**“It changed my life”: Surveys of Users of NASA Educational Materials**

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**Abstract**

We present the results of two surveys of users of NASA SMD educational materials, to determine whether these materials have been effective in the past and to determine which kinds of educational activities and materials will be most effective in the future. The results from users of NASA data are quite striking: an overwhelming fraction when asked whether they were inspired by NASA missions replied “a lot” or “changed my life”: 98% of teachers and 100% of museum educators. What was perhaps more important is that we also got surveys from a control group of 114 adults, internet active but otherwise not selected by age, gender, occupation or location. Even in this group, a substantial fraction reported that NASA inspiration was very important (45%) and helped encourage their study of STEM subjects and even career choice. When asked, “should NASA continue to create educational materials?”, virtually all teachers and museum educators selected “absolutely” or “yes”, and 89% of the control group agreed. A second study evaluated whether 201 teachers preferred for their own professional development either fully-online courses with no realtime faculty feedback (e.g. a MOOC) or a hybrid system with part of the instruction being remote over internet videoconferencing but synchronous, coupled with an in-person workshop to do hands-on activities. The teachers polled overwhelmingly preferred instruction with real-time participation over a fully-online course with no live teacher interaction.

**Background**

Educational activities at NASA have been performed over the past twenty years by two distinct groups. One is the “Office of Education”, that runs the teacher resource centers around the country, and the other is the Science Mission Directorate (SMD) Education and Public Outreach (E/PO) efforts, which were created in 1993 by a 1% set aside of SMD mission funds. Over the past two years, the funding of NASA SMD E/PO has been curtailed substantially, first from the sequestration of early 2013 to the government shutdown of late 2013 to the “COSTEM” [*White House*, 2013] initiative that removed all NASA mission-related E/PO ($50 Million in FY14). Despite congressional action that restored $42 Million, none of the education funding was restored to the missions in FY14. The funds for FY15 are being distributed via several COSTEM venues, none of which are administered or directly associated with missions, and much of it is not even administered by NASA. This is a travesty, since the funds for NASA mission-based E/PO were never education funds in the first place.

The reason NASA scientists voted the set-aside of 1 to 3% of *mission* funds because they did not think that their missions were being adequately explained to the public by the Education Division at that time [*Morrow et al.,* 2014]. That strategic plan devised an “education ecosystem”, where scientists associated with the missions would work closely with educational professionals to create accurate educational materials, communication of the science results and coordination of programs [e.g. *Peticolas et al.,* 2010]. The missions would be associated with one of more discipline “Forums”, which would perform the coordination efforts and reduce duplication and identify gaps. The four Forums existing today (but threatened) are the Solar System, the Earth Science, the Astrophysics, and Heliophysics Forum. Their workspace for collaboration and communication has over 700 registered members [ <http://www.smdepo.org/page/544> ].

This program has worked remarkably well for the past twenty years. The SMD-developed materials, for example, are all reviewed by scientists and educators and available to the public via a searchable database [<http://www.nasawavelength.org>]. The recent budget actions have effectively dismantled the program, with a number of education professionals leaving the field. This survey was designed to help determine whether NASA mission outreach efforts were successful in inspiring teachers, informal educators, and the public.

***Survey #1: “NASA Influences on your Life”***

Survey #1 was designed to measure the effectiveness of NASA as an inspiration, both for future careers and for interest in science. The survey was conducted online using the “Survey Monkey” web application with only private funds. Links to the survey were sent out to three groups of registered users of our outreach materials. Most of the outreach materials (e.g. Space Update or Discovery Dome) had been created at Rice University by our various NASA grants and Cooperative Agreements, or the teachers have participated in workshops or booth activities. These email exploders reach the following groups: (1) “E-teachers”: teacher users plus E/PO professionals. (2) “spacemus”: Museum and planetarium educators; and (3) “spaceup”: private and student users. Responses from each of these were categories were tabulated separately. A notice of the survey was also posted to various news groups and facebook pages for educators. These respondents were included in the (3) “Other users” category along with the “spaceup” group. In addition, we purchased from SurveyMonkey.com 114 responses from the general adult population, internet active adults >18 years old but otherwise not selected by age, gender, or occupation, to be our control “General Public” group.

Here are the questions in Survey #1, plus the answers separated by respondents. Note the tremendous influence of NASA noted by teachers and museum educators. However, even 44% of the general public stated they were inspired “a lot” or “changed my life”. Most of the teachers (82%) and museum educators (85%) reported strong influence of NASA on their careers, but remarkably even 14% of the general public reported strong influence of NASA on their careers.

*Figure 1a. Did NASA inspire you? The colors represent the various categories of respondents. For the numerical data, see the appendix.*

*Figure 1b. Responses to “Did NASA encourage you to study STEM in college?”, sorted by respondent*

*Figure 1C. Responses to the question “did NASA influence your career choice?”*

Unfortunately, it is difficult to get longitudinal studies on the effects of workshops and activities on student careers, but we have examples of students being profoundly influenced by such events: for example, one girl just enrolled as a freshman at Rice University as a direct result of attending a Sally Ride Festival in middle school. Another Hispanic woman had participated in our “Brownsville Space Days”, then helped with them, then majored in science at a minority-serving University and now is an instructor at a junior college.

Our next series of questions involved how the respondents received NASA information during their school years, their method of learning now, and their preferred methods. They could select multiple responses for each. As youths, teachers were profound influences, but museums, books, TV, and planetariums were all important ways they learned about NASA.

We then asked what ways they learned from NASA now, and what was their favorite mode. The web has now risen to the primary way that most receive information, but Museums and Planetariums remain strong. Teachers also strongly prefer workshops and meetings, presumably to be able to learn hands-on techniques from experts and from their peers.

*Figure 2A. Responses to the question “how did you receive NASA information during your school years?” Note: “Workshop” selection was actually “teacher workshops or meetings”*

Our next series of questions involved the quality of the NASA-created materials they had seen and used. Only some of the ‘general public’ had little contact with NASA materials.

*Figure 3A. “What is the quality of the NASA materials you have seen lately?”*

 The final survey question asked: “Should NASA mission continue to create educational materials such as activities, planetarium shows, etc?”. The response was a tremendous acclaim, with 75% saying “Absolutely”. Even of the general public, 89% responded “Absolutely” or “Yes”.

*Figure 3A. “What is the effectiveness of the NASA materials you have seen lately?”*

In addition to these study questions, we asked the respondents demographic questions about their college field of study, their careers now, and their highest level of school attained (available on request for further study).

***Survey #2: Teacher Professional Development***

In our second survey, conducted in spring 2014, we asked teachers about their preferred professional development avenues. The first question was “are you interested in STEM teacher professional development?”

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| **1. Would you be interested in getting Educator Professional Development on any NASA topic (e.g. solar system, earth science, astronomy, aeronautics, or human exploration), either as Continuing Education Units (CEU's) or as actual college graduate credit (applicable to a degree?).** | Definite-ly not0.0% | Probab-ly not2.0% | Possibly yes 24.8% | Definitely yes 68.8% |

The second question asked about which topics the teachers were interested in getting training in. The answers are shown below in order of average score, with definitely not = 1 and definitely yes = 4. Not surprisingly, the topics most desired are the ones that are most common in the science standards and in their own curricula.

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| **2. Which of these subjects would you be most interested in getting additional content training in?** (answer as many as you choose; listing here by score) | Definitely not | Probably not | Possibly yes | Definitely yes | Average Score |
| Earth Science (geology) | 1.1% | 7.3% | 28.5% | 63.1% | 3.54 |
| Earth System Science (climate, etc) | 1.6% | 6.5% | 31.4% | 60.5% | 3.51 |
| Sun and its effects | 1.7% | 6.9% | 33.7% | 57.7% | 3.47 |
| Solar System | 1.7% | 10.7% | 36.7% | 50.9% | 3.37 |
| Astronomy and Astronomy Missions | 2.9% | 12.2% | 38.4% | 46.5% | 3.28 |
| Basic Physics (Mechanics, magnetism) | 3.5% | 14.5% | 32.4% | 49.7% | 3.28 |
| Mathematics from space science | 4.2% | 11.5% | 38.0% | 46.4% | 3.27 |
| The Moon | 3.5% | 18.8% | 28.8% | 48.8% | 3.23 |
| Astrobiology | 4.8% | 14.4% | 34.7% | 46.1% | 3.22 |
| Human Exploration | 3.5% | 16.8% | 36.4% | 43.4% | 3.20 |
| Aeronautics and Flight | 6.0% | 19.9% | 37.4% | 36.8% | 3.05 |
| Electronics and Ham Radio | 12.1% | 26.7% | 35.2% | 26.1% | 2.75 |

We then asked the teachers about how they would like their professional development delivered. We proposed a hybrid national program: “We are considering offering a program where inservice teachers come to a central location for one week in the summer, expenses paid, and then participate in one or more classes during the academic year, one evening a week for three hours. These classes are set up such that you can participate remotely from your home, from your school, or from a local community college. You would get a modest stipend and either CEU's or 3 hours of academic credit each semester course that you completed. Does this sound like something that you would like to do, assuming that it might fit your schedule? There would be a range of possible courses, including Solar System, Astronomy, Earth Science, Solar Science, Electronics, Astrobiology, etc).”

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| **3. Would you be interested in a hybrid program (one week in person, school year remote participation)?** | Definitely not0.0% | Probably not1.5% | Possibly yes25.4% | Definitely yes 71.1% | N/A2% |

We asked what kind of recognition of completion would be desired after the training: CEU’s (Continuing Education Units) or full academic credit (3 hours per semester). Most do not require full academic credit, but nearly half would want some kind of official CEU documentation of their participation to keep their certificates up to date.

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| **4. What type of recognition of completion would you like to have at the end of the semester?** | Certificate of completion40.0% | CEU’s14.4% | 3 hours academic credit21.1% | CEU’s or academic credit 30.4% | N/A2% |

Finally, we asked whether a fully-online asynchronous course, like a MOOC, with no personal interaction with the teacher, would be of interest to them. There was a lot of interest, but not nearly as much as for the hybrid synchronous course.

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| **5. Would you be interested in a com–pletely online course with no live human interaction, like a Coursera course?** | Definitely not3.6% | Probably not21.24% | Possibly yes46.6% | Definitely yes 26.4% | N/A2% |

We also asked what sort of stipend would be needed for one week of summer workshop (Most teachers would participate for $500 or less a week plus expenses), and what amount the teachers would be willing to pay for such training if grant resources were not available (many would pay $150 for CEUs but few can afford $1200 for 3 hours of credit). Other demographic questions asked in this survey included what level the teachers were teaching, and what subjects the teachers were teaching. Sorting the results by grade level or by courses taught, not surprisingly, affects the subjects that the teachers are most interested in. The full survey responses will be made available on request.

**Survey Comments**

Quite a few of respondents added comments to the surveys, emphasizing the influence of NASA.

Sample comments, all from the “general public” respondents of survey 1:

*“I am a fine arts man, while NASA did not directly influence me to go into Science, Technology, Engineering or Math, I know it has affected my life in innumerable ways; many of which, I am sure, I don't even recognize. It is a vital program and worth the full investment of the American people.”*

*“I'm not sure if any one NASA mission specifically influenced me, but I have to think that the sum total of NASA's accomplishments affected my interest in STEM and thus my career as an engineer.”*

*“If anything, NASA needs more support and funding to encourage and educate people of all ages and backgrounds.”*

*“Being from a very small community with no access to museums, the materials provided through school, videos and television programs were wonderful to spark interest in an area which wasn't prevalent in my area”.*

**Conclusions**

An overwhelming fraction of the educators said that NASA information had a major impact or “changed my life”. But, perhaps surprisingly, even 44% of the general public said NASA inspired them “a lot” or “changed my life”. Almost 25% of the general public said that NASA encouraged them to study STEM.

Many routes reached users in their youth, particularly teachers and museums/planetariums. The preferred route for all now is the web, but museums and planetariums and TV remain strong.

As for online synchronous or asynchronous teacher professional development, a number of teachers expressed interest, with more of them interested in courses in which they could participate remotely in real time than in a fully online MOOC. The subjects they were interested in receiving professional development were subjects which were part of the curriculum they are teaching, with less interest in aeronautics, human exploration, and electronics that are not part of the typical curriculum.

We are using these results to inform our outreach efforts [*Reiff and Cline*, 2014] and the operation of our Master of Science Teaching program courses (<http://space.rice.edu/MST>) that we offer at Rice University. This year we are offering synchronous remote participation in our “Astronomy for Teachers” course with eight remote participants.

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**References**

Morrow, C., P. Reiff, R. Lopez, and T. Moore, "Morrow, Reiff Receive 2014 Space Physics and Aeronomy Richard Carrington Awards" (Citations and Responses), *EOS,* 95, doi: 10.1002/2014EO330015 (2014).

Peticolas, L.; Méndez, B. J. H.; Yan, D.; Bartolone, L.; Robinson, D.; Maggi, B.; Adams, P.; Walker, A.; Reiff, P.; Beisser, K.; Turney, D. "A Heliophysics Education and Public Outreach Effort: Training and Supporting the Trainers", in Science Education and Outreach: Forging a Path to the Future. Proceedings of a conference held September 12-16, 2009 in Millbrae, California, USA. Edited by Jonathan Barnes, Denise A. Smith, Michael G. Gibbs, and James G. Manning, p.420, (2010).

Reiff, P. H. and T. Cline, “Education and Communication for the Magnetospheric Multiscale Mission”, submitted, *Space Science Reviews*, 2014.

White House, Federal Science, Technology, Engineering, and Mathematics (STEM) Education: 5-Year Strategic Plan, available from:

 <http://www.whitehouse.gov/sites/default/files/microsites/ostp/stem_stratplan_2013.pdf> , (2013).

Appendix. Survey Data

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| **Question 1** | **General Public (114)** | **Other Users****(65)** | **Museum Educa-tors (42)** | **Teachers****(164)** |
| **Have you been inspired by NASA Science Missions?** |  |  |  |  |
| **Not at all** | 14.9% | 0.0% | 0.0% | 0.0% |
| **A little** | 40.4% | 4.6% | 0.0% | 1.8% |
| **A lot**  | 39.0% | 56.9% | 36.6% | 48.2% |
| **Changed my life** | 5.3% | 38.5% | 63.4% | 50.0% |
| **Did NASA science encourage you to study science (or other STEM subjects: Science, Technology, Engineering, or Math)?** |  |  |  |  |
| **Not at all** | 42.0% | 4.6% | 2.4% | 3.1% |
| **A little** | 34.0% | 15.4% | 4.8% | 5.5% |
| **A lot**  | 20.4% | 43.1% | 57.1% | 57.7% |
| **Changed my life** | 4.4% | 36.9% | 35.7% | 33.7% |
| **Did NASA science encourage you to pursue a career in Science, Technology, Engineering or Math?** |  |  |  |  |
| **Not at all** | 58.0% | 12.3% | 4.9% | 4.3% |
| **A little** | 27.4% | 15.4% | 9.8% | 13.4% |
| **A lot**  | 12.4% | 33.9% | 39.0% | 43.3% |
| **Changed my life** | 1.8% | 38.5% | 46.3% | 39.0% |

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| **Question 2A. How did you learn about NASA during your school years?** (multiple answers allowed; top two highlighted) | **General Public (114)** | **Other Users****(65)** | **Museum Educa-tors (42)** | **Teachers****(164)** |
| **None** | 7.3% | 1.5% | 0.0% | 2.5% |
| **Planetariums** | 50.9% | 62.3% | 61.9% | 46.3% |
| **TV** | **55.5%** | 57.4% | 50.0% | 55.0% |
| **Movies** | 40.0% | 31.2% | 35.7% | 36.3% |
| **Museums** | 51.8% | 63.9% | **73.8%** | 56.9% |
| **Teachers** | **65.5%** | **66.9%** | **69.1%** | **79.4%** |
| **Web** | 14.6% | 18.0% | 11.9% | 22.5% |
| **Books** | 49.0% | **68.9%** | **69.1%** | **59.4%** |
| **Activities** | 28.2% | 52.5% | 35.7% | 42.5% |
| **Informal Groups (e.g. Scouts)** | 19.1% | 26.2% | 33.3% | 23.8% |
| **Social Media** | 8.2% | 4.9% | 7.1% | 4.4% |
| **Teacher workshops or meetings** | 10.9% | 18.0% | 19.1% | 28.8% |

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| **Question 2B. What way(s) do you receive NASA information now?** (multiple answers allowed; top two highlighted) | **General Public (114)** | **Other Users****(65)** | **Museum Educa-tors (42)** | **Teachers****(164)** |
| **None** | 12.7% | 0.0% | 0.0% | 0.0% |
| **Planetariums** | 10.9% | 42.6% | 59.5% | 36.1% |
| **TV** | **55.5%** | 54.1% | **61.9%** | 44.3% |
| **Movies** | 14.6% | 16.4% | 28.6% | 27.2% |
| **Museums** | 22.7% | **55.7%** | **61.9%** | 51.9% |
| **Teachers** | 4.6% | 24.6% | 50.0% | 44.9% |
| **Web** | **60.0%** | **88.5%** | **85.7%** | **91.8%** |
| **Books** | 13.6% | 47.5% | 45.2% | 40.5% |
| **Activities** | 0.9% | 27.7% | 54.8% | 53.2% |
| **Informal Groups (e.g. Scouts)** | 0.9% | 29.5% | 33.3% | 22.8% |
| **Social Media** | 27.3% | **55.7%** | 50.0% | 44.3% |
| **Teacher workshops or meetings** | 1.8% | 44.3% | 59.5% | **77.9%** |

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| **Question 2C. What is your favorite way(s) to receive NASA information?** (multiple answers allowed; top two highlighted) | **General Public (114)** | **Other Users****(65)** | **Museum Educa-tors (42)** | **Teachers****(164)** |
| **None** | 11.1% | 0.0% | 0.0% | 0.6% |
| **Planetariums** | 12.0% | 35.6% | **50.0%** | 22.2% |
| **TV** | **34.3%** | 37.3% | 33.3% | 23.4% |
| **Movies** | 13.9% | 15.3% | 21.4% | 11.4% |
| **Museums** | 17.6% | 45.8% | 38.1% | 24.7% |
| **Teachers** | 3.7% | 15.3% | 23.8% | 24.1% |
| **Web** | **60.2%** | **79.7%** | **73.8%** | **77.2%** |
| **Books** | 9.3% | 37.3% | 26.2% | 15.8% |
| **Activities** | 1.9% | 33.9% | 29.6% | 32.9% |
| **Informal Groups (e.g. Scouts)** | 1.9% | 15.3% | 26.2% | 11.4% |
| **Social Media** | 9.3% | **40.7%** | 21.4% | 27.9% |
| **Teacher workshops or meetings** | 1.9% | 28.8% | 47.6% | **70.3%** |