Bringing Space Down to Earth and into the Classroom

Edna DeVore
Director of Education & Outreach
SETI Institute
The NASA SMD vision for Education is:

• To share the story, the science, and the adventure of NASA’s scientific explorations of our home planet, the solar system and the universe and beyond through stimulating and informative activities and experiences created by experts, delivered effectively and efficiently to learners of many backgrounds via proven conduits, thus providing a return on the public’s investment in NASA’s scientific research.
SMD Model

SMD Science Education Model

SMD Assets (Content, SME’s, etc) *
- Heliophysics
- Astrophysics
- Planetary
- Earth
- Cross-divisional

Science Education Provider(s)
- Examples:
  - Translate Datasets to useful information for users
  - Alignment to education Standards and Decadal Questions
  - Enable SMEs to share science with target audiences
  - Professional Educator Development/Workshops
  - Open/transparent reporting
  - Timely evaluation/relevant assessment
  - Development of curricula & other education materials, as requested

Outcomes to Meet these SMD Science Education Objectives
- Enable STEM Education
  - Improve U.S. Science Literacy
  - Advance National Education Goals
  - Leverage Through Partnerships

Partnering Opportunities

* Divisions responsible for science content datasets, Infrastructure/Tools (e.g. Eyes, GSFC Visualizations), SME selection, and enabling flight opportunities
Five priority STEM education investment areas.

• Improve STEM instruction
• Increase and sustain youth and public engagement in STEM
• Enhance STEM experiences for undergraduate students
• Better serve groups historically under-represented in STEM fields
• Design graduate education for tomorrow’s STEM workforce
**Improve STEM Instruction**

Prepare 100,000 excellent new K-12 STEM teachers by 2020, and support the existing STEM teacher workforce.

- **NASA/IPAC Teacher Archive Research Program**
- **STEM Teacher as Researcher**
- **Airborne Astronomy Ambassadors**
Increase and Sustain Youth and Public Engagement in STEM

Support a 50 percent increase in the number of U.S. youth who have an authentic STEM experience each year prior to completing high school.
Enhance STEM Experience of Undergraduate Students

Graduate one million additional students with degrees in STEM fields over the next 10 years
Better Serve Groups Historically Underrepresented in STEM Fields

Increase the number of students from groups that have been underrepresented in STEM fields that graduate with STEM degrees in the next 10 years and improve women’s participation in areas of STEM where they are significantly underrepresented.
Percent of Bachelor’s Degrees Earned by Women, by Major

Data: American Physical Society
Better Serve Groups Historically Underrepresented in STEM Fields

Increase the number of students from groups that have been underrepresented in STEM fields that graduate with STEM degrees in the next 10 years and improve women’s participation in areas of STEM where they are significantly underrepresented.
Design Graduate Education for Tomorrow’s STEM Workforce

Provide graduate-trained STEM professionals with basic and applied research expertise, options to acquire specialized skills in areas of national importance, mission-critical workforce needs for the CoSTEM agencies, and ancillary skills needed for success in a broad range of careers.
Challenge:
How do NASA’s programs match the Framework and the NGSS?

July 2011

April 2013
Next Generation Science Standards
Challenge:
How to match NASA’s programs with the Framework and the NGSS?

Rubric helps measure alignment with:
- Practices
- Crosscutting concepts
- Core Disciplines

All students should graduate from high school ready for college, careers and citizenship.
Achieve Rubric for NGSS Alignment

**Equipped Rubric for Lessons & Units: Science**

**Reviewer Name or ID:**
**Science Lesson/Unit Title:**
**Grade:**

### I. Alignment to the NGSS

The lesson or unit aligns with the conceptual shifts of the NGSS:

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Specific evidence from materials and reviewers’ reasoning</th>
<th>Suggestions for improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ A. Grade-appropriate elements of the science and engineering practice(s), disciplinary core idea(s), and crosscutting concept(s), work together to support students in three-dimensional learning to make sense of phenomena and/or to design solutions to problems. i. Provides opportunities to develop and use specific elements of the practice(s) to make sense of phenomena and/or to design solutions to problems. ii. Provides opportunities to develop and use specific elements of the disciplinary core idea(s) to make sense of phenomena and/or to design solutions to problems. iii. Provides opportunities to develop and use specific elements of the crosscutting concept(s) to make sense of phenomena and/or to design solutions to problems. iv. The three dimensions work together to support students to make sense of phenomena and/or to design solutions to problems.</td>
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A unit or longer lesson will also:

<table>
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<tbody>
<tr>
<td>□ B. Lessons fit together coherently targeting a set of performance expectations. i. Each lesson links to previous lessons and provides a need to engage in the current lesson. ii. The lessons help students develop proficiency on a targeted set of performance expectations.</td>
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</tr>
<tr>
<td>□ C. Where appropriate, disciplinary core ideas from different disciplines are used together to explain phenomena.</td>
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<tr>
<td>□ D. Where appropriate, crosscutting concepts are used in the explanation of phenomena from a variety of disciplines.</td>
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<tr>
<td>□ E. Provides grade-appropriate connection(s) to the Common Core State Standards in Mathematics and/or English Language Arts &amp; Literacy in History/Social Studies, Science and Technical Subjects.</td>
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</tbody>
</table>
Challenge: Who uses the Framework and NGSS?
Common Core Standards for Reading and Mathematics

![Map of the United States showing states that have adopted or not adopted Common Core standards.](Image)

Source: Common Core State Standards Initiative
NGSS Adopted: 12 States + DC

Next Generation Science Standards Activity Map* as of 10/23/14

- **Green** denotes states that have adopted NGSS.
- **Yellow** denotes states with other science standards.

*DC*
Standards: The Challenge

• NASA SMD Education supports NASA’s Vision for Education, which reflects *Federal STEM Education 5-Year Strategic Plan*
• NASA Education programs need to think *nationally* yet *serve State and local needs*.
• *Framework* and *NGSS* are new, and still undergoing adoption
• Education is the constitutional responsibility of the States.
• State and local property taxes pay 90%+ of $700 Billion
• States formulate state standards
• Districts implement or adapt State standards
• Schools/teachers develop curriculum based on State or District standards
• Teachers implement the curriculum
Challenge:
How can NASA best encourage and support teachers to use NASA Education resources in the classroom?
Challenge:
Reaching Teachers and Students

• 67,000 public elementary schools
• 35 million students grades K-8
• 1.7 million teachers
  - 18,000 science
  - 32,000 math
Challenge: Reaching Teachers and Students

- 25,000 public high schools
- 15 million students grades 9-12
- 1.7 million teachers
  - 209,000 science
  - 250,000 math
Challenge:
Reaching Teachers and Students

- ~50 million students in all schools, K-12
- 92,000 public schools
- 33,370 private schools
- ~3.4 million public school teachers
  - 227,000 science
  - 282,000 math
- ~456,000 private school teachers
Challenge:
What do Teachers and Students Need?

*Needs assessment:*
- Inspiration?
- Motivation?
- Teacher professional development?
- Standards-based materials?
- New inquiry-based lessons?
- New hands-on labs?
- Simulations?
- NASA data for teacher and student use?
- Assessment tools?
Inspiration and Motivation

- NASA has great stories
- Adventure and exploration
- Amazing discoveries
- Exciting careers
Professional Development

• Exposure: NSTA, State conferences, websites
• Instruction: presentations in-person, video, online
• In-depth training:
  - institutes
  - courses
  - sustained relationship to a community
• Research experiences/internships
• Sustained relationships with scientists, engineers and other educators
Continuum of scientist-engineer’s engagement in science education

Observatory/Research Site Laboratory

- Teacher/Scientist Partnerships
- Mentoring teachers/students
- Pre-service & In-service Teacher Preparation
- Reform curriculum development
- Text products web, print, media
- Lecture with slides

Classroom
Continuum of scientist-engineer’s engagement in science education

NASA’s people:
- 18,000 civil servants
- 40,000 contractors
How Can We Have the Greatest Impact?
No Shortage of On-line Materials....

- NASA Wavelength Digital Library: 2,134 lessons
- NASA Summer of Innovation: 90 lessons

Beyond NASA.....

- *Open Culture Portal*
  - 950 free, online courses
  - 675 online films
  - 550 free audio books
  - 600 free eBooks
  - online language instruction: 46 languages
  - 200 free kids educational lessons
    (video, apps, books, websites)
The FOSS (Full Option Science System) Planetary Science middle school module is a kit-based course, with hard-copy teacher guide, student materials, plus web-based resources. Kepler EPO infused Kepler science and discoveries in the newly revised Planetary Science course. FOSS curriculum is used in all fifty states by over 100,000 teachers and 2 million students; it is in about 16% of the nation’s school districts. More importantly, FOSS is adopted in 50 of the 100 largest urban school districts where FOSS reaches large populations of under-served students.
# Expanded Reach through Partnerships*

<table>
<thead>
<tr>
<th>ORGANIZATIONS</th>
<th>TEXTBOOKS/CURRICULUM</th>
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<tbody>
<tr>
<td>Space Grant Consortia</td>
<td>Houghton Mifflin</td>
</tr>
<tr>
<td>Learning.com</td>
<td>Lawrence Hall of Science</td>
</tr>
<tr>
<td>WorldWide Telescope</td>
<td>NSTA SciGuides</td>
</tr>
<tr>
<td>American Library Association</td>
<td>Brooks/Cole</td>
</tr>
<tr>
<td>Association</td>
<td>McGraw-Hill</td>
</tr>
<tr>
<td>National Federation of the Blind</td>
<td>Harcourt</td>
</tr>
<tr>
<td>Night Sky Network</td>
<td>Scholastic</td>
</tr>
<tr>
<td>Spitz Digital Institute</td>
<td>Open Court</td>
</tr>
<tr>
<td>Maryland Science Center</td>
<td>MacMillan</td>
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<tr>
<td>The After-School Institute</td>
<td>Baltimore County Curriculum</td>
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<tr>
<td></td>
<td>&amp; Star Lab Program</td>
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* OPO at STScI
## Expanded Reach through Partnerships

### UNIVERSITIES
- Johns Hopkins University
- Morgan State University
- University of Texas at Austin
- University of Chicago
- Georgia State University
- California State University, Sacramento
- Penn State University
- Virginia Tech University
- Immaculata University

### DIVERSITY
- Morgan State
- Baltimore City After School Institute
- Women’s Collaborative Project Tactile Astro
- STEMcx

### STATE DEPTS. OF EDUCATION
- Texas, Mississippi, Virginia, Pennsylvania, California, Ohio, South Carolina

*Selected by 27 states, and used in all 50.*

* OPO at STScI
Does the Digital Divide Exist?

At School:
- 3.1 students per computer
- Band-width issues remain

At Home—Impacted by:
- Age
- Ethnicity
- Income
Age & Ethnicity Impact on Computer Use

**Percentage of Households With Computers and Internet Use: 2013**
(Data based on sample. For information on confidentiality protection, sampling error, nonsampling error, and definitions, see www.census.gov/acs/www/)

### Age of Householder

- **15–34 years**
  - Computer ownership: 92.1%
  - Internet use: 77.7%

- **35–44 years**
  - Computer ownership: 92.5%
  - Internet use: 82.5%

- **45–64 years**
  - Computer ownership: 86.8%
  - Internet use: 78.7%

- **65 years and older**
  - Computer ownership: 65.1%
  - Internet use: 58.3%

### Race and Hispanic Origin of Householder

- **White alone non-Hispanic**
  - Computer ownership: 85.4%
  - Internet use: 77.4%

- **Black alone non-Hispanic**
  - Computer ownership: 75.8%
  - Internet use: 61.3%

- **Asian alone non-Hispanic**
  - Computer ownership: 92.5%
  - Internet use: 86.6%

- **Hispanic (of any race)**
  - Computer ownership: 66.7%
  - Internet use: 79.7%
Income Impact on Computer Use

<table>
<thead>
<tr>
<th>Household income</th>
<th>Internet Use (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than $25,000</td>
<td>62.4</td>
</tr>
<tr>
<td>$25,000 to $49,999</td>
<td>81.1</td>
</tr>
<tr>
<td>$50,000 to $99,999</td>
<td>92.6</td>
</tr>
<tr>
<td>$100,000 to $149,999</td>
<td>97.1</td>
</tr>
<tr>
<td>$150,000 and more</td>
<td>98.1</td>
</tr>
</tbody>
</table>

Note: About 4.2 percent of all households reported household internet use without a paid subscription. These households are not included in this figure.
Source: U.S. Census Bureau, 2013 American Community Survey.
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Conclusion:

• NASA Education can make a difference
• Be attentive to Standards: Framework, NGSS, and State Standards
• Identify the needs of teachers and students
• Engage in teacher professional development
• Leverage partnerships to maximize reach and impact
• Continue to reach across the digital divide to schools and homes to deliver NASA’s story
• Think nationally; be prepared to act locally.
Need to make contact?

www.seti.org
edevore@seti.org