

## **GSEE Working Group on Grand Challenges in Engagement<sup>1</sup>**

**Chairs:** David Pines, Martin Storksdieck

**Members:** Beth Cunningham, Philip Hammer, Peter Littlewood, Tiffany Lohwater, Tom Rosenbaum, Patricia Sievert, Becky Thompson

### **Background**

The Global Partnership Promoting Science Education Through Engagement (GSEE) was founded on four premises:

- Major improvements in science literacy become possible if significant numbers of research scientists and engineers engage in educating non-scientists at every level, from K-12 on, about science.
- Now is the time to initiate experiments in engagement on a large scale by building new partnerships in the engagement community of research scientists and engineers in universities, the private sector and government, and their professional and honorary societies, to carry these out in collaboration with the educational community of teachers, informal science educators, and behavioral scientists.
- Science literacy is a major global problem and education about science can become a global multi-disciplinary effort.
- It follows that a global partnership can accelerate global science literacy by connecting, coalescing, and expanding the community of engaged scientists and engineers, across disciplines and borders, and providing them with the tools to make their work with educators, informal science education professionals, and the public more effective.

### **Experiments in Engagement**

Research scientists can and do play a myriad of roles in outreach and informal science education, from giving public talks to being involved in instructional materials development, and from running science festivals to offering research internships to students. At present there are only the beginnings of efforts to treat *engagement* with school-aged children and the public at large by scientists as an experiment-based empirical science, as compared to an art practiced on an individual basis. Moreover, because improving science education, outreach and communication at every level is a major *global* challenge and significant experiments in engagement in these efforts are (and could be) carried out in many different countries, developing *engagement* as an experiment-based science is both important and desirable within the context of a global perspective.

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<sup>1</sup> This draft paper represents a current state of discussion between the listed individuals. It does not necessarily indicate a consensus, and does not represent the position of the organizations the individuals are affiliated with.

Experiments in science engagement that involve active scientists and researchers occur within a larger context that involves institutions that organize science engagement efforts, from community-based organizations to afterschool programs and science clubs to science centers and museums, professional societies and institutions of higher education. *Experiments in science engagement* are therefore about developing new and more effective ways of improving science literacy through the direct engagement and involvement of scientists, and finding ways in which researchers can improve their own outreach efforts through empirical research and evaluation, and by connecting to the entire community of professionals who work in science engagement (be that formal or informal).

GSEE is itself an experiment in engagement—to see whether by sharing information and working together on major initiatives, scientists working with their colleagues in leading educational institutions, scientific societies, science museums, and corporations, can accomplish far more than they can by working separately. Its goals are:

- To inspire more working scientists to become engaged in science education and outreach at every stage in their careers, and to give them the tools and guidance to do so effectively, and
- To foster, grow and support a global community of *engaged* scientists who share information about the experiments in engagement in which they have participated and consider what their overall collective impact on science education, outreach and communication might be.
- To enhance and expand the connections between engaged scientists and the well-established professional informal science education/outreach community.
- To raise the status and impact of engaged scientists in the research community.

**Grand Challenges in Engagement** GSEE is asking: What are the *Grand Challenges in Engagement*—the major problems that need to be addressed in order to increase substantially the number of scientists who actively participate in science education, outreach and communication, and make their *engagement* more effective and impactful.

In April 2013 *Science* magazine published its 4<sup>th</sup> special issue on twenty "Grand Challenges in Science Education," which also featured several education forum and perspective papers and an editorial devoted to the issues that the Grand Challenges pose.<sup>2</sup> While the challenges that were chosen are of considerable

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<sup>2</sup> All of the papers in this special issue can be accessed at <http://www.sciencemag.org/content/340/6130.toc>.

significance to science education as a whole, there was almost no mention of the role that scientists themselves might play in furthering science learning of students and adults.

In the following we are suggesting 4 *Grand Challenges in Science Engagement* that involve active scientists, engineers and mathematics professionals, whether they work in academia, government or the private sector.

**Grand Challenge 1:**

**Build, expand, and sustain a community of *engaged scientists* within and across the disciplines by providing better opportunities for natural and physical scientists to involve themselves in education, outreach and communication, with the long-term goal of creating a *science of engagement*, and in so doing, change the culture of science.**

We will refer to a scientist as “engaged” for the purpose of this White Paper when he or she is actively involved in efforts to reach a non-expert audience directly or indirectly through formal and informal education, outreach and communication, and/or is conducting empirical research on the effectiveness of such efforts.

This Grand Challenge could be achieved by a variety of activities:

a) Develop an on-line peer-reviewed journal “Experiments in Engagement,” that will enable engaged scientists to communicate with one another while reaching a global audience with peer-reviewed descriptions of their initiatives in science education, their “Experiments in Engagement”. The journal idea is further developed in another White Paper. The journal (or equivalent product) would fill a current gap and is associated with the strategic goal to improve significantly outreach, education, communication and engagement efforts by science and technology based professionals, and to raise the profile of these endeavors within the various relevant disciplines.

b) Develop communications hubs that connect and expand the community of engaged scientists and the teachers, informal science educators, and outreach professionals with whom they collaborate. These might include a National Registry of Engaged Scientists that includes descriptions of, and links to, their potentially scalable experiments in engagement, and a blog site or equivalent [SEEitNow.org?] that could develop into must-read for the engagement community. The hub’s overall design and hosting remains to be determined, but it ought to:

- link to and learn from current and previous efforts to establish an engagement registry
- be supported by many disciplinary societies and outreach, education and communication organizations that work with scientists and link to their

efforts

- be able to aggregate relevant meta-data, and potentially create a two-way flow of information to and from users
- be discipline neutral
- provide a basis for connecting interested “scientists” with relevant projects to which they might contribute
- include a link to the journal to encourage discussions between engaged scientists and those who conduct empirical research on science engagement
- allow for a growing collection of relevant national and international initiatives that utilize science and technology based professionals in outreach, education and communication and link to them
- link to relevant social media sites
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c) Create a Center for Engaged Scientists for the community of engaged scientists, and the teachers, museum designers, and others with whom they work. Modeled after the Aspen Center of Physics [ACP], it would be a summer center with global reach where engaged scientists, on their own or in collaboration with others, can spend appreciable blocks of time developing new materials for science education in or out of classroom use. GSEE could play a catalytic role by organizing a Founding Workshop that leads to the creation of such a Center. The Center could act as a retreat for design workshops, donor conferences (see below), and other forms of activities. Whether the Center would be located in any specific place, or exist as an institution that would be hosted physically by a variety of universities, non-profits, science centers and other informal learning spaces, blue chip research institutions, etc, would depend on the specific model. The Center could be supported by GSEE, if sufficient funds become available, or become a stand-alone institution.

d) Expand the role that professional and honorary societies play in supporting and enhancing the experiments in education being carried out by their members. The recently formed APS Forum on Outreach and Engaging the Public is an excellent model. Activities should include efforts to improve the standing of education, outreach and communication activities by active scientists and engineers within AAAS, NAS, and the science and engineering disciplinary societies in the US, and equivalent societies around the world. As part of this effort, a national survey should determine the current state of affairs in terms of scientist involvement in education, outreach and communication. The survey results should be reported in the biannual NSB’s Science and Engineering Indicator Report, and would thereby act as a basic monitor for progress made towards getting more scientists and engineers engaged in outreach, education and communication. An international expansion of this survey should follow soon.

**Grand Challenge 2:  
Establish major new programs to enhance significantly opportunities for engagement by scientists in schools, after-school and informal settings.**

GSEE will provide leadership in connecting engaged scientists to the well-established informal science education community. This community has a long tradition of success, scholarship, and knowledge from which the community of engaged scientists can learn.

Such programs [*such as Portal to the Public or Project ASTRO*] should be supported by public and private funding and should be designed in ways that make it easy for scientists to meaningfully engage in ways that fit their interest, time, capabilities and resources. These programs could be housed in universities, government agencies and research laboratories, science centers and museums of all kinds, community-based organizations, professional science societies, etc. One idea for new approaches towards science engagement are *Frontier Learning Centers*; these would establish major partnerships between universities, K-12 educators, science museums, honorary and professional societies, environmental learning groups, and the private sector to carry out large scale experiments in engagement that integrate resources and opportunities for science learning across diverse sectors.

**Grand Challenge 3:  
Involve research scientists in the current revolution of technology-enabled learning to render these opportunities meaningful for science teaching and learning.**

Massive Open Online Courses have become the metaphor and rallying point behind a rapid development of online and blended learning that is currently revolutionizing K-16 education. However, while there are wonderful examples of thoughtful MOOCs and other forms of computer- and online supported teaching, there is nonetheless serious doubt whether many of these new opportunities align with demands for quality science teaching and learning. Engaged scientists should play a major role, together with experts in the learning sciences and science education, to guide this development and to ensure that courses represent the scientific basis of science teaching and learning, and the nature of scientific discovery itself with a focus on concepts, not facts.

**Grand Challenge 4: Finding effective ways to encourage students of STEM disciplines to include education, outreach and communication as a significant component of an engaged career path, or as a career path in itself.**

Various countries have found different mechanisms successful for attracting emerging science and engineering scholars into professional careers in science

education, outreach or communication, or for creating the interest, skill and determination in emerging science and engineering scholars to stay engaged in such activities even as they pursue careers in their respective science and engineering disciplines or fields. It is now time to take stock of these experiences, learn from successful practices and scale them or transfer them where appropriate. A major challenge will be to infuse relevant capabilities into the undergraduate curriculum and graduate training.

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