



**Endeavor Science Teaching Certificate Project
Administered by U.S. Satellite Laboratory, Inc.
Cooperative Agreement – Year III Report
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PROJECT DESCRIPTION

The Endeavor Teacher Certificate Project (ESTCP) is a national Fellowship project for in-service, pre-service, and alternative-route teachers. The project awards over 200 Fellowships over a five-year grant lifetime. More than half of the NASA Endeavor Fellows serve underrepresented student populations, engaging them in NASA-related STEM content and career possibilities in the STEM areas as a result of their ESTCP experiences. ESTCP Fellows are selected by a diverse group of science education professionals and represent the 50 states, Puerto Rico and the U.S. Territories.

Fellows are required to complete a series of online courses and individualized Action Research projects. All 19 course offerings include cutting-edge content and are based upon NASA content from all mission directorates and the infusion of “STEM pedagogical strategies” and educational materials. Fellows also engage in a Leadership Distinction project to promote systemic change within their school system, their region, and state.

Endeavor Fellows are awarded a NASA Endeavor Certificate in STEM Education from Teachers College, Columbia University, with whom Endeavor partners. Columbia is the affiliation of a number of the Endeavor course instructors, as well as the coordinators of educational research that was initiated during Year II. In addition fifteen (15) graduate credits are awarded to each Fellow as each earns their STEM Certificate, and come from a regionally accredited partner in higher education.

Endeavor offers workshops for science teacher instructors in colleges of education to provide guidance and expertise about the implementation of STEM strategies in the classroom. The sessions guide the incorporation and delivery of NASA content in Methods and Practicum courses for pre-service and alternate-route educators.

Endeavor establishes cooperative dialogues with state departments of education to advance the opportunity for Fellows to apply credit for Endeavor courses toward state certification requirements.

PROJECT GOALS

Two primary ESTCP goals directly support two of the objectives of the NASA Education Framework Outcome Two.

1. Contribute to the development of a highly qualified educator workforce knowledgeable in NASA-related STEM content, proficient in effective instructional delivery models that are based

upon research-based best practices, and pro-active in STEM system change within their respective schools, regions and states.

2. Engage K-12 students in NASA-related STEM activities and experiences that positively influence their academic performance and interest in STEM careers through the Endeavor Fellows' classrooms or those of teachers they have trained.

PROJECT BENEFIT TO OUTCOME 2

Endeavor's goals contribute to achievement of NASA Education's Outcome 2 – Elementary and Secondary Education. Specifically, Endeavor advances the following Goals and Objectives.

Goal 1/ Objective 2.2.; Educator Professional Development – Long Duration

The Endeavor professional development model is designed to create a national cadre of 200+ Endeavor Fellows who demonstrate leadership in use of NASA-related STEM content within their classrooms and in educator workshops at the district, regional and state levels.

Goal 2/ Objective 2.4; Student Involvement

Throughout their individualized PD, Fellows explore how they will incorporate the content and best practices in their respective classes. The required Action Research Plan and Methods in STEM Education course require Fellows to apply and evaluate delivery of the content and instructional methods.

PROJECT ACCOMPLISHMENTS

The Endeavor Science Teaching Certificate Project has successfully recruited, selected, and implemented work with Cohort I, II, and III Fellows. 130 NASA Endeavor Fellows from 38 states (and Washington, DC, and Puerto Rico) in addition to 5 sponsored Endeavor Fellows, and 9 Teacher Educators from partnering universities, have been selected through a competitive process, completed at least one course, and have begun to infuse NASA content and educational products into their classroom practice.

A new partnership agreement was official on June 17, 2011. Houghton-Mifflin Harcourt will widely promote Endeavor as a solution for STEM professional development.

GOAL 1: Contribute to the development of a STEM workforce through a national science teacher certificate program including a series of online Short Courses and Action Research, based on NASA content and educational materials for 1) in-service, 2) alternate-route and 3) pre-service teachers, in elementary, middle or high school education.

GOAL 1 Project Objectives	Performance Measures	Progress as of 06/30/11 and plans for Year IV
<p>1. Receive over 2000 applications and award ESTCP Fellowships to over 200 diverse teachers from all 50 states, Washington DC, Puerto Rico and U.S. Territories so that they may take courses, receive graduate credit and collaborate with the NASA network of Fellows as they work toward certification at the state level.</p>	<ul style="list-style-type: none"> • 1000 teachers will be recruited from 50 states and U.S. territories to become ESTCP Fellows. 	<ul style="list-style-type: none"> • 1058 educators have submitted partial or completed applications for Cohorts I –III. 500 or more expected by 10/15/11 for Cohort IV. • 130 educators from 38 states, including 17 pre-service teachers, have been awarded Fellowships. • Fellows represent Urban, Suburban and Rural schools; Public, Private and Charter Schools; 62% of in-service Fellows’ schools report they are Title I eligible. • All Cohorts I, II, & III Fellows have completed at least one course.
<p>2. Improve <u>teacher pedagogical content knowledge</u> in related STEM disciplines as educators demonstrate changes in their practice, and <i>apply</i> science concepts with NASA content based on the latest research in science education.</p>	<ul style="list-style-type: none"> • By the end of each year, 75% of the participating Fellows will demonstrate increased PCK in related STEM disciplines. • By the end of each year, 75% of participating Fellows will demonstrate improved content knowledge in related STEM disciplines. • Action research reports will demonstrate changes in teaching practices in 75% of teachers 	<ul style="list-style-type: none"> • Teachers College research demonstrates improved PCK in the STEM disciplines and increased use of NASA content for instruction. Exit interviews illustrate that Fellows completing certificate report improved content knowledge. • 100% of Fellows demonstrate change in teaching practice.
<p>3. Infuse NASA content from all Mission Directorates and materials into pre-service teacher education programs</p>	<ul style="list-style-type: none"> • By the end of year 1, at least 3 partnering pre-service universities. • By the end of year 5, at least 20 partnering pre-service universities 	<ul style="list-style-type: none"> • Science Teacher Educators (Professors) from 9 universities (Columbia University, Alabama A&M, Kentucky State University, University of Pennsylvania, University of South Carolina, Southern Illinois University, Cleveland State University, Clemson University, and the University of Central Florida) are partnering with Endeavor. • Cohort II Teacher Educators (3) have already implemented NASA content into their pre-service methods courses. Cohort III Teacher Educators (6) are currently each taking Endeavor courses and will implement NASA content during the 2011-12 academic years. • 100% of Cohort II Teacher Educators (3) will begin presenting research on implementation at national conferences in early 2012.

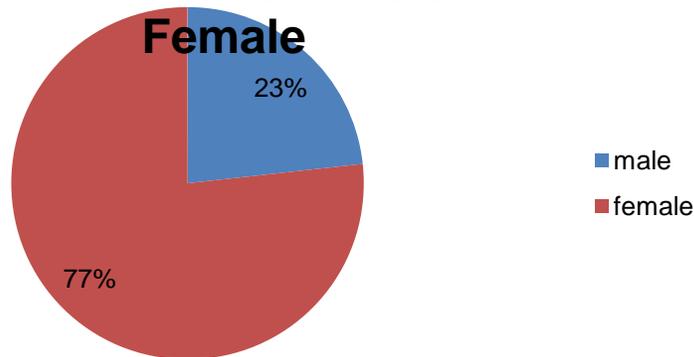
4. Assist teachers in earning/maintaining STEM credentials in their respective states	By the end of year 5, 50% of Fellows will meet state requirements for earning/maintaining credential.	<ul style="list-style-type: none"> • Coursework counted toward state certification established with State of Maine. • Additional meetings with state Departments of Education planned for Summer/Fall 2011 • SPECIAL new partnership expected to be announced with most prominent teacher association in Summer 2011
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Objective 1: Selection, Recruitment, and Partnerships with Teacher Educators.

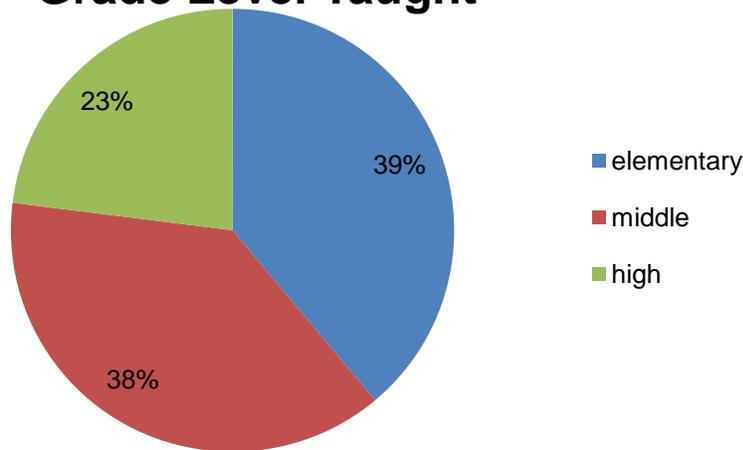
Endeavor Fellow recruitment and selection has been strong, with a very dedicated Selection Committee of now, “8” comprised of current and former classroom teachers and administrators, and current and former academic deans and education professors.

The charts below provide a cumulative overview of Fellows from Cohorts I- III.

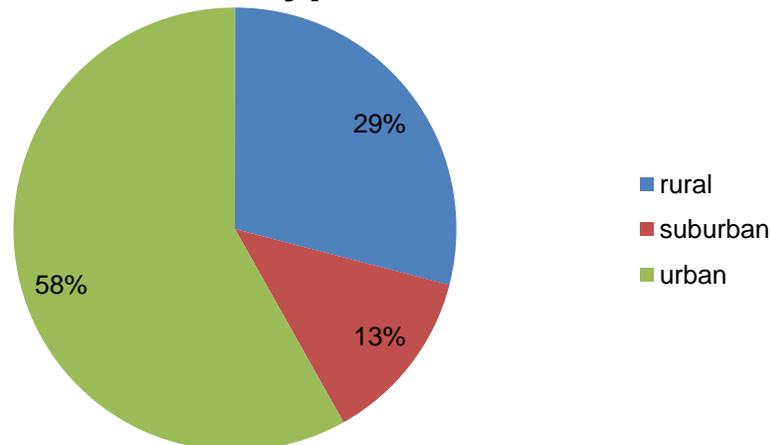
Endeavor Fellows - Male vs Female



Grade Level Taught



School Type



Objective 2: Improve Pedagogical Content Knowledge (PCK). *RESEARCH.* Research conducted by faculty and doctoral students from partner Teachers College, Columbia University, illustrates several key findings, including 1) an increase in self-efficacy of elementary teachers; 2) shifts in Fellows' STEM pedagogical beliefs toward more constructivist and student-centered learning models; 3) shifts in Fellows' mental models of teaching practices toward more modern research-based STEM pedagogical strategies. These findings are promising in terms of changing teachers' views and practices about STEM education, and may help to inform future research and program design within the field. Highlights are abbreviated below:

Finding 1-Increase in self-efficacy of elementary teachers. A case study of elementary Fellows revealed that the adaptability and flexibility of Endeavor contributed to Fellows' professional growth and self-efficacy as science teachers. In other words, the teachers directed their learning in the NASA Endeavor Project in a way that allowed them to gain both subject matter content and PCK, which in turn made them more confident teaching science and topics with science to their students. This increase in self-efficacy as teachers within their class prompted more leadership roles in the school.

Teachers report increasing their content knowledge within the STEM disciplines. Quotes from interviews of Fellows include:

- I feel more confident in my content knowledge, of course, because I've read a lot and learned a lot in the last eighteen months.
- It exposed me to a lot of different content that I did not have a great amount of background knowledge on... it just helped strengthened my class skills and ability to provide greater quality information to the students .

Finding 2-Shifts in Fellows' STEM pedagogical beliefs revealed that Fellows believe in more constructivist, student-centered teaching methodologies including using more inquiry, student-to-student discourse, and differentiated instruction. The following results from a belief questionnaire conducted with Cohort I Fellows describe some examples of how they felt about aspects of STEM instruction before and after participation in Endeavor.

During a lesson, all of the students in the class should be encouraged to use the same approach for conducting an experiment or solving a problem.

Answer Options	Before	After
Strongly Disagree	11.1%	38.9%
Disagree	30.6%	61.1%
Strongly Agree	5.6%	0.0%
Agree	52.8%	0.0%

Students should do most of the talking in science classrooms.

Answer Options	Before	After
Strongly Disagree	0.0%	2.9%
Disagree	51.4%	8.6%
Strongly Agree	5.7%	37.1%
Agree	42.9%	51.4%

Students know very little about science before they learn it in school.

Answer Options	Before	After
Strongly Disagree	5.6%	33.3%
Disagree	58.3%	52.8%
Strongly Agree	0.0%	11.1%
Agree	36.1%	2.8%

People are either talented at science or they are not, therefore student achievement in science is a reflection of their natural abilities.

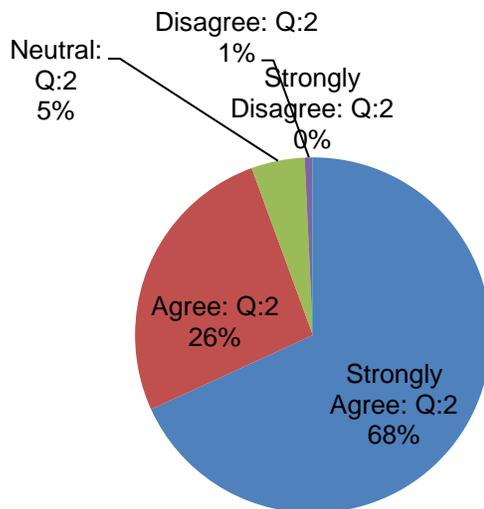
Answer Options	Before	After
Strongly Disagree	30.6%	69.4%
Disagree	47.2%	30.6%
Strongly Agree	0.0%	0.0%
Agree	22.2%	0.0%

These findings show a clear trend toward Fellows’ evolution of STEM pedagogical beliefs in the direction of supporting all STEM learners, building on their prior knowledge, and engaging them actively in lessons at all stages of the learning cycle.

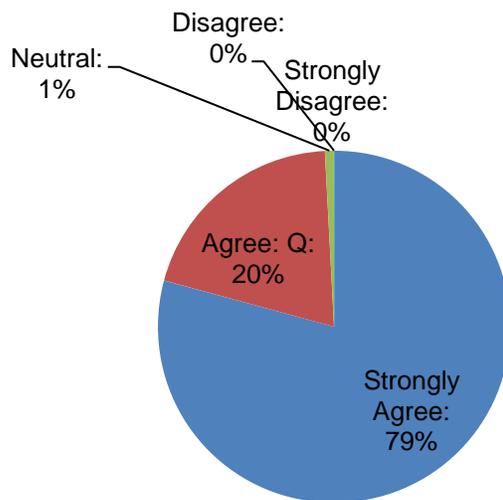
Finding 3- Evolution of mental models. Established research shows that the way teachers think about what good teaching looks like, and how they were taught, strongly influence their own teaching. Once mental models of teaching are established, it is difficult to change them. A researcher found, however, that the Endeavor project seems to contribute to the evolution of mental models of STEM teaching. For instance, in a survey conducted of a sample of Endeavor Fellows, 85% reported a shift in instructional practice to include more inquiry and 70% reported increased confidence in using inquiry-based instruction as a result of Endeavor courses. 93% reported using technology more frequently in classroom, despite not having been taught in classrooms that were technology-focused as children.

Course Evaluations.

Aggregated course evaluation data from Fall 2009 through Spring 2011 (charts shown below) demonstrate that even with such diverse offerings and a diverse group of Fellows, educators are gaining important understandings from each course.



This course [specific] contributed to my professional growth



I plan to implement something from the course into my teaching practice.

Comments in course evaluations also reflect changes in PCK. Examples include:

- I have worked on including Blooms taxonomy levels in my objectives. I have also incorporated some engineering lessons.
- The course helped with learning how to teach the various elements of STEM education.
- Through the readings I have opened up my thinking and added to my toolbox of strategies as an educator.
- Giving students choices and learning to instruct my subject areas together and more cohesively has been a highlight.
- I think more about including integrated lessons into my classes. I had never written a complete lesson plan; I had just used other sources. I feel very confident about using the NASA materials in my classes.

In addition to the studies above, several articles were written (some published) based on the work done by Endeavor Fellows. Soon, a link will be online that catalogs these for future reference.

Objective 3: Infuse NASA Content into Pre-service programs. The Cohort II Teacher Educators from Columbia University, Alabama A & M and Kentucky State University implemented NASA content including *NASA eClips*, *Project 3D-VIEW*, and *Why Files?* into their methods courses for pre-service educators in Fall 2010 and Spring 2011. In addition, the professors from Columbia and Kentucky State used an online collaboration tool to allow for communication and collaboration between their disparate students (students living in rural

Kentucky vs. New York City). The collaboration was highly successful, with the pre-service students sharing lesson plans and microteaching videos as well as discussing ways of engaging students and being respectful of students' backgrounds. The teacher educators are currently analyzing data from this collaboration and will present their findings at national research conferences in early 2012. The professor from Alabama A & M followed her pre-service Endeavor Fellow as she implemented NASA content in her student teaching, and will continue to support her as she begins her teaching career.

Objective 4: State DOE Partnerships. This objective has been a challenge. There are several reasons for this, but great headway has been made in this area with a new partner that will likely be announced in Summer 2011. Discussions with DOEs will evolve in a far different manner with the new partner.

GOAL 2: Attract K-12 students to STEM disciplines by providing professional development opportunities to teachers and, additionally, to science educator college faculty.

GOAL 2 Project Objectives	Performance Measures	Progress as of 06/30/11 and plans for Year IV
<p>1. Lead live, online, interactive workshops for science teacher educators at nationwide colleges and universities to learn to infuse NASA content and materials into methods and practicum courses and spark the interest of and attract pre-service teachers to become candidates for ESTCP Fellowships.</p>	<ul style="list-style-type: none"> ● Conduct successful workshops for college faculty. ● 50% of workshop participants will infuse NASA content in materials 	<ul style="list-style-type: none"> ● Science Teacher Educators participated in special live, online interactive seminar sessions this spring, and are each taking one course. ● All 3 Cohort II Teacher Educators have infused NASA content into one or more of their courses. ● Cohort III Teacher Educators (6) will infuse content during the next academic year.
<p>2. Support teachers in the field to ensure success in engaging a community of NASA Fellows in implementing NASA content and materials featuring a special, new Stanford online collaboration tool.</p>	<ul style="list-style-type: none"> ● 50% of Fellows will use online collaboration tool for support in classroom implementation. 	<ul style="list-style-type: none"> ● 100% of Fellows are using online collaboration tool(s). ● Fellows report that use of collaboration tool varies by course. ● Endeavor team presents results of online community at National Association of Research in Science Teaching (NARST) and is currently preparing a paper for publication.

<p>3. Award, in association with Teachers College and NASA's AESP Program, a <i>Leadership Distinction</i> to teachers who scale up what they have learned as part of the final course to the district and/or regional level.</p>	<p>At least 10% of ESTCP Fellows will earn <i>Leadership Distinction</i> to illustrate scaling up of ESTCP program to school, district, and/or regional level.</p>	<ul style="list-style-type: none"> • A major change in the project calls for 100% of Cohort II to earn the Leadership Distinction. This will contribute to Goal 1 and the ROI. This is taking place at the conclusion of earning the STEM Certificate • A new "Capstone Seminar Series" for a "non-credit" Endeavor Educator option to be marketed by Houghton-Mifflin Harcourt will promote short-term episodic PD beginning in Year IV.
<p>4. Increase interest of K-12 students in STEM and STEM careers.</p>	<ul style="list-style-type: none"> • At least 50% of students of ESTCP Fellows will show increased interest in NASA content and STEM careers. • At least 75% of students will show increased knowledge of NASA content • At least 75% of Fellows will demonstrate successful classroom implementation of NASA content 	<ul style="list-style-type: none"> • Pre/post student attitude and NASA content surveys will be conducted during the 2011-12 school year. • Electronic Portfolios and Action Research reports demonstrate successful implementation of NASA content by all Fellows. • Teachers College research reveals that coursework leads to improved understanding of infusion of NASA content and evolution of STEM pedagogical beliefs. • 5 Fellows participate in 2011 Summer internships at NASA centers; internships contribute to classrooms directly through piloting standards-based material, designed for both the NASA Endeavor Fellow community and the public.

Objective 1: Science Teacher Educator Workshops. The 6 Cohort III Teacher Educators from six distinct university partners participated in a webcast series this spring, and are taking diverse Endeavor courses, including Methods of STEM Education, Lessons from the Ocean, SPRINTT

and the “E” in STEM, and will be implementing NASA content and pedagogy for pre-service educators of their own, on their respective campuses, during the 2011-12 academic year.

Objective 2: Online Collaboration. 100% of Endeavor Fellows are using the online collaborative space. Fellows report that the importance of the online community varies among courses. For example, the Action Research course involves mostly independent work in one’s own school, making Fellows less likely to seek support from others. In other courses, it played a more important role. The team also believes that the live interaction in courses contributes to the building of an online community of practice. The difference between professional development here, and within a school district, is that here, there are many ways in which to successfully infuse content and the single educator decides how that takes place. Strategies and camaraderie of others who are “in the same boat” create an important dynamic for the successful implementation of content with instructional technology tools. Endeavor is on the lookout for the right, balanced “social/professional media tool” beyond the current, simple-to-use online management system.

ESTCP is planning additional activities during the 2011-2012 and 2012-2013 years. However, the marketing plan is still in development with Houghton-Mifflin Harcourt. Ideas include:

- Leading a webcast series for the New York STEM Collaborative and/or the nation, or other states with Houghton-Mifflin Harcourt or NASA, or with a successful “i3” winning proposal. This will invite thousands of educators and many various stakeholders to join and participate in webcasts that promote STEM professional development. Participants will be interactive with the webcasts. All types of education stakeholders are expected to participate.

- Leading a STEM Conference with Teachers College, Columbia University for a New York and regional audience. Endeavor continues to meet with officials in Newark, NJ to expand the project.

- Leading STEM workshops at national conferences. The model is to have Endeavor Fellows always present with Endeavor staff at these venues.

Objective 3: Leadership Distinction. New for Cohort 2 and beyond is the requirement for NASA Endeavor Fellows to earn a leadership designation, the Leadership Distinction. Each educator from Cohort 2 onward will be responsible for carrying out a project that offers a sample of their Endeavor experience to other educators. Endeavor Fellows will: 1) Share projects with other educators so that new teachers can learn pedagogical techniques to successfully integrate NASA assets into standards-based curriculum; 2) Offer professional development sessions and produce pre-and post- results; and 3) Access projects from others in order to serve a variety of needs outside of the NASA Fellows’ classroom walls.

The “Capstone Seminar Series” (non-credit) will help facilitate many more educators to adopt systemic practices throughout schools and districts.

Objective 4: Student Outcomes. Fellows’ Action Research Reports and Electronic Portfolios have demonstrated the effects of the program on students, specifically in the areas of student engagement and inquiry skills. Going forward this will continue. Additionally, in Year IV we will conduct a study assessing student attitudes toward STEM and STEM careers. “Content” for teachers and students need to be choreographed in a sophisticated study which may require funding beyond the scope of the current budget.

Action Research is an important part of the Endeavor Fellowship. Fellows select some aspect of teaching and learning to study. Topics studied in Year III include:

- Promoting self-directed learning in elementary school
- Engineering for struggling learners
- Underserved students' perceptions of science learning
- Reflective journaling in science class

Fellows are encouraged to share their work through presentations and publications.

PROJECT CONTRIBUTIONS TO PART MEASURES

Endeavor aligns with the following NASA Education's Outcomes, Objectives, and Measures:
Outcome II -Attract and retain students in STEM disciplines through a progression of education opportunities for students, teachers, and faculty.

Objective 2.2 Educator Professional Development – Long Duration

- Cohort II, and III plus 5 sponsored Fellows and 9 Teacher Educators from partnering universities = 145 Endeavor Fellows committed to -
- Completion of 5 online, NASA content focused STEM courses
- Development of an Action Research and Individual Plan for integration of content and best practices in their respective classrooms followed by assessment of student response
- Lead educator workshops and/or systemic efforts on how to integrate this content in current curriculum

2.2.1 Percentage of educators who participate in NASA training and use NASA resources in their classroom instruction

- 96% of Fellows report use of NASA resources in their respective classrooms
- 30 recipients of teaching awards
- 36 received professional promotion in science area and/or are serving on local or state science-related strategic committees.

2.2.2 Cost per participant, Endeavor Fellow

- In FY2011, \$4,950/participant for 101 NASA Endeavor Fellows

2.2 Student involvement K-12 Measures

2.4.1 Number of elementary and secondary student participants in NASA instructional and enrichment activities.

Metrics below come from Endeavor Fellow self-reported information from April 2011.

12,825 students are engaging in NASA content or instructional assets in the classroom due to direct interactions with Endeavor Fellows

6,666 additional students are engaging in NASA content or instructional assets in the classroom, due to interactions with educators who were trained or influenced by Endeavor Fellows.

Endeavor's Fellows are in-service, pre-service, and/or alternate-route educators. As Fellows they are required to be actively engaged in a 12-18 month professional development plan designed to improve their personal STEM proficiency, understanding of NASA-related STEM content plan, and use of evidence-based best pedagogical practices. Fellows incorporate 'lessons learned' into their classroom instructional delivery, in informal and formal methods of sharing with colleagues, and in participation on systemic committees at the local, regional, and state level.

Evaluation and data collection for Cohorts I,II, and III include independent Endeavor surveys, the number of self-reported recognition awards for teaching excellence, the number of self-reported professional promotion and/or appointment to systemic committees, individual Action Research Plans and reports and exit interviews.

IMPROVEMENTS (e.g. project management, efficiencies, etc.) MADE IN THE PAST YEAR

In a new partnership, Houghton Mifflin Harcourt became an exclusive distributor of sponsored fellowships and will widely promote Endeavor as a solution for STEM professional development.

As a note, due to staffing changes, project management of ESTCP within the Office of Education at Goddard Space Flight Center transitioned during March 2011 to Katherine Bender.

PROJECT PARTNERS AND ROLE OF PARTNERS IN PROJECT EXECUTION

By design, Endeavor's partnership with Teachers College, Columbia University has been significant in ensuring rigor of online courses and a high degree of credibility to the issued Certificates in STEM Education. Additionally, this partnership is key in exploring opportunities for publishable, academic research to be conducted with this project.

Significant partners and their role include:

- U.S. Satellite Laboratory, Inc.
 - Administers and implements the ESTCP

- Teachers College, Columbia University
 - 2011 Research results in use of STEM pedagogical strategies; mental models; use of NASA resources
 - Kentucky State University, Columbia University, Alabama A&M University, University of Pennsylvania, Cleveland State University, Southern Illinois University-Edwardsville; University of South Carolina; Clemson University-Greenville; University of Central Florida
 - Pre-service instructors infuse content into methods courses

- State Departments of Education (varied levels of application of Endeavor courses to state requirements for credit, certification)
 - Maine – Endeavor courses meet state science content & pedagogy certification requirements
 - Florida, Virginia – varied recognition but not full certification

- Higher Education Institutions
 - Adams State College, Alamosa, Colorado (provides graduate credit)
 - Kentucky State University (teacher educator involvement)
 - Alabama A&M University (teacher educator involvement)

- University of West Florida (provides graduate credit towards Masters Degree)
- Purdue University (course instructor and research partnership)
- Illinois State University (course instructor and research partnership)

Selection Committee (8 esteemed educators include retired and active Superintendents, K12 Science Supervisors, Elementary and High School Principals, Professional Development Specialist, Professors)

School Districts

- School Districts may sponsor additional Endeavor Fellows

Education Resource Providers

- Houghton-Mifflin Harcourt, distributor of sponsored fellowships will widely promote Endeavor as a solution for STEM professional development.

NASA Centers & Mission Directorates

- 2011 Summer Experiences – Teaching from Space; Goddard; Wallops
- Subject Matter Experts (SME's) – 20+



"I'm ten times more confident as a Science educator after going through the Endeavor program. I now have the knowledge, and state of the art resources, to keep my student engaged and on the cutting edge of science. It has made a world of difference to me and my students."

"My confidence as a STEM educator has grown tremendously since becoming a NASA Endeavor Fellow. Because I was a relatively new science teacher when I entered the program (had been a physical education teacher for 18 years before) I felt like I had so much to learn. The way the courses were set up and the way that the assignments were able to be tailored to my teaching situation, allowed me to come out of the program with so many usable activities and lessons. The fact that I was also exposed to such a great group of fellow educators through the online community was awesome and I still communicate with many of them. Because of my involvement with the fellowship, I was offered many leadership opportunities, which also helped to strengthen my confidence as an educator."