

STScI's Education Program: A Strategic Approach

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Discoveries from the Hubble Space Telescope provide an unprecedented resource to inspire, engage, and educate students of all ages and backgrounds in the fundamental concepts of science, technology, engineering, and mathematics. As the science operations center for Hubble, the Space Telescope Science Institute (STScI) is uniquely positioned to bring Hubble's current research to the classroom. Education materials created by STScI have been adopted by more than half the state Departments of Education in the country and reach an estimated half million teachers and six million students across the United States each year. We describe in this white paper the strategic approach we have taken to achieve this goal, and present some metrics of our success.

Two decades ago, the Space Telescope Science Institute (STScI) posed for itself this question: Could a small group of scientists and educators transform the breathtaking discoveries from the Hubble Space Telescope into meaningful and measurable education programs for America's schools, reaching millions of youths at a time? Hubble's discoveries provide an unprecedented opportunity to inspire, engage, and educate students of all ages and backgrounds in the fundamental concepts of science, technology, engineering, and mathematics (STEM). Today STScI's education materials have been adopted by more than half the state Departments of Education in the country and reach an estimated half million teachers and six million students across the United States each year. We describe below the strategic approach we have taken to achieve this goal.

Why Hubble and STScI

As the science operations center for Hubble, STScI is uniquely positioned to bring current research to the classroom. We do this through **scientist/educator partnerships**, which are at the heart of STScI's education programs. By bringing together active research scientists with education experts, we assure current, accurate science content and education products that are classroom-ready and held to the highest pedagogical standards. The commitment by scientists to communicate with students and the public has become so deeply embedded it has been called "NASA's social contract with the nation."

A strategic approach is necessary to deliver high caliber products on a national scale within a very limited budget. We have taken a two-fold strategic approach: a well-defined

development and evaluation model to produce products of high quality and impact; and leveraging strategies to extend reach.

Development and evaluation model

To attract and keep students in STEM fields, we **targeted middle school**. This represents a critical turning point for the STEM pipeline, as many students lose interest in science at this time. STSci’s education programs build on the natural appeal astronomy holds for children. To retain their interest, we create interactive middle school education materials using real data so that students remain engaged and have the opportunity to see themselves as real scientists.

STSci’s **development and evaluation model**, shown in Figure 1, assures that all products are standards-based, field-tested and evaluated for impact. A list of evaluations performed of STSci education products and programs can be found at <http://outreachoffice.stsci.edu/evaluation/>

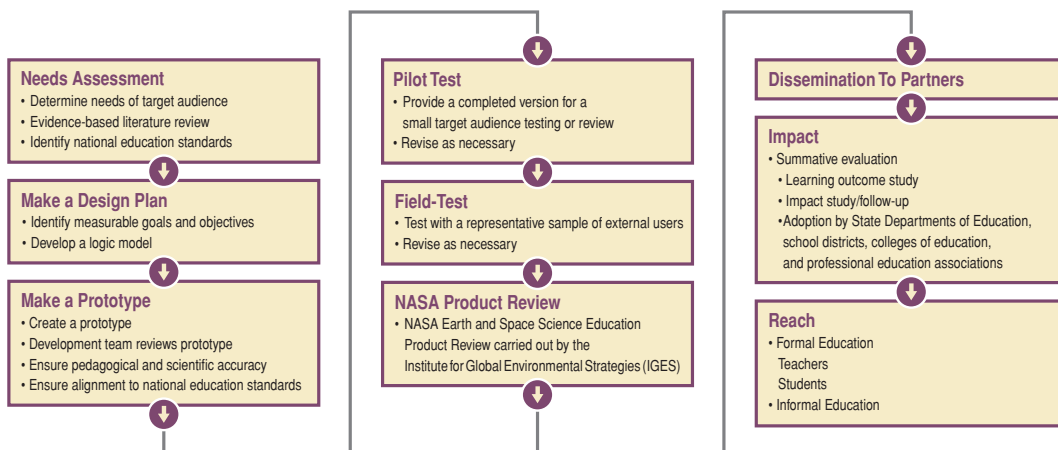


Figure 1 Development and evaluation model. Every formal and informal educational product follows a rigorous development model. Every product is standards-base, field-tested and evaluated for impact.

Impact studies confirm that these products and programs achieve their intended outcomes. For example, a learning outcome study by McREL demonstrated that STSci’s *Planet Impact* activity would increase the average student’s performance 13 percentile points relative to a control group on a standardized test for content.

We obtain feedback from a representative sample of more than 1400 venues (including colleges, school districts, and informal science education centers) to provide information on how, where and why our materials are used. These summative evaluations are sufficient to assure that these products remain useful and effective. A map of these evaluation venues is given in Figure 2.

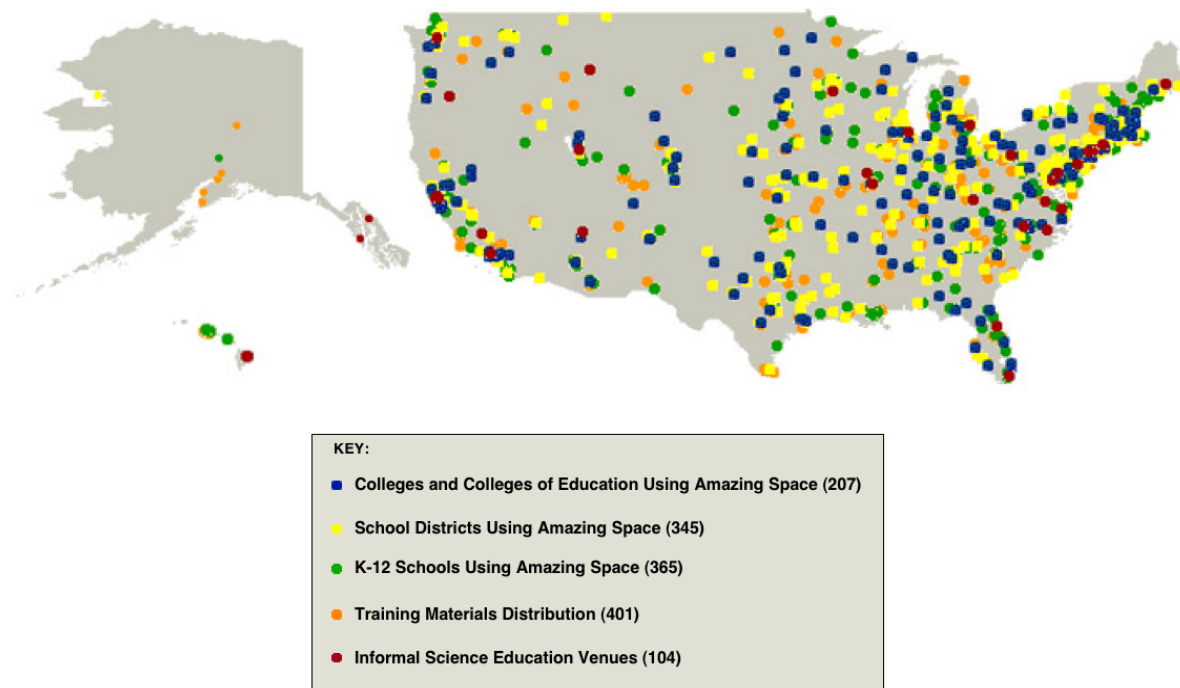


Figure 2 STSci carries out an ongoing program of interviews and surveys of over 1400 representative venues (including colleges, school districts and science centers) that use STSci’s education products, giving evidence that these materials remain useful and effective.

The most important indicator of the impact of STSci’s education products is its widespread use and adoption by the formal education community. STSci materials are used in all 50 states. More than half the state Departments of Education use STSci materials as a required or recommended element (see <http://outreachoffice.stsci.edu/evaluation/>)

Leveraging Strategies

In order to achieve national reach, it is necessary to use leveraging strategies. We employed three strategies: Strategic partnerships, professional development focused on master teachers, and online access to education materials.

Strategic partnerships allow us to reach new audiences and to integrate new techniques into our programs without reinventing or duplicating effort. We use a top-down approach, and enter into partnerships based on specific criteria that include sustainability, service to underserved/underrepresented populations and the willingness to collect and share follow-up data (summative evaluation). STSci places its materials in the hands of those who can best use them, and best disseminate them, for broad reach. STSci’s network of over 500 partners can be found at <http://outreachoffice.stsci.edu/education-partnerships/>.

Master Teachers represent a very powerful leveraging factor. STScI targets professional development workshops for master teachers aimed at training them how to use our *Amazing Space* materials so they can bring this knowledge back to the classroom. Each master teacher agrees to teach two classes of middle school science teachers. In effect, the ~1,100 master teachers who participated in our professional development workshops last year are expected to teach more than ~55,000 teachers, thereby reaching ~1.7 million students.

Online access. STScI was an early adopter to the use of the internet and web-based distribution of our educational products. Our online site for education materials, *Amazing Space*, provides students with interactive, inquiry-based learning that allows students to self-test, all of which are strategies known to enhance student learning. Nearly half of our student access comes through *Amazing Space*, the other half through extensive distribution of hardcopy materials. In total, we reach over 6 million students each year. Through informal education venues such as libraries, museums and science centers, STScI's internet-fed multimedia exhibit *ViewSpace* reaches nearly 9 million viewers.

Alignment with the Administration's goals

Our leveraging strategies are proven to work, and are strikingly similar to three initiatives described by the OSTP document, *Preparing a 21st Century Workforce: Science, Technology, Engineering and Mathematics (STEM) Education in the 2014 Budget* (April 10, 2013). These initiatives are:

- STEM Innovation Networks, which builds strategic partnerships
- STEM Master Teacher Corps
- STEM Virtual Learning Network

STScI continues to successfully transform Hubble discoveries into effective education products reaching millions of students nationwide. By targeting those students most vulnerable to abandoning future STEM careers, middle school students, we are taking a concrete step toward advancing the President's goal of a million new STEM graduates within a decade.

The STScI education metrics are summarized below, along with metrics for Public Outreach and News, which address national goals of student engagement and public awareness¹. For context, there are approximately 10 million students in public middle schools across the country. Our estimates suggest we reach more than half this number. We have achieved substantial national reach – at a remarkable cost of about 25¢ per student per year.

For a detailed breakdown of the metrics see <http://outreachoffice.stsci.edu/education-metrics/>
More detailed discussion of the topics covered in this paper can be found on the linked websites.

¹ Report of the Academic Competitiveness Council, U.S. Department of Education 2007.

SUMMARY OF STSci METRICS

FORMAL EDUCATION - ½ million teachers, 6 million students per year at a cost of 25¢ per student per year

STSci Formal Education	Metric	Leverage
K-12 students: Direct Interactions	2,000	
K-12 Teachers: Direct Interactions	1,100	Through Master Teachers, a further 55,000 teachers and 1.7 million students reached
K-12 engaged *	6.7 million	Materials used in all 50 states, integrated into programs of more than half the U.S. state departments of education
K-12 teachers engaged	520,000	STSci's <i>Amazing Space</i> website is integrated into Ohio's required pre-service educator training program, reaching over 20,000 educators

* McREL Inc conducted a learning outcome study showing that students using STSci's *Planet Impact* would score 13 percentile points higher than a control group on a standardized test.

INFORMAL EDUCATION (e.g., museums, libraries) - 9 million people per year

STSci Informal Education	Metric	Measurement Example
Participants/Observers	9 million	Preliminary result by Cornerstone Evaluation Associates LLC of library program measured ~30% increase in astronomy book check-out rates

PUBLIC OUTREACH - 24 million people per year

STSci Public Outreach	Metric	Measurement Example
Outreach: Direct Interactions	46,000	
Outreach	24 million	HubbleSite receives 2 million visits per month (10% of NASA's online traffic)

NEWS - over 100 million potential readers every two weeks

STSci NEWS	Metric	Reach metric	Circulation
Press Releases	28 per year	Average circulation per release	140 million
Online Articles	3,300 per year	Total circulation per year	3.8 billion