

**FY2010 COV Report**

**Directorate for Geosciences (GEO)**

**Committee of Visitors for Geosciences Education and**

**Diversity Programs**

**Date of the COV: 24/25/26 May 2010**

**Programs: Education and Diversity Programs**

**Committee Membership:**

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### **1.0 Process**

The Committee of Visitors for the Directorate of Geosciences Education and Diversity (E&D) Programs met at the National Science Foundation (NSF) headquarters on 24/25/26 May 2010. The meeting began with introductions, followed by welcoming remarks from Tim Killeen (Assistant Director, GEO) and Robert Detrick (Division Director, Division of Earth Sciences). Jill Karsten then covered logistics for the meeting and discussed possible conflicts of interest. Karsten then provided an overview of the current GEO E&D portfolio and a review of the previous (2007) COV Report and subsequent responses by NSF, recommended programmatic procedures now in place or in development, and various other actions taken during the 2007-2010 period. Following a short break, Karsten and Lina Patino made presentations on specific programs in the E&D portfolio that were to be considered by the COV in its review:

- GEO Front Office Programs (Karsten)
  - Geoscience Education (GeoEd)
  - Opportunities for Enhancing Diversity in the Geosciences (OEDG)
  - Global Learning and Observations to Benefit the Environment (GLOBE)
  - Geoscience Teacher Training (GEO-Teach)
  - Digital Library for Earth System Education (DLESE) (2007 only)
- Earth Sciences Education and Human Resources (Patino)

Input from the COV was requested to assist in framing solicitations for upcoming opportunities for the GLOBE and GEO-Teach programs. Detailed information on major program elements, including proposals and outcomes; the 2007 COV report and subsequent NSF responses; and the GLOBE and GEO-Teach programs were provided via a website and in handouts.

Following lunch, Patino provided a brief introduction to the NSF proposal review procedures. The COV then devised a strategy for responding to the Charge to the Committee of Visitors: a) review of the funding decisions taken by GEO E&D programs during the fiscal years 2007/2008/2009; b) evaluate the products and contributions supported and overseen by the programs over the three year period; c) review and comment on the effectiveness of the programs, identify areas needing improvement, and recommend future courses for the programs. Further, the COV was asked to examine and comment on d) the integrity and efficiency of processes used to solicit, review, recommend, and document proposal evaluation and actions, including the effectiveness of the programs' use of NSF's two merit review criteria, and e) the relationship between funding decisions and program goals. A standard NSF COV report template was provided to guide the development of the COV's report. This template is the basis for the report that follows.

With the charge to the COV and the standard NSF COV report template as background guidance, this report is divided into four major sections. Section 1 describes the GEO E&D COV review process; Section 2 provides an overview of the COV's findings. Detailed information on the integrity and efficiency of the individual program's processes and management is provided in the completed COV Report Template (Part A). Section 2 also examines the Directorate-wide outputs and outcomes with respect to NSF mission and strategic goals. Section 3 presents a detailed list of suggestions for improvement of existing individual programs. Section 4 examines how the COV perceived NSF-wide issues and provides suggestions for addressing GEO E&D issues.

The review of the efficiency and integrity of each individual program's processes and management was carried out by three subcommittees of the COV. Detailed examination of a set of jackets, previously selected to be representative of the full set of such jackets, for many of the programs in the GEO E&D portfolio of education and diversity programs were conducted. The subcommittee assignments were GeoEd, OEDG, and EAR. Jackets for GLOBE and GEO-Teach were not examined because there were no solicitations for these programs in the review period. Within these broad categories, several other program elements were reviewed, including the Research Experiences for Undergraduates (REU) program. This process produced recommendations related to proposal processing and program management, improvement of existing programs, as well as suggestions for addressing Geosciences Directorate- and NSF-wide issues.

## **2.0 Overview of Findings**

The current GEO E&D leadership team has consistently demonstrated the highest levels of professional expertise, programmatic experience, and broad-based community support in nurturing and sustaining an innovative portfolio of GEO E&D programs. These programs span the educational continuum from K-12 through post-graduate work. All indications are that GEO E&D funding is the main limitation that restricts future growth of an important suite

of education and diversity projects. This finding was made evident by the number of additional meritorious projects available for funding under the America Recovery and Reinvestment Act (ARRA). The COV commends the NSF, the Geosciences Directorate, and the GEO E&D staff for the progress that has been made since the last COV review (2007). The current GEO E&D leadership team efforts will ensure the academic excellence and enhance the diversity of coming generations of students in the geosciences and the future geosciences workforce. Enhancing the quality and the range of geosciences education available nation-wide in K-12 and community college programs contributes directly to meeting the national needs for workforce development and increasing student interest in all areas of science, technology, engineering, and mathematics (STEM).

### **2.1. Integrity and Efficiency of Processes**

The COV found the GEO E&D programs' processes and management to be exemplary. Differences among individual program elements, both in process and management, appeared to reflect true needs for different approaches necessary to achieving optimal outcomes.

### **2.2 Outputs and Outcomes**

The 2003 and the 2007 COV's both recommended thorough investigation of pathway/pipeline issues, and the NSF and the Geosciences Directorate is to be commended for significant progress with tribal universities and MSI. However, the 2010 COV asserts that even more effort is needed, particularly among two-year college students and faculty, to overcome barriers that prevent participation by a large population of potential geosciences students.

## **3.0 Priority Recommendations**

### **3.1 GEO E&D Goals and Strategies**

A key recommendation from the COV is for each program in the GEO E&D portfolio be mapped to goals identified in the GeoVision and (draft) GEO E&D strategy. This alignment should be explained/described in program solicitations, proposal writers should be encouraged to describe how their project advances these goals, and reviewers should be asked to comment on how well the proposed project ties to these strategies. The review analysis also might include a statement that indicates the extent to which the proposed project meets an identified GeoEd strategy; such an analysis may provide a rationale for the funding decision and help future COV members have an improved understanding of the basis for making decisions about proposals (award/decline).

It was noted that Goal 2 of the draft GEO E&D Strategy, "Preparing the Geoscience Workforce", could benefit from objectives aligned with current and projected future

workforce needs. Geoscience is important ancillary knowledge to many occupations and a thorough workforce study should be conducted to properly inform the crafting of the Strategy document. A thorough workforce study would include, for example, a survey of U.S. Bureau of Labor Statistics occupations that require some knowledge and understanding of the geosciences. Additional surveys and focus groups of employers who hire people into these occupations would also be very helpful to understand current conditions and future trends in these fields. Directly encouraging students to pursue geoscience degrees without concrete workforce data to justify such recommendations may be counterproductive in the long run, especially for underserved audiences.

### **3.2 Geoscience Teacher Training (GEO-Teach)**

Two funded projects are nearing completion; both were scaled back in duration and budget (from 5 to 3 years and from 5 million to ~3 million) from the original concept. Documents provided to the COV included annual reports. Karsten reviewed the program during the COV orientation and shared outcomes/accomplishments for each program. This program was not reviewed by the COV at the same level as GeoEd, OEDG, and the programs in the EAR portfolio.

The 2007 COV noted that the GEO-Teach solicitation suffered from vague references to “transformative projects”; the subsequent response from the community signaled confusion about the goals of the program. The pool of proposals did not include as many competitive proposals as anticipated. The GEO-Teach program has not had another round but one is planned for 2011. The COV was asked to provide feedback about future directions of the GEO-Teach program that could inform the revision of the current solicitation.

The 2010 COV agreed that although it appears that the two funded GEO-Teach projects have produced significant regional/local impacts on teacher preparation and/or in-service teacher professional development, neither project appears to have succeeded in having a significant large-scale/national or transformative impact. Clearly participants benefited from project activities and insights have been gained into what works/doesn't work. Whether or not maximum benefits from the significant investments in the two projects have been realized is unclear.

#### Recommendations:

1. The revision of the solicitation should not be done until the goals of GEO-Teach can be clearly articulated; otherwise the next solicitation will suffer some of the same shortcomings as the previous solicitation.
2. The GEO-Teach should reflect the goals outlined in the GeoVision report and the draft GEO E&D Strategy and take advantage of the new literacy frameworks in ocean, atmospheric science, climate, and Earth Science that identify what concepts/processes people should know to be literate in these areas. GEO-Teach projects might be required to demonstrate how the frameworks inform the proposed activities.

3. While large projects with longer duration might attract some PIs, an alternate strategy could be to fund more, but smaller projects. Perhaps two tracks might be offered (one for projects with budgets between \$1 and \$2 million for 3-4 years) and a track supporting efforts to scale-up projects already shown to be successful (up to \$10 million for 5 years). If the teacher/faculty professional development component of GeoEd is moved to GEO-Teach (to consolidate activities funded across separate GEO programs) then it might be necessary to have a third track for much smaller efforts (in the \$100-\$200K category).
4. To be transformative, GEO-Teach must impact teacher education/professional development at the national level. Projects could be asked to partner with national/regional professional societies, accreditation organizations, and/or state/regional policy makers (e.g., an AP exam in geoscience or Earth System Science would impact teacher preparation programs).
5. Consider the possible benefits of regionalizing teacher education/professional development to take advantage of place-based curriculum and recognize differences in state standards. [Through DLESE/NSDL projects, state standards are being mapped to the national standards; strand maps for particular curriculum could then be created]. Proposers could be asked to consider this strategy in their project plans.
6. Projects should be required to demonstrate how they are leveraging existing resources and partnerships and collaborations with other organizations and institutions.
7. Consider that the “transformative projects and the response from the community” (page 5) desired from the GEO-Teach solicitations is in part being accomplished by the GLOBE project. Reflecting on the GEO-Teach through the lens of the suggestions regarding GLOBE (see 8, below) may inform the revision of the GEO-Teach solicitation and could take it in a new and exciting direction. One fruitful avenue may be to offer a percentage of GEO-Teach funding to experienced teachers/ participant teams in GLOBE, many of whom are likely to have strong desires to grow existing projects beyond the current GLOBE data gathering approach and structure. GEO-Teach could support K-12 teachers and college/university faculty to develop meaningful place-based research projects for their students that leverage established GLOBE protocols. The inclusion of an evaluation component to projects could deepen our understanding of student learning and how students use these experiences (e.g., selection of STEM as a major, greater awareness of issues surrounding global/environmental change, among others). This last point is expanded in Section 3.3.

### 3.3 GLOBE

The goals of the GLOBE program are stated as follows on the GLOBE website, [http://www.globe.gov/about\\_globe/globe\\_program/vision](http://www.globe.gov/about_globe/globe_program/vision):

- Improve student achievement across the curriculum with a focus on student research in environmental and Earth system science.

- Enhance awareness and support activities of individuals throughout the world to benefit the environment
- Contribute to scientific understanding of Earth as a system; and
- Connect and inspire the next generation of global scientists.

Therefore, the COV noted that historically the GLOBE program focused on encouraging and supporting students to conduct their own research. However, the model currently being promoted by the GLOBE Programs Offices appears to emphasize offering student-collected data for use by scientists, with minimal or no contact back to the teachers or students. NSF recently has shifted the focus of its GLOBE support back to a student-centered approach. The COV applauds and endorses this approach and urges NSF to stay the course with a student-research focus as the GLOBE program continues to evolve.

NSF support to the GLOBE program should encourage students to use their data in some way – inform the community, carry out an action project, work with local scientists, and at the same time contribute to a high quality global database, which may be used by students and scientists elsewhere. The COV suggests NSF support projects that “connect and inspire the next generation of global scientists “by creating opportunities for students to come to understand that they can do science through the discovery process, use the results to act locally, and even enact local change. The COV believes the old mantra, “Think Globally, Act Locally”, is appropriate here.

Student-researchers should be able to easily add their research, including data sets, to the global database. An improved means for such sharing appears to be necessary: Earth browsers (such as Google Earth) might be effective archives for student-generated results and data, using existing GLOBE technology/collection protocols to tie the information together.

The COV discussed at some length one possible approach for a model GLOBE project. The COV urges NSF GEO to consider such an approach as it develops its next GLOBE-related solicitation. In this approach, an investigator (which could be a K-12 teacher or a community college faculty member) arranges for local scientists, local science-based agencies, and teachers with GLOBE training to meet to discuss possible projects. Local companies (geospatial technology, engineering, and hydrology), local professional societies (geology, hydrology, paleontology, and others) or local informal education groups (master naturalists, museum educators, and others) also are invited to participate in the discussion. Each scientist or agency would propose a project in which they could benefit from the participation of local students to help in the acquisition of samples/data, sample/data analysis, and the organization and execution of a post-research activity based on the findings. A slate of potential projects is then chosen by the investigator to be presented to their students. The finalist scientists and other project stakeholders then present to the students who decide which project to do. As the students work on the chosen project, they

undertake explorations and discovery activities at the local level to assess the response the local environment/climate to proposed activity. They can also communicate and share their experiences with peers around the world. There would be opportunities for schools on different continents to partner on similar projects. The bottoms-up, grass-roots process is key—it brings the local scientists, teachers and students together early in the process and guarantees there will be support for the chosen project across the community. An example of such a local resource in which students could become involved and make significant contributions is the Community Mapping Project ([http://www.broadmoorimprovement.com/resources/community\\_mapping.pdf](http://www.broadmoorimprovement.com/resources/community_mapping.pdf)).

An important secondary benefit is that such a local approach would provide opportunities for NSF GEO and the GLOBE program to connect more effectively with community college faculty and students. K-12 teachers often do not know what Earth science projects are taking place in a city or within a county. Being closer to the professional community of Earth scientists and geotechnical companies, community college faculty often do know what projects are underway or planned for cities, counties, and within a state. Community college faculty can thus serve as a bridge between K-12 teachers interested in a GLOBE partnership and the Earth scientists who might be engaged as partners and advisors.

Community college faculty often have unique knowledge on the local geology, ecology, and biology. Since a large percentage of their students are non-science majors, they are very good at communicating with general audiences. Additionally, they generally have good relationships with local area high schools. Many community college faculty chose a community college career track over a university research career because they do not want to continually be pursuing research grants; instruction/learning-related grants, however, may be attractive to them. Consider using special incentives to attract community college faculty and their students into the GLOBE program, for example, by offering supplemental funding to university based projects that include a meaningful partnership with a community college (with a large percentage of these supplemental funds going to community college faculty member(s) and their students) to encourage community college participation without placing a large burden of grant writing and administration on community college faculty.

Finally, it is highly desirable that GLOBE students be tracked to extent practical to estimate the numbers who go into the sciences (and, especially, the geosciences). Student evaluation and tracking efforts should be applied to discover GLOBE student-researcher demographics (such as gender, race, educational background, and other useful indicators), career choices that were influenced by the GLOBE experience, and what percentage of GLOBE students continue their education beyond the high school level.

### **3.4 The Jacket Review Process – a few suggestions**

As noted above, the COV reviewed a number of jackets to evaluate how the proposal review process was working. This review resulted in a number of questions and suggestions regarding the COV process.

It was not always clear how many reviewers had examined/commented on a proposal or how many were individual/ad-hoc/mail reviews or were panel reviews. In situations when the number of reviews summarized at the top of the Review Analysis (ad-hoc and panel) does not agree with the number of reviews found in Form 7, an explanation of the difference should be provided to the COV. For example, in one case 4 reviews given for ad hoc reviews and 4 panel reviews are provided, yet only 5 reviews are found on the Form 7. This suggests that panel members are able to assign or change ratings without inputting a review. This was explained that in some cases, all members of the panel assign a rating, while only a sub-set of the panel members are required to input an individual review in FastLane.

Further, when providing example jackets to COV members, randomly select jackets yet still provide a balance for each member so that they can determine how the program officer addresses different 'types' of decisions (e.g., program officer recommends an award for a proposal with lower ratings from the panel; program officer recommends decline for a highly rated proposal; and a program officer and panel are in agreement regarding the decision to fund or decline a proposal).

**Question A.1.4:** This question is not clear and requires too much interpretation on the part of the COV as to what type of input was being sought. In the end, many COV members referred to the question wording in A.1.4 of the 2007 COV.

In the wrap-up discussion, it became apparent that some COV members expected there to be a very direct and consistent relationship between reviewers' ratings/recommendations and program officer decisions. Lost in such a perspective is the fact that while reviewers' comments and ratings are taken seriously by program officers, other 'less obvious' factors also come into play, including, balancing portfolio, institutional type, project topic, first-time vs. experienced PI, past record of PI, among others. The COV recommends that pre-meeting materials and the orientation session ensure that all COV members understand how program directors balance reviews and other factors to make recommendations to award or decline a proposal. The COV recognize that it may not be appropriate to share all factors with PIs and so that Program Officer comments often do not touch upon all the factors being considered in their decision, rather the PO comments address the strengths and weaknesses of the proposed project. COV members should be reminded that while PO comments are an important document to review to understand the process followed, it does not provide all information needed to fully understand the role of program officers in making recommendations.

Given the limited time available on site at NSF, the COV suggests that a NSF GEO hold a pre-meeting webinar that focuses on the 'factors/rationale' for making funding decisions as well as other topics that would guide COV members as they prepare for the COV and what to expect during the COV.

Other advance materials that COV members would find very useful include one-page summaries describing GEO E&D's portfolio and investments made in other areas of NSF (e.g., GK-12, IGERT, CCLI/TUES, CCE, STEP Center (solicitation released shortly after the 2010 COV, among others). The COV would not be asked to review jackets in these programs. Rather, the intent is to provide COV members with a more complete understanding of where GEO E&D dollars help support NSF-wide programs and initiatives.

#### 4.0 GEO Directorate Issues

The GEO E&D program attracts an impressive number of proposals, indicative of the significant interest by members of the geosciences community in education and diversity issues. The recommendations of this COV (2010) encourage the GEO E&D program officers to continue to develop and implement strategies that will attract proposals from all across the geosciences community. Programs enhancing the involvement of individuals from under-represented groups and minority serving institutions (MSIs) should be a top priority, as well as expanding proposals submitted (and funded) from faculty at two-year colleges (community colleges).

As recommended by the previous COV (2007), the current COV (2010) encourages the Geosciences Directorate to complete in a timely fashion a single document that looks across all its education and diversity program elements, identifies the amounts spent each year, and relates them to directorate and NSF mission and goals. Such a document should guide the revision of upcoming solicitations such as GEO-Teach and OEDG. As an example of information that should be in such a document: *what is the total investment of the Geosciences Directorate in specific education and diversity enhancement programs (i.e., less those expenditures related the Broader Impacts of funded projects)?* GEO also needs to have a clearer picture of its contributions to other NSF programs such as IGERT. Because several of the education and diversity efforts within the Geosciences Directorate are handled outside the GEO E&D program, it is difficult to answer important questions about how funds are allocated relative to Directorate and foundation-wide priorities and initiatives.

The COV notes that it was asked to review only a portion of the total E&D effort being made by the Geosciences Directorate (albeit a significant portion of the total), specifically, the E&D programs in the Director's Office and the EAR division E&D programs. The COV notes that OCE has a permanent program officer and a rotator to handle its E&D portfolio and that AGS largely relies on UCAR to coordinate E&D activities. The COV was concerned that this split approach might result in a loss of synergy among the E&D programs and reduced impact, particularly with K-12 and undergraduate programs where a broader, multidisciplinary Earth Systems approach is appropriate. The COV recommends that the Directorate examine the rationale for the current placement and handling of E&D activities within each division and articulate this rationale to future COVs. This could help future COV

members better understand why they are being asked to review only a portion of the total E&D investment being made by the Directorate.

Under NSF's national security mission is the responsibility for the development of the national science and engineering workforce. The COV notes that there is a growing movement in government and the education community to promote the "professional masters" as the credential in many applied science and engineering areas. Consequently GEO should consider the role of professional masters degrees in specific areas or applications of the geosciences, and how support for such degree programs may fit into the strategic directions of the GEO programs at NSF. Examples of such programs include the Master of Arts degree in Climate and Society at Columbia University and the Master of Science in Professional Meteorology at the University of Oklahoma. The demand for workforce expertise in multidisciplinary Earth-related issues is growing from both industry and policy circles. Strategic investments in programs such as relevant professional graduate degrees could prove fruitful in meeting the Directorate's goals of science literacy and 21<sup>st</sup> century workforce.

Finally, the Directorate should consider the desirability of initiating a longitudinal study of the long-term effectiveness of its full portfolio of E&D programs, particularly in the diversity area. While such a study would represent a significant effort and long-term investment, over time it would provide data that could better guide the allocation and distribution of funds to enhance the participation of culturally diverse individuals in the geosciences and provide benchmarks for the community to assess progress made in broadening participation.

<b>Date of COV: 24/25/26 May 2010</b>
<b>Program/Cluster/Section: Geosciences Education Programs</b>
<b>Division: Office of the Assistant Director for Geosciences</b>
<b>Directorate: Geosciences</b>
<p><b>Number of actions reviewed:</b></p> <p><b>Awards: 58</b> (OEDG = 20, GeoEd = 16, EAR E&amp;HR = 22)</p> <p><b>Declinations: 52</b> (OEDG = 23, GeoEd = 17, EAR E&amp;HR = 12) )</p> <p><b>Other: 5</b> (EAR E&amp;HR = 5)</p> <p><b>Total: 115</b> (OEDG = 43, GeoEd = 33, EAR-E &amp; HR = 39)</p>
<p><b>Total number of actions within Program/Cluster/Division during period under review:</b></p> <p><b>Awards: 341</b> (OEDG = 124, GeoEd = 84, GLOBE = 17, GEO-Teach = 7, EAR E&amp;HR = 109)</p> <p><b>Declinations: 288</b> (OEDG = 83, GeoEd = 106, GLOBE = 21, GEO-Teach = 25, EAR E&amp;HR = 53)</p> <p><b>Other: 33</b> (OEDG = 6, GeoEd = 1, EAR E&amp;HR = 26)</p> <p><b>Total: 662</b> (OEDG = 213, GeoEd = 191, GLOBE = 38, GEO-Teach = 32, EAR E&amp;HR = 188)</p>
<p><b>Manner in which reviewed actions were selected:</b> Proposals suggested for review were selected for the three programs that held competitions during the COV period of review: GeoEd, OEDG, and the EAR E &amp;HR programs. GEO-Teach and GLOBE did not hold competitions during 2007-2009. For the three programs holding competitions, a set of 30-36 proposals was selected randomly from each program to provide a snap shot of three types of decisions: 1) high rated/ranked proposals recommended for awards; 2) low rated/ranked proposals recommended for decline; and 3) proposals at the “fund-do not fund boundary” where proposals with similar overall rankings had different funding recommendation outcomes.</p>

**PART A. INTEGRITY AND EFFICIENCY OF THE PROGRAM’S PROCESSES AND MANAGEMENT**

**A.1 Questions about the quality and effectiveness of the program’s use of merit review process.** Provide comments in the space below the question. Discuss areas of concern in the space provided.

<p><b>QUALITY AND EFFECTIVENESS OF MERIT REVIEW PROCESS</b></p>	<p><b>YES, NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b></p>
<p>1. <i>Are the review methods (for example, panel, ad hoc, site visits) appropriate?</i></p> <p><i>Comments:</i></p> <p>EAR E&amp;HR: The review procedures seem to be appropriate for the education programs and seemed to be reasonably tailored to those programs.</p> <p>OEDG: The process of using both ad-hoc reviews and panels is working well for this program. Efforts have been made to expand the reviewer pool in order to reduce the burden placed on individual reviewers as well as building capacity within the community with expertise in issues related to attracting and retaining underrepresented students. The COV recognizes the challenges faced in seeking qualified reviewers and agree that the OEDG leadership team has taken proactive steps to ensure that each proposal receives a minimum of four reviews. Overall, the quality of the reviews is high and reviewers describe both Intellectual Merit and Broader Impacts. This is indicative that the OEDG program officers have responded to concerns raised by the 2007 COV about reviews not describing both merit review criteria.</p> <p>GeoEd: Review methods were appropriate. There was a good mix of ad hoc and panel reviews. <i>The concern from the 2007 COV about the ad hoc and panel review overlap appears to have been corrected.</i> Site visits were not used, possibly because there were no Track 2 proposals awarded in our subset.</p>	<p>YES</p>
<p>2. <i>Are both merit review criteria addressed</i></p> <p style="padding-left: 40px;"><i>a) In individual reviews?</i></p> <p>The broader impact statements generally were appropriate. Less attention was paid to broader impacts than to intellectual merit and there was a divergence of opinion as to what broader impacts means. In the individual reviews, the intellectual merit was sometimes a summary or</p>	<p>YES</p>

<p>feedback on of the scope of work rather than addressing intellectual merit specifically.</p> <p><i>b) In panel summaries?</i></p> <p>In general, the panel summaries were better written and more effectively addressed the proposals broader impacts than the individual reviews. However, similar issues relating to a focus on intellectual merit remained but to a lesser degree. When the broader impact and intellectual merit statements are discussed in a single narrative, it is difficult to ascertain if the problem with the proposal is conceptual, mechanical, or just a lack of intellectual merit.</p> <p><i>c) In Program Officer review analyses?</i></p> <p>These seemed quite good overall, particularly for borderline proposals. It helped significantly that the project synopsis was stated separately from the intellectual merit and broader impact sections.</p> <p><i>Comments:</i></p> <p>The COV recommends that the individual reviews and panel reviews follow the same format as the PO review analyses, specifically separating the project summary feedback, the broader impacts feedback, and the intellectual merit feedback.</p>	
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<p><i>3. Do the individual reviewers provide substantive comments to explain their assessment of the proposals?</i></p> <p><i>Comments:</i></p> <p>Overall, the quality of reviews, both panel and individual/<i>ad hoc</i>/mail, was good, in terms of providing a basis for an overall evaluation and recommendation by the PO. The majority of reviewers supply substantive comments. The quality of individual reviews is high and the reviewers' comments demonstrate their understanding of issues and challenges related to attracting and retaining members from underrepresented groups.</p> <p>Some exceptions were noted. There are inconsistencies regarding comments on broader impacts. Reviewers' interpretations on this merit review criteria are varied and reflect lack of an agreed upon definition of what is included under the BI criteria.</p>	<p>In general, YES, but there is still a relatively large range of review quality</p>
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<p>A small number of individual reviews are short and lack constructive remarks regarding strengths and ways to improve the proposed project. Compensating for this was the pattern that most proposals included a minimum of four reviews so that taken together, the individual reviews adequately addressed both merit review criteria and identified strengths and weaknesses.</p> <p>The program should work to ensure that all reviewers have a good understanding of the two merit review criteria, what the assigned ratings mean in terms of proposal quality, and the need for substantive comments to justify the assigned rating.</p>	
<p><i>4. Do the panel summaries provide the rationale for the panel consensus (or reasons consensus was not reached)?</i></p> <p><i>Comments:</i></p> <p>EAR E&amp;HR: There is good consistency and it is clear that the panels are receiving good instruction.</p> <p>OEDG: Overall, panel summaries for the jackets reviewed provided a rationale for the recommendation (fund, fund if possible, do not fund). Summaries outlined the major strengths and weaknesses and considered both intellectual merit and broader impacts. In some cases, the panel summaries identified issues that were overlooked in ad-hoc reviews and demonstrated the advantage of having combined ad-hoc and panel reviews.</p> <p>GeoEd: Overall the panel summaries provided sufficient information to the PIs as to why their proposal was or was not recommended for funding.</p>	<p>YES</p>
<p><i>5. Does the documentation in the jacket provide the rationale for the award/decline decision?</i></p> <p><i>Comments:</i></p> <p>The jacket documentation is excellent. A clear rationale for an award/decline decision was provided, and in cases where the program officer recommended a project as an award when the panel was less enthusiastic about the project, the reasons were clearly explained and reviewers' concerns were addressed in the Review Analysis. In the jackets reviewed by the COV, the opposite was not commonly noted (program officer declining a highly rated proposal). For proposals that were deemed 'fundable' the Review Analysis provided a clear rationale</p>	<p>YES</p>

<p>for the recommendation (award/decline).</p> <p><i>(Note: Documentation in jacket usually includes context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), program officer review analysis, and staff diary notes.)</i></p> <p><i>During FY 2009, NSF permitted reversal of a declined decision for funding through ARRA for proposals declined after October 1, 2008. (NOTE: This question does not apply to programs for which the reversal decline option was not used.)</i></p> <p>i) <i>Were the reversals of the decision to decline based on both the high quality* of the reviews received on the initial submission and the lack of available funding at the time the origin was made?</i></p> <p><i>*Rated "Very Good or above" or the functional equivalent by review panels.</i></p> <p>ii) <i>Is documentation provided, including a revised Review Analysis, to support the award decisions?</i></p> <p><i>Comments:</i></p> <p>In several proposals that were recommended for ARRA-supported awards, jacket documentation did not indicate that reviewers' suggestions about changes that could improve the project were in fact raised by the program officer during the negotiation process. In these cases, it is uncertain whether or not the reviewers' suggestions were incorporated before the award was made.</p>	
<p>6. <i>Does the documentation to PI provide the rationale for the award/decline decision?</i></p> <p><i>(Note: Documentation to PI usually includes context statement, individual reviews, panel summary (if applicable), site visit reports (if applicable), and, if not otherwise provided in the panel summary, an explanation from the program officer (written or telephoned with diary note in jacket) of the basis for a declination.)</i></p> <p><i>Comments:</i></p> <p>This is consistently well done. The program officers clearly understand this need and are thorough and thoughtful in their responses.</p>	<p>YES</p>

<p>Panel summaries usually provided information sufficient for PI's to understand the funding decision; however, some synthesizing of the comment from the individual panelists' comments is required. To be most useful, the panel summary information should be more clearly organized and labeled "intellectual merit", "broader impact", and "additional comments", as appropriate.</p> <p>The PO's comments usually clearly explained the rationale for the award/decline decision. In cases where a recommendation to decline the proposal was made, the PO comments included suggestions to the PI about ways to strengthen the proposal and where appropriate, encouraged revision and submission to a future round of the program. In some jackets reviewed by the COV, the PO comments also included suggestions about other possible avenues of funding for the PI to pursue.</p> <p>The lack of adequate feedback to the PI was raised by the previous COV; it appears that some of that concern resulted from the COV members not fully understanding where this advice would be found among the jacket documents. The COV members reviewing OEDG jackets reviewed the relevant jacket documents and noted that the program officers have responded to this concern. In fact, it was noted that the PO comments were not simply adequate, but often very detailed and very supportive/encouraging to the PI(s).</p> <p>The COV encourages continuing diligence by the PO's on communicating clearly to PIs the results of the reviews and their rationale for acceptance or declination of a proposal. A template for preparing panel summaries might better guide panel members that are assigned as scribes. Such a template would include clearly labeled heading for Intellectual Merit, Broader Impacts and remind reviewers to consider other additional program-specific review criteria describe in the solicitation.</p>	
<p>7. <i>Is the time to decision appropriate?</i></p> <p><i>Note: Time to Decision --NSF Annual Performance Goal: <b>For 70 percent of proposals, inform applicants about funding decisions within six months of proposal receipt or deadline or target date, whichever is later.</b> The date of Division Director concurrence is used in determining the time to decision. Once the Division Director concurs, applicants may be informed that their proposals have been declined or recommended for funding. The NSF-wide goal of 70 percent recognizes that the time to</i></p>	<p>YES</p>

<p><i>decision is appropriately greater than six months for some programs or some individual proposals.</i></p> <p><i>Comments:</i></p> <p>Six months is an appropriate dwell time for proposal processing. Overall, the program is meeting their dwell time targets but it is clear that the ARRA funds and sharp increase in proposal load impacted the time to decision for proposals submitted in 2009.</p> <p>OEDG: The jacket dwell time for the OEDG round in 2007 for declines was under 6 months and about 7 months for awards. In the 2009 round dwell times for both awards and declines was between 7 and 8 months. Considering the increase in proposals handled due to ARRA, the time to decision should be considered excellent. It also should be noted that the data provided to the COV are for ALL proposals submitted to the OEDG program, so in both rounds (2007 and 2009) of the program, the 70% goal was attained.</p> <p>GeoEd: Of the GeoEd proposals reviewed by the COV, 70% or more appear to have been handled, start to finish, within six months. From Chart A, the average dwell time for awarded proposals appears to be just short of 8 months, but we were not sure if this was due to outliers or not.</p> <p>The COV notes that the GEO E&amp;D programs attract a large number of very diverse proposals. The PO's are to be commended for their efforts in meeting the NSF Annual Performance Goal for dwell time (not counting the exceptional ARRA period), given the complicated nature of the proposals.</p>	
<p><i>8. Additional Comments</i></p> <p><i>a) Additional comments on the quality and effectiveness of the program's use of merit review process.</i></p> <p>It was not always possible to relate the relationship between the ranking of an individual proposal (either by ad-hoc reviewers or by the panel) and the recommendation to fund or decline the proposal – reference Table 6.4A in the COV documents, many of the average rankings for the funded proposals are not available. <i>(It was unclear in this question if it is asking about the whole process, or the intellectual merit part of the process. We responded as if the question was asking about the whole process.)</i></p> <p><i>b) To what extent does the documentation in the jacket or otherwise available provide the rationale for use of ARRA funding?</i></p>	

The candidate pool appeared to include a number of proposals that were worthy of funding but that would not have been funded without the addition of ARRA funds.

**A.2 Questions concerning the selection of reviewers.** Provide comments in the space below the question. Discuss areas of concern in the space provided.

<p><b>SELECTION OF REVIEWERS</b></p>	<p><b>YES , NO, DATA NOT AVAILABLE, or NOT APPLICABLE</b></p>
<p><i>1. Did the program make use of reviewers having appropriate expertise and/or qualifications?</i></p> <p><i>Comments:</i></p> <p>To the extent that could be determined, the COV found that the reviewer pool was diverse, consisting of individuals with appropriate expertise and professional qualifications. There was a good distribution of institution type, gender, and geographic location of the reviewers The COV would have liked more information about some reviewers' backgrounds. It was clear from the documentation provided and discussion that the current PO's are very dedicated to identifying and using highly qualified reviewers. The COV encourages the POs to remain diligent in the selection of reviewers, including both experienced and new reviewers in the pool. It is desirable that the POs ask reviewers to provide basic background/demographic information as part of their reviews (see following section).</p> <p>In some cases, it was very hard for the COV to determine how many people reviewed each proposal, and what their backgrounds were. It was not always possible to determine if an ad-hoc reviewer also was invited to serve as a panel member. This may in part be related to how reviewers were identified in documents. For future COVs, we recommend that this 'overlap' be described as part of the orientation session.</p> <p>A possible area of concern is the review of proposals in cases when the PI is a science education researcher or a teacher in a community college or a K-12 setting. From the reviewer demographics, it appears that the</p>	<p>DATA NOT AVAILABLE</p>

<p>majority of GeoEd reviewers represent geoscientists teaching in colleges and universities or working at agencies with varying levels of expertise in research on learning, teacher preparation, or K-12 teaching. How might this impact the review process and what steps are being taken to assure that all PIs enjoy access to the GEO E&amp;D programs?</p>	
<p>2. <i>Did the program use reviewers balanced with respect to characteristics such as geography, type of institution, and underrepresented groups?</i></p> <p><i>Note: Demographic data is self-reported, with only about 25% of reviewers reporting this information.</i></p> <p><i>Comments:</i></p> <p>It was clear from the documentation provided and discussion that the current PO's are very dedicated to ensuring to the extent possible an equitable and balanced review process.</p> <p>To the extent possible to determine (not all reviewers elected to provide complete demographic information), it appears that a diverse group of reviewers was used. However, in many cases, the COV was unable to assess location, institutional association, or race/ethnicity of reviewers. The COV was not provided enough information about reviewers' demographics to answer fully the above question. NSF might consider development of a scheme to document reviewers' location, institutional type if not the specific institution, and race/ethnicity. Even a one-paragraph biographical sketch appended to the review would be helpful. The COV recommends the PO should strongly encourage reviewers to provide demographic data.</p> <p>From the opening presentation, geographic distribution seemed reasonable, but it was really hard to tell about underrepresented groups. In terms of types of institutions, it appeared that the community colleges were not well represented based on the data presented in the opening presentation.</p>	<p>DATA NOT AVAILABLE</p>
<p>3. <i>Did the program recognize and resolve conflicts of interest when appropriate?</i></p> <p><i>Comments:</i></p> <p>The COV found that the PO's had paid careful attention to potential conflicts of interest and moved to quickly resolve them when COI's were identified.</p>	<p>YES</p>

*4. Additional comments on reviewer selection:*

The COV finds that GEO E&D programs continue to face a unique challenge in the breadth of reviewer expertise and diversity necessary for a comprehensive review process. The fundamental issue is the near impossibility of constituting review panels covering the desirable breadth of expertise – including both scientific disciplines and pedagogy -- and diversity given the small sizes of the panels. This situation can be mitigated in part by using ad hoc/mail reviews specifically targeting the intellectual merit allowing the panel to focus on pedagogy, or vice versa.

**A.3 Questions concerning the resulting portfolio of awards under review.** Provide comments in the space below the question. Discuss areas of concern in the space provided.

<p style="text-align: center;"><b>RESULTING PORTFOLIO OF AWARDS</b></p>	<p style="text-align: center;"><b>APPROPRIATE, NOT APPROPRIATE<sup>1</sup>, OR DATA NOT AVAILABLE</b></p>
<p><i>1. Overall quality of the research and/or education projects supported by the program.</i></p> <p><i>Comments:</i></p> <p>In general, the funded programs were of extremely high quality.</p> <p>OEDG: The program officers have taken steps to ensure that the overall quality of projects for the OEDG is high. As the community gains experience in the goals of this program the quality of projects taking place has steadily increased. A recent effort being undertaken using an outside contractor is gathering data to identify best practices used in projects. These findings will help shape future solicitations and also provide guidance to the geosciences community about effective practices and pedagogies that prove successful in attracting and retaining members from underrepresented groups in the geosciences.</p> <p>GeoEd: It is difficult to determine the specifics or the range of impact intended to result from the projects funded under the GeoEd solicitation.</p>	<p>APPROPRIATE</p>
<p><i>2. Does the program portfolio promote the integration of research and education?</i></p> <p><i>Comments:</i></p> <p>EAR E&amp;HR: The REU proposals represent a model integration of research and education. The opportunity to hold an REU seems like an excellent method to increase undergraduates' understanding of the</p>	<p>APPROPRIATE</p>

<sup>1</sup> If "Not Appropriate" please explain why in the "Comments" section.

<p>nature of research and provides information to help them decide if research is the best career path for them. Even in cases where they do not go on to a research career, they have a better understanding of the nature and value of scientific research and the scientific method.</p> <p>In Post-doc proposals, the PIs interpretation of Broader Impacts was quite variable in their practicality and potential impact. Some were quite naïve. The requirement of inclusion of a broader impact statement does encourage the integration of research and education. The extent to which it succeeds is wholly dependent on how the independent investigator performs. In general, the postdoc program primarily seeks to support individual research careers by supporting ongoing research projects. The difficulties inherent in making frontier-specific scientific research accessible to a general audience are often vastly underestimated by many research scientists. These same comments apply to the six funded CAREER proposals that we examined.</p> <p>OEDG: While not a primary goal of the OEDG program, the COV found evidence that some projects effectively used research as a means to attract and retain underrepresented students and as part of teacher/faculty professional development activities. Proposal authors also demonstrated that the pedagogies identified in their projects reflected what is known about how students learn and some of the literature on why students do not enter or leave the geosciences. In proposals where current research in pedagogy was not applied, the reviewers generally gave lower ratings and pointed out the lack of research base in their reviews.</p> <p>GeoEd: The projects supported by the GeoEd portfolio had both science education and scientific research components, many with the aim of educating populations of learners on aspects of scientific research. There was less evidence of using research to inform the educative aspects of the projects, or researching the effectiveness of particular educational activities. This is a direction that the program may consider addressing more specifically in the future.</p>	
<p><i>3. Are awards appropriate in size and duration for the scope of the projects?</i></p> <p><i>Comments:</i></p> <p>EAR E&amp;HR: The cost per participant for REUs and post-docs are</p>	<p>APPROPRIATE</p>

<p>basically set and are consistent and appropriate.</p> <p>OEDG: Yes, the award sizes and duration were appropriate.</p> <p>GeoEd: The size the GeoEd grants was quite small given the expectations for the effort involved in the work, particularly when considering the amount taken by many institutions for indirect costs.</p> <p>The COV committee reviewed almost exclusively Track 1 projects, the smaller funding amounts as compared to Track 2 proposals. It was unclear if these projects lead to future larger proposals to other parts of the Foundation. This needs to be tracked with current and future awards to better judge the impact of the program against accomplishment of stated goals.</p>	
<p><i>4. Does the overall program portfolio (including ARRA funded awards) have an appropriate balance of innovative/potentially transformative projects?</i></p> <p><i>ARRA Specific Question: Does the ARRA funded portfolio have an appropriate balance of innovative/potentially transformative projects?</i></p> <p><i>Comments:</i></p> <p>The proposals overall did not seem to be “transformational” in terms of educational innovation. Most of the approaches appeared to be applications of proven strategies and pedagogies.</p> <p>While we did not identify any proposals as “transformative,” we did see proposals that were highly innovative and we recognize that the pairing of a promising post-doc with a well-respected mentor has the potential to significantly advance research frontiers.</p> <p>There was evidence indicating that some high risk and potential high-reward projects are funded. It also seemed to the COV that the higher risk proposals most often were of smaller duration with smaller budgets and that these potentially transformative projects were being recommended for funding at appropriate levels.</p> <p>For higher risk projects, we suggest greater post-award monitoring (as a program officer’s time permits) to improve the likelihood of a successful outcome. This higher level of involvement can also serve to help the program officer better understand the challenges of such projects so that future decisions about which high-risk projects to fund build on previous experience. An alternative would be to bring PIs</p>	<p>APPROPRIATE</p>

<p>together from such projects part-way through the project and after the project is completed</p>	
<p>5. <i>Does the program portfolio have an appropriate balance of:</i></p> <ul style="list-style-type: none"> <li>• <i>Inter- and Multi- disciplinary projects?</i></li> </ul> <p><i>Comments:</i></p> <p>It appeared from our reading that narrowly focused Post-Doc proposals had a lower chance of getting funded than did the more multidisciplinary ones. This approach seems to be both appropriate and to reflect trends in science at large.</p> <p>Many of the GeoEd projects focused on larger multidisciplinary issues facing the field, such as global climate change. For such projects, the project focus was appropriately interdisciplinary.</p>	<p>APPROPRIATE (not applicable to OEDG)</p>

<p>6. Does the program portfolio have an appropriate balance considering, for example, award size, single and multiple investigator awards, or other characteristics as appropriate for the program?</p> <p><i>Comments:</i></p> <p>EAR E&amp;HR: The targets of the EAR for REUs and postdocs are pretty straightforward. The ad hoc proposals made up 31% of the non-ARRA 2009 distribution but we only saw two of those proposals so we feel that we did not have enough information to understand this aspect of the program.</p> <p>OEDG: The OEDG portfolio generally is well balanced. The COV recognizes the challenges of compiling a balanced portfolio while maintaining program quality, with a good mix of experienced and new PIs.</p> <p>Since the last COV, the number of awards made to PIs at MSIs has increased. This was an area of concern identified by the previous COV.</p> <p>GeoEd: We reviewed only one larger GeoEd Track 2 proposal. The rest were the smaller Track 1. Most had multiple investigators, which is appropriate for the effort proposed but a challenge given the budget constraints for Track 1 projects.</p>	<p>APPROPRIATE</p>
<p>7. Does the program portfolio have an appropriate balance of:</p> <ul style="list-style-type: none"> <li>• Awards to new investigators?</li> </ul> <p><i>ARRA Specific Question: Does the ARRA funded portfolio have an appropriate balance of awards to new investigators?</i></p> <p><i>NOTE: A new investigator is defined as an individual who has not served as the PI or co-PI on any award from NSF (with the exception of doctoral dissertation awards, graduate or postdoctoral fellowships, research planning grants, or conferences, symposia &amp; workshop grants.)</i></p> <p><i>Comments:</i></p> <p>The data provided to the COV indicates that there is good representation by new investigators. The program officers identify this as an ongoing priority for the OEDG program and continue to be</p>	<p>APPROPRIATE</p>

<p>proactive about ensuring that this balance is achieved and maintained.</p>	
<p>8. <i>Does the program portfolio have an appropriate balance of:</i></p> <ul style="list-style-type: none"> <li>• <i>Geographical distribution of Principal Investigators?</i></li> </ul> <p><i>Comments:</i></p> <p>While there are not active awards in every state or territory in the US, there is a very good geographic distribution of PIs. Some projects involve collaborations that bring together PIs from different parts of the country. Ongoing activities by the program officers to promote this program should continue to attract PIs from across the country.</p>	<p>APPROPRIATE</p>
<p>9. <i>Does the program portfolio have an appropriate balance of:</i></p> <ul style="list-style-type: none"> <li>• <i>Institutional types?</i></li> </ul> <p><i>Comments:</i></p> <p>There is a good balance of institutional types though community college participation in GEO E&amp;D was very low.</p> <p>There was an increase in awards to MSIs and tribal colleges. This was identified as an issue by the previous COV and is an area where improvements are noted by the COV.</p> <p>Two-year colleges showed little change in award numbers from 2007-2009 (Source: EIS-Web COV module, using 'Chart J. Actions by Institution Type'.) The COV recommends providing additional financial incentives to encourage universities to partner with community colleges. As noted in the discussion of the GLOBE program, consider offering a supplement to projects that utilize community college faculty (with a large percentage of these supplemental funds going to the community college faculty and students) to encourage community college participation without placing the burden of grant writing and administration on the community college faculty).</p>	<p>APPROPRIATE</p>

<p>10. <i>Does the program portfolio have an appropriate balance:</i></p> <ul style="list-style-type: none"> <li>• <i>Across disciplines and sub disciplines of the activity?</i></li> </ul> <p><i>Comments:</i></p> <p>The jackets reviewed by the COV represent a good mix of geosciences, including oceanography, meteorology/atmospheric sciences, and geology. Projects with environmental themes illustrated some of the best opportunities to integrate and apply the Earth systems approach.</p>	<p>APPROPRIATE</p>
<p>11. Does the program portfolio have appropriate participation of underrepresented groups?</p> <p><i>Comments:</i></p> <p>Participation in the program by underrepresented groups increased since the last COV and this is an area of continuing efforts by the program officers.</p> <p>There seems to be an absence of proposals by minority PIs. Continuing outreach to MSIs by the PO may be useful here.</p>	<p>APPROPRIATE</p>
<p>12. <i>Is the program relevant to national priorities, agency mission, relevant fields and other constituent needs? Include citations of relevant external reports.</i></p> <p><i>Comments:</i></p> <p>EAR E&amp;HR and OEDG: The Program Officers are painfully aware of the fact that the geosciences are in ‘last place’ when it comes to increasing participation by members of underrepresented groups. The benefits of projects that have been running nearly five years is starting to result in some improvements (although with such small numbers to begin with, there is great variability in year-to-year statistics).</p> <p>OEDG: The OEDG program speaks directly to the critical need to broaden participation of women and underrepresented groups and raise awareness of the need for greater diversity in the geosciences. It supports the pipeline of Ph.D. research scientists by encouraging their career choice with the REUs and supporting their early careers with Post-doc and CAREER grants.</p>	<p>APPROPRIATE</p>

The OEDG program also takes advantage of current needs in the field (climate change, resource use, sustainability) as a strategy for attracting and retaining underrepresented students in geosciences and for some, encouraging them to pursue Ph.D. degrees.

GeoEd: The GeoEd program addresses a key need in connecting scientific advances with the education of today's youth. The program is very relevant to national priorities of preparing students for the 21<sup>st</sup> century workforce and the agency's mission of supporting the development of a more scientifically-knowledgeable society in the area of the geosciences.

*13. Additional comments on the quality of the projects or the balance of the portfolio:*

*ARRA Specific Comments: Additional comments regarding the portfolio of ARRA awards addressing the NSF or program-specific priorities for ARRA funding?*

The balance of the current awards portfolio focuses on serving undergraduates and post-docs. We encourage the NSF to seek opportunities to fund submittals which plainly support learning about geoscience research by k-12 students and teachers, and the general public. This could include direct interaction with researchers through lectures, interviews, and demonstrations.

Two-year institutions are lagging behind in awards, even though they represent a common point of entry for underrepresented groups and minorities. The 4-year university is often perceived as "leading" the project rather than looking for a true community college partner. Also, universities seem to have a poor understanding of the community college structure: for example, community colleges concentrate on high school recruitment; community colleges cannot easily partner across "service sector" lines; and their budget is based solely on enrollment of participating students, so that there is actually a cost involved in "losing" their students to a 4-year program.

On the community college side, there is very little understanding of the NSF RFP structure, and, among other barriers to participation, the need for evaluation tools causes confusion.

**A.4 Management of the program under review.** Please comment on:

*1. Management of the program.*

*Comments:*

EAR E&HR The management is smooth and appropriate from our perspective. The PO has been proactive in her efforts to make the program more focused and responsive to community need. Two examples: 1) the reinstatement of the post doctoral fellow program in 2008, using models from other directorates from within the foundation and improving upon those (e.g. the addition of health and parental benefits for post docs); and 2) the desire to transition the ad hoc part of the portfolio to a specific solicitation in 2011.

OEDG: Overall the management of the OEDG program is excellent. We call particular attention to the ongoing efforts to identify best practices and strategies proven successful for attracting and retaining underrepresented students in geosciences. The alignment between OEDG and other programs that provide support for geoscience education activities is a priority activity and now that there is a vision/strategic planning document and results from the OEDG evaluation, the time is right to prepare the document that describes how the OEDG program is synergistic with other geosciences education programs while also addressing its own set of goals.

GeoEd: Overall the management of the GeoEd program is excellent. We recognize the challenge in coordinating a very diverse portfolio of projects, and the PO and her staff have done a remarkable job over the past three years. We encourage the PO to further identify where and how GeoEd projects are synergistic with other programs both within the directorate and across other areas of NSF (specifically EHR), and explore strategies for PIs to be able to share, compare, and learn from each other's successes and challenges with their geo-education projects.

*2. Responsiveness of the program to emerging research and education opportunities.*

*Comments:*

EAR E&HR: The PO has specifically requested input from this COV on new opportunities as she continues to optimize her program in consultation with stakeholders. Based on our conversations with the PO, we discussed possible options for the redeployment of the ad hoc portion of the portfolio. The boundary conditions are that there must be a direct connection to EAR research. Based on the fact that the present program covers undergraduates, post doc, and young researchers, we recommend that there be some consideration to funding the access to EAR research by high school interns, k-12 teachers and students, informal science education institutions, and free choice learners from the general public.

OEDG: Yes, the OEDG program appears to be responsive based on the types of projects

funded and range of education methods used.

GeoEd: There may be opportunities in the GeoEd program to make use of new findings in educational research and development, particularly related to the use of new emerging technologies and data representation tools as supports for learning complex systems.

*3. Program planning and prioritization process (internal and external) that guided the development of the portfolio.*

*Comments:*

EAR E&HR: The PO inherited a program that funded ad hoc (a variety of proposals) and REU proposals in 2007. The PO has actively sought to focus the program and make sure that underserved areas are supported and that new programs are tailored to the needs of the community.

OEDG: Ongoing efforts are taking place and the COV recommends that this activity be completed within the next 6-12 months. It definitely should be done before the next OEDG solicitation is released.

GeoEd: Building from the COV's recommendation for using the recently developed strategic vision documents to guide the overall program, similar work should be completed specifically for the GeoEd program with attention paid to the specific contributions that Type 1 GeoEd projects can make to the overall portfolio.

*4. Responsiveness of program to previous COV comments and recommendations.*

*Comments:*

GEO E&D and OEDG leadership team has been extremely responsive to the recommendations/concerns raised in the previous COV, and in many cases, have gone beyond the recommendations made by the previous COV. The program officers also have sought advice from an 'expert team' and are using those findings to further improve the programs for which they are responsible.

*5. Additional comments on program management:*

None

## PART B. RESULTS OF NSF INVESTMENTS

**B. Please provide comments on the activity as it relates to NSF's Strategic Outcome Goals. Provide examples of outcomes as appropriate. Examples should reference the NSF award number, the Principal Investigator(s) names, and their institutions.**

**B.1 OUTCOME GOAL for Discovery: “Foster research that will advance the frontier of knowledge, emphasizing areas of greatest opportunity and potential benefit and establishing the nation as a global leader in fundamental and transformational science and engineering.”**

*Comments:* Geosciences E&D programs are central to the Geoscience Directorate's success on the outcome goal for learning. Overall, the COV believes the programs are doing an excellent job contributing to this goal. REU and Post-doctoral programs are directly addressing geoscience workforce challenges with approaches that are attracting members of underrepresented groups to become geoscientists of the future.

Increased involvement of instructors at two-year colleges in geoscience education projects is a goal that deserves increased attention because community colleges have an important role in broadening participation in STEM fields including the geosciences.

Geosciences E&D programs also are supporting projects that are making geosciences research inviting and accessible to broad audiences while emphasizing the relevance of the geosciences to sustainability. The *ad-hoc* awards have produced several outcomes applicable to continuing geoscience discovery that is appropriate for a general audience (i.e. Earth Exploration Toolbook, Understanding Sciences, GSA Graduate Research Fellowship, and Earth Science Literacy). This provides a sustainable transformative effect that is capable of reaching non-scientific and K-12 audiences. The COV encourages Program Officers for Geosciences E&D to continue support of geosciences education projects that translate frontier research (e.g. EarthScope, MARGINS, etc.) for learners from K-12 to the general public.

The recent completion of the Geovision Report and the Earth Science Literacy frameworks provide insight and guidance as program officers for Geosciences E&D look forward to new GLOBE and GEO-Teach solicitations. The COV encourages program officers to use these programs for support of partnerships between K-12 teachers, community college instructors, geosciences educators, and geoscience researchers that can attract wide and diverse audiences to become students of the geosciences. Projects that enhance Earth science teaching and learning for young audiences (e.g. K-12 Earth Science teacher professional development and informal education at public museums and parks) will address geosciences workforce challenges while promoting Earth Science literacy and public support for geosciences research.

**B.2 OUTCOME GOAL for Learning: “*Cultivate a world-class, broadly inclusive science and engineering workforce, and expand the scientific literacy of all citizens.*”**

*Comments:* Geosciences E&D programs play a critical role in promoting research on geosciences learning and teaching. Indeed much of the recent progress in acceptance of geosciences education as an academic research discipline is traceable to support received from current and predecessor education programs within the NSF Geosciences Directorate.

Geosciences E&D programs often have served as an incubator or testing ground for geosciences education research projects that developed into model programs of science education in general (e.g., SERC). Continued support for new investigators and new research frontiers will be required for geoscience education research to maintain the present rate of advancement as a research endeavor. While collaborating with programs in EHR, Program Officers for Geosciences E&D must also inform that directorate about special challenges and opportunities of geoscience education research that are distinct from those of other sciences.

Geosciences education research has identified discipline-specific science content and pedagogical challenges faced by geosciences educators. To investigate geological structures, learners must develop three-dimensional spatial reasoning and visual representation. To understand the evolution of mountain systems, changes in Earth’s surface conditions, and the resulting history of our planet’s biota, learners must engage in a journey through deep time. And on that journey, novice geoscientists must carefully apply fundamental principles of physics, chemistry, and biology across atomic-to-global ranges of scale.

Geosciences educators also face challenges in educational psychology. For example, In some situations, fear of natural hazards can close the gate to learning how and why these natural events occur. Geosciences education research can inform Earth science educators how to overcome the fear factor and help learners understand how application of the science of natural hazards can mitigate damage and deaths caused by these inevitable events. Recent advances in cognitive science provide exciting opportunities for geosciences education research to address these and many other discipline-specific educational challenges.

**B.3 OUTCOME GOAL for Research Infrastructure: “*Build the nation’s research capability through critical investments in advanced instrumentation, facilities, cyber infrastructure and experimental tools.*”**

*Comments:*

None

## **PART C. OTHER TOPICS**

### **C.1. Please comment on any program areas in need of improvement or gaps (if any) within program areas.**

Over the years, a history and a culture of partnerships and specific types of dialogue have developed between NSF and the 4-year colleges/research universities that allow those institutions and the NSF to communicate goals (even subjective ones) clearly. However, a similar history/culture and ease of communication does not yet exist between the NSF, the MSIs, and 2-year colleges. A training session portfolio (web-based possibly) for each of these “gap institutions” (GIs) types would be well worth the time and effort. The excellent procedural PowerPoint presentations to which the 2010 COV was treated as part of the introductory overview would be a good place to start. The next step could be changes to RFPs, encouraging more substantive partnerships between existing NSF partner institutions (defined as those four-year colleges/research universities with long histories of funded projects and experienced PIs) and the GIs.

There are even fewer existing pathways between NSF and the K-12 realm—with the notable exception of the GLOBE project. A brainstorming session between carefully selected participants (including GLOBE staff and teachers) across the spectrum of involved institutions might help with identifying barriers. (One COV member commented: *“I am aware of several NSF-funded programs which encouraged K-12 teachers to participate in 4 yr. college/research institutions Masters of Education programs. The results were dismal: a tiny percentage of teachers responded—usually due to the terrific expense and time constraints added by the university system itself. A way needs to be found around this barrier.”*)

### **C.2. Please provide comments as appropriate on the program’s performance in meeting program-specific goals and objectives that are not covered by the above questions.**

The desired goals and outcomes of each RFP need to be very clearly delineated. For example, the desired outcome of institutionalizing programs at two-year institutions needs to be better explained (the community college is required to be focused on workforce development as well as adding new college credit programs; so the question “which one (or both) is NSF interested in for this RFP?” will always come up).

### **C.3. Please identify agency-wide issues that should be addressed by NSF to help improve the program's performance.**

The COV views very positively the collaborative relationship between Geosciences E&D and EHR. The COV considers this relationship as a model for the rest of the science directorates in the Foundation.

It appears that sustainability commitments (or even levels of participation) from industry are not solicited in most RFPs, although industry participation often is encouraged in the Advisory Boards once a grant is awarded. Given the interest of many industries in both education and diversity, NSF might consider increasing opportunities for industry participation in E&D efforts.

Types of support that industry could contribute include offering internships to the participants of the grant, offer “XXX Scholar” awards through the university to encourage teachers to pursue advanced degrees, and career explorations for students that would both expand “sustainability” and reinforce the “learn geosciences, get a Job!” mantra. Many companies do these things now for (usually graduate level) science students they expect to hire; more teachers and student at all educational levels would translate into more workforce candidates at all educational levels. In return, industrial and commercial supporters could be offered a prestigious logo or targeted media releases (written/funded by NSF) for their participation.

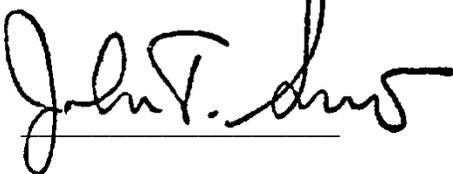
**C.4. Please provide comments on any other issues the COV feels are relevant.**

The COV feels there are insufficient staff resources (i.e., program officers) to manage the expanding GEO E&D portfolio. We recommend the addition of at least one more PO to ensure the high level of professionalism and timeliness demonstrated by the current staff.

**C.5. NSF would appreciate your comments on how to improve the COV review process, format and report template.**

See comments embedded in text above.

**SIGNATURE BLOCK:**

A handwritten signature in black ink, appearing to read "John T. Snow", written over a horizontal line.

For the NSF GEO E&D Program COV

John T. Snow

Regents Professor of Meteorology, The University of Oklahoma

COV Chair