Mobilizing STEM Education for a Sustainable Future

Information about Critical Advisors

Susan Albertine

Susan Albertine is Senior Director of the Liberal Education and America's Promise (LEAP) States Initiative at the Association of American Colleges and Universities (AAC&U). An advocate throughout her career for curricular reform and educational equity, she has taught every level from pre-school through graduate school. She has served as professor of English and dean, School of Culture & Society, the College of New Jersey; Vice Provost for Undergraduate Studies, Temple University; and Assistant to the Provost, 21st Century Project, University of Pennsylvania; and has held faculty positions at the University of North Florida, St. Olaf College, and Susquehanna University. Albertine received her BA (English) from Cornell University and her Ph.D. (English) from the University of Chicago. Albertine's recent collaboration on undergraduate public health programs makes a case for the value that 19th-century literature—and liberal education as a whole—can bring to study of public health and global sustainability. Active in an array of baccalaureate and PK-20 reform initiatives, Albertine is a national leader of the Educated Citizen and Public Health, a collaborative project co-sponsored by APTR (Association for Prevention Teaching and Research), CCAS (Council of Colleges of Arts and Sciences), ASPH (the Association of Schools of Public Health), and AAC&U.

Susan's response to "What I bring to this meeting"

Mobilizing STEM addresses an urgent imperative by taking up theories of change and aiming to define robust, durable strategies to make change possible in STEM disciplines. My work now with the AAC&U Liberal Education and America's Promise (LEAP) initiative likewise advances sustainable, systemic change, including STEM disciplines and general education. Directing the LEAP initiative in the states, I am working with three large state university systems (California, Oregon, and Wisconsin), using LEAP frameworks to re-design baccalaureate education. In these systems, student mobility and student diversity are present and future facts. We intend to educate the broadest possible array of citizens prepared to meet 21st-century challenges. Experience tells me that all such work begins with campaign theory, informed by applied or action research in the social sciences and organizational studies. If we want to create conditions for systemic change, we need simultaneously to shape a campaign strategy that employs the best of systemic- and organizational-change thinking. In the 1990s, many higher education leaders began to draw on ideas from the business world: chaos theory applied to business, systems thinking, just-in-time practices, total quality management. These theories and practices advance the ways we can imagine systemic change in disciplines and fields of higher education. The process of change must be fluid and flexible if it is to evolve over time, and it must break away from the factory model. My current project with LEAP states is the largest I have ever undertaken; I am relying on previous experience in other systemic change projects (especially in the realm of PK-20 reform). Our new initiative to advance the study of public health at the undergraduate level likewise responds to an understanding of system change for long-term social good.

Ann E. Austin

Ann E. Austin is a Professor at Michigan State University, holding the Mildred B. Erickson Distinguished Chair in Higher, Adult, and Lifelong Education (HALE). Her interests focus on faculty careers, roles, and professional development, work and workplaces in academe, organizational change and transformation in universities and colleges, reform in doctoral education, and the improvement of teaching and learning in higher education. She was a Fulbright Fellow in South Africa (1998) and the 2001-2002 President of the Association for the Study of Higher Education (ASHE). She is currently Co-P.I. of the Center for the Integration of Research, Teaching, and Learning (CIRTL), a National Science Foundation Center now in its sixth year. She also is the director of a new institute at Michigan State focused on higher education issues in a global context. Her recent publications include R*ethinking Faculty Work: Higher Education's Strategic Imperative* (2007), concerning changes in academic workplaces and faculty careers, as well as work on doctoral education and higher education issues in developing countries.

Ann's response to "What I bring to this meeting"

First, I bring to this meeting my enthusiasm for participating in thoughtful collegial interactions. Many of my research interests and professional experiences also closely match the goals of this meeting:

1. Several colleagues and I have been studying changes pertaining to faculty work and careers, including (1) changes in faculty demographic characteristics; (2) changes in the societal context in which faculty work; and (3) changes in the pattern of faculty appointments, resulting in shifts toward more fixed term, non-tenure-track, and part-time positions. These changes are important in regard to theories of change in academe.
2. In my research on faculty professional development, I have studied how faculty members learn and grow over time, and have identified approaches that enhance this growth, as well as approaches that are less effective.
3. My research on the sociology and reform of doctoral education has identified challenges facing doctoral students and programs, as well as reform strategies both at the institutional and national levels (CIRTL is one example of a reform effort.)
4. My experience with organizational change processes includes: evaluating NSF ADVANCE projects concerning women in STEM fields; serving as an institutional leader for MSU's involvement in the American Council on Education project on institutional transformation; and consulting with universities in South Africa as they strengthen their learning environments.
5. In our graduate program in higher education, I teach courses on organizational change, higher education history, curriculum development, and teaching and learning.
6. Some of my recent work focuses on higher education in the global context, where theories of change are very relevant to cross-national discussions as leaders strive to respond effectively to pressures to expand access and improve quality.

Last, regarding theories of change, I believe that to achieve sustainable change, we need multi-level, systemic approaches (including individuals, units, institutions, and national systems) that take into account contextual variables, and involve multiple change levers.

David Blockstein

David Blockstein is Senior Scientist with the National Council for Science and the Environment (NCSE), a nonpartisan organization of scientists, educators, environmentalists, and policymakers working to improve the scientific basis of environmental decision-making. He joined the organization at its inception in 1990 and was its first Executive Director. He organizes NCSE's annual National Conference on Science, Policy and the Environment and also serves as Executive Secretary of the Council of Environmental Deans and Directors (CEDD) and of the Council of Energy Research and Education Leaders (CEREL) and the Vice-President of the US Partnership for Education for Sustainable Development. He is the founding Chair of The Ornithological Council. As the 1987-88 Congressional Science Fellow of the American Institute of Biological Sciences (AIBS) and American Society of Zoologists, David worked with the House of Representatives Environment Subcommittee of the Science Committee to prepare the National Biological Diversity Conservation and Environmental Research Act. In 2008, he received the AIBS Distinguished Service Award.

David's response to "What I bring to this meeting"

I am an ecologist. I see the world through ecological eyes, thinking of systems, interconnections and seeing limits and natural boundaries as well as opportunities. I see science and environmental understanding hand-in-hand. I see the damage that our ironically self-named species *Homo sapiens sapiens* has inflicted upon the beautifully interconnected world of nature and see what Aldo Leopold called, "a world of wounds". As a person of morality and a Jew, I see my role as contributing to "Tikkun Olam" – the repair and healing of the world.

I am a community organizer and an institution builder. I organize the academic community. I have helped to organize the interdisciplinary environmental community through a leadership organization of the nation's deans of colleges of environment and natural resources and directors of institutes for environmental studies (CEDD) and a nascent professional society (the Association of Environmental Sciences and Studies). I recently began trying to organize the academic energy community. I have tried to bring about institutional reform in the federal government and its relationship with scientific and education community through earlier efforts to create a National Institute for the Environment and through current efforts to support strong programs within and among environmental and science agencies.

I also bring a sense of urgency. The biodiversity crisis is being exacerbated by the climate crisis. The lack of scientific understanding and knowledge among Americans and others impedes our ability to recognize and respond to these crises of our own making. Education is the only thing that ultimately lasts.

Finally, I hope that I bring a sense of humility to this process. I am honored to be invited to be among the leaders in this community and I look forward to making at least a small contribution to this vital effort.

George Boggs

Dr. George Boggs is President and Chief Executive Officer of the American Association of Community Colleges (AACC). From its Washington, D.C., headquarters, AACC represents over 1,100 associate degree-granting institutions and over 11 million students. Prior to coming to AACC, Dr. Boggs served as faculty member, division chair, and associate dean of instruction at Butte College in California and, for fifteen years, he served as the Superintendent/President of Palomar College in California. He served as a member of the Committee on Undergraduate Science Education of the US National Research Council and has served on several U.S. National Science Foundation panels and committees. Dr. Boggs holds a bachelor's degree in chemistry from The Ohio State University, a master's degree in chemistry from the University of California at Santa Barbara, and a Ph.D. in educational administration from The University of Texas at Austin.

George's response to "What I bring to this meeting"

My interests in this initiative go back to my time as a chemistry instructor at Butte College in the 1960s where I started the college's first environmental science class. It was cross-disciplinary and drew in faculty members from across the college. This was right at the time that interest in the environment was just emerging and the course drew a tremendous amount of student interest.

What I bring to this work is my connections to the 1200 community colleges across the country. They enroll almost half of all U.S. undergraduates and most of the "at-risk" students in higher education. I have a passion for both STEM education and environmental science education and am dismayed to see the low level of science literacy among our population and want to do whatever I can to raise that level of literacy. At community colleges there is a growing interest in STEM education, shaped by the "Rising above the Gathering Storm" and similar reports—although I think we are living in the age of the "silent Sputnik," that is, we don't yet realize how significant the needs and the challenges are, and how much we need to do to strengthen STEM education.

With respect to community college learners, a first challenge is that 60% of our students coming directly from high school are not prepared for college work and need to do remedial work, especially in math: this is obviously very critical to entering the STEM disciplines. We at AACC have partnered with National Science Foundation to support the Advanced Technical Education program; this is a shining example of success in strengthening technical education, involving partnerships between community colleges, universities, schools, and industry.

Peter J. Bruns

Peter J. Bruns is Vice President for Grants and Special Programs at the Howard Hughes Medical Institute. Dr. Bruns received an A.B. in Zoology (1964) from Syracuse University and a Ph.D. in Cell Biology (1969) from the University of Illinois. He held faculty and numerous administrative positions at Cornell University, starting in 1969. He was a visiting scientist at the Biological Institute of the Carlsberg Foundation, Copenhagen, where he was a Guggenheim fellow. He currently serves on the External Advisory Committee of the Vermont Genetics Network and the Board of Directors of the Boyce Thompson Institute for Plant Research. In addition to grants in support of his research, he obtained several HHMI and NSF grants for educational efforts, including outreach efforts by the Cornell Institute for Biology Teachers, which he founded. His research group pioneered methods to genetically manipulate and transduce new genes into the separate somatic and germinal nuclei of Tetrahymena. At HHMI, he oversees design, implementation and administration of one of the nation's largest private funds in support of science education from pre-college through graduate, with goals to develop the next generation of scientists and educators, and improve science literacy. In addition he directs an active international research program.

Peter's response to "What I bring to this meeting"

Peter brings to the meeting three theories of changes that are grounded in his experience over time of working with science education programs funded by HHMI:

1. Any addition requires associated subtraction.
We need to add appropriate inquiry-based instruction to replace major parts of the curriculum at all levels. Active learning and exposure to authentic science converge in inquiry-based learning and are appropriate for all levels of students, not just advanced students doing individual research projects. This means that the community must determine
    a. Level appropriate learning goals, materials and activities that use and convey the essentials of inquiry
    b. Delivery strategies for all students
    c. Specific elements and practices to be dropped in order to make room, time and resources for the new approach
2. Science teaching practices must mirror science research practices.
Although interdisciplinary science is a popular buzz word, we have not worked out how to include this approach in curricula, or how to credit inter-unit and team teaching.
3. Experiments in change must be properly assessed.
We need to formulate and widely apply ways to assess learning gains of changed educational practices by measuring subsequent performance of students (attitudes, knowledge and skills as practiced in the context subsequent courses and activities).

Carol Carmichael

Carol Carmichael advises administrators, faculty and staff on the development of sustainability programs at the California Institute of Technology. She also focuses on the role of the university campus in education for sustainability, both within the campus and in the community at-large. She serves on the City of Pasadena's Environmental Advisory Commission (EAC), whose mandate is to advise the Mayor and City Council on the implementation of the City's commitment to the United Nation's Green Cities Declaration, and chairs the EAC sub-committee on energy and water. Prior to coming to Caltech, Carmichael was the director of the Institute for Sustainable Technology and Development at the Georgia Institute of Technology. She has over 20 years of experience in technology and science policy, with a particular emphasis on sustainability policy and the need to help students learn about the societal context of science and engineering. She has developed and implemented corporate research and educational programs that engaged over 100 firms nationally. Dr. Carmichael has degrees in higher education, technology and science policy, and chemistry.

Carol's response to "What I bring to this meeting"

For 20 years at Georgia Tech, I worked with colleagues across the campus to help engineering and science students develop contextual competence in the definition of problems and the development of solutions to them. My work focused on the long-term goal to have every graduate of that institution understand his or her role in creating a more prosperous and sustainable society. This work included developing a green campus as an integral part of the educational process. I was responsible for developing and implementing strategies for engaging faculty members in research and educational programs relevant to sustainability. In that capacity, I mentored faculty members new to the concept of sustainability and helped them develop not only the conceptual bases for their work, but also the plans for securing funding to support it. I have facilitated faculty efforts to define outcomes for the more socio-humanistic objectives of engineering education, engaging faculty in engineering and the social sciences and humanities, within the context of an academic program, in the development of outcomes that draw upon learning from both domains. I was fortunate to spend 15 of my 20 years working on a long-term agenda for systemic, institutional change. Now at Caltech, I have had the opportunity to examine the differences between two institutes of technology, one a large public institution and the other an extremely small private institution.

Jeanne Century

Jeanne Century is the Director of Science Education and Research & Evaluation at the University of Chicago's Center for Elementary Mathematics and Science Education (CEMSE). Before coming to the University of Chicago, Century was at the Center for Science Education at Education Development Center (EDC), Inc. in Newton, MA. Century's career has focused on improving science education in urban settings, primarily at the preK-8 level. She has developed instructional materials and provided professional development, technical assistance and strategic planning support for educators at the school, district, and state levels and for the last ten years, has focused on research and evaluation. Her work targets questions of effective science instruction, systemic reform, improving utilization of research and evaluation, sustainability of reform, and measuring enactment of innovation. Most recently, Century served on the education policy and Department of Education transition teams for the Obama administration where she focused on STEM education and education Research and Development.

Jeanne's response to "What I bring to this meeting"

For the last twenty years, I have been engaged in efforts to improve K-12 STEM education in large urban school districts. For the last ten, one strand of my research has focused on the question, "What factors contribute to and inhibit sustainability of change?" In this project, I see those two areas of focus come together and with that, I bring questions. It is my experience that we in the business of improving education are very poor at defining our terms and ensuring that we use shared language in our conversations. Further, we devise ways to address our challenges without giving attention to their place in a larger conceptual framework that would allow us as a field to accumulate knowledge. So, I expect to explore with the group what is meant by "STEM." Likewise, I expect to explore questions about designing and implementing efforts that will last, and what it means to have them "last." To both of these conversations, and the others in the meeting, I will bring a perspective informed by the literature that tells us that both—knowledge development and enduring innovations—require a collaborative change process that is resilient, adaptable and flexible. Finally, I come to the meeting convinced that we know a great deal about what good STEM teaching is and how to develop and support it. It seems to me that the lack of change is not from lack of knowledge, but rather from lack of capacity and more importantly, will. I will bring an interest in exploring how these elements can be part of a change strategy.

Sharon Dunwoody

Sharon Dunwoody is Evjue-Bascom Professor in the School of Journalism and Mass Communication and Associate Dean for Social Studies in the Graduate School at the University of Wisconsin-Madison. Her scholarship focuses on the construction of media science messages and on how those messages are employed by individuals for various cognitive and behavioral purposes. She has co-edited two volumes, Communicating Uncertainty (Erlbaum, 1999) and Scientists and Journalists (Free Press, 1986), and authored a third book, Reconstructing Science for Public Consumption (Deakin University Press, 1993). Dunwoody has served as a Fulbright Distinguished Lecturer in Brazil, a visiting fellow at Deakin University in Australia, and as Donnier Guest Professor at Stockholm University. She is former head of the section on General Interest in Science and Technology of the AAAS and former president of both the Midwest Association for Public Opinion Research and the Association for Education in Journalism and Mass Communication. Before joining the UW-Madison faculty in 1981, she earned her doctorate in mass communication from Indiana University, worked as a science writer, and served on the faculty of the Ohio State University.

Sharon's response to "What I bring to this meeting"

My passion is to figure out how to help people learn about and use science information within the wild and wooly natural environment that we all inhabit. Once formal education has ended, most of our science learning takes place in the course of daily life, as we read, watch, talk and multi-task. It is important to understand how that happens, as well as to figure out how we can maximize the prospects of learning in these complex environments. Theories of change are critical to our efforts, as these informal environments are rife with variables that can truncate learning and behavior change; individuals' control over their information gathering and learning is a particularly important aspect of this domain. I also think it is important to help colleagues figure out how to apply our learning to real world situations. To that end, my research focuses on individuals' use of information in service to public engagement in environmental issues such as the contamination of the food supply and global warming.

James L. Elder

James Elder is Director of the Campaign for Environmental Literacy (CEL, www.FundEE.org), which he launched in 2005. He is a social entrepreneur and change agent who creates and implements high leverage projects that help improve the nation's environmental literacy. Through CEL, he focuses on strengthening national policy, funding, and advocacy work for environmental and sustainability education. CEL has restored over $50 million in federal environmental education funding. He drafted, created the supporting coalition, and enlisted Congressional sponsors for two active bills: the Higher Education Sustainability Act, and the "No Child Left Inside" Act. He co-managed the start-up of *The Ocean Foundation*, a $3 million community foundation for philanthropists committed to ocean conservation, and the *Global Environmental Alliance - China*, a bilateral organization that brings sustainable approaches to development into mainstream Chinese society through education. He founded *The School for Field Studies* in 1980, and built it into the nation's leading international environmental studies field program for undergraduates. He sits on numerous boards and proposal review committees, provides strategic advice to many organizations, authored "A Field Guide to Environmental Literacy: Making Strategic Investments in Environmental Education, and received an honorary doctorate for his sustainability education work.

Jim's response to "What I bring to this meeting"

The guiding question in my professional life for the past three decades has been "How can we tip our education system(s) to fully embrace sustainability?" I spend a lot of time thinking about this, searching for those gaps and leverage points in the system that, given my skills and situation, I might actually be able to help take hold. Unfortunately, we don't have a discipline of "change agency" so I feel like I'm trying to make it up as I go along. We don't train people to think about how to affect change in systems and institutions in this country; this deficiency needs to be addressed.

Higher education has champions for sustainability within institutions but they need help from a larger sphere (external stakeholders?), because the structural barriers are just too large. Institutions need federal support, business sector support, and external pressure. My most recent efforts have involved developing an advocacy movement in the federal policy arena. I am working to catalyze various sectors of the environmental/sustainability education community to advocate for support of environmental and sustainability education. I am trying to be the scout out on the front line to find and shape opportunities, and bring them to the higher education community. Most recently, this effort resulted in passage of the University Sustainability Program (USP, formerly the Higher Education Sustainability Act) as part of the new Higher Education Act. The USP will provide grants through the Department of Education to schools and higher education associations to tackle leverage points that broadly infuse sustainability into teaching and operations. The Campaign for Environmental Literacy has not only restored over $50 million of the funding for environmental and sustainability education cut by from the federal government over the past three years, but also has increased this amount by $15 million.

Peter Ewell

Peter Ewell is the Vice President at the National Center for Higher Education Management Systems (NCHEMS). A member of the staff since 1981, Dr. Ewell's work focuses on assessing institutional effectiveness and the outcomes of college, and involves both research and direct consulting with institutions and state systems on collecting and using assessment information in planning, evaluation, and budgeting. He has directed many projects on this topic, including initiatives funded by the W. K. Kellogg Foundation, the National Institute for Education, the Consortium for the Advancement of Private Higher Education, and The Pew Charitable Trusts. He is currently a principal partner in the Pew Forum on Undergraduate Learning. In addition, he has consulted with over 375 colleges and universities and twenty-four state systems of higher education on topics including assessment, program review, enrollment management, and student retention. Dr. Ewell has also authored six books and numerous articles on the topic of improving undergraduate instruction through the assessment of student outcomes. Prior to joining NCHEMS, Dr. Ewell was Coordinator for Long-Range Planning at Governors State University. A graduate of Haverford College, he received his Ph.D. in Political Science from Yale University in 1976 and was on the faculty of the University of Chicago.

Peter's response to "What I bring to this meeting"

My work connects with this project in both specific and general ways. The specific: I've been engaged a long time with both curriculum reform and the use of active pedagogies to increase student learning. I continue to believe that these are the ways forward in achieving quality in undergraduate education. I also served as an evaluator on two projects relative to the improvement of mathematics teaching and quantitative literacy: MAA's Student Assessment in Undergraduate Math and their Preparing Mathematicians to Educate Teachers Project, which was impressive in its ability to draw from what works in mathematics education in other countries such as China and Japan. My other strong interest is in the assessment of student learning: any transformation initiative needs to address effective ways to gather and represent learning outcomes to move the improvement process forward. A larger frame concerns institutional change work: I have learned that implementing large-scale institutional change is incredibly difficult to do. While many can envision where we want to go, identifying specific steps to get there is very difficult. Using an analogy from evolutionary biology, institutions or change leaders need to imagine intermediate forms (what each "living stage of the organism" might look like) on the way to their imagined end result.

Ted Greenwood

Ted Greenwood is a Program Director at the Alfred P. Sloan Foundation in New York City. His areas of responsibility include programs to increase the number of underrepresented minority students receiving PhDs and American Indian students receiving master's and PhDs in mathematics, science and engineering and to collect and use data on student outcomes in undergraduate and graduate education. Prior to joining the Foundation in 1992, Dr. Greenwood spent eight years as Director of the International Security Policy Program in the School of International and Public Affairs at Columbia University. Between 1974 and 1984 he was Assistant and then Associate Professor of Political Science at the Massachusetts Institute of Technology. From 1977 to 1979, he was on leave from M.I.T. as a Senior Policy Analyst in the Office of Science and Technology Policy in the Executive Office of the President. Dr. Greenwood received a B.Sc. in physics from the University of Toronto, and an S.M. in physics and a Ph.D. in Political Science from M.I.T. He has written widely on U.S. and NATO defense and arms control policy; environmental, health and safety regulation; and domestic and international energy policy, especially nuclear power and nuclear waste management.

Ted's response to "What I bring to this meeting"

- An understanding of the market for people trained in STEM disciplines that is grounded in data (including analysis of the work of Sloan Foundation grantees over many years, and knowledge of what our system looks like from the perspective of students and others), and also in an understanding of the political motives shaping opinions about the STEM job market.

- An appreciation for the many ways in which the U.S. system of higher education and training discourages Americans from persisting in preparation for STEM careers.

- A commitment to increasing completion rates in STEM disciplines at the undergraduate and graduate level.

- Experience with increasing the representation of women and minorities in STEM higher education.

- The perspective of a funder that has been more interested in replicating what we know works than with stimulating the creation of new and innovative ideas.

Richard J. Jackson MD MPH

Richard Joseph Jackson is Professor and Chair of Environmental Health Sciences at the UCLA School of Public Health. He has served as a Professor in similar roles at the University of Michigan and at the UC Berkeley School of Public Health. A pediatrician and public health leader, he served as the State Health Officer with the California Health Department, and was Director of the Centers for Disease Control and Prevention's (CDC's) National Center for Environmental Health in Atlanta. In 2005 he was recognized with the Presidential Distinguished Executive Award. Richard's work led to the establishment of the California Birth Defects Monitoring Program and state and national laws that reduced risks from dangerous pesticides. While at the CDC he established the national asthma epidemiology and control program, and advanced the childhood lead poisoning prevention program. He also instituted the current federal effort to "biomonitor" chemical levels in the US population. In the late 1990s he was the CDC leader in establishing the US National Pharmaceutical Stockpile to prepare for terrorism and other disasters. In 2006 he received the Breast Cancer Fund's *Hero Award* and was recognized at the UC Berkeley 2007 Commencement as the *Distinguished Teacher and Mentor of the Year*.

Richard's response to "What I bring to this meeting"

Based on my different professional experiences, I have been, and increasingly am, struck by the following viewpoints and knowledge that I believe are relevant to the problem we are addressing in this meeting:

1. The urgency and rapidity of the global issues we face;
2. The energy and goodwill of the students who want to address these, and by the need to help them avoid feeling overwhelmed to the point that they cannot act;
3. How social, cultural and ethical aspects of the problem may be more important than the technical aspects of the STEM disciplines;
4. How the breadth and complexity of the global challenges we face urgently calls for cross-disciplinary thinking and action, yet our current intellectual and heuristic structures remain so focused within the disciplines,
5. How we need leaders to look out far beyond the bow of the ship, using the best data to forecast and prepare for the future, leaving trusted lieutenants to worry about what's going on inside the ship; and
6. How institutions with good leaders can be extraordinarily effective in moving society in a positive direction.

Regarding the 3rd point, I found some of the highest quality of dialog on Sustainability at U Michigan was in the Ethics and Sustainability working group. The others tended to provide single factor solutions from within their stovepipes. Along these lines, we need to develop a richer and more effective vocabulary to help us accomplish our goals. Perhaps, we need a poet in the room. Regarding the 4th point, it feels to me that the hardest questions are at interstices between disciplines, and I consider it urgent that our organizational structures be changed to foster this kind of collaboration. I also draw on my experience in medicine when I think about the need to work across disciplines. Patients rarely present with just one problem, but a panoply of interwoven problems. With limited resources and time, I think to respond effectively, we seek treatments that provide benefits, and co-benefits. Regarding the 6th point, I have stories to tell about how leaders can act in ways that leave powerful residual institutional changes that benefit society. These changes have to be energetically conceived by a core of people with both the intellectual and emotional power to get somewhere (e.g., our own Founding Fathers), and be adequately capitalized. And leaders need solid intelligence about the environment to be able act on opportunities at that sweet spot between jumping so fast that you do the wrong thing (as they say in ERs, "Don't just do something, stand there."), and waiting so long that the window of opportunity passes.

Adrianna Kezar

Adrianna Kezar is an Associate Professor for Higher Education at the University of Southern California. Kezar holds a Ph.D. and M.A. in higher education administration from the University of Michigan and a B.A. from the University of California, Los Angeles. She was formerly an assistant professor at the University of Maryland and George Washington University. Her research focuses on change, leadership, organizational theory, governance, and diversity issues in higher education. Kezar was director of the ERIC Clearinghouse on Higher Education and editor of the ASHE-ERIC Higher Education Report Series. She has published over 75 articles and books and is featured in the major journals for higher education. Kezar has participated actively in national service. For example, she has served as a member of the editorial boards for *The Journal of Higher Education*, *The Review of Higher Education*, *Change*, and *The ERIC Review*, and as a member of the AERA-Division J Council, and the Association for the Study of Higher Education Publication Committee. Kezar also serves(d) as a board member for the American Association for Higher education, Association of American Colleges and Universities' Peer Review and Knowledge Network; National TRIO Clearinghouse; and the American Council on Education's CIRP Research Cooperative.

Adrianna's response to "What I bring to this meeting"

I have been studying change in the higher education for fifteen years and have developed some research insights that I think can be helpful for rethinking approaches to change. Specifically, I was involved in: the Kellogg-funded Institutional Transformation project that studied 20 campuses undergoing transformational change; the Lumina-funded Documenting Effective Educational Practices project (also a study of 20 institutions that had undergone significant change); the FIPSE-funded Building Organizational Capacity project (a study of 12 institutions involved in change); a study of how four campuses became collaborative to enable interdisciplinary and cross-campus work; and a study of how six institutions fostered bottom up and grassroots campus leadership to create change. I have also extensively studied leadership and the role of specific leaders, and worked with the American Council on Education on studies of college presidents and chief academic officers. I have examined specific change initiatives, notably, service learning, collaborative learning, interdisciplinary teaching, diversity, college access, and student and academic affairs collaboration. Through my research on change and leadership, I hope to help the group consider various theories about change and the research evidence about how change happens in higher education. I hope that my specific knowledge of specific types of changes and what enable these to become embedded and sustained within institutions will also help the discussion.

William (Brit) Kirwan

Dr. William (Brit) Kirwan is chancellor of the University System of Maryland, and served as president of Ohio State University (1998-2002), and of the University of Maryland, College Park (1988-1998). He served as a member on mathematics faculty at the University of Maryland for 34 years. A widely recognized authority on critical issues shaping the higher education landscape, Dr. Kirwan has given national and international presentations on topics including diversity, access and affordability, cost containment, accountability, economic impact, gender equity, financial aid, partnerships, and innovation. He has published many articles on mathematical research, and authored several pieces on higher education. Dr. Kirwan has served on scores of commissions and boards. He currently serves as co-chair of the Knight Commission on Intercollegiate Athletics, the Board of Directors of the Council for Higher Education Accreditation; chair of the College Board's Commission on Access, Admissions, and Success in Higher Education; the Business-Higher Education Forum, the editorial board of the Journal of Diversity in Higher Education, and the Council of Presidents of The Washington Center for Internships and Academic Seminars. His honors include the Reginald Jones Distinguished Service Award from the National Action Council for Minorities in Engineering, and election as a Fellow of the American Academy of Arts and Sciences.

Brit's response to "What I bring to this meeting"

As a mathematician and university administrator, I have been intimately involved with math and science education for most of my professional career. As I've moved more deeply into administration, my concerns about the quality of education (especially in STEM) have increased. As co-chair of a STEM commission for the state of Maryland, I am acutely aware of the workforce problems faced by employers. For example, one defense contractor in the state recently told me his company has 150 openings for engineers they cannot fill.

The problem seems clear. We've let 1000 flowers bloom in STEM education, with isolated and temporal examples of what can work to improve STEM education, but we have failed miserably to create systemic and enduring change based on these models of what can work. I look forward to participation in an effort to embed the good knowledge we have into the culture and programs of our universities. One encouraging development is the growing external forces and interests that can motivate/assist us in accomplishing these needed systemic changes. For example, my recent experience with regional accreditation agencies leads me to believe they are increasingly willing to insist that institutions define educational outcomes and then assess their programs to make sure these outcomes are achieved. The change in engineering education required by ABET is a good example of positive change in the quality of education and learning outcomes expectations. Also, the recently-created NASULGC STEM initiative suggests also that we work more closely with higher educational organizations to motivate the kind of large-scale change we desire, building on the good work we already have at the grass-roots level.

Shirley Malcom

Shirley Malcom is Head of the Directorate for Education and Human Resources Programs of the American Association for the Advancement of Science (AAAS). Dr. Malcom serves on several boards (including the Heinz Endowments and the Heinz Center for Science, Economics and the Environment), is a trustee of Caltech, honorary trustee of the American Museum of Natural History, and former trustee of the Carnegie Corporation of New York. In 2006 she was named co-chair (with Leon Lederman) of the National Science Board Commission on 21st Century Education in STEM. She serves as a Regent of Morgan State University and a fellow of the AAAS and the American Academy of Arts and Sciences. She has chaired a number of national committees addressing education reform and access to scientific and technical education, careers and literacy. She served on the National Science Board, the policymaking body of the National Science Foundation (1994 – 1998), and on the President's Committee of Advisors on Science and Technology (1994 – 2001). Dr. Malcom received her doctorate in ecology from Pennsylvania State University, and holds 15 honorary degrees. In 2003 Dr. Malcom received the Public Welfare Medal of the National Academy of Sciences, the highest award given by the Academy.

Shirley's response to "What I bring to this meeting"

In considering the goal of the meeting, I bring my experience in surfacing the underlying reasons why organizations and people resist or embrace change, which is strongly related to theories of change. I also have experience identifying structures that maintain the status quo and noting areas of potential high leverage in supporting change. For example, one of my theories of change is that, because rewards and punishments strongly motivate their behavior, the great majority of people will change, with changes in their daily and long term rewards and punishments. In the aggregate we refer to this as "affecting policy."

Change agents thus need to surface the subtle and obvious roles of rewards/incentives and punishments/disincentives in the lives of the people and organizations that need changing, and use these insights to shape policy and practice. And to do this, change agents need to remember that we are both the product and captive of all our prior experiences; we need to be aware of how we ourselves are bounded by these experiences in order to be able to see possibilities beyond our experiences. Other theories of change that I have seen work are: managing the alternatives that get placed on the table; requiring changes in behavior rather than waiting to change hearts and minds, even where required changes in behavior are not welcome and are actively resisted; and employing simultaneous top-down/bottom-up approaches to change (it is often the folks in the middle who resist change as they have the most to gain by sticking with the status quo). I will bring examples of good responses to emergent challenges, drawing on my experiences growing up as a black female in the segregated South, as an active participant in the policy arena, including as a member of the National Science Board, and as a someone who early on recognized the need for new degree requirements that tracked better with the knowledge and *skills* required in the workplace, and as a leader in the national effort to achieve greater representation of minorities, women and persons with disabilities in higher education.

Sarah Banas Mills

Sarah Banas Mills is a Program Associate at the American Association for the Advancement of Science and the key staff member for the AAAS Center for Science, Technology, and Sustainability. In this role, she organizes activities to bring together scientists and engineers from developed and developing countries to address fundamental science and technology issues at the nexus of social and environmental development. One central activity is the Forum on Science and Innovation for Sustainable Development, an online network highlighting important programs, resources, and events for the scholars, managers, and decision makers interested in conducting and applying science and technology to support a sustainability transition. Sarah has also organized a series of roundtable discussions for university-based Sustainability Science programs at which key university actors in Sustainability Science dialogue on collaborative approaches to building this emerging field. Sarah holds an MPhil in Engineering for Sustainable Development from the University of Cambridge (UK) and a B.S. in Mechanical Engineering from Villanova University.

Sarah's response to "What I bring to this meeting"

I get paid to learn about and connect actors around the world who are working in the realm of science and technology for sustainability. I end up spending a lot of time talking to universities who have established or are establishing programs in science for sustainability, learning about program structure, the focus of research/teaching efforts, and also the challenges being faced: finding funding, working within the well-established disciplinary structures of research universities, allowing faculty members who are working on these interdisciplinary projects the credentials they need to meet tenure in their primary discipline, and involving community members (who rarely have PhDs) as part of the research team.

What I have found is that there are two distinct approaches to science and sustainability. One is *sustainability science*, a transdisciplinary field of study that meshes social and natural sciences along with engagement of the community in the research itself. I spent a good portion of my time tracking and serving as a resource-hub for the field, and provide meeting and networking space for the various sustainability science programs, whose leaders have no other professional-organization 'home'.

The other approach that I see is *sustainability across the sciences*. This seems to really resonate with employers who are looking for chemists or biologists or engineers who understand sustainability. There is both an expectation of depth within a given discipline, and also a broader understanding of the principles of sustainability (not just environmentalism, but an understanding of economic and social dimensions) and the ability to weigh different choices. It is the role of the disciplinary associations to take up the work of defining sustainability and disseminating practices as it relates to their specific disciplines. AAAS's role in this realm is really to follow developments within the disciplinary associations, collect information, and track activities.

Caryn McTighe Musil

Caryn McTighe Musil is Senior Vice President at the Association of American Colleges and Universities (AAC&U) where she oversees the Office of Diversity, Equity, and Global Initiatives. Under her leadership, the office has been working to mobilize powerful and overlapping educational reform movements involving civic, diversity, global, and women's issues. Dr. Musil received her B.A. from Duke University and her M.A. and Ph.D. in English from Northwestern University. Before moving into national level administrative work in higher education, she was a faculty member for eighteen years. She has special expertise in curriculum transformation, faculty development, and institutional change. Dr. Musil is currently directing a multi-project national initiative, *Core Commitments: Educating Students for Personal and Social Responsibility* that focuses on engaging students with core questions about their ethical responsibilities to self and others, and about their responsibilities as citizens in a diverse democracy. A frequent campus consultant and plenary speaker, Dr. Musil has edited a series of books on educational reform including *Gender, Science, and the Undergraduate Curriculum.* She was named a Pennsylvania "Woman of Distinction" by the Women's Campaign Fund in 1986. In 2005, she was awarded the American Council on Education's Donna Shavlik Award for Sustained and Continuing Commitment to Women's Advancement in Higher Education.

Caryn's response to "What I bring to this meeting"

I cut my teeth on institutional change when I arrived in 1971 as a young women's studies faculty member to teach at a school that had just gone co-ed. I had not been formally trained in women's studies that was itself just defining itself, so I learned first hand the demands of reinventing a professional identity, a scholarly area of investigation, and an institutional home in a place that didn't originally have me in mind when it started and whose canon for the most part erased any evidence of women's agency in the world. I learned about how the power of a good idea, targeted research, powerful pedagogies, innovative curriculum, and intellectually captivating scholarship could be resources for change in academia. I also became convinced about the importance of working in small groups of smart, institutional savvy people who leverage their good ideas and commitments to students to create larger institutional change. As a result, I am a strong believer in the power of big ideas that are often carried out through incremental change by the bottom up and middle in directions and all too rarely from the top down. I welcome such support from top leadership when I can get it, but my lifetime of experience suggests it is not how it typically happens. Effective change is also impossible without reaching out to allies—both predictable and surprising ones—and keeping diversity informing all we do. All our change efforts should ask: who benefits, what perspectives are missing, who's shaping this initiative, and how does it connect with what others are trying to do? Finally, I also learned that campus work does not occur in a vacuum but can be accelerated or derailed by powerful societal and economic forces. The Civil Rights era nationally through legislation, bully pulpits, government and private foundations, etc created a different climate, resources, legal environment, and set of norms in the academy. The last decade or more has produced a far less hospitable environment for inclusive excellence as a driving force.

Jeanne L Narum

Jeanne. Narum is the founding director of Project Kaleidoscope (PKAL). For almost two decades, PKAL has built networks of individuals and institutions taking responsibility for improving the quality and character of science, technology, engineering, and mathematics (STEM) learning of undergraduates. This is a large network, including STEM faculty at all career stages and their administrative colleagues. Narum coordinates the work of the many volunteers who are the core of PKAL. PKAL's focus on what works in transforming the undergraduate STEM learning environment has been the thrust of the nearly 200 meetings PKAL has sponsored since 1991, as well as the PKAL print and web publications (http://www.pkal.org). Major themes in all PKAL activities include: developing STEM leaders; bringing how 21st century STEM is practiced into undergraduate learning environments; and capitalizing on research-based approaches to engaged learning. The kaleidoscopic metaphor reflects PKAL's attention to the relationships among all facets of institutional culture. Narum is PI of the current major PKAL grants—an initiative with six collaborating partners involving over 100 colleges and universities focusing on pedagogical reform (NSF), and an initiative involving 32 campuses focusing on determining what works in facilitating interdisciplinary undergraduate STEM learning (W.M. Keck Foundation).

Jeanne response to "What I bring to this meeting"

I am not a STEM practitioner but an intelligence broker within the undergraduate STEM community. I've had a unique opportunity to interact with and observe leading agents of change in STEM higher education, noting similarities and differences in what they do – but not *why*. I have learned a lot from them, particularly by listening to questions they are asking – for it is the questions being asked that are really important. These agents of change are people who are pushing the envelope, and they have a depth of wisdom about the theory and practice of change. I am excited about the many good things that are happening in undergraduate STEM education, but at the same time I realize that we have not been able to figure out how to use and build on the accumulated wisdom of these change agents so as to expand and intensify those good things, moving them to a new level.

Stephanie Pfirman

Stephanie Pfirman is Alena Wels Hirschorn '58 and Martin Hirschorn Professor in Environmental and Applied Sciences and Chair of the Barnard College, Columbia University, Department of Environmental Science. Throughout her career, Pfirman has been engaged in Arctic environmental research, undergraduate education, environmental policy and public outreach. Current interests include understanding changes in Arctic sea ice, and development of women scientists and interdisciplinary scholars. A member of the National Academy of Science's Polar Research Board, Pfirman is also President of the Council of Environmental Deans and Directors, and co-PI of the National Science Foundation-sponsored Advancing Women in the Sciences initiative of the Columbia Earth Institute. The first chair of the NSF's Advisory Committee for Environmental Research and Education, Pfirman oversaw analysis of a 10-year outlook for environmental research and education at NSF. She was also a research scientist at the University of Kiel and GEOMAR, Germany; staff scientist for the US House of Representatives Committee on Science; and oceanographer with the US Geological Survey in Woods Hole, Massachusetts. Pfirman received a Ph.D. in Marine Geology and Geophysics from the Massachusetts Institute of Technology, and a BA in Geology from Colgate University.

Stephanie's response to "What I bring to this meeting"

I believe that scientists are doing an ever better job of diagnosing problems, but are stuck when it comes to moving from diagnosis to actual change. Thus, I bring to this meeting a desire to get insight about this problem. In particular, I hope that a better understanding of theories of change might shape a strategy that leads to undergraduates who are both trained and motivated to use science to help address global problems. I also bring many years of experience helping people understand science and its relevance to addressing global issues in contexts that include higher education and informal education (museums), as well as national policy organizations (US House of Representatives Committee on Science, Environmental Defense Fund, NSF Advisory Committees on Polar Programs and Environmental Research and Education, NRC Polar Research Board).. As for theories of change, I am intrigued by the well-tested and practical "stages of change" traditions that Alcoholics Anonymous and grief counselors use to support change for individuals. I assume that effective theories of change underlie these methods, starting with the need for strong motivation to change. So in addition to my own experience and motivation, I come with questions: How can we engage and motivate our students, as individuals, to take action that addresses global problems? In what ways might this "stages of change" approach—that works well for individuals—be applied to organizations, which make decisions in somewhat different ways than individuals?

Judith A. Ramaley

Dr. Judith A. Ramaley (pronounced Rah may' lee) is President and Professor of Biology at Winona State University (WSU) in Minnesota. Prior to joining WSU, she held a presidential professorship in biomedical sciences at the University of Maine and was a Fellow of the Margaret Chase Smith Center for Public Policy. She also served as a Visiting Senior Scientist at the National Academy of Sciences in 2004. From 2001-2004, she was Assistant Director, Education and Human Resources Directorate (EHR) at The National Science Foundation. Dr. Ramaley was President of The University of Vermont (UVM) and Professor of Biology from 1997 to 2001. She was President and Professor of Biology at Portland State University in Portland, Oregon for seven years from 1990-1997. Dr. Ramaley has a special interest in higher-education reform and institutional change and has played a significant role in designing regional alliances to promote educational cooperation. She also has contributed to a national exploration of the changing nature of work and has written extensively on civic responsibility and partnerships between higher education and community organizations as well as articles on science, technology, engineering and mathematics education.

Judith's response to "What I bring to this meeting"

During my service (2001-2004) as Assistant Director of the NSF for Education and Human Resources, I worked very hard to develop a coherent philosophy and a clear statement of goals to guide program development and decisions in the Directorate. I also served as co-chair of a cross-agency group that tried to develop a government-wide approach to improving STEM education and research. In doing these things, I learned a great deal about the context in which STEM improvements take place, about the larger national and international issues surrounding attempted improvements, and about the influence of federal policy on STEM educational efforts. After the NSF, I spent 6 months at the National Academies working on a project attempting to integrate education, workforce development, and economic development. In addition, my work in several states and institutions on University-community relations has added to my understanding of the relationships between STEM improvement and social-economic-political issues in society.

Debra Rowe

Dr. Rowe (PhD, Business, University of Michigan) is the President of the U.S. Partnership for Education for Sustainable Development (www.uspartnership.org). The U.S. Partnership convenes members of the business, education, communities, government, and faith sectors of the U.S. and catalyzes sustainability initiatives. Dr. Rowe is also Senior Fellow at the Association of University Leaders for a Sustainable Future (www.ulsf.org), National Co-coordinator of the Higher Education Associations Sustainability Consortium (www.heasc.net), Founder of the Disciplinary Associations' Network for Sustainability (www.aashe.org/dans), and Senior Advisor to the Association for the Advancement of Sustainability in Higher Education(www.aashe.org). She helps higher education associations and institutions integrate sustainability into mission, curricula, research, student life, purchasing and investments, facilities and operations, and community partnerships. Debra has been professor of energy management, renewable energy technology and psychology for over 28 years at Oakland Community College. She created a model energy management degree design for community and technical colleges, funded by the U.S. Department of Energy. She also created and teaches energy management and renewable energies in an on-line format with National Science Foundation support, has hosted over one hundred conferences and customized trainings on energy and sustainable design practices, and has helped numerous colleges develop their energy curricula.

Debra's response to "What I bring to this meeting"

I am a researcher, professor, and implementer of change regarding sustainability and education on a national scale. I also design and implement educational programs to bring the utilization of energy management and renewable energies to scale. All my degrees were geared toward studying how institutional and societal changes can be catalyzed. I utilize theories from the fields of business (specifically marketing, organizational behavior, and corporate strategy, including theories of information processing, decision-making, and diffusion of innovation) as well as from psychology (theories of persuasion, social psychology, social norm formation and change, learning theories, behavior change theories, and theories of compliance and obedience). Over the last 6 years as part of my work with the U.S. Partnership for the UN Decade of Education for Sustainable Development, I have travelled to dozens of campuses and have worked with hundreds of college and university presidents and academic VPs. In addition, I have had an opportunity to collaborate with thousands of faculty members, offering faculty and staff development at college-wide events and doing individual consultations. I have had a chance to see the range of attitudes toward sustainability from champions to skeptics. In these activities, and as a founder of the Disciplinary Associations Network for Sustainability, I see a strong national trend to include sustainability in all disciplines, with an increasing percentage of faculty members willing to make changes. We have a lot of "early adopters" and "product champions"; we need to engage more of the "obedient middles." I also have thirty years of experience, teaching STEM topics to technology, pre-engineering and liberal arts college students.

Karl Smith

Karl A. Smith is Cooperative Learning Professor of Engineering Education, School of Engineering Education, and Fellow, Discovery Learning Center at Purdue University West Lafayette. He has been at the University of Minnesota since 1972 and is in phased retirement as Morse-Alumni Distinguished Professor of Civil Engineering. Karl's research and development interests include building rigorous research capacity in engineering education; the role of cooperation in learning and design; problem formulation, modeling, and knowledge engineering; and project and knowledge management. He has worked with thousands of faculty all over the world on pedagogies of engagement, especially cooperative learning, problem-based learning, and constructive controversy. Karl has co-written eight books including, *Cooperative learning: Increasing college faculty instructional productivity*; *Strategies for energizing large classes: From small groups to learning communities*; and *Teamwork and project management, 3rd Ed.* His Bachelor's and Master's degrees are in Metallurgical Engineering from Michigan Technological University, 1969 & 1972, and his Ph.D. is in Education Psychology from the University of Minnesota, 1980.

Karl's response to "What I bring to this meeting"

I seek to participate in this meeting from three key perspectives. First, for roughly 40 years, I have worked in the trenches as an engineering faculty, helping countless undergraduate and graduate students to better understand and practice engineering. Second, after earning a doctorate in educational psychology, I spent the past 30 years applying social science theory and research to engineering education. As a result, I have worked at the interface between the practice of cultivating student learning and its systematic study. From this follows a third and more recent focus in my work on helping others develop the skills needed to systematically study STEM education, particularly engineering education. With respect to theories of how change in higher education occurs, I am skeptical of those based in predictive relationships between action and change, preferring instead the ideas of complexity theory and those who embrace it, such as Harlan Cleveland (*Nobody in Charge: Leadership for the Management of Complexity).*

James Stith

James H. Stith is the former Vice President, Physics Resources Center for the American Institute of Physics. Prior to his retirement in 2008, he directed a broad portfolio of programs and services that included AIP's Magazine Division, the Media and Government Relations Division, the Education Division, the Center for the History of Physics, the Statistical Research Division and the Careers Division. He earned his Doctorate in physics from The Pennsylvania State University, and his Masters and Bachelors in physics from Virginia State University. A physics education researcher, his primary interests are in Program Evaluation, and Teacher Preparation and Enhancement. Throughout his career, he has been an advocate for programs that ensure ethnic and gender diversity in the sciences. Dr. Stith was formerly a physics professor at Ohio State and spent 21 years at the U.S. Military Academy at West Point (the first African American to earn tenure). He is past president of the American Association of Physics Teachers and of the National Society of Black Physicists. He is a Fellow of AAAS and the American Physical Society, a Chartered Fellow of the National Society of Black Physicists, and a member of the Ohio Academy of Science. He is a life member of the NAACP.

Jim's response to "What I bring to this meeting"

Few would disagree with the position that quality STEM education is vital if we are to successfully address and solve the myriad of problems that face the planet. In my view, the disagreement comes when we talk about scale, about who has the capacity to understand STEM principles and about how one goes about educating the general populous so that they have the ability to make informed STEM decisions.

I bring to this meeting a deep belief in and commitment to the principle that all students can learn and do science. I believe that one's access to STEM disciplines should be governed by their own talents and abilities and not by the preconceived notions that others have regarding the student's ability to do science. My entire career has been spent working on and with programs that seek to ensure broader access to STEM by all students.

I also believe that STEM education is a partnership – a team activity. It is built upon the work and research of education researchers and disciplinary STEM researchers. I believe that successful STEM education is built upon open debate, critical assessment of research, and respect for the body of knowledge that has been assembled in our respective fields. My career has been spent trying to facilitate productive discussions between and among disciplines. My experiences as a faculty member at a minority serving institution, an elite traditionally white institution, and a large research one institution each uniquely shaped the way I think about STEM. My experience as a participant in the National Science Education Standards effort, as President of the American Association of Physics Teachers and as a senior officer of a 10-member federation of physics professional societies (American Institute of Physics) have provided a broad view of the way STEM education works.

Finally, I hope I bring an open mind as reflected in a willingness to listen to ideas other than my own.

William Sullivan

William M. Sullivan is Senior Scholar at the Carnegie Foundation for the Advancement of Teaching and has been Professor of Philosophy at La Salle University, where he is now Associate Faculty. He holds the Ph.D. in Philosophy from Fordham University. Sullivan directs the Foundation's project on the Preparation for the Professions. This is a multi-year study comparing professional education for the law, engineering, and the clergy, nursing, and medicine. One of the special concerns of the program is the relationship between professional education and the liberal arts. Dr. Sullivan has been an active researcher in the areas of political and social theory, the philosophy of the social sciences, ethics, the study of American society and values, the professions, and education. He is co-author of *Habits of the Heart* (1985) and *The Good Society* (1991). He is author of *Reconstructing Public Philosophy* (1982), the second edition of *Work and Integrity: The Crisis and Promise of Professionalism in America* (2004) and, most recently, *A New Agenda for Higher Education: Shaping a Life of the Mind for Practice* (with Matthew S. Rosin, 2008).

William's response to "What I bring to this meeting"

I bring to this meeting a longstanding interest in studying the preparation of people for the professions. With respect to the aims of the Mobilizing STEM Education meeting, I am especially interested in the relationship between STEM education and the broader concerns of both liberal education and professional training. Within the conversation about improving STEM education, which tends to be framed as a way of improving American competitiveness, I do not think there has been much discussion about an understanding of technology for citizenship. By this, I am suggesting that professionals who apply scientific and technological expertise to address social problems (engineers, for example) may not be giving enough thought or attention to larger ideas and concerns, such as the significance and consequences of technology. I think a real problem of our times is preparing professionals who can participate meaningfully in conversations with various stakeholders about short- and long-term effects of technology on the environment and society.

Uri Treisman

Philip Uri Treisman is professor of mathematics and of public affairs at The University of Texas at Austin, where he serves as executive director of the University's Charles A. Dana Center. He serves on the Carnegie-Institute for Advanced Study Commission on Mathematics and Science Education as well as on the Leadership Team of the Strategic Education Research Partnership (SERP). Uri is a founder and chair of the steering committee of the Urban Mathematics Leadership Network, a coalition of 22 large urban districts seeking to improve PreK-12 mathematics teaching and learning. He serves on the board of the New Teacher Project. Uri is especially proud of his service on the National Advisory Committee of the Military Child Education Coalition (MCEC). He also serves on the Science Advisory Board of MCEC's Living in the New Normal Initiative. Uri has received numerous honors and awards for his efforts to strengthen American education. In 1992, was named a MacArthur Fellow for his pioneering work in mathematics education. In February 2006, he was named "2006 Scientist of the Year" by the Harvard Foundation for his outstanding contributions to mathematics.

Uri's response to "What I bring to this meeting"

I have been privileged to have the opportunity to work at many levels - with national policy groups, with state legislatures, and in the design of numbers of actual courses in many institutions. These experiences have given me a broader perspective than I could otherwise have had, about the education system and the public perceptions of it. There are certainly increased public pressures for access to higher education and a growing public intolerance for what are seen as artificial barriers. I have been particularly interested in the "on-ramp" courses that lead from K-12 into higher education, where there are massive failure rates that are simply not acceptable to growing numbers of the public. The stasis of higher education has always been overstated - it is in fact quite entrepreneurial, and external pressures will promote change, whether in reducing barriers or in reorganization ourselves in higher education to produce the new knowledge required for dealing with energy, environmental, and health issues.

Karan L. Watson

Karan L. Watson (http://dof.tamu.edu/about/dean.php) has been Dean of Faculties and Associate Provost at Texas A &M University since February 2002. She joined the faculty of Texas A&M University in 1983 in the Electrical Engineering Department, where she is currently a Regents Professor. Dr. Watson is a registered professional engineer and has been named a fellow of the Institute of Electrical and Electronic Engineers (IEEE) and the American Society for Engineering Education (ASEE). She received the US President's Award for Mentoring Minorities and Women in Science and Technology, the American Association for the Advancement of Science (AAAS) mentoring award, the IEEE International Undergraduate Teaching Award, the TAMU Association of Former Students University Award for Student relationships, the TAMU Provost's Award for Diversity, the TAMU Women's Week Award for Administrators, the College of Engineering Crawford Teaching Award, and was named a TAMU Regents Professor. She has chaired the doctoral committees of 32 students and over 60 master degree students. In 2003/4 she served as a Senior Fellow of the National Academy of Engineers' Center for the Advancement of Scholarship in Engineering Education, and currently serves on the ABET Board of Directors.

Karan's response to "What I bring to this meeting"

I bring to this meeting various theories of change based on my professional experiences with efforts to make change in higher education. I start with theories about the attributes of people who are effective as change agents. Based on my experience with NSF project leaders, we know something about types of change agents who are *not* effective. People who act as "change priests" (theory = preaching works) are not effective. Nor are people who act like science (hypothesize , experiment, present data) will motivate significant change. Their theory that evidence is all that is needed to cause significant change virtually always fails. (Data is necessary but it is not sufficient to motivate change). Also, people who bring great passion about imagined terrible future consequences may well harm rather than foster change, depending on how others react to them. So then, what kind of people *are* effective change agents for higher ed STEM? In my view, they are people:

- Who understand that change that is of sufficient size and cultural depth to make a significant difference in beliefs and practices requires an emergent (not deterministic) approach, and who know that initiatives must be vigilantly watched and adjusted as conditions change;
- Who understand that culture matters, where by "culture" I mean the stuff that happens in daily conversations and decisions where people make visible their actual (not espoused) values and beliefs;
- Who can use these understandings to accurately assess the culture in which they are operating and then create the right sense of urgency (not panic, and not busy-ness) for the broad enterprise of higher education STEM.

Ralph Wolff

Ralph Wolff was appointed President and Executive Director of the Senior College Commission of the Western Association of Schools and Colleges in 1996. WASC serves 160 4-year and graduate institutions in California, Hawaii, and the Pacific Basin (with more than 1 million students). With over $2 million in grants, he led WASC to a multi-stage learning-centered approach to accreditation. For this work, he was selected as the recipient of the 2008 Virginia B. Smith Innovative Leadership Award. In 2007, he was appointed by Secretary of Education Spellings to serve as a negotiator for negotiated rulemaking proceedings on accreditation. He is an elected Fellow of Meridian International, a global think tank, and the World Academy of Art and Science. He writes and speaks extensively on the changing character of accountability and quality assurance. Prior to joining the Commission staff, Mr. Wolff was on the law faculty of the University of Dayton Law School. Previously, he was a founder of the Antioch School of Law, the first law school expressly designed to prepare lawyers to serve in public interest. He also served as Associate Provost of Antioch College and Dean of the Graduate School of Education.

Ralph's response to "What I bring to this meeting"

Perhaps the most relevant experience I bring to this meeting is what I learned helping WASC transform its approach to accreditation; since 2001, WASC has been using new a multi-stage accreditation process that includes a peer-reviewed proposal identifying outcomes for the accrediting review, followed by a first site visit focusing on institutional capacity (resources, processes and structures, and infrastructure to assess student learning), and 18-24 months later, a second review focusing on educational effectiveness. This process was designed with extensive support from research universities, and has been externally validated as changing the focus of all institutions toward student learning in the accrediting process and beyond. In our own transformation process, we have worked to move beyond the compliance mentality of accreditation to make the process intellectually engaging, inquiry based, and outcomes-centered. Applying these 2001 Standards we have now moved to develop a set of tools to assist institutions and teams that have been widely adopted by institutions throughout the region and beyond. These include rubrics for defining what are good learning outcomes, how to design and evaluate capstones and portfolios to be learning-centered, and how to move program review processes to be learning-centered.

Bearing in mind the limitations and opportunities inherent with accreditation, I also bring 3 questions. (1) Although all accrediting bodies now require that IHEs define and develop student outcomes at all levels (course, program and institutional), we find that essentially no one is focusing on scientific literacy as a core outcome. (My concern about this is partially motivated by our work with faith-based IHEs.) We know that taking a single intro science course is not enough; they typically do not prepare students, especially non-science majors, to understand or evaluate scientific or technological issues, read scientific reports, or understand the role of science in policy arenas. To me, scientific literacy is as core a requirement for any degree as writing and critical thinking. How can we move in this direction? (2) Can accrediting agencies play a role in improving access and graduation rates in the STEM disciplines? WASC, for example, is now requiring analyses of retention and graduation rates as part of all accrediting reviews. How can we incorporate a focus on STEM disciplines? Research shows that gateway courses are a powerful deterrent effect to underrepresented groups and those with strong science backgrounds. How can we give attention to these courses? (This problem appears to be especially acute for non-residential IHEs.) (3) As many scholars and change-makers have noted, faculty at 4-year IHEs are deeply conflicted about whether their primary goal is to winnow their students to identify the best candidates for graduate schools (research-centered), or to enable learning for all their students (learning-centered). This conflict is very strong in STEM disciplines. Can accrediting bodies help stimulate IHEs to focus on this conflict, and develop positive, creative resolutions to it, especially in this period when we need science literate citizens to address global crises?

Robert Zemsky

Dr. Zemsky, a professor at The University of Pennsylvania, was the founding director of the University of Pennsylvania's Institute for Research on Higher Education. The research for which he is best known has centered on how colleges and universities, in a world increasingly dominated by market forces, can be both mission-centered and market-smart. His writings have regularly appeared in *Policy Perspectives* and in a series of pioneering articles and analyses in *Change* magazine. Within the University of Pennsylvania, Dr. Zemsky has served as the University's chief planning officer and as Master of Hill College House. He currently serves as chair of The Learning Alliance for Higher Education, a major experiment in bringing just-in-time strategic expertise to college and university presidents. In 1998, *Change* named him as one of higher education's top 40 leaders for his role as an agenda-setter. He is a former Woodrow Wilson Fellow. He was a postdoctoral Social Science Research Council Fellow (SSRC) in Linguistics and also Chair of the SSRC's Council's Committee on Social Science Personnel. Dr. Zemsky served as a member of the Spellings Commission, and has received honorary degrees from Towson University and from Franklin and Marshall College.

Bob's response to "What I bring to this meeting"

My involvement in studying, thinking and writing about, and participating in change in American higher education has led to the conviction that American higher education is more an interrelated "system" than many in higher education would admit. Several things sustain this "system-ness": a) there is a unified market structure that impacts it; b) accreditation imposes a common language set used in American higher education; and c) annually, $10 billion dollars enter the system through a single narrow hose of student financial aid, homogenizing it. Given the nature of the beast, there is no way to change American higher education one institution at a time. Rather, what is necessary is a "dislodging event" that will force all institutions in the system to pay attention, rethink what they are doing and how. What is required is not just thinking outside the box but rolling the box over. One other important principle to keep in mind about STEM education is that it is not a single activity but has quite different branches, including both preparation of professional scientists and fostering science literacy.