

## Federal STEM Education Goals and Metrics

### K-12 Education

#### *K-12 National Metrics*

Goal 1. Student Learning: Prepare all students with the science, engineering, and math skills needed to succeed in the 21<sup>st</sup> century technological economy, whether in postsecondary education or the workforce; and graduate students with the capability and motivation to become STEM professionals, educators, and leaders

	<b>Metric</b>	<b>Source and Supplemental Information</b>
1	NAEP Long Term Trend Mathematics scores for 9, 13, and 17 years old	IES/NCES: National Assessment of Educational Progress (NAEP) – Data available for 1973 – 2004; future assessments every 4 years – Data available for key subgroups (gender, major ethnic categories, parental education)
2	NAEP National Mathematics and Science data for grades 4, 8, and 12 – percent of students at or above proficient	IES/NCES: National Assessment of Educational Progress (NAEP) – Math data are collected every 2 years for grades 4 and 8 and every 4 years for grade 12. Science data available for 1996, 2000, and 2005; next assessment in 2009. – Data available for key subgroups (gender, major ethnic categories, poverty)
3	Percentage of students scoring at proficient or advanced levels on State mathematics and science assessments	Department of Education – Annual - Data available for key subgroup – State science assessments are required starting in 2007-2008
4	SAT Mathematics and ACT mathematics and science scores; SAT subject tests	College Board and ACT – Annual Data – Data available for key subgroups – Comparability issues across time
5	Number of AP exams with scores of 3, 4, or 5 in particular subjects Number of students taking AP exams	ETS – Annual data – Data available for key subgroups – Keep in mind change in number of high school students
6	Trends in International Mathematics and Science Study (TIMSS) scores and ranking	ETS/NCES – Allows international comparisons. – 4th grade data available for 1995, 1999, and 2003; 8 <sup>th</sup> grade data available for 1995 and 2003
7	Program for International Student Assessment (PISA) scores and U.S. ranking	ISE/NCES – Allows international comparisons of 15 year old students. – Data every 3 years (with math focus in 2003 and science focus in 2006)
8	Percentage of college students who took remedial or developmental courses in mathematics during their freshman or sophomore years	National Postsecondary Student Aid Study (NPSAS) – Periodic data since the 1986-1987 school year

Goal 2. Teacher Quality: Recruit and retain teachers with majors or minors in STEM fields and increasing the content knowledge of current K-12 STEM teachers.

	<b>Metric</b>	<b>Source and Supplemental Information</b>
1	Percentage of middle and secondary school students whose mathematics and science classes are taught by teachers with (a) a major and (b) minor in the subject being taught	IES/NCES: Schools and Staffing Survey (SASS) – SASS is collected approximately every 4 years, with data for 1987-88, 1990-91, 1993-1994, 1999-2000, and 2003-4. – Data available for different types of schools (e.g., high poverty) – Percentage of students rather than percent of teachers wording is used to keep the focus on students and to help get around the issue of out-of-field teaching.
2	Percentage of mathematics and science teachers who are highly qualified under No Child Left Behind	U.S. Department of Education
3	Average number of years of teaching experience for mathematics and science teachers	IES/NCES: Schools and Staffing Survey (SASS)
4	Percentage of mathematics and science teachers with a master’s degree or higher in their primary teaching field	IES/NCES: Schools and Staffing Survey (SASS)
5	Percentage of mathematics and science teachers who meet criteria for being “effective” teachers	No current measures

Goal 3. Engagement: Increase student engagement in STEM and their perception of its value to their lives.

	<b>Metric</b>	<b>Source and Supplemental Information</b>
1	Average number of Carnegie units earned by HS students in math and science	NCES transcript studies (data now available for 1982, 1990, 1994, 1998, and 2000.)
2	Number of students who major in STEM fields in college	National Postsecondary Student Aid Study (NPSAS) – Periodic data since the 1986-87 school year
3	Percentage of 8 <sup>th</sup> graders taking algebra	The 2005 Grade 8 Math Student Background Questionnaire asks students what math class they were taking
4	Percentage of students who express an interest in mathematics and science	No current measures identified for math. The 2005 NAEP Science assessment asked students if they liked science
5	Percentage of students participating in extracurricular activities in mathematics and science	No current measures identified.

## K-12 Program and Project Metrics

Goal 1. Student Learning: Prepare all students with the science, engineering, and math skills needed to succeed in the global economy, whether in postsecondary education or the workforce; and graduate students with the capability and motivation to become STEM professionals, educators, and leaders.

	<b>Metric</b>	<b>Suitable for:</b>	<b>Supplemental Information</b>
1	Percentage of projects that demonstrate significant improvement in student achievement in a given subject, based on rigorous evaluation designs	Program	Individual projects would assess the effect of the projects on student achievement, using, whenever possible, experimental or quasi-experimental designs. Program effectiveness would be based on the percentage of projects that were effective. Suitable for programs that fund demonstration and service projects.
2	Percentage of students who meet or exceed proficient and advanced levels on State assessments of a given subject	Project or program	Suitable for programs that fund basic research, demonstration, and service projects.
3	Percentage of basic research projects judged by independent experts to make a significant contribution to our understanding of student learning in a given subject	Program	Suitable for programs that fund basic research projects
4	Percentage of funded projects that are using multi-site, controlled trials of interventions and programs to assess project effectiveness	Program	Suitable for initial assessment of programs that fund applied research and demonstration projects
5	The number of new approaches and interventions developed with program funds that have been found to be effective and that subsequently have been adopted at scale	Program	Suitable for long-term assessment of programs that fund applied research and demonstration projects

Goal 2. Teacher Quality: Recruit and retain teachers with majors or minors in STEM fields and increasing the content knowledge of current K-12 STEM teachers.

	<b>Metric</b>	<b>Suitable for:</b>	<b>Supplemental Information</b>
1	Percentage of projects, based on rigorous evaluations, where the students of participating teachers demonstrate increased competency in a given subject or area	Program	Experimental or quasi-experimental designs would be preferred
2	Percentage of teachers, based on rigorous evaluations, demonstrating increased competency in a given subject or area	Project or program	Experimental or quasi-experimental designs would be preferred
3	Percentage of teachers, based on rigorous evaluations, who improve classroom instruction in a given subject or area	Project or program	Experimental or quasi-experimental designs would be preferred
4	Percentage of participants who become teachers in high poverty schools	Project or program	Experimental or quasi-experimental designs would be preferred
5	Percentage of participating teachers who are still teaching in 5 years	Project or program	Experimental or quasi-experimental designs would be preferred

Goal 3. Encouragement: Increase student engagement in STEM and their perception of its value to their lives.

	<b>Metric</b>	<b>Suitable for:</b>	<b>Supplemental Information</b>
1	Percentage of students whose enjoyment of a given subject increased after participation in project activities	Project or program	Experimental or quasi-experimental designs would be preferred
2	Number of mathematics and sciences courses taken by participants, compared to nonparticipants, in high school	Project or program	Experimental or quasi-experimental designs would be preferred
3	Percentage of participants, compared to nonparticipants, who major in STEM fields in college	Project or program	Experimental or quasi-experimental designs would be preferred
4	Percent of participants, compared to nonparticipants, who participate in sustained extracurricular activities	Project or program	Experimental or quasi-experimental designs would be preferred

## Undergraduate Education

### Undergraduate National Goals and Metrics/Program, Project and Intervention Metrics

Goal 1. STEM Workforce: Increase the number of undergraduates who enroll in and complete STEM degree programs, and are thus prepared to enter STEM or STEM-related careers or advanced education.

	<b>Metric</b>	<b>Source and Supplemental Information</b>
1	The number and/or percentage of students who declare and complete a STEM major or program of study (this includes students who transfer from 2-year colleges and go on to complete 4- year STEM degrees, even if they transferred prior to completing an associate's degree)	Institutions of higher education or IPEDS can provide the basic information on number of STEM graduates. – Persistence from freshman year (% of STEM-oriented freshman getting B.S. degrees in STEM 5 or 6 years later); Data on freshman plans available from the Higher Education Research Institute (HERI) covering a large similar data are available from ACT and SAT – National Center for Education Statistics – Unit Record System
2	The number and/or percentage of STEM graduates who stay in STEM by attending a STEM or STEM-related graduate program	Department of Education & NSF/SRS recent graduates surveys (available biennially) provide aggregated data on total number of students who are enrolled in graduate programs. – Unit Record System
3	The number and/or percentage of STEM graduates who take a job in a STEM or STEM-related field	Department of Education & NSF/SRS recent graduates surveys (available biennially); however, new definitions are required for STEM-related fields.
4	Employer satisfaction with student preparation and readiness to enter the STEM job market	American Customer Satisfaction Survey
5	Where appropriate, student achievement on national STEM exams, standardized tests within disciplines, and licensure exams	Professional societies – Testing services organizations

Program Goal 1. STEM Workforce: Increase the number of undergraduates who enroll in and complete STEM degree programs, and are thus prepared to enter STEM or STEM-related careers or advanced education.

	<b>Metric</b>	<b>Source and Supplemental Information</b>
1	The number and/or percentage of students who declare and complete a STEM major or program of study (which includes students who transfer from 2-year colleges and complete 4-year STEM degrees even if they transfer prior to completing the 2-year degree first)	Institutions of higher education of IPEDS can provide the basic information on number of STEM graduates. – Persistence from freshman year (% of STEM-oriented freshman getting B.S. degrees in STEM 5 or 6 years later); Data on freshman plans available from the High Education Research Institute (HERI) covering a large sample of institutions (“American Freshman: National Norm”); similar data available from ACT and SAT – National Center for Education Statistics – Unit Record System
2	The number and/or percentage of STEM graduates who stay in STEM by attending a STEM or STEM-related graduate program	Department of Education & NSF/SRS recent graduates surveys (available biennially) provide aggregated data on total number of students who are enrolled in graduate programs. – Unit Record System
3	The number and/or percentage of STEM graduates who take a job in a STEM or STEM-related field	Department of Education & NSF/SRS recent graduates surveys (available biennially); however, new definitions are required for STEM-related fields.
4	The number/percentage of students who are not STEM majors, but who successfully complete STEM courses	
5	Where appropriate, students scores on relevant licensure, national disciplinary exams, graduate/professional entrance exams and the like	Professional societies – Testing services organizations
6	Employer satisfaction with students preparation and readiness to enter the STEM job market	American Customer Satisfaction Survey

Goal 2. Collaborative Communities: Encourage and support STEM professional collaborations, networks, communities and alliances among educators, students, practitioners, government, professional organizations and industry.

	<b>Metric</b>	<b>Source and Supplemental Information</b>
1	The number and/or percentage of student who participate in scientific activities or research experience in industry, government or the non-profit sector	Project reports
2	The number and/or percentage of students who present research findings at scientific meetings or student science exchanges events	Project reports
3	The number of students who participate in interdisciplinary research or educational experiences	Project reports
4	The number of students who earn minors in a second STEM field	Project reports
5	The number of STEM courses successfully completed by non-STEM majors	Project reports

Goal 3. Institutional Capacity: Support advancement and development of STEM personnel, programs, and infrastructure in institutions that educate.

	<b>Metric</b>	<b>Source and Supplemental Information</b>
1	The number of students who engage in research experiences in an academic, industry, government, or nonprofit laboratory	Program and project date
2	Number of courses that integrate the use of instruments, methods, and procedures that are commonly used in an academic, industry, or government	Program and project reports

Note: An overarching goal of all STEM undergraduate programs is to increase the diversity of STEM majors and workers. Data should be collected in such a way that it can be disaggregated by gender and ethnicity.

## Graduate and Postgraduate Education

### Graduate and Postgraduate National Goals and Metrics

	<b>Metric</b>	<b>Source / Supplemental Information</b>
1	The number and/or percentage of graduate/postdoctoral fellowship or traineeship recipients who complete a STEM graduate or postdoctoral program; the number and/or percentage of program completers who are employed in a STEM or STEM-related field	Survey of Earned Doctorates – Survey of Doctorate Recipients
2	Average time to degree completion for STEM doctoral students.	Survey of Earned Doctorates – Survey of Doctorate Recipients
3	Average age at which graduate and/or post-doctoral fellows established an independent scientific career.	Source not yet known
4	Contributions to the research enterprise	Metrics to be developed

### Graduate and Postgraduate Program Metrics

	<b>Metric</b>	<b>Source / Supplemental Information</b>
1	The number and/or percentage of graduate/postdoctoral fellowship or traineeship recipients who complete a STEM graduate or postdoctoral program; the number and/or percentage of program completers who are employed in a STEM or STEM-related field	Survey of Earned Doctorates – Survey of Doctorate Recipients
2	Average time to degree completion for STEM doctoral students.	Survey of Earned Doctorates – Survey of Doctorate Recipients
3	Career induction and retention in academia (independent funding, tenure), industry, government and in STEM or STEM-related fields.	Survey of Earned Doctorates – Survey of Doctorate Recipients – Professional society data
4	Career satisfaction – actual career pathway versus desired pathway.	Survey of Earned Doctorates – Professional society data
5	Research quality and productivity.	Metrics to be developed

\*\* Metrics to evaluate the research quality and contributions of graduate and post-doctoral programs have not been developed as part of this effort. The ACC recommends a follow-up effort to examine the state of graduate and post-doctoral education at large and to develop appropriate metrics to evaluate the quality of research and professional productivity of graduate students and post-doctoral fellows

Note: An overarching goal of all STEM undergraduate programs is to increase the diversity of STEM majors and workers. Data should be collected in such a way that it can be disaggregated by gender and ethnicity.

## **Informal Education and Outreach**

### **Informal Education and Outreach – National and Program Metrics**

**Goal 1. Public Audiences:** Increase awareness, interest, engagement, and understanding of STEM concepts, processes, and careers by the general public and other targeted populations in the context of informal education and outreach.

<b>Metric</b>	<b>Type</b>	<b>Source / Supplemental Information</b>
Awareness, knowledge, or understanding of STEM concepts, processes, or careers via informal STEM education and outreach deliverables	number, percent; trend; gain	Project: in target audience Program: across portfolio National: public survey data
Engagement or interest in STEM concepts, processes, or careers via informal STEM education and outreach deliverable	number, percent; trend; gain	Project: in target audience Program: across portfolio National: public survey data; ASTC, Nielson, Arbitron, web site data
Attitude towards STEM-related topic or capabilities via informal STEM education and outreach deliverable	number, percent; trend; gain	Project: in target audience National: public survey data
Behavior in target audience resulting from engagement with informal STEM education and outreach deliverable	number, percent; trend; gain	Project: in target audience
New skills in target audience based on engagement with informal STEM education and outreach deliverable	number, percent; trend; gain	Project: in target audience

**Goal 2. Professional Audiences.** Improve practice and build professional and institutional capacity through efforts that seek to generate, develop, and apply effective ideas and models for the informal STEM education field.

<b>Metric</b>	<b>Type</b>	<b>Source / Supplemental Information</b>
Awareness, knowledge, or understanding of informal STEM education/outreach research or practice.	number, percent; trend; gain	Project: in target audience Program: in informal STEM education and outreach field
Engagement or interest in advancing the informal STEM education/outreach research or practice.	number, percent; trend; gain	Project: in target audience Program: in informal STEM education and outreach field
Attitude towards informal STEM education/outreach research or practice.	number, percent; trend; gain	Project: in target audience Program: in informal STEM education and outreach field
Behavior in target audience relating to informal STEM education/outreach research or practice.	number, percent; trend; gain	Project: in target audience Program: in informal STEM education and outreach field
New skills in target audience based on engagement with informal STEM education/outreach research or practice.	number, percent; trend; gain	Project: in target audience Program: in informal STEM education and outreach field