STEM for ALL Action Plan: High Potential, Underrepresented, Nontraditional

Purpose: The STEM for ALL committee identifies priorities and programs to increase recruitment and retention of high-potential, underrepresented, and nontraditional students in STEM disciplines in the state of Iowa.

1. Priority/5-Year Plan:

STEM for ALL is characterized by high expectations and a commitment to excellence. We can get a peek at the future for STEM for ALL by looking back 50+ years and recognizing that high expectations and a commitment to excellence look a lot like the educational programs that were implemented after the Russians launched Sputnik in 1957. In response to Sputnik, we looked hard and fast at our educational system, and the following year the U.S. government passed the National Defense Education Act (NDEA). NDEA was a source of federal aid for math, science, foreign language, and student guidance and also established forgivable loans for high education costs incurred by pre-service teachers (http://www.archives.nysed.gov/edpolicy/research/res_essay_eisenhower_ndea.shtml).

In the decades following Sputnik and NDEA, educators and psychologists made significant pedagogical and research contributions to programming for students in math and science. The educational treatments that were implemented in response to Sputnik worked—but along the way, other issues distracted us from following through with those treatments. Through reports like PISA 2009 (OECD, 2010), we have well-documented evidence of our decreased momentum today in math and science. *The recommendations from this subcommittee seek to revive our momentum and lead us back to a place of excellence with increased opportunities for a diversity of students to get involved with STEM*.

Numerous high-quality STEM-related opportunities and programs that target specific demographics already exist throughout the state of Iowa. However, there is a *critical need* for publicizing and promoting these events and programs to students, parents, and education professionals in order to increase public awareness and student participation. **Our five-year plan therefore begins with the establishment of a state-wide, inter-agency communication system and central repository for information about STEM-related programs and opportunities in Iowa**.

Research suggests that the attitude and interest in the study of science has been largely formed by age 14 (Tai et al., 2006; Archer et al., 2010) and also that parents/guardians can support future STEM innovators if they display a positive attitude towards learning and discovery to their children at the earliest ages (NSB, 2010). Our plan calls for the development of **parent and teacher education, outreach partnerships with K-12 schools, and other efforts to increase early and ongoing exposure to/learning of STEM, recognition of academic excellence in STEM and the increase of awareness of STEM**.

In the years since Sputnik we have learned much about meeting the needs of gifted students—but we have not always met them. Research such as Benjamin Bloom's (1985) seminal study on talent development exposed the deficiency of schools in providing the challenges high ability students need to develop their talent. An important element of our plan is to **nurture high quality teaching and to provide advanced learning opportunities that encourage students to set ambitious goals**.

In the mathematically-based fields of computer science, physics, and engineering at Iowa universities, women earn less than one in four bachelor's degrees (IMSEP, 2009). Native Americans and African American students also are underrepresented in STEM fields compared to the number of Native Americans and African Americans in the student body as a whole at Iowa universities (IMSEP, 2009).

Increased undergraduate success among underrepresented populations would not only increase the pool of students who may consider graduate education and careers in STEM, it may also stimulate interest in STEM on the part of younger cohorts (NAS, 2011). Our plan calls for the **expansion of policies and programs that increase undergraduate retention and completion of STEM degrees.** This includes efforts to increase undergraduate participation in STEM research (based on research that demonstrates the positive effects of such participation [PCAST 2012; Lopatto, 2004; Lopatto, 2007]), and to facilitate the transition from community college into STEM-related majors at a 4-year college.

Each element of this plan addresses the need to increase participation of high-ability, underrepresented, and nontraditional students (including nontraditional K-12 students and also nontraditional undergraduates, such as student veterans) in STEM education and career development.

2. Goals:

1. Collaborate statewide across education systems, community-based organizations, and businesses—as well as within each Iowa regional STEM network— to **identify formal and informal STEM-related opportunities** targeted towards K-12 student populations. **Disseminate information about these opportunities** to constituents in order to promote STEM career path development in underrepresented, nontraditional, and high-ability learners.

   National recommendation: Create a . . . database of formal and informal education opportunities. . . and publicize and promote such opportunities . . . to parents, education professionals, and content and resource providers (NSB 2010).). Create a national campaign aimed at increasing the appreciation of academic excellence and transforming stereotypes towards potential STEM innovators (NSB, 2010).

2. Implement school-university-college-community partnerships—at the elementary, middle, and high school levels— that include a best-practices system to **discover, develop, and recognize STEM talent in diverse populations**, including underrepresented students.

   National recommendations: Provide advanced courses that press students to set ambitious goals and achieve at higher levels (NAGC

3. **Establish regional STEM-Hub Schools for Math and Science** (including residential schools) in the state of Iowa.

   National recommendation: Create 1,000 new STEM-focused schools to excite and motivate students (NAGC).

4. **Facilitate the transfer of [underrepresented] community college students into STEM-related majors at 4-year Iowa colleges and universities** through the STEM regional networks, which can serve as a hub to disseminate course transfer information and foster partnerships developed among Iowa's Regent universities and Iowa community colleges.

   State recommendation: Strengthen articulation agreements between public postsecondary institutions and promote greater awareness of such agreements (Iowa House File 815).

5. Maintain and expand programs that seek to **increase undergraduate retention of underrepresented and nontraditional students** and completion of degrees in STEM-related fields.

   State recommendation: Maintain existing STEM diversity programs at the universities and pursue opportunities to expand these programs within and beyond the university system (IMSEP 2009).

6. **Ensure that 15% of new teacher hires in STEM areas have a master's degree in a STEM discipline**, 9-12 hours of coursework in the field of gifted and talented education, and 3-6 hours of workshop training in universal design for learning (UDL).

   National recommendation: Recruit and train 100,000 great STEM teachers . . . who are able to prepare and inspire students (PCAST 2010).

7. Develop programs in each regional STEM network to **increase parental STEM awareness** based on best practices for fostering relationships with families, including families that are economically disadvantaged.

   National recommendation: Learning opportunities should be available for parents/guardians about the importance of developing their children's abilities at the earliest ages, supporting their children's academic achievement and creative endeavors, and fostering a family culture that expects excellence (NSB 2010).

3. Dissemination of Identified Best Practices:

Selected Best Practices

Develop early intervention programs that expose elementary and middle school students to STEM knowledge, skills and fields and educate them about STEM careers. Equip parents, teachers, and community leaders with information to guide and support STEM interests in students at an early age.

Cast a wide net to discover high-ability students. Specifically, increase access to above-grade-level assessments – especially in economically disadvantaged communities.

Encourage pre-service and in-service professional development that includes steps for recognizing and developing early signs of high ability – especially in students from traditionally underrepresented groups – in order to help students set ambitious goals.

Expand access to advanced coursework, college coursework, and other accelerated learning opportunities for *all* students.

Be all-inclusive by identifying STEM opportunities for K-12 students within nontraditional settings such as community-based organizations that are serving youth, home schooled, and juvenile justice students.

Create communication and marketing strategies in conjunction with non-profit organizations that have experience working with families that are economically disadvantaged.

What Needs to Happen in Iowa: Suggested Strategies

Create a web site to make information about formal and informal STEM-related education opportunities available to the public. Incorporate social media networking tools and create a calendar of events for each STEM regional network.

Encourage school districts to utilize the STEM regional networks in forming STEM outreach partnerships.

Develop an Adopt-A-School program through which industry scientists, researchers and instructors at colleges and universities, and staff at nonprofit organizations provide services such as teacher training, personnel, or monetary resources for STEM-related programs and activities in Iowa school districts. The program should be based on a model that utilizes best practices for

similar outreach programs and provides a plan for establishing buy-in by upper administration officials at universities and colleges, corporate executives, and non-profit board members through visible PR campaigns. A marketing strategy should be implemented to attract outreach partners.

Establish a "STEM All-Star" program to recognize and highlight the development and achievement of STEM skills, knowledge, and aspirations among 3rd, 8th, and 11th grade students, with an emphasis on those who are underrepresented (e.g., women, minority, disabled, or rural). The program should launch in a small number of communities and expand to state level.

Create STEM-focused schools.

Design (and disseminate through the regional networks) a curriculum for training parents to be "STEM savvy" and to encourage the formation of local parent STEM networks.

Communicate with parents, teachers, and community leaders through web-based STEM trainings, and/or community forums that increase STEM awareness and identify needs in specific communities.

Leverage partnerships with industry to enhance the research capacity of rural schools by providing much needed laboratory equipment and internship opportunities for students and teachers (see for example the Visionary-innovation incubator [V-ii] pilot program being conducted by Cathy Molumby, district superintendent of Valley Community School District).

Use data collected within each regional network to identify specific locales (*e.g*. low income or rural areas) or populations (*e.g*. minority or disabled students) where opportunities to get involved with STEM are lacking and/or inaccessible. Expand cyber-learning opportunities (*e.g.*, remote connections with STEM experts, online learning communities, virtual laboratories [NSB 2010]) and other programs in such locales.

Establish mentoring programs based on successful models; *e.g.*, the Veterans Employee Network at Rockwell-Collins in Cedar Rapids has reached out to the University of Iowa's student veteran population with 70 volunteer mentors (in all majors and career fields).

Inventory academic programs and support services at the three Regent universities and evaluate them for best practices and potential expansion throughout and beyond those universities.

Use the STEM regional networks to foster relationships among community colleges and universities and ensure that up-to-date course transition information is readily available.

Develop plans (and identify funding requirements) to institutionalize extramurally funded STEM diversity/gender programs within the public universities.

Enhance support for undergraduate laboratory research experiences (*e.g.*, through partnerships with private industry) as a means to increase retention and graduation rates of underrepresented students.

Explore programs with similar purposes that are already available nationally and modify for Iowa rather than reinventing what already exists

Note: best practices for high potential students adapted from NAGC, Advanced Achievement in STEM Fields: Essentials for Success.

4. Resources:

What resources are needed (human and material)?

Human Resources (New Hires and Task Forces):

A website and database designer as well as strategic communication and marketing experts for the STEM regional network initiative. A website design framework can be shared among regional network sites, but communication and marketing strategies will need to be adapted to the unique demographic attributes of each regional network.

A permanent staff member *for each STEM regional network* with job duties including: soliciting information about STEM related opportunities offered by area universities and colleges, industry partners, and non-profit organizations; updating the calendar, website, and social media sites on a weekly basis; establishing connections among every public K-12 school in the STEM regional network and outreach partners; disseminating information through recommended marketing strategies to appropriate staff and parent organizations at K-12 schools within the region; and conducting regional surveys to assess student participation and demographics of participating students in the regional network.

A permanent staff member *for each STEM regional network* with job duties that include identifying contacts in each of the community colleges and providing bi-annual updates to academic transfer-related information for each STEM-related major at the Iowa Regent institutions.

A coordinator for the many Iowa state agencies and activities that deal with veterans' issues.

A task force charged with creating a model to sustain the Adopt-A-School program. Once a model is in place, it will be the responsibility of the STEM regional network to foster connections between outreach partners and K-8 schools and promote the program.

A task force charged with recommending a set of criteria to be utilized for recognizing students through the STEM All-Star program.

Material:

Continued expansion of the IMSEP Iowa STEM Education Activities Inventory (http://www.iowamathscience.org/inventory/list).

An expanded inventory of programs and initiatives (identified in the IMSEP 2009 report on women and minorities) that target underrepresented groups in STEM to include federally funded and university funded academic programs and support services that serve underrepresented students (including disabled and first-generation students) at each of the three Regent institutions.

An assessment of the resource needs at Iowa's research institutions and community colleges to increase the number of undergraduate students involved in undergraduate research experiences in STEM.

Professional development programs in STEM education focused on adaptations for the nontraditional, underrepresented, and highly able student.

Funding:

A pool of funds set aside *within each STEM regional network* for cost-sharing with industry.

Corporate sponsorship of awards and collaboration with communication providers to promote the recognition of STEM All-Stars.

A system of compensation for professional development.

Funding for specific action items such as the creation of STEM-focused schools and the expansion of opportunities for STEM enrichment and exploration in existing schools.

What can be done without new investment?

Transform negative attitudes and mindsets of educators (pre-K through 20) and students (pre-K through 20) regarding high ability, underrepresented, and nontraditional students.

Hold schools accountable for the performance of all students.

Reward schools and districts that close the achievement gap at the high end of the ability spectrum.

Encourage state and local policies to adopt *consistent* and appropriate policies on curriculum acceleration and enrichment.

See also "existing resources," below.

5. Existing Resources:

The Iowa Mathematics and Science Education Partnership (IMSEP) is conducting an inventory of outreach and professional development activities related to STEM education (see http://www.iowamathscience.org/parents/inventory). This inventory captures many programs across the state of Iowa in pre-K-16 STEM education and serves as a starting point for collection and dissemination of such information within each regional network.

The National Academy of Engineering's 2008 report *Changing the Conversation*: *Messages for Improving Public Understanding of Engineering* provides a framework for marketing strategies and messages that may improve the public understanding of the importance of STEM fields.

A cadre of STEM-related business partners with outreach programs already in place (as demonstrated most recently at the January 25, 2011 Governor's STEM Council meeting on Business and Community Partnerships in STEM)—as well as other existing partnerships—serve as models upon which to build best practices for successful outreach programs.

Multiple resources are available at the national level, including federal agencies.

At the state level, there are several opportunities for high-ability students to pursue advanced coursework through colleges and universities. Additionally, there are many post-secondary institutions that offer pre-service and in-service professional development.

There are numerous useful models for STEM related "Adopt-A-School"-style programs, including Minnesota Governor's Adopt-A-School initiative (http://www.education.state.mn.us/MDE/Welcome/AdoptASch) and Ohio-based Imagination Station Adopt-A-School program (http://www.imaginationstationtoledo.org/content/). In Iowa, The Iowa Business Council/PE4life Adopt-A-School Challenge (AASC) (http://www.pe4life.org/your-pe4life/iowa/) provides a statewide model of an Adopt-A-School program that is designed to enhance the quality of physical education for elementary and secondary students in Iowa schools.

United Way (http://www.unitedwaydm.org/) is a non-profit organization with a long-standing track record of working with economically disadvantaged families in Iowa and should be engaged in helping to develop communication and marketing strategies.

NewtonSTEM (http://newtonstem.org/), established in 2011, provides a model example of a parent STEM network.

Iowa employers provide internships and mentorships to returning service members via the Iowa Committee for Employers Support of the Guard and Reserve (ESGR) and the Hire to Hired (H2H) programs. These could be directed toward STEM activities.

State universities allow veteran undergraduate work-study students to be part of new research (*e.g.* The Virtual Soldier Project (SANTOS) at the University of Iowa).

The University of Iowa is home to an international center for gifted and talented education.

6. Timeline:

Year 1

Survey the depth of opportunities available in each regional network; identify current and potential STEM outreach partners and school/ university/ industry/ parent network contacts.

Construct a website and searchable database to disseminate information about programs and partners.

Conduct communication and marketing analyses in each regional network.

Administer a web-based survey to assess the partnership needs for each K-8 school in the regional network (Iowa has approximately 758 elementary and 269 middle schools [2010 Condition of Education in Iowa Report]).

Assign a task force to plan for implementation of the Adopt-A-School and STEM All-Star programs. Launch both programs.

Design a "STEM savvy" parent curriculum and guidelines for establishing parent STEM networks.

Identify priority areas for scale-up where opportunities for particular demographics are lacking.

Develop a strategic plan for more effective sharing of STEM-related course transfer information among Iowa Regent institutions and community colleges.

Inventory federally funded and university funded academic programs and support services that serve underrepresented students at each of the three regent institutions.

Develop a plan to assess undergraduate research resource needs at Iowa's research institutions and community colleges.

Year 2

Achieve "adoption" (through the Adopt-A-School program) of 10% of Iowa's public K-8 schools.

Launch the STEM All-Star program to the 8+ major metropolitan areas of Iowa.

Year 2-5

Achieve "adoption" and provide direct outreach support to 50% of public K-8 schools statewide over a five-year period.

Create online learning communities and virtual laboratories or science clubs for schools that have not been adopted.

Develop evaluation/outcomes tools for "best practices."

Scale up programs.

Year 3-5

Create STEM-focused schools.

Expand the STEM All-Star program to 2 or 3 other communities each year as knowledge of the program spreads.

7. Council Action:

Promote STEM priorities statewide. Act as a catalyst for, cultivate, and support collaboration among STEM regional networks and non-profits, schools, educators, businesses and community leaders.

Establish a portion of each regional network budget to be set aside for specific programs such as Adopt-A-School.

Work with policymakers to ensure that formal and informal education policies are inclusive to highly able, under-represented and nontraditional learners and support policy solutions.

Ensure equal opportunities for STEM funding.

Encourage Regent institution and community college leaders to develop strategies to improve transfer issues and communication.

Coordinate the timeline for identifying programs that have significant impact and may compete for scale-up funds.

Monitor established timeline.

8. Indicators of Success:

Increased attendance and participation of underrepresented students in STEM-related activities outside of school.

Establishment of STEM parent networks and increased involvement of parents in STEM-related activities.

Number of STEM partnerships.

STEM outreach opportunities in rural areas.

STEM Indicator 15: Percentage of ACT test-takers interested in majoring in a STEM area in college.

STEM Indicator 16: Percentage of ACT-Plan test-takers interested in majoring in a STEM area in college.

STEM Indicator 17: Percentage of Iowa 8th graders interested in STEM careers and educational paths (IPLAN).

STEM Indicator 18: Number/Percentage of K-12 students interested in STEM topic areas.

STEM Indicator 20: Number of college students who complete 4-year degrees in individual STEM majors.

STEM Indicator 21: Number of college students who complete graduate degrees in individual STEM majors.

STEM Indicator 22: Number of college students who complete degrees in all STEM majors.

9. Implications for the Future:

The Governor's vision, shared by the STEM Advisory Council, is for Iowa's schools to compete with top-performing schools around the world with regard to STEM education. This vision encompasses all learners in the state, seeking to include high ability, underrepresented, and nontraditional students in STEM exploration and enrichment.

The action plan proposed by the STEM for ALL committee will foster innovative, diverse, and supportive learning environments. It will increase interest in STEM careers among diverse populations, and help to close the gap in the STEM pipeline—leading to better career opportunities for individuals, and to the retention of a highly skilled and educated workforce for Iowa.

As the STEM Advisory Council works toward establishing Iowa as a center for STEM excellence, the recommendations of the STEM for ALL committee will ensure that we recognize and nurture the talents and contributions of all of Iowa's learners.

10. Appendix:

Working Definitions

Working Definition for Underrepresented Students:

A person belonging to group that historically has been disadvantaged and underrepresented in the workforce: *Women, racial and ethnic minorities (*including those whose primary language is not English), *disabled students, and rural students.*

Women

Women are considered underrepresented in science and engineering because they constitute smaller percentages of science and engineering degree recipients and of employed scientists and engineers than they do of the population (NSF, 2011).

Racial/Ethnic Minority

Three racial/ethnic groups—African American, Hispanic, and American Indian—are considered underrepresented in science and engineering because they constitute smaller percentages of science and engineering degree recipients and of employed scientists and engineers than they do of the population (NSF, 2011).

Disabled

Defined under the Americans with Disabilities Act 1990 as an individual that has a physical or mental impairment that substantially limits one or more of his or her major life activities, has a record of such impairment, or is regarded as having such an impairment. The Iowa Code (256B.2) defines "children requiring special education" as "persons under twenty-one years of age, including children under five years of age, who have a disability in obtaining an education because of a head injury, autism, behavioral disorder, or physical, mental, communication, or learning disability, as defined by the rules of the department of education."

Rural

The National Center for Education Statistics provides a definition of "rural" (http://nces.ed.gov/surveys/ruraled/page2.asp) and the Census Bureau uses specific criteria to define an area's urbanicity

Fringe: Census-defined rural territory that is less than or equal to 5 miles from an urbanized area, as well as rural territory that is less than or equal to 2.5 miles from an urban cluster.

Distant: Census-defined rural territory that is more than 5 miles but less than or equal to 25 miles from an urbanized area, as well as rural territory that is more than 2.5 miles but less than or equal to 10 miles from an urban cluster.

Remote: Census-defined rural territory that is more than 25 miles from an urbanized area and is also more than 10 miles from an urban cluster.

Working Definition for High Potential (Gifted and Talented)

Iowa has a state mandate for identification of, and services to, gifted and talented students. Iowa's definition of "gifted and talented" is based upon the federal definition.

257.44 Gifted and talented children defined.

1. *"Gifted and talented children"* are those children who are identified as possessing outstanding abilities and who are capable of high performance. Gifted and talented children are children who require appropriate instruction and educational services commensurate with their abilities and needs ***beyond those provided by the regular school program*** [emphasis added].
2. Gifted and talented children include those children with demonstrated achievement or potential ability, or both, in any of the following areas or in combination:
   a. General intellectual ability.
   b. Creative thinking.
   c. Leadership ability.
   d. Visual and performing arts ability.
   e. Specific ability aptitude.

High Potential Student Population Data (2010-2011)

Total Student Population (K-12)	473,493
Number of Identified Gifted Students	43,967
State Funding for Gifted and Talented Education	**$34.8 million (2010-2011)** $34.3 million (2009-2010) $33,204,910(2008-2009) $32,042,202(2007-2008) $30,885,376(2006-2007)

Non Traditional Learners:

The National Center for Education Statistics (NCES) acknowledges there is no precise definition for non-traditional student, but suggests that anyone who satisfies at least one of the following is considered non-traditional:

- Delays enrollment (does not enter postsecondary education in the same calendar year that he or she finished high school)
- Attends part time for at least part of the academic year
- Works full time (35 hours or more per week) while enrolled
- Is considered financially independent for purposes of eligibility for financial aid
- Has dependents other than a spouse (usually children)
- Is a single parent
- Does not have a high school diploma (completed with a GED or HS completion certificate or did not finish high school)

In researching numerous sites the definition of non-traditional student was similar and the age level focuses on adult students 20+ years of age.

According to Universal Service Administrative Company (USAC) eligibility table they define non-traditional K-12 students as Head Start, Pre-Kindergarten, Adult Education (High School equivalency programs), and Juvenile Justice.

Since our group will be more inclusive and include students from Kindergarten through 12th grade when relating to nontraditional learner related to STEM we would want to include in our state definition:

- Informal Education through Community Based Organizations – Girl Scouts, Boy Scouts, 4-H, Boys and Girls clubs, after school and in school programs
- Home schooled students
- Orphans or wards of the court (or were wards of the court until age 18)
- Juvenile justice students
- Incarcerated students – rehabilitation
- Veterans

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