90	42	155	118	54
Power Teaching Math	33	10	4	8	5	0	6
PLTW: Introduction to Computer Science	20	0	4	1	3	6	6
PLTW: Principles of Biomedical Science	14	0	3	6	0	3	2
Science Education for Public Understanding Program (SEPUP)	29	8	5	4	4	3	5
Spatial-Temporal (ST) Math	519	23	26	191	144	17	118

Source: Iowa Governor's STEM Advisory Council, Office of the Executive Director (as of April, 2016)

[a] Note that CASE – AFNR and CASE - NRE were awarded in 2016-2017, but will not be implemented and reported until 2017-2018.

According to records provided by the Iowa Governor's STEM Advisory Council, Office of the Executive Director (dated April 2016), over 74,000 PK-12 students participated in the 2016-2017 Scale-Up programs (Table 39). Over 37,000 students participated in the Making STEM Connections program, almost 15,000 students in the Engineering is Elementary program, and over 11,000 in Spatial-Temporal (ST) Math program. Over 3,000 participated in the Power Teaching Math program, over 2,300 in the HyperStream program, and more than 1,500 in the SEPUP program. Other programs such as FIRST Robotics Competition and PLTW attracted over 1,500 students. Almost 2,000 students are expected to participate in the CASE programs next school year. Others who participated included parents, community members/partners, engineers, corporate volunteers and business mentors, college students, family members, and school administrators. Most of the respondents' Scale-Up programs served K-6 students, although all grade levels participated in educators' programs.

Table 39. Number of students participating in Scale-Up programs by region

Scale-Up Program	Total n	Number by STEM Region NW	NC	NE	SW	SC	SE
Total	**74,038**	**13,059**	**10,807**	**9,634**	**13,029**	**14,905**	**12,604**
CASE – AFNR	580	0	85	300	0	60	135
CASE – NRE	1,230	47	95	65	410	573	40
Engineering is Elementary	14,881	3557	2543	2048	1315	3322	2096
FIRST Robotics Competition	279	28	15	66	0	75	95
HyperStream	2,330	339	872	315	554	125	125
Making STEM Connections	37,428	7048	4848	2261	7330	9763	6178
Power Teaching Math	3,038	1050	450	715	300	0	523
PLTW: Introduction to Computer Science	770	0	105	15	125	390	135
PLTW: Principles of Biomedical Science	468	0	125	165	0	108	70
Science Education for Public Understanding Program (SEPUP)	1,569	439	370	195	160	100	305
Spatial-Temporal (ST) Math	11,465	551	1299	3489	2835	389	2902

Source: Iowa Governor's STEM Advisory Council, Office of the Executive Director (as of April, 2016)

Descriptive Information about the Educator Survey

In 2016-2017, 1,146 Scale-Up educators were sent an email invitation to complete an educator survey. Valid surveys were completed and returned by 730 educators (64% response rate). Responding educators represented 202 Iowa school districts and 11 organizations such as extension and outreach, libraries, and museums. Ninety-two percent of the respondents identified themselves as in-school educators and eight percent as informal or out-of school educators.

Overall, the six regions were well represented. Seventeen percent of the responses represented the Northwest region, 17% represented the North Central region, 23% represented the Northeast region, 9% represented the Southwest region, 15% represented the South Central region, and 19% represented the Southeast region.

Respondents most often implemented Engineering is Elementary (29%), ST Math (26%), and Making STEM Connections (27%). Four percent of respondents each implemented HyperStream programs and SEPUP. Three percent or less implemented CASE – Food Science (3%), Power Teaching Math (3%), PLTW: Introduction to Computer Science (2%), PLTW: Principles of Biomedical Science (2%), and FIRST Robotics Competition (2%).

Program Implementation

The educators reported on five aspects of program implementation: 1) whether programs were implemented as intended or were modified; 2) experiences with service providers and challenges or barriers faced in working with service providers; 3) collaboration with local groups; 4) local involvement; and 5) challenges in and recommendations for implementing the Scale-Up program. Summaries of open-

ended responses follow. Over two-thirds of the educators implemented their Scale-Up programs as intended, and about one-fourth implemented their programs with minor changes. A small percentage implemented their programs with major changes. Reasons given for minor or major changes to programs included setbacks due to time constraints, late arrival of or insufficient materials, other lessons or curriculum requirements that interfered with STEM programs, and changes in educators or scheduling.

Implementation Most educators reported a positive experience working with their Scale-Up service providers, indicating that they had adequate contact with the service provider (78%), they received materials and resources in a timely manner (89%), the service provider was responsive to questions and needs (90%), and the partnership met their overall expectations (90%). Over half did not report any challenges in working with their service providers and over one-third did not contact them. Forty-one educators thought that their training did not adequately prepare them to implement the program, and 26 thought their Scale-Up program's website was difficult to navigate.

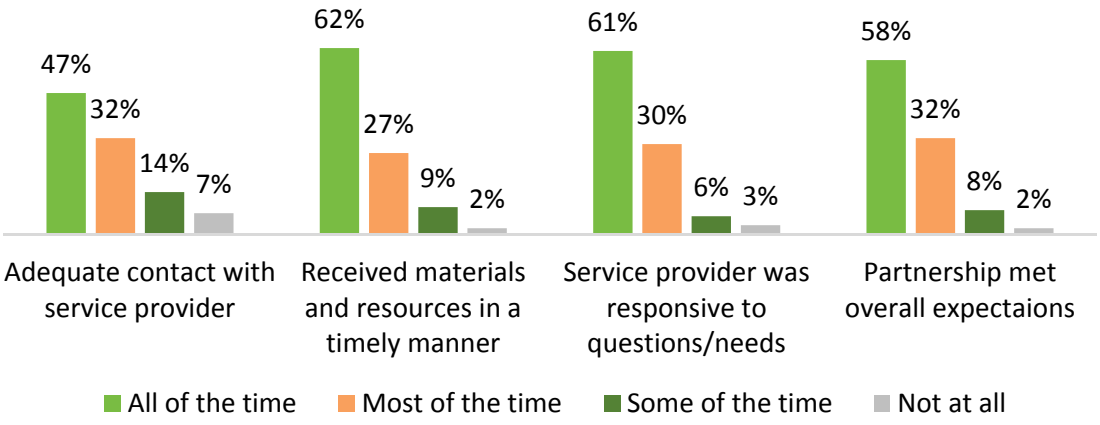


Figure 30. Educator experiences with service providers

Challenges, barriers, and recommendations to others Educators reported some challenges in implementing their programs, including that they did not have enough time to implement the program, that it took longer than expected for them to plan, prepare, and set up the materials, that the program was too advanced for their students, that they did not feel familiar enough with the program to teach it properly, or that they received their program's materials or information late. Fifty or fewer reported that they did not have enough materials for all of their students, that they found it difficult to recruit and find meeting times for students with busy schedules, or struggled to find volunteers, mentors, and business partners.

Educators offered recommendations to others implementing Scale-Up programs, including seeking advice from other educators who have used the programs, preparing materials early and planning extra time, using resources provided by the program, breaking up classes into smaller groups, having volunteers, and having sufficient technology at their facilities.

Over half of the educators reported collaborating with local groups, primarily with others in their schools. About 10% of the educators indicated they had business partners that most often provided guest speakers, discussed STEM careers and opportunities with students, and mentored students. Business partners also helped students design or build their projects, hosted field trips or gave tours of their facilities, provided funding or specific materials and resources, provided the use of their facilities during implementation, or organized events where educators and students could present their projects.

Program outcomes and impact of the 2016-2017 Scale-Up programs.

Educators were asked to report gains in their skills and confidence in teaching STEM-related content; whether they used or developed school-business partnerships in implementing their programs, the number of school-business partnerships, and a description of their most used partnership; and observed outcomes resulting from the program.

Educator gains in knowledge, skills, and confidence Educators reported that they gained skills and confidence in teaching STEM topics as a result of their participation in Scale-Up programs. The majority of educators agreed or strongly agreed that they now have more confidence to teach STEM topics (70%), have increased their knowledge of STEM topics (74%), are better prepared to answer students' STEM-related questions (65%), and have learned effective methods for teaching in STEM-content areas (67%).

Educators observed that their students benefitted from their participation in the Scale-Up programs. Over 70% of the educators reported observing increased student interest in STEM topics, while almost two-thirds reported increased student awareness in STEM topics. Approximately 40% of educators observed increased student achievement in STEM topics. About 30% reported increased student awareness in STEM careers, and 25% reported increased student interest in STEM career opportunities. About 15% reported increased interest in post-secondary STEM opportunities. Other observed student outcomes included increases in student engagement, excitement for STEM content, and confidence in their abilities. Several educators commented that the programs improved students' math abilities in particular. Also, educators observed increased awareness of STEM for parents, other students and educators, and the community due to the Scale-Up programs.

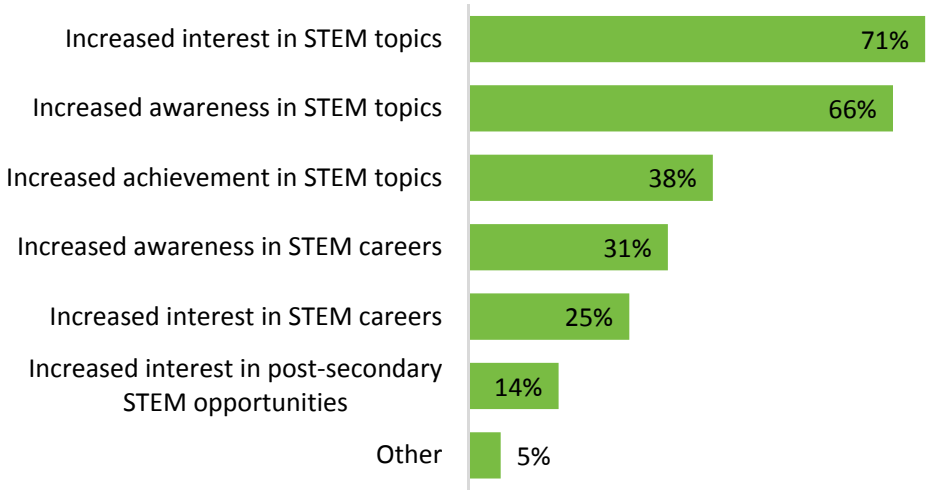


Figure 31. Observed Student Outcomes of the Scale-Up Programs

In an open-ended question, many respondents reported that students experienced an increase in excitement, engagement, and interest in STEM content areas due to the hands-on experiences provided by the programs. They also thought that students' critical thinking, problem solving, confidence, and perseverance showed improvement throughout the program. Moreover, students were seen as more likely to pursue careers and further education in STEM fields due to participating in the Scale-Up programs. Anecdotally, educators reported improvements in students' assessments, test scores, and academic performance. Furthermore, educators observed their students thinking more like scientists and engineers due to the programs, as well as applying their knowledge of math, science, and technology to real-world problems. Some educators reported their students gained a better general understanding of STEM topics and developed their abilities to collaborate with others and work as a team. Educators also noticed students making connections between what they learned in the Scale-Up program, other areas in school, and the world around them. The programs provided individualized learning based on each student's needs, allowing students to move at their own pace and solve problems in multiple ways. A few educators noted that students gained new experiences with STEM technology provided by the programs. Besides noticing these benefits for their students overall, educators also realized the programs allowed struggling students to learn in new ways and succeed; piqued interest and participation in STEM among girls; increased STEM awareness and participation from teachers, parents, and the community; and proved challenging for high-achieving students.

See below for a list of representative comments related to the impact of the Scale-Up programs.

Engagement

> *The students' interest in this program and their excitement to learn more was the biggest impact I could see. They asked every day if we were going to work on the STEM activity. Their knowledge and use of vocabulary throughout this unit definitely grew. They were eager to go home and try this activity at home and talk with their parents about it.*

Opportunities to be creative in a hands-on environment. It has gotten more students involved in STEM activities.

Students have become more engaged in the regular classroom during math instruction. They have been able to relate what they are doing on ST Math to what is being taught in the classroom.

One boy in my class "hated" math at the beginning of the year. He insisted that he couldn't do math, he destroyed his math workbook, and refused to even attempt anything that had to do with math. By second semester, although he still wasn't real excited about math instruction in the classroom, he was asking daily during any free work time, including indoor recess time, if he could do ST Math. He was extremely proud of the levels he was passing and found that some of them were "actually easy." This complete turnaround in his attitude toward math was incredible to see. I never would have guessed it possible. The other big thing I saw was the students' increased perseverance in problem solving. Amazing!

The activities help students experience what it is like to be an engineer, not just hear me talk about it which allows them to be much more engaged. The materials provided make it easy for all students to create and try all activities, and they are able to try and re-try things when they don't work the first time.

The kids loved these after-school activities at our library! They had so much fun making and testing their rockets outside and creating recycled race cars. Because they had so much fun, it really increased their interest in engineering professions. They had tons of questions and the lesson plans got them to think critically.

My students are excited to do ST Math and are always asking if we get to do ST Math. My students were able to problem-solve and complete the majority of the program independently.

The program has improved the rigor of the academics at my school. Students have become much more engaged in learning and the process of learning through this program.

The students who have used these materials were so excited to have hands-on opportunities to learn. Overall, student engagement was really high and every student has wanted more time to use the materials.

Students were excited to implement the skills and some asked their parents about using similar things at home, students created things that could be used in the classroom over and over again.

Students were consistently engaged and excited about learning and teaching others. They pushed themselves and were incredible problem-solvers!

My students informed me that it was their favorite activity this year!

My students looked forward to ST Math. They loved the "challenge" activities and were very determined to pass each level.

Students were always engaged and there was so much more discussion on topics.

The students have become more interested in science and many say that it is their favorite subject this year.

A young man was in the library using the Makey Makey tools. Soon there was a group of 7 - 8 children wanting to know what he was doing. This led to him explaining the tools and next thing you know all of the other children are actively engaged with the Making STEM Connections items. They were so interested in the "making" concept that it drew them away from the ever popular computer video games. Success! I had 60 children using the program…in… grades K - 6th.

Students were very motivated to participate in the weekly ST Math sessions and often asked to work on ST Math in their free time. When math topics were presented in class that students had worked on in ST Math, students were excited to "make the connection" and could easily relate their ST Math experiences to their daily math instruction.

Students were more engaged in our science/STEM activities than before. As a result, the activity and learning experiences were more meaningful and helped them better understand the concepts.

Students are more engaged because they are doing projects that are hands-on. They LOVE STEM time and look forward to it whenever we are working on experiments.

More engagement of students with hands-on learning. Students thought learning was fun and welcoming - they felt comfortable and could relate to connections made within the units of study.

Our elementary students were able to perform more STEM-related projects, which really helped increase their interest and awareness in STEM topics. They were so excited and enthusiastic about coming to science. It has made a significant impact.

My students always looked forward to Maker projects! For many, our Makerspace times were their highlights from the whole year. They learned that they can be Makers in many different ways. It definitely inspired creativity!

Students have verbally shared how much they learned and how much they enjoyed the learning process. They were able to articulate their learning process and explain what went well, what didn't go well, and how they kept trying new things. Students are excited about what they are going to learn next and are attentive when listening to others share what they are creating. The conversation often continues for days outside of the classroom.

My students were extremely engaged in the STEM activities, they asked about doing them all the time. They retained the knowledge from the activities and applied it when we were in different situations, i.e., we were on a field trip to Jester Park and my students pointed out the types of bridges we crossed on the road.

Student personal development

Students were exposed to the engineering design process, worked in collaborative small groups, and learned how to accomplish the tasks/challenges presented to them by working with each other. They also learned from their mistakes and that it was okay to make mistakes. Reflection, revision, and creation were all skills learned and used throughout the lessons.

Students have learned to stay with a challenge longer and work through the math puzzles. Students are more motivated and excited about learning more/harder levels of math.

Students were very self-motivated to complete ST Math everyday. They learned and cooperated to help each other to meet the challenges of each level.

Participants have been able to get hands-on experience with several science practices. Participants have been encouraged to push themselves and take charge of their learning.

The students have had increased opportunities to use their 21-century skills, such as communication, collaboration, creativity and critical thinking.

One of the biggest impacts this program had with students is allowing students the opportunity to build on their problem-solving skills. Many of the students within this program learned the value and importance of never [giving] up on a task and seeing their task being completed fully. With this program, this impact has affected our classrooms as our teachers are seeing the new drive students have with their problem solving skills and determination to succeed.

My students are identifying as Makers. They are solving problems and creating solutions instead of looking for the answer in a book or online. They learned to use tools and safety. GREAT program!

I think this program helped my students understand the sky is the limit and gave them more of an open mind to think outside of the box to try and solve a problem.

Students had to use higher-order thinking skills very often during this unit and they also learned problem solving skills. Labs were hands-on and worked well to teach the material in a way that students will remember.

Students are spending more time engaged in critical thinking, reflection, problem solving, etc. Students gained confidence in their ability to approach academic work.

The students challenge themselves more on a daily basis and feel confident when they are being challenged; it's a positive! The students have become better problem solvers as a result of the ST Math Program.

I think the biggest impact CASE has had on my students is to help them think more critically. In order to complete assignments, they have to think about more components that they covered either in the beginning CASE classes or at the beginning of the unit so I like how everything ties together. Some of my students have gone into Agriculture-related careers as well, and I think CASE has a lot to do with that.

Students learned to think independently and not strictly depend on adults to provide support and assistance.

The students are more motivated to try STEM activities. Their mindset has improved and they are not so quick to give up.

The confidence and math talk I hear from my students has increased dramatically. They rely on themselves and their teammates to work problems. Their understanding of math topics has also increased through my implementation of the Power Teaching Math curriculum as well as the cooperative learning framework.

It allowed students to think differently and more abstractly. ST Math pushed my students to try harder.

Student interest and excitement was evident the more activities I conducted with classrooms. I fielded some engaging questions from students at the beginning and end of activities. I observed some high quality critical thinking during activities at all grade levels.

Students make comments indicating confidence in their ability to figure something out...."I did it"..."We're geniuses!"

The ST Math program gave students the opportunity to understand their strengths/challenges with math concepts when presented in a visual way. Students began to collaborate more with each other to problem-solve through the challenges. Students also developed a stronger base for problem-solving. The ST Math program develops the critical skills needed to be successful in STEM fields.

The students understand how attempts don't have to be seen as failures, but rather as chances to learn from what didn't work and then try again. Learning isn't always a direct path and that the journey to the end result was the learning not necessarily the final product.

Our students are now having more in-depth discussion in the process of math and a deeper understanding of 'why' it works. They have also increased their abilities to collaborate in a productive manner.

Students were better able to explain their answers using valid reasoning and examples.

I had my doubts that the students would fully understand the problem presented and be able to improve on given designs or imagine a new design. I was stunned when all teams were able to verbalize the problem each design had and were able to arrive at improvements to test and eventually settle on a design that met the criteria set in the curriculum.

The students are more willing to problem solve when given a task. Instead of giving up, they will try other options or seek advice from others. Communication among students has also improved.

My students really wanted me to give them a way to design a project, when they realized it was up to them to be in charge of their designs as a team, the creativity exploded!!

Careers and further education in STEM

Students gained a lot of knowledge about what an engineer does, and many expressed interest in becoming an engineer in the future.

This [program] exposed students to more career opportunities in STEM fields.

Students were able to learn about different career opportunities and more about the world around them.

Many students have indicated their interest in pursuing a career in an engineering field. Students applied for scholarships through the FIRST Robotics Competition Program.

There have been a few students asking how they can get involved in taking computer science courses in college. Others have sat down to discuss what degree they would need in order to get involved in a certain computer science-related career.

Students felt programming apps in app inventor was fun and said it opened their eyes to career fields in programming and robotics.

Many of my students didn't know what Industrial Engineers did and now they do. Some even said they want to go into engineering because designing and building is fun.

Some of my students have taken an interest in pursuing medical careers.

Better understanding of careers within Food Science and related to Agriculture.

One of the best parts of the PLTW: Biomedical Sciences program was the exposure to different career areas in the medical field. There were several assignments where Career Journals were a part of the overall assignment where research needed to be done on a specific field within the overall medical career field. I think some of these really opened some eyes to all the possibilities out there beyond just being a "nurse" or "paramedic".

Students are now aware of jobs in the science field and how fun they can be! Students have written about wanting to be scientists and engineers when they grow up.

One of my 5th graders stated that if a career in the NBA doesn't happen for him, he is excited about majoring in computer science or an engineering field.

Student achievement

My students look forward to STEM activities each week and when they took their Iowa Assessments, questions were related to the activities we had done this year. They felt very confident in their answers. I was astonished that they shared their "aha moment" with me in testing.

I believe our students were able to achieve higher levels of success with our math curriculum by having the experience of learning through solving visual puzzles. The visual representations were very effective in teaching many of our essential standards such as fractions, elapsed time, place value, etc.

Increased math scores on formative and summative assessments.

ST Math has really helped students in fourth grade improve their mathematical skills. They have a much better understanding of the topics covered.

Students knew concepts and had mastery of them earlier in the school year.

Overall improvement on Iowa Assessments. Growth in collaborative learning projects.

The students were able to attack core curriculum after having used ST Math. They also enjoyed the challenge.

Students wanted to build, create, explore more. Teachers had more interest in using the materials. The percentage of students making expected growth in science increased by 18% as compared to last year.

The students began to better understand many of the topics presented in ST Math which helped them to do better in our school math curriculum.

My students' math scores/understanding have grown, and they are excited about math!

At the beginning of the school year, I had 4 students out of 54 that were proficient in math in our I-Ready program. At the end of the school year, we had 16 students proficient in I-Ready and 80% of them were proficient on Iowa Assessments. After using the Power Math Curriculum and program we had an average growth effect of .55, with .4 being one year's growth. Many students showed at least 2 years' growth. I had 5 students that were in the Power Math Algebra course that improved 4 grade levels in Math on Iowa Assessments and I-Ready Diagnostic testing. The 8th grade group had a .78 average growth effect on Iowa Assessments which is almost two years' growth. Map testing showed similar results. The cooperative learning element promoted mathematical discourse, improved students' communication skills and improved their problem solving skills. I have been very impressed with the results after just one year of using this program.

Students thinking like scientists and engineers

Students loved going through the design process of STEM and re-imagining their redesign of their water filters. My students are always referring to STEM processes during math, reading, and social studies now too.

The students loved doing the experiments and when they tried to improve the model to keep the frog membrane wet, they really felt like it was a challenge.

My students developed skills to help them investigate science. My students also are better able to have discussions and form a stance on complex science topics.

Students were challenged to work together. I heard lots of really good conversations. Students had to make decisions about the data. This required them to use many of the methods of science.

It challenged the students to think more like mathematicians. They had to solve everyday math in various ways and apply to real-life situations.

The students were using the engineering process to problem solve.

The students enjoyed problem solving, especially when building the solar oven. They were able to test materials and then try out which ones they felt would be the most successful. I also loved hearing their discussions while doing these activities.

The students have begun asking higher-level questions. They are also using various classroom materials in new/different ways.

Youth were able to use terms associated with electrical currents correctly. Youth were able to problem shoot issues when their experiment did not work.

My students have gained knowledge and experience with the engineering design process. My students have learned to take risks and stretch themselves to try new things. With STEM, they have learned that it does not have to be perfect to start with. If things do not work as planned, they can revise their plan and make improvements along the way.

Students were given time to explore with materials not usually used. They were able to design something and create and, if needed, change to meet the needs of the function of the design.

Through the tinkering process, the students have improved their growth mindset. They have to plan, test, build, and modify repeatedly in order to complete their goal/project. The students had to learn they couldn't give up if they wanted to see their project through. We had a pretty equal participant ratio of male to female. More girls were becoming excited about STEM and wanting to participate in the program.

Got the students to think like engineers. Let the students build and construct their own product. They enjoyed the end results.

The participants have a better understanding of the design cycle and focus is not on the end result, but the process.

Science in the real world

Students could use the information they were learning in science and apply it [to] the real world through agriculture.

Students understand the challenges engineers face when creating new technology.

Students understand networking and protecting themselves from cyber attacks. They know how to set up virtual machines and run programs on them.

The program provided my students with an opportunity to problem-solve a simulated life experience of an oil spill and what to do in order to clean it up. It was amazing seeing their minds work together to find the best solution.

Students became more aware of science in their everyday lives.

Students were quite interested in and concerned about the environmental impacts of the issue we studied.

I believe that linking the entire topic of genetics to GMOs gave the students a real-world application to connect to. This connection helps the students to understand how genetics is used in everyday life. Also, because our school is located in a rural area, students who are involved in agricultural studies had an opportunity to share their knowledge on the GMO topic.

The students really liked how realistic the program was. They were also fans of the hands-on stuff.

We spent a lot of time with Engineering and the design process. I had a former student who is now an engineer come to class and speak to my students. He reinforced the elements of the engineering step and design process and gave us real-life examples. This was very motivating to the students.

Chance to talk about real-world biological issues and how to solve them.

I think it opened students' eyes to the fact that engineering is needed in so many different fields, from zoology to humanitarian aid organizations.

The case studies show students how current topics in biology are affecting real-world situations. This makes science more real and certainly shows them the relevance of the topics we teach. I like that the activities center around controversial topics in some cases and get the students to consider all sides.

General understanding of STEM

They have a different and better understanding of the term "technology". They have learned that there is NO RIGHT answer to some problems, as long as the solution works.

It allowed the students to learn new STEM topics and it allowed them to use different objects they may never come in contact with.

My students had a lot of misconceptions of what technology and engineering [was] at the beginning of the week. They saw technology as something that had cords and some students who thought that engineers only work on trains. It was amazing to see how their knowledge and thought processes matured into the realization that technology improves upon a process or solves a problem. Also we interviewed some different engineers and were able to better understand their role as well. Thank you!

They really enjoyed learning about the definitions of scientist, engineer, and technology. It was difficult at first for them to think about those concepts. They are really excited about engineering now!

Our students gained a lot of vocabulary during this unit.

Basic concepts of technology, engineering, and processes.

Students became more aware of what engineering is and became excited about building things and improving technologies.

My students had no background in biotechnology and this really provided initial ideas of this topic.

Students are using more language that is related to STEM (planning, testing, creating).

Students are aware of programs and software they can use to pursue their personal interest in creating games and apps.

Many of the students were not aware of what engineers did when I asked before we began the unit. After the unit, there was a significant increase in their knowledge. The students also found that they may not get it right the first time but they can make changes and continue to make a structure better.

The circuit kits provided a tangible understanding of how circuits are formed. You need a closed path and all parts must be oriented correctly. Allowing children to build the circuits allowed them to problem solve. Why did the light not come on? What needs to change to make it work?

Teamwork and student collaboration

My students are better collaborators and are doing a better job of thinking outside of the box due to working with these materials.

They learned how to work as a team.

I believe that the greatest impact this has had on my students is working collaboratively to try to solve ideas. They wanted all the groups to succeed, not just their own. They saw helping others [as] a win/win. I also saw students go from giving up on an idea the first few times, to really working through their ideas and trying and retrying ideas. I saw teams helping other teams. I found that very rewarding.

Several new students have made friends and become more social. They share ideas. The after-school program involves parents who are not involved in other opportunities at the school.

The students love that they can be actively engaged with the materials from the kit. I loved hearing their conversations and watching their collaboration when they worked in groups. It was amazing to witness the results of their problem solving skills.

I have noticed how students are able to help each other and problem solve. They have been very creative given a set of parameters.

The major impact that I have seen from the Scale-Up program was the collaboration efforts from my students. The many projects created with the tools and resources helped students work together for a purpose.

It provided the opportunity for my homeschool students to work collaboratively and problem solve together. Often, they don't have this particular opportunity. It was amazing to watch these

diverse students (both age and ability) come together to solve problems, create new technologies, and present together. Many had never done any sort of activity like this before. It was truly a joy to be a part of!

I see the positive teamwork that my students can use to help in problem solving. That has had a good impact on our classroom overall in terms of understanding and productivity.

My students loved the team approach that Power Teaching Math provided. They found it to be a great way to learn math. I loved the structure of the program for my students.

We have a very diverse team varying from ethnic backgrounds, levels of understanding/interest in STEM, and a wide range of personalities. Some of the girls joined the team because they were truly interested in a career in STEM while others joined because they wanted to try something new and wanted to put themselves out there for the experience. They all started out very timid - not even the common hello's and goodbye's. We focused the first couple of months on team building and then transitioned over to the robotics as soon as our materials were received. Now, about a little over a month until competition, the girls are working together, sharing ideas, problem-solving, and ready to take the challenge.

Making connections and transferring knowledge

Students have used our Makerspace, along with the engineering process in not only science, but in social studies, reading, and math.

My students connect content from ST Math to daily math core instruction and said they were better prepared in the subject because of ST Math.

Students made connections between in-class learning and the ST Math program.

Many of my students have made comments about how the concepts of CASE have shown them the application and utilization aspects of many science topics and theories. They have also commented on how when taking MAP tests this year that they were able to fall back on knowledge learned from the course when taking the standardized test.

The students were better able to relate science and agriculture, seeing how they play hand in hand with one another.

Students were able to practice benchmarks I had taught in a different way than the way I had presented them. The visual representations were very helpful for many students to get the concept and it helped me to see how they were or were not visually interpreting information.

Transfer of mathematical concepts/skills.

Our unit was on sound and we talked about primary and competing sounds. The kids are really aware of and talk about the competing sound they hear in our classroom. The engineering design process also came up with something else we were doing and the kids made a reference back to it! The kids loved the unit.

Students were more engaged in their learning. I had students applying examples from their STEM experiences to other subject areas. One student used his learning about geotechnical engineering in his persuasive/opinion paper.

Students' interest in math grew a lot through the ST [Math] program. They looked forward to working on the program and made great connections to classroom learning and real life problems.

Individualized learning

Students were able to work at their own pace in order to reach mastery of a variety of topics.

Students are able to learn and apply math skills at their own pace and the hands-on, guided learning gave them confidence to persevere and stretch their thinking of math. It has increased confidence in my math students.

Students were given the opportunity to create and plan projects that were of interest to them with the STEM materials. Everyone learned something new, including the teachers. Students who could sew taught other students simple skills. Students enjoyed doing Makey Makey and used interesting materials to create connections.

Students had first-hand experience with learning math through an online environment that was customized to their level of learning. In addition, students were able to learn math conceptually through the ST Math program, which is different than the typical online math games that emphasize skill and drill type problems.

Allowed students to work at their own pace and figure out how to problem solve in order to correctly answer the given problem. Students were excited to figure out how to solve a problem on their own instead of following the steps provided by the teacher.

Students were able to choose materials from the grant that would help them to solve a problem at home or at school. Some used power tools for the first time in order to create a table for home use, some used zip ties, binder clips, glue guns, etc. to create entertaining devices (such as games, as seen on Caine's Arcade). Some groups created Rube Goldberg projects with various materials, and challenged their problem solving as they adjusted angles, force, and other concepts to successfully complete their goal. We also used the materials from the Scale-Up grant to extend our learning from literature. One of the books that we read piqued the interest of the kids in various areas of science, such as: rabbits, marmots, SMART cars, and carbon footprints (as well as platform shoes). Students were able to research these concepts further and create models from the Scale-Up grant to demonstrate their learning to their classmates. Students also became computer engineers as they designed their own Scratch programs with Makey Makey.

My students were incredibly enthusiastic about having the opportunity to use the equipment that came with our cart. They had great creative thought processes and created many interesting projects on their own. We actually had a STEM time each day so they could work on

their ideas and projects. Most projects were individual and met some need or solved a problem they discovered.

New experiences with STEM technology

Students were really excited to try things that they hadn't tried before and really got parents excited about working with them outside the classroom with STEM activities.

Students were able to create an app that they could use on their own device.

Students were able to use materials that they had never been introduced to before such as a hand saw, hot glue gun, dowels, safety goggles, sewing kits, etc. in the Maker Space carts.

Students received opportunities to work with materials they had not been exposed to previously. They were able to learn how different tools worked, and learned to be comfortable around them.

Several students used the sewing machine for the first time. One student experimented with melting plastic, tested theories and now understands what techniques to use when handling an iron.

Introduction to new, memorable sensory materials.

Success for struggling students

Some of our students who struggle academically have had [the] opportunity to succeed and excel in building, creating, and figuring things out on their own.

I had three very bright but not very motivated students really excel in this class. All three students went above and beyond my expectations on several projects/assignments, and all three are interested in a computer science career.

The students were excited to try hands-on activities and make things through the maker program. For students who don't do as well with traditional learning programs such as reading or writing, STEM provided them with an opportunity to succeed in a different capacity.

Opportunity for our at-risk population to build self confidence, work on their problem solving and reasoning skills, and explore career opportunities.

Students who have not been successful in math up to this point found it helpful and less scary to discuss in teams to form an answer as a whole. It has been a positive.

I have two low-level 7th grade students that saw success using the EV3. They also had an English language learning student help them. To see the three of them able to make their robot do what they wanted was exciting!

We were able to get some students that have less connectivity to the school than most interested in a program that fit their interests and needs. We fully expect the program to grow and have a greater opportunity to connect to other classes in the district.

One particular student who is normally quiet took a leadership role as he felt confident in his abilities in this area.

I have some English Language Learning students in my talented and gifted classes. With ST Math being about visualizing and watching the animation to see how the math modules work, they were able to better develop and deepen their understanding of math concepts, rather than focusing on the reading and vocabulary of words.

Increased participation from girls

I think the program did a great job of getting many girls involved and excited about the STEM topics and career opportunities.

Students are excited to complete STEM challenges. I was especially excited to see girls getting excited about STEM topics because traditionally fewer girls participate in STEM careers.

I saw a lot of girls achieving math at high levels, giving them a lot of confidence.

Implementation of this program has offered the girls in our program an outlet to explore STEM-related fields. Throughout the implementation, more girls participated than boys! It was incredible to see the students collaborating and working with one another.

Through this program and the materials I have received, I now have captured the interest of more female students than ever before. This program has tripled the number of females involved in computer programming within our school.

Increased participation in STEM from teachers, parents, and the community

This award was shared with classroom teachers, who became much more engaged in using our already existing MakerSpace. They are showing ownership now towards implementing a STEM program.

Had community members join our STEM program when the students presented their idea in a Shark Tank-like format.

Several of our high school content area teachers experimented with the STEM materials provided through this grant. Because of that, STEM education and the use of creative tools is happening in a lot of different content areas.

My students enjoyed the opportunity to work with parents/grandparents on activities that we normally could not do in the classroom.

Many of our families came from bilingual (usually Hispanic) families and the parents do not have an opportunity to work with the equipment and tools that we had available at our our Family STEM Program. One family in particular was excited to see that learning can occur with recyclable materials and a little instruction and asked for more ideas that we provided that night. They went home with a variety of books and instructions for more activities they can do as a family at home. Most of the parents were intrigued by the materials that involved coding,

electronics and robotics. The question, "How soon will you plan another night like this? It was a learning time for us as well as our children." The question, "Will you provide this program weekly?" came up several times.

Challenging high-achieving students

It was able to extend many of our higher learners in math. They were intrinsically motivated.

Challenged students who are not normally challenged in math.

Section 4.2 Report of participant information

Data Source Student Participant Lists, Iowa STEM Monitoring Project
Provided by Iowa Testing Programs, University of Iowa

Key findings

There were 29,415 students listed on student participant lists submitted to Iowa Testing Programs, of which 19,102 had matches to Iowa Assessments regardless of STEM Interest Inventory participation (65% match rate). Of these, 48% were females and 52% males. The distribution of students by race/ethnicity was 84% white, 8% Hispanic, 3% Black/African American, and 6% Other (Table 40).

Table 40. Demographics of Scale-Up program participants matched to Iowa Assessments[1]

	2012/13	2013/14	2014/15	2015/16	2016/17
Number of students on student participant list submissions	7,771	26,238	23,779	29,396	29,415
Number of Scale-Up students matched to Iowa Assessments information (match rate)	6,225 (80%)	19,497 (74%)	15,905 (67%)	17,122 (58%)	19,102 (65%)
Gender distribution					
Female	44%	48%	46%	47%	48%
Male	56%	52%	54%	53%	52%
Race/ethnicity distribution					
White	87%	80%	84%	87%	84%
Black/African American	6%	5%	2%	3%	3%
Hispanic	3%	9%	9%	5%	8%
Other	4%	6%	5%	6%	6%
Grade level (n)[2, 3]					
3rd grade	12% (755)	13% (2,534)	10% (1,604)	13% (2,301)	17% (3,311)
4th grade	13% (795)	9% (1,693)	11% (1,761)	16% (2,714)	19% (3,597)
5th grade	13% (805)	13% (2,475)	14% (2,194)	17% (2,949)	19% (3,577)
6th grade	19% (1,202)	11% (2,109)	14% (2,225)	14% (2,321)	11% (2,070)
7th grade	7% (439)	17% (3,403)	12% (1,972)	19% (1,584)	7% (1,255)
8th grade	21% (1,309)	24% (4,707)	12% (1,843)	12% (2,054)	7% (1,331)
9th grade	9% (584)	3% (583)	4% (655)	4% (629)	3% (596)
10th grade	3% (167)	2% (341)	3% (417)	4%(608)	8% (1,502)
11th grade	3% (168)	2% (303)	3% (471)	2% (399)	2% (334)

1. Reflects distribution of Scale-Up program student participants matched to their Iowa Assessments scores alone regardless of a match to the STEM Interest Inventory.
2. Iowa Assessments are standardized tests taken annually by nearly every student in grades 3 through 11 in the state of Iowa. Since 2012-2013, the Interest Inventory has been added to the Iowa Assessments. Schools have the option to administer the inventory with their students.

3. Grade level distributions updated for all years in 2016-2017.

STEM Interest among Scale-Up students versus students statewide

The proportion of Scale-Up participants expressing interest in STEM subjects and careers was compared to the proportion of students statewide that expressed interest.

- In 2016-2017, a higher percentage of students who participate in STEM Scale-Up programs said *I like it a lot* (Grades 3-5) or were V*ery interested* (Grades 6-12) in STEM subjects, in pursuing a STEM career, and in working in Iowa after graduation compared to all students statewide (Figure 32).
- The percent of students who said they were *very interested* in having a STEM job was 42% of Scale-Up program participants compared to 39% of students statewide.
- The percent of students who said they were *very interested* in working in Iowa was 46% of Scale-Up program participants compared to 38% of students statewide.
- There was no difference in the patterns comparing students who participated in a Scale-Up program versus all students statewide in subgroup analyses by gender. That is, female students who participated in a Scale-Up program followed the same trend versus all female students statewide. The same was true for male Scale-Up participants versus all male students statewide.

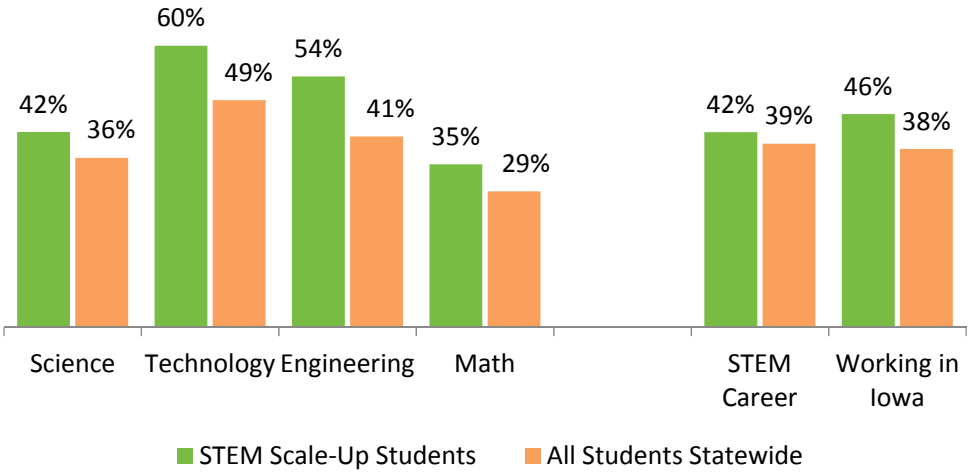


Figure 32. STEM Interest among Scale-Up students in grades 3 through 11 versus students statewide, 2016/17

- For students in grades 3-5 and grades 6-8, interest in STEM topics and STEM careers between Scale-Up participants and students statewide is very similar (Figure 33 and Figure 34, respectively).
- For grades 9-12, students participating in Scale-Up programs showed more interest in STEM topics and STEM careers than students statewide (Figure 35).

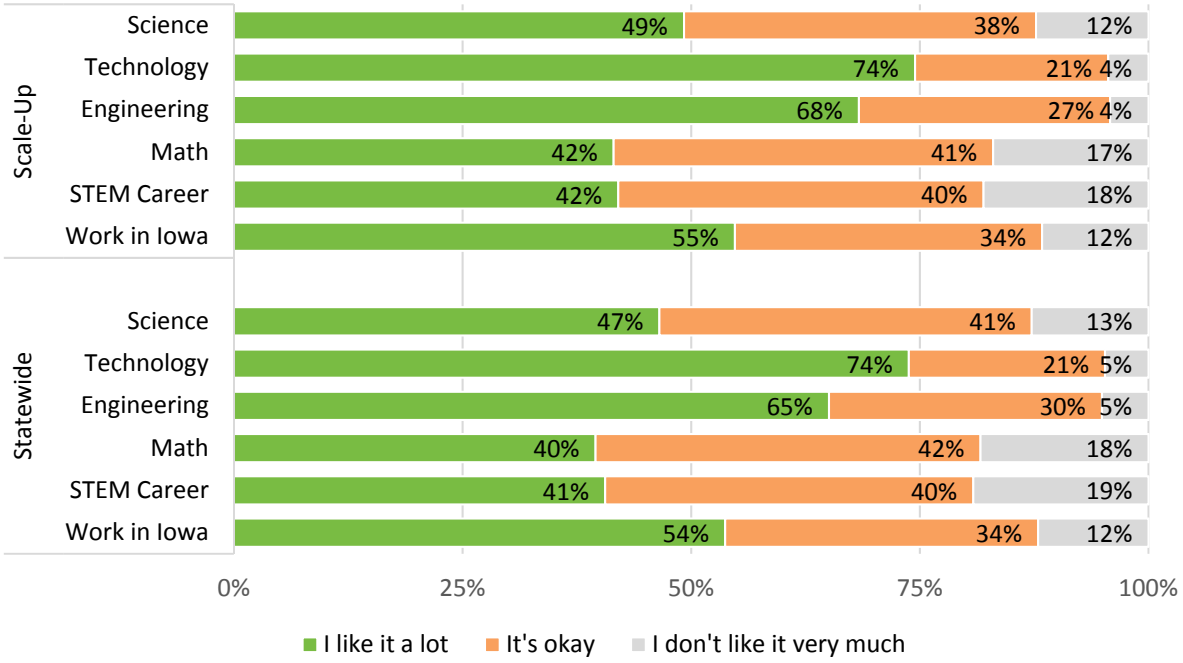


Figure 33. Interest in STEM topics and careers for *grades 3-5* Scale-Up students and students statewide, 2016/17

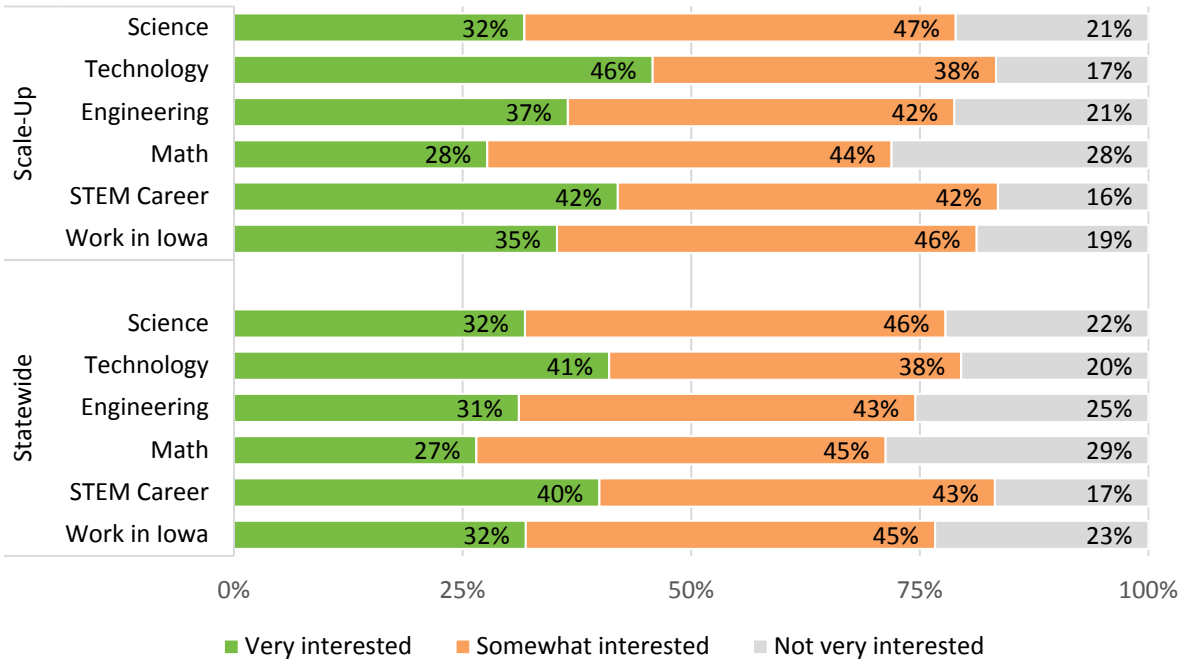


Figure 34. Interest in STEM topics and careers for *grades 6-8* Scale-Up students and students statewide, 2016/17

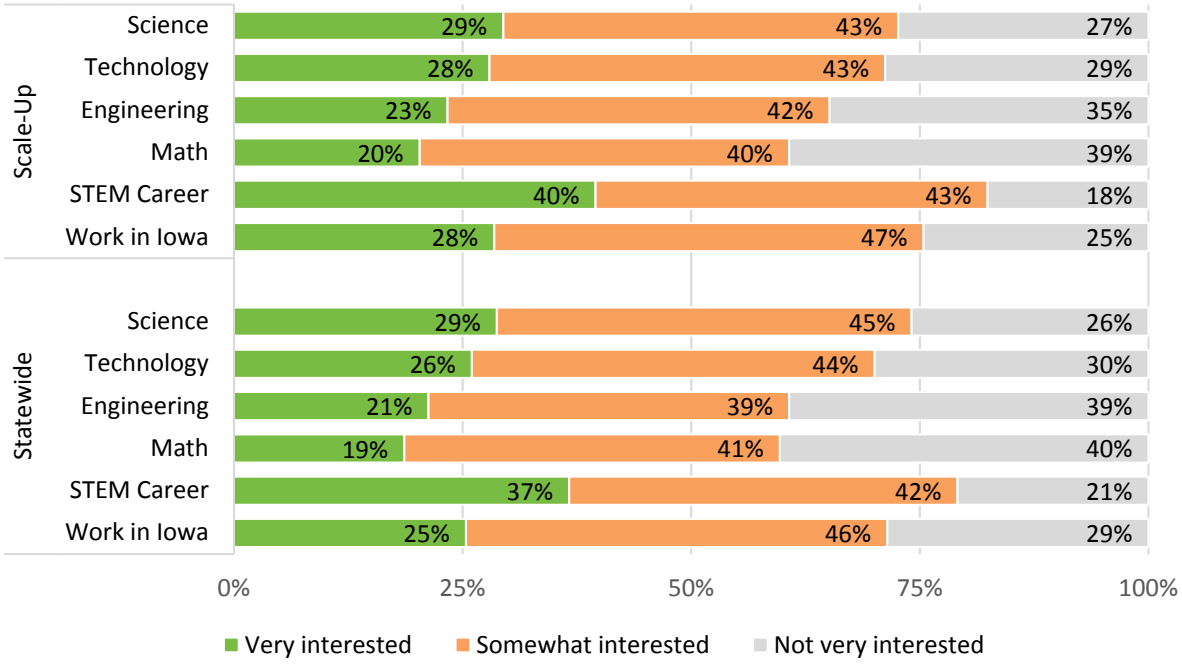


Figure 35. Interest in STEM topics and careers for *grades 9-12* Scale-Up students and students statewide, 2016/17

Achievement in math, science, and reading on the Iowa Assessments, Scale-Up students versus statewide comparison

Students who participated in a STEM Scale-Up program were compared to students statewide with regard to achievement in math, science, and reading. The Iowa Assessment scores in these subjects were compared using National Percentile Rank (NPR). Note that comparisons reflect association between Scale-Up Programs and achievement, not causation. Therefore, these findings should be interpreted with caution.

- STEM Scale-Up program participants continue to perform better on the Iowa Assessments compared to all students statewide. In 2016-2017, Scale-Up participants scored an average of +3 points higher in National Percentile Rank in *math* and *reading*, and +4 points higher in *science*.
- The difference in achievement is greater when comparing elementary Scale-Up students versus all elementary students statewide. Elementary Scale-Up participants score +4 higher in National Percentile Rank in *math* and r*eading*, and +5 higher in *science*.
- Minority students who participated in a STEM Scale-Up program scored an average of +6 points higher in National Percentile Rank in *math*, and +7 points higher in *science*, compared to minority students who had not participated in a Scale-Up Program. (Minority students are aggregated scores of all non-white STEM Scale-Up students due to small sample sizes in subgroup analysis).
- In 2016-2017, both elementary (grade 3-5) and secondary (grades 6-11) students who participated in STEM Scale-Up programs had higher average National Percentile Ranks in *math*, *science*, and *reading* scores on the Iowa Assessments compared to all students statewide (Figure 36).

Table 41. National percentile rank (NPR) of *Math*, *Science*, and *Reading* scores on the Iowa Assessments, 2016-2017

	Math			Science			Reading		
	All students statewide	Scale-Up students	Difference	All students statewide	Scale-Up students	Difference	All students statewide	Scale-Up students	Difference
Elementary average NPR, grades 3-5	60	64	**+4**	63	68	**+5**	68	72	**+4**
Secondary average NPR, grades 6-11	64	67	**+3**	65	69	**+4**	67	69	**+2**
Overall average NPR, grades 3-11	63	66	**+3**	65	69	**+4**	67	70	**+3**

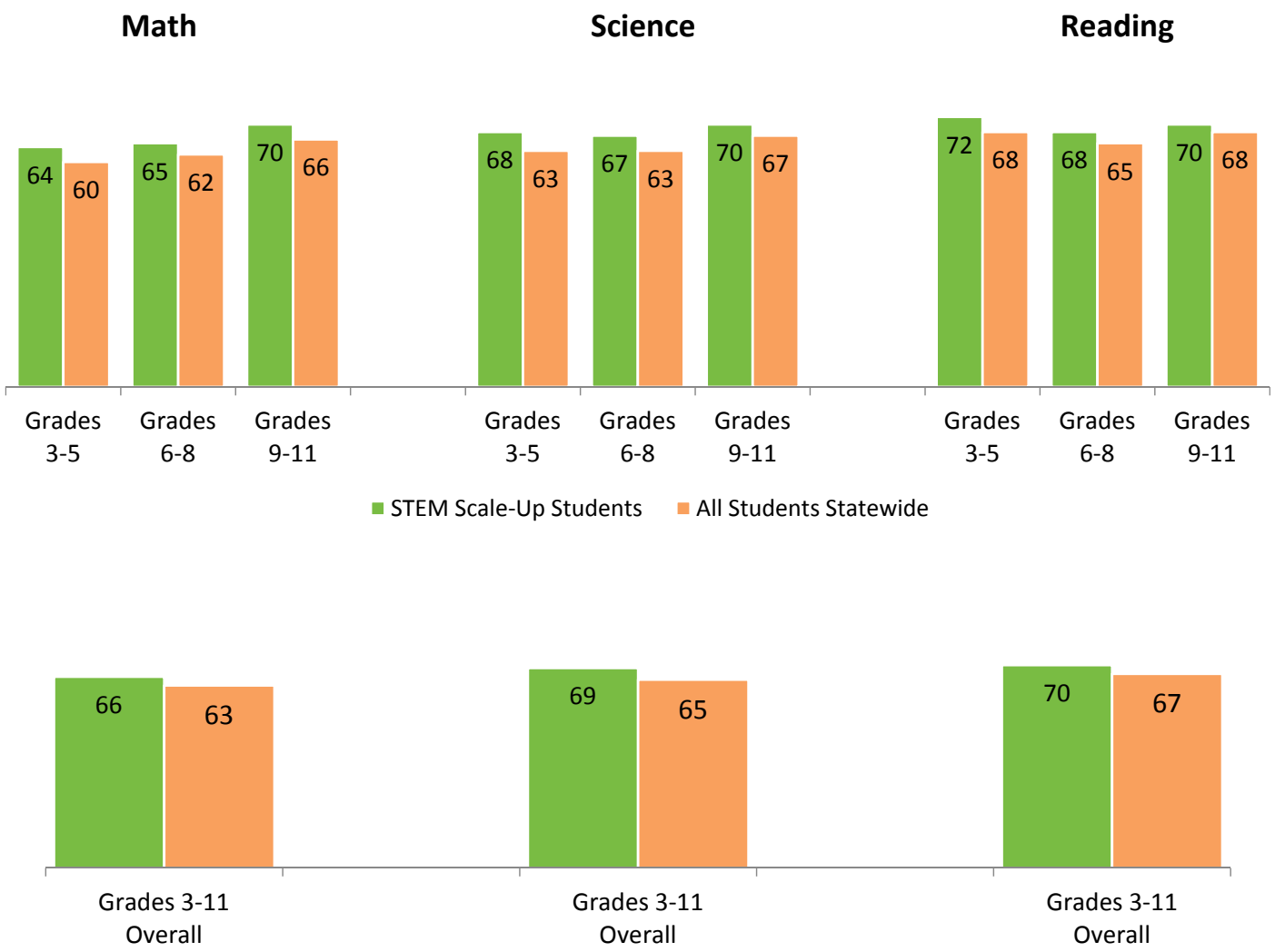


Figure 36. National Percentile Rank of *Math*, *Science,* and *Reading* achievement on the Iowa Assessments, Scale-Up students versus all students statewide, 2016-2017

Appendix A: Additional representations Statewide Student Interest Inventory data

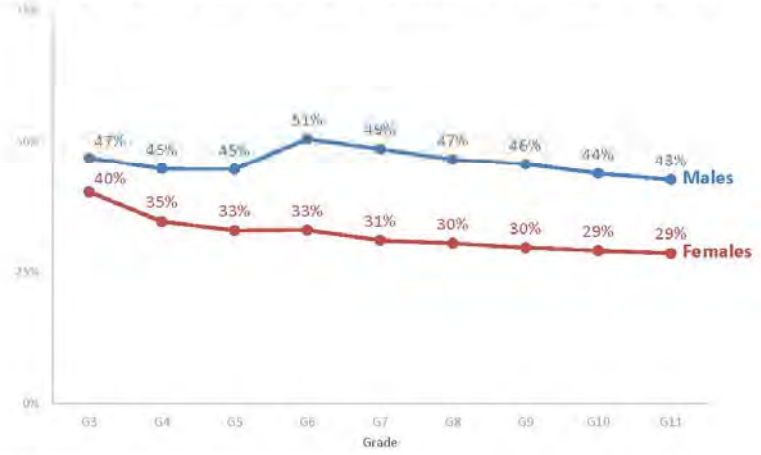
Prepared by Iowa Testing Programs, The University of Iowa

Appendix A includes additional data and representations of data presented in Indicator 8, Section 3, and Section 4.2

Percentage of Male or Female students statewide who said they were "Very Interested" in a STEM career, 2016-17

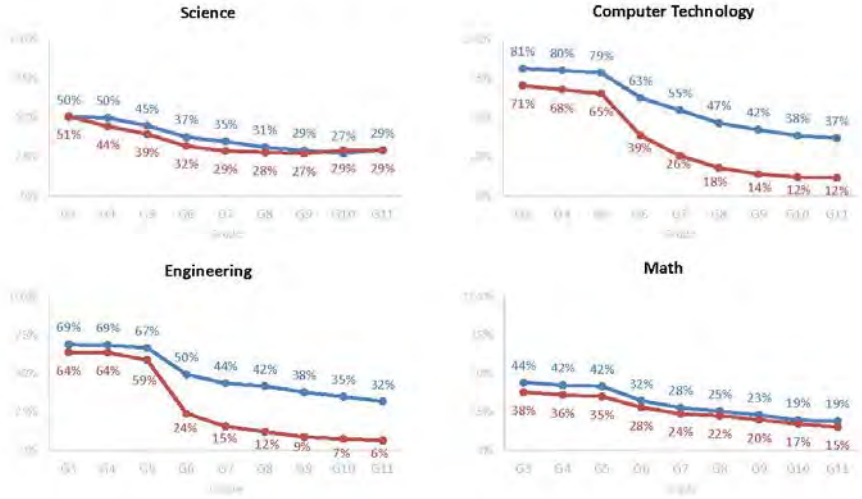
For all grades, a higher percentage of males said they were "Very Interested" in a STEM career compared to the percentage of females who said the same.

The proportion of students who responded they were "Very Interested" in a STEM career decreased from grade 3 to grade 11, and was more marked for females (-11% among female vs. -4% among male students).



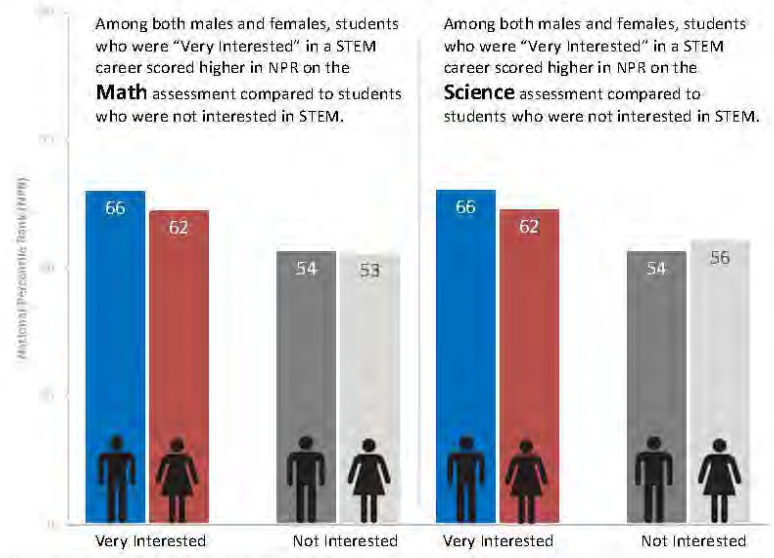
Source: Statewide Student Interest Inventory, Iowa Testing Programs, 2016-2017
Prepared by Iowa Testing Programs, June 2017

Percentages of Male or Female students statewide who said they were "Very Interested" in STEM subject areas by grade, 2016-17



Source: Statewide Student Interest Inventory, Iowa Testing Programs, 2016-2017
Prepared by Iowa Testing Programs, June 2017

National Percentile Rank (NPR) of Math and Science assessment scores by gender and STEM Interest, 2016-2017

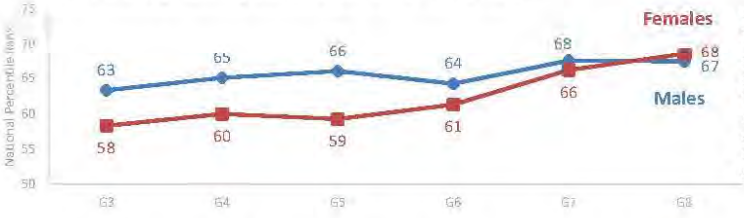


Source: Iowa Assessments, Iowa Testing Programs, 2016-2017
Prepared by Iowa Testing Programs, June 2017

National Percentile Rank of Math and Science assessment scores by gender, grade, and STEM Interest, 2016-2017

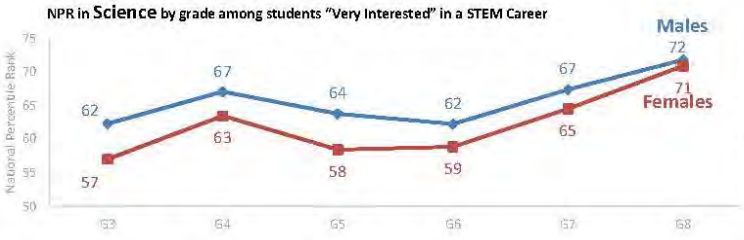
Among 8th graders who reported they were "Very Interested" in a STEM Career, female students scored nearly the same in NPR as male students on the Math and Science assessment.

NPR in **Math** by grade among students "Very Interested" in a STEM Career



For students who reported they were "Very Interested" in a STEM Career, the differences in NPR in **Math** between female and male students were smaller among students in grades 6-8.

NPR in **Science** by grade among students "Very Interested" in a STEM Career



For students who reported they were "Very Interested" in a STEM Career, the differences in NPR in **Science** between female and male students were smaller among students in grades 6-8.

Source: Iowa Assessments, Iowa Testing Programs, 2016-2017
Prepared by Iowa Testing Programs, June 2017

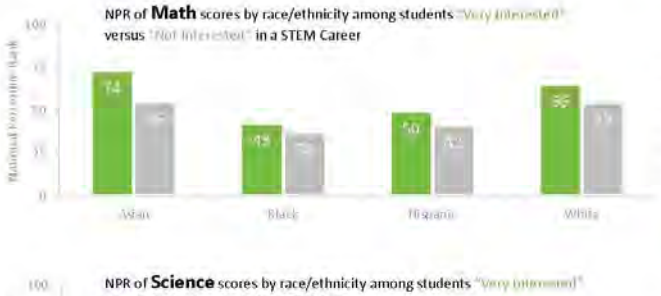
Percentage of all students statewide who said they were "Very Interested" in a STEM Career by race/ethnicity, 2016-2017

While the proportion of Asian students who said they were "Very Interested" in a STEM Career stayed relatively the same across grades, the proportion of White, Hispanic, and African American students who were "Very Interested" in a STEM Career all decreased with advancing grade levels, respectively.

Source: Statewide Student Interest Inventory, Iowa Testing Programs, 2016-2017
Prepared by Iowa Testing Programs, June 2017

National Percentile Rank (NPR) of Math and Science assessment scores by race/ethnicity and STEM Interest, 2016-2017

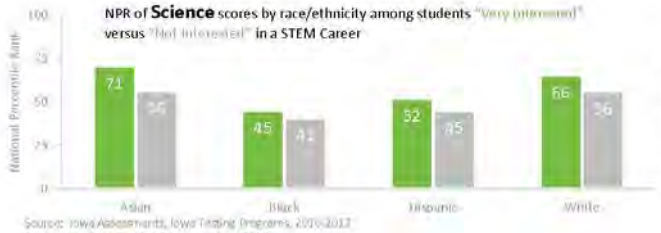
Among all racial/ethnic subgroups, students who reported they were **"Very Interested" in a STEM Career** scored higher in NPR on the Math and Science assessment compared to students **"Not Interested"** in STEM.



Among four racial/ethnic categories, Asian students who were interested in a STEM career scored highest in National Percentile Rank on the **Math** assessment compared to students who were not interested in STEM.

STEM Interested

Not Interested

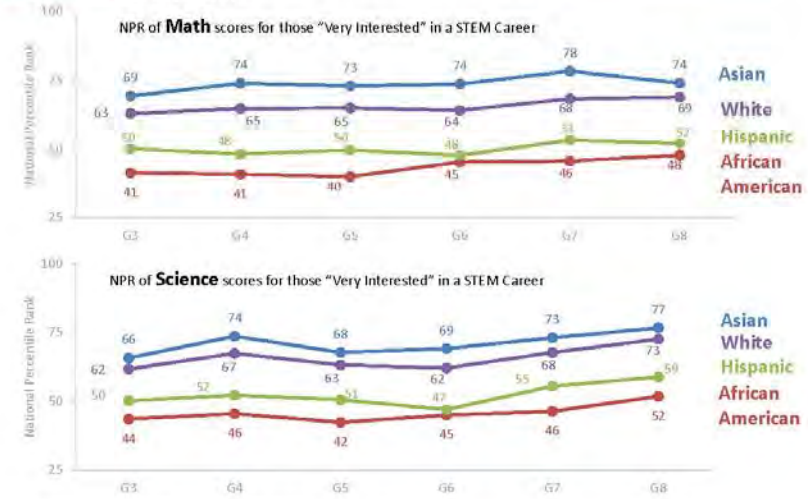


Among four racial/ethnic categories, Asian students who were interested in a STEM career scored highest in National Percentile Rank on the **Science** assessment compared to students who were not interested in STEM.

Source: Iowa Assessments, Iowa Testing Programs, 2016-2017
Prepared by Iowa Testing Programs, June 2017

National Percentile Rank (NPR) of Math and Science scores among students who said they were "Very Interested" in a STEM Career by race/ethnicity, 2016-2017

Among students who said they were "Very Interested" in a STEM Career, the NPR of Math and Science scores was higher among students in grade 8 compared to grade 3 for Asian, White, Hispanic, and African American students, respectively.



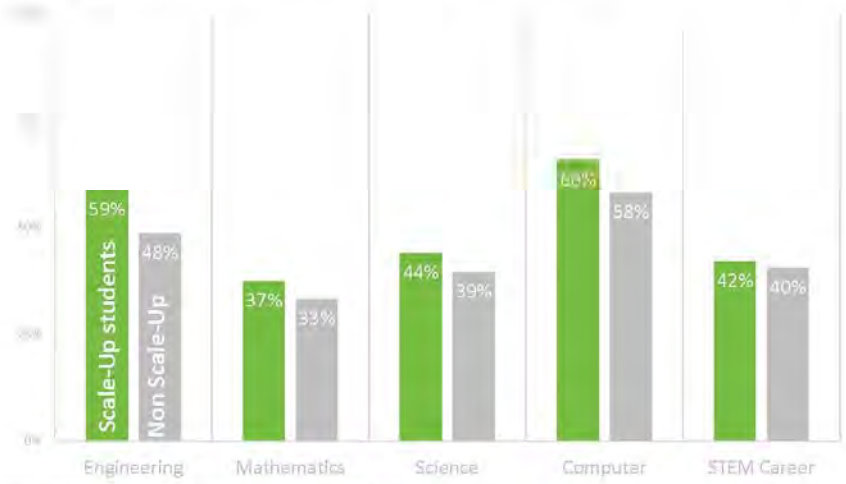
Source: Iowa Assessments, Iowa Testing Programs, 2016-2017
Prepared by Iowa Testing Programs, June 2017

Measuring Impact of STEM Scale-Up Program Participation, Grades 3-8

Prepared by Iowa Testing Programs, June 2017

Percentage of STEM Scale-Up students versus Non-participants in grades 3 through 8 who said they were "Very Interested" in STEM-subjects or a STEM career, 2016-2017

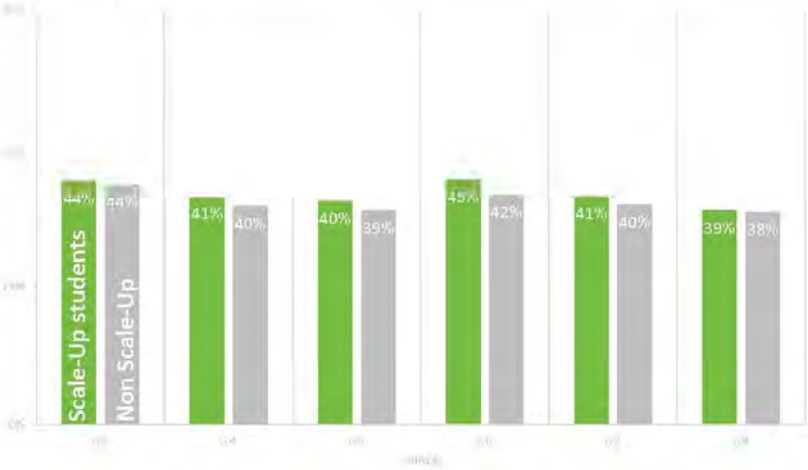
Compared to students who did not participate in a Scale-Up program, a higher proportion of students who participated in a Scale-Up Program said they were "Very Interested" in all STEM-subjects and in pursuing a STEM career.



Source: Statewide Student Interest Inventory, Iowa Testing Programs, 2016-2017
Prepared by Iowa Testing Programs, June 2017

Percentage of students in grades 3 through 8 "Very Interested" in a STEM Career by Scale-Up program participation, 2016-2017

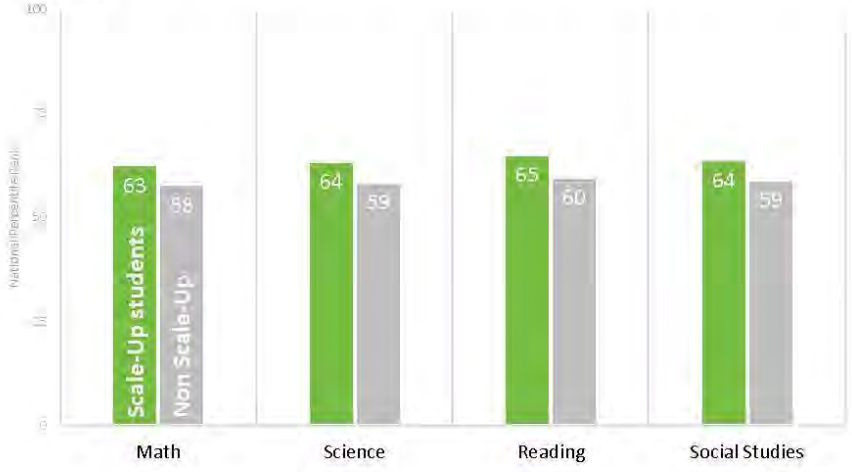
A slightly higher percentage of STEM Scale-Up Program participants in 4th through 8th grades said they were "Very Interested" in a STEM Career compared to students who did not participate in a Scale-Up program.



Note: Sufficient sample size for subgroup analysis limited to grades 8 and under.
Source: Statewide Student Interest Inventory, Iowa Testing Programs, 2016-2017
Prepared by Iowa Testing Programs, June 2017

National Percentile Rank in Math, Science, Reading, and Social Studies by STEM Scale-Up program participation among students in grades 3 through 8, 2016-2017

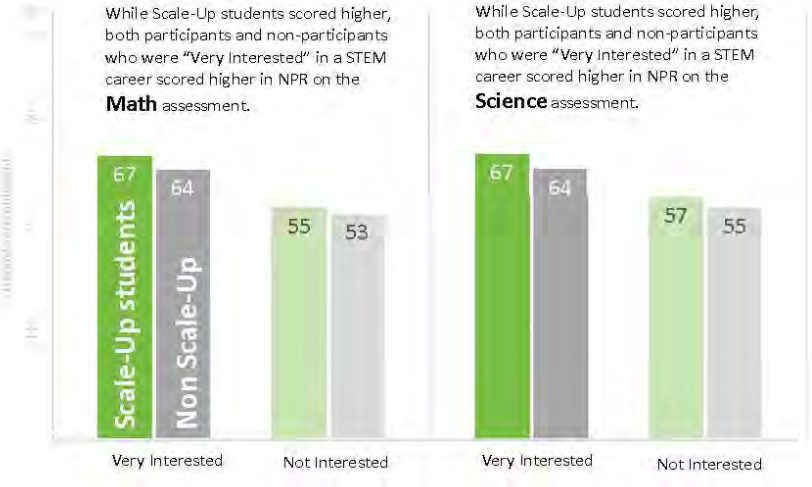
Compared to non-participants, Students who participated in a STEM Scale-Up program scored an average of +5-points higher in National Percentile Rank (NPR) across all four subject areas on the Iowa Assessments, respectively.



Source: Iowa Assessments, Iowa Testing Programs, 2016-2017
Prepared by Iowa Testing Programs, June 2017

National Percentile Rank (NPR) of Math and Science assessment scores among STEM Scale-Up students versus non-participants in grades 3 through 8 by STEM Interest, 2016-2017

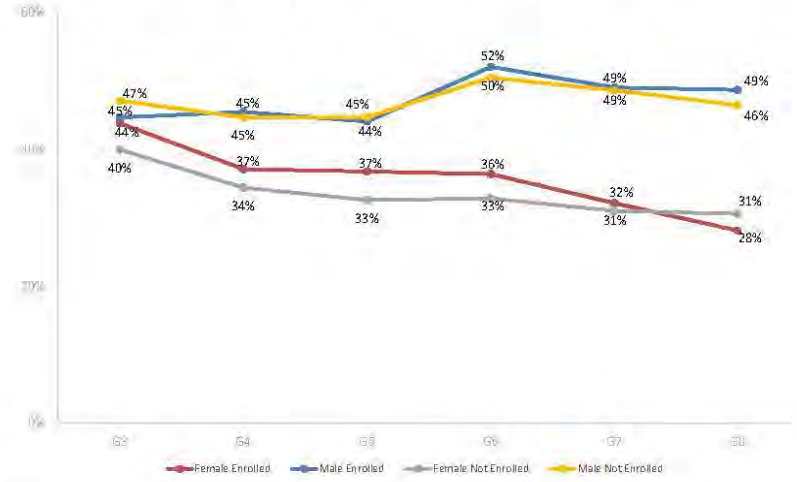
Among both Scale-Up participants and non-participants, students who were "Very Interested" in a STEM career scored higher in NPR on the **Math** and **Science** assessments compared to students who were not interested in pursuing a STEM career.



Source: Iowa Assessments, Iowa Testing Programs, 2016-2017
Prepared by Iowa Testing Programs, June 2017

Percentages of Males or Females who participated in a STEM Scale-Up program who said they were "Very Interested" in a STEM Career compared to non-participants (Grades 3-8), 2016-2017

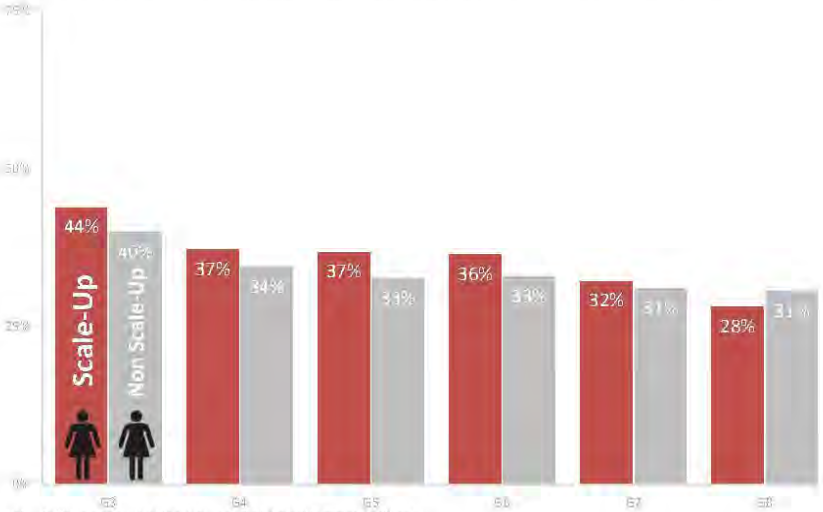
In grades 3 through 6, a higher percentage of females who participated in a STEM Scale-Up program said they were "Very Interested" in a STEM career versus non-participant female students. Among males, there was little difference between Scale-Up participants versus non-participants across grades 8th and under.



Prepared by Iowa Testing Programs, June 2017

Percentages of Females who participated in a STEM Scale-Up program who said they were "Very Interested" in a STEM Career compared to non-participants (Grades 3-8), 2016-2017

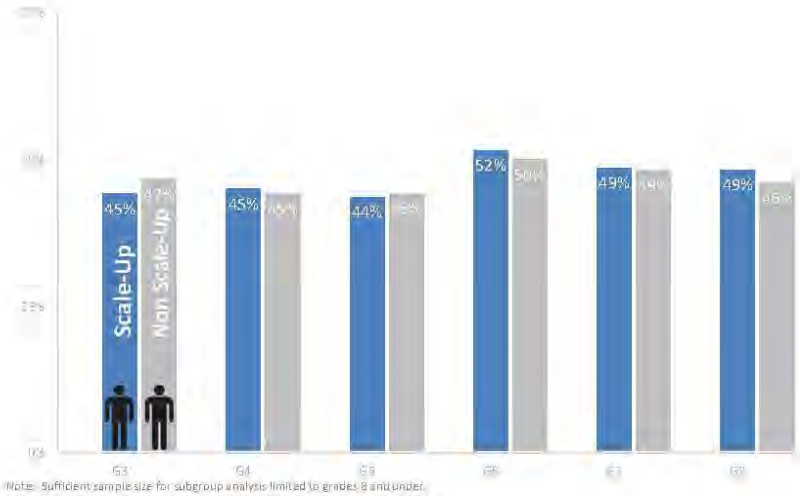
In grades 3 through 7, a higher percentage of females who participated in a STEM Scale-Up program said they were "Very Interested" in a STEM career versus non-participant female students.



Note: Sufficient sample size for subgroup analysis limited to grades 8 and under.
Source: Statewide Student Interest Inventory, Iowa Testing Programs, 2016-2017
Prepared by Iowa Testing Programs, June 2017

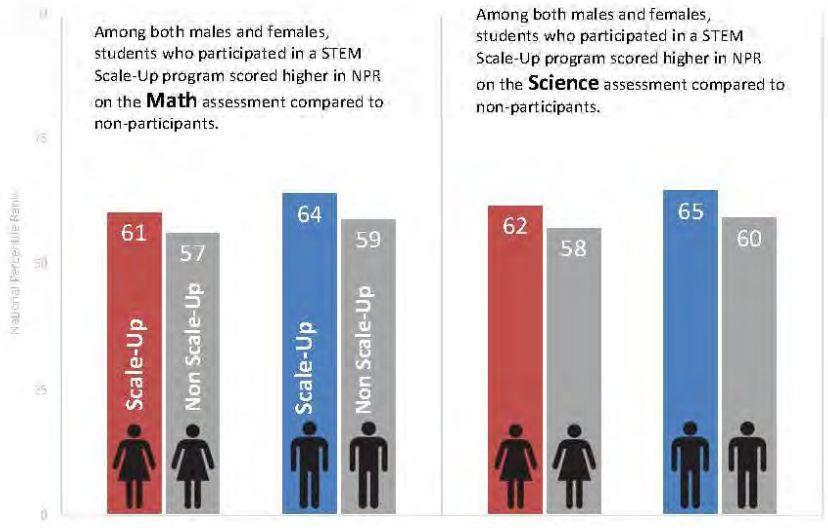
Percentages of Males who participated in a STEM Scale-Up program who said they were "Very Interested" in a STEM Career compared to non-participants (Grades 3-8), 2016-2017

Among males in grades 3 through 8, there was little difference between Scale-Up participants versus non-participants.



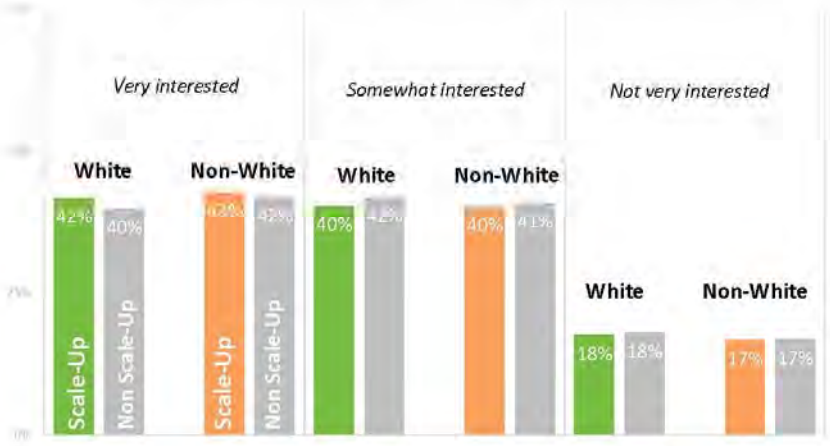
Note: Sufficient sample size for subgroup analysis limited to grades 8 and under.
Source: Statewide Student Interest Inventory, Iowa Testing Programs, 2016-2017
Prepared by Iowa Testing Programs, June 2017

National Percentile Rank (NPR) of Math and Science assessment scores by gender and STEM Scale-Up program participation (Grades 3-8), 2016-2017



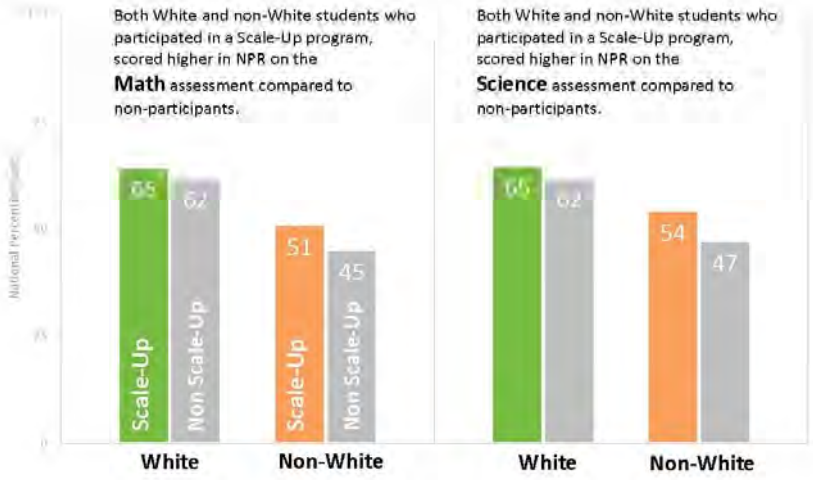
Source: Iowa Assessments, Iowa Testing Programs, 2016-2017
Prepared by Iowa Testing Programs, June 2017

White versus non-White students' interest in a STEM career by Scale-Up program participation
A slightly higher proportion of both White and non-White students in grades 3 through 8 who participated in a Scale-Up program said they were "Very Interested" in a STEM career, compared to non-participants.



Source: Statewide Student Interest Inventory, Iowa Testing Programs, 2016-2017
Prepared by Iowa Testing Programs, June 2017

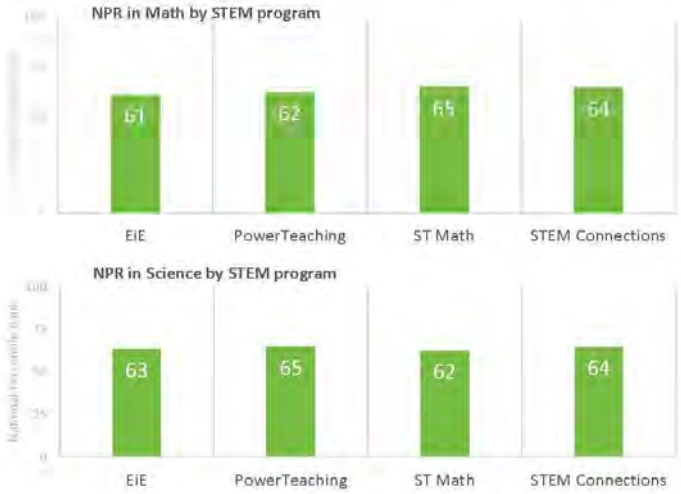
National Percentile Rank (NPR) of Math and Science assessment scores among White versus non-White students in grades 3 through 8 by STEM Scale-Up program participation, 2016-2017



Source: Iowa Assessments, Iowa Testing Programs, 2016-2017
Prepared by Iowa Testing Programs, June 2017

National Percentile Rank (NPR) of Math and Science assessment scores among students in grades 3 through 8 by STEM Scale-Up Program, 2016-2017

Among the four STEM Scale-Up programs with sufficient sample size for analysis, Math and Science scores ranged from 61 to 65 in NPR.



*Only considered programs with at least 179 matched records from submitted student participant lists, grades 3-8
Source: Iowa Assessments, Iowa Testing Programs, 2016-2017
Prepared by Iowa Testing Programs, June 2017

Appendix B: Description of Iowa STEM Endorsements K-8, 5-8, and K-12 STEM Specialist

975 K-8 STEM

(1) Authorization. The holder of this endorsement is authorized to teach science, mathematics, and integrated STEM courses in kindergarten through grade eight.

(2) Program requirements. Be the holder of the teacher—elementary classroom endorsement.

(3) Content.

1. Completion of a minimum of 12 semester hours of college-level science.
2. Completion of a minimum of 12 semester hours of college-level math (or the completion of Calculus I) to include coursework in computer programming.
3. Completion of a minimum of 3 semester hours of coursework in content or pedagogy of engineering and technological design that includes engineering design processes or programming logic and problem-solving models and that may be met through either of the following:
    - Engineering and technological design courses for education majors;
    - Technology or engineering content coursework.
4. Completion of a minimum of 6 semester hours of required coursework in STEM curriculum and methods to include the following essential concepts and skills:
    - Comparing and contrasting the nature and goals of each of the STEM disciplines;
    - Promoting learning through purposeful, authentic, real-world connections;
    - Integration of content and context of each of the STEM disciplines;
    - Interdisciplinary/transdisciplinary approaches to teaching (including but not limited to problem-based learning and project-based learning);
    - Curriculum and standards mapping;
    - Engaging subject-matter experts (including but not limited to colleagues, parents, higher education faculty/students, business partners, and informal education agencies) in STEM experiences in and out of the classroom;
    - Assessment of integrative learning approaches;
    - Information literacy skills in STEM;
    - Processes of science and scientific inquiry;
    - Mathematical problem-solving models;
    - Communicating to a variety of audiences;
    - Classroom management in project-based classrooms;
    - Instructional strategies for the inclusive classroom;
    - Computational thinking;
    - Mathematical and technological modeling.
5. Completion of a STEM field experience of a minimum of 30 contact hours that may be met through the following:
    - Completing a STEM research experience;
    - Participating in a STEM internship at a STEM business or informal education organization; or
    - Leading a STEM extracurricular activity.

976 5-8 STEM

(1) Authorization. The holder of this endorsement is authorized to teach science, mathematics, and integrated STEM courses in grades five through eight.

(2) Program requirements. Be the holder of a 5-12 science, mathematics, or industrial technology endorsement or 5-8 middle school mathematics or science endorsement.

(3) Content.

1. Completion of a minimum of 12 semester hours of college-level science.
2. Completion of a minimum of 12 semester hours of college-level math (or the completion of Calculus I) to include coursework in computer programming.
3. Completion of a minimum of 3 semester hours of coursework in content or pedagogy of engineering and technological design that includes engineering design processes or programming logic and problem-solving models and that may be met through either of the following:
    - Engineering and technological design courses for education majors;
    - Technology or engineering content coursework.
4. Completion of a minimum of 6 semester hours of required coursework in STEM curriculum and methods to include the following essential concepts and skills:
    - Comparing and contrasting the nature and goals of each of the STEM disciplines;
    - Promoting learning through purposeful, authentic, real-world connections;
    - Integration of content and context of each of the STEM disciplines;
    - Interdisciplinary/transdisciplinary approaches to teaching (including but not limited to problem-based learning and project-based learning);
    - Curriculum and standards mapping;
    - Engaging subject-matter experts (including but not limited to colleagues, parents, higher education faculty/students, business partners, and informal education agencies) in STEM experiences in and out of the classroom;
    - Assessment of integrative learning approaches;
    - Information literacy skills in STEM;
    - Processes of science and scientific inquiry;
    - Mathematical problem-solving models;
    - Communicating to a variety of audiences;
    - Classroom management in project-based classrooms;
    - Instructional strategies for the inclusive classroom;
    - Computational thinking;
    - Mathematical and technological modeling.
5. Completion of a STEM field experience of a minimum of 30 contact hours that may be met through the following:
    - Completing a STEM research experience;
    - Participating in a STEM internship at a STEM business or informal education organization; or
    - Leading a STEM extracurricular activity.

977 K-12 STEM Specialist

(1) Authorization. The holder of this endorsement is authorized to serve as a STEM specialist in kindergarten and grades one through twelve.

(2) Program requirements.

1. The applicant must have met the requirements for a standard Iowa teaching license and a teaching endorsement in mathematics, science, engineering, industrial technology, or agriculture.
2. The applicant must hold a master's degree from a regionally accredited institution. The master's degree must be in math, science, engineering or technology or another area with at least 12 hours of college-level science and at least 12 hours of college-level math (or completion of Calculus I) to include coursework in computer programming.

(3) Content.

1. Completion of a minimum of 3 semester hours of coursework in content or pedagogy of engineering and technological design that includes engineering design processes or programming logic and problem-solving models and that may be met through either of the following:
    - Engineering and technological design courses for education majors;
    - Technology or engineering content coursework.
2. Completion of 9 semester hours in professional development to include the following essential concepts and skills:
    - STEM curriculum and methods:
        - Comparing and contrasting the nature and goals of each of the STEM disciplines;
        - Promoting learning through purposeful, authentic, real-world connections;
        - Integration of content and context of each of the STEM disciplines;
        - Interdisciplinary/transdisciplinary approaches to teaching (including but not limited to problem-based learning and project-based learning);
        - Curriculum/standards mapping;
        - Assessment of integrative learning approaches;
        - Information literacy skills in STEM;
        - Processes of science/scientific inquiry;
        - Mathematical problem-solving models;
        - Classroom management in project-based classrooms;
        - Instructional strategies for the inclusive classroom;
        - Computational thinking;
        - Mathematical and technological modeling.
    - STEM experiential learning:
        - Engaging subject-matter experts (including but not limited to colleagues, parents, higher education faculty/students, business partners, and informal education agencies) in STEM experiences in and out of the classroom;
        - STEM research experiences;
        - STEM internship at a STEM business or informal education organization;
        - STEM extracurricular activity;
        - Communicating to a variety of audiences.
    - Leadership in STEM:
        - STEM curriculum development and assessment;
        - Curriculum mapping;
        - Assessment of student engagement;
        - STEM across the curriculum;
        - Research on best practices in STEM;
        - STEM curriculum accessibility for all students.
3. Completion of an internship/externship professional experience or prior professional experience in STEM for a minimum of 90 contact hours.

Appendix C: Statewide Survey of Public Attitudes Toward STEM_Questionnaire

SECTION A: Understanding/awareness of STEM and exposure to STEM topics

A1. I'm going to read a short list of topics. Please tell me how much you have heard about each one, if anything, in the past month.

[RANDOMIZE LIST]

a. The size of Iowa's workforce
b. Agriculture in Iowa
c. K-12 education in Iowa
d. Water quality in Iowa
e. Healthcare in Iowa
f. Manufacturing in Iowa

Have you heard…
1 A lot,
2 A little, or
3 Nothing in the past month?

7 Don't know/Not sure
9 Refused

A2. What jobs or careers do you think are most important to Iowa's economy?

[DO NOT READ – Select up to 6]

11 Farming
12 Agriculture manufacturing (e.g. John Deere)
13 Agricultural science (e.g. plant, soil, animal sciences)
14 Business
15 Engineering
16 Manufacturing
17 Insurance
18 Health care
19 Transportation
20 Technology (e.g. computer and technology start-ups)
21 Education

66 Other **[SPECIFY]**
77 Don't know/Not sure
99 Refused

A3. Please tell me how much you have heard about each of the following, if anything, in the past month. **[RANDOMIZE LIST]**

a. The Governor's Future Ready Iowa initiative
b. Improving math, technology, science, and engineering education

Have you heard…
1 A lot,
2 A little, or
3 Nothing in the past month?

7 Don't know/Not sure
9 Refused

A4. Have you visited any of the following in the past 12 months? **[RANDOMIZE LIST]**

a. A museum?
b. A zoo or aquarium?
c. A science or technology center?
d. A public library?
e. A K-12 school?
f. An arboretum or botanical center?

1 Yes
2 No

7 Don't know/Not sure
9 Refused

A5. You may have heard about STEM education or STEM careers lately. What, if anything, comes to mind when you hear the letters S-T-E-M, or the word STEM? **[SELECT ALL THAT APPLY - DO NOT READ]**

1 Exact or close definition of 'Science, Technology, Engineering, Math' (Some or all words)
2 Related to education and/or schools, in general, but no specific mention of science, technology, engineering, or math
3 Stem cells or stem cell research
4 Other **[SPECIFY]**

7 Don't know/Not sure/Nothing
9 Refused

[IF RESPONDENT ANSWERED "SCIENCE, TECHNOLOGY, ENGINEERING, AND MATH" TO A5; INTERVIEWER MAY SELECT "1." TO A6 WITHOUT READING THE QUESTION.]

A6. STEM stands for "science, technology, engineering, and mathematics." Have you read, seen, or heard of this before?

1 Yes
2 No

7 Don't know/Not sure
9 Refused

[IF A6>1, SKIP TO A10]

A7. What slogans or taglines, if any, have you read, seen, or heard about STEM?
[SELECT ALL THAT APPLY - DO NOT READ]

1 Greatness STEMs from Iowans
2 Governor's STEM Advisory Council
3 iexploreSTEM
4 I heard something but I don't remember what it was
5 Other **[SPECIFY]**

8 HAVE NOT READ, HEARD, OR SEEN ANY
7 Don't know/Not sure
9 Refused

[SPLIT HALF – HALF GET A8, HALF GET A88]

A8. In the past 30 days, have you read, seen, or heard anything about STEM education from any of the following sources of information? Please answer yes or no to each source.
[RANDOMIZE LIST]

a. TV
b. Newspaper or news website (e.g. cnn.com, nbcnews.com, desmoinesregister.com)
c. Billboard
d. Radio
e. A school or teacher
f. Non-news website (e.g. iowastem.gov, scstemhub.drake.edu)
g. A child or student
h. Twitter
i. A specific event, program, or activity **[SPECIFY]**
j. Facebook

1 Yes
2 No

7 Don't know/Not sure
9 Refused

A88. In the past few months, have you read, seen, or heard anything about STEM education from any of the following sources of information? Please answer yes or no to each source.
[RANDOMIZE LIST]

a. TV
b. Newspaper or news website (e.g. cnn.com, nbcnews.com, desmoinesregister.com)
c. Billboard
d. Radio
e. A school or teacher
f. Non-news website (e.g. iowastem.gov, scstemhub.drake.edu)
g. A child or student
h. Twitter
i. A specific event, program, or activity [SPECIFY]
j. Facebook

1 Yes
2 No

7 Don't know/Not sure
9 Refused

A9. What specific groups or events, if any, have you heard about during the past year that promote Iowa STEM education or programs?
[SELECT ALL THAT APPLY - DO NOT READ]

11 A booth/display at a COUNTY FAIR
12 A booth/display at the STATE FAIR / STEM Day at the Iowa State Fair
13 A STEM Festival
[INTERVIEWER NOTE: This includes regional STEM festivals with location-based names, e.g. Cedar Valley Family STEM Festival, Southeast Iowa STEM Festival, Cedar Rapids iExplore STEM Festival, Muscatine STEM Festival]
14 Any reference to the Governor's STEM Advisory Council
15 I went to another STEM event [SPECIFY]
16 Other [SPECIFY]

88 HAVE NOT HEARD ANYTHING
77 Don't know/Not sure
99 Refused

A10. I'm going to read a short list of some groups and events promoting STEM education and careers. Please tell me how much you have heard, if anything, about each one in the past year.
[RANDOMIZE LIST]

a. "Hour of Code" or Code Iowa
b. Iowa Governor's STEM Advisory Council
c. A STEM Festival
[**INTERVIEWER NOTE:** This includes regional STEM festivals with location-based names, e.g. Cedar Valley Family STEM Festival, Southeast Iowa STEM Festival, Cedar Rapids iExplore STEM Festival, Muscatine STEM Festival]
d. Governor's 2016 Future Ready Iowa Summit
e. A STEM Academy, STEM School, or STEM Classroom
f. STEM Day at the Capitol
g. STEM Day at the Iowa State Fair
h. The STEM Scale-Up Program
i. Iowa STEM Teacher Externships
j. I.O.W.A. STEM Teacher Award

Have you heard…
1 A lot,
2 A little, or
3 Nothing in the past year?

7 Don't know/Not sure
9 Refused

[IF A7=1, SKIP TO A12]

A11. I am going to read a list of slogans or taglines about STEM education.
Please tell me if you've heard the slogan or tagline…
[RANDOMIZE LIST]

a. Greatness STEMs from Iowans?
b. Commit2STEM?
c. Iowa's future demands STEM?

1 Yes
2 No

7 Don't know/Not sure
9 Refused

[IF A11a=1 or A7=1]

A12. Where did you see, hear, or read about the slogan, "Greatness STEMs from Iowans"?
[Select all that apply. DO NOT READ]

11 TV
12 Newspaper or news website (e.g. cnn.com, nbcnews.com, desmoinesregister.com)
13 Billboard
14 Radio
15 A school or teacher
16 Non-news website (e.g. iowastem.gov, scstemhub.drake.edu)
17 A child or student
18 Twitter
19 Facebook
20 A STEM Event [SPECIFY]
21 Other [SPECIFY]

77 Don't know/Not sure
99 Refused

A14. Now, think about jobs **in IOWA** that rely on science, technology, engineering, and math skills. As far as you know, would you say there are…

1 More than enough skilled workers to fill STEM jobs,
2 Not enough skilled workers to fill STEM jobs, or
3 Just the right number of skilled workers to fill STEM jobs **in IOWA**?

7 Don't know/Not sure
9 Refused

SECTION B: Attitudes Toward STEM and the Role of STEM in Iowa

B1. There are several initiatives in Iowa to improve STEM education and STEM careers. The next questions are about your thoughts regarding these topics. Please tell me whether you strongly agree, agree, disagree, or strongly disagree with each of the following statements.
[RANDOMIZE LIST]

a. Many more companies would move or expand to Iowa if the state had a reputation for workers with great science and math skills.
b. Increased focus on STEM education in Iowa will improve the state economy.
c. There are more jobs available for people who have good math and science skills.
d. Careers in agriculture do not rely heavily on STEM skills
e. Progress is being made to increase the number of women working in STEM jobs.
f. Progress is being made to increase the number of Hispanics working in STEM jobs.
g. More people would choose a STEM job if it didn't seem so hard.
h. Progress is being made to increase the number of African Americans working in STEM jobs.
i. There is an urgent need in Iowa for more resources to be put toward STEM education.
j. Science, technology, and engineering are too specialized for most people to understand it.
k. Training in visual arts, music, or drama improves performance in STEM.
l. The push for STEM is more about filling open jobs than making sure students are taught about specific STEM concepts in school.

Do you…
1. Strongly agree,
2. Agree,
4 Disagree, or
5 Strongly disagree?

3. Neither agree nor disagree

7 Don't know/Not sure
9 Refused

B2. Compared to a year ago, would you say that Iowa K-12 student achievement in **SCIENCE** is getting better, staying the same, or getting worse?
1 getting better,
2 staying the same, or
3 getting worse?

7 Don't know/Not sure
9 Refused

B3. Compared to a year ago, would you say that Iowa K-12 student achievement in **MATH** is getting better, staying the same, or getting worse?
1 getting better,
2 staying the same, or
3 getting worse

7 Don't know/Not sure
9 Refused

SECTION C: STEM Education

C1. How well do you think the schools in your community are teaching each of the following subjects? **[RANDOMIZE LIST]**

a. Mathematics
b. Science
c. Social studies such as history, American studies, or government
d. English, language arts, and reading
e. Designing, creating, and building machines and devices, also called engineering
f. Computers and technology
g. Foreign languages
h. Art
i. Music
j.

Would you say that the instruction in **[MATHEMATICS]** is…
1 Excellent,
2 Good,
3 Fair, or
4 Poor?

8 NOT OFFERED
7 Don't know/Not sure
9 Refused

C3. I'm going to read some statements about STEM education. Please tell me whether you strongly agree, agree, disagree, or strongly disagree with each of the following statements. **[RANDOMIZE LIST]**

a. It is more important for students to graduate from high school with strong skills in reading and writing than it is to have strong skills in math and science.
b. Overall, the quality of STEM education in Iowa is high.
c. Iowa colleges and universities are doing a good job preparing STEM teachers.
d. Iowa colleges and universities are doing a good job preparing students for careers in STEM fields.
g. Emphasis on STEM education takes too many resources away from other important subjects in schools

Do you…
1 Strongly agree,
2 Agree,
4 Disagree, or
5 Strongly disagree?

3 Neither agree nor disagree

7 Don't know/Not sure
9 Refused

C5. Overall, to what degree do you support or oppose state efforts to devote resources and develop initiatives to promote STEM education in Iowa? Would you say you are…?

1 Very supportive,
2 Somewhat supportive,
3 Neither supportive nor opposed,
4 Somewhat opposed, or
5 Very opposed?

7 Don't know/Not sure
9 Refused

C6 Do you think STEM education **is a priority** in your local school district?
1 Yes
2 No

7 Don't know/Not sure
9 Refused

C7 Do you think STEM education ***should*** be a priority in your local school district?
1 Yes
2 No

7 Don't know/Not sure
9 Refused

C8. In Iowa, when you think of STEM jobs or STEM careers, what jobs or careers do you think of? **[DO NOT READ – Select up to 6]**

11 Farming
12 Agriculture manufacturing (e.g. John Deere)
13 Agricultural science (e.g. plant, soil, animal sciences)
14 Business
15 Engineering
16 Manufacturing
17 Insurance
18 Health care
19 Transportation
20 Technology – (e.g. computer and technology start-ups)
21 Education

66 Other **[SPECIFY]**

77 Don't know/Not sure
99 Refused

SECTION D: Child selection

D1. How many children, if any, do you have that are …
a. Under age 3 in your household?
b. 3-11 years old in your household?
c. 12-19 years old in your household?
[ ] = number of children
99 Refused

[IF D1a-c=99, SKIP TO E1]
[D1b AND D1c = 0, SKIP TO E1]

D2. What is the age and gender of the child, age 3 or older, in your home?

[ ]

D2. We need to select one child, currently age 3 or older, as the focus of the next few education questions. What is the age and gender of the child having the next birthday?
[ ] = AGE
[ ] = GENDER (1=Male / 2=Female)

D2a. Are you the legal guardian of this child?
[INTERVIEWER NOTE: Do not ask if relationship is "self" or respondent IS the child, just select option 8.]
1 Yes
2 No **[SKIP TO E1]**

8 Respondent is the child **[SKIP TO E1]**
7 Don't know/Not sure **[SKIP TO E1]**
9 Refused **[SKIP TO E1]**

D3. **[ASK IF D2=17-19]** Has this child graduated from high school or obtained their GED?
1. Yes [SKIP TO E1]
2. No

7. Don't know/Not sure **[SKIP TO E1]**
9. Refused **[SKIP TO E1]**

[IF CHILD IS AGE >6 SKP TO D12]

D6. **[ASK IF D2=3-6]** Has this child started pre-school or school?
1 Yes
2 No **[SKIP TO E1]**

7 Don't know/Not sure **[SKIP TO E1]**
9 Refused **[SKIP TO E1]**

D12. In general, how much interest, if any, does this child show in the following subjects? **[RANDOMIZE LIST]**

a. How much interest in Science?
b. How much interest in Computers and technology?
c. How much interest in Designing, creating, and building machines and devices, also called engineering?
d. How much interest in Math?

Would you say…

1 A lot of interest,
2 Some interest, or
3 Little or no interest?

8 RESPONDENT OFFERS NOT SURE YET OR CHILD TOO YOUNG TO KNOW
7 Don't know/Not sure
9 Refused

[**IF CHILD AGE < 6 SKP D18]**

D13. In general, how well is this child doing in the following subjects? **[RANDOMIZE LIST]**

a. In Science?
b. In Computers and technology?
c. In Designing, creating, and building machines and devices, also called engineering?
d. In Math?

Would you say…

1 Excellent
2 Above average
3 Average
4 Below average

8 CHILD IS NOT GETTING THAT INSTRUCTION YET
7 Don't know/Not sure
9 Refused

D14. Thinking about the past school year and this summer, has this child participated, enrolled, or plan to enroll in any of the following activities? **[RANDOMIZE a-d]**

a. day program or summer camp related to science, technology, engineering, or mathematics
b. after-school program for enriched learning about science, technology, engineering, or mathematics
c. boy/girl scouts
d. 4-H
e. Any other structured activity related to science, technology, engineering or mathematics

1 Yes
2 No

8 TOO YOUNG TO PARTICIPATE IN THAT ACTIVITY
7 Don't know/Not sure
9 Refused

[IF CHILD IS AGES 6-11, SKIP TO D18]
[USE SPLIT HALF, IF CHILD IS AGES 12-19, HALF GET D18 HERE, HALF GET D18 after D17]

D15. Which of the following do you think this child will most likely do after high school graduation? Would you say…

1 Attend a 4-year college or university,
2 Attend a 2-year community college,
3 Attend a vocational or training school,
4 Enlist in the military,
5 Begin work immediately, or
6 Something else [SPECIFY]?

7 Don't know/Not sure
9 Refused

D16. How likely is it, if at all, that this child will pursue a career in a field related to science, technology, engineering, or math? Would you say…

1 Very likely,
2 Somewhat likely,
3 Somewhat unlikely, or
4 Very unlikely?

7 Don't know/Not sure
9 Refused

D17. How prepared do you feel this child is to study… **[RANDOMIZE LIST]**

a. science in college?
b. technology in college?
c. engineering in college?
d. math in college?

Would you say…

1 Very prepared,
2 Somewhat prepared, or
3 Not at all prepared?

7 Don't know/Not sure
9 Refused

D18. How important is it to you that this child… **[RANDOMIZE LIST]**

a. does well in math.
b. does well in science.
c. has good computer and technology skills.
d. has some exposure to engineering concepts.
e. does well in social studies such as history, American studies, or government
f. does well in English, language arts, and reading

Is it…

1 Very important,
2 Important,
3 Somewhat important, or
4 Not important at all?

7 Don't know/No opinion
9 Refused

SECTION E: Demographics

E1. Now I have just a few background questions and we'll be finished.
How do you identify yourself? Is it…

1. Male
2. Female, or
3. In another way – please specify, if you wish [SPECIFY]

9. PREFER NOT TO ANSWER

E2. What is your current age?

_____ [range 18-96]

96 96 or older
97 Don't know/Not sure
99 Refused

E3. What is the highest level of education you have completed?

1 Less than high school graduate
2 Grade 12 or GED (high school graduate)
3 One or more years of college but no degree
4 Associate's or other 2-year degree
5 College graduate with a 4 year degree such as a BA or BS
6 Graduate degree completed (MA, MS, MFA, MBA, MD, PhD, EdD, etc.)

7 Don't know/Not sure
9 Refused

[IF E3 <3 OR >6, SKIP TO E5]

E4. What was your major? **[OPEN]**

E5. Have you received any specialized training in a field related to science, technology, engineering, or math?

1 Yes
2 No

7 Don't know/Not sure
9 Refused

E6. Which of the following best describes where you live? Do you live…

11 On a farm,
12 In a rural setting, not on a farm,
13 In a rural subdivision outside of city limits,
14 In a small town of less than 5,000 people,
15 In a large town of 5,000 to less than 25,000 people,
16 In a city of 25,000 to less than 50,000 people,
17 In a city of 50,000 to less than 150,000 people, or
18 In a city of 150,000 or more people?

77 Don't know/Not sure
99 Refused

E7. Are you currently…?

11 Employed for wages,
12 Self-employed,
13 Out of work for more than 1 year,
14 Out of work for less than 1 year,
15 A Homemaker,
16 A Student,
17 Retired, or
18 Unable to work?

99 Refused

[IF E7=11, 12, 13, 14, 17 OR 99]

E8. Please tell me if you are now, or were recently, employed in a career that significantly uses skills in science, technology, engineering, or math?

1 Yes
2 No

7 Don't know/Not sure
9 Refused

E9. What is your annual gross household income from all sources before taxes? Is it…

11 Less than $15,000,
12 $15,000 to less than $25,000,
13 $25,000 to less than $35,000,
14 $35,000 to less than $50,000,
15 $50,000 to less than $75,000,
16 $75,000 to less than $100,000,
17 $100,000 to less than $150,000, or
18 $150,000 or more?

77 Don't know/Not sure
99 Refused

[IF E9 < 77, SKIP TO E11]

E10. Can you tell me if your annual gross household income is less than, equal to, or greater than $50,000?

1 Less than $50,000
2 Equal to $50,000
3 More than $50,000

7 Don't know/Not sure
9 Refused

E11. Now I'm going to ask you about what social media you may use on a regular basis, if any. Do you use:
[RANDOMIZE a-c]

a. Facebook
b. Twitter
c. Instagram
d. Any other social media

1. Yes [E11d=1, SPECIFY]
2. No

7. Don't know/Not sure
9. Refused

[IF E11a-c = 1, ASK E12a-c]

E12. How often do you use [Facebook]?

a. Facebook
b. Twitter
c. Instagram
d. Other social media

Would you say

1. Daily
2. 2 or more times a week
3. Once a week
4. 2-3 times a month
5 Monthly or less

7. Don't know/Not sure
9. Refused

E13. Are you of Hispanic, Latino, or Spanish origin?

1. Yes
2. No

7. Don't know/Not sure
9. Refused

E14. Which one or more of the following would you say is your race? **[SELECT ALL THAT APPLY]**

Would you say...
1 White,
2 Black or African American,
3 Asian,
4 Native Hawaiian or Other Pacific Islander,
5 American Indian or Alaska Native, or
6 Other **[SPECIFY]** _____?

7 Don't know / Not sure
9 Refused

CATI note: If more than one response to E14; continue. Otherwise, go to E16.

E15. Which one of these groups would you say best represents your race?
1 White
2 Black or African American
3 Asian
4 Native Hawaiian or Other Pacific Islander
5 American Indian or Alaska Native
6 Other **[SPECIFY]** _____

7 Don't know / Not sure
9 Refused

E16. What county do you live in?

_____ County

E17. What is your ZIP Code?

[ ]

77777 Don't know/Not sure
99999 Refused

Appendix D: Statewide Survey of Public Attitudes Toward STEM_Weighting methdology

Report prepared by Trent D. Buskirk, Ph.D.
Marketing Systems Group

November 1, 2016

WEIGHTING METHODOLOGY REPORT
IOWA STEM SURVEY – 2016

Design Overview:

This study has secured a total of 1,857 interviews with adults 18 or older residing in Iowa. In order to provide a probability-based sample representative of all adults in Iowa, a dual-frame random digit dial (RDD) sampling methodology was used, whereby both landline and cellular telephone numbers were included in the sample. Moreover, Hispanic and African American households were oversampled to reduce screening costs. The following table provides a summary of completed interviews by sampling strata.

Table 1. Distribution of completed interviews by sampling strata

Stratum	Respondents	
	n	(%)
1. Cellular RDD	1,244	67.0%
2. Landline RDD	203	10.9%
3. Listed Landline Households with Hispanic Surname	201	10.8%
4. Listed Landline Households with African American Ethnic Code	209	11.3%
Total	**1,857**	**100.0%**

Weighting:

Virtually, all survey data are weighted before they can be used to produce reliable estimates of population parameters. While reflecting the selection probabilities of sampled units, weighting also attempts to compensate for practical limitations of a sample survey, such as differential nonresponse and undercoverage. The weighting process for this survey essentially entailed two major steps. The first step consisted of computation of *base weights* to reflect unequal selection probabilities for different sampling strata, increased chance of selection for adults with both landline and cell phones, and selection of one adult per household. In the second step, base weights were adjusted so that the resulting final weights aggregate to reported totals for the target population.

For the second step, weights were adjusted (raked) simultaneously along several dimensions using the *WgtAdjust* procedure of SUDAAN. The needed population totals for weighting have been obtained from the Current Population Survey 2016 March Supplement. It should be noted that survey data for a number of demographic questions, such as race, age, and education, included missing values. All such missing values were first imputed using a *hot-deck* procedure before construction of the survey weights. As such, respondent counts reflected in the following tables correspond to the post-imputation step.

Table 2. First raking dimension for weight adjustments by gender and age

Age	Males				Females			
	Respondents		Population		Respondents		Population	
18-24	83	9.3%	137,631	11.8%	59	6.1%	140,494	11.7%
25-34	118	13.2%	220,377	18.9%	101	10.5%	208,812	17.3%
35-44	113	12.6%	192,228	16.5%	122	12.7%	180,073	15.0%
45-54	133	14.8%	173,702	14.9%	179	18.6%	210,382	17.5%
55-64	210	23.4%	212,716	18.2%	196	20.4%	208,582	17.3%
65+	239	26.7%	231,382	19.8%	304	31.6%	255,360	21.2%
Total	**896**	**100.0%**	**1,168,036**	**100.0%**	**961**	**100.0%**	**1,203,703**	**100.0%**

Table 3. Second raking dimension for weight adjustments by gender and ethnicity

Ethnicity	Males				Females			
	Respondents		Population		Respondents		Population	
Hispanic	82	9.2%	73,549	6.3%	73	7.6%	71,218	5.9%
Others	814	90.8%	1,094,487	93.7%	888	92.4%	1,132,485	94.1%
Total	**896**	**100.0%**	**1,168,036**	**100.0%**	**961**	**100.0%**	**1,203,703**	**100.0%**

Table 4. Third raking dimension for weight adjustments by race

Race	Respondents		Population	
White	1,671	90.0%	2,212,135	93.3%
African American	63	3.4%	57,832	2.4%
Others	123	6.6%	101,772	4.3%
Total	**1,857**	**100.0%**	**2,371,739**	**100.0%**

Table 5. Fourth raking dimension for weight adjustments by gender and education

Education	Males				Females			
	Respondents		Population		Respondents		Population	
Less than high school	59	6.6%	106,509	9.1%	43	4.5%	96,550	8.0%
High School or GED	227	25.3%	401,294	34.4%	219	22.8%	327,026	27.2%
College 1 year to 3 years	280	31.3%	358,267	30.7%	315	32.8%	402,645	33.5%
College 4 year or more	209	23.3%	217,763	18.6%	247	25.7%	283,130	23.5%
Graduate degree	121	13.5%	84,203	7.2%	137	14.3%	94,352	7.8%
Total	**896**	**100.0%**	**1,168,036**	**100.0%**	**961**	**100.0%**	**1,203,703**	**100.0%**

Table 6. Fifth raking dimension for weight adjustments by gender and place of residence

Place	Males				Females			
	Respondents		Population		Respondents		Population	
Farm	239	26.7%	246,097	21.1%	259	27.0%	226,656	18.8%
Small Town	172	19.2%	251,108	21.5%	214	22.3%	267,930	22.3%
Large Town	153	17.1%	214,656	18.4%	172	17.9%	230,619	19.2%
Small City	233	26.0%	380,809	32.6%	221	23.0%	397,408	33.0%
Large City	99	11.0%	75,366	6.5%	95	9.9%	81,090	6.7%
Total	**896**	**100.0%**	**1,168,036**	**100.0%**	**961**	**100.0%**	**1,203,703**	**100.0%**

Table 7. Sixth raking dimension for weight adjustments by telephone status

Telephone Status	Respondents		Population	
Cell-only	1,075	57.9%	1,033,646	43.6%
Others	782	42.1%	1,338,093	56.4%
Total	**1,857**	**100.0%**	**2,371,739**	**100.0%**

Variance Estimation for Weighted Data:

Survey estimates can only be interpreted properly in light of their associated sampling errors. Since weighting often increases variances of estimates, use of standard variance calculation formulae with weighted data can result in misleading statistical inferences. With weighted data, two general approaches for variance estimation can be distinguished. One method is *Taylor Series linearization* and the second is *replication*. There are several statistical software packages that can be used to produce design-proper estimates of variances using linearization or replication methodologies, including:

- SAS: http://www.sas.com
- SUDAAN: http://www.rti.org/sudaan
- WesVar: http://www.westat.com/westat/statistical_software/wesVar
- Stata: http://www.stata.com

An Approximation Method for Variance Estimation can be used to avoid the need for special software packages. Researchers who do not have access to such tools for design-proper estimation of standard errors can approximate the resulting variance inflation due to weighting and incorporate that in subsequent calculations of confidence intervals and tests of significance. With w_i representing the final weight of the i^{th} respondent, the inflation due to weighting, which is commonly referred to as *Design Effect*, can be approximated by:

$$\delta = 1 + \frac{\sum_{i=1}^{n} \frac{(w_i - \bar{w})^2}{n-1}}{\bar{w}^2}$$

For calculation of a confidence interval for an estimated percentage, $\hat{p}$, one can obtain the conventional variance of the given percentage $S^2(\hat{p})$, multiply it by the approximated design effect, δ, and use the resulting quantity as adjusted variance. That is, the adjusted variance $\hat{S}^2(\hat{p})$ would be given by:

$$\hat{S}^2(\hat{p}) \approx \frac{\hat{p}(1-\hat{p})}{n-1}\left(\frac{N-n}{N}\right) \times \delta$$

Subsequently, the (100-α) percent confidence interval for *P* would be given by:

$$\hat{p} - z_{\alpha/2}\sqrt{\frac{\hat{p}(1-\hat{p})}{n-1}\left(\frac{N-n}{N}\right) \times \delta} \leq P \leq \hat{p} + z_{\alpha/2}\sqrt{\frac{\hat{p}(1-\hat{p})}{n-1}\left(\frac{N-n}{N}\right) \times \delta}$$

Technical Appendix

A.1: Overall Sampling Design

The overall sample for the STEM 2016 study utilized a "dual frame" RDD approach that selected samples from MSG's Cell Phone RDD frame as well as MSG's Landline Phone RDD frame. In addition to samples from the overall landline RDD frame, the sampling design also employed oversampling of phone numbers from specific subframes of landline numbers including:

A. Listed landline numbers with Hispanic Surnames

B. Listed landline numbers with African American Ethnic codes

These frames are all subsets of the larger Landline RDD frame and potentially overlap with one another as depicted in **Figure A1**.

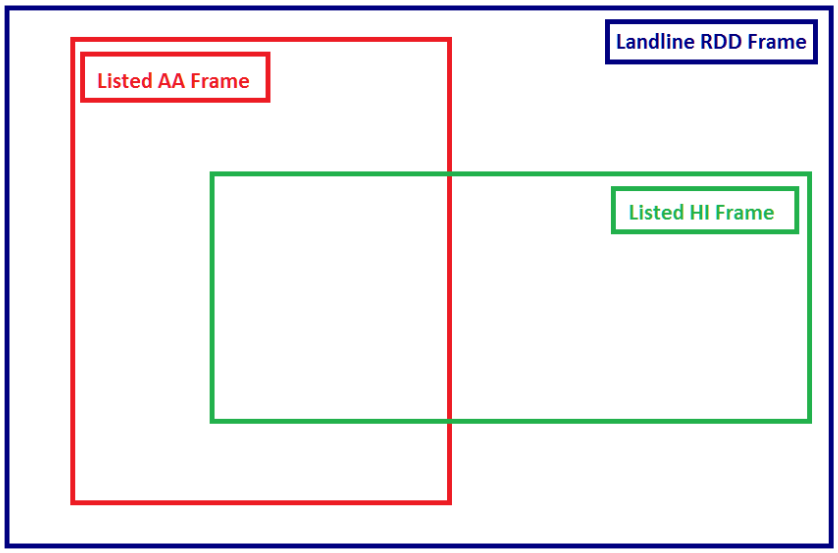


Figure A1: The Landline RDD frame and the Four List-Specific subframes used to generate the final Landline Samples for the Stem 2016 Study. Note: This figure is not drawn to scale.

More specifically, independent random samples were selected from each of the 3 frames depicted in Figure A1 and the resulting samples were generated and de-duplicated in the following order: (1) RDD Landline Sample; (2) Listed HI Sample; (3) Listed AA sample.

A2: Weighting Methods

The sample weighting used for this study incorporates several aspects of the sampling design including: (a) the inclusion of both landline and cellular numbers; (b) the selection of landline numbers from one of 3 overlapping frames and (c) the selection of an eligible adult within each contacted landline household. In this section we will describe how the inclusion probabilities and resulting sampling weights were computed.

A2.1: Selection and Base Weighting for Landline Numbers

Household Inclusion Probabilities (HHIP)

Landline numbers selected for this study could have multiple chances of being included in the final sample if they were included in more than one of the five overlapping frames depicted in Figure A1. To account for this multiplicity of selection we computed the inclusion probability for landline number i (LLIP(i)) as follows:

$$\text{LLIP(i)} = P(landline_i \in S_L) = 1 - \prod_{\{j:i \in L_j\}} \left[1 - P\left(i \in S_{L_j}\right)\right] \qquad (Eq:A21)$$

where S_L is the final landline sample and S_{Lj} is the landline sample taken from landline subframe j (j=1 (Landline RDD frame), 2 (Hispanic Surname), or 3 (African American Ethnic codes). These inclusion probabilities account for the multiplicity of landline frames which contain each specific landline number contained in the final sample. See Buskirk and Best (2012) and Bankier (1986) for more details on this methodology.

Within Household Selection Probabilities (WHHSP)

Within each landline household an adult was selected at random using the Most Recent Birthday method. The within person selection probability for household whose landline number, i, is included in the Final Overall Landline Sample is computed as:

$$WHHSP(i) = \frac{1}{NumAdults(i)}$$

For those adults who were dual users, a base weight that reflected possibilities of being included in the sample from either of the two frames was computed as described in Buskirk and Best (2012) (www.amstat.org/sections/srms/proceedings/y2012/files/304351_72969.pdf). The multiplicity adjustment for within household selection of one adult for respondents on the landline frame was capped at 3 for those households that had 3 or more adults.

Final Landline Base weight

The final landline baseweight for households associated with landline numbers included in the final overall landline sample is the reciprocal of the product of the household and within household probabilities as given by:

$$FLBW(i) = [LHSP(i) * WHHSP(i)]^{-1}$$

A2.2: Selection and Weighting for Cellphone Numbers

Final Cell Phone Base weight

The final cell phone base weights were computed simply as the inverse of the inclusion probabilities which were defined by the total sample size divided by the total cell phone universe size.

Note on base weight calculations: Both the landline samples and the cell samples were randomly selected across three distinct waves. To simplify the computations, the inclusion probabilities at the phone number level were computed simply as the ratio of the total sample size from a given frame (across the four waves) divided by the average frame size from across the four waves. In general, the frame sizes were the same across the three waves but in a few cases, the total frame sizes were slightly smaller for the third and final wave of data collection. This approach provides a more streamlined computation of the inclusion probabilities and represents a very reasonable approximation to the per wave inclusions.

A2.3: Landline and Cellphone Dual User Compositing

A household could be included in the sample by having a phone number included in the landline frame and a second, distinct number, included in the cellphone frame. Such households would be identified as dual users in the sample and as such represent a multiplicity of inclusion that is not accounted for in the separate inclusion probability and weight computations for the overall landline and cell phone samples. We account for this multiplicity of inclusion in a separate compositing step and not within each of the separate frames because we do not have specific landline subframe (e.g. Listed AA, Listed HI, etc.) information for each dual user that responds in the cell phone sample. Essentially the compositing step multiplies the weights of the dual users in the landline sample by a compositing factor λ (between 0 and 1) and the corresponding dual users in the cell phone frame by (1-λ). While many recommendations have been provided in the literature as to the specific value of the compositing factor, we compute λ as the ratio of the effective sample size of dual landline users to the total effective sample size of the landline and cellphone users as displayed in Table A1 and discussed by the AAPOR task force report (2010), Brick et al. (2011) and Frankel et al. (2007).

Table A.1 Computation of Compositing Factor for Dual Phone Users

Completed By	Number of Dual Users		UWE	Effective Sample Size	Compositing Factor, λ
Landline	469	49.6%	3.37	469/3.37=140	λ_{land} =140/(140+476)=.2273
Cell	476	50.4%	1.00	476/1.00=476	λ_{cell} =476/(140+476) = .7727

**** We note that the compositing factor derived for this year's STEM survey is higher for cell phone dual users compared to last year because the overall sample allocation favored cell phone samples at a ratio of 3:1 and by virtue of the fact that there was no oversampling or additional frame or design elements for the cell phone samples making the UWE for dual users from the cell frame sample equal to 1.**

Summary Information for the Weighted Data:

An overall histogram illustrating the design weights computed from the first step as well as the final, calibrated weights from the second are shown in Figures A2 and A3, respectively. Based on the UWE equation in the previous sample, the value computed for this study based on the final weights is: 1.692. The UWE for the first stage weight (without calibration to population totals) is 1.326. The increase in the UWE is expected as the calibration process potentially decreases coverage/nonresponse bias at the expense of increases in the variability of the sampling weights. However, in this case the increase is rather small. The UWE of 1.692 can be used in the computation of confidence intervals for estimates derived using the final sampling weights as described in the previous section.

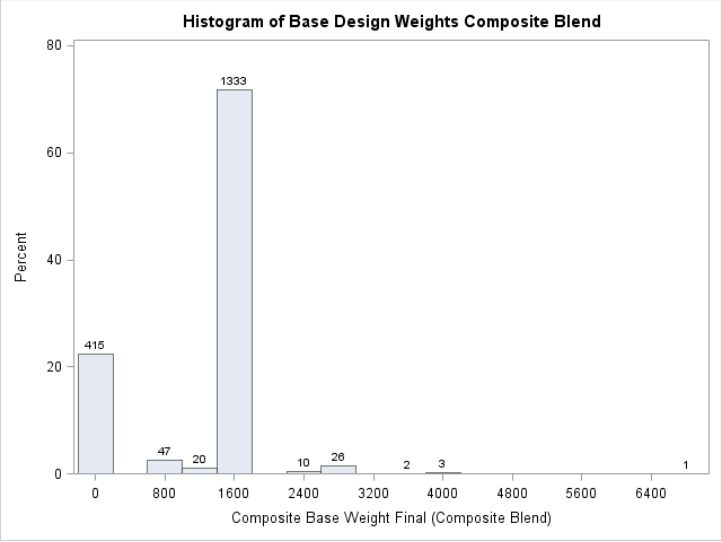


Figure A2: Distribution of the Base Design Weights computed from Step 1 of the overall weight computation (including base weight-probability of selection as well as multiplicity for within household selection of one adult).

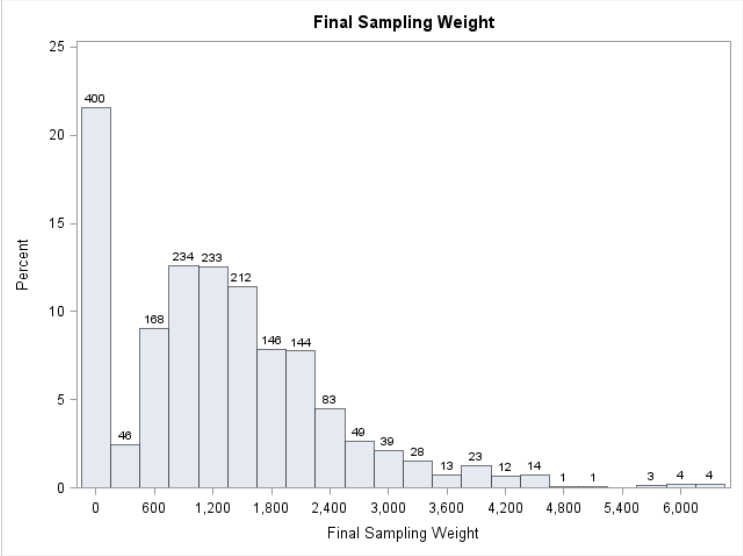


Figure A3: Distribution of the final calibrated sampling weights. These weights should be used in all analyses.

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Appendix E: Statewide Survey of Public Attitudes Toward STEM_Item frequencies

The tables in this section are presented in the order they were asked in the statewide public awareness survey.

A1. I'm going to read a short list of topics. Please tell me how much you have heard about each one, if anything, in the past month.

a. The size of Iowa's workforce	n	Weighted %
A lot	233	13%
A little	833	43%
Nothing in the past month	779	44%
Total	1,845	100%

b. Agriculture in Iowa	n	Weighted %
A lot	865	43%
A little	706	39%
Nothing in the past month	281	18%
Total	1,852	100%

c. K-12 education in Iowa	n	Weighted %
A lot	520	27%
A little	848	45%
Nothing in the past month	486	28%
Total	1,854	100%

d. Water quality in Iowa	n	Weighted %
A lot	562	25%
A little	769	41%
Nothing in the past month	523	34%
Total	1,854	100%

e. Healthcare in Iowa	n	Weighted %
A lot	826	42%
A little	759	43%
Nothing in the past month	265	15%
Total	1,850	100%

f. Manufacturing in Iowa	n	Weighted %
A lot	318	17%
A little	941	49%
Nothing in the past month	592	34%
Total	1,851	100%

A2. What jobs or careers do you think are most important to Iowa's economy?
[Open ended. Select up to 6]

	n	Weighted %
Farming	909	48%
Agriculture manufacturing (e.g. John Deere)	349	18%
Agricultural science (e.g. plant, soil, animal sciences)	313	17%
Business	122	6%
Engineering	102	5%
Manufacturing	555	29%
Health care	389	20%
Transportation	34	2%
Technology (e.g. computer and technology start-ups)	205	9%
Education	459	23%
Other [SPECIFY]	392	20%

A3. Please tell me how much you have heard about each of the following, if anything, in the past month?

a. The Governor's Future Ready Iowa initiative	n	Weighted %
A lot	77	3%
A little	561	28%
Nothing in the past month	1,208	69%
Total	1,846	100%

b. Improving math, technology, science, and engineering education	n	Weighted %
A lot	291	14%
A little	790	39%
Nothing in the past month	775	47%
Total	1,856	100%

A4. Have you visited any of the following in the past 12 months?

a. A museum	n	Weighted %
Yes	827	43%
No	1,029	57%
Total	1,856	100%

b. A zoo or aquarium	n	Weighted %
Yes	625	36%
No	1,229	64%
Total	1,854	100%

c. A science or technology center	n	Weighted %
Yes	471	26%
No	1,381	74%
Total	1,852	100%

d. A public library	n	Weighted %
Yes	1,137	60%
No	719	40%
Total	1,856	100%

e. A K-12 school	n	Weighted %
Yes	1,065	58%
No	790	42%
Total	1,855	100%

f. An arboretum or botanical center	n	Weighted %
Yes	517	27%
No	1,338	73%
Total	1,855	100%

A5. You may have heard about STEM education or STEM careers lately. What, if anything, comes to mind when you hear the letters S-T-E-M, or the word STEM? [Open ended]

	n	Weighted %
Exact or close definition of 'Science, Technology, Engineering, Math' (Some or all words)	447	21%
Related to education and/or schools, in general, but no specific mention of science, technology, engineering math	226	11%
Stem cells or stem cell research	279	15%
Other [SPECIFY]	28	1%
Plants, Biology, Flowers, Growth...	29	2%
Don't know/Not sure/Nothing	876	51%
Refused	3	0%
Total	1,857	100%

A6. STEM stands for "science, technology, engineering and mathematics. Have you read, seen heard of this before?

	n	Weighted %
Yes	979	49%
No	855	51%
Total	1,834	100%

[If A6>1, Skip to A10]

A7. What slogans or taglines, if any, have you read, seen heard about STEM? [Open ended]

	n	Weighted %
Greatness STEMs from Iowans	4	1%
Governor's STEM Advisory Council	2	0%
iexploreSTEM	1	0%
I heard something but don't remember what it was	124	13%
Other [SPECIFY]	56	6%
Total	979	100%

A8. In the past few months, have you read, seen heard anything about STEM education from any of the following sources of information? [Randomized]

a. TV	n	Weighted %
Yes	412	41%
No	561	59%
Total	973	100%

b. Newspaper or new website (e.g. cnn.com)	n	Weighted %
Yes	521	48%
No	452	52%
Total	973	100%

c. Billboard	n	Weighted %
Yes	85	7%
No	889	93%
Total	974	100%

d. Radio	n	Weighted %
Yes	288	27%
No	685	73%
Total	973	100%

e. A school or teacher	n	Weighted %
Yes	490	48%
No	485	52%
Total	975	100%

f. Non-news website	n	Weighted %
Yes	202	20%
No	767	80%
Total	969	100%

g. A child or student	n	Weighted %
Yes	331	33%
No	644	67%
Total	975	100%

h. Twitter	n	Weighted %
Yes	64	6%
No	914	94%
Total	978	100%

i. A specific event, program activity [SPECIFY]	n	Weighted %
Yes	242	25%
No	726	75%
Total	968	100%

j. Facebook	n	Weighted %
Yes	219	26%
No	754	74%
Total	973	100%

A9. What specific groups or events, if any, have you heard about during the past year that promote Iowa STEM education or programs? [Select all that apply. Field code]

	n	Weighted %
A booth/display at a COUNTY FAIR	3	0%
A booth/display at a STATE FIAR / STEM day at the Iowa State Fair	13	2%
A STEM festival	17	2%
Any reference to the Governor's STEM Advisory Council	18	1%
I went to another STEM Event [SPECIFY]	27	3%
Other [SPECIFY]	281	27%
Total	979	100%

A10. I'm going to read a short list of some groups and events promoting STEM education and careers. Please tell me how much you have heard, if anything, about each one in the past year. [Randomized]

a. "Hour of Code" or Code Iowa	n	Weighted %
A lot	62	3%
A little	246	13%
Nothing in the past year	1,542	84%
Total	1,850	100%

b. Iowa Governor's STEM Advisory Council	n	Weighted %
A lot	46	2%
A little	416	19%
Nothing in the past year	1,390	79%
Total	1,852	100%

c. A STEM Festival	n	Weighted %
A lot	55	2%
A little	176	8%
Nothing in the past year	1,623	90%
Total	1,854	100%

d. Governor's 2016 Future Ready Iowa Summit	n	Weighted %
A lot	41	2%
A little	511	25%
Nothing in the past year	1,295	73%
Total	1,847	100%

e. A STEM Academy, STEM School, or STEM Classroom	n	Weighted %
A lot	101	4%
A little	468	23%
Nothing in the past year	1,283	73%
Total	1,852	100%

f. STEM Day at the Capitol	n	Weighted %
A lot	42	2%
A little	298	13%
Nothing in the past year	1,510	85%
Total	1,850	100%

g. STEM Day at the Iowa State Fair	n	Weighted %
A lot	69	3%
A little	359	18%
Nothing in the past year	1,428	79%
Total	1,856	100%

h. The STEM Scale-Up Program	n	Weighted %
A lot	28	1%
A little	189	9%
Nothing in the past year	1,636	90%
Total	1,853	100%

i. Iowa STEM Teacher Externships	n	Weighted %
A lot	29	1%
A little	227	10%
Nothing in the past year	1,593	89%
Total	1,849	100%

j I.O.W.A. STEM Teacher Award	n	Weighted %
A lot	34	1%
A little	378	20%
Nothing in the past year	1,438	79%
Total	1,850	100%

A11. I am going to read a list of slogans or taglines about STEM education. Please tell me if you've heard the slogan or tagline…

a. Greatness STEMs from Iowans	n	Weighted %
Yes	291	16%
No	1,546	84%
Total	1,837	100%

b. Commit2STEM	n	Weighted %
Yes	135	7%
No	1,715	93%
Total	1,850	100%

c. Iowa's future demands STEM	n	Weighted %
Yes	238	12%
No	1,602	88%
Total	1,840	100%

[If A11a=1 or A7=1]

A12. Where did you see, hear read about the slogan, "Greatness STEMs from Iowans? [Select all that apply. Do not read]

	n	Weighted %
TV	57	18%
Newspaper or news website (e.g. cnn.com)	61	15%
Billboard	10	3%
Radio	28	11%
A school or teacher	24	9%
Non-news website (e.g. iowastem.gov, scstemhub.drake.edu)	8	3%
A child or student	6	2%
Twitter	2	1%
Facebook	11	6%
A STEM Event [SPECIFY]	6	1%
Other [SPECIFY]	47	15%
Total	295	100%

A14. Now, think about jobs **in IOWA** that rely on science, technology, engineering, and math skills. As far as you know, would you say there are…

	n	Weighted %
More than enough skilled workers to fill STEM jobs	73	4%
Not enough skilled workers to fill STEM jobs	1,372	82%
Just the right number of skilled workers to fill STEM jobs	209	14%
Total	1,654	100%

SECTION B: Attitudes Toward STEM and the Role of STEM in Iowa

There are several initiatives in Iowa to improve STEM education and STEM careers. The next questions are about your thoughts regarding these topics. Please tell me whether you strongly agree, agree, disagree, or strongly disagree with each of the following statements.

a. Many more companies would move or expand to Iowa if the state had a reputation for workers with great science and math skills.

	n	Weighted %
Strongly agree	409	21%
Agree	1,144	64%
Neither agree nor disagree	19	1%
Disagree	212	13%
Strongly disagree	14	1%
Total	1,798	100%

b. Increased focus on STEM education in Iowa will improve the state economy.

	n	Weighted %
Strongly agree	425	24%
Agree	1,234	68%
Neither agree nor disagree	25	1%
Disagree	92	6%
Strongly disagree	8	0%
Total	1,784	100%

c. There are more jobs available for people who have had good math and science skills.

	n	Weighted %
Strongly agree	380	21%
Agree	1,135	63%
Neither agree nor disagree	25	1%
Disagree	235	14%
Strongly disagree	14	1%
Total	1,789	100%

d. Careers in agriculture do not rely heavily on STEM skills.

	n	Weighted %
Strongly agree	24	1%
Agree	239	14%
Neither agree nor disagree	10	1%
Disagree	1,090	62%
Strongly disagree	414	22%
Total	1,777	100%

e. Progress is being made to increase the number of women working in STEM jobs.

	n	Weighted %
Strongly agree	156	10%
Agree	1,112	69%
Neither agree nor disagree	53	4%
Disagree	237	15%
Strongly disagree	24	1%
Total	1,582	100%

f. Progress is being made to increase the number of Hispanics working in STEM jobs.

	n	Weighted %
Strongly agree	49	3%
Agree	740	56%
Neither agree nor disagree	89	7%
Disagree	422	32%
Strongly disagree	38	2%
Total	1,338	100%

g. More people would choose a STEM job if it didn't seem so hard.

	n	Weighted %
Strongly agree	181	11%
Agree	1,110	63%
Neither agree nor disagree	31	2%
Disagree	396	23%
Strongly disagree	35	1%
Total	1,753	100%

h. Progress is being made to increase the number of African Americans working in STEM jobs.

	n	Weighted %
Strongly agree	50	3%
Agree	814	62%
Neither agree nor disagree	77	6%
Disagree	369	27%
Strongly disagree	38	2%
Total	1,348	100%

i. There is an urgent need in Iowa for more resources to be put toward STEM education.

	n	Weighted %
Strongly agree	355	20%
Agree	1,203	69%
Neither agree nor disagree	31	2%
Disagree	133	8%
Strongly disagree	10	1%
Total	1,732	100%

j. Science, technology, and engineering are too specialized for most people to understand it.

	n	Weighted %
Strongly agree	64	3%
Agree	676	38%
Neither agree nor disagree	27	2%
Disagree	874	48%
Strongly disagree	186	9%
Total	1,827	100%

k. Training in visual arts, music drama improves performance in STEM.

	n	Weighted %
Strongly agree	353	18%
Agree	1,100	64%
Neither agree nor disagree	37	2%
Disagree	227	15%
Strongly disagree	16	1%
Total	1,733	100%

l. The push for STEM is more about filling open jobs than making sure students are taught about specific STEM concepts in school.

	n	Weighted %
Strongly agree	70	4%
Agree	710	45%
Neither agree nor disagree	56	4%
Disagree	689	44%
Strongly disagree	64	4%
Total	1,589	100%

B2. Compared to a year ago, would you say that Iowa K-12 student achievement in SCIENCE is getting better, staying the same getting worse?

	n	Weighted %
getting better,	511	35%
staying the same	696	43%
getting worse	321	22%
Total	1,528	100%

B3. Compared to a year ago, would you say that Iowa K-12 student achievement in MATH is getting better, staying the same getting worse?

	n	Weighted %
getting better,	484	30%
staying the same, or	689	43%
getting worse?	416	27%
Total	1,589	100%

SECTION C: STEM Education

C1. How well do you think the schools in your community are teaching each of the following subjects?

a. Mathematics	n	Weighted %
Excellent	212	12%
Good	806	44%
Fair	522	31%
Poor	213	13%
Total	1,753	100%

b. Science	n	Weighted %
Excellent	208	12%
Good	860	49%
Fair	509	30%
Poor	155	9%
Total	1,732	100%

c. Social studies such as history, American studies government		Weighted %
Excellent	141	9%
Good	744	42%
Fair	529	31%
Poor	315	18%
Total	1,729	100%

d. English, language arts, and reading	n	Weighted %
Excellent	274	16%
Good	838	46%
Fair	461	26%
Poor	190	11%
Total	1,763	100%

e. Designing, creating, and building machines and devices, also called engineering	n	Weighted %
Excellent	136	8%
Good	568	32%
Fair	543	34%
Poor	409	25%
Total	1,656	100%

f. Computers and technology	n	Weighted %
Excellent	354	22%
Good	939	51%
Fair	367	21%
Poor	97	6%
Total	1,757	100%

g. Foreign languages	n	Weighted %
Excellent	101	7%
Good	549	33%
Fair	611	36%
Poor	387	23%
Total	1,648	100%

h. Art	n	Weighted %
Excellent	190	11%
Good	755	45%
Fair	540	32%
Poor	206	12%
Total	1,691	100%

i. Music	n	Weighted %
Excellent	325	18%
Good	758	44%
Fair	481	29%
Poor	162	9%
Total	1,726	100%

C3. I'm going to read some statements about STEM education. Please tell me whether you strongly agree, agree, disagree, or strongly disagree with each of the following statements. [RANDOMIZED]

a. It is more important for students to graduate from high school with strong skills in reading and writing than it is to have strong skills in math and science.

	n	Weighted %
Strongly agree	105	5%
Agree	486	26%
Neither agree nor disagree	75	3%
Disagree	975	54%
Strongly disagree	173	11%
Total	1,814	100%

b. Overall, the quality of STEM education in Iowa is high.

	n	Weighted %
Strongly agree	45	3%
Agree	899	58%
Neither agree nor disagree	39	2%
Disagree	574	35%
Strongly disagree	31	2%
Total	1,588	100%

c. Iowa colleges and universities are doing a good job preparing STEM teachers.

	n	Weighted %
Strongly agree	74	5%
Agree	1,004	71%
Neither agree nor disagree	56	4%
Disagree	277	18%
Strongly disagree	26	2%
Total	1,437	100%

d. Iowa colleges and universities are doing a good job preparing students for careers in STEM fields.

	n	Weighted %
Strongly agree	130	8%
Agree	1,201	75%
Neither agree nor disagree	39	2%
Disagree	246	14%
Strongly disagree	23	1%
Total	1,639	100%

e. Emphasis on STEM education takes too many resources away from other important subjects in schools.

	n	Weighted %
Strongly agree	31	2%
Agree	318	18%
Neither agree nor disagree	26	1%
Disagree	1,115	68%
Strongly disagree	217	11%
Total	1,707	100%

C5. Overall, to what degree do you support or oppose state efforts to devote resources and develop initiatives to promote STEM education in Iowa?

	n	Weighted %
Very supportive	714	37%
Somewhat supportive	792	44%
Neither supportive nor opposed	218	13%
Somewhat opposed	76	4%
Very opposed	25	2%
Total	1,825	100%

C6. Do you think STEM education **is a priority** in your local school district?		Weighted %
Yes	927	50%
No	553	30%
Don't know / Not sure	371	20%
Total	1,851	100%

C7. Do you think STEM education ***should*** be a priority in your local school district?

	n	Weighted %
Yes	1,625	93%
No	134	7%
Total	1,759	100%
Don't know / Not sure (<5% Unweighted)	89	

C8. In Iowa, when you think of STEM jobs or STEM careers, what jobs or careers do you think of?

[DO NOT READ. Open ended. Select up to 6]	n	Weighted %
Farming	308	15%
Agriculture manufacturing (e.g. John Deere)	256	14%
Agricultural science (e.g. plant, soil, animal sciences)	317	15%
Business	122	6%
Engineering	954	50%
Manufacturing	349	18%
Insurance	38	2%
Health care	422	20%
Transportation	22	1%
Technology (e.g. computer and technology start-ups)	451	22%
Education	286	14%
Other [Specify]	496	25%
Total	1,857	100%

Section D. Parent module

Questions in the parent module were asked of respondents who were parents of a child between the ages of 3 to 19 years old, and whose child was enrolled in pre-kindergarten through twelfth grade.

D1 [Recoded]. Final classification of parent status

	n	Weighted %
No children/no school aged children	1,298	65%
Child 3-11	252	17%
Child 12-19	307	19%
Total	1,857	100%

D2 [Recoded]. Final classification of child gender

	Unweighted Count	Unweighted %
Male child	288	51%
Female child	271	49%
Total	559	100%

Descriptive statistics for screening questions in Section D are not reported because they were asked as part of the selection criteria to randomly select one child in households with more than one child to be the focus of questions in the parent module, and to determine if the respondent was a legal guardian of the selected child. Of the 559 respondents who lived in a household with a child 3-19 years old, 383 respondents met the selection criteria to complete the questions in the parent module as a mother/father (birth, adoptive, step, or foster) or legal guardian of a child who was enrolled in pre-school through 12th grade.

D12. In general, how much interest, if any, does this child show in the following subjects? [Randomize]

a. Science	n	Weighted %
A lot of interest	191	48%
Some interest	126	30%
Little or no interest	63	21%
Respondent offers not sure yet or child is too young to know	2	0%
Total	382	100%

b. Computers and technology	n	Weighted %
A lot of interest	249	67%
Some interest	102	26%
Little or no interest	29	7%
Respondent offers not sure yet or child is too young to know	2	0%
Total	382	100%

c. Designing, creating, and building machines and devices, also called engineering	n	Weighted %
A lot of interest	138	38%
Some interest	121	30%
Little or no interest	117	32%
Respondent offers not sure yet or child is too young to know	5	0%
Total	381	100%

d. Math	n	Weighted %
A lot of interest	161	38%
Some interest	128	32%
Little or no interest	90	29%
Respondent offers not sure yet or child is too young to know	2	0%
Total	381	100%

[If child age < 6 SKP D18]
D13. In general, how well is this child doing in the following subjects?

a. Science	n	Weighted %
Excellent	81	22%
Above average	113	29%
Average	121	41%
Below average	24	8%
Total	339	100%

b. Computers and technology	n	Weighted %
Excellent	93	27%
Above average	120	34%
Average	104	34%
Below average	11	4%
Total	328	100%

c. Designing, creating, and building machines and devices, also called engineering	n	Weighted %
Excellent	54	19%
Above average	65	24%
Average	114	41%
Below average	49	16%
Total	282	100%

d. Math	n	Weighted %
Excellent	101	27%
Above average	99	27%
Average	107	34%
Below average	34	13%
Total	341	100%

D14. Thinking about the past school year and this summer, has this child participated, enrolled, or plan to enroll in any of the following activities? [RANDOMIZED]

a. Day program or summer camp related to STEM	n	Weighted %
Yes	72	22%
No	267	78%
Total	339	100%

b. After-school program for enriched learning about STEM	n	Weighted %
Yes	59	16%
No	279	84%
Total	338	100%

c. Boy/girl scouts	n	Weighted %
Yes	73	24%
No	268	76%
Total	341	100%

d. 4-H	n	Weighted %
Yes	44	10%
No	292	90%
Total	336	100%

e. Any other structured activity related to STEM	n	Weighted %
Yes	44	10%
No	295	90%
Total	339	100%

D15. Which of the following do you think this child will most likely do after high school graduation? Would you say… [Asked only of parents of a 12-19 year old child]

	n	Weighted %
Attend a 4-year college or university	117	58%
Attend a 2-year community college	35	23%
Attend a vocational or training school	9	5%
Enlist in the military	9	8%
Begin work immediately	4	3%
Something else [SPECIFY]	4	3%
Total	178	100%

D16. How likely is it, if at all, that this child will pursue a career in a field related to science, technology, engineering, or math? Would you say… [Asked only of parents of a 12-19 year old child]

	n	Weighted %
Very likely	79	40%
Somewhat likely	63	37%
Somewhat unlikely	26	14%
Very unlikely	16	9%
Total	184	100%

D17. How prepared do you feel this child is to study…
[Asked only of parents of a 12-19 year old child] [RANDOMIZED]

a. Science in college	n	Weighted %
Very prepared	53	25%
Somewhat prepared	98	52%
Not at all prepared	35	22%
Total	186	100%

b. Technology in college	n	Weighted %
Very prepared	51	24%
Somewhat prepared	96	48%
Not at all prepared	39	27%
Total	186	100%

c. Engineering in college	n	Weighted %
Very prepared	26	13%
Somewhat prepared	78	38%
Not at all prepared	79	49%
Total	183	100%

d. Math in college	n	Weighted %
Very prepared	61	29%
Somewhat prepared	90	45%
Not at all prepared	36	26%
Total	187	100%

D18. How important is it to you that this child… [Asked of all parents] [RANDOMIZED]

a. Does well in math	n	Weighted %
Very important	285	73%
Important	79	22%
Somewhat important	16	5%
Not important at all	2	1%
Total	382	100%

b. Does well in science	n	Weighted %
Very important	230	57%
Important	104	30%
Somewhat important	40	11%
Not important at all	6	2%
Total	380	100%

c. Has good computer and technology skills	n	Weighted %
Very important	273	70%
Important	92	27%
Somewhat important	13	3%
Not important at all	3	1%
Total	381	100%

d. Has some exposure to engineering concepts	n	Weighted %
Very important	176	47%
Important	130	35%
Somewhat important	60	16%
Not important at all	13	3%
Total	379	100%

e. Does well in social studies such as history, American studies, or government	n	Weighted %
Very important	160	43%
Important	131	35%
Somewhat important	74	18%
Not important at all	14	4%
Total	379	100%

f. Does well in English, language arts, and reading	n	Weighted %
Very important	281	71%
Important	87	26%
Somewhat important	14	4%
Total	382	100%

SECTION E. DEMOGRAPHICS

E1. Now I have just a few background questions and we'll be finished. How do you identify yourself?

	n	Weighted %
Male	896	49%
Female	961	51%
Total	1,857	100%

E2 [Recoded]. What is your current age?

	n	Weighted %
18-24 years old	141	12%
25-34 years old	216	18%
35-44 years old	231	16%
45-54 years old	311	16%
55-64 years old	400	18%
65 years or older	535	20%
Total	1,834	100%

E3. What is the highest level of education you have completed?

	n	Weighted %
Less than high school graduate	102	9%
Grade 12 or GED	444	31%
One or more years of college but no degree	312	17%
Associate's or other 2-year degree	281	15%
College graduate with a 4-year degree such as a BA or BS	456	21%
Graduate degree	258	8%
Total	1,853	100%

[If E3 <3 or >6, skip to E5]

E3 [Recoded]. Final classification of education

	n	Weighted %
High School or less	548	39%
Some College	595	32%
BA or More	714	29%
Total	1,857	100%

E4 [Recoded]. What was your major? [Open]

	n	Weighted %
Agriculture	33	3%
Natural Resources	5	0%
Architecture	2	0%
Computer and Information Sciences	68	6%
Engineering	65	4%
Biological Sciences	66	4%
Mathematics and Statistics	19	1%
Physical Sciences	7	0%
Health Sciences	189	15%
Education - STEM	15	1%
STEM - Other (Diesel Tech, welder,	66	7%
Social Science	77	6%
Education - Other or Unspecified	168	11%
Not STEM Degree	520	41%
Total	1,300	100%

E5. Have you received any specialized training in a field related to science, technology, engineering, or math?

	n	Weighted %
Yes	680	35%
No	1,170	65%
Total	1,850	100%

E6. Which of the following best describes where you live?

	n	Weighted %
On a farm	190	8%
In a rural setting, not on a farm	183	7%
In a rural subdivision outside of city limits	114	5%
in a small town of less than 5,000 people	376	22%
In a large town of 5,000 to less than 25,000 people	315	19%
In a city of 25,000 to less than 50,000 people	192	15%
In a city of 50,000 to less than 150,000 people	254	17%
In a city of 150,000 people	188	6%
Total	1,812	100%

E6 [Recoded]. Final location size classification

	n	Weighted %
Lives on a Farm/Rural(LT 5K)	863	42%
Town (5K to 50K)	507	34%
Large City (GT 50K)	442	24%
Total	1,812	100%

E7. Are you currently…? [employment status]

	n	Weighted %
Employed for wages	952	56%
Self-employed	181	10%
Out of work for more than 1 year	25	2%
Out of work for less than 1 year	36	2%
A homemaker	72	4%
A student	49	4%
Retired	475	19%
Unable to work	66	4%
Total	1,856	100%

[If E7=11,12,13,14,17 or 99]

E8. Are you now or were you recently employed in a career that significantly uses skills in science, technology, engineering, or math?

	n	Weighted %
Yes	916	54%
No	746	46%
Total	1,662	100%

E9. What is your annual gross household income from all sources before taxes?

	n	Weighted %
Less than $15,000	161	10%
$15,000 to less than $25,000	176	12%
$25,000 to less than $35,000	160	9%
$35,000 to less than $50,000	226	15%
$50,000 to less than $75,000	302	18%
$75,000 to less than $100,000	258	16%
$100,000 to less than $150,000	204	12%
$150,000 or more	147	7%
Total	1,634	100%

[If E9 < 77, skip to E11]

E10. Can you tell me if your annual gross household income is less than, equal to, or greater than $50,000?

	n	Weighted %
Less than $50,000	48	46%
Equal to $50,000	10	16%
More than $50,000	51	39%
Total	109	100%

Now I'm going to ask you about what social media you may use on a regular basis, if any. [RANDOMIZED]

E11a. Do you use Facebook?	n	Weighted %
Yes	1,220	70%
No	637	30%
Total	1,857	100%

E12a. How often do you use Facebook?	n	Weighted %
Daily	831	72%
2 or more times a week	229	16%
Once a week	84	7%
2-3 times a month	39	3%
Monthly or less	34	3%
Total	1,217	100%

E11b. Do you use Twitter?	n	Weighted %
Yes	230	13%
No	1,627	87%
Total	1,857	100%

E12b. How often do you use Twitter?	n	Weighted %
Daily	96	43%
2 or more times a week	51	24%
Once a week	30	15%
2-3 times a month	23	7%
Monthly or less	29	10%
Total	229	100%

E11c. Do you use Instagram?	n	Weighted %
Yes	265	18%
No	1,590	82%
Total	1,855	100%

E12c. How often do you use Instagram?	n	Weighted %
Daily	99	39%
2 or more times a week	64	23%
Once a week	42	15%
2-3 times a month	27	10%
Monthly or less	33	13%
Total	265	100%

E11d. Do you use Other [Specify]?	n	Weighted %
Yes	149	8%
No	1,596	92%
Total	1,745	100%

E11e. Snapchat?	n	Weighted %
Not selected	1,748	92%
Selected	109	8%
Total	1,857	100%

E13. Are you of Hispanic, Latino, or Spanish origin?

	n	Weighted %
Yes	155	6%
No	1,696	94%
Total	1,851	100%

E14 [Recoded]. What is your race?	n	Weighted %
White	1,662	92%
Black or African American	64	2%
Asian	18	1%
Native Hawaiian or Other Pacific Islander	4	0%
American Indian or Alaska Native	33	1%
Other [SPECIFY]	91	3%
Refused	18	1%

E16. What county do you live in? [Available upon request]

E17. What is your ZIP code? [Available upon request]

E18 [Recoded]. Final phone status of respondents

	n	Weighted %
Landline Only	130	4%
Cellphone Only	782	56%
Dual-User	945	40%
Total	1,857	100%

Appendix F: Statewide Survey of Public Attitudes Toward STEM_Multivariate logistic regression

The complete set of multivariate tables with SUDAAN outputs follow. These tables show estimated regression coefficients, standard errors, 95% confidence intervals, t-test and p-values. The reference subgroup for all covariates in the model is indicated in the table. It is important to remember that caution should be used in generalizing the findings where confidence intervals are wide.

Variance Estimation Method: Taylor Series (WR)
SE Method: Robust (Binder, 1983)
Working Correlations: Independent
Link Function: Logit
Response variable A6: STEM stands for “science, technology, engineering and mathematics. Have you read, seen heard of this before?
LOGISTIC REGRESSION (all variables with income) - stem awareness - YEAR 2016 by: Independent Variables and Effects.

Independent Variables and Effects		Beta Coeff.	SE Beta	Lower 95% Limit Beta	Upper 95% Limit Beta	T-Test B=0	P-value T-Test B=0
Intercept		-1.06	0.21	-1.48	-0.65	-4.99	0.0000
	Male	0.00	0.00	0.00	0.00	.	.
	Female	0.42	0.14	0.14	0.70	2.98	0.0030
	18 - 34 years	0.00	0.00	0.00	0.00	.	.
	35 - 54 years	-0.39	0.19	-0.77	-0.02	-2.07	0.0387
	55 or older	-0.16	0.18	-0.52	0.19	-0.90	0.3693
	High School or less	0.00	0.00	0.00	0.00	.	.
	Some College	0.63	0.17	0.29	0.97	3.62	0.0003
	BA or More	1.35	0.18	1.00	1.71	7.50	0.0000
	Whites	0.00	0.00	0.00	0.00	.	.
	All other races	-0.24	0.31	-0.85	0.37	-0.77	0.4390
	Less than 50K	0.00	0.00	0.00	0.00	.	.
	50 - <100K	0.28	0.16	-0.03	0.60	1.77	0.0767
	100K or more	0.26	0.20	-0.14	0.65	1.26	0.2072
	Lives on a farm/Small town (LT 5K)	0.00	0.00	0.00	0.00	.	.
	Large town/Small city (LE 50K)	0.35	0.16	0.03	0.66	2.17	0.0304
	City(GT 50K)	0.46	0.18	0.11	0.80	2.60	0.0095
	No children/no school aged children	0.00	0.00	0.00	0.00	.	.
	Child 3-11	0.05	0.21	-0.36	0.47	0.24	0.8096
	Child 12-19	0.18	0.21	-0.23	0.59	0.85	0.3932

STEM-state wide survey, 2016, CSBR, Iowa adults (18+)

Link Function: Logit
Response variable A6: STEM stands for “science, technology, engineering and mathematics. Have you read, seen heard of this before?
LOGISTIC REGRESSION (all variables with income) - stem awareness - YEAR 2016 by: Contrast.

Contrast	Degrees of Freedom	Wald F	P-value Wald F
OVERALL MODEL	13	8.24	0.0000
MODEL MINUS INTERCEPT	12	8.89	0.0000
INTERCEPT	.	.	.
GENDERIM	1	8.85	0.0030
AGEIM	2	2.15	0.1162
EDUCATIONIM	2	28.46	0.0000
RACEIM	1	0.60	0.4390
INCOMEIM	2	1.69	0.1852
PLACEIM	2	4.31	0.0135
PARENTIM	2	0.37	0.6937

STEM-state wide survey, 2016, CSBR, Iowa adults (18+)

Independent Variables and Effects		Odds Ratio	Lower 95% Limit OR	Upper 95% Limit OR
Intercept		0.35	0.23	0.52
	Male	1.00	1.00	1.00
	Female	1.52	1.15	2.01
	18 - 34 years	1.00	1.00	1.00
	35 - 54 years	0.67	0.46	0.98
	55 or older	0.85	0.59	1.22
	High School or less	1.00	1.00	1.00
	Some College	1.87	1.33	2.63
	BA or More	3.86	2.71	5.50
	Whites	1.00	1.00	1.00
	All other races	0.79	0.43	1.45
	Less than 50K	1.00	1.00	1.00
	50 - <100K	1.33	0.97	1.82
	100K or more	1.29	0.87	1.92
	Lives on a farm/Small town (LT 5K)	1.00	1.00	1.00
	Large town/Small city (LE 50K)	1.41	1.03	1.93
	City(GT 50K)	1.58	1.12	2.22
	No children/no school aged children	1.00	1.00	1.00
	Child 3-11	1.05	0.69	1.59
	Child 12-19	1.20	0.79	1.81

STEM-state wide survey, 2016, CSBR, Iowa adults (18+)

Appendix G: Statewide Student Interest Inventory_Item frequencies

Interest Inventory participation summary, 2013-2014 to 2016-2017

	2013/14		2014/15		2015/16		2016/17	
	n	Match rate	n	Match rate	n	Match rate	n	Match rate
Total statewide participation in the Iowa Assessments	346,774		346,914		350,270		351,355	
Total statewide Interest Inventory participation[1]	174,184	50%	215,134	62%	199,416	57%	202,041	58%
Number of students on student participant list submissions	26,238		23,779		29,396		29,415	
Scale-Up students matched to Iowa Assessments scores	19,497	74%	15,905	67%	17,122	58%	19,102	65%
Scale-Up students matched to Iowa Assessments scores *and* STEM Interest Inventory	9,352	36%	10,907	46%	10,245	35%	10,971	37%

1. Schools have the option to administer the STEM Interest Inventory at the same time students take the Iowa Assessments.

ITEM 1: Engineering

E1. How much do you like to create and build things?

MS/HS1. How interested are you in designing, creating, and building machines and devices (also called engineering)?

Response Options		Scale-Up Students					All Students Statewide				
Grades 3-5	Grades 6-12	Total n	Subtotal %	Grades 3-5	Grades 6-8	Grades 9-12	Total n	Subtotal %	Grades 3-5	Grades 6-8	Grades 9-12
I like it a lot	Very interested	5,866	54%	68%	37%	23%	82,157	41%	65%	31%	21%
It's okay	Somewhat interested	3,653	33%	27%	42%	42%	74,905	37%	30%	43%	39%
I don't like it very much	Not very interested	1,426	13%	4%	21%	35%	44,373	22%	5%	25%	39%
Total		10,945					198,953				

ITEM 2: MATH

E2. How much do you like math?

MS/HS2. How interested are you in math?

Response Options		Scale-Up Students					All Students Statewide				
Grades 3-5	Grades 6-12	Total n	Subtotal %	Grades 3-5	Grades 6-8	Grades 9-12	Total n	Subtotal %	Grades 3-5	Grades 6-8	Grades 9-12
I like it a lot	Very interested	3,814	34%	42%	28%	20%	58,526	29%	40%	27%	19%
It's okay	Somewhat interested	4,597	42%	41%	44%	40%	86,094	43%	42%	45%	41%
I don't like it very much	Not very interested	2,523	23%	17%	28%	39%	56,621	28%	18%	29%	40%
Total		10,934					201,241				

ITEM 3: SCIENCE

E3. How much do you like science?

MS/HS3. How interested are you in science?

Response Options		Scale-Up Students					All Students Statewide				
Grades 3-5	Grades 6-12	Total n	Subtotal %	Grades 3-5	Grades 6-8	Grades 9-12	Total n	Subtotal %	Grades 3-5	Grades 6-8	Grades 9-12
I like it a lot	Very interested	4,565	42%	49%	32%	29%	72,963	36%	47%	32%	29%
It's okay	Somewhat interested	4,522	41%	38%	47%	43%	87,950	44%	41%	46%	45%
I don't like it very much	Not very interested	1,827	17%	12%	21%	27%	40,168	20%	13%	22%	26%
Total		10,914					201,081				

ITEM 4: ART

E3. How much do you like art?

MS/HS3. How interested are you in art?

Response Options		Scale-Up Students					All Students Statewide				
Grades 3-5	Grades 6-12	Total n	Subtotal %	Grades 3-5	Grades 6-8	Grades 9-12	Total n	Subtotal %	Grades 3-5	Grades 6-8	Grades 9-12
I like it a lot	Very interested	5,661	52%	63%	40%	27%	88,702	44%	63%	38%	27%
It's okay	Somewhat interested	3,203	29%	27%	32%	35%	62,680	31%	27%	34%	33%
I don't like it very much	Not very interested	2,064	19%	10%	28%	39%	49,683	25%	10%	28%	39%
Total		10,928					201,065				

ITEM 5: READING

E3. How much do you like reading?

MS/HS3. How interested are you in reading?

Response Options		Scale-Up Students					All Students Statewide				
Grades 3-5	Grades 6-12	Total n	Subtotal %	Grades 3-5	Grades 6-8	Grades 9-12	Total n	Subtotal %	Grades 3-5	Grades 6-8	Grades 9-12
I like it a lot	Very interested	4,217	38%	53%	17%	16%	60,737	30%	52%	18%	17%
It's okay	Somewhat interested	4,192	38%	36%	45%	37%	79,006	39%	36%	44%	38%
I don't like it very much	Not very interested	2,508	23%	11%	38%	46%	61,291	30%	11%	39%	45%
Total		10,918					201,034				

ITEM 6: COMPUTERS & TECHNOLOGY

E6. How much do you like using computers and technology?

MS/HS6. How interested are you in computers and technology?

Response Options		Scale-Up Students					All Students Statewide				
Grades 3-5	Grades 6-12	Total n	Subtotal %	Grades 3-5	Grades 6-8	Grades 9-12	Total n	Subtotal %	Grades 3-5	Grades 6-8	Grades 9-12
I like it a lot	Very interested	6,587	60%	74%	46%	28%	97,888	49%	74%	41%	26%
It's okay	Somewhat interested	3,120	28%	21%	38%	43%	67,984	34%	21%	38%	44%
I don't like it very much	Not very interested	1,211	11%	4%	17%	29%	35,111	17%	5%	20%	30%
Total		10,918					200,983				

ITEM 7: SOCIAL STUDIES

E7. How much do you like social studies?

MS/HS7. How interested are you in social studies (such as history, American studies, or government)?

Response Options		Scale-Up Students					All Students Statewide				
Grades 3-5	Grades 6-12	Total n	Subtotal %	Grades 3-5	Grades 6-8	Grades 9-12	Total n	Subtotal %	Grades 3-5	Grades 6-8	Grades 9-12
I like it a lot	Very interested	2,916	27%	28%	28%	20%	49,839	25%	27%	25%	22%
It's okay	Somewhat interested	4,933	45%	48%	42%	38%	87,072	43%	49%	41%	39%
I don't like it very much	Not very interested	3,070	28%	24%	30%	42%	64,146	32%	25%	34%	39%
Total		10,919					201,057				

ITEM 8: STEM CAREERS

E8. When you grow up, how much would you like to have a job where you use science, computers, or math?

MS/HS8. As an adult, how interested would you be in having a job that uses skills in science, technology, math, or engineering?

Response Options		Scale-Up Students					All Students Statewide				
Grades 3-5	Grades 6-12	Total n	Subtotal %	Grades 3-5	Grades 6-8	Grades 9-12	Total n	Subtotal %	Grades 3-5	Grades 6-8	Grades 9-12
I like it a lot	Very interested	4,543	41%	42%	42%	40%	78,772	39%	41%	40%	37%
It's okay	Somewhat interested	4,450	41%	40%	42%	43%	84,182	42%	40%	43%	42%
I don't like it very much	Not very interested	1,915	17%	18%	16%	18%	37,938	19%	19%	17%	21%
Total		10,908					200,892				

ITEM 9: WORKING IN IOWA[1]

E9. When you grow up, how much would you like to have a job in Iowa?

MS/HS9. How interested are you in living in Iowa after you graduate and go to work?

Response Options		Scale-Up Students					All Students Statewide				
Grades 3-5	Grades 6-12	Total n	Subtotal %	Grades 3-5	Grades 6-8	Grades 9-12	Total n	Subtotal %	Grades 3-5	Grades 6-8	Grades 9-12
I would like it a lot	Very interested	4,992	46%	55%	35%	28%	76,126	38%	54%	32%	25%
It would be okay	Somewhat interested	4,209	38%	34%	46%	47%	82,480	41%	34%	45%	46%
I would not like it very much	Not very interested	1,670	15%	12%	19%	25%	41,421	21%	12%	23%	29%
Total		10,871					200,027				

Appendix H: STEM Scale-Up Program_Educator Survey

Coordinated by Research Institute for Studies in Education (RISE), Iowa State University

Scale-Up Educator Survey - 2016-2017

The purpose of this survey is to inform the Iowa STEM Monitoring Project by providing the Monitoring Team with consistent information about all STEM Scale-Up programs implemented in the six STEM regions. This survey should be completed by the educator who implemented the STEM Scale-Up program.

The following questions will provide summative data regarding participation in your STEM Scale-Up program, information about its implementation and working with the service provider, and outcomes of implementing a STEM Scale-Up program. Your responses to these questions will enable us to provide a detailed story about Iowa's STEM Scale-Up programs in 2016-17.

Please complete this survey as soon as possible after you have completed your STEM Scale-Up program. The link will remain open until May 30, 2017. If you have questions about gathering or completing this information, please contact Mari Kemis (mrkemis@iastate.edu) or your regional manager.

Are you . . .

- ☐ an in-school educator
- ☐ an informal or out-of-school educator

Which subject(s) do you teach, if applicable? (Check all that apply.)

- ☐ Elementary self-contained classroom
- ☐ English/language arts (2)
- ☐ Mathematics (3)
- ☐ Science (4)
- ☐ Social studies (5)
- ☐ Foreign language (6)
- ☐ Fine arts (7)
- ☐ Computer science (8)
- ☐ Career technical/vocational education (9)
- ☐ Informal education setting (11)
- ☐ Other (10) _____

What grade(s) do you teach? (Check all that apply.)

- ☐ Preschool (1)
- ☐ Kindergarten (2)
- ☐ 1st (3)
- ☐ 2nd (4)
- ☐ 3rd (5)
- ☐ 4th (6)
- ☐ 5th (7)
- ☐ 6th (8)
- ☐ 7th (9)
- ☐ 8th (10)
- ☐ 9th (11)
- ☐ 10th (12)
- ☐ 11th (13)
- ☐ 12th (14)
- ☐ Other (15) _____

Please specify the STEM region in which you are located.

- ☐ NW--Northwest (1)
- ☐ NC--North Central (2)
- ☐ NE--Northeast (3)
- ☐ SW--Southwest (4)
- ☐ SC--South Central (5)
- ☐ SE--Southeast (6)

Please select your STEM Scale-Up program. If you implemented more than one program, select only one.

- ☐ Curriculum for Agricultural Science Education (CASE)--Introduction to Agriculture, Food, and Natural Resources (4)
- ☐ Curriculum for Agricultural Science Education (CASE)--Natural Resources and Ecology (5)
- ☐ Engineering is Elementary (EiE) (7)
- ☐ FIRST Robotics Competition (6)
- ☐ HyperStream (8)
- ☐ Making STEM Connections (3)
- ☐ Power Teaching Math (11)
- ☐ Project Lead the Way: Introduction to Computer Science (9)
- ☐ Project Lead the Way: Principles of Biomedical Science (12)
- ☐ Science Education for Public Understanding Program (SEPUP) (10)
- ☐ Spatial-Temporal (ST) Math (13)

Participant Demographics

Please indicate the approximate grade level of students in your STEM Scale-Up program. (Check all that apply.)

- ☐ Preschool (1)
- ☐ Kindergarten (2)
- ☐ 1st (3)
- ☐ 2nd (4)
- ☐ 3rd (5)
- ☐ 4th (6)
- ☐ 5th (7)
- ☐ 6th (8)
- ☐ 7th (9)
- ☐ 8th (10)
- ☐ 9th (11)
- ☐ 10th (12)
- ☐ 11th (13)
- ☐ 12th (14)
- ☐ Other (15) _____

Implementation

Please answer the following questions in this section about the program you selected earlier.

Did you implement your STEM Scale-Up program. . .

- ☐ as intended (1)
- ☐ with minor changes (please describe) (2) _____
- ☐ with major changes (please describe) (3) _____
- ☐ did not implement (why?) (4) _____

Please give us your opinions about working with your service provider. To what extent...
[Not at all, Some of the time, Most of the time, All of the time]

- ☐ did you have adequate contact with the service provider?
- ☐ did you receive materials and resources in a timely manner?
- ☐ was the service provider responsive to your questions and needs?
- ☐ did your partnership with the service provider meet your overall expectations?

What, if any, challenges or barriers did you face in working with your service provider. (Please check all that apply.)

- ☐ The training did not adequately prepare me to implement the program. (1)
- ☐ It was difficult to navigate the program's website to find information I needed. (2)
- ☐ The service provider could not sufficiently solve my software or equipment malfunctions. (3)
- ☐ Responses to my emails, phone calls, or voicemails were not made in a timely manner or not at all. (4)
- ☐ Reimbursements of expenses from the service provider were late or not made at all. (5)
- ☐ I did not know who my service provider was. (6)
- ☐ Other (please describe) (7) _____
- ☐ Other (please describe) (8) _____
- ☐ I did not have any challenges or barriers in working with my service provider. (9)
- ☐ I did not contact my service provider. (10)

What, if any, challenges or barriers did you face in implementing your STEM Scale-Up program. (Please check all that apply.)

- ☐ I did not have enough time to implement the entire program. (1)
- ☐ It took more time than I expected to plan, prepare, or set up the lessons and activities. (2)
- ☐ I was not familiar enough with the program or did not know enough about the topics to teach it properly. (3)
- ☐ I did not have enough materials for all of my students. (4)
- ☐ I did not have additional resources to get all of the materials required for the program. (5)
- ☐ I received materials or information late. (6)
- ☐ The quality of some of the provided materials did not meet expectations. (7)
- ☐ The instructions or lesson plans were difficult to understand. (8)
- ☐ The online resources and information were difficult to navigate and use. (9)
- ☐ The provided equipment or software programs did not work. (10)
- ☐ It was difficult to recruit students, particularly those involved in other activities, or schedule meeting times that worked for everyone. (11)
- ☐ The program was too advanced for my students. (12)
- ☐ It was hard to find volunteers, mentors, or business partners to help implement the program. (13)
- ☐ It was difficult to align the STEM Scale-Up program with curricular requirements (i.e., Iowa Core Curriculum) (14)
- ☐ Other (please describe) (15) _____
- ☐ Other (please descibe) (16) _____
- ☐ I did not encounter any challenges or barriers with implementation. (17)

What, if anything, would you recommend to other educators implementing a Scale-Up program? Please check up to three items only.

- ☐ Reach out to others, such as school administrators, industry partners, community members and parent volunteers, and/or colleges and universities, to help you implement the program. (1)
- ☐ Seek advice from other educators who have or are currently implementing the program. (2)
- ☐ Use resources provided by the program (e.g., handouts and students materials, teachers's manuals, and websites). (3)
- ☐ Prepare materials early and plan that implementing the program will take extra time. (4)
- ☐ Provide models or other supplemental materials for your students. (5)
- ☐ Break up classes into smaller groups or have other adults or students present to help with activities. (6)
- ☐ Have sufficient technology. (7)
- ☐ Contact service providers with questions or when you encounter challenges. (8)
- ☐ Other (please describe) (9) _____
- ☐ Other (please describe) (10) _____

What groups, if any, did you collaborate with in the implementation of your STEM Scale-Up program? Please be specific and do not use acronyms.

- ☐ In-school/school districts (1) _____
- ☐ Out-of-school groups (2) _____
- ☐ Community/business (3) _____
- ☐ Volunteer groups (4) _____
- ☐ Other (please describe) (5) _____

Outcomes, Dissemination, and Sustainability

We are interested to know if you, as an educator for a STEM Scale-Up program, have gained skills or confidence as a result of your participation. Please indicate your level of agreement with the following statements. [Strongly Disagree, Disagree, Somewhat Disagree, Somewhat Agree, Agree, Strongly Agree, Not Applicable]

- ☐ I have more confidence to teach STEM topics.
- ☐ I have increased my knowledge of STEM topics.
- ☐ I am better prepared to answer students' questions about STEM topics.
- ☐ I have learned effective methods for teaching STEM topics.

Did you use a business partnership in the implementation of your Scale-Up program?

- ☐ Yes (1)
- ☐ No (2)
- ☐ I did not have a business partnership but would like to form one for future programs. (3)
- ☐ Not applicable/My Scale-Up program did not require a business partnership. (4)

Which activities or services did your business partner provide during program implementation? (Please check all that apply.)

- ☐ Provided guest speakers. (2)
- ☐ Hosted field trips or gave tours of their businesses/facilities. (1)
- ☐ Mentored students. (3)
- ☐ Helped students design or build their projects. (4)
- ☐ Discussed STEM careers and opportunities with students. (5)
- ☐ Provided funding for the program. (6)
- ☐ Provided specific materials or resources for students. (7)
- ☐ Provided the use of their facilities during implementation. (8)
- ☐ Organized events where educators and students could present their projects. (9)
- ☐ Other (please describe) (10) _____
- ☐ Other (please describe) (11) _____
- ☐ I did not have a business partner. (12)

Which of the following outcomes, if any, did you observe as a result of your program? (Check all that apply.)

- ☐ Increased student awareness in STEM topics (1)
- ☐ Increased student interest in STEM topics (2)
- ☐ Increased student awareness in STEM career opportunities (3)
- ☐ Increased student interest in STEM career opportunities (4)
- ☐ Increased student achievement in STEM topics (5)
- ☐ Increased student interest in STEM educational opportunities in college (6)
- ☐ Other (please describe) (9) _____

Please provide one or two examples of the impact the program has had on participants.

Have you received any information about or the visited the website iowastem.gov? (Check all that apply.)

- ☐ Yes, I have received information about the website (1)
- ☐ Yes, I have visited the website (2)
- ☐ No, I have not heard of or visited iowastem.gov (3)

Have you received any information about or visited the website findSTEMIowa.org? (Check all that apply.)

- ☐ Yes, I have received information about the website (1)
- ☐ Yes, I have visited the website (2)
- ☐ No, I have not heard of or visited findSTEMIowa.org (3)

[If 'Yes, I have received information about the website'.. Is Selected] From where did you receive information about findSTEMIowa.org?

Please enter your email address to receive an email confirmation for completing the survey.
Thank you so much for your responses. Please click on the >> to submit your responses.

Appendix I: Description of 2016-2017 STEM Scale-Up Programs

Prepared by Research Institute for Studies in Education (RISE), Iowa State University

Curriculum for Agricultural Science Education (CASE) –Introduction to Agriculture, Food and Natural Resources
Description: CASE utilizes science inquiry for lesson foundation, and concepts are taught using activity-, project- and problem-based instructional strategies. In addition to the curriculum aspect of CASE, the project ensures quality teaching by providing extensive professional development for teachers that leads to certification.
Grade Level: 9-12
Contact: Joshua Remington, Iowa FFA Foundation, joshua.remington@iowaffafoundation.org
For more information: www.iowaffafoundation.org

Curriculum for Agricultural Science Education (CASE) –Natural Resources and Ecology
Description: CASE utilizes science inquiry for lesson foundation, and concepts are taught using activity-, project- and problem-based instructional strategies. In addition to the curriculum aspect of CASE, the project ensures quality teaching by providing extensive professional development for teachers that leads to certification.
Grade Level: 9-12
Contact: Joshua Remington, Iowa FFA Foundation, joshua.remington@iowaffafoundation.org
For more information: www.iowaffafoundation.org

Engineering is Elementary (EiE)
Description: Engineering is Elementary is a research-based, standards-driven, and classroom-tested curriculum that integrates engineering and technology concepts and skills with elementary science topics.
Grade Level: 1-6
Contact: Christopher Soldat, Grant Wood AEA Van Allen Science Teaching Center, csoldat@gwaea.org
For more information: www.aea10.k12.ia.us/vastscience/curriculumnew.html

FIRST Robotics Competition*
Description: High school students call it "the hardest fun you'll ever have." Under strict rules, limited resources and an intense, six-week time limit, teams of 10 or more students are challenged to raise funds, design a team "brand," hone teamwork skills and build and program industrial-size robots to play a difficult field game against like-minded competitors.
Grade Level: 9-12
Contact: Kenton Swartley, kenton.swartley@cfschools.org
For more information: http://www.firstinspires.org/robotics/frc
Link to Webinar: goog.gl/drzfi6

HyperStream
Description: HyperStream fosters real-world learning for 5th-12th graders through hands-on technology projects, completions, showcases and engaging presentations through after-school clubs or integrated into curriculum, combined with the opportunity to work with technology mentors.
Grade Level: 5-12
Contact: Tyler Wyngarden, Program Manager, Technology Association of Iowa (TAI), tyler@technologyiowa.org
For more information: http://hyperstream.org

Making STEM Connections*
Description: The Science Center of Iowa's *Making STEM Connections* program provides a kit, including tools, teacher resources and lessons to inspire the "makers mentality" in youth ages 5-14 through highly engaging, interactive and safe experiences. Building upon the natural inclination to tinker, this program empowers participants to explore STEM principles and 21st Century Skills as they design, create and make.
Grade Level: K-8
Contact: Jolie Pelds, Science Center of Iowa, makingsteamconnections@sciowa.org
For more information: htpp://www.sciowa.org/makingstemconnections; **Link to Webinar:** goo.gl/drzfi6

PowerTeaching Math*

Description: Developed by John Hopkins Researchers, PowerTeaching Math is the leader in cooperative learning mathematics instruction helping teachers transform their classroom environments to engage ALL students.
Grade Level: 6-8
Contact: Jill Hanson, PowerTeaching Mat, jhanson@successforall.org
For more information: htpp://www.sfapowerteaching.org/

Project Lead the Way (PLTW) Introduction to Computer Science*

Description: Designed for students who have never programmed before, ICS is an optional starting point for the PLTW Computer Science Program. Students work in teams to create apps for mobile devices using MIT App Inventor®. They explore the impact of computing in society and build skills in digital citizenship and cybersecurity. Beyond learning the fundamentals of programming, students build computational thinking skills by applying computer science to collaboration tools, modeling and simulation and data analysis. In addition, students transfer the understanding of programing gained in App Inventor to text-based programming in Python® and apply their knowledge to create algorithms for games of chance and strategy.
Grade Level: 9-12
Contact: Kim Glenn, PLTW Director of School Engagement, kglenn@pltw.org
For more information: www.pltw.org
Link to Webinar: goo.gl/drzfi6

Project Lead the Way (PLTW) Principles of Biomedical Science

Description: Students explore concepts of biology and medicine to determine factors that led to the death of a fictional person. While investigating the case, students examine autopsy reports, investigate medical history, and explore medical treatments that might have prolonged the person's life. The activities and projects introduce students to human physiology, basic biology, medicine and research processes while allowing them to design their own experiments to solve problems.
Grade Level: 9-12
Contact: Kim Glenn, PLTW Director of School Engagement, kglenn@pltw.org
For more information: www.pltw.org
Link to Webinar: goo.gl/drzfi6

Science Education for Public Understanding Program (SEPUP)—Science and Global Issues: Biology*

Description: Science and Global Issues: Biology (SGI Biology) is a research-based high school biology course (also available as individual biology units) developed by the Science Education for Public Understanding (SEPUP) team at the Lawrence Hall of Science at the University of California Berkeley, and field tested in classrooms across the country. It has a proven record of engaging students in scientific inquiry and STEM.
Grade Level: 9-12
Contact: Darin Christianson, SEPUP, darin@lab-aids.com
For more information: http://lab-aids.com/high-school-curriculu/science-global-issues-biology

Spatial-Temporal (ST) Math

Description: ST Math is game-based instructional software designed to boost math comprehension and proficiency through visual learning. Integrating with classroom instruction, ST Math incorporates the latest research in learning and the brain and promotes mastery-based learning and mathematical understanding. The ST Math software games use interactive, graphically-rich animations that visually represent mathematical concepts to improve conceptual understanding and problem-solving skills.
Grade Level: K-6
Contact: Brian Molitor, MIND Research Institute, bmolitor@mindresearch.org
For more information: http://www.mindresearch.org/