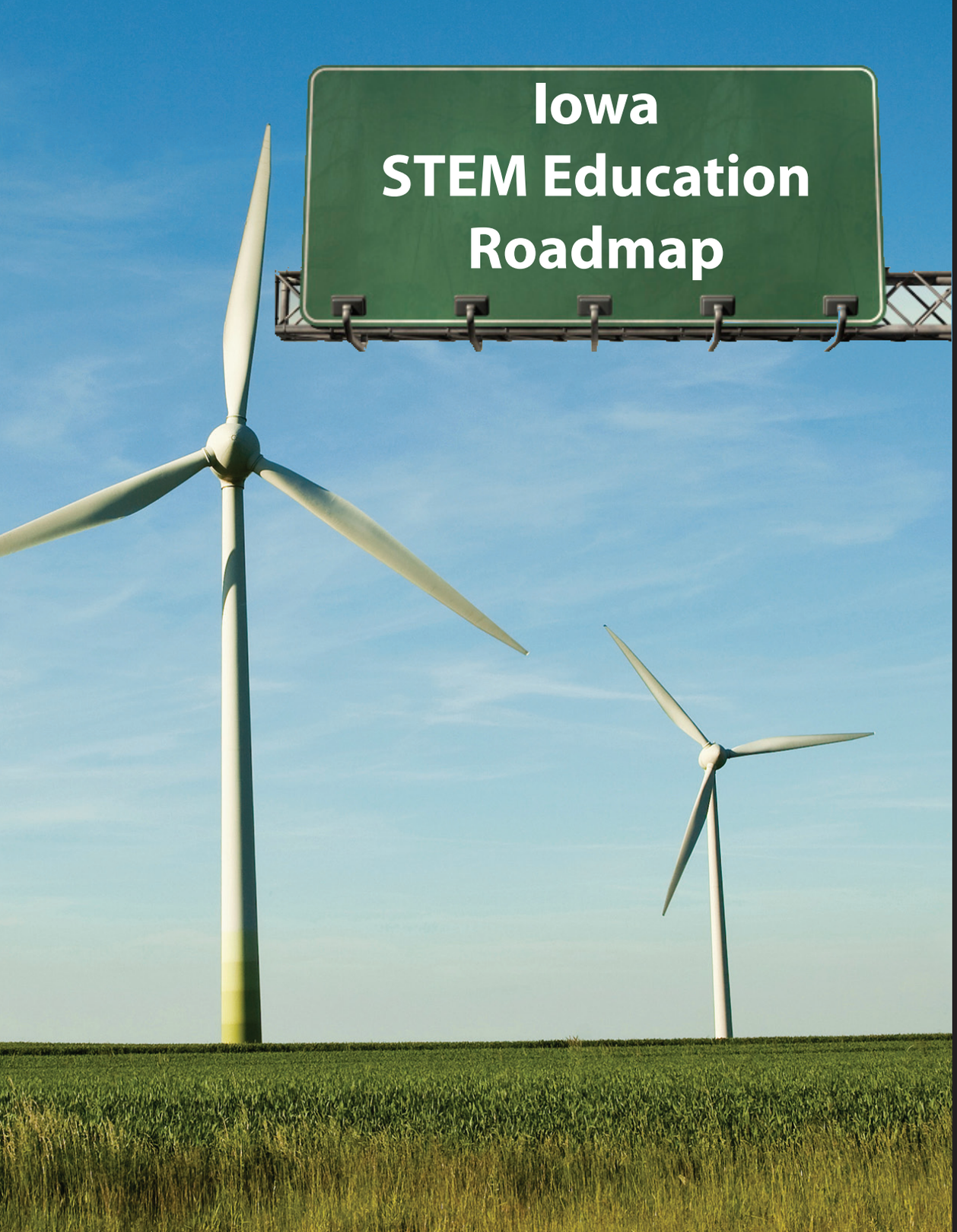


A Strategic Plan for Science, Technology, Engineering and Mathematics (STEM) Education

2011

Iowa STEM Education Roadmap
Executive Summary

Travelers are welcomed to Iowa by road signs proclaiming "Fields of Opportunity." More and more, those opportunities arise from an educational and economic foundation in STEM (science, technology, engineering, mathematics). Presently, a traveler would discover that STEM opportunities in Iowa depend on where one might stop, and when. As a state we lack a common vision and commitment, resulting in gaps and redundancies, inefficiency and inequity, amidst great talent and potential. Only by working together on challenges of **scale** (focusing resources on STEM), **innovation** (creating a climate of high expectations), **replication** (giving all Iowans access to excellent programming), **evaluation** (assuring that what we do works), and **cooperation** (more teaming, less competing) will we create fields of opportunity in STEM. Seven targets comprise the STEM education priorities of this *Roadmap*:

1. Increased interest and performance of Iowa learners in STEM fields.
2. Increased emphasis on STEM fields from Pre-K through 20.
3. More high quality STEM teachers prepared at Iowa's institutions of higher education.
4. An Iowa citizenry that recognizes the importance of STEM in leading productive lives and creating/sustaining a vibrant economy.
5. A national leader in STEM workforce preparation and retention in STEM careers.
6. Wide-scale partnership of Iowa's education systems and private enterprise.
7. Coordinated, complementary and uniform STEM education opportunities across Iowa.

Where we currently stand, what actions need to be taken and what measures might indicate success make up this *Roadmap*. Iowa's future prosperity and ability to compete in a global economy depend on an inclusive statewide STEM education pipeline of learners and future workers reflective of our increasingly diverse population. This *Roadmap* can take us there.

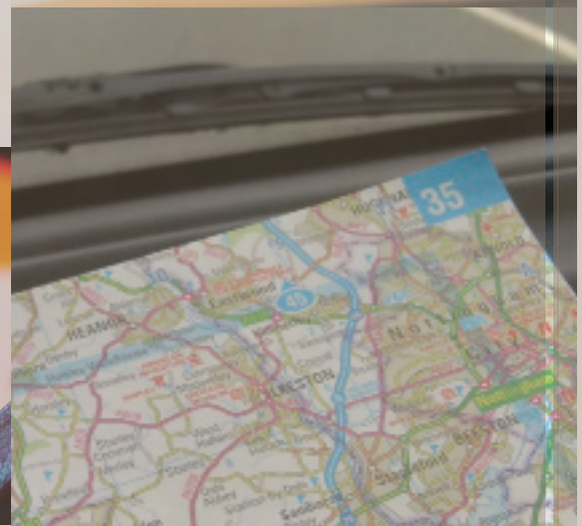


TABLE OF CONTENTS

Science, Technology, Engineering, Mathematics (STEM) Education:

An Iowa Imperative

Where We Stand

- Iowa fourth graders were outperformed in mathematics by their peers in six other states on the 2009 National Assessment of Education Progress (NAEP).
- Iowa eighth graders were outperformed in science by their peers in seven other states on the 2009 National Assessment of Educational Progress (NAEP).
- Fifty (50) percent of Iowa students who took the American College Test (ACT®) in 2009 were not ready for college-level mathematics study, while for science only 37 percent were ready for college level work (ACT®, 2009).
- Nationally, fifteen-year-olds in the United States ranked 23rd among developed nations on the science portion of the 2006 Program for International Student Assessment (PISA), and in mathematics they ranked 31st.

Troubling statistics continue to pile on, reminding us that the status quo in STEM (science, technology, engineering, mathematics) education here in Iowa and across America cannot be defended. STEM fluency is no longer just a worthy "initiative." It is an imperative to stave off the risk of becoming an irrelevant state of a slipping nation.

Why STEM Matters

STEM is everywhere—from the manufacturing plant to the kitchen table to the corner boutique. Every Iowan needs a strong foundation in science and mathematics accompanied by familiarity with their applications to engineering and technology to be productive citizens and economic contributors. Some of the most rapidly expanding job prospects for young Iowans are in the STEM fields. Actuaries, computer programmers, veterinarians, science teachers, health care workers, engineers of all sorts and other related professions are increasingly in demand to meet the needs of our state economy which is rapidly shifting to focus on information technology, advanced manufacturing and bioscience. And beyond mere employment, the daily lives of Iowans involve increasingly frequent encounters with STEM concepts: the elderly couple who must balance the physiological benefits of a medicine against side effects, a young jurist considering DNA evidence at trial, the vegetarian accounting for essential nutrients at mealtime, a commuter balancing modes of transportation on convenience versus environmental impact, and the cell-phoner deciphering reports contradicting whether his brain cells intercept signals from the antenna.

To empower Iowans for effective citizenry and employment for the 21st century, a great responsibility falls upon our schools, colleges, universities, museums, science centers and other educational venues to educate well and to educate all, especially to engage with renewed vigor our rapidly growing yet under-represented minority populations, so that all can thrive in our STEM-based economy and society.

Our Joint Responsibility

As the importance of STEM education rises, it is essential that our educational institutions and organizations have the resources to fulfill this profound responsibility. Iowa is fortunate to have intellectual assets to lead the nation in comprehensive STEM education, but we need a common vision and consistent, long-term commitment from our leaders in order to coordinate actions efficiently leveraging those assets. This Strategic Plan, a *Roadmap* for STEM Education, provides a backbone of vision and action for all who may wish to engage in STEM education in our state so that together, we may lead.

Stakeholders

Our state is rich with human capital when it comes to STEM education. Expertise within our P-12 school systems, colleges and universities, informal educational venues, businesses and industries, youth agencies, trade organizations, and local and state government positions Iowa well for national and global leadership we have historically enjoyed. Today we do not lead. Only by working together on challenges of **scale** (focusing resources on STEM), **innovation** (creating a climate of high expectations), **replication** (giving all Iowans access to excellent programming), **evaluation** (assuring that what we do works), and **cooperation** (more teaming, less competing) will our intellectual and fiscal assets be best used. Our experts across the education spectrum each have a stake in this Plan, but so do citizens who care about Iowa's education and economy. Stakeholders for a state STEM education *Roadmap* must include policy makers, community leaders, school board members, business owners, parents and students; indeed it is difficult to exclude any individual or group from this responsibility. Each of these partners is vital and must contribute and support such a plan for it to be realized.

Beneficiaries

This *Roadmap* is for learners—toddlers tinkering with marbles at a museum, Girl Scouts steering their robot through a maze, middle schoolers investigating flood impacts on their town, youth of low socioeconomic communities seeking connections between STEM and their lives and future careers, graduates commanding the mathematics skills to enter post-secondary study, collegians researching at the shoulders of mentors, employees getting as much as they give by coaching the community school science club and citizens sighting the space station on a pre-dawn sky tour. These are examples of the beneficiaries of a common Plan that creates a scaffold of complementary experiences sensible in their continuity.

This Plan is about jobs as much as it is about quality of life. The two are inextricable. As the global economy increasingly impacts the profile of American trades and professions, the demand for science and engineering workers grows rapidly. Thus, to adequately prepare Iowa students for the new and expanding career opportunities of the 21st century, enhanced STEM education must be made available to all Iowa students, especially those of under-represented populations—women in engineering, for example, and our growing population of learners of ethnic and racial minorities currently under-represented in all STEM fields. Iowa's future prosperity and ability to compete in a global economy depend on an inclusive statewide STEM education pipeline of learners and future workers reflective of our increasingly diverse population. Our common commitment, as exemplified by this *Roadmap*, can make that intention a reality.

Contributors to the Development of *Iowa's STEM Education Roadmap*

A cadre of sixty-seven (67) volunteers comprised the ad hoc committee who, over the span of nearly a year, helped to shape this Strategic Plan through on-line and in-person participation. A subset of writers is credited with the hard work of authoring. Committee representation includes faculty of Iowa's public universities, private colleges, community colleges and K-12 schools, along with a cross-section of leaders of these organizations: the Iowa Department of Economic Development, the Iowa Department of Education, the Iowa Department of Human Rights, the Iowa Biotechnology Association, the Iowa Association of Business and Industry, the Iowa Academy of Science, the Iowa Business Council, the Iowa Council of Teachers of Mathematics, the Grant Wood Area Education Agency, the Girl Scouts, industries including John Deere and Rockwell Collins, and the Iowa Mathematics and Science Education Partnership. Names and affiliations of developers are listed on page 24 of this document. The developmental process that led to this *Roadmap* is detailed as Appendix II.

Our Call to Action

Mission

All stakeholders will work in collaboration committed to ensuring that Iowa has a world class STEM education system consistently supported at the state level—a system readily adaptive to the changing world and accessible by all Iowa citizens which adds value to their lives, communities and the Iowa economy.

Vision

All Iowa learners, from Pre-K through adult, will acquire knowledge and skills in STEM-related subjects which will provide benefits to all community members for effective citizenry and employability. Access will be ensured for all Iowa citizens with particular attention on engaging under-represented minorities in STEM study and careers. Iowa STEM education, consistently supported at the state level, will be able to rapidly incorporate new knowledge and adapt to innovations in educational practices. A well-trained STEM workforce will make it possible for the State of Iowa to maintain and attract employers to the State, as well as ensure that Iowa is a key participant in the global workforce and global economy.

Targets

Seven major target objectives have been identified by Iowa's STEM education advocates:

1. Increased interest and performance of Iowa learners in STEM fields
2. Increased emphasis on STEM fields in Iowa from Pre-K through 20
3. More high quality STEM teachers prepared by Iowa's institutions of higher education
4. An Iowa citizenry that recognizes the importance of STEM in leading productive lives and creating/sustaining a vibrant economy
5. A national leader in STEM workforce preparation and retention in STEM careers
6. Wide-scale partnership of Iowa's education systems and private enterprise
7. Coordinated, complementary and uniform STEM education opportunities across Iowa

Each target description to follow includes comment on current status, actions needed and success indicators.

TARGET 1:
Increased interest and performance of Iowa learners in STEM fields

Current Status

1. An incrementally increasing percentage of Iowa high schoolers are taking upper level mathematics and science, and numerous existent and new enrichment programs in Iowa are growing in participation. But for many Iowa students STEM is not an attractive option.
2. There are state-funded initiatives that focus on STEM education, but they are inconsistently resourced and lack purview beyond discrete stakeholder groups.
3. Equal opportunities in STEM are not available to Iowa learners, especially in rural districts and socioeconomically challenged regions.
4. Females and students of under-represented ethnic and racial minorities enroll at disproportionately low rates in some STEM courses and enrichment activities.
5. Elementary school age learners may not have opportunities to study STEM as a standard part of the curriculum.
6. The mass media do not always help portray a positive, inviting image of STEM for Iowa's youth.
7. STEM programming to inspire Iowa youth currently relies heavily on "soft" money (grant funding) with inadequate, unreliable state support. The result is an atmosphere of competition rather than cooperation.

Actions Needed

1. Expand STEM education innovations statewide to priority regions of the state such as high population diversity centers and low socioeconomic and rural regions, using successful schools and programs as models.
2. Build a statewide ulta-highspeed internet infrastructure for access at low or no cost to all Iowans.
3. Improve upon the inventories that have begun through existent initiatives to make accessible and frequently updated records of programs and resources.
4. Build on and advertise existing communication networks for STEM education stakeholders across Iowa.
5. Create a communication portal for Iowa's teachers to access STEM programs, activities, professional development and business partnerships with clubs, industries, colleges and universities.
6. Establish a long-term, steady, reliable, consistent funding stream for building interest and performance in STEM education for Iowa learners Pre-K through 20, insulated from annual budget vagaries.
7. Build on the marketing plans of existent initiatives to promote mathematics, science and technology professions, including teaching as valued and important.

Success Indicators

1. Improved student achievement—grades, course completions, standardized test scores and participation in STEM majors, notably a particular gain made by students of underrepresented minorities.
2. More proportional engagement of females and students of ethnic and racial minorities in STEM programs and majors in higher education, including teaching.
3. Increased levels of cooperation and collaboration among the universities, community and private colleges, schools, AEAs, museums, clubs, businesses and other groups.

TARGET 2:

Increased emphasis on STEM fields in Iowa from Pre- K through 20

Current Status

1. Currently, some Iowa learners enjoy quality science, mathematics and technology education from elementary through high school thanks to a clear Iowa Core and continuous professional development. But we can do better within and across classrooms of the state.
2. New requirements for completing three years of secondary mathematics and science are succeeding in drawing more students into upper level courses such as statistics and chemistry.
3. Iowa community colleges and universities are supplementing secondary-level STEM offerings for many districts, and providing a complete spectrum of post-secondary STEM opportunities.
4. At the elementary school level, science is often de-prioritized.
5. When it comes to professional development, school districts and Area Education Agencies (AEAs) do not always have the capacity to provide support for teaching STEM lessons.
6. Within the school culture, time for updating content, technology skills and collaborative interdisciplinary strategies toward STEM lesson planning is often brief.
7. Quality STEM curriculum materials are not uniformly available to teachers and districts.
8. School leaders may not always be aware of cutting edge teaching strategies in STEM education that enhance learning and attract students of under-represented populations.
9. Engineering concepts are not always well-integrated into traditional high school mathematics, science and technology curricula.
10. STEM teacher retention is a problem in Iowa, as it is nationally, particularly for new teachers who depart the profession at nearly a 50% rate within the first five years.

Actions Needed

1. Professional development in STEM education should be offered to administrators, school board members and community leaders so that they can be more supportive of the content and process skills and teaching strategies detailed in the Iowa Core.
2. Professional development focused on creating a classroom environment and pedagogy that support success in STEM courses by under-represented populations is needed.
3. Model STEM classrooms should be used for demonstrating effective teaching practices to teachers and leaders.
4. Iowa's AEAs each should be comparably equipped to deliver exemplary material, curriculum and professional development for STEM teaching and learning.
5. Pre-K, elementary and secondary teacher preparation and the school curriculum should feature active STEM inquiry and problem solving.
6. State K-20 education leaders—including the Iowa Department of Education, the associations of school administrators and school board members,the state's education unions, the Board of Regents and other influential groups—should advocate for STEM emphasis in school and for time necessary within the school schedule for teachers to plan STEM lessons.
7. Distance education models should be scaled up to help remedy the inconsistent course availability problem for Iowa's hundreds of districts.
8. The integration of engineering concepts in P-12 STEM education requires the modification of STEM teacher preparation and practitioner professional development. A comprehensive plan for P-12 engineering education should be commissioned.
9. Colleges and universities should be sufficiently resourced to attract and retain excellent STEM students and faculty.

Success Indicators

1. Higher retention and increased job satisfaction among STEM teachers in our systems.
2. Greater inclusion of science and mathematics in the elementary schools and the use of problem solving and inquiry-oriented curricula at the Pre-K, elementary and secondary levels.
3. A higher percentage of participation in quality STEM education professional development for both teachers and their administrators.
4. More students in post-secondary STEM study and/or careers including students of under-represented populations.
5. The assessments used by teachers will demonstrate growth in skills and processes of problem solving and creative, critical analysis that come from STEM.

TARGET 3:
More high quality STEM teachers prepared by Iowa's institutions of higher education

Current Status

1. Iowa has a state-funded mathematics and science education initiative through the universities aimed at increasing teacher production and student performance, though vagaries in funding retard its progress.
2. Wide variation exists across Iowa's institutions of higher learning in preparatory program characteristics including admission standards, the extent of field experiences, specialization in mathematics, science or technology, backgrounds of instructors, field experience supervisors and knowledge of best practices.
3. Graduates of teaching programs may not always be prepared in cutting-edge techniques and methods of a modern STEM classroom, including inquiry and problem solving.
4. Mathematics and science teachers often teach subjects outside of their major content strength.
5. Our best and brightest young Iowans are often not encouraged by their high school and college-level STEM instructors to enter the teaching profession, nor do economic forces favor STEM teaching.
6. Practicing STEM professionals who seek a career change to teach now have several nontraditional entry options in Iowa.
7. At the elementary school level where minds get made up about abilities in STEM, teacher preparation may not emphasize mathematics, science and technology adequately.
8. There are too few under-represented minorities in STEM teaching in Iowa.

Actions Needed

1. Professional development over the skills, concepts and teaching strategies of the Iowa Core should be delivered to community college and university-level teacher preparers, content instructors, field experience supervisors, classroom hosts, mentors and administrators.
2. Similar to model classrooms for K-12 professional development, exemplary pre-service methodology instruction and curriculum in STEM should be disseminated to all Iowa teacher preparatory institutions.
3. Scale up existing programs that provide early field experiences to prospective mathematics, science and technology teachers.
4. Strengthen and expand existing mathematics, science and technology teacher recruitment programs within and across teacher preparatory institutions including community colleges and high schools.
5. Expand support for existing nontraditional licensure pathways for practicing or retired STEM professionals.
6. Require that any professional development for mathematics and science teachers follow the Iowa Professional Development Model.
7. Unite the assets of the universities, AEAs, community colleges, Iowa Department of Education and other qualified entities in coordinating professional development for STEM teachers.
8. Deliver STEM K-12 and post-secondary training to improve the recruitment and retention of under-represented minorities in teaching.
9. Target STEM professionals/retirees from business and industry to consider a second career as a STEM educator.

Success Indicators

1. An increasing number, type, scope and impact of projects in which STEM faculty and pre-service teacher education faculty within and across institutions collaborate for the benefit of future teachers.
2. Inquiry and problem solving are the favored instructional approaches of methods instructors, disciplinary instructors, field supervisors and administrators.
3. Increased numbers of new teaching graduates using exemplary curriculum and who integrate the most timely of innovations including technology, engineering education, interdisciplinary, etc.
4. An increase in the number, quality and diversity of new recruits to mathematics, science and technology teaching at Iowa colleges and universities in both traditional and nontraditional pathways.
5. An increase in the amount of professional development co-delivered by the Iowa Department of Education, the AEAs, the colleges and universities and qualified private sector entities, which adheres to the Iowa Professional Development Model.

TARGET 4:
An Iowa citizenry that recognizes the importance of STEM in leading productive lives and creating/ sustaining a vibrant economy

Current Status

1. Iowa's STEM industries such as information technology, advanced manufacturing and bioscience are major employers staffed by hard working and conscientious professionals. However, significant challenges to Iowa's talent pipeline exist.
2. Statewide STEM education efforts are currently compartmentalized and silo-ed. Groups are not efficiently leveraging resources for maximal statewide impact.
3. The education system may not capitalize on the fact that today's youth are thoroughly familiar and comfortable with technology tools.
4. Iowa citizens, voters and policy makers may not always appreciate or understand STEM's relevance to sound/long-term (environmental, financial and health) quality of life.
5. An inadequate workforce pipeline for fueling Iowa's new economy exists.

Actions Needed

1. Build on messaging campaigns of existing initiatives that alert students, parents, the public, policy makers, employers and all citizens that STEM is an essential tool for our state.
2. Build on existing STEM networks and organizations representing education, government and industry to create a singular voice on policy and practice.
3. Economic developers and government leaders of Iowa should aggressively advocate for P-20 STEM education in recognition of the foundation it provides to workforce and productivity challenges.
4. Create and scale up successful STEM programming that links business and school.
5. Increase involvement of students under-represented in STEM (i.e. women, ethnic/racial minority students, students with disabilities, etc.) in STEM enrichment programs.
6. Build a registry of experts/skills for matching needs with assets in STEM across Iowa.

Success Indicators

1. New STEM-related businesses and industries will locate to Iowa, and Iowa's existing industries will expand.
2. Increased media attention and awareness of Iowa STEM activities and endeavors in and outside of academia.
3. Wider public recognition of, and involvement in, STEM promotion as study, hobby and career notably increased among students of under-represented minorities.
4. Increased funding to STEM programming from both public and private sources.
5. Improved support of STEM teachers by parents and community.

TARGET 5:
A national leader in STEM workforce preparation and retention in STEM careers

Current Status

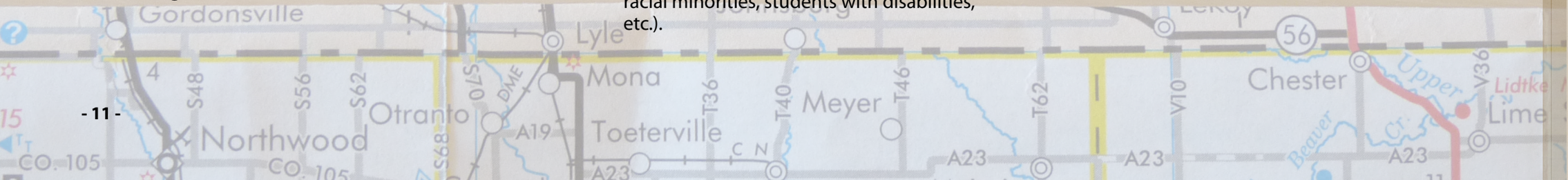
1. Students who enter higher education with the intent to major in STEM programs are not always adequately prepared in science, mathematics and technology.
2. The robustness of educational pathways to the STEM workforce is nonuniform. From elementary school through high school and college, the number of students interested in and prepared to pursue STEM study and careers declines disproportionately affecting underrepresented minorities.
3. Parents of elementary and secondary students may dissuade them from opting for STEM enrichment programs or advanced coursework in STEM due to lack of awareness of career options and quality of life in these professions.
4. Teachers may not always be aware of the many Iowa career opportunities in STEM available to their students.
5. Brain drain may result if the production of STEM graduates—technicians, engineers, teachers, etc.—fail to find jobs in Iowa.

Actions Needed

1. To create more STEM jobs, expand entrepreneurial incentive programs to grow current and start-up STEM companies in Iowa and monitor their needs for proactive climate management.
2. Equip parents and teachers with STEM-related Iowa-specific career information for creating awareness and interest among children and students.
3. Periodically measure the attitudes and career interests of secondary and collegiate STEM learners.
4. Expand opportunities for STEM teachers to learn more about the work world of Iowa so that they incorporate relevant lessons and news of careers to their students.
5. Develop "Transition Guides" for use by counselors and instructors of STEM subjects at the transition points in a student's course of study (i.e., middle school to high school, senior year of high school to freshman year of college or transfer student at the two-year point of post-secondary education).
6. College and university STEM professionals should regularly review curriculum and programs to ensure alignment with workforce and societal needs.
7. Expand programs (such as mentoring, learning communities, early academic interventions, scholarships, role model programs, etc.) with demonstrated success recruiting and retaining students in STEM. Special emphasis should be placed on programs addressing students under-represented in STEM (e.g. women, ethnic/racial minorities, students with disabilities, etc.).
8. Build and maintain an Iowa career-focused website that connects mentors to classrooms and STEM job seekers to employers.
9. STEM enrollments and degrees at all Iowa community colleges, private colleges and public universities should be collected and reported annually.

Success Indicators

1. Upward trends in placement test scores and career assessments such as ACT® and COMPASS.
2. Student interest in STEM will grow as they progress through K-12 and post-secondary coursework.
3. Decrease in the number students under prepared for STEM study at the secondary and higher education levels.
4. Increase in the number of students enrolling and graduating in STEM majors at Iowa community colleges and universities, notably including an increase in participation of students from under-represented groups.
5. Increased supply of STEM-ready workforce within Iowa.



TARGET 6:
Wide-scale partnership of Iowa's education systems and private enterprise

Current Status

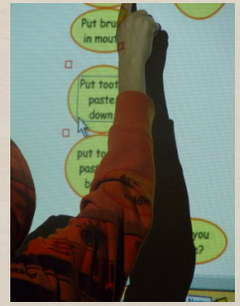
1. Isolated examples of productive business-education partnerships exist across Iowa between schools, community colleges, universities and local companies as well as major industries. The breadth and depth of these partnerships is variable.
2. Personnel at schools, colleges and universities too often view partnerships with business as little more than a donation and may not know how to initiate partnerships.
3. Businesses that seek to partner with education entities of Iowa may not always do the necessary "homework" to understand the needs and challenges of the school which a partnership might address or how to go about initiating partnerships.
4. A disproportionate share of wide-scale partnerships is carried by a few visible and active companies.
5. The culture of schools may make it difficult for teachers to pursue business partnerships.

Actions Needed

1. School leaders, from state level to individual schools, should create incentives for teachers to build partnerships—e.g., create space in the workday for teachers who want to reach out to the private sector.
2. School leaders should devote professional development time to activities in partnerships. Reporting on such activities should be implemented.
3. Expand existent programs that catalyze school-business partnerships by coaching teachers and school leaders on ways and means for creating partnerships with local businesses while interfacing with regional business organizations such as Chambers of Commerce to help business connect to schools.
4. School days and calendars should be modified to embrace rather than discourage STEM programming with business—for example, class period lengths that permit outings, flexible scheduling that allows for assemblies around business matters, time built in for job-shadowing, opportunities for business leaders to teach classes, the integration of subjects such as chemistry and economics to model real-world experience, etc.
5. State policies that interfere with school-business partnerships at all levels should be modified—e.g., how courses count, the value of internships on credentials, the value of business contributions to education.
6. Business trade groups and economic development agencies need to aid the scale up of successful partnerships through campaigns targeting business owners and the guidance of the development of STEM education strategic plans on the part of businesses.
7. Expand existent databases of school-business partnerships within Iowa (and beyond).
8. Canvass the business sector of Iowa annually for tallied investments in STEM education partnerships and include such information in an annual report.

Success Indicators

1. Every school in Iowa that seeks to partner with a business for the improvement of STEM education has at least one willing partner and often many more.
2. The number of business-school partnerships grows each year.
3. The number of STEM-related after school and summer enrichment programs and internships coordinated jointly by education and business representatives increases throughout the state.
4. Financial and in-kind personnel investment by the business sector to STEM education in Iowa will increase.
5. Employers in STEM-related businesses will find more prospective employees more job-ready.
6. Entities that govern schools at the state level and organizations that serve business statewide will create tools and mechanisms for promoting businesses-school partnerships.



TARGET 7:
Coordinated, complementary and uniform STEM education opportunities across Iowa

Current Status

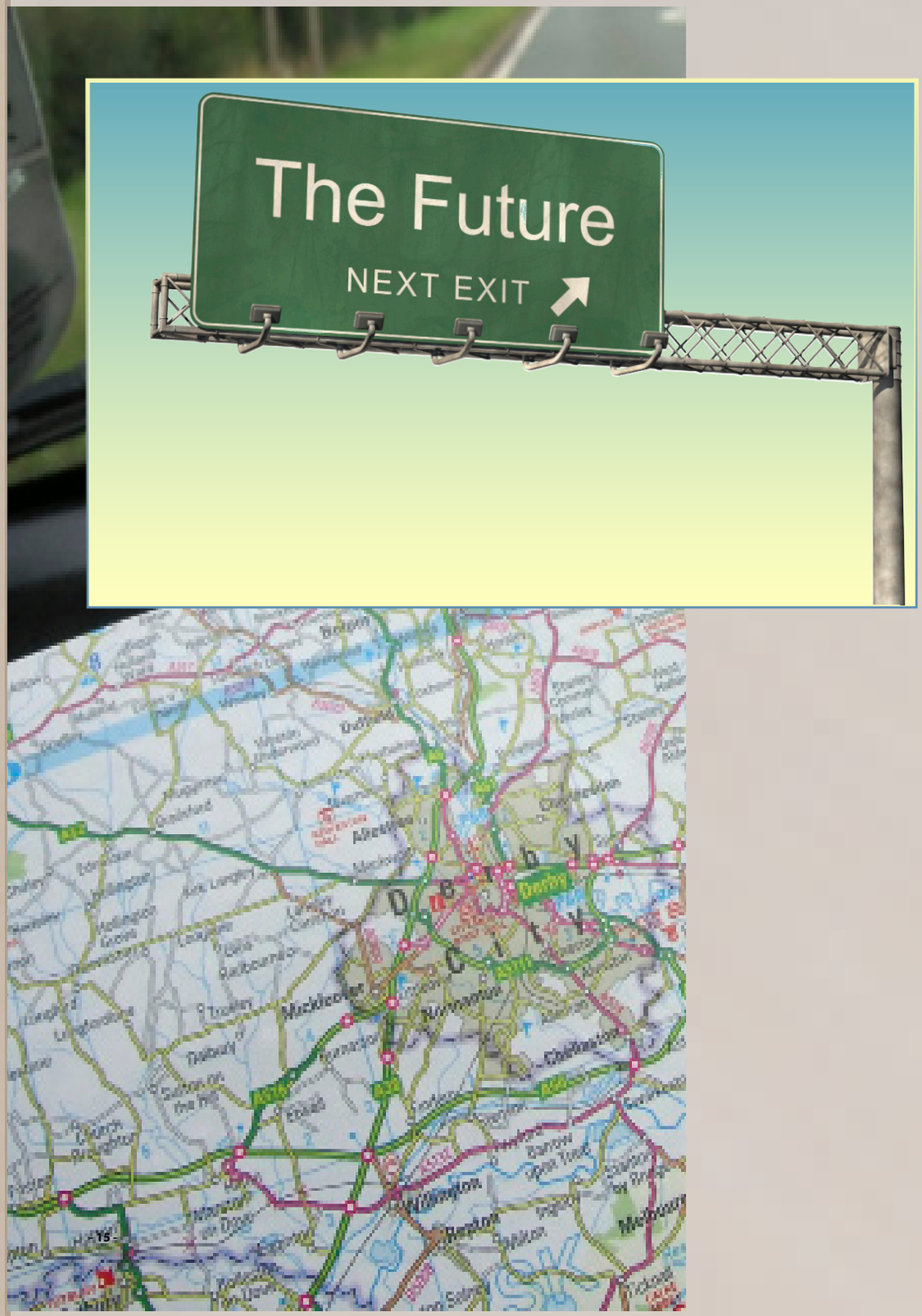
1. Iowa is "program rich:" STEM initiatives exist in K-12, public and private colleges and universities, community colleges, AEAs, museums, science centers, youth organizations, business and industry, and policy groups. Our state is "coordination poor:" opportunities are isolated and uncoordinated.
2. The uneven distribution of STEM education assets usually concentrates in the state's population centers, disadvantaging rural students, learners in low socioeconomic regions and under-represented minorities, resulting in a condition of haves and have-nots.
3. In STEM education, a statewide governance structure does not exist.
4. STEM education stakeholder groups across Iowa lack a communication structure or network.

Actions Needed

1. A statutory reform should identify a STEM advocacy group for the State of Iowa. This group, whether an augmented existent body or a new creation, would be a cross-section of STEM education, business and policy leaders.
2. The group will be a state-level voice for STEM education in Iowa when it comes to legislative advocacy and public relations. This group should be the point of contact for interface with other state and national STEM education initiatives.
3. The group should aggregate STEM-related data into annual or specialized reports, take responsibility for benchmarking the STEM Education Strategic Plan and measure whether goals have been met.
4. An official widely sanctioned and formalized communication network should be established by which the group interacts with statewide interests.

Success Indicators

1. A single unified voice for statewide STEM education which leads the cause of STEM education in Iowa on behalf of all vested parties.
2. An annual report on the *State of STEM Education*. The report will include STEM activities, STEM funding and learner/educator performance data organized around the objectives and indicators of the state's strategic plan.
3. A communication and networking infrastructure for all parties to engage.



STEM Education Horizon for Iowa

Dozens of U.S. states have embarked on comprehensive STEM education plans this decade. They are led by governors, universities, state education departments, regional consortia, trade groups, community colleges, industrial alliances, public-private partnerships, and in the most successful of cases, amalgams of all these groups working together under a clear mandate.

Most states, like Iowa, have become project-rich through the unprecedented level of investment being made in STEM education by private foundations, federal programs and state legislatures. Across the states, schools have launched summer STEM camps, museums have produced hands-on curriculum, businesses have spawned job shadows and mentoring, universities have fashioned K-12 workshops, community colleges have sponsored science fairs and robot competitions, and Scouts now have badges for science and technology. That is the current state of STEM strategy in the states of the U.S. — busy, talented people doing wonderful work inefficiently, in isolation and in competition. The few states leveraging the efforts of their STEM education talent for maximum benefit do so under a comprehensive plan. Iowa will be ahead of the pack by enacting the recommendations of this *STEM Education Roadmap*.

What if Iowa's policy leaders fail to act on a *STEM Education Roadmap*? Then we should expect nothing different from the "current status" depicted in the seven Targets above—spotty opportunity for youth (disproportionately affecting our rural, minority and poor students); curricular disconnect from school to school, grade to grade, classroom to shop floor or office; secretive competition instead of sharing of resources; miscues across the public-private bridge; a nonchalant citizenry asleep at the STEM education wheel; and ultimately a trickling STEM pipeline to majors and careers needed to fuel Iowa's economy in the coming decades.

The authors, editors, contributors and reviewers of this *Roadmap*, leaders across the STEM education spectrum of Iowa, speak collectively with the unanimous hope that our vision of Iowa as a STEM education leader can become reality. We are absolutely confident that an enlightened public, supportive policymakers, receptive educators and committed business leaders will equate to empowered STEM learners capable of re-branding our state a national model. It will take resolve and sustained commitment.

APPENDIX I

STEM in Iowa

{Sample exemplary programs, websites listed below}.

Awards	Awareness	Initiatives and Events		Organizations	Programs
ISTS Excellence in Science Teaching Award - *http://www.iacad.org/esta_archives.html* **Presidential Awards for Excellence in Mathematics and Science Teaching -** *http://www.nsf.gov/cgi-bin/good-bye?http://www.paemst.org/*	**Iowa Mathematics and Science Education Partnership (IMSEP) Media -** *http://www.iowamathscience.org/media2/* **Iowa Public Television (IPTV) -** *http://www.iptv.org/education/science_technology.cfm* **IPTV Math -** *http://www.iptv.org/education/math.cfm* **Science Center of Iowa -** *http://www.sciowa.org/*	***FIRST*® LEGO® League (ISU) -** *http://www.isek.iastate.edu/fll/* ***FIRST*® Tech Challenge (UI) -** *http://sites.google.com/site/ftciowa/* **IT Olympics -** *http://www.it-adventures.org/itolympics.html* **Physics Olympics -** *http://www.physics.uni.edu/outreach/olympics.shtml* **Science Fairs in Iowa -** *http://www.sciencefairofiowa.org/Science_Fairs_in_Iowa.html*	**Corridor STEM Initiative -** *http://www.corridorstem.org/* **International Technology and Engineering Educators Association -** *http://www.iteea.org/* **IMSEP -** *http://www.IowaMathScience.org/* **Project Lead the Way® Pre-Service Teacher Preparation Curriculum Project -** *http://www.uni.edu/indtech/* **Quad Cities Engineering and Science Council -** *http://www.qcesc.org/* **Regional Academy for Math and Science (RAMS) -** *http://www.go2rams.org/* **STEM Equity Pipeline Project -** *http://www.stemequitypipeline.org/StateTeams/IA.aspx*	**4-H -** *http://www.extension.iastate.edu/4h/* **Girl Scouts of Iowa -** *http://www.girlscoutsiowa.org/* **Heart of Iowa Society of Women Engineers -** *http://www.heartofiowaswe.org/* **Iowa Biotechnology Association -** *http://www.iowabiotech.com/* **Project Lead The Way® (PLTW) -** *http://www.pltwiowa.org/* **Technology Association of Iowa -** *http://www.technologyiowa.org/* **Technology Student Association -** *http://www.tsaweb.org/*	**Hyperstream -** *http://www.technologyiowa.org/en/hyperstream/about_hyperstream/* **Iowa Intern License Pathway -** *http://www.iowateacherintern.org/* **Program for Women in Science and Engineering -** *http://www.pwse.iastate.edu/* **Real World Design Challenge -** *http://www.realworlddesignchallenge.org/* **Real World Externships for Teachers of Mathematics & Science -** *http://www.iowamathscience.org/externships/*

Extensive inventories of Iowa STEM education programming can be accessed at these websites: http://www.iowamathscience.org/inventory.shtml and http://cesmee.hs.iastate.edu/ISU%20STEM%20project%20database.pdf.

APPENDIX II
The Process Behind This Plan

Coincidental developments in Iowa paved the way for the need for this Strategic Plan to align programs for maximal impact:

1. Burgeoning numbers of STEM education programs and projects have sprung up across the state, ranging from Iowa Department of Education initiatives, to industry-sponsored innovations, to university and community college-based outreach, to informal learning center expansions, to regional and local clubs, to competitions and so on.

2. The performance and interest of Iowa learners in the STEM fields have remained stagnant and by some measures have declined compared to learner progress in other states and nations. Test scores on the National Assessment of Education Progress (NEAP) place Iowa students near the middle of the pack among states, all of whom collectively compare dismally to other top-tier nations by measures such as the Trends in International Math and Science Study (TIMSS). The disparity in resources allocated geographically and socioeconomically in Iowa presents a particular challenge for STEM learning among students of our urban and rural settings.

3. State and national leaders have come to recognize the foundational importance of STEM education to sustain and grow our increasingly technical economy, cycling additional resources into programming and outreach. This is the point at which Iowa finds itself—rich in talent, steeped in projects, poised to be a national model for how state entities can work together toward a common goal, but lacking coordination and unified direction. The need for a unifying plan as the first step in aligning programs for maximal impact led to this document.

4. With guidance and endorsement by the Office of the Governor, a three-member facilitation team representing K-12, higher education and the business sector was formed in early spring of 2010. A preliminary plan for how to proceed, including invitations to a broad cross section of STEM education leaders to engage, a hybrid operational mode of in-person and on-line collaboration, and a canvass of other state strategic plans emerged by March 2010. By April, some 67 professionals—teachers, professors, scientists, consultants, government officials, agency directors and project administrators—accepted an invitation to help in this planning process. A website for sharing documents and collaborating was created ***(www.IowaSTEM.org)***, and a first in-person meeting was declared for May 13, 2010. Slightly over fifty (50) percent of the participants were able to attend; others were able to monitor and contribute to developments through on-line discussion.

   Three focal questions were explored at the first meeting of this group in setting the stage for plan development:

   A. For whom should Iowa have a STEM education strategic plan?

   B. What components would be of most value in a strategic plan?

   C. What outcomes should be considered as a result of developing a state strategic plan?

Co-facilitators captured the group responses to these questions and generated summary responses to post to the website for a three-week period of on-line review and comment. Upon the consensus approval by the group, summarized responses were fashioned into an outline for the Strategic Plan itself. This outline was posted to the website, also, for a review period of three weeks. A call to all participants seeking draft writers of content for Sections I and II of the *Roadmap* was issued in early July 2010. By latter August, a core team of eight writers had drafted text for Sections I and II, as well as modified the outline to fit evolving themes. The draft was posted to the website for a period of a three-week review and comment. Planners determined that a second face-to-face meeting was in order as a check-point and issued an invitation to a strategic plan forum held on September 29, 2010. At that meeting, Sections I and II were discussed and revised. Direction, voice and content of the Strategic Plan were further honed. A format for the Appendix was approved, and Section III was drafted by table groups and posted to the virtual community site for review by all 69 now registered as participants in this process. This draft of the *Roadmap* was posted for a 30-day on-line review and comment period. Upon the completion of Sections III and IV, a 30-day review period on-line was launched in early December 2010. At that time, contributions to the *Roadmap*, as well as to Appendix I, were also sought from professional organizations including the Iowa Science Teachers Section of the Iowa Academy of Science and the Iowa Council of Teachers of Mathematics. From January 3 to January 15, all edits, additions, deletions and suggestions of reviewers were weighed and incorporated as appropriate, by the coeditors. On January 14, the *Roadmap* was posted for one last one-week period of final review by all stakeholders. By January's end, the *Iowa STEM Education Roadmap* was distributed widely to policymakers and STEM education leaders across the state, promoting awareness, endorsement and adoption.

APPENDIX III

Basic Definitions of Science, Technology, Engineering and Mathematics (STEM)

Most people have a general understanding of the terms **science, technology, engineering and mathematics (STEM)**. However, each of these terms has a range of meanings depending on the context in which they are used. For the purposes of planning, it is important to have precise, common definitions for these terms. It is also important to have a common understanding of what is meant by the expressions "STEM major" and "STEM literacy." What follows are the definitions on which this plan is based.

Science can be characterized as the knowledge of the physical world gained through systematic observation and experimentation. A process by which this knowledge is developed is referred to as the scientific method, though in reality scientists use different methods for different challenges. Typically, developing a testable or falsifiable hypothesis is a crucial first step in the traditional scientific method. Properly designed experiments test hypotheses and credibility is determined by how well a hypothesis is supported by physical data. Scientific methods, through many mechanisms for identifying mistakes, have the ability to discard inaccurate hypotheses and retain those that have withstood significant testing.

Technology is the application of scientific knowledge to the development of tools, machines, materials, or processes that change or manipulate the human environment to accomplish practical tasks or objectives. Technology is intimately related to science and to engineering. Whereas science deals with understanding and engineering uses that knowledge to create plans and designs, technology creates the tools and techniques to implement those plans and designs.

Engineering is the application of scientific principles to the design of a device, system, or process to accomplish a defined task. Engineers use approximate solutions to problems that cannot be solved exactly by science and mathematics as well as semi-empirical methods to achieve desired objectives. Although scientific and engineering processes may be different, scientists must use engineering to design and implement experiments while engineers often need to use the scientific method to test devices, processes, or systems. The two disciplines are inseparable.

Mathematics is the language by which one communicates **science and engineering concepts**, and a discipline in its own right which has trained the world's great thinkers through history. Mathematically formulating problems lets scientists and engineers develop models of real and hypothetical phenomena, develop hypotheses, make predictions, conjectures, design devices and protocols, and express and evaluate data. Advances in an area of science have often led to advances in an area of mathematics and vice versa.

STEM literacy refers to an individual's ability to apply his or her understanding of how the world works within and across the four areas of science, technology, engineering, and mathematics. It does not simply mean achieving literacy in these areas individually. Rather, STEM literacy refers to the ability to investigate and question these facets of the world in an interdisciplinary manner

APPENDIX IV

STEM Majors Defined by Higher Education

While there is general agreement about the description of STEM, the college majors that are associated with specific STEM fields vary. The National Science Foundation (NSF), the Board of Regents, State of Iowa and the Iowa Department of Education all have a different list of majors that are considered STEM, with the Iowa Department of Education being the most inclusive and the National Science Foundation being the most exclusive. While this can make comparing data difficult, the fundamental approach to strengthening the participation and success in STEM fields are the same.

APPENDIX V

The Current State of STEM Education in Iowa and the Nation

Here, an overview of the current state of STEM education is presented in a national context in order to frame the discussion within Iowa, and then the current state of STEM education in Iowa is presented in order to provide the foundation for the successes and areas of need within Iowa.

a. National Level

Science and mathematics has transformed the world in almost every way imaginable. Technological and engineered innovations have "flattened" the world socially, politically and economically. A new citizenry and workforce of problem-solvers, innovators and inventors who are self-reliant and able to think logically is one of the critical foundations that drive innovative capacity in a state (Schleicher, 2007). America's economic growth in the 21st century will be driven by our nation's ability to generate ideas and translate them into innovative products and services. A citizenry with these skills and attitudes is crucial as well, if America is to maintain its position as a world leader. STEM education is a key component to maintaining a position of leadership and strength. A survey of the current state of education, however, shows the United States is falling behind in several important areas.

***Slipping International Rank*:** For most of the 20th century, the United States had the most educated workforce and populace in the world. That advantage is now eroding. In 2005, nearly a third of all students tested below basic skill levels in mathematics on the National Assessment of Educational Progress (NAEP). The NAEP also confirmed persistent mathematics and science achievement gaps between students relative to their race/ethnicity, gender and socioeconomic status (National Center for Educational Statistics, 2005). On the 2009 National Assessment of Educational Progress (NEAP), Iowa 4th graders were outperformed in mathematics by their peers in six other states; 8th graders were outperformed in science by students in seven other states. Results from the 2003 *Trends in International Mathematics and Science Study (TIMSS)*, which is one type of measure of mathematics and science knowledge, showed that U.S. 8th and 12th graders did not do well by international standards. Further, in the 2006 Organization of Economic Cooperation and Development (OECD) *Programme for International Student Assessment* (PISA) in which 15-year-olds from 57 nations participated, U.S. students ranked 35th in math and 29th in science.

STEM Educator Preparation: A significant number of American mathematics and science teachers did not major in the STEM field that they teach. The National Governor's Association (2007) reported that "40 percent of U.S. middle-school physical science teachers teach out of their field, about 20 percent of middle-school biology teachers teach outside of their field," further, "eighth grade math and science teachers were less likely to specialize (i.e., have either an undergraduate major or master's degree) in STEM than their counterparts in other countries."

The NCES reports that the United States faces a critical shortage of highly qualified mathematics and science teachers—projected to reach 283,000 by 2015. The shortage of technology educators is even more severe. The problem of out-of-field teaching is particularly pronounced in low-income, urban school districts in the United States.

College Readiness Challenge: ACT, Inc., which administers the American College Test (ACT®), identified a connection between a rigorous high school curriculum and students' success on college-entrance exams. They found that taking upper-level mathematics courses improves achievement on the mathematics portion of the test, regardless of the student's gender, family income, or racial/ethnic background (ACT, 2006). Although a greater percentage of ACT® test-takers met the college-readiness benchmark on the mathematics and science assessments in 2006 than in 2005, a majority of the test-takers still lacked college-ready skills and are likely to struggle in first-year college mathematics and science courses. Nearly three out of ten first-year college students in the United States are placed immediately into a remedial course (NCES, 2000). This need for remediation has caused the community college system to spend an estimated $1.4 billion annually on remedial mathematics for inadequately prepared freshmen (Alliance for Excellence, 2006).

Student Interest in STEM Tepid: Studies suggest that America's best and brightest, those whom we count on for innovation and revolutionary ideas, are not demonstrating an interest in STEM and are instead moving into other subfields (Hamermesh & Donald, 2004). The Ewing Marion Kauffman Foundation (2007) found through attitudinal surveys that while both parents and students believed science and mathematics are important to society, the students did not feel that either subject was necessary for their personal success. Further, parents did not feel that improvement in mathematics and science education was a priority within their area. Yet, when asked to identify job applicants' common deficiencies, employers in most industries reported a lack of mathematics, computer and problem-solving skills. This disconnect between parents, students and employers is troubling for it reveals that those with the greatest voice in local education reform (parents and residential taxpayers) may not be sufficiently motivated to address the mounting issues regarding STEM (Kadlec & Friedman, 2007). Exacerbating matters, the existing Iowa Core Curriculum and the National Core Curriculum in Mathematics, as well as the content standards of the National Science Education Standards, are sometimes taught in such a way as to be perceived of as irrelevant and boring to today's students. Despite the fact that STEM plays an increasingly important role in the lives of American students outside of school through the use of everyday technologies, such as cell phones and computers and the explosion of STEM-related television programs and websites, the interest of American students, especially girls, in science and mathematics begins to show a drop around middle school (Cunningham, Lachapelle, and Lindgren-Streicher, 2006).

Gender and Racial Inequity in STEM: Nationally, the good news is that more and more students are entering higher education with plans to major in science, technology, engineering and mathematics (STEM) fields. The bad news is completion rates in these majors lags far behind graduation rates of other fields, especially if the student is black, Latino or Native American (HERI, 2010). This is an unsustainable and unacceptable condition.

According to the public-private partnership Building Engineering & Science Talent (BEST), in 1999 "despite decades of effort to broaden its base, the U.S. science and engineering workforce remains about 75 percent male and 80 percent white" (Building Engineering & Science Talent, 2008). Women, African Americans, Hispanics, Native Americans and persons of disabilities—the "underrepresented majority" that makes up two-thirds of the entire U.S. workforce—account for only 25 percent of the technical workforce. This is particularly relevant to our economy as performance in high school mathematics and science correlates to higher wage earnings later in life.

Joensen & Nielson (2009) found that students who take higher-level mathematics courses had an average wage 25-30% higher than students who did not. It is estimated that by 2014, 75 percent of the fastest growing occupations will require significant training in mathematics and science (State Educational Technology Directors Association, 2008). According to Butz, Kelly, Adamson, Bloom, Fossum & Gross (2004), "The implications of a shortage of skills critical to U.S. growth, competitiveness and security are serious, probably more so now than in recent decades, as are the implications of continuing low entry of female and minority students into many STEM fields." The extent and quality of education in STEM at the elementary, secondary and post-secondary levels is a matter of state and national concern. The situation is aggravated by shortages in the pool of interested students, as well as shortages of qualified STEM teachers and of faculty in universities and colleges, especially in many of the engineering disciplines.

STEM Occupational Opportunities*:* Iowa's targeted industry clusters include the following: Advanced Manufacturing, Biosciences and Information Solutions/ Financial Analysis. Additionally, the future of Iowa's economic development includes Renewable Energy. Advanced Manufacturing is the largest industry in Iowa consisting of 4,200 manufacturers with a workforce of over 230,000 employed. The annual contribution to the state economy is $19 billion. Bioscience industries are involved in the application of biological sciences to plants, animals, processed foods or humans. Also, this industry is involved in production agriculture, value-added processing and pharmaceuticals. More than 1,100 companies are included in the Bioscience industry employing over 72,000 Iowans. Information Solutions/Financial Analysis include insurance and financial services and Information Technology consisting of over 6,100 companies which employ over 81,000 employees. The Financial Services sector also employs an additional 29,000 employees. Renewable energy production includes wind, biomass, ethanol, cellolosic ethanol and biodiesel. Iowa is the leader in production of ethanol, E-85 and biodiesel fuels and ranks third in wind energy production (IWD, 2009).

Many STEM majors exist within the manufacturing sector of the U.S economy and, according to the National Association of Manufacturing (NAM), the United States is the world's largest manufacturing economy, producing 21 percent of global manufactured products. Japan is second at 13 percent and China is third at 12 percent. U.S. manufacturing represents 11 percent of the U.S. GDP or $1.6 trillion of value each year. U.S. manufacturing supports an estimated 18.6 million jobs or about one in six private sector jobs. Nearly 12 million Americans (or 10 percent of the workforce) are employed directly in manufacturing. These jobs are high paying averaging $70,666 annually, including pay and benefits compared to the average non-manufacturing worker earned who earns $57,993 annually. Half of all Research and Development is performed by U.S. manufacturers driving more innovation than any other sector. The strength of U.S. manufacturing and the continued growth of high-technology industries are dependent on the availability of high-quality personnel, especially in the scientific, technological, engineering and mathematical disciplines. U.S. manufacturing leads the world in global innovation, but it is essential to inspire a continuing pipeline of students to pursue STEM careers to sustain our technological edge and compete in the global economy.

Iowa Occupational Projections by Growth Rate, 2004-2014

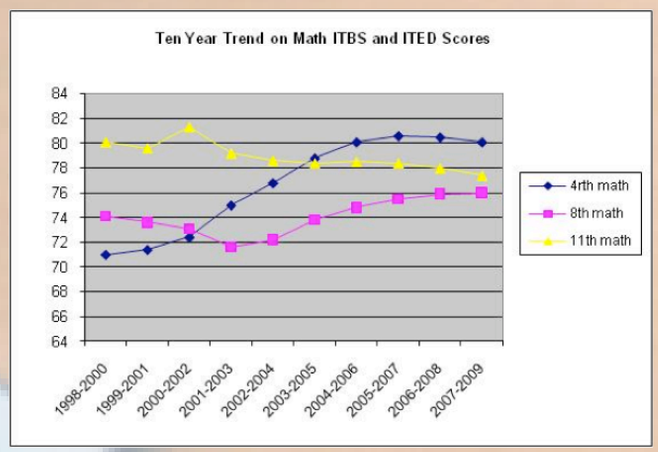
Computer Software Engineers, Applications	**4.80%**
Computer Software Engineers, Software Applications	**4.70%**
Home Health Aides	**4.60%**
Network Systems and Data Communication Analysts	**4.00%**
Physician Assistants	**3.40%**
Personal Home Health Aides	**3.20%**
Network and Computer System Administrators	**3.20%**
Database Administrators	**3.10%**
Computer System Analysts	**3.10%**
Industrial Engineers	**3.00%**
Occupations dealing with Computer, Mathematical and Health Services dominate the highest growth projections for occupations in 2014.	

Source: Workforce Data and Business Development Bureau, Iowa Workforce Development

b. Iowa

According to the Iowa Department of Education in the periods between 1998-2009, 4th grade mathematics scores have steadily increased at or above the proficient level. During the same time period, 8th grade mathematics scores saw a decline from the 1998-2000 period to the period 2001-2003. The scores then increased to a maximum score of 76 during the 2007-2009 biennium period. Eleventh grade students in mathematics saw a decline in scores from the 2001-2003 period to the 2007-2009 period with a ten year low score of 77.4 (Fig. 1).

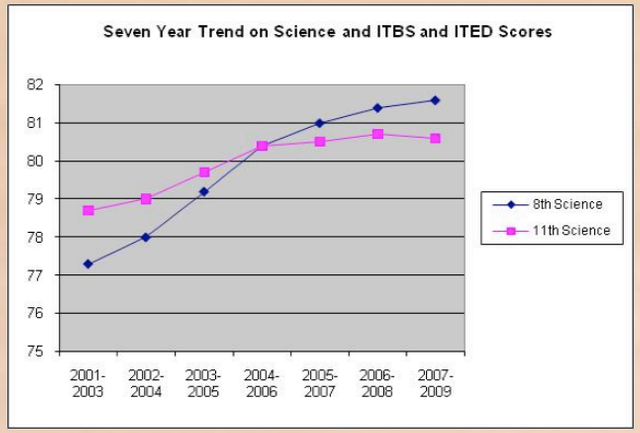
Fig. 1



Fourth grade scores were not reported for science on the ITBS. Eighth grade scores on the ITBS increased from 77.3 in 2001-2003 to a high score of 81.6 in 2007-2009. Similarly, 11th grade science scores have improved to 80.6 over the same time period (Fig. 2). By contrast, though, 41 percent of Iowa's 4th graders and 34 percent of 8th graders scored at proficient level or above on the National Assessment of Educational Progress in 2009.

The enrollment of Caucasian students in Iowa at public K-12 institutions has steadily declined from 91.9 percent in 1997-1998 to 84.6 percent in 2008-2009. The enrollment of Latino/Hispanic students in Iowa at public K-12 institutions

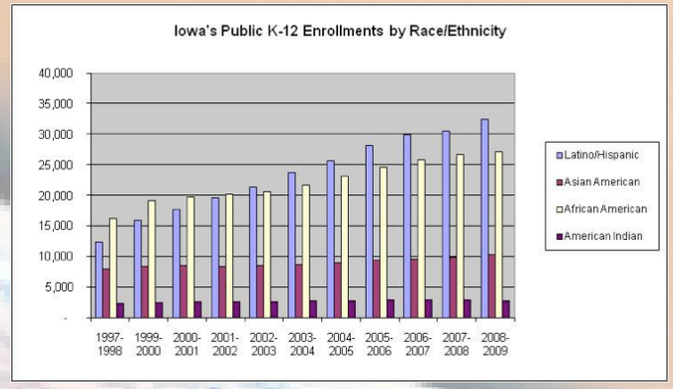
Fig. 2



has the most dramatic increase from 2.56 percent in 1997-1998 to 6.87 percent in 2008-2009. The enrollment of Asian American students in Iowa at public K-12 institutions has also seen a slight increase from 1.62 percent in 1997-1998 to 2.17 percent in 2008-2009.

The enrollment of African American students in Iowa at public K-12 institutions has increased from 3.37 percent in 1997-1998 to 5.76 percent in 2008-2009. Total minority enrollment of students in Iowa at public K-12 institutions has nearly doubled from 8.04 percent in 1997-1998 to 15.39 percent in 2008-2009 (Fig. 3).

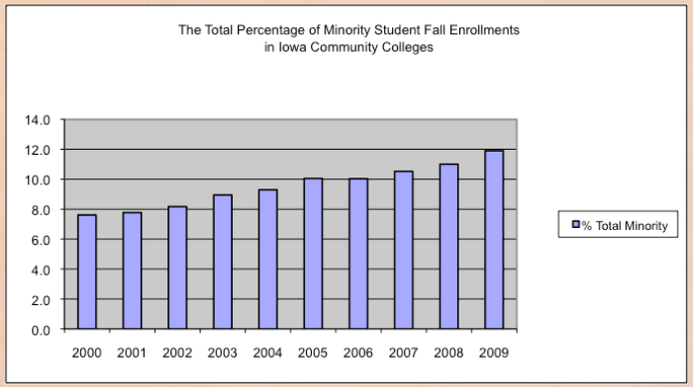
Fig. 3



***Demographics*:** Over the past ten years, the demographics of the K-12 population in Iowa have changed significantly with the White/Asian population decreasing by 9.9 percent, the African American population increasing by 63.1 percent, the Hispanic population increasing by 143.3 percent, and the Native American increasing by 24.3 percent (Iowa Department of Education, 2009). On a yearly average, this represents a combined 7 percent per year increase in the underrepresented minority K-12 population and a 1.1 percent decrease in the White/Asian K-12 population, which compares to an estimated national 1.3 percent increase of the African American and Hispanic population and 0.9 percent decrease in the White population (Murdock, 2006). These demographic shifts represent a change in the state K-12 population that will be reflected in future college STEM graduation rates.

At the community college level in Iowa, the ten-year trend indicates that the total percentage of minority fall enrollments have increased from 7.6 percent in 2000 to 11.9 percent in 2009. In conjunction, the total percentage of White students has steadily declined every year during the last ten years. The fall enrollment numbers have decreased from 92.4 percent in 2000 to 88.1 percent in 2009 (Fig. 4).

Fig. 4



Iowa Student Preparedness for Higher Education in STEM: Our state has recently enacted legislation that will soon have a significant impact on K-12 student preparedness for STEM by requiring additional science and mathematics study of all graduates. Comparing the data from the 2010-2011 to the 2008-2009 graduation requirements in STEM, 97.7 percent compared to 62.4 percent will have three units of mathematics and 99.9 percent of enrollees compared to 56.8 percent will have three units of science (Iowa Department of Education). This change will generate a group of entering freshman who should be increasingly prepared for pursuing STEM majors.

Iowa has an enviable higher education system for the two-year, four-year and graduate-level scholar. And, Iowa learners are doing well comparatively to prepare themselves for higher education eligibility. The percentage of Iowa 9th graders who graduate from high school is 84 percent compared to a national average of 69.7 percent (Iowa is 4th). with 62 percent going directly to college compared to a national average of 56 percent (National Center for Higher Education Management Systems, 2010). Students from low income families participate in college at a rate of 35 percent compared to a national average of 24 percent (Iowa ranks highest.) (National Center for Higher Education Management Systems, 2010). In Iowa, the percentage of graduating seniors planning or intending to pursue a post-secondary education is 81.2 percent overall with a race/ethnic breakdown of: African American 72.6 percent, American Indian 67.1 percent, Hispanic 67.9 percent, Asian 81.2 percent and White 82.3 percent (Iowa Department of Education, 2009). Iowa ACT scores in mathematics and science (Figures 5, 6) remain above national averages, although only 51 percent of mathematics learners and 34 percent of science learners are college ready in these fields, according to ACT.

An encouraging rise of 2.8 percent of Iowa students took advanced mathematics classes (e.g., Calculus, trigonometry, statistics) in 2009 compared to 2007, and 5 percent more Iowa youth took chemistry in 2009 compared to 2007. And, signature STEM majors at our universities are enjoying increased enrollments over the period of 2008 to 2010: chemistry is up 34 percent, physics is up approximately 30 percent, engineering has increased by about 14 percent, and biology has gained about 10 percent.

Women & Minorities in Iowa Higher Education: The graduation of under-represented minority students from STEM fields at the Iowa Regents institutions and other bachelor granting institutions has increased over the past five years but at a rate below the average yearly increase in the K-12 minority population in Iowa. Performance of underrepresented minority students on the ACT® continues to lag their peers in Iowa. State-wide ACT® performance shows that African American, Hispanic, Native American and Alaskan Native students perform at levels lower than White students but at higher levels than the national averages on all tests. At the state's public universities, undergraduate enrollment in STEM programs increased by 6.5 percent (16,138 to 17,183) from 2008 to 2009. The number of women majoring in STEM programs increased over that period by 6.5 percent (6,037 to 6,431)—their percentage remaining steady at 37 percent of STEM majors in 2008 and 2009. The number of Native American, African-American and Hispanic American students combined majoring in STEM programs increased over that period by 8.5 percent (1,371 to 1,487), from 8.5 percent of all STEM majors to 8.7 percent.

Fig. 5

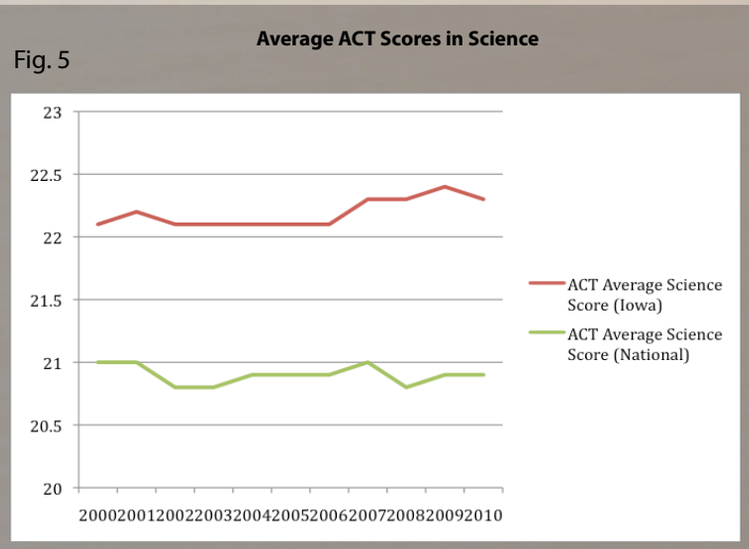
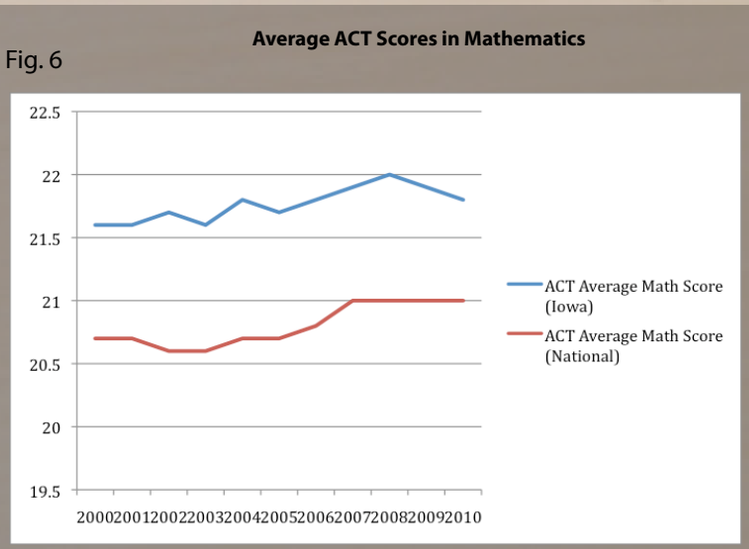


Fig. 6



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Development Team

Co-Facilitators/Editors

Cindy Dietz, Senior Manager, Community Relations, Rockwell Collins

Yvette McCulley, State Science Consultant, Iowa Department of Education

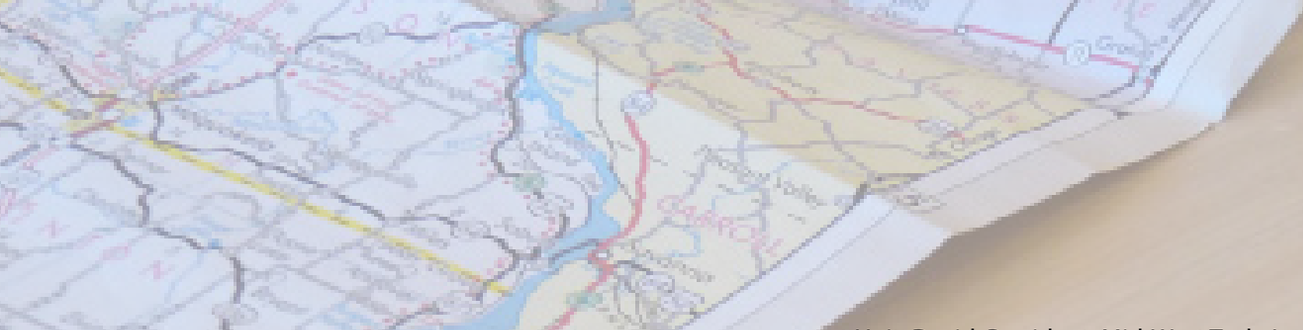
Jeff Weld, Director, Iowa Mathematics and Science Education Partnership

Contributing Writers

- Anderson, Alana , programming manager, innovation and commercialization, Iowa Department of Economic Development
- Barnes, Pat, IT Team Leader, John Deere, and President of the Quad City Engineering and Science Council (QCESC)
- Bottrell, Cynthia A. , Dean, Arts and Sciences, Hawkeye Community College
- Denson, Rob, President, Des Moines Area Community College
- Dietz, Cindy, Senior Manager, Community Relations, Rockwell Collins
- Halyard, Vaughn, CEO and producer, Story Lounge Films
- Heinzel, Chad, Assistant Professor of Earth Science, University of Northern Iowa
- Holger, David K., Associate Provost for Academic Programs and Dean of the Graduate College, Professor of Aerospace Engineering, Iowa State University
- Lee, Cherin, Associate Professor of Biology and Chair, Science Education, University of Northern Iowa
- McCulley, Yvette, State Science Consultant, Iowa Department of Education
- Maguire, Kenneth, Director of Marketing Development and Relationships, Project Lead The Way®
- Mann, Adin, Principal Engineer, Fisher Division of Emerson Process Management
- Rider, Paul, Head, Natural Sciences Division, Grand View University
- Schatteman, Gina, Associate Professor of Integrative Physiology, University of Iowa
- Schenk, Tom, Bureau of Community Colleges and Career and Technical Education, Iowa Department of Education
- Seaman, Walter, Associate Professor, Mathematics and Mathematics Education, University of Iowa
- Spitzli, Judith, State Mathematics Consultant, Iowa Department of Education
- Williams, Henry, Graduate Student, Student Affairs, University of Northern Iowa
- Weld, Jeff, Director, Iowa Mathematics and Science Education Partnership
- Zunkel, Karen, Director, Program for Women in Science and Engineering, Iowa State University

Reviewers

- Anderson, Alana, Program Manager, Iowa Department of Economic Development
- Balong, Megan, Mathematics Educator, Price Lab School, University of Northern Iowa
- Barnes, Patrick, President, Quad City Engineering and Science Council (QCESC) and Information Technology Leader, Computer Aided Engineering Services, Deere & Company World Headquarters
- Bisgaard, Linda, Director of Collaborations and Advocacy, Girl Scouts of Greater Iowa
- Bottrell, Cynthia, Dean of Arts and Sciences, Hawkeye Community College
- Breitsprecker, Corrine, Mathematics Consultant, AEA 11
- Busta, Maureen, Professor of Mathematics and Chair of the Division of Science and Mathematics, Upper Iowa University, and Executive Secretary, Iowa Council of Teachers of Mathematics
- Campbell, Lynne, Science Consultant, AEA 267
- Carlson, Denise, Mathematics Consultant, AEA 11
- Chancey, Cliff, Professor and Department Head of Physics, University of Northern Iowa
- Cooper, Sarah, Gifted/Talented Teacher, Waverly-Shell Rock
- Countryman, Lyn, Professor of Secondary Science Methods and Interim Director of Malcolm Price Laboratory School/Northern University High, University of Northern Iowa
- Didier, Kim, Iowa Association of Business and Industry
- Dietz, Cindy, Senior Manager of Community Relations, Rockwell Collins
- Dougherty, Barbara, Director, Center for Excellence in Science, Mathematics, Engineering Education, Iowa State University



- Drake, Corey, Associate Professor of Elementary Mathematics Education, Iowa State University
- Escalada, Lawrence, Professor of Physics Education, University of Northern Iowa
- Fielder, Ronald, Chief Administrator, Grant Wood Area Education Agency
- Finken, Teresa, Associate Professor and Chair, Iowa Wesleyan University
- Getter, Doug, Iowa Biotechnology Association, Retired
- Gray, Kyle, Assistant Professor Earth Science Education, University of Northern Iowa
- Greenbowe, Thomas, Professor of Chemistry, Iowa State University
- Haack, Joel, Dean, Natural Science and Humanities/Fine Arts, University of Northern Iowa
- Halyard, Vaughn, CEO and Executive Producer, Story Lounge Media
- Hand, Brian, Professor of Science Education, the University of Iowa
- Hardcastle, Dan, President, I-GEMS
- Heaverlo, Carol, Outreach Program Coordinator, Program for Women in Science and Engineering (PWISE), Iowa State University
- Heinzel, Chad, Earth Science Assistant Professor, University of Northern Iowa
- Higby, Patricia, Energy Education and Outreach Coordinator, University of Northern Iowa
- Hobson, Tom, Senior Manager Government Relations, Rockwell Collins
- Hochstedler, Beth, Training and Outreach Coordinator, Iowa Hygienic Lab, the University of Iowa
- Hoit, David, President, Mid-West Tech, Inc.
- Hotek, Doug, Associate Professor of Technology Education, University of Northern Iowa
- Hughes, Elizabeth, Assistant Professor of Mathematics Education, University of Northern Iowa
- Hurley, Rachel, Executive Director, Iowa Biotechnology Association
- Hutchison, Paul, Assistant Professor of Education, Grinnell College
- Hylton, Latricia, Mathematics Coordinator, Academic Support Services, University of Northern Iowa
- Jaras, Vic, Education Technology Consultant
- Jastorff, Kari, Program Manager, Iowa Mathematics and Science Education Partnership
- Jergens, Valerie, School Improvement Consultant, AEA 8
- Johnson, Craig, Executive Director, Iowa Academy of Science
- Kotval, Gail, Division Coordinator, Iowa Department of Economic Development
- Lee, Cherin, Department Chair of Science Education, University of Northern Iowa
- Louk, Annette, Education Consultant, AEA 8
- Maguire, Kenneth, Director of Marketing Development and Relationships, Project Lead The Way®
- Mann III, J. Adin, Principal Engineer, Fisher Division of Emerson Process Management
- Martin-Hiner, Jason, Science Consultant, AEA 1
- McCartney, Lynne, Program Assistant, Educational Technology, AEA 11
- McCulley, Yvette, Secondary Science Consultant, Iowa Department of Education
- McLeod, Scott, Associate Professor and Director of the Center for the Advanced Study of Technology Leadership in Education (CASTLE), Iowa State University
- Miller, Tracie, Program Assistant, Center for Excellence in Science, Mathematics, Engineering Education, Iowa State University
- Miller, Catherine, Associate Professor of Mathematics Education, University of Northern Iowa
- Mills, James, Owner, Mason City Sylvan Learning Center
- Mupasiri, Douglas, Interim Department Head and Professor of Mathematics, University of Northern Iowa
- Murphy, Joseph, State Relations Officer, Iowa Board of Regents
- Neal, Ted, Clinical Instructor of Science Education, the University of Iowa
- Neuhaus, Ellen, Reference Librarian & Associate Professor, University of Northern Iowa
- O'Donnell, Kim, Science Curriculum Coordinator, Des Moines Public Schools
- Ogilvie, Craig, Professor of Physics, Iowa State University
- Oldfield, Curt, Vice President of Academic Affairs, Northeast Iowa Community College
- Oleson, Vicki, Instructor of Mathematics, University of Northern Iowa
- Ophus, John, Assistant Professor, Department of Biology, University of Northern Iowa
- Osborn, Paul, Dean of Applied Science and Technology, Hawkeye Community College

- Reardon, Cheryl, Assistant Vice President for Research, the University of Iowa
- Reno, Mary Hall, Physics Professor and Chair, the University of Iowa
- Rich, Michelle, Network Coordinator, Iowa After School Alliance
- Richards, Tonja, Communications and Marketing Specialist, Iowa Mathematics and Science Education Partnership
- Rider, Paul, Department Head of Physics, Grand View University
- Ruback, Chad, Assistant Vice President for External Relations, University of Iowa Health Care
- Schatteman, Gina, Associate Professor of Physiology, the University of Iowa
- Schenk, Jr., Tom, Consultant for Institutional Effectiveness and Accountability, Iowa Department of Education
- Schroeder, Camille Sloan, Manager of Engineering Precollegiate Programs, Director of Iowa FIRST LEGO League, University Affiliate Director of Project Lead The Way®, Iowa State University College of Engineering
- Scott, Rachel, Executive Officer, Iowa Commission on the Status of Woman, Iowa Department of Human Rights
- Seaman, Walter, Associate Professor of Mathematics and Math Education, the University of Iowa
- Sieck, Sarah, Math Consultant, AEA 1
- Smith, Elliott, Executive Director, Iowa Business Council
- Smith, Carl, Professor and Chair, Curriculum and Instruction, Iowa State University
- Smith, Lisa, Instructor, Mt. Mercy University
- Spitzli, Judith, Mathematics Consultant, Iowa Department of Education
- Staker, Jay, Program Director, Extension-Science, Engineering & Technology, Extension and 4-H
- Stefanich, Greg, Professor of Elementary Science Education, University of Northern Iowa
- Stevens, Bridgette, Assistant Professor of Mathematics Education, University of Northern Iowa
- Temeyer, Michelle, Retired Administrator, Waterloo Schools
- Thomas, Jeanette, Equity/Perkins Consultant, Iowa Department of Education
- Twait, Christy, Associate Provost for Sponsored Programs, University of Northern Iowa
- Uhlenberg, Jill, Interim Department Head for Curriculum and Instruction, University of Northern Iowa
- Utman, Roger, Administrator, Division of Community College and Career and Technical Education, Iowa Department of Education
- Wallingford, Eugene, Computer Science Head and Associate Professor, University of Northern Iowa
- Walljasper, Tim, Mathematics Teacher, Des Moines Public Schools
- Weld, Jeff, Director, Iowa Mathematics and Science Education Partnership
- Whitaker, Rebecca, K-12 Outreach Coordinator, the University of Iowa College of Engineering
- Winter, John, Adjunct Instructor, Hawkeye Community College
- Woolstron, Todd, CFO, Mid-West Tech, Inc.
- Zachary, Loren, Professor of Engineering, Iowa State University
- Zastrow, Paul, Strategic Communications Specialist, Rockwell Collins
- Zunkel, Karen, Director, Program for Women in Science and Engineering, Iowa State University

Technical Assistance

- Jastorff, Kari, Program Manager, Iowa Mathematics and Science Education Partnership
- Johnson, Cody, Program Assistant, Information Technology Services–Educational Technology, University of Northern Iowa
- Mark, Marty, Director of Technology Systems and Services, Financial Accounting-Technology Services, University of Northern Iowa
- Murray, Blake, Information Technology Specialist, Financial Accounting-Technology Services
- Neil, Brandon, Assistant Manager, Design and Multimedia Productions, ITS- Education Technology, UNI

Graphic Design

- Linn, Jacci, Senior Communications/Public Relations Major, University of Northern Iowa and Undergraduate Student Assistant, Iowa Mathematics and Science Education Partnership
- Richards, Tonja, Communications and Marketing Specialist, Iowa Mathematics and Science Education

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