Community for Advancing Discovery Research in Education

Discovery Research K-12 (DR K-12):

Descriptive Overview of Portfolio

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Introduction and Approach

The National Science Foundation (NSF) Division of Research on Learning in Formal and Informal Settings (DRL) supports complementary programs aimed at improving science, technology, engineering, and mathematics (STEM) learning at all stages. Within DRL, the Discovery Research K-12 (DR K-12) program supports high-quality research and development on STEM learning and teaching from kindergarten through high school.[1] Together, the diverse projects supported by DR K-12 span what NSF has characterized as the *Cycle of Research and Development.*[2] The cycle represents a dynamic process through which knowledge and products are conceived, developed, disseminated and revised in an on-going developmental progression. DR K-12 projects address all aspects of the cycle by: synthesizing existing research, theory, and practice; hypothesizing about or clarifying important ideas, issues, phenomenon, and goals; designing new teaching and learning materials; implementing and studying educational STEM interventions; and evaluating their effectiveness. Collectively, DR K-12 projects advance the development of STEM learning and teaching.

This process is supported by the *Community for Advancing Discovery Research in Education* (CADRE) network, funded under a cooperative agreement, to support the diverse DR K-12 community and further the goals of the DR K-12 program. Part of CADRE's mission includes articulating where the field and various individual projects are on the *Cycle of Research and Development*, supporting the development of research in STEM education, and characterizing the landscape of the DR K-12 portfolio.

The specific objectives of creating a portfolio landscape are:
1. Describing important characteristics of the projects in the DR K-12 portfolio;
2. Explaining how grantees are working towards meeting the goals of the program;
3. Identifying potential areas in which syntheses and targeted thematic studies can be conducted to deepen, broaden, or advance the fields' understanding of specific aspects of STEM education;
4. Informing the support activities developed for grantees.

In sum, the main goal of the portfolio overview is to provide a descriptive summary of the growing DR K-12 portfolio to help NSF better understand the scope and depth of research and development currently funded on STEM resources, models, and technologies and to highlight areas that would be advanced by conducting more targeted summaries and syntheses of project information.

In order to address these goals, a team of CADRE reviewers initially collected materials from projects in the first two cohorts of the DR K-12 portfolio. Team members developed a schema for systematically coding specific pieces of information across projects. The results of the review were summarized in a report in 2009 that provided an overall portrait of the DR K-12 portfolio that included a description of the types of projects funded and the areas of research undertaken (e.g., on resources, models, or technologies). It also presented information on the characteristics of projects including their distributions across geographic areas, grade levels, subject areas, project contributors, proposed collaborators, populations targeted, research designs, and dissemination plans.

Subsequent to that report, a third cohort of projects was added to the portfolio, additional materials were solicited from all DR K-12 projects, and the review protocol was revised to take into account the evolving

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[1] Other programs in DRL's current portfolio include the Research and Evaluation on Education in Science and Engineering (REESE), Informal Science Education (ISE), and Information Technology Experiences for Students and Teachers (ITEST) programs.

[2] NSF DR K-12 Solicitation, NSF09602.

information, foci, and questions associated with the portfolio. The current report provides an updated overview of the DR K-12 portfolio as of August 2010.[3]

Approach to portfolio review

Project dataset

The DR K-12 portfolio of 205 awards was determined through NSF nomination as well as the inclusion of all projects that received funding during one of the three DR K-12 award cycles prior to fall 2010.[4] Eleven of these awards were linked to other awards funded for the same, shared project. For each set of linked awards, only one project was retained in the analysis database in order to avoid inflating counts of project characteristics. In other words, each project funded with multiple awards was treated as a single project in this analysis, and the principal investigator identified in the proposal, or that had the largest award, was recorded as the project principal investigator (with the principal investigators of the linked awards being identified for the purposes of this analysis as co-principal investigators). The award supporting CADRE was also removed from the analytic database. In all, 193 projects were eligible for inclusion in the portfolio overview.

CADRE operates under a cooperative agreement with the NSF and does not have access to the data and materials maintained at NSF. Sources of data for the portfolio analysis were limited to publicly available documents and information, and materials provided to CADRE by individual awardees. Each project's principal investigator was contacted and asked to provide CADRE with a copy of their project's proposal, annual reports, any project publications, and any other information that would provide information about the plans, activities, and achievements of the DR K-12 project. Principal investigators have been periodically asked to update the materials they provided originally with any new information.

In order to be included in the review, each project was required to have at minimum a project abstract and proposal. Projects that did not meet this minimum standard were set aside from the analysis because reviewers did not have enough information to reliably code the project information. Of the 193 eligible projects in the portfolio, sixteen could not be included in the analysis because their principal investigators did not provide sufficient materials for review (8.3 percent). In all, 177 projects were included in the portfolio review (representing 188 awards in total when the linked awards are counted as well).

Project materials

All of the materials used in project reviews were obtained from principal investigators or project staff. The volume of information as well as the amount of detail provided in them varied extensively across projects. All 177 projects included in the analysis, however, had at minimum the initial project proposal narrative and an abstract. Many projects also provided their responses to questions raised in the proposal process so that reviewers could take into account adjustments made to project plans during the review process. In addition, some projects made other materials associated with their work available including annual reports, drafts of papers and presentations (published or in press), working papers and other documents.

It is important to keep in mind that the materials reviewed for this analysis were developed for purposes other than this review. As a result, the information required for coding was reported in diverse and

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[3] The fourth cohort funded in 2010 is not included in this summary report.

[4] NSF DR K-12 Solicitations: nsf06593, nsf08502, and nsf08609.

unsystematic ways across projects. This limited the level of detail that could reliably be extracted and coded in the analysis. Details concerning research designs and methods were especially limited by this issue because many of the project proposals that CADRE reviewed provided more detail about the resources, models, and technologies being developed and/or studied then on the research being conducted. In addition, most of the materials included in the review reflected projects' plans or the early stages of their implementation. Consequently, the review was limited for the most part to projects' plans and goals rather than their accomplishments or their operationalized development and research designs and activities.

Analytic approach

A team of seven reviewers was trained and had supervised practice coding projects based on a set of detailed coding definitions and instructions. The team leader co-coded at least two projects with each of the reviewers to ensure that each was following a systematic approach and was applying the instructions and definitions in the same way.

The review protocol captures information about project attributes and project characteristics as well as the DR K-12 program goals being addressed. Project *attributes* include general project features such as cohort and placement on the cycle of research and development. Codes for these attributes are mutually exclusive and were derived from descriptions and definitions in the solicitations.

Project *characteristics* are specific features of projects such as substantive discipline (e.g., science and math), subject area within discipline (as appropriate), grade level (e.g., elementary, middle, or high school), and population (e.g., students, in-service or pre-service teachers, administrators). Project characteristics also include elements of projects' research plans and activities. These types of characteristics are not mutually exclusive and projects received multiple codes when appropriate.

Codes from individual projects were aggregated to provide the portfolio overview presented in this report. The data were analyzed to provide a comprehensive picture of the landscape, guided by research questions that describe the types of projects and investigators funded and questions that characterize the research and development activities of the projects.

- What are the sizes of the projects DR K-12 is funding?
- Who is being funded?
- What types of projects is DR K-12 funding?
- Where is the program focusing its investment?
- What research is being conducted?
- Are projects evaluating their work?
- How do projects plan to disseminate their work?

The following section provides an overview of the portfolio that answers these research questions. This is followed by section that presents the distribution of projects across areas of interest to the DR K-12 program, broken out by grades, discipline, and type of resource, model and/or technology of the project. Short summaries of the individual projects are contained in Appendix A.

Overview of Portfolio

Size of the projects

Three cohorts of projects had been funded in the DR K-12 program at the time of this analysis; Cohort 1 included 75 projects (42.4% of the projects in the portfolio), cohorts 2 and 3 each included 51 projects (28.8% each).

Size of awards

The 166 projects that had information on the length and the amount of the grant awards lasted for an average of 41 months, ranging from a few months (for planning and producing conferences) to 5 years (Exhibit 1). The total intended funding amounts for these projects ranges from $12,000 to almost five million dollars, with a median of $1,499,991.[5]

Exhibit 1: Duration and Current Funding Levels of DR-K12 Projects

	Duration (months)	Intended Funding ($)
N	166	167
Mean	41.1	$1,617,362
Standard deviation	15.9	$1,345,593
Median	36.0	$1,499,991
Minimum	4.0	$12,000
Maximum	60.0	$4,997,156

Investigators

Principal investigators' experience

The DR K-12 portfolio funds principal investigators who have received awards from NSF prior to receiving their current DR K-12 as well as those who have not. In the current portfolio, 128 projects (72.3 percent) are led by principal investigators who have received NSF funds in the past, 29 projects are led by those who have not (16.4 percent), and 20 projects had insufficient information to make a determination (11.3%). When all of the principal and co- principal investigators in each project are considered, however, 138 of the projects had at least one key investigator who has received NSF funding in the past (78.0 percent), 20 did not (11.3 percent) and 19 projects had insufficient information to determine (10.7 percent).

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[5] Additional DR K-12 funds have been distributed to projects that are primarily funded in other NSF programs and not included in this portfolio analysis.

Geographical distribution

The institutional locations of DR K-12 principal and co- principal investigators are distributed across the country in 33 states and the District of Columbia. Exhibit 2 presents the number of projects located in each state. In the exhibit if either a principal or co- principal investigator reported their institutional address as being in a state then the project was counted as being in the state. Note, however, that 38 of the projects were missing this information and are not included in the table. The number of states represented in a single project ranges from one to three states.

The states hosting the largest number of projects are California and Massachusetts (22 and 29 projects, respectively), New York (15 projects). Eleven of DR K-12 principal and co- principal investigators are located in *Experimental Program to Stimulate Competitive Research* (EPSCoR) states,[6] which represents 33.3 percent of the states with funding.

Exhibit 2: Geographical Distribution of Project Principal and Co-Principal Investigators (n= 139)

Investigators per State	
More than 20	California, Massachusetts
11 to 20	New York
6 to 10	Colorado, Maryland, Michigan, North Carolina, New Jersey, Pennsylvania
5 or fewer	Alaska, Alabama, Arizona, Connecticut, District of Columbia, Georgia, Hawaii, Iowa Illinois, Indiana, Kansas, Maine, Missouri, Montana, Nebraska, New Mexico, Ohio, Oregon, Tennessee, Texas, Utah, Virginia, Washington, Wisconsin,

Notes: 38 projects were missing information on the location of the principal investigators.

Exhibit reads: California and Massachusetts each had more than 20 projects located in their state when all of the principal investigators (and co-principal investigators) that are not missing this information are taken into account.

Populations targeted

Grade levels

Most of the projects in the DR K-12 portfolio focus on students and teachers in elementary, middle, and high school (39.0, 54.8, and 44.1 percent respectively), and a third of them include multiple grade bands (Exhibit 3). Only 2.8 percent of the projects work with pre-kindergarten students or teachers, while 4.0 percent of them target other grade levels such as doctoral students in scholar programs, and early college levels.

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[6] Twenty-five states, Puerto Rico, and the Virgin Islands are designated as Experimental Program to Stimulate Competitive Research (EPSCoR) states.

Exhibit 3: Grade Levels in Projects (n = 177 projects)

	n	%
Pre-K	5	2.8%
Elementary school	69	39.0%
Middle school	97	54.8%
High School	78	44.1%
Other	7	4.0%

Disciplines

Of the 177 projects in the portfolio, 42.4 percent are in science fields, 34.5 percent are in mathematics, 2.8 percent deal with engineering, and 0.6 percent cover computer and information science (Exhibit 4). Another 17.5 percent of the projects involve two or more of these disciplines.

Exhibit 4: Major Disciplines Addressed in Portfolio

	Percentage of Projects in….			
Number of Projects	**All Grades** 177	**Elementary** 69	**Middle** 97	**High** 78
Mathematics	34.5%	40.6%	33.0%	32.1%
Science	42.4%	31.9%	43.3%	43.6%
Multi-discipline	17.5%	21.7%	18.6%	16.7%
Engineering	2.8%	2.9%	2.1%	5.1%
Computer and information science	0.6%	1.4%	1.0%	1.3%
Other discipline	2.3%	1.4%	2.1%	1.3%

Exhibit reads: 34.5 percent of the 177 projects in the portfolio address topics in the field of mathematics. Considering each grade band separately, 40.6 percent of the 69 elementary school projects, 33.0 percent of the 97 middle school projects, and 32.1 percent of the high school projects address mathematics topics.

A large majority of the projects addressing multiple disciplines include science as well as another discipline (87.1 percent). Almost half of the 32 multi-discipline projects include both science and mathematics (45.2 percent) and a slightly more than a quarter of the projects include mathematics (12.9 percent) or science (12.9 percent) and a discipline in the "other" category (Exhibit 5). The "other" category includes all substantive areas that were not covered by the major disciplines described above (such as general STEM or technology concerns with no discipline focus, language, and music).

Exhibit 5: Projects that Address More than One Discipline by Grade

	Percentage of Projects in….			
Number of Projects	All Grades N = 31	Elementary N = 15	Middle N = 18	High N = 13
Mathematics and…				
Science	45.2%	60.0%	50.0%	53.8%
Other	12.9%	13.3%	16.7%	7.7%
Science, computer, information sciences	3.2%	6.7%	0.0%	0.0%
Science, engineering	9.7%	0.0%	11.1%	15.4%
Science, engineering, other	3.2%	0.0%	5.6%	0.0%
Science and…				
Mathematics	45.2%	60.0%	50.0%	53.8%
Other	12.9%	13.3%	5.6%	30.8%
Social sciences	3.2%	0.0%	5.6%	0.0%
Engineering	6.5%	6.7%	0.0%	7.7%
Engineering, computer, information sciences	3.2%	0.0%	5.6%	0.0%

Exhibit reads: 45.2 percent of the 31 multi-disciplinary projects in the portfolio cover topics in both mathematics and science. Considering each grade band separately, 60.0 percent of the 15 elementary school multi-disciplinary projects address mathematics and science, 50.0 percent of the 18 middle school multi-disciplinary projects, and 53.8 percent of the 13 high school multi-disciplinary projects address mathematics and science.

Mathematics disciplines

Eighty-four of the projects (47.5 percent) include a focus on mathematics (including those that addressed other disciplines as well as mathematics). The specific topics addressed varied by grade (Exhibit 6). Many of the projects, however, targeted multiple grade bands.

Elementary school projects include a focus on a range of topic areas including rational numbers, proportional reasoning, whole number arithmetic, early algebra, fractions and decimals, measurement, geometry, problem solving, and word problems, puzzles (Exhibit 6). In addition, 14.5 percent of the projects focused on multiple math topics and the specific mathematics topics being covered could not be determined in 23.2 percent of projects (either because they were dealing with mathematics in general or the information provided did not specify the mathematics topic areas). The two specific topic areas that were the most common are whole number arithmetic (11.6 percent) and rational numbers and proportional reasoning (10.1 percent).

Projects involving the middle school grades also include a wide range of topic areas and a similar percentage of projects. The most common topics among these projects are rational numbers and proportional reasoning (12.4 percent) and geometry (10.3 percent).

The projects that involve high school grades address fewer topics than those targeting middle and elementary schools. These projects more commonly address early or intermediate algebra (14.1 percent) or geometry (10.3 percent).

Exhibit 6: Mathematics Topics Covered in Projects by Grade

Number of Projects	All Grades N = 177	Percentage of Projects in…. Elementary N = 69	Middle N = 97	High N = 78
Mathematics (all)	**47.5%**	**58.0%**	**48.5%**	**44.9%**
General	11.9%	23.2%	10.3%	9.0%
Multiple mathematics topics	14.7%	14.5%	14.4%	15.4%
Measurement	5.1%	7.3%	5.2%	0.0%
Problem solving, word problems, puzzles	3.4%	2.9%	2.1%	2.6%
Whole number arithmetic	5.7%	11.6%	8.3%	1.3%
Fractions and decimals	5.1%	8.7%	9.3%	0.0%
Early algebra (elementary school)	3.4%	8.7%	4.1%	1.3%
Rational numbers, proportional reasoning	7.3%	10.1%	12.4%	0.0%
Geometry	10.2%	5.8%	10.3%	10.3%
Pre-calculus	0.0%	0.0%	0.0%	0.0%
Statistics	1.1%	0.0%	1.0%	2.6%
Calculus	0.0%	0.0%	0.0%	0.0%
Elementary and intermediate algebra	9.0%	2.9%	7.2%	14.1%
Higher algebra	2.8%	0.0%	0.0%	6.4%
Other mathematics topics	3.4%	1.5%	3.1%	5.1%

Exhibit reads: 47.5 percent of the 177 projects in the portfolio are in mathematics. Considering each grade band separately, 58.0 percent of the 69 elementary school projects, 48.5 percent of the 97 middle school projects, and 44.9 percent of the 78 high school projects address mathematics.

Science disciplines

Of the 74 projects (57.1 percent) that include a focus on science (including those that address other disciplines as well), 19.2 percent emphasize biology, 11.9 percent geosciences (including environmental sciences), 10.2 percent physical science, 7.3 percent physics, 6.8 percent chemistry, 4.0 percent astronomy, and 5.1 percent address another science topics (e.g., science literacy or education in general, or the nature of science itself). The specific science topic area of 8.5 percent of the projects could not be determined based on the information provided. In another 17.5 percent of the science projects, multiple topic areas are covered (Exhibit 7).

Number of Projects	All Grades N = 177	Percentage of Projects in….		
		Elementary N = 69	Middle N = 97	High N = 78
Science (all)	57.1%	50.7%	57.7%	59.0%
General	8.5%	14.5%	6.2%	3.9%
Multiple science topics	17.5%	11.6%	17.5%	20.5%
Biology	19.2%	11.6%	18.6%	24.4%
Geosciences	11.9%	8.7%	16.5%	15.4%
Physical Science	10.2%	11.6%	10.3%	3.9%
Physics	7.3%	1.5%	6.2%	10.3%
Chemistry	6.8%	1.5%	5.2%	12.8%
Astronomy	4.0%	4.4%	4.1%	5.1%
Other science topics	5.1%	4.4%	3.1%	3.9%

Exhibit reads: 57.1 percent of the 177 projects in the portfolio are in science. Considering each grade band separately, 50.7 percent of the 69 elementary school projects, 57.7 percent of the 97 middle school projects, and 59.0 percent of the 78 high school projects address mathematics.

The science topics covered in most elementary school projects involve general science (14.5 percent), biology or physical science (11.6 percent each); or else cover multiple science topics (11.6 percent). Less than five percent of the elementary school projects cover any other specific science topic area (Exhibit 7). Middle school projects followed a similar pattern with the exception that there were more geosciences projects (16.5 percent) than physical sciences ones (10.3%) and more projects in physics (6.2 percent) and chemistry (5.2 percent).

High school projects infrequently address general science (3.8 percent) and more often cover biology (24.4 percent), geosciences (15.4 percent), chemistry (12.8 percent) and physics (10.3 percent). More high school projects also combine science topics than projects in the lower grades (20.5 percent).

Special groups

The projects in the portfolio are studying and/or developing resources, models, and technologies for use by diverse consumers in a variety of settings, but the bulk of them target students and teachers in kindergarten through eighth grade in classrooms[7] (71.2 and 80.2 percent of projects, respectively). In addition to students and teachers, 4.0 percent of the projects include K-12 school administrators in their focus (Exhibit 8).

Of the 142 projects that include a focus on teachers, pre-service or alternative certification teachers are involved in 8.5 percent. In addition, a small number of projects highlight subgroups of teachers who work with special populations of students including: students in special education (2.3 percent), English Language Learners (ELLs, 8.5 percent), and students in low performing schools or districts (2.8 percent). Nine of the projects (5.1 percent) have an emphasis on teachers who work with other special populations such as those from low income families or areas, urban and rural schools, and students from minority groups.

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[7] Projects that specified age ranges rather than particular grade levels were classified as follows: Pre-K (ages 3-4); Kindergarten to 5th grade (ages 5-10); 6th to 8th grade (ages 11-13); 9th to 12th grade (ages 14-18).

Of the 126 projects that focus on students in K-12 schools, 8.5 percent target ELLs, 2.8% highlight students in low performing schools or districts, and 1.1 percent emphasizes students receiving special education. In addition, 7.3 percent of the programs target students in other subgroups such as those highlighted as teacher foci.

A smaller group of the DR K-12 projects include a focus on education outside of K-12 school settings. A few (4.5 percent) of the projects target doctoral students in programs designed to develop scholars and researchers in particular substantive areas and 6.2 percent of the projects focus on higher educational faculty. Finally, 10.7 percent of the projects target a variety of other types of educational groups including parents and families, discipline coaches (e.g., math coaches), curriculum developers, and researchers, and policy makers.

Exhibit 8: Populations Targeted by Projects (n = 177 projects)

	n	%
Teachers	**142**	**80.2%**
Pre-service and alternative certification	15	8.5%
Of targeted subgroups of students:		
Special education	4	2.3%
English language learners	15	8.5%
Low performing schools or districts	5	2.8%
Other	9	5.1%
Students	**126**	**71.2%**
Special education	2	1.1%
English language learners	15	8.5%
Low performing schools or districts	5	2.8%
Other	13	7.3%
School administrators	7	4.0%
Doctoral students in scholars' programs	8	4.5%
Higher education faculty	11	6.2%
Other	19	10.7%

Research and development

Placement in cycle

The *Cycle of Research and Development (formerly known as the Cycle of Innovation and Learning)* was introduced in the DR K-12 program in the FY2008 program solicitation[8] and revised in the FY2010 program solicitation.[9] The cycle posits a dynamic process through which knowledge and products are conceived, developed, disseminated, and revised in an on-going developmental progression. The components of the cycle are:

- **Design**, develop, test, validate, and refine materials, measurement tools, and methods, in specific contexts;

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[8] NSF DR K-12 Solicitation, NSF08502.

[9] NSF DR K-12 Solicitation, NSF09602.

- **Implement** innovations; study why interventions have the impacts they have, with particular groups;

- **Evaluate** effectiveness; study complex phenomena, generalize;

- **Synthesize** lines of work; identify new insights and questions to inform new research and development; set research and development agendas; and

- **Hypothesize**, study and clarify phenomena of interest; frame issues; operationalize goals and constructs; develop and propose theory; conduct basic research on learning.

While all projects are expected to address multiple aspects of the cycle, most emphasize one or two components of the cycle over others. The aggregate representation of the DR K-12 projects across the stages provides a sense of DR K-12 program's contribution to advancing the STEM education field overall. For this purpose, each project was classified according to the stage in the *Cycle of Research and Development* that it most emphasizes or that best characterizes their work (presented in Exhibit 9).

Overall, the DR K-12 portfolio is heavily weighted toward developing, refining, testing, and validating materials, measurement tools, and methods for STEM education. More than half of the projects in the portfolio are developing, designing, and testing educational resources, models, technologies, or other educational-related tools (61.6 percent). Another 12.4 percent of the projects are conducting research that hypothesizes about or clarifies issues or are conducting basic research on learning. The focus of 11.3 percent of the projects is on synthesizing previous research and theory in order to indentify new directions for the field. Less than 10 percent of the projects focus primarily on studying the implementation of interventions, programs, or resources (7.9 percent) or on evaluating the effectiveness of the interventions, programs, or resources, or engaging in large scale research from which they plan to general to large segments of the educational community (6.8 percent). In 10.2 percent of the projects, the stage could not be determined from the information available.

Exhibit 9: Projects' Placement on the Cycle of Research and Development

	n	%
Design, develop and test	109	61.6%
Implement, study efficacy, and improve	14	7.9%
Scale up and study effectiveness	12	6.8%
Synthesize and theorize	20	11.3%
Explore, hypothesize and clarify	22	12.4%

It is also informative to examine how projects are distributed throughout the cycle within major STEM disciplines (Exhibit 10). Most of the science projects (75.7 percent) are in the "design, develop, and test" stage of the cycle, while about half of the math projects (50.8 percent) and 62.5 percent of the multi-discipline projects are. Almost a fifth of the math and multi-discipline projects (18.0 and 18.8 percent, respectively) emphasize earlier stages of the cycle ("explore, hypothesize, and clarify" and "synthesize and theorize", respectively). An additional 13.1 percent of math projects—the largest proportion across disciplines—primarily test the efficacy and impact of resources, models, or technologies that have been implemented on a large scale.

Exhibit 10: Percentage of projects in major disciplines developing or researching resources, models, and technologies

	Math	Science	Multi-discipline
Number of projects per discipline	*61*	*74*	*32*
Percentage of Projects in each discipline:			
Design, develop and test	50.8%	75.7%	62.5%
Implement, study efficacy, and	9.8%	6.8%	9.4%
Scale up and study effectiveness	13.1%	4.1%	0.0%
Synthesize and theorize	8.2%	5.4%	18.8%
Explore, hypothesize and clarify	18.0%	8.1%	9.4%

Resources, models and technology

Projects in the DR K-12 portfolio were also classified according to whether they were developing, revising, or studying new or existing educational resources, models, or technologies (or a combination of these). For the purposes of this analysis **resources** were considered to be instructional or instructionally-related materials used directly in instruction, learning, or teachers' professional development. Projects that are studying or developing resources are those focusing on the materials or activities used most directly in teaching and learning or professional development.

Projects are classified as focusing on **technology** if they are developing or studying technologies through which teaching and/or learning occurs. Most projects use some form of technology (i.e., computers). Consequently, projects were identified by reviewers as focusing on technology only if they used it in ways that directly shaped or influenced teaching and learning experiences (e.g., the use of contingent computer-based assessments, the creation of a virtual environment in which a topic can be explored and learned, or the development of an online space or support for virtual professional networking). Projects that used technology as a simple vehicle for communicating ideas and materials (e.g., online dictionaries, news sources, or worksheets available as PDF documents online) were not classified as technology projects.

Finally, **models** were defined as having a more indirect or distal influence on learning and instruction than resources or technologies. Projects that focused on models were developing or researching materials that provided support or guidance for teaching and educational materials and curriculum such as instructional guidelines, curriculum frameworks, topic area standards, or theoretical frameworks.

Most of the projects in the DR K-12 portfolio (86.4 percent) are developing, revising, or studying an educational resource that can be used directly in teaching, learning, or professional development (see Exhibit 11). Almost a third of these are technological resources (32.8 percent), 14.7 percent concern both resources and models, and 6.2 percent of the projects incorporate work in all three areas. Almost a third of the projects focus exclusively on educational resources that do not rely on technology (32.8 percent).

A little less than half of the projects (42.4 percent) are developing or studying a technology that is used to mediate teaching, learning, or professional development. As mentioned earlier, most of these are educational resources. Only 2.8 percent of the projects are focusing exclusively on technology and only one of the projects was classified as including both a model and a technology.

Projects working with models are in the minority. Not quite a third of the projects (31.6 percent) are developing models to be used to guide educational activities, curriculum, policies, or frameworks. Almost ten percent of these have an exclusive focus on models; the rest, however, are combining a focus on models with work on technologies and resources.

Exhibit 11: Proportion of Projects Developing or Studying Resources, Models, and Technologies (n=177 Projects)

	n	%
All Resources	**153**	86.4%
Resources Alone	58	32.8%
Resource and Technology	58	32.8%
Resource and Model	26	14.7%
Resource, Model, and Technology	11	6.2%
All Technologies	**75**	42.4%
Technology Alone	5	2.8%
Resource and Technology	58	32.8%
Model and Technology	1	0.6%
Resource, Model, and Technology	11	6.2%
All Models	**56**	31.6%
Model Alone	18	10.2%
Resource and Model	26	14.7%
Model and Technology	1	0.6%
Resource, Model, and Technology	11	6.2%

Type of resource

The types of resources being developed, revised, and studied vary across DR K-12 projects. More than half of the projects working with resources (68.0 percent) are developing or studying professional development materials and activities or professional networks (Exhibit 12). Note, however, that this figure includes all projects that address professional development as one segment of a larger plan in which the primary goal is to develop or research a curriculum for students. Most of the projects that work with curriculum resources directed at students also need to train teachers to use the curriculum as well. Conversely, many projects that have a focus on professional development also study students and teacher-student interaction. Consequently, it is difficult to isolate teacher professional development from all other resource-related activities.

Only 20.9 percent of resource projects are focusing on professional development alone (i.e., with no student assessments, curriculum, learning materials or technologies being developed or studied as well). More than half of the resource projects (63.4 percent) are studying or developing student curriculum or learning materials. Almost a third of the projects are studying or developing assessments (32.0 percent).

Exhibit 12: Specific Types of Resources being Developed, Revised, or Studied in Projects with a Resource Focus (n = 153 Projects)

	%
Professional development activities, materials, or networks	68.0%
Curriculum units or short courses	35.3%
Materials used by students in learning activities	28.1%
Assessment instruments	32.0%
Other	3.3%

Exhibit reads: Of the 153 projects developing, revising, or studying resources, 68.0 percent are working with professional development activities, materials, or networks for teachers.

Type of model

Across the 56 projects that are studying or developing models, the most common types of models are learning progressions (Exhibit 13). Projects working on these study and articulate the sequence traversed when learning a topic or a set concepts. Many of these projects are ultimately planning to develop student assessments and they initially study an associated learning progression in order to guide their development of the scope and sequence of topics to cover in the assessment. These types of projects represent 28.6 percent of the projects with models.

These are followed by models of educational practices (26.8 percent). These projects are producing or studying examples of promising practices that can be used by teachers, programs, and others to guide their own practice. The remaining models in projects include curriculum or professional development frameworks (12.5 and 17.9 percent respectively) and educational standards (8.9 percent). Finally, a quarter of the projects included diverse models that fell outside these categories. These projects focus on a diverse array of models such as theoretical frameworks, recommendations or guidelines for educational practices, and educational policy documents.

Exhibit 13: Types of Models being Developed, Revised, or Studied in Projects with a Model Focus (n = 56 Projects)

	%
Learning progression	28.6%
Model of ideal educational practice	26.8%
Theoretical framework	20.0%
Teacher professional development curriculum frameworks	17.9%
Curriculum frameworks	12.5%
Standards	8.9%
Guidelines	4.4%

Exhibit reads: Of the 56 projects developing, revising, or studying models, 28.6 percent are working with learning progressions.

Type of technology

More than three quarters of the 75 projects that include a technology component (82.7 percent) are developing or studying an interactive resource[10] or a virtual or cyber learning experience (Exhibit 14). These include projects focusing on learning through interacting with a virtual environment, online laboratory, cyber game, or other interactive online experiences. They also include those working with resources that are not as interactive as cyber games, but that allow users to interact on some level (such as interactive databases and online journals and other information sources).

More than a third of the projects (36.0 percent) are developing or studying online networking tools that allow students to communicate with each other or with STEM experts, or that support collaboration between teachers or the development of professional learning communities. Twenty-eight percent of the technology projects involve developing or researching student assessments, and eight percent are using software for personal computers that are not involved with cyber earning or virtual environments. Twelve percent of projects incorporate technologies that do not fall under the other categories. These include the use of diverse technologies such as using robotic platforms for learning, research on the use of laptops, specialized scientific equipment, or wireless devices in schools.

Exhibit 14: Specific Types of Technologies being Developed, Revised, or Studied in Projects with a Technology Focus (n = 75 Projects)

	%
Cyberlearning (On-line gaming, interactive learning, or virtual environment)	40.0%
Interactive resource (cohorts 1 & 2 only)	42.7%
On-line network/collaboration tool	36.0%
Assessment	28.0%
Other	12.0%
Software	8.0%

Exhibit reads: Of the 75 projects developing, revising, or studying technolgies, 40.0 percent are working with on-line gaming, interactive learning, or virtual learning environments.

Research conducted

Specified research design

Most of the projects in the DR K-12 portfolio incorporate plans to conduct research, but the scope of the work and the types of designs and methods are diverse. The variation in research methods and designs reflects the diversity of projects' goals and foci. Many projects, for instance, are designing or developing a resource, model or technology and consequently incorporate design research approaches that involve small scale field tests, extensive iterative revisions, formative evaluation activities, and pilot studies. Other projects are studying the impacts of resources, models or technologies that are being scaled up and used in larger settings. These projects tend to utilize research designs more approach for drawing causal conclusions such as randomized control trials.

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[10] Only cohorts 1 and 2 were classified into the category "interactive resource" because it was established as a review category after the completion of the cohort 3 review. Projects in cohort 3 that meet the requirements for this classification were included in the "cyberlearning" category.

The diversity in the portfolio makes it difficult to succinctly characterize the research designs and methods in detail. In addition, most of the materials available for coding across projects were limited to those associated with projects' initial proposals or reports from their early years of work. Consequently, reviewers were restricted to coding projects' plans and goals (rather than implemented or completed designs) at whatever level of detail they found available in project materials.

While most of the projects incorporated some type of research into their activities, the research in 6.8 percent of them could not be classified due to insufficient information. Almost half of the projects used both qualitative and quantitative methods (49.2 percent), and 14.1 percent used only qualitative methods and 12.4 percent used only quantitative methods.

Almost a quarter of the portfolio (23.7 percent) is planning to incorporate experimental designs into their research (e.g., randomly assigning study participants to groups which are compared to one another after one or more of the groups receive an intervention and the others do not). Seventeen percent of the projects are planning to use quasi experimental designs in which groups are formed in order to make comparisons, but random assignment is not used (Exhibit 15). Almost a quarter or the projects are planning to make pre-post comparisons without using any comparison group (22.6 percent), 6.2 percent of them are using correlational methods to explore trends or draw contrasts across sub-groups, and 7.3 percent of the projects are planning to use quantitative methods to develop descriptions of educational settings or groups.

Exhibit 15: Projects' Research Designs (n = 177 projects)

Quantitative	n	%
Quantitative	109	61.6%
Randomized control trial	*42*	*23.7%*
Quasi experimental design (with comparison group)	*30*	*17.0%*
One group (pre/post)	*40*	*22.6%*
Correlational	*11*	*6.2%*
Descriptive	*13*	*7.3%*
Insufficient information	*5*	*2.8%*
Qualitative	112	63.3%
Synthesis	13	7.3%
Measurement/assessment development	40	22.6%
Design research	59	33.3%
Examination of research quality or progress	26	14.7%
Longitudinal research	19	10.7%
Insufficient information	12	6.8%

Some of the projects incorporate other more specialized research designs or methods into their plans. A third of the projects plan to use design research methods (e.g., small scale, often qualitative research methods that actively guide work designing resources or technologies). Almost a quarter (22.6 percent) of the projects has explicit plans to conduct extensive measurement development including studies of validity and reliability of student assessments or data collection instruments. Just over ten percent of the projects plan to conduct longitudinal research, collecting outcome data at three of more points in time (10.7 percent), and just fewer than ten percent are conducting meta-analyses, extensive literature reviews, or syntheses of existing research and theories (7.3 percent).

Outcome domains

Two thirds (66.1 percent) of the projects in the portfolio are researching student outcomes (Exhibit 16). For the most part this includes student achievement, performance, or content knowledge (61.6 percent) and to a lesser extent student attitudes or beliefs (33.9 percent) or behavior (e.g., engagement, usage of materials, etc., 19.8 percent). Similarly, 63.3 percent of the projects are researching teacher outcomes. Almost half of them are researching classroom practices or instruction (48.0 percent), 36.7 percent are studying teachers' attitudes or beliefs, 32.8 percent are researching teachers' pedagogical content knowledge, and 23.7 percent are researching teachers' content knowledge.

Fewer projects are investigating fidelity of implementation, administrator attitudes or beliefs, or the progress or quality of research being conducted as part of the project (17.5, 6.8, and 8.5 percent, respectively).

Exhibit 16: Outcome Domains of Projects Collecting Data (n= 177 Projects)

	n	%
Students	**117**	**66.1%**
Achievement/performance	109	61.6%
Attitudes/beliefs	60	33.9%
Behavior	35	19.8%
Other	3	1.7%
Teachers	**112**	**63.3%**
Classroom practices	85	48.0%
Attitudes and beliefs	65	36.7%
Pedagogical content knowledge	58	32.8%
Content knowledge	42	23.7%
Other	11	6.2%
Administrators	**12**	**6.8%**
Knowledge	2	1.1%
Attitudes/beliefs	8	4.5%
Other	5	2.8%
Fidelity of implementation	**31**	**17.5%**
Quality/progress of research	**15**	**8.5%**
Other	**13**	**7.3%**
Insufficient information	**11**	**6.2%**

Project evaluations

Evaluation plans

More than three quarters of the projects (76.3 percent) have plans for conducting formative evaluations in the materials they provided for this review. Slightly less than three quarters (74.3 percent) have plans for a summative evaluation (Exhibit 17). Most projects also planned to seek guidance or review from an advisory group or experts (70.8 percent).

Exhibit 17: Evaluation Designs among Projects Including Detailed Plans

	n	%
Formative	116	76.3%
Summative	113	74.3%
Advisory group	109	70.8%

Dissemination activities

Dissemination plans

DR K-12 solicitations require that projects include a dissemination plan as part of their project description. In these plans, more than half of the projects identify the materials that they would disseminate, the potential target audience or end-users, or their dissemination partners (alone or in combination; 66.7, 54.8, and 50.3 percent, respectively). More than a third of the projects plan to incorporate input from their targeted users into their research or development plans (37.9 percent). Few projects, however, discuss their sustainability strategies, plans for developing a more formal dissemination plan, or the challenges they anticipated (6.2, 2.3, and .6 percent, respectively).

Exhibit 18: Details Included in Dissemination Plan among Projects with a Dissemination Plan (n= 177 Projects)

	n	%
Identifies what will be disseminated	118	66.7%
Identifies potential adopter or end user	97	54.8%
Identifies dissemination partners	89	50.3%
Includes end user input in design or development of research	67	37.9%
Addresses strategies for sustainability	11	6.2%
Intends to develop a formal dissemination plan	4	2.3%
Identifies dissemination challenges	1	0.6%

Dissemination vehicles

Projects reported plans for disseminating their work via a wide variety of vehicles (Exhibit 19). The most common way that projects plan to disseminate their work is through presentations or poster sessions (76.8 percent of projects) and journal articles (67.8 percent). Many projects are also planning to disseminate their work or materials via websites—either ones they are developing specifically for this purpose, or on partners' websites. Other common vehicles for dissemination include workshops (22.6 percent), commercial publication or distribution of materials (15.8 percent), and books or chapters in books (10.7 percent).

Exhibit 19: Planned Dissemination Mechanisms among Projects with a Dissemination Plan (n= 177 Projects)

	%
Presentations/poster sessions	76.8%
Journal articles	67.8%
Websites	59.3%
Workshops	22.6%
Books or book chapters	10.7%
Commercial product or publication	15.8%
White papers	7.9%
CDs/DVDs	3.4%
Newsletter	7.3%
Blogs	1.7%
Webinars	4.5%
Popular media	6.8%
Other	32.2%
Insufficient information	3.4%

Anticipated products

Projects also anticipated the development and dissemination of diverse products. For this portfolio analysis, these products were classified by reviewers into discrete categories. These codes, however, were developed after the cohort 3 projects were reviewed. Consequently, this summary includes only the 126 projects in cohorts 1 and 2 (Exhibit 20).

The most common products being developed in projects are curriculum, materials, assessments, or technologies for supporting student learning (40.5 percent of projects) or teacher professional development (44.4 percent), and research findings (46.0 percent).

Exhibit 20: Anticipated Products Being Developed in Projects in Cohorts 1 and 2 (n= 126 Projects)

	n	%
Student learning:	51	40.5%
Curriculum	28	22.2%
Materials or activities	27	21.4%
Technology	21	16.7%
Assessments	17	13.5%
Teacher professional development:	56	44.4%
Curriculum	24	19.0%
Materials or activities	40	31.7%
Technology	21	16.7%
Research findings	58	46.0%
Syntheses	11	8.7%
Conference proceedings	14	11.1%
Standards	4	3.2%
Data collection instruments	7	5.6%
Other	26	20.6%

Distribution of Projects across Areas of Interest

The DR K-12 projects are distributed across a wide range of substantive areas. Exhibit 21 displays the number of projects in each major discipline area that was developing, revising, or studying a resource, model or technology by grade. In addition, the specific types of resources, models and technologies are presented. The largest numbers of projects are developing, revising, or studying resources in mathematics or science.

In addition, Appendix A presents brief descriptions of the projects organized by major disciplines and grade levels. Where possible, the project descriptions were drawn directly (i.e., verbatim) from the thumbnail sketches developed by NSF for the NSF-generated content analysis of the DR K-12 portfolio and projects' abstract. In Appendix A project descriptions are organized according to the four challenges presented in the latest grant solicitation (i.e., assessments; STEM learning and instruction; professional development and teacher practice; and the implementation, efficacy, impact, and cost effectiveness of specific interventions). Within each challenge section, project descriptions are further categorized by grade and topic area. In other words, the sections are arranged as in the outline below:

1. Developing and/or studying innovative assessments of STEM teaching and learning
- Elementary, middle, and high school (and pre-k in areas in which there is at least one project with a specific focus on PRE-K)
  - Mathematics
  - Science
  - Multidiscipline
  - Engineering

2. Developing and/or studying innovative instructional strategies, materials, and technologies designed to enhance student learning
- Elementary, middle, and high school (and pre-k in areas in which there is at least one project with a specific focus on PRE-K)
  - Mathematics
  - Science
  - Multidiscipline
  - Engineering

3. Developing and/or studying innovative models and materials for teacher preparation and professional development
- Elementary, middle, and high school (and pre-k in areas in which there is at least one project with a specific focus on PRE-K)
  - Mathematics
  - Science
  - Multidiscipline
  - Engineering

4. Studying implementation and the effectiveness of specific interventions
- Elementary, middle, and high school (and pre-k in areas in which there is at least one project with a specific focus on PRE-K)
  - Mathematics
  - Science
  - Multidiscipline
  - Engineering

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Exhibit 21: Number of Projects by Major Discipline Areas - Developing, Revising or Studying Types of Resources, Models, and Technologies by Grade

	Mathematics			Science			Engineering			Other		
	Elem.	Middle	High	Elem.	Middle	High	Elem.	Middle	High	Elem.	Middle	High
Resource												
Professional development activities, materials, networks	21	32	20	19	32	30	2	5	3	0	0	0
Curriculum unit or short course	7	7	10	14	24	16	1	3	2	0	0	0
Materials used by students in learning activities	0	3	8	10	19	15	0	2	2	1	1	1
Assessment instrument	10	16	9	8	22	17	0	1	1	0	0	0
Other	2	3	2	1	1	2	0	0	0	0	0	0
Model												
Learning progression	5	5	1	3	5	3	0	0	0	0	0	0
Model of ideal educational practice	7	7	4	3	2	4	0	0	0	0	0	0
Theoretical framework	3	4	2	2	1	1	0	0	0	0	0	0
Teacher professional development frameworks	1	3	3	1	5	5	0	0	0	0	0	0
Curriculum frameworks	1	2	2	1	1	1	0	0	1	0	0	0
Standards	2	2	1	0	0	1	1	1	1	0	0	0
Guidelines	1	1	1	0	0	0	0	0	0	0	0	0
Technology												
Interactive resource	3	2	4	10	13	13	0	1	2	0	0	0
On-line gaming, interactive learning, etc.	1	3	3	4	16	14	0	1	0	0	0	0
On-line network/collaboration tool	2	3	3	5	11	12	1	1	1	0	0	0
Assessment	1	2	1	2	12	9	0	0	0	0	0	0
Software	3	4	2	2	7	5	0	0	2	0	0	0
Other	1	2	0	3	6	2	0	2	0	0	1	0

Future Work with the Portfolio

The current portfolio analysis was conducted on the first three cohorts of projects. We are currently collecting materials from the fourth cohort of projects recently funded and we are soliciting updated materials from projects in the first three cohorts. We will conduct a review of the new projects and update our portfolio data with new materials received form projects. These updates will be occur annually as needed to respond to new project materials in order to keep the portfolio overview up to date.

The CADRE team will discuss with the NSF the future priorities and directions for additional information and inquiries based on the portfolio reviews. In addition, we will use information drawn from the portfolio overview to inform support activities for PIs and to guide future work conducting targeted, in-depth studies on specific aspects of the DR K-12 work. For example, we are currently completing an analysis of DR K-12 projects focused on education among English language learners and how aspects of these projects compare to the STEM education field in general. In addition, we developed an overview of the science technology-based projects in response to inquiries from principal investigators in the DR K-12 science curriculum special interest group.

The topics of other targeted studies such as these will be determined in the future by NSF and CADRE. They are a valuable resource for the support of the DR K-12 community. In addition, they have the potential to contribute directly to the field of STEM education because they can synthesize activities and knowledge from across DR K-12 projects and relate them to important and topical issues in the wider STEM community. The unique perspective offered by the knowledge gained from the synthesis of the overview of the DR K-12 landscape and the detailed pictures of the targeted studies can contribute to the progression of DR K-12 and the field of STEM education as it advances along the cycle of research and development.

Appendix A. Project Descriptions

Developing and/or Studying Innovative Assessments of STEM Teaching and Learning[11]

Elementary School

Award Number	Project Description
Mathematics	
0732090	This project evaluates the assessment components in *Everyday Mathematics and Math Trailblazers*.
0733272	This project is developing software for integrating diagnostic interviews, group assessments, and student data in real-time to provide teachers with information about their students' progress through a learning landscape of rational number concepts.
0822064	The *Diagnosing Teachers' Multiplicative Reasoning* (DTMR) project is building a demonstration assessment using a new class of psychometric models called cognitive diagnosis models (CDMs) that measures teachers' abilities to identify and work with students' problem-solving strategies.
0831450	This project is developing five assessments of student achievement for use in upper elementary grades as growth-sensitive measures of student learning in mathematics.
0848681	This grant funds a forum designed to develop action plans to improve math education based on a report by the *National Mathematics Advisory Panel*.
0918126 0918141	These projects focus on revealing and assessing the teacher understandings needed for productive use of mathematics curriculum materials.
0918780	*Mapping Developmental Trajectories of Students' Conceptions of Integers* uses data from interviews with K-12 students and adults to describe common understandings and progressions of development for negative number concepts and operations.
Science	
0711579	This project consists of the *CAESL2008: International Conference on Assessments for Learning in Mathematics and Science* which targets international researchers in math and science who are focused on assessments that help teachers to diagnose student learning in the classroom.
0733642	The *Chemistry Education Research (CER) Doctoral Fellows Program* produces scholars with deep content knowledge in chemistry and the specialized training to conduct CER.
Multidiscipline	
0732217	This longitudinal study looks at developmental progressions in measurement concepts and strategies (used in math and science) over a seven-year span. The study compares this progression to a variety of educational standards.

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[11] The text of the descriptions was drawn (in most cases verbatim) from project abstracts and the NSF content analysis of the DR K-12 portfolio.

0733329	The goal of this project is to use NAEP data to investigate whether and how students' standardized test scores may systematically vary as a function of their cultural backgrounds and knowledge.
0733334	This project is developing a practical, teacher-managed computer system for formative assessment in both mathematics and science.
0733590	This project aims to build a learning community to foster the development of research and leadership in evaluation and to recruit a cadre of five STEM Education Research Scholars into it who will be trained in and conduct research on measurement and evaluation.

Middle School

Award Number	Project Description

Mathematics

0822362	This project investigates the effectiveness of including vignette illustrations in test items as a strategy of test accommodation for English language learners.
0830029	This project is developing instruments and analytical methods to measure equity-related aspects of African American students' and English language learners access to mathematics instruction and knowledge.
0918780	*Mapping Developmental Trajectories of Students' Conceptions of Integers* uses data from interviews with K-12 students and adults to describe common understandings and progressions of development for negative number concepts and operations.
0822064	The *Diagnosing Teachers' Multiplicative Reasoning* (DTMR) project is building a demonstration assessment using a new class of psychometric models called cognitive diagnosis models (CDMs) that measures teachers' abilities to identify and work with students' problem-solving strategies.
0848681	This grant funds a forum designed to develop action plans to improve math education based on a report by the *National Mathematics Advisory Panel*.
0732090	This project evaluates the assessment components in *Everyday Mathematics and Math Trailblazers*.
0733272	This project is developing software for integrating diagnostic interviews, group assessments, and student data in real-time to provide teachers with information about their students' progress through a learning landscape of rational number concepts.

Science

0822038	This is a longitudinal study is developing a set of assessments to compare students on a scale measuring the progression of understanding of the transformation of matter (ToM) that this study will also produce.
0733172	This project aims to develop high quality large-scale technology-based assessments for science learning in the middle school grades.
0733286	This project focuses on improving inquiry science assessments by developing a technology-based system for middle school standards-aligned assessments of inquiry skills.
0733642	The *Chemistry Education Research (CER) Doctoral Fellows Program* produces scholars with deep content knowledge in chemistry and the specialized training to conduct CER.

0822308	This project is creating instruments that assess student inquiry skills and content knowledge authentically through a series of virtual environment situated assessment modules.
0822314	This project is developing a formative assessment intervention that integrates existing classroom network technologies and curriculum activities to help teachers adjust instruction.
0733345	This project is developing and studying simulation-based, curriculum-embedded, formative assessments of inquiry skills and complex science learning.
0822342	This project is investigating the development of a national model of teacher education that focuses on the establishment of a diagnostic learning environment in the classroom.
0822388	This project is using randomized classroom comparisons to investigate ways in which assessments (in combination with instruction) are effective in promoting and measuring middle school students' cumulative understanding of energy concepts and whether the use of the approach in one course impacts progress in the next.
0711579	This project consists of the *CAESL2008: International Conference on Assessments for Learning in Mathematics and Science* which targets international researchers in math and science who are focused on assessments that help teachers to diagnose student learning in the classroom.

Multidiscipline

0744486	This project will develop general theory and an exemplar cognitively-based assessment of proportional reasoning that can provide information deemed diagnostic, highly informative, and potentially prescriptive, therefore more relevant to learning and useful in applied instructional settings.
0733329	The goal of this project is to use NAEP data to investigate whether and how students' standardized test scores may systematically vary as a function of their cultural backgrounds and knowledge.
0733590	This project aims to build a learning community to foster the development of research and leadership in evaluation and to recruit a cadre of five STEM Education Research Scholars into it who will be trained in and conduct research on measurement and evaluation.
0733334	This project is developing a practical, teacher-managed computer system for formative assessment in both mathematics and science.

High School

Award Number	Project Description
Mathematics	
0821967	*Geometry Assessments for Secondary Teachers* is developing a knowledge framework to collect validity evidence for predicting effective geometry instruction and assessments for teachers' geometry knowledge.
0918780	*Mapping Developmental Trajectories of Students' Conceptions of Integers* uses data from interviews with K-12 students and adults to describe common understandings and progressions of development for negative number concepts and operations.
0848681	This grant funds a forum designed to develop action plans to improve math education based on a report by the *National Mathematics Advisory Panel*.
Science	
0732151	This project consists of a validation study evaluating the effectiveness of high school chemistry and physics curriculum and professional development aligned with the NRC's Physical Science Content Standards for grades K-12.
0733642	The *Chemistry Education Research (CER) Doctoral Fellows Program* produces scholars with deep content knowledge in chemistry and the specialized training to conduct CER.
0822308	This project is creating instruments that assess student inquiry skills and content knowledge authentically through a series of virtual environment, situated assessment modules.
0918295	This project is developing, validating, and evaluating formative assessments based on computer modeling in order to improve high school students' learning in chemistry.
0822342	This project is investigating the development of a national model of teacher education, which focuses on the establishment of a diagnostic learning environment in the classroom.
0733169	This project will improve formative assessment in high school chemistry by using students' ideas to develop assessment items and thereby enhance the *Diagnoser* assessment system.
0711579	This project consists of the *CAESL2008: International Conference on Assessments for Learning in Mathematics and Science* which targets international researchers in math and science who are focused on assessments that help teachers to diagnose student learning in the classroom.
Multidiscipline	
0733590	This project aims to build a learning community to foster the development of research and leadership in evaluation and to recruit a cadre of five STEM Education Research Scholars into it who will be trained in and conduct research on measurement and evaluation.

Developing and/or Studying Innovative Instructional Strategies, Materials, and Technologies Designed to Enhance Student STEM Learning

Pre-K

Award Number	Project Description
0821988	This project uses a mixed methods approach to analyze what STEM concepts should be taught in pre-kindergarten and what professional development practices best support these lessons.

Elementary School

Award Number	Project Description

Mathematics

0733189	This project is developing and testing efficacy of replacement curriculum materials in measurement and geometry to develop mathematical thinking of talented K-2 mathematics students.
0907896 0910672	These grants fund a series of conferences analyzing why African American students are underrepresented in advanced mathematics classes and how mathematics classes can better serve them.
0918060	This project studies 1st and 2nd grade students who struggle with number and operations in order to identify cognitive obstacles to learning and implications for instruction.
0918109	This project seeks to understand the district- and school-level supports needed to implement comprehensive elementary mathematics instructional materials.
0918239	This project is developing and testing a curricular learning progression, teaching resources, and assessment tools for early algebra instruction.
0918309	This project aims to increase mathematics learning of students in elementary school by developing and testing efficacy of culturally and linguistically sensitive curriculum units.
0918733	This project designs software and learning materials using a new technological paradigm (*Dynamic Number*), which allows students in grades 2-8 to directly manipulate number representations and numerical constructions.

Science

0733233	*Making Science* is developing an elementary level curriculum focused on data modeling and scientific argumentation, using scientific data and sensor technology from the *Center for Embedded Networked Sensing*.
0733218	Sensing technologies are used to transform students' physical actions during play into a set of symbolic (computer) representations and to engage them in a form of scientific modeling.
0732793	*SPRINTT* is using an innovative, live, online training format to train teachers in how to teach life, Earth, and physical science content in a polar context.
0733223	The *Fossil Finders* project develops an interactive website where grade 5-8 students examine and identify fossils to enhance their understanding of the nature of science and evolutionary concepts, as well

as to motivate them to learn more about science.

| 0733195 | The goals of this project are to form communities of practice among rural science teachers, to use web-based resources help them improve their teaching of science, and then to study teacher adaptations of FOSS, Insights, and STS lessons. |

0822200   The project draws on intelligent tutoring and narrative-centered learning technologies to develop and study the effects of a suite of intelligent game-based learning environments.

0918533   This design-based research project examines whether elementary school children can learn the nature of scientific evidence when provided a coherent, contiguous course of study in one topic area sustained over time.

0732233   This project is developing learning progressions on scientific inquiry for topics related to energy for both teachers and students in grades 4 and 5 as well as corresponding model materials and teaching strategies.

0733323
0733322   These projects are developing a computer program (*My Science Tutor)* which students will use immediately following classroom science investigations to reinforce and extend concepts embedded in the investigations. The program uses an animated character to engage students in scaffolded guided learning activities and tutorial dialogs that stimulate scientific reasoning.

0822213   This project is using computer-based models of interacting organisms to support a learning progression about the theory of evolution. Curricular activities and formative assessments that link models to text and multimedia materials are being created.

0822119   This project looks at the effects of educational curriculum materials, focusing on teachers of English language learners.

0731739   This project provides students with field experiences and classrooms lessons on permafrost, an outreach activity of the International Polar Year.

Multidiscipline

0918216   The goal of this project is to develop and test effects of a systemic one-computer-per-child intervention to support STEM learning and lead more urban children to STEM career paths.

0733209   The project is developing four half-year curriculum units that use design of toys and game strategies as starting points for learning the concepts of force, motion and energy in grades K-2 and 3-5.

0751664   This grant funds a workshop in which American and Chinese researchers can collaborate on issues pertaining to elementary school mathematics.

0822153   This project is a two-year randomized trial of a curriculum model that has been enhanced to improve science achievement and academic English proficiency of middle school English language learners.

0733180   This project develops materials that infuse bio-music into standards-based elementary science and music curricula.

0733550   This project's goal is to contribute to the capacities of urban school districts and educational researchers to work collaboratively in the effective planning, implementation, scale-up, adaptation, documentation, and evaluation of systemic reform in mathematics and science education.

0822055
0822278   Through classroom observations and interviews, these projects examine the advantages and disadvantages of tablet computers in elementary and middle school math and science classrooms.

Engineering

0733584	This project is assessing the feasibility of developing and implementing K-12 content standards for engineering education.

Other

0958058	This project is conducting a series of workshops to examine challenges and opportunities for future innovations in STEM curricula, instruction, and instructional materials.

Middle School

Award Number	Project Description

Mathematics

0918735 0918653	Software and curriculum materials being developed by the *Data Games* projects use data generated by students playing computer games as the raw material for mathematics classroom activities.
0907896 0910672	These grants fund a series of conferences analyzing why African American students are underrepresented in advanced mathematics classes and how mathematics classes can better serve them.
0918309	This project aims to increase mathematics learning of students in elementary school by developing and testing efficacy of culturally and linguistically sensitive curriculum units.
0918733	This project designs software and learning materials using a new technological paradigm (*Dynamic Number*), which allows students in grades 2-8 to directly manipulate number representations and numerical constructions.
0918794	This project develops and evaluates the efficacy of computer-mediated animations and games of increasing student conceptual understanding and skills in core mathematical topics of middle grades.
0918239	This project is developing and testing a curricular learning progression, teaching resources, and assessment tools for early algebra instruction.

Science

0732945	*IPY STEM Polar Connections* is a curriculum and professional development program that advances the knowledge that STEM teachers have of polar science.
0732793	*SPRINTT* is using an innovative, live, online training format to train teachers in how to teach life, Earth, and physical science content in a polar context.
0733223	The Fossil Finders project develops an interactive website where grade 5-8 students examine and identify fossils to enhance their understanding of the nature of science and evolutionary concepts, as well as to motivate them to learn more about science.
0918409	The project builds on existing research and extends it to develop an automated mentoring system that uses natural language conversations to help students learn about science and technology and an assessment/analysis protocol to quantify students STEM behavior. AutoMentor is implemented and tested in Land Science, a multi-player urban planning game.
0918618	The project is developing a physical science program that utilizes engineering design, LEGO robotics and mechanics, and a problem-based learning approach to teach mechanics, waves, and energy.

0918583 0918629	These projects are producing and testing the efficacy of three curriculum modules that link environmental issues to ecological principles through analysis of real data from published research on the environmental impacts of familiar everyday activities.
0733299	The project seeks to advance technology to support formative assessment of student learning and provide feedback to teachers using computer-based curriculum materials.
0929774	The project tests the hypothesis that using the *Science* magazine list of unanswered science questions that scientists are actively exploring is a replicable and sustainable strategy for increasing student interest in science.
0822039	This project aims to increase access of learning disabled students to science learning by developing curriculum materials for students with executive function limitations.
0918560	This project analyzes how institutions of informal science education can best support scientific learning and understanding in middle school students by looking at how these institutions support the work of teachers, administrators, and parents.
0730260 0730603 0730348	These projects are working together, applying heuristics for universal design for learning to create and test efficacy of exemplar instructional materials in middle school science.
0733269	This project is developing ecology curriculum resources for junior high teachers. The resources utilize multiple media and case studies and address national and state ecology standards.
0918683	This project develops new instructional materials for middle school science teachers that help create a compelling classroom culture of scientific discovery, engages students in the creative opportunities that abound in science, and inspires them to pursue the high school science coursework needed for future careers in science.
0822302	This project is developing and studying immersive, interactive, and participatory augmented reality (AR) outdoor learning simulations using wireless handheld computers equipped with global positioning system (GPS) receivers to enhance science teaching and learning.
0733252	This project is developing and testing materials to support use of online telescopes for laboratory investigations in middle and high school astronomy.
0918590	This project is developing learning progression-driven visualization technologies, curricular units, and assessments in order to develop empirical evidence about middle and high school students' complex thinking about ecological impacts of global climate change.
0918836	This project is developing, field-testing, and evaluating a prototype instructional module designed to stimulate and sustain urban-based students' interest in STEM. The module will include inquiry-oriented activities thematically linked by the standards-aligned concept of energy transfer, which highlights the fundamental processes and integrative nature of 21st Century scientific investigation.
0822370	This project is redesigning popular commercial video games to support development of students' understanding of Newtonian mechanics.
0822213	This project is using computer-based models of interacting organisms to support a learning progression about the theory of evolution. Curricular activities and formative assessments that link models to text and multimedia materials are being created.
0731739	This project provides students with field experiences and classrooms lessons on permafrost, an outreach activity of the International Polar Year.
0918832	This project studies the effects of linguistically sensitive science instructional materials by translating into English, enhancing, and testing effects of a series of Collaborative Online Projects (COPs) originally

written in Spanish.

0918743	This project studies ways that visualizations can improve science learning, investigates successful strategies to embed visualizations in curriculum materials, and shows how practices and cyber-learning tools can be generalized.
0822181	This proposal focuses on teaching and learning of global warming and climate change by developing a model of how middle school students learn about these complex issues.
0836099	This grant supports development of a book and a research study to investigate the impact of that book and accompanying professional development on teachers' beliefs and classroom practices to support grade 5-8 students in writing scientific explanations.

Multidiscipline

0821965	Simulation and Modeling in Technology Education studies a hybrid instructional model that infuses simulations, modeling, and gaming into technology education programs.
0733140	This project uses physics as the context to develop mathematics literacy *(PhysicsUnionMath)* by modifying a physics curriculum, *Investigative Science Learning Environment.*
0736967	This grant funds a conference for a variety of STEM education professionals and an academy for teachers, which were designed to help teachers integrate mathematics and science education research into their teaching.
0822153	This project is a two-year randomized trial of a curriculum model that has been enhanced to improve science achievement and academic English proficiency of middle school English language learners.
0918769	This project is developing and testing engineering education modules that have the goal of developing engineering habits of mind through work on design challenges in the life and physical sciences.
0733228	This project is developing instructional modules on robotics for Grades 5-8 that are organized into a flexible, internet-accessible curriculum focused on topics in science, technology, engineering, and mathematics.
0746348	This project seeks to leverage game technologies, game design principles, and specific gaming techniques to support middle school students in learning scientific literacy and citizenship skills.
0733550	This project's goal is to contribute to the capacities of urban school districts and educational researchers to work collaboratively in the effective planning, implementation, scale-up, adaptation, documentation, and evaluation of systemic reform in mathematics and science education.
0822055 0822278	Through classroom observations and interviews, these projects examine the advantages and disadvantages of tablet computers in elementary and middle school math and science classrooms.

Engineering

0733584	This project is assessing the feasibility of developing and implementing K-12 content standards for engineering education.

Other

0958058	This project is conducting a series of workshops to examine the challenges and opportunities for future innovations in STEM curricula, instruction, and instructional materials.

High School

Award Number	Project Description
Mathematics	
0732161	This study examines the effects of high school mathematics curriculum on students' successes in two and four year post secondary institutions.
0733015	This project is developing and testing materials for a high school linear algebra course. The materials will consist of a core semester that introduces students to vectors and matrices and twelve stand-alone modules devoted to applications of this mathematics.
0733137	This project creates, implements, and evaluates a new curriculum and textbook that will teach a non-calculus mathematics course to fourth year high school students to enhance their mathematical ability and improve their attitudes toward science.
0747536	This project examines the effects of using networked graphing calculators in mathematics classrooms in order to produce a rich account of new possibilities for technology-supported collaborative mathematics learning and a well-articulated model for integrating those tools and practices into classroom instruction.
0814571	This study tests the effectiveness at scale of the hypothesis that students who learned by comparing and contrasting alternative solution methods in algebra make greater gains in procedural knowledge and flexibility than those who did not.
0822104	This project compares three different curricular approaches to algebra education and develops instruments to assess student learning that will be used in later phases of the project.
0822175	This project creates a cohort of low-achieving 9th grade mathematics students and develops a curriculum for them so that they will enter college ready to take college-level mathematics courses.
0822391	This research and development project is studying how English language learners in beginning algebra classes solve word problems. The results of this research inform the development of online programs to support English language learners in solving these problems more effectively.
0839209	This project funds educational and demographic data collection on students from 800 schools from grade 9 to age 26 for the *High School Longitudinal Study.*
0907896 0910672	These grants fund a series of conferences analyzing why African American students are underrepresented in advanced mathematics classes and how mathematics classes can better serve them.
0917958	This project creates and tests the effects of instructional materials focused on developing conceptual understanding and mathematical habits of mind that will enable students to succeed in elementary algebra.
0918434	This project designs, develops, and tests the efficacy of student and teacher instructional materials and software for double-period courses in elementary algebra.
0918735 0918653	Software and curriculum materials being developed by the *Data Games* projects use data generated by students playing computer games as the raw material for mathematics classroom activities.
Science	
0731739	This project provides students with field experiences and classrooms lessons on permafrost, an outreach activity of the International Polar Year.

0732793   *SPRINTT* is using an innovative, live, online training format to train teachers in how to teach life, Earth, and physical science content in a polar context.

0730260
0730603   These projects are working together, applying heuristics for universal design for learning to create and test efficacy of exemplar instructional materials in middle school science.
0730348

0732945   *IPY STEM Polar Connections* is a curriculum and professional development program that advances the knowledge that STEM teachers have of polar science.

0733188   This project investigates strategies for increasing scientific literacy in urban communities and on tribal reservations by testing efficacy and refining the *Astrobiology in the Secondary Classroom* curriculum.

0733252   This project is developing and testing materials to support use of online telescopes for laboratory investigations in middle and high school astronomy.

0733255   The objective of this project is to develop and test web-based tools that high school students can use to conduct research in bioinformatics. An online assessment tool will be included.

0733268   This project is creating and studying an online professional development platform that provides just-in-time support for teachers as they are enacting targeted units of the *Active Physics* curriculum.

0733269   This project is developing ecology curriculum resources for junior high teachers. The resources utilize multiple media and case studies and address national and state ecology standards.

0733280   This project creates professional development that links scientists with urban classrooms so participants engage in an "authentic" inquiry project in plant science.

0807575   This project is developing and testing activities that enable students to understand how the cryosphere changes on multiple time scales and how it impacts the Earth system.

0822354   This project aims to develop, pilot, and evaluate a model of instruction that focuses on science journalism as a sustainable model for improving science literacy.

0918583
0918629   These projects are producing and testing the efficacy of three curriculum modules that link environmental issues to ecological principles through analysis of real data from published research on the environmental impacts of familiar everyday activities.

0918590   This project is developing learning progression-driven visualization technologies, curricular units, and assessments in order to develop empirical evidence about middle and high school students' complex thinking about ecological impacts of global climate change.

0918610   The project is identifying essential elements in the ecological nature of science (ENOS), investigating how these elements can be taught and learned, and exploring ways that ENOS skills enhance citizenship.

0918642   This project is developing and testing bioinformatics and DNA science cyberlearning modules. Students work in virtual laboratories to conduct genetics research.

0918743   This project studies ways that visualizations can improve science learning, investigates successful strategies to embed visualizations in curriculum materials, and shows how practices and cyber-learning tools can be generalized.

0929774   This project tests the hypothesis that using the *Science* magazine list of unanswered science questions that scientists are actively exploring is a replicable and sustainable strategy for increasing student interest in science.

Multidiscipline

0733140   This project uses physics as the context to develop mathematics literacy *(PhysicsUnionMath)* by modifying a physics curriculum, *Investigative Science Learning Environment*.

0733264   This project is developing and testing a strategy for using cutting-edge genomics data to foster inquiry by secondary students using publicly accessible biological datasets and powerful analysis tools.

0733284   This project is designing and testing multimedia laboratory activities to engage artistically gifted students in science, technology, engineering, and mathematics.

0733550   This project's goal is to contribute to the capacities of urban school districts and educational researchers to work collaboratively in the effective planning, implementation, scale-up, adaptation, documentation, and evaluation of systemic reform in mathematics and science education.

0736967   This grant funds a conference for a variety of STEM education professionals and an academy for teachers, which were designed to help teachers integrate mathematics and science education research into their teaching.

0822128   This project develops and tests professional development that combines an instructional design framework with nanoscale science content using multiple delivery methods for high school science teachers.

0822178   This project is reviewing research literature and consulting experts in order to identify the concepts and techniques in data analysis needed for students to learn from analysis of large scientific data sets.

0917540   This project is developing high school biology and chemistry instructional materials that incorporate engineering design and cutting-edge research in STEM fields.

0918522   This project studies the educational value of "*Smart Graphs*", digital objects that "know" about themselves and that provide scaffolding to students to help them learn about graphs and the concepts conveyed in graphs.

Engineering

0733584   This project is assessing the feasibility of developing and implementing K-12 content standards for engineering education.

0918449   The project is developing a simulation tool *(SimEng),* which is capable of accurately modeling engineering problems and comparing its effects to hands-on work in four instructional units that involve engineering design problems.

0918621   This project compares students' understandings of design-thinking to experienced practitioners' and investigates whether participation in a multiyear sequence of courses focused on engineering correlates with changes in design thinking.

Other

0958058   This project is conducting a series of workshops to examine challenges and opportunities for future innovations in STEM curricula, instruction, and instructional materials.

Developing and/or Studying Innovative Models and Materials for Teacher Preparation and Professional Development

Elementary School

Award Number	Project Description

Mathematics

0732204	This study aims to identify effective teaching strategies by comparing videotapes of 60 5th grade mathematics teachers giving lessons on similar topics. Teachers' value-added effect estimates are based on student achievement data, as well as additional tests administered by the study to both teachers and their students.
0732495	The Coaching Cycle project is creating and studying effects of an online course for K-8 mathematics instructional coaches in rural areas and small schools.
0736305	This grant funds a conference for classroom teachers, mathematics educators, mathematicians, and community college faculty to collaborate and produce professional development that is grounded in all of their respective fields.
0736964	This grant funds a conference examine the relationship between children's mathematical thinking and their cultural, linguistic, family, and community-based knowledge, and how this knowledge can inform effective mathematics education.
0822034	This project extends an existing library of CD-ROM digital learning environments by adding an algebra strand and evaluating the impact of the new algebra materials on elementary teacher development.
0822189 0822204	These projects are studying mathematics teachers' development using the *Video Mosaic Collaboratory*, an interactive digital environment for teacher professional development.
0822313	This project examines the kinds of supports needed for developing teacher-leaders' capacities to implement the *Math For All* and *Advancing Accessibility in Mathematics* programs in their districts.
0918223	This project expands and studies the effects of scaling up a Mathematics Specialist model to rural school systems, using a combination of distance and face-to-face learning.
0918834	This project is developing ten online professional development modules to help teachers implement the *Math Pathways and Pitfalls* lessons.
0918326	This project studies how knowledge of coaching strategies and mathematics content effects the ability of coaches to improve teachers' knowledge, attitudes, and classroom practices.
0918383	This project studies the efficacy of the *Math Solutions* professional development model in enhancing teacher mathematical knowledge for teaching, classroom practice, and student outcomes.
0929816	This projects funds a conference designed to help teachers and administrators who work in predominantly African American and Hispanic classrooms teach in ways that are culturally relevant and promote high achievement in these groups and studies the effect of the conference on the teaching and classroom planning of a sample of its participants.

Science

0733024	This project is developing materials and strategies to enable elementary school teachers to integrate polar concepts into their teaching through increased access to learning resources.

0732109	This project explores the effects of three teacher professional development models on teacher performance and student achievement in STEM disciplines at schools serving large numbers of minority students.
0732173	The goal of this project is to identify characteristics of exemplary African American elementary science teachers and examine the role of mentoring on beginning elementary science teachers and their students.
0723433	This project evaluates different models for the delivery of online professional development aimed at elementary science teachers. The focus is on asynchronous and minimally facilitated models.
0822402	This project is conducting an experimental study on the impact of the *ESTELL* elementary teacher education program designed to prepare novice teachers to teach science to English language learners.
0918435	This project studies ways to help elementary teachers facilitate scientific discourse.

Multidiscipline

0711138	This project consists of a conference designed to synthesize and disseminate research findings on promising ways to promote equitable access and opportunities for all students in mathematics classes and an understanding what mathematics means in students' lives.
0732143	This project aims to improve programs for pre-service elementary mathematics and science teachers by having them develop and revise lesson plans after working with students to create models of students' reasoning through teaching experiments and reflecting on practice in study groups.
0822373	This project is defining and synthesizing effective feedback strategies of daily classroom assessment practices. The project will create a toolkit for practitioners.
0844556	This longitudinal study looks at how third grade mathematics instructors can better serve the needs of English language learners and it develops corresponding professional development materials.

Engineering

0822261	This project is developing and evaluating a learning progression for elementary school teachers as well as associated asynchronous, cyber-enabled professional development and networks aimed at supporting teachers' use of instructional engineering concepts and materials in classrooms.

Middle School

Award Number	Project Description
Mathematics	
0732074	This project examines adaptive expertise in mathematics education, exploring relationships between this concept from cognitive psychology and effective middle school mathematics instruction.
0732184	This study is exploring middle school mathematics teachers' implementation of standards-based curriculum materials (i.e., viewed as cultural tools) in urban schools.
0732212	This scale-up project tests the effectiveness of the *Problem-Solving Cycle* model of mathematics professional development.
0732495	The Coaching Cycle project is creating and studying effects of an online course for K-8 mathematics instructional coaches in rural areas and small schools.
0736305	This grant funds a conference for classroom teachers, mathematics educators, mathematicians, and community college faculty to collaborate and produce professional development that is grounded in all of their respective fields.
0746936	This project studies middle school mathematics teachers' learning opportunities and their impact on achievement of their students.
0821950	This project is studying the effects of the *Fostering Geometrical Thinking Toolkit* (FGTT) program on participating middle school teachers of English language learners.
0822189 0822204	These projects are studying mathematics teachers' development using the *Video Mosaic Collaboratory*, an interactive digital environment for teacher professional development.
0822313	This project examines the kinds of supports needed for developing teacher-leaders' capacities to implement the *Math For All* and *Advancing Accessibility in Mathematics* programs in their districts.
0824511	This project helps form *Teacher's Circles* in which school mathematics teachers and mathematicians meet regularly to engage in mathematics activities.
0829306	This project examines discourse in middle school mathematics classrooms with the aim of improving teacher preparation and professional development.
0918326	This project studies how knowledge of coaching strategies and mathematics content effects the ability of coaches to improve teachers' knowledge, attitudes, and classroom practices.
0918117	This project is developing and testing professional development materials that help teachers analyze the discourse patterns of their own classrooms in order to improve instruction.
0918339	This project is developing and testing an interactive digital textbook that combines elements from *SimCalc*, *Geometer's Sketchpad*, and data analysis software to teach core topics in proportionality.
0918438	This project is developing and testing a professional development model for building middle school mathematics teachers' facilities with formative assessment.
0918834	This project is developing ten online professional development modules to help teachers implement the *Math Pathways and Pitfalls* lessons.
0929816	This projects funds a conference designed to help teachers and administrators who work in predominantly African American and Hispanic classrooms teach in ways that are culturally relevant and promote high achievement in these groups and studies the effect of the conference on the teaching and

classroom planning of a sample of its participants.

Science

0732109	This project explores the effects of three teacher professional development models on teacher performance and student achievement in STEM disciplines at schools serving large numbers of minority students.
0733143	This project develops and studies the effects of online professional development in support of teachers using *BirdSleuth*, a program that encourages students to do scientific research.
0733350	This project examines the impact of a teacher professional development program that connects teachers and science researchers.
0822016	This project develops a series of tools to help early career and pre-service science teachers rate their teaching and transition into using expert-like pedagogical practices.
0829225	This project represents the NSF's contribution to the International Polar Year. It consists of two symposia followed by four web seminars designed to share science content and educational resources with a large group of teachers across the country.
0918340	This project seeks to determine circumstances that enhance teacher ability to provide STM education using cyber collaboration between experts in science, technology and mathematics and middle and high school teachers working on issues of climate change.
0918697	This project examines the effect of four types of induction programs (district-based, e-mentoring, university-based, intern programs) on science teachers' retention.

Multidiscipline

0711138	This project consists of a conference designed to synthesize and disseminate research findings on promising ways to promote equitable access and opportunities for all students in mathematics classes and an understanding what mathematics means in students' lives.
0733198	The project revises STEM modules and an accompanying professional development component in order to facilitate high school teachers' instruction of 21st Century skills.
0822223	This project consists of case studies of mathematics teachers working in high poverty middle schools, focusing on an analysis of the intersection between language and learning.
0822373	This project is defining and synthesizing effective feedback strategies of daily classroom assessment practices. The project will create a toolkit for practitioners.
0918505	This exploratory project examines professional development on the integration of mathematics and science instruction, mediated by technology tools, to improve middle school teachers' teaching of scientific inquiry and problem solving.

Engineering

0822261	This project is developing and evaluating a learning progression for elementary school teachers as well as associated asynchronous, cyber-enabled professional development and networks aimed at supporting teachers' use of instructional engineering concepts and materials in classrooms.

High School

Award Number	Project Description

Mathematics

0732798	This project is developing a practice-based curriculum that focuses on reasoning proof for the professional education of pre-service and practicing secondary mathematics teachers.
0808817	This grant funded a national conference on progressive ideas about the future of curriculum, teaching, assessment, and technology in high school and early college mathematics.
0821996	The *Knowledge for Teaching Secondary School Mathematics* project examines the process of collaboration between mathematicians and mathematics teacher educators.
0822189 0822204	These projects are studying mathematics teachers' development using the *Video Mosaic Collaboratory*, an interactive digital environment for teacher professional development.
0918117	This project is developing and testing professional development materials that help teachers analyze the discourse patterns of their own classrooms in order to improve instruction.
0918425	This project develops materials to survey the rationality behind secondary mathematics teaching practice and to support the development of pre-service teachers, focusing on classroom algebra and geometry discussions.
0929816	This projects funds a conference designed to help teachers and administrators who work in predominantly African American and Hispanic classrooms teach in ways that are culturally relevant and promote high achievement in these groups and studies the effect of the conference on the teaching and classroom planning of a sample of its participants.

Science

0732186	This project is examining the effects of online professional development courses on high school biology teachers' content and pedagogical knowledge, and on their students' knowledge.
0733303	This project develops teacher guides for use of *Virtual Fieldwork Experiences* that support the use of inquiry based learning practices among Earth science teachers.
0733350	This project examines the impact of a teacher professional development program that connects teachers and science researchers.
0822016	This project develops a series of tools to help early career and pre-service science teachers rate their teaching and transition into using expert-like pedagogical practices.
0829225	This project represents the NSF's contribution to the International Polar Year. It consists of two symposia followed by four web seminars designed to share science content and educational resources with a large group of teachers across the country.
0918340	This project seeks to determine circumstances that enhance teacher ability to provide STM education using cyber collaboration between experts in science, technology and mathematics and middle and high school teachers working on issues of climate change.
0918697	This project examines the effect of four types of induction programs (district-based, e-mentoring, university-based, intern programs) on science teachers' retention.
0918702	This project is creating and testing an electronic teacher's guide for a genetics unit in *Foundation Science: Biology*.

Multidiscipline

0711138	This project consists of a conference designed to synthesize and disseminate research findings on promising ways to promote equitable access and opportunities for all students in mathematics classes and an understanding what mathematics means in students' lives.
0733198	The project revises STEM modules and an accompanying professional development component in order to facilitate high school teachers' instruction of 21st Century skills.
0822373	This project is defining and synthesizing effective feedback strategies of daily classroom assessment practices. The project will create a toolkit for practitioners.

Engineering

0822261	This project is developing and evaluating a learning progression for elementary school teachers as well as associated asynchronous, cyber-enabled professional development and networks aimed at supporting teachers' use of instructional engineering concepts and materials in classrooms.

Studying Implementation and the Effectiveness of Specific Interventions

Award Number	Grades	Project Description
Mathematics		
0918744	High school	This project compares the effects of dynamic geometry software and supporting instructional materials with standard instruction that does not make use of computer drawing tools.
0714890	Elementary, Middle school High school	This project funded participants' attendance at the *11th International Congress on Mathematical Education* in 2008, designed to present trends in all levels of mathematics teachers on an international scale.
0733690	Elementary Middle school	This project tests the scalability and replicability of the systemic *Gadsden Mathematics Initiative*.
Science		
0918277	Elementary	This project is testing the effectiveness at scale of the *Science Teachers Learning from Lesson Analysis* (STeLLA) professional development program.

Other

Award Number	Grades	Project Description
Mathematics		
0736558	No specific grade	This grant funds two conferences designed to allow researchers, practitioners, and policy makers to collaborate in the endeavor to ensure that the mathematics education research is addressing relevant problems.
0922410	No specific grade	This project forms a series of working groups designed to examine potential futures of STEM education and to brainstorm ways to effectively implement these visions.
Science		
0840039	Elementary, Middle school High school	This grant funds a symposium designed to improve K-12 education by supporting Black science educators and Black science education university faculty.
0733613	No specific grade	This project supports masters-level candidates with backgrounds in both science and education to conduct STEM education research for grades k-12.
Other		
0819063	Middle school	This project looks at the effects of a two year loan of laptops to middle school students, evaluating a variety of outcomes over a 12 month period.
0733379	Elementary, Middle school High school	This project's goals are to increase awareness of the need for computer science education standards, provide professional development for computer science educators, support research in computer science education, and promote this subject as a unique field of study.