

Advancing Earth Science

K-12 Earth System Science Education Summit

Report on the Conference and Progress to Date

**February 8-11, 2010
Helios Plaza
Houston, TX**



Executive Summary

The American Geological Institute (AGI) hosted the first Earth System Science (ESS) Education Summit in Houston, Texas, at BP Exploration's new Helios Plaza meeting facility on February 8-11, 2010. The Summit was supported by a grant from the National Science Foundation, as well as by funding from AGI, the American Association of Petroleum Geologists and the Geological Society of America. Forty-two representatives of AGI member societies and key partners met to discuss and address key issues facing the K-12 geoscience education community. The issues included:

- Perception of high school ESS as a non-rigorous, non-laboratory course;
- Status of the preparation and continuing education of ESS teachers;
- Inclusion of ESS alongside other sciences in the new national science education standards;
- Lack of an ESS advanced placement course;
- Challenges to ESS in schools by the creationist and Intelligent Design movements; and
- Role of the International Earth Science Olympiad in raising the profile of ESS.

Summit participants aimed to establish a formal consensus about key challenges, identify initiatives and individuals to address challenges, form teams to work on specific projects, identify possible funding sources for projects, and plan for U.S. participation in the International Earth Science Olympiad. In doing so, participants endeavored to achieve an appropriate profile for ESS education, a better prepared contingent of K-12 ESS teachers, and dissemination of updated ESS standards that are integrated with national science standards and that reflect current geoscience.

The Summit was a combination of keynote presentations, break-out group discussions, and whole-group discussions. Each break-out group was led by a facilitator, who orchestrated the report-back sessions to the entire group. In addition to affirming the priority issues listed above, the meeting resulted in five chaired **Working Groups**, as well as lists of **Big Ideas** and **Action Items**.

Big Ideas

Participants substantively agreed:

1. The geoscience community must speak with a common voice.
2. The geoscience community needs a public relations campaign for ESS education.
3. ESS education needs to be inclusive.
4. Teacher professional development for ESS must be organized nationwide.
5. There needs to be a state-level network to deal with crises in ESS education.
6. A nationwide campaign is needed to encourage institutions of higher learning to accept ESS high school courses as laboratory science courses.
7. The geoscience community must be politically savvy in ensuring ESS inclusion in national and state standards.
8. The geoscience community needs to work with guidance counselors and parents to raise the profile of ESS in schools for subject literacy and as a career option.
9. The AP Earth Science Exam can legitimize ESS in schools.
10. Look to the International Earth Science Olympiad as a public relations opportunity for ESS education and a chance to engage students at all levels in solving local geoscience problems.

Action Items

Participants made a shared commitment to:

1. Collect baseline data on existing ESS teacher pre- and in-service programs in the U.S.
2. Collect baseline data on four-year institutions that do and do not accept a high school ESS course for admission.

3. Update AGI's Pulse of Earth Science web site to reflect states that both require a course in ESS and that accept a course in ESS for high school graduation.
4. Review the draft version of the new national science education standards and provide feedback.
5. Seek funding support for a Center for Geoscience Understanding.
6. Seek funding and explore potential partnerships for the International Earth Science Olympiad.

Post-Summit Progress to Date

The **Earth Science Teacher Education Working Group**, chaired by the National Association of Geoscience Teachers' Cathy Manduca, is working with AGI to survey 800 members of the American Association of Colleges of Teacher Education on the status of their Earth science pre-service teacher education programs. To date, there have been some 250 responses to the online survey, which will remain "live" until January 31, 2011. Once the group collects and analyzes survey data, the National Association of Geoscience Teachers will post program descriptions and contacts on its web site. Ultimately, this group hopes to hold a conference so that faculty with singularly effective pre-service programs can share their ideas and practices with others.

As chair of the **Perception Working Group**, AGI's Education Department director is collecting information on what college admissions offices want to see in an "acceptable" laboratory science course. To date, 265 four-year institutions have been contacted (at least one large state university and one sizable four-year college per state). AGI also has obtained the College Board Standards for College Success recommendations for what should be criteria for acceptable high school science courses, as well as definitions of "laboratory science courses" from the American Association of Collegiate Registrars and Admissions Officers and from the University of California system. AGI will be sharing these data at the end of the data-collection process (estimated to be mid-February 2011). Once AGI has a clearer picture of the criteria admissions offices are using to define a laboratory science, it plans to launch a campaign making the case to college and university leaders that they should accept Earth science courses on a par with biology, chemistry, and physics. AGI has also updated the Pulse of Earth Science web site.

The **National Standards and AP Exam Working Group** has fed into the process of reviewing the framework for the new national science education standards. Michael Wysesession, who presented at the Summit, leads the Earth and Space Science Design Team for the standards. Eric Pyle of NAGT is also a member of that team. Following the Summit, Cathy Manduca, executive director of the National Association of Geoscience Teachers, established a listserv for announcements and updates about the National Academies' process and other topics related to standards. The list currently has 75 members and has received 10 updates. In addition, Working Group Chair Roberta Johnson, executive director of the National Earth Science Teachers Association, has been exploring the option of establishing a workshop to help develop models for capstone Earth science courses.

David Gibson, chair of the **International Earth Science Olympiad Working Group**, has been making contacts and looking for interest from people and groups that could help secure funding for the International Earth Science Olympiad. Many educational professional organizations are interested and ready to help, but they lack resources. The olympiad is promoting an integrated, team-based, problem-solving (and "engineering") approach that uses digital media, connects students from remote locations, and emphasizes Earth science.

Rob Ross, chair of the **Challenges Working Group**, reports that challenges to ESS nationwide are minimal at the moment. There have been flare-ups in Florida recently (including serious talk about not accepting Earth science as a course for high school graduation), but that was more in the Perception area than in Challenges. There have been some recent challenges to evolution and climate change education in Louisiana textbook adoptions, which AGI is monitoring.

Introduction

At the invitation of the American Geological Institute (AGI), representatives of AGI member societies and key partners gathered for the first Earth System Science Education Summit in Houston in February 2010. The following report summarizes the origins of the meeting, major discussions that took place, and strategic actions moving forward. AGI offers sincere thanks to all participants for their demonstrated commitment to excellence in Earth system science education and their continuing dedication to this vital enterprise.

I. Need for the Summit

The meeting was motivated by a set of critical questions facing the field:

A. Perception: The Earth and space sciences apply an integrated methodology to the study of science. How may the basic tools of physics, chemistry, biology and mathematics be used to understand the time-integrated, complex interactive systems that constitute the natural world? The historical evolution of natural systems provides unique insights into the scaling of time, the rates of change in system processes, and how time integrated phenomena are fundamental to understanding natural and laboratory systems. Teaching science as an integrated body of knowledge, rather than isolated disciplines, is one of the most important intellectual challenges now facing humankind. Earth science knowledge is also vital to understanding global issues such as the limits of energy, mineral and water resources, climate change, ocean resources distribution, and pollution and natural hazards, which rank high among public threats in a progressively overpopulated world. Despite the holistic intellectual perspective and the need to understand the impending crises in this new century of limits, the Earth and space sciences are not perceived by the general public, school administrators, or university leaders as an essential part of science education. How can the geoscience community work together to change this perception?

B. Threats. Especially troubling, Earth science has come under threat from the creationist and “intelligent design” movements in recent years. In the area of biology, the theory of evolution, issues of human origins, origins of life and major extinctions are all rooted in the study of Earth history. These fundamental concepts and research are all part of the web of modern biology. How can the geoscience community combat such efforts to ensure that what is taught in schools is actual science?

C. Standards. National science standards are undergoing revision. How can the geoscience community ensure that Earth science is an equal partner in this effort with the other major sciences? To meet standards, teachers need resources and systems of accountability to get the job done. How should Earth science figure, for instance, in curriculum development, statewide assessments, high school graduation and university admission requirements?

D. Teacher Quality. Teachers of Earth science are often uncertified in this content area. How can the geoscience community do a better job of ensuring that these teachers are prepared to teach Earth science, both at the pre-service and in-service levels?

E. Workforce and Recruitment. Industry leaders and others harbor grave concerns that U.S. schools, colleges, and universities are not producing graduates qualified to meet the demands of the competitive geoscience workforce of the 21st century. How can the geoscience community collaborate more effectively to connect education with employers’ needs? Can wider U.S. participation in the International Earth Olympiad help recruit students to the geosciences?

II. Purpose of the Summit

The overall purpose of the K-12 Earth System Science (ESS) Education Summit was to provide a forum for AGI's member societies and others with a stake in ESS education to discuss the questions in Section I above and devise initial plans to systematically address each question.

The **broader impacts** of the Summit included:

- an appropriate profile for ESS education in the U.S. and beyond (in school systems, institutions of higher learning, and the general public);
- a better prepared contingent of K-12 ESS teachers; and
- dissemination of updated ESS standards that are integrated as part of the national science standards and that reflect current geoscientific practice and technologies.

AGI, working with its member societies and other partners, submitted a proposal to the Geoscience Directorate of the National Science Foundation (NSF) to secure funding for the Summit. Support from NSF, as well as from AGI, the AGI Foundation, the Geological Society of America, the American Association of Petroleum Geologists, and BP Exploration, made the Summit a reality.

III. Goals of the Summit

The **goals** of the Summit were to:

- establish a formal consensus about challenges facing ESS education;
- identify the initiatives, roles, and players needed to address these challenges, particularly among AGI's member societies;
- identify teams across organizations to work on specific projects;
- identify possible funding sources for projects and efforts to address challenges; and
- devise a plan for moving forward on U.S. participation in the International Earth Science Olympiad.

IV. Summit Details

Overview: The Summit was held at BP's new training facility at Helios Plaza in Houston, Texas, an in-kind donation from BP. There were 42 on-site participants drawn from AGI's 46 member societies, as well as from other organizations with a stake in geoscience education. The meeting began with a reception and dinner on the night of February 8, 2010, and concluded at noon on February 11. The agenda was a combination of keynote presentations, break-out group discussions, and whole-group discussions. Each break-out group was led by a facilitator, who orchestrated the report-back sessions to the entire group. Notes from the break-out group discussions are in Appendix A. Summaries of these discussions are below. During the final break-out session, groups were asked to prioritize the five areas under discussion in terms of their urgency to the geoscience community. Dr. Ian MacGregor, AGI senior advisor on education, summarized and presented the key points of the three days of discussion at the end of the meeting.

A. International Earth Science Olympiad: U.S. Participation and Raising Awareness of the Geosciences

Presenters: *David Gibson, Aparna Katre, Tom Tailer and Beth Tailer, Global Challenge Award*

What We Can Learn from the U.S. and International Physics Olympiads

Presenter: *Warren Hein, American Association of Physics Teachers*

1. Summary of Presentations

Warren Hein, who presented remotely from Maryland, discussed the process of running the U.S. component of the International Physics Olympiad. He provided specifics on student recruitment, competition logistics management, promotion, exam development and administration, and funding support. David Gibson, Aparna Katre, Tom Tailer, and Beth Tailer made a group presentation on U.S. participation in the relatively new International Earth Science Olympiad.

2. Break-Out Questions

1. List the benefits of a national strategy for Earth and Space Systems Olympiad.
2. List some challenges to consider.
3. List some suggestions to address these challenges.
4. Give directions for an executive team and working group to devise and implement next steps, if appropriate.
5. Who is interested in working on this topic after the Summit?

3. Discussion Summary

In the post-break-out discussion, Summit participants emphasized that a U.S. Earth Science Olympiad (as a precursor to the wider involvement in the International Earth Science Olympiad) could be a good opportunity to raise awareness of ESS in the wider public and to recruit students (especially minority students) into the geosciences. Participants suggested that organizers of the U.S. Olympiad take advantage of communications technologies to recruit students and teachers, administer any assessments involved in the program, share information between teams, and disseminate results. Past participants in the International Earth Science Olympiad stressed that it was important to challenge students to solve local geoscience-related problems as a part of the contest. Summit participants overall expressed concern about funding and logistics, as well as ensuring that the Olympiad had broad support from geoscience organizations, school districts, and universities.

B. Status of Secondary Earth Science Teachers in the U.S.

Presenters: *Roberta Johnson, National Earth Science Teachers Association*
Cathy Manduca, National Association of Geoscience Teachers

Examples of Best Practices in Earth Science Teacher Education

Presenters: *Steve Semken, Arizona State University School of Earth and Space Exploration*
Jackie Huntoon, Michigan Technological University
Bob Myers, Earth System Science Education Alliance

1. Summary of Presentations

Roberta Johnson described the results of a recent study that NESTA conducted on Earth science teachers' needs. Cathy Manduca's presentation focused on the work of NAGT to promote excellence in Earth science teaching at the college level. For the Best Practices session, Steve Semken and Jackie Huntoon discussed the exemplary teacher education programs at their respective universities, and Bob Myers presented information on the goals and operations of the Earth System Science Education Alliance (ESSEA), a consortium of institutions providing online Earth science education courses to teachers.

2. Break-Out Questions

1. What creates demand for well-prepared Earth science teachers in school districts? Incentives? Mandates?
2. How could AGI member societies and other geoscience organizations collaborate to increase that demand?
3. What are best practices in Earth science teacher preparation, both pre-service and in-service?
4. What can Summit attendees do to identify and disseminate those best practices?
5. Who is interested in working on this topic after the Summit?

3. Discussion Summary

Discussion on this topic centered on the need to increase the status of and demand for ESS teachers, particularly at the high school level, and to provide exemplary pre-service and in-service programs for

ESS teachers. Suggestions for how to raise the status and demand for ESS teachers included: reaching out to parents and guidance counselors with information on the importance of ESS education and career possibilities in the geosciences (including teaching); working to make ESS a high school graduation requirement in states; having exemplary ESS curricula available; establishing and supporting state-based ESS teacher groups; ensuring that ESS concepts are included in state assessments; and advocating for ESS courses being accepted for college admission requirements.

There were many suggestions on how to improve ESS teacher preparation and professional development programs. These included: creating a strategic plan for ESS professional development nationwide; rewarding effective teacher preparation programs; encouraging geoscience university departments and faculty members to ensure that science teachers come out of the universities with a satisfactory education in ESS; tailoring professional development programs for different audiences; collaborating with national teacher education organizations such as AACTE and NSTA; supporting teachers who do professional development in their schools with materials and guidance; including field experiences; using technology (such as ESSEA) and including teacher research experiences; using research-based best practices in professional development that combine content, pedagogy, and assessment; teaming experienced and less experienced teachers in professional development efforts; and holding meetings with researchers and professional development deliverers to build bridges with practitioners to develop and use common language.

C. Earth Science Standards: Current and Future Initiatives

Presenter: *Michael Wysession, Washington University*

Status of Earth Science and Advanced Placement

Presenter: *Bob Ridky, U.S. Geological Survey*

1. Summary of Presentations

Michael Wysession, who headed the Earth Science Literacy Initiative, presented the work of that group (Earth Science Literacy Principles). He also discussed his role in ensuring the inclusion of Earth science concepts in the new National Science Education Standards. Bob Ridky talked about the importance of having an Advanced Placement (AP) examination in Earth science as a driver for Earth science courses at the high school level.

2. Break-Out Questions

1. What can the Summit group do to disseminate the Earth Science Literacy Principles as widely as possible?
2. What is the geoscience education community doing to ensure equal status with the other sciences in the standards revision process?
3. How can we ensure that literacy principles and standards are not only circulated but put into use in curriculum development, instruction, and assessment?
4. How can the AP test drive inclusion of Earth science in the secondary curriculum?
5. Who is interested in working on this topic after the Summit?

3. Discussion Summary

Discussion on this topic broke into two sections: ideas on how to disseminate the Earth Science Literacy Principles (ESLP) and ensure their inclusion in national science education standards; and discourse on the role of an AP Earth Science Exam in promoting ESS in high schools. Suggestions for disseminating the ESLP included: creating an integrated flyer and/or web site showing all the literacy documents created for the geoscience community; educating AGI member societies about the existence of the ESLP and how to get involved and advocate for them; using the ESLP in undergraduate education and teacher professional development; sharing the ESLP with parents and guidance

counselors; providing ready-to-use resources (including multi-media) incorporating the ESLP; disseminating them to interested parties outside the geosciences but with strong interest in STEM education such as NSTA; cross-linking the ESLP with state science standards and integrating them with existing and new curricula; advocating for federal agencies to require reference to ESLP in new grant-supported projects; and setting up a feedback mechanism whereby teachers can evaluate the impact of ESLP on their students.

Participants said that an AP Earth Science Exam could create a demand for ESS and legitimize it in the high school curriculum. One suggestion was to work with the College Board to move this effort forward, possibly establishing a relationship with the Environmental Science AP Exam. If an AP Earth Science Exam is established, participants said, it should be aligned with the ESLP and the new national science education standards.

D. Challenges to Earth Science Education

Presenters: *Eugenie Scott, National Center for Science Education*
Steven Schafersman, Texas Citizens for Science

1. Summary of Presentations

Eugenie Scott presented the work that the National Center for Science Education does to track and combat threats to science education in the U.S. by the creationist and intelligent design movements. Steven Schafersman's talk focused on the efforts made by the geoscience community in Texas over several years to include Earth science in the high school curriculum. They were eventually successful, despite the presence on the Texas state school board of members promoting the teaching of creationism in schools along with science.

2. Break-Out Questions

1. What are geoscience education organizations already doing to counter "intelligent design" and creationism in science classrooms?
2. What tools are available to accomplish this?
3. How can the geoscience education community support the efforts of existing groups such as the National Center for Science Education?
4. What should be the main components of this effort? Influencing public opinion? Influencing policy makers?
5. Who is interested in working on this topic after the Summit?

3. Discussion Summary

The discussion following the break-out session for this topic concentrated on ways to ensure that correct science is taught in schools. Suggestions to accomplish this included having a focused, agreed-upon message and statements of support for correct science; ensuring that evolution is specifically discussed in standards; writing letters to policy makers to show support; using available tools (AGI's online Advocacy Guide, National Center for Science Education's information); making AGI member societies and others aware of available tools; and educating members to act rapidly when ESS is challenged. Other suggestions were: using social media, web sites and email blasts to communicate when and where ESS is under threat; and working with and actively supporting groups that deal directly with this issue.

E. Perception of Earth Science Courses at the Secondary School Level

Presenters: *Michael Gallagher, Oakland, Michigan Schools*
Ragan Spain, North Carolina State Board of Education
Eldridge Moores, University of California at Davis

1. Summary of Presentations

2. Break-Out Questions

1. What can we learn from the North Carolina experience?
2. Who should be targeted in states when secondary Earth science is under threat of becoming excluded from the curriculum?
3. Where (what states, districts) would a concerted effort by the geoscience education community have the most impact in ensuring that Earth science has equal status in high schools with the other sciences?
4. What tools are available to help in this effort (Advocacy Guide, Pulse of Earth Science web site, others)?
5. How can we ensure an ongoing, organized effort to advance Earth science as a core curriculum priority and, ideally, a high school graduation requirement?
6. Who is interested in working on this topic after the Summit?

3. Discussion Summary

The discussion following this break-out session initially targeted the need for better data from states to monitor the status of ESS education. Once these data were available, participants suggested targeting “vulnerable” states, designated as states in which ESS was under threat of removal from the high school science program, or “strategic” states that other states tend to follow (CA, TX, NY, etc.). These suggestions led to talk about ways to ensure that ESS is included in the high school curriculum in all states. One idea was to make sure that the geoscience community had a common message about the importance of ESS education in schools (Michael Wyssession’s statement on the Earth Science Literacy Initiative web site was offered as an exemplar). North Carolina (where there was a long struggle to have ESS as a requirement for high school graduation) was cited as an example of how to get this task accomplished. North Carolina provides extensive curriculum support for teachers, but the state’s amount of professional development was questioned. Participants also suggested that one strategy to ensure inclusion of ESS in secondary curricula was to build demand through the establishment of an AP Earth Science Exam. Such an exam would legitimize ESS high school courses in the eyes of parents, guidance counselors, and other school district stakeholders. Another suggestion was to create a savvy task force to respond rapidly when states or school districts consider eliminating ESS courses. There was debate about what persons or entities can speak and act effectively for the geoscience community.

V. Summit Outcomes

A. Priorities

In the final break-out and whole group discussion in the Summit, participants ranked the discussion topics in order of importance and urgency. The rankings were:

1. Perception of ESS Education by Schools and the Public
2. Inclusion of ESS in the New National Science Education Standards
3. ESS Teacher Education
4. Competition of Non-science Movements with ESS in Schools
5. International Earth Science Olympiad

See **Section G. Progress to Date** below for a summary of how participants moved forward on these priorities after the Summit.

B. Big Ideas from the Summit

Ten major imperatives for the field emerged from the Summit’s three days of discussions:

11. **The geoscience community must speak with a common voice.**
12. **The geoscience community needs a public relations campaign for ESS education.** Is there a high profile champion willing to join the cause?

13. **ESS education needs to be inclusive.** Everyone should have a basic understanding of ESS (Earth Science Literacy Principles).
14. **Teacher professional development for ESS must be organized nationwide.** There must be a plan that addresses teachers' needs at various entry points and is accessible for all audiences. While it is important to take advantage of communication technology in delivering professional development, it is also important to include field experiences. ESS teacher professional development needs to use research-based strategies that combine content, pedagogy, and assessment. In addition, ESS faculty in colleges and universities need to be more responsible for ensuring that their institutions include ESS training in teacher education and accreditation. Better ESS pre-service training will reduce the remedial efforts that dominate current in-service professional development.
15. **There needs to be a state-level network to deal with crises in ESS education.** Collect and/or create a set of tools for this network to use when responding to crises in ESS perception and competition. Examples of such tools are the AGI Advocacy Guide, Pulse of Earth Science website, National Center for Science Education, COPUS, *Why Earth Science?* video and brochure, AGI Critical Needs for the 21st Century document, and statements from State Science Teachers Associations.
16. **A nationwide campaign is needed to encourage institutions of higher learning to accept ESS high school courses as laboratory science courses.**
17. **The geoscience community must be politically savvy in ensuring ESS inclusion in national and state standards.**
18. **The geoscience community needs to work with guidance counselors and parents to raise the profile of ESS in schools for general ESS literacy and as a career option.**
19. **The AP Earth Science Exam can legitimize ESS in schools.** What does it take to get a critical mass of students to convince the College Board to move forward?
20. **Look to the IESO as a public relations opportunity for ESS education and a chance to engage students at all levels in solving local geoscience problems.** IESO can also provide an opportunity to work across the sciences.

C. Action Items

1. Collect baseline data on existing ESS teacher pre- and in-service programs in the U.S.
2. Collect baseline data on four-year institutions that do and do not accept a high school ESS course for admission.
3. Update AGI's Pulse of Earth Science web site to reflect states that both require a course in ESS and that accept a course in ESS for high school graduation.
4. Review the draft version of the NRC's new national science education standards and provide feedback.
5. Seek funding support for a Center for Geoscience Understanding.
6. Seek funding support and explore potential partnerships for the IESO.

D. Working Groups

Moving forward, ESS Education Summit participants volunteered to serve on five working groups, each accepting the charge to work on the Action Items in Section C above.

Topic: IESO	
Name	Organization
David Gibson, Chair	Global Challenge Award
Tom Tailer	Global Challenge Award
Beth Tailer	Global Challenge Award
Jessica Moore Ali-Adeeb	Chevron

Susan Chapman	Soil Science Society of America
Cathy Manduca	National Association of Geoscience Teachers
Larry Becker	Association of American State Geologists
Topic: ESS Teacher Education	
Cathy Manduca, Chair	National Association of Geoscience Teachers
Michael Passow, Co-Chair	National Earth Science Teachers Association
Laura Zahm	American Association of Petroleum Geologists
Roberta Johnson	National Earth Science Teachers Association
Ardis Herrold	National Earth Science Teachers Association
Mike Gallagher	Oakland Schools, Michigan
Susan Chapman	Soil Science Society of America
Rob Ross	Paleontological Research Institute
Gary Lewis	Geological Society of America
John Taber	Incorporated Research Institutions for Seismology
Andy Milson	Association of American Geographers
Jackie Huntoon	Michigan Technological University
Keith Etheridge	National Energy Education Development Project
Steve Semken	Arizona State University
Ines Cifuentes	American Geophysical Union
Heather Pacheco	National Science Foundation
Jim Brey	American Meteorological Society
Larry Becker	Association of American State Geologists
Ron Wallace	American Institute of Professional Geologists
Mike Taber	Colorado College (NABT)
Topic: Challenges to ESS Education (ID, Creationism, etc.)	
Rob Ross, Chair	Paleontological Research Institute
Roberta Johnson	National Earth Science Teachers Association
Ardis Herrold	National Earth Science Teachers Association
Elizabeth Wright	SAIC: National Association of Geoscience Teachers
Cathy Manduca	National Association of Geoscience Teachers
Corina Cerovski-Darrieau	American Geological Institute
Gary Lewis	Geological Society of America
Steven Schafersman	Texas Citizens for Science
Larry Becker	Association of American State Geologists
Steve Newton	National Center for Science Education
Topic: ESS Standards and AP Exam	
Roberta Johnson, Chair	National Earth Science Teachers Association
Eric Pyle, Co-Chair	National Association of Geoscience Teachers
Laura Zahm	American Association of Petroleum Geologists
Ardis Herrold	National Earth Science Teachers Association
Mike Gallagher	Oakland Schools, Michigan
Kathy Butcher	National Ground Water Association
Cathy Manduca	National Association of Geoscience Teachers
Corina Cerovski-Darrieau	American Geological Institute
Rob Ross	Paleontological Research Institute
Jackie Huntoon	Michigan Technological University

Steven Schafersman	Texas Citizens for Science
Larry Becker	Association of American State Geologists
Bob Ridky	U.S. Geological Survey
Heather Pacheco	National Science Foundation
Steve Newton	National Center for Science Education
David Steer	National Association of Geoscience Teachers
Topic: Perception of ESS by School Districts and Higher Education	
Ann Benbow, Chair	American Geological Institute
Roberta Johnson	National Earth Science Teachers Association
Ardis Herrold	National Earth Science Teachers Association
Mike Gallagher	Oakland Schools, Michigan
Eldridge Moores	University of California Davis
Bruce Herbert	National Association of Geoscience Teachers
Geoff Camphire	American Geological Institute
John Taber	Incorporated Research Institutions for Seismology
Mike Heinz	NJ State Department of Education
Ines Cifuentes	American Geophysical Union
Heather Pacheco	National Science Foundation
Steve Newton	National Center for Science Education
David Steer	National Association of Geoscience Teachers
Linda Rowan	American Geological Institute

E. Wiki

AGI has established a secure wiki to facilitate working group discussion, planning, and sharing. Each working group participant has his/her unique sign-on code and will be able to access any of the working group strands. Other information on the wiki includes Summit presenters' PowerPoint presentations, notes from break-out groups, photographs, contact information, and online tools that the various groups might find useful.

F. Next Steps

Short-term Steps: AGI has identified chairs of the working groups and has initiated post-Summit conversations to help each group plan its next steps. These steps include setting up and facilitating teleconferences, signing all participants onto the wiki, helping to identify funding sources that each group might need, linking interested groups, and keeping members abreast of one another's progress.

Longer-term Step: AGI plans to host a second Summit (possibly in the fall of 2011) as a whole group report-back session on progress, challenges, problems, and successes.

G. Progress to Date

1. **Earth Science Teacher Education Working Group.** Chair: Cathy Manduca, Carleton College and Executive Director, NAGT; Co-Chair, Michael Passow, Passaic County Schools, New Jersey. The ES Teacher Education group has met by teleconference and email. As a first step in accomplishing Action Item 1, AGI purchased the list of addresses for 800 colleges of teacher education from the American Association of Colleges of Teacher Education (AACTE). AGI also collected emails for each of the individuals on that list. Cathy Manduca and other Working Group members collaborated with AGI to develop a survey that will help the group to identify who provides Earth science teacher education, both pre-service and in-service. AGI emailed a letter to each faculty member on the address list explaining the project and directing interested parties to the online survey. Once the group collects and analyzes the survey data, which will be available online through January

31, 2011, NAGT will put program descriptions and contacts on its web site. Ultimately, this group hopes to have a conference so that faculty with singularly effective pre-service programs can share their ideas and practices with others.

2. Perception Working Group. Chair: Ann Benbow

AGI's Education Department is collecting information on what college admissions offices want to see in an "acceptable" laboratory science course (Action Item 2). AGI has taken a first step on this by contacting the admissions officers at 265 institutions of higher learning (at least one large state university and one sizable four-year college per state). AGI also has the College Board Standards for College Success recommendations for what should be criteria for acceptable high school science courses. Mike Heinz of the New Jersey State Department of Education has collected information on definitions of "laboratory science courses" from the American Association of Collegiate Registrars and Admissions Officers (AACRAO) and from the University of California system. AGI will be sharing these data as soon as they finish the process (estimated to be mid-February 2011). Once AGI has a clearer picture of the criteria admissions offices are using to define a laboratory science, it plans to launch a campaign making the case to college and university leaders that they should accept Earth science courses on a par with biology, chemistry, and physics. AGI has also updated the Pulse of Earth Science web site (Action Item 3). The AGI Foundation is exploring securing funding for this work and other post-Summit efforts, such as the proposed Center for Geoscience Understanding (Action Item 5).

3. National Standards and AP Exam Working Group. Chair, Roberta Johnson, Executive Director, NESTA; Co-Chair, Eric Pyle, James Madison University.

Michael Wyssession, who presented at the Summit, leads the Earth and Space Science Design Team for the new national science education standards. Eric Pyle is also a member of that team. Various entities participating in the Summit were asked by the National Academies to review the new national science standards when they came out in the summer of 2010. Both NAGT and AGI formed online focus groups and compiled responses (Action Item 4). Following the Summit, Cathy Manduca established a listserv for announcements and updates about the National Academies' process and other topics related to standards. The list was advertised to NAGT, and members of the Summit were invited to advertise the list to their members. The list currently has 75 members and has received 10 updates. In addition, Roberta Johnson has been exploring the option of establishing a workshop to help develop models for capstone Earth science courses.

4. IESO Working Group. Chair: David Gibson, Global Challenge Award Project.

David Gibson has been making quiet contacts behind the scenes, looking for interest from people and groups that could help secure funding for the International Earth Science Olympiad (Action Item 6). Many educational professional organizations are interested and ready to help, but they lack resources. David is promoting an integrated, team-based, problem-solving (and "engineering") approach that uses digital media, connects students from remote locations, and emphasizes Earth science.

5. Challenges Working Group: Chair, Rob Ross, Paleontological Research Institute.

Rob Ross reports that things are quiet on this front at the moment. There have been flare-ups in Florida recently (including serious talk about not accepting Earth science as a course for high school graduation), but that was more in the Perception area than in Challenges. AGI's President, a Florida resident and businessman, sent a strong letter of support for Earth science in high school to the Florida Department of Education. There have been some recent (September 2010) challenges to evolution and climate change education in Louisiana textbook adoptions, which AGI is monitoring.

Appendix A: Conference Evaluation

One week after the conclusion of the Summit, the project's external evaluator, Dr. Robert A. Bernoff, sent a seven question email questionnaire to meeting participants (the three meeting staff were not included). The 39 people surveyed were assured that their individual responses would be kept confidential. Three people declined to complete the form, two because they had only attended one day of the meeting, and one because of organizational affiliation. Ninety-seven percent (35 of the 36 possible people) completed the questionnaire. Participants' replies to the questionnaire are summarized below:

Note: The questions on the questionnaire are shown in *italics*. Summary percentages and the evaluator's remarks appear in **bold**. Selected comments from the participants are shown in *italics* as "quotations."

The first three questions assessed participants' opinions about how well the Summit met the three short-term goals.

A. To what extent, in your opinion, did the Summit meet the three goals below?

Goal 1: Participants will become better informed about five key issues/opportunities in Earth Science Education. Please place an X next to your choice.

69% Very well
31% Well
0% Fair
0% Not very well
0% Poorly

Goal 2: Participants will begin discussions about possible ways of addressing the five key issues/opportunities. Please place an X next to your choice.

51% Very well
40% Well
9% Fair
0% Not very well
0% Poorly

Goal 3: Participants will elect to join one or more follow-up working groups. Please place an X next to your choice.

74% Yes, I have already done that.
9% Not yet, but I plan to do that soon.
6% No, I am still undecided about joining a working group.
11% No, I do not plan to join any of the working groups at this time.

The next two questions were an assessment of participants' opinions about the effectiveness of various aspects of the meeting.

B. What aspects of the Summit did you think were particularly effective in achieving the goals of the meeting? (Please place an X next to all that apply.)

91% Mix of participants
40% Residential set-up
69% Choice of speakers
80% Break-out groups
49% Report-out sessions

- 51% Whole group discussions
- 63% Informal chances to network
- 86% Meeting facility
- 43% Agenda design
- 0% Others (Please add to Comments section below)

C. What aspects of the Summit did you think hindered the meeting from achieving any of its goals? (Please place an X next to all that apply.)

- 11% Mix of participants
- 3% Residential set-up
- 9% Choice of speakers
- 6% Break-out groups
- 11% Report-out sessions
- 9% Whole group discussions
- 0% Informal Chances to network
- 0% Meeting facility
- 17% Agenda design
- 17% Others (Please add to Comments section below)

The next question asked for participants' advice about the future.

D. What general and/or specific advice would you give to ensure that the working groups make an impact in their target areas (IESO, ESS Teacher Education, Challenges to ESS Education, Standards and AP Exam, Perception of ESS Education)?

Ninety-four percent of respondents (33 out of 35) made comments here. Advice varied widely. Consistent themes were the importance of effective leadership, clear goals, and timely action.

The final question asked for additional comments about the Summit.

E. Any additional comments about the Summit.

Half of the respondents made comments here. Responses were uniformly positive. A few representative comments are quoted below:

"Well done! Great, dedicated group of participants."

"Thanks for letting me be a part of the Summit."

"I was exposed to many different organizations of which I was unaware."

"Wonderful, wonderful opportunity to hear ideas, discuss strategies. It really felt like a working group – thank you!"

"The challenges are still there. It was a good meeting."

External Evaluator's Assessment of the Current (3/15/2010) Status of Summit actions and the Summit Participants Response to the Post Summit Meeting Evaluation Questionnaire

Summit participants' responses to the questionnaire as well as their actions to date are very strong indicators that the Summit meeting itself was extremely successful in accomplishing its three immediate short-term goals:

Goal 1: Consensus about challenges facing ESS education.

By the conclusion of the Summit, 10 major imperatives had been identified. Furthermore, everyone (100 percent) responding to the Summit evaluation questionnaire said participants were now better informed about the five key issues in ESS education.

Goal 2: Identification of initiatives and people needed to meet these challenges.

Over 90 percent responded on the questionnaire that discussions about ways of addressing these issues had started well at the Summit.

Goal 3: Identify teams to work on specific projects

To date, five groups have begun work on addressing the five key issues identified at the Summit. Each group has a chairperson. Over 80 percent of Summit participants have joined one or more of these working groups.

Appendix B: Conference Participants

AGI once again thanks all of the dedicated professionals participating in both the initial meeting and ongoing work of the K-12 Earth System Science Education Summit:

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