

CEOS: Comprehensive Equity at Ohio State

Universities are remarkably poor at documenting, let alone understanding, their personnel failures. Data on recruiting and retaining faculty in STEM (science, technology, engineering and mathematics) show such failures are particularly acute for women and under-represented ethnic minorities (44). Women and minorities together far outnumber white males, and a sustainable strategy to build the faculty of the future requires understanding and correcting factors that discourage their full participation (5, 27, 28, 55).

Comprehensive Equity at Ohio State (CEOS) proposes to increase the recruitment, retention and advancement of diverse women faculty in STEM by addressing entrenched cultural barriers to equity for women and members of historically underrepresented groups, including women with disabilities. The Ohio State University has studied its departmental climates for women faculty and faculty of color, and has adjusted its policies to provide flexibility on the tenure track, partner placement, and targeted hires. Yet understanding and implementation of these progressive policies are limited and uneven (26). OSU has an infrastructure of support offices that promote gender equity and our Office of Human Resources provides substantial training on balancing work-life and other gender equity issues. But OSU is highly decentralized, with individual colleges and departments being responsible for implementing policies locally. Faculty recruitment, retention and advancement are most sensitive to local department and college culture, making long-term cultural change within these units our primary aim.

CEOS involves four colleges: two basic science units, the College of Biological Sciences (CBS) and the College of Mathematical & Physical Sciences (MAPS) and two professional colleges, Engineering (ENG) and Veterinary Medicine (VET). These colleges span the breadth of science, technology, mathematics, and engineering. Collectively, they comprise 650 tenure-track faculty members (roughly 1/4 of the total at Ohio State and about 2/3 of those in STEM disciplines). Guided by a framework of transformational leadership that emphasizes changing deep-seated cultural assumptions and practices, our interventions include leadership training for deans and chairs that will culminate in action project learning teams; peer mentoring for women leaders, including mentoring circles for women of color; and workshops on entrepreneurship for women STEM faculty. Project CEOS is designed to induce broad institutional transformation through dissemination of best practices outside the four colleges.

I. THE CURRENT STATUS OF WOMEN AT THE OHIO STATE UNIVERSITY

The President's Council on Women is a highly visible group of faculty, staff, and administrators who concentrate on policy issues. The Council's work is supported by The Women's Place, directed by the Associate Vice Provost for Women's Policy Initiatives (see womensplace.osu.edu), and by the Office of Human Resources, led by an Associate Vice President. Appointments to the Council are highly sought after, and its influence can be seen in numerous policies adopted and refined over the past five years.

Ohio State has a progressive set of institutional policies that differentially affect women and minorities: 1) automatic time extensions to the tenure clock for childbirth or adoption; 2) stopping the clock for unanticipated personal challenges; 3) part-time tenure track positions, with scaled extensions of the tenure clock; 4) dual-career accommodation policies; 5) targeted hiring; and 6) central funds to recruit diverse faculty. Furthermore, Ohio State has two child-care centers that accommodate 300 children. Our institution has adopted most of the policy recommendations (1, 35) to achieve gender equity and actively disseminates them (see supporting documents); it also is a full member of MENTORNET and the Association for Women in Science (AWIS). Our efforts towards gender equity were applauded by the recent Collaborative on Academic Careers in Higher Education (COACHE) study that affirmed Ohio State as an institution with highly progressive policies (29).

Despite this institutional progress, challenges remain. Numerous climate studies document that our female faculty members have lower job satisfaction and attachment to the institution than do men, with Assistant Professors showing the greatest gender divide. Historical data on faculty demographics show Ohio State has made slow progress increasing the representation of minority women over the past 20 years (61).

Our four colleges have a mixed record on gender and ethnic diversity. We are proud of our progress over the past five years recruiting women to leadership positions (Table 1), and comparable positive

change has occurred among our Endowed Chairs and Center Directors. Even so, women remain under-represented on our faculty (Table 2).

Table 1. Leadership changes in the participating colleges over the past five years. Entries indicate the number of women / total number in those positions

College	Deans		Assoc & Asst Deans		Chairs	
	2002	2007	2002	2007	2002	2007
CBS	0/1	1/1	1/2	2/3	0/6	2/6
MAPS	0/1	0/1	0/2	1/3	0/6	0/6
ENG	0/1	0/1	2/5	2/5*	0/12	3/12
VET	0/1	0/1	0/3	1/3	0/3	0/3
Totals	0/4	1/4	3/12	6/14	0/27	5/27

* one male is African-American

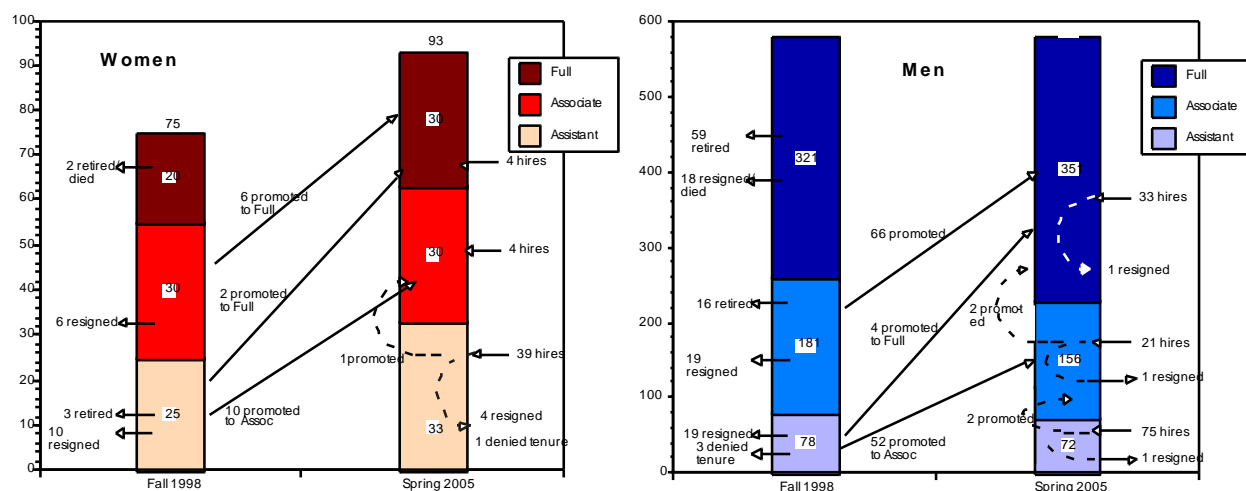
Table 2. Representation of women on the colleges' faculty (headcount data in autumn 2007)

College	Asst Prof	Assoc Prof	Prof	Total	N of Faculty
CBS	39.1%	23.7%	17.1%	25.5%	102
MAPS	37.8%	14.8%	6.3%	13.3%	225
ENG	26.8%	19.3%	5.4%	12.8%	272
VET MED	44.4%	33.3%	20.0%	27.1%	70
All OSU	40.8%	34.6%	18.2%	30.6%	3477

The data in Table 2 show that Veterinary Medicine has the most equitable gender representation of the four colleges—yet faculty are less than 30% female and the student body is 80% female. Biological Sciences has the second-highest proportion of women faculty with a student body that is now more than 50% female. In addition to the disparity between student and faculty gender diversity, all the four colleges show the same pattern: women are concentrated in the lower ranks, with relatively few enjoying full Professor status. We also have a low number of women of color on our faculties, described below. Despite progressive policies, we have problems similar to other research universities (40, 62).

We studied faculty recruitment and retention across the four colleges via faculty flux analysis (Figure 1). We chose 1998 as a starting point to compare with the 2005 state because faculty who were Assistant Professors in 1998 should have been tenured and promoted within 7 years, and those who were Associate Professors in 1998 should have been promoted to Professor during that same time frame, if their careers were progressing at a reasonable rate.

Figure 1. Flux of tenure-track faculty (summed over the four colleges).



The data (Figure 1) have the following salient features:

- We have more women and slightly fewer men on our faculties now than in 1998.
- Of 103 Assistant Professors in 1998, 69% of the men and 44% of the women were still on the faculty seven years later; only three individuals were denied tenure.
- Of the 1998 Associate Professors, 42% of the men and 60% of the women were still in that rank seven years later.
- Since 1998, women constituted 38% of the Assistant Professor hires, 16% of the Associate Professor hires and 11% of the Professor hires.
- Of those hired since 1998, 95% of the men and 87% of the women are still on the faculty.

We take little comfort from our modest growth in the numbers of women on our faculty. Women now receive half the doctorates in the life sciences, more than half the DVM degrees, 40% of the doctorates in Chemistry, and nearly 20% of doctorates in all other STEM fields (24, 40, 41); clearly, we are not recruiting women to our faculty in proportion to their availability. Most worrying is that our retention of women lags behind that of men, and women faculty more frequently get “stuck” at the Associate Professor level. Thus demographic inertia alone cannot explain the composition of our faculty (31, 36).

We are especially concerned that female faculty members in the four colleges include only one African-American, 2 Latinas, and 12 Asian-Americans¹; we cannot even report on ability status by gender due to lack of data. Women of color are badly under-represented in STEM: of all doctorates in these disciplines awarded in 2006, African-American women received 2.1%, Hispanic women 2.1%, Native American women 0.1%, and Asian-American women 3.9% (40, 41). Their representation on the STEM faculties of research universities is even worse; the top 50 research universities *collectively* had only one female minority full Professor in the physical sciences and engineering in 2003 (42). Recruiting and retaining women of color requires concerted systemic effort (31), woven throughout our proposed work.

Each of the four Colleges has conducted local studies of salaries, laboratory space, startup funds, and other important job parameters; despite perceptions to the contrary, no evidence has emerged of systematic bias against women in their working conditions (37). To be sure, we will remain vigilant monitoring these metrics; more important, we will shift our focus from overt signals of gender disparity to those that lie embedded within our academic culture.

II. SPECIFIC BARRIERS TO GENDER EQUITY FOR FACULTY IN STEM AT OHIO STATE

Ohio State highlights gender equity through programming and policy. The inaugural lecture every fall in the President’s and Provost’s Diversity Lecture series is devoted to women’s issues; in the last few years we have featured Nancy Hopkins, Virginia Valian, Linda Babcock, Judy Heumann, Harilyn Ruosso, Debra Rolison, Robert Drago, and Joan Williams. The comprehensive work of the President’s Council on Women and The Women’s Place has altered our policies, an important first step. Yet entrenched, institutional problems remain.

An internal 2003 survey, followed by the COACHE study (29) evaluated faculty job satisfaction, sources of stress and uncertainty, and other issues important for work-life balance. Both surveys revealed that female faculty members at Ohio State are less satisfied with their jobs than men, have heavier family obligations (such as having or planning to have children, caring for elders), and are more likely to consider leaving the institution. Factors cited by our female professors include partner placement issues, work-life stresses (balancing child care, elder care), and unsupportive local department cultures. The 2003 survey revealed **one-third** of the female Assistant and Associate Professors might be willing to receive less pay in order to have a reduced workload; about 20% of the men faculty suggested that option might prove attractive. Thus our faculty are no different from their counterparts across the country: men and women alike find the workload of tenure-track faculty difficult to manage, and women are more adversely affected by work-life imbalances (6, 10, 20, 21, 44, 48, 50, 65).

¹ Asian-American men constitute 15.7% of our faculties but Asian-American women only 1.6%

Additional insights come from The Cohort Project, commissioned by The Women's Place. A cohort of 50 women Assistant Professors hired in 2001 (including 6 from our four colleges) was invited to participate in the three-year project that included receptions with academic leaders, workshops on the tenure and promotion process, teaching skills, and research infrastructure support; informal gatherings provided opportunities for networking and mutual support. The Cohort Project provided crucial qualitative data on the faculty experience (19). Participants indicating they intended to remain at Ohio State cited a sense of personal community, supportive colleges, tier-one prestige, and access to facilities; those indicating they intended to leave cited an overwhelming workload, an unsupportive chair, a lack of resources and/or partner discontent (19).

Our progressive policies have yielded mixed results. In addition to indicators of faculty discontent provided by recent surveys, we studied use and efficacy of our "stop the tenure clock" policy. Since 1986, 9.1% of male and 19.1% of female Assistant Professors have lengthened their probationary periods for childbirth, adoption, or extenuating circumstances. Unfortunately, only 54% of the faculty members who took an extension remain at the University, compared with 79% of all new hires in that period. Such data are difficult to interpret, but they surely show that our policies have not been silver bullets. Rather, we must confront the underlying culture that produces "microinequities" (25, (30, 39, 62) that disadvantage women and minorities; further we must keep in mind differing abilities by incorporating universal design for learning (UDL) strategies in our interventions (46).

Our institutional goal of comprehensive equity is complicated by a central feature of Ohio State's operational structure. Our university is highly decentralized and each college has developed its own budgeting, support systems, and expectations for faculty success. Those differences are reinforced by our college-centric responsibility-based budgeting system. The decentralized structure allows each college to develop practices that enhance its local success, but it can militate against broad implementation of institutional policy. Perhaps the most striking illustration is that the University has no central AA/EO office; rather, each dean has the responsibility for ensuring that principles promoted by the university are operational in his or her college. While we have very important and highly valued support offices (notably the Women's Place, the Office of Human Resources, the Office of Minority Affairs, Office of Human Resources, and the Office for Disability Services), nonetheless institutional progress on diversity issues is crucially dependent on local college and department culture becoming aligned with policies. To the extent that local values do not reflect what our policies promote, Ohio State's extreme decentralization represents a formidable hurdle to comprehensive equity.

We offer two illustrations of how institutional policies are perceived and used by departments. The President's Council on Women found widespread understanding across campus of policies that extend the probationary period for family reasons (25); as a result, use of those policies is increasing. However, other policies designed to help faculty are less well understood and implemented. We can point to only two cases where our dual career placement policy was used effectively in the past few years. Similarly, policies to allow reduced-time appointments for tenure-track faculty are poorly understood and rarely used—only 3 of more than 1000 probationary tenure-track faculty members at Ohio State are on partial appointments, and none of those is in our four STEM colleges (25).

In general, the University does an adequate job training academic administrators. A training series for newly-appointed chairs and deans is augmented by annual updates. These workshops focus on the litigation environment, development activity, diversity issues, and conflict management. A workshop on "Hidden Barriers for Women" has reached some administrators throughout the University. Furthermore, quarterly meetings for department chairs with the Provost attract roughly one-third of our department leaders. A pilot program involved chair-to-chair peer mentoring sessions that participants found of value. However, many of these efforts do not reach those chairs most in need of training. **The four colleges here have committed to requiring their chairs to attend the CEOS training described below.** Even so, we recognize that training alone does not create long-lasting cultural change (15). We describe below our approach that encourages leaders to accept ownership of the CEOS goal of comprehensive equity.

A related problem is that too few women are in leadership positions. Across our institution, women are under-represented in administration, endowed chairs, and other highly visible locations (see Table 1).

As a result, the Women's Place launched the President's and Provost's Leadership Institute (PPLI) in 2005, specifically to cultivate local interest in administrative positions. The PPLI is a two-year on-campus program of workshops, networking, mentoring, and internships. Using a cohort model, the PPLI offers monthly workshops on communication, personality types, negotiation, conflict management, and university governance procedures that are complemented by personal projects and individualized mentoring programs. Now starting its third cohort, the PPLI can boast that 12 of the first 25 participants (all of them women!) have now moved into leadership positions across the University; the PPLI serves all disciplines at Ohio State, and to date 26 of the 68 participants are from STEM units, including 13 from our four colleges. We will use the PPLI model as the design for workshops proposed below, and Project CEOS will take the next step of providing a supportive structure for women in leadership designed to enhance their success.

Another dimension of our proposed work focuses on entrepreneurship with regard to intellectual property, at which women lag substantially behind men (51, 54). Across our four colleges, we have considerable interest in commercialization activity, from initial inquiries to our Office of Technology Licensing, through to patent disclosures and startup companies. Yet at Ohio State, such entrepreneurial activity is disproportionately pursued by white male faculty (and their postdocs/ graduate students). Commercialization is valued by the institution and also is a hallmark of successful careers in STEM disciplines. Therefore comprehensive gender equity must ensure that women and faculty of color have full access to this range of activity as well as to traditional forms of scholarship and service. CEOS will provide intensive training in the world of commercialization to women in our colleges, modeled on the successful PPLI.

III. CONCEPTUAL FRAMEWORK: A Transformational Leadership Model

A major barrier for women in academic STEM fields is the difficulty of balancing career and family (9, 48). At OSU, as in other Research I universities, success, especially in the STEM fields, is considered to equate to the "ideal worker" (64), for whom family responsibilities do not interfere with time at work. Such normative views deter faculty from taking advantage of flexible policies as they fear negative judgments from their peers (7, 17, 23). Recent research shows that those norms are responsible for women voting with their feet—away from the professoriate (11, 36, 39).

To achieve comprehensive equity, Ohio State and other research universities must transform not only their policies but also their practices. How can we engage OSU leaders (deans, department chairs, center directors, senior professors), a growing number of whom are women, to become agents of that kind of change? How can we modify organizational cultures in STEM units, and throughout the university, so that faculty, especially women, make use of the new policies without fear of adverse consequences? How can we integrate the institutionalization of the family-friendly policies with other practices that will create a welcoming environment for diverse women scientists in academic departments and colleges?

Project CEOS will be anchored in a Transformational Leadership model which draws on several social science organizational leadership approaches to creating lasting organizational change. Transformational leadership theory, together with team leadership and feminist leadership approaches, will guide our plan for changing STEM cultures and institutionalizing flexible career policies at OSU. Our model employs the most effective elements of these approaches to devise a *comprehensive* strategy for changing departmental and college cultures, in order to improve the recruitment, retention and advancement of women, including women of color and women with disabilities, in STEM fields.

We define leadership as a process, rather than as traits residing in the individual; leadership arises from interactions that take place between people and by definition leadership roles are available to everyone (43). Leaders may be assigned (formally designated) or emergent (informal). The department or academic culture refers to a patterned set of beliefs and activities that affect how people behave and relate to one another (67). The culture of an academic unit thus involves common understandings/meanings of prevailing views and attitudes (e.g., assumptions about who is a "good" scientist), norms or rules of conduct (e.g., standards used to evaluate performance), shared beliefs (e.g., that collaborations should take place between people who are of similar social and academic backgrounds), and practices (e.g., use of gendered and/or racialized language).

The concept of transformational leadership was first developed by Burns (8) and later extended by Bass (3). In contrast to this early work, more recent transformational leadership approaches shift from a focus on moral or charismatic leadership of an individual to emphasize a group or team approach to systemic transformation of organizations. Organizational change that relies on an individual's power lasts only as long as that individual is in leadership; by contrast, team leadership by members who are interdependent, share common goals, coordinate their activities to accomplish goals, and transmit those values to others in the organization can produce long-lasting transformational change (43). The team approach we espouse reduces differences in status between organizational members, emphasizing participatory decision-making, and is based on a form of "consensual" or "facilitative" power that is manifested by working *with* instead of *over* people (32).

Scholars have found that as women have increasingly assumed leadership roles, they tend to lead in substantially different ways from the traditional male model (12). In particular, feminist leaders have tended to value and foster a more collaborative approach to interpersonal relationships, including those in the workplace. Feminist, collaborative leaders encourage active participation and value contributions from all participants involved in a process. Such leaders cultivate proactive practices that foster greater inclusiveness and social justice, striving to incorporate people from diverse social backgrounds at all levels of an organization. Other changes that reflect this orientation include fostering an environment that encourages more appreciation for the whole person and for honoring commitments outside of the work place to one's self, one's family and one's community (i.e., a work/life balance). Feminist leadership is inherently transformational and increases the probability of long-term organizational success (47).

Higher education organizational research has shown that the academic department is the place from which change needs to be launched and that department chairs have a crucial role to play in the process (4, 20, 33). Many of the ADVANCE projects have focused their interventions at this level (e.g., Case Western Reserve, Iowa State, Kansas State, Rensselaer Polytechnic Institute, Wisconsin, Washington, University of Maryland-Baltimore County) and some have provided various forms of training for department chairs (U. Colorado-Boulder, Iowa State, U. Washington, U. Wisconsin). Research on women of color in academia indicates that racism and sexism is often perpetuated by department chairs, deans, and senior colleagues (56, 60). Many ADVANCE initiatives have included diversity training for chairs, hiring and P&T committees, and senior faculty in order to increase awareness of diversity issues with a view to improving departmental environments for women and people of color. However, a recent study across numerous organizations found that such training does not work; reliance on diversity workshops alone fails to create a culture of inclusivity and "fails to boost minorities into management" (16).

Traditional approaches to diversity and leadership training often are prone to failure because they do not engage participants fully as members of groups and do not address the deep cultural assumptions or underlying values held in organizations (52, 58, 67). In the majority of higher education organizations these foundational elements of culture include rigid beliefs about power, hierarchy, and their expression; the lack of acceptance that almost all human beings seek to balance their work with family/personal life; a focus on instrumentality manifested in the reduction of organizational goals to a narrow set of indicators; and a tendency to emphasize individual achievement at the expense of collaborative efforts that involve both visible and so-called invisible work (45). Such underlying assumptions work to encourage and justify certain behaviors and to exclude others; they do not allow for approaches and practices that potentially could create an open and welcoming environment for women, and especially minority women (56, 60) and women with disabilities. Although it is still too early to assess their long term effectiveness, ADVANCE programs that have addressed the deeply held assumptions of academic STEM cultures appear to have created positive change by generating understanding among faculty and administrators of how cultures operate and helping them develop viable strategies for improving academic climate (e.g., at the University of Washington, (67)).

The Transformational Leadership model guiding our work (Figure 2) connects five essentials for institutional transformation. Informed and committed leadership teams will work collaboratively within and across departments and colleges, addressing deep-seated cultural assumptions, creating local change and collaborating on strategies to achieve comprehensive equity across the entire institution.

Transformational leadership involves the development of a vision, a view of the future that excites people, and of putting the vision into practice. At OSU, the vision of welcoming STEM cultures will be developed by teams of formal and informal leaders and will emerge from a broad series of discussions. The vision will then be promoted by action learning teams as they work collaboratively to achieve the vision.

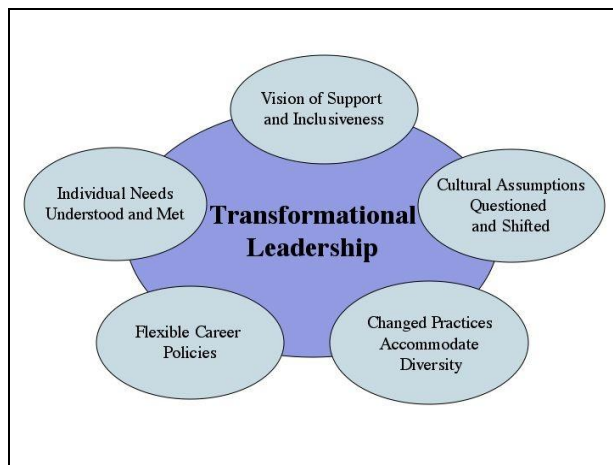


Figure 2. The Transformational Leadership model that will guide our work.

Our model includes characteristics of leadership teams themselves, as well as processes those teams undergo and changes they produce in institutional culture. As leaders work together, they develop a common vision by inclusive thinking. That inclusivity can only be achieved if teams are challenged to question and shift shared assumptions and to change practices that disallow full participation. The development of an inclusive vision, and changes in underlying cultural assumptions and in daily practices must occur interdependently for successful transformation of departmental and college culture. While it is possible to begin work by starting with any one of the five elements of the model (indeed, thus far, OSU has focused on adopting flexible career policies), true transformation can only be achieved when all five areas are addressed as interconnected dimensions within a holistic leadership plan. Our CEOS projects by design incorporate all five elements into their interventions.

IV. CEOS: A plan for comprehensive equity across the STEM disciplines

Four programs will be sponsored by CEOS, targeting different audiences: (a) leadership training for *Deans and Department Chairs* in the four STEM Colleges; (b) action learning teams consisting of *deans, chairs, faculty and staff* in the four Colleges and beyond; (c) *women leaders* in the four STEM Colleges; and (d) *women entrepreneurs* in the four STEM Colleges. Each program will include structured work, peer networking, and reflective practice, an optimal combination recommended by Wolverton et al. (66) for developing academic leaders. Furthermore, each program will stress Universal Design for Learning by making use of multiple means of representation, expression, and engagement in all forums, workshops, and materials (46).

Our goals differ for the four groups. Deans and Chairs have had training in the nuts-and-bolts of their job responsibilities, but there has been comparatively little emphasis on leadership itself. The focus for Deans and Chairs will be experiential learning about transformational leadership, executive coaching to assist these leaders in shifting deeply held cultural assumptions and norms, and informal learning through peer problem solving groups. The action learning teams will bring together a cross-section of departmental and college members to craft a vision and a plan for attaining that vision in each College. These teams will undertake the important work of deliberately and systematically changing the Colleges' cultures, and will visualize how their plans can contribute to an institution-wide transformational plan. By contrast, the program for women leaders in STEM will use the facilitated mentoring circle approach from its onset. Recent research shows clearly that women benefit from directed peer mentoring (14, 22), and this approach is especially useful for women of color (56,60); this group will be guided to develop their own leadership agendas. Finally, women entrepreneurs will receive structured training across a two-year

period to develop their skills on a wide range of intellectual property issues. Each program is outlined in more detail below, and the four share several important features. All four audiences will be introduced to transformational leadership theory, its applications and practices. Universal topics will include: crafting a leadership philosophy and set of values; assessing organizational cultures; communicating to engage; engaging in difficult conversations; managing conflict; and increasing awareness and encouraging implementation of the OSU flexible career policies. Thus all four programs will conform to our model of transformational leadership (Figure 2).

Leadership development for Deans and Chairs

The Deans and Department Chairs will form a cohort that meets quarterly to learn and reflect on leadership issues. Participants will first take the Meyers-Briggs assessment, thereby initiating a discussion of personality, communication styles, and diversity of approaches needed in leadership. Subsequent workshops in the first year will focus on topics such as inspiring a shared vision; leading by example; mentoring diverse women STEM faculty; dealing with difficult people and situations; helping women faculty develop career plans; and developing a plan for using the range of departmental talent effectively to meet group goals. Throughout, these workshops will stress 1) recognizing and addressing underlying cultural assumptions that pose barriers for women in STEM departments and colleges; 2) inclusive versus exclusive practices to help leaders understand the impact of different behaviors, emphasizing gender, ethnicity, and ability status; and 3) the importance of faculty mentoring throughout a long career, to prevent post-tenure burnout, recognize and redirect frustration, and engineer equitable work loads and reward structures. By the second year, this cohort will have established a sufficient level of expertise and comfort to move to the more difficult topic of leading organizational change. Transformative leadership skills and practices will form the core of this series, providing a necessary background for Deans and Department Chairs to become ready for the Action Learning Project (below).

Deans and Chairs will be provided parallel access to executive coaches. These coaches will help participants strengthen the skills they already have mastered, as well as extend their range of skills via reflection and practice. A coach will guide the reflection of effective and ineffective behavior strategies and will help a participant commit to new strategies. While individual development is the intended outcome of coaching, our underlying purpose is to challenge and influence cultural assumptions held in departments and colleges. Assumptions that are incongruent with espoused values often lead to stalled change efforts (18), and thus it is crucial that we help leaders explore, name, and address any internal inconsistencies that hamper lasting change. Working individually with coaches is essential to ready Deans for the next step of forming an action learning project team.

Action learning project teams

Changing the culture at Ohio State to institutionalize existing flexible career policies will require more than increased knowledge and enhanced leadership skills, because workshops alone do not necessarily bring about cultural change (16). Rather, we will pair leadership development with action learning, commonly used in private industry (13). Action learning asks teams to develop plans for local change via specific projects. This approach serves two purposes: it provides experiential learning for participants, and it is more likely to result in useful outcomes or strategies (13).

In Year 3, each of the four STEM College Deans will appoint an action learning project team to transform features of his/her current college culture. Ridding the culture of underlying assumptions that reinforce gender disparity and discourage full participation of all individuals will require local goals. Membership on the project team will include, and is not limited to, the Dean, chairs, male and female members of the faculty, and staff within the College and within the university who can lend additional expertise (e.g., the director of Disability Studies). These college-specific project teams will begin their work in the third year of the grant, after the formal leaders have participated for two years in the development programs described above. Each team will develop a portfolio of their plans and activities, to be shared across colleges at quarterly meetings.

The Deans will use the project teams as a platform to communicate a vision for the type of culture he/she wants to create, one that supports inclusivity, and specifically women's and underrepresented minorities' opportunities for achievement. Crafting and communicating this vision will be an extension of

the workshop focusing on the same topic. The team itself will operationalize the vision and set out specific goals for their project. Examples that teams may choose to incorporate into their plans include: a) developing a code of conduct for faculty, staff, and students; b) developing strategies to increase the usage of flexible career policies; c) incorporating into local governance conditions of work for part-time faculty; d) increasing the presence of women and people of color on administrative and leadership teams; e) developing a broad culture of entrepreneurship. The action plan will include measurable goals to assess progress, and the CEOS Research Team will help each College Team to monitor their progress.

After the college-specific action learning project teams have completed their action plan and started implementation of their change strategies, they will be re-organized into cross-college teams. The newly-formed action learning teams will use their pooled experiences to propose university-wide culture changes; we anticipate that cross-college teams will be ready to form by the middle of year 4. Reassembling change leaders from each of the colleges will enable them to discuss how well their efforts are meeting intended goals, will spark new ideas for local implementation, and will focus on nucleating change outside the four STEM colleges. The cross-college action teams will be crucial for differentiating between successful and unsuccessful implementation strategies (18), and will guide diffusion of those strategies through additional portions of the University. In this way, CEOS will truly produce *institutional* transformation for women and historically underrepresented groups.

Leadership Development for STEM Women

The peer mentoring program for *women leaders* in the four STEM Colleges will employ a cohort model as well. Here we define women leaders as loosely as possible, since all tenured women in STEM are emergent leaders (53). Making this program available to all tenured women in our four colleges (N=73 at present) will ensure broad participation.

The CEOS Women in Leadership program will have two components. First, we will offer quarterly workshops on leadership topics, including some of those above and other topics such as influencing without authority; we will emphasize the issues facing women leading men. The second component is monthly mentoring circles, facilitated by a professional trained in group mentoring techniques, possibly through the Women Executive Peer Exchange Network (WEPEN). More than their male counterparts, women leaders experience isolation and disconnection from those they are leading and thus peer mentoring will allow them to bring problems to a safe group for suggested solutions. Building trust is essential for any program that includes peer mentoring, and a necessary condition for such trust is repeated interactions with a constant set of colleagues (14). Group size is an important variable affecting success with peer mentoring. We will form groups of 12-15 participants, and expect that 4-6 such groups will be necessary to meet demand. We will use the first meeting to set expectations for individual and group behavior (especially confidentiality). Participants will be encouraged to bring to the group real-time issues they are facing, with the expressed purpose of exploring possible solutions; the group then will engage with the problems at hand via facilitated discussions that focus on finding workable solutions. This technique not only helps women leaders solve problems, but also builds a community that prevents feelings of isolation and burnout. We will initiate one set of circles in year 1, and another in year 3. In year 3, the first cohort will no longer receive facilitated peer mentoring, but will be ready for self-directed interaction; CEOS will continue to be the organizational context that allows the first circle to continue if participants wish.

We will establish a mentoring circle for our women scientists and engineers of color, based upon their interest and expressed desires. Women of color have special challenges in higher education, to be sure (31, 34, 56), and we will provide a structure to support them. Since there are very few women of color in our four Colleges, we will rely on minority women leaders across the university (61) to provide mentorship.

Another group we wish to engage comprises the probationary women faculty members in STEM. This group can benefit greatly from facilitated peer mentoring, and we will implement in year 2 such a structure for our junior women faculty members.

Entrepreneurship Training for Women in STEM

Knowledge is shared in the academic community along two trajectories: 1) traditional peer-reviewed publications and presentations at conferences; and 2) practical applications of discoveries in the *commercial science* marketplace, which includes invention disclosure, patents, licensing, consulting, Scientific Advisory Board (SAB) membership, and start-up companies (38). Participation by women in this second set of activities lags substantially behind men (2, 15, 57, 63). Universities can encourage female participation in commercial science by active mentoring and training, as well as institutional support for entrepreneurial activities (38). Rothaermel et al. (51) and Siegel et al. (54) outline four factors that promote academic entrepreneurship: innovation networks, science parks, incubators, and geographic location. Ohio State provides an infrastructure for such activities through an Office of Technology Licensing, the TechColumbus incubator, a Center for Entrepreneurship in the Fisher College of Business, and a community of colleagues actively involved in entrepreneurship. What we lack is targeted training.

Project CEOS will fill that gap with a series of activities for women interested in scientific entrepreneurship. The target audience includes women who are center directors and those leading a research team of post-docs and graduate students. We will recruit a cohort from across our four colleges; if possible, we will offer spaces to women in other STEM colleges as well. The two-year CEOS Entrepreneurship Institute will be patterned after OSU's successful PPLI program. Structured workshops offered by internal and external experts will provide the information and tools to move ideas from the bench to the marketplace, and will draw upon the expertise of our Office of Technology Licensing and our Center for Entrepreneurship. Topics will include: entrepreneurship and intrapreneurship, how to write a business plan, intellectual property and trademarks, business ethics, technology licensing issues (technology transfer), the patenting process (patent disclosures), communication and negotiation skills, the Small Business Innovation Research program (SBIR), market research (taking financial risks), sources of funding (obtaining venture capital), developing a research team (difficult conversations, hiring and firing), and work-life issues in a research intense environment. Each participant will be paired with a mentor experienced in that area (many of them likely to be men) to complete a project. Individual projects are expected to develop from an idea towards commercialization over the two-year time frame; examples of expected outcomes include patent disclosure, business plan development, and SBIR proposal submission.

The CEOS Entrepreneurship Institute will be initiated in year 1 for a cohort of up to 15 women. We will start a second cohort in year 3 of the project. The lessons learned from our local training will inform development of a national Entrepreneurship workshop, to be offered in year 4 and repeated in year 5. For these 3-day workshops, we will recruit participants nationally, using both the ADVANCE networks and the Big-10 Women in Science and Engineering (WISE) consortium.

V. CEOS Evaluation Model

Formative and summative CEOS project evaluation will assess the degree to which the project achieves its overall goal of changing the culture of the four Colleges as well as the conduct and effectiveness of each of the project activities. Using a mixed methods case study approach, internal evaluation will employ monitoring procedures and instruments as appropriate to project goals, to the populations addressed, and to available data. Data sources will include institutional databases and documents, records and observations of training sessions, focus groups, interviews, questionnaires, and portfolios. Evaluation will be ongoing, and through formative evaluation we anticipate that by the end of the second year initial goals and benchmarks will be modified; evaluation will change accordingly. Individual and group portfolios will serve as an important medium for data collection, monitoring of progress, and assessment of cumulative change over the course of the project (59).

The overall goal of CEOS is to effect a change in STEM college cultures by developing transformational leadership through deans' and chairs' leadership groups, women's circles (learning and support groups) and action learning project teams. In turn these changes should lead to an increase in the presence and success of women in the STEM fields at all faculty ranks and in faculty leadership positions, and to increased satisfaction with their professional lives. Progress toward the overall goal will be assessed at regular intervals, at least once a year. Cultural change will be assessed by gathering

information from faculty samples using a questionnaire and focus group discussions covering issues of climate and policy. Initially we will pattern our climate questionnaires on the 2003 internal work-life survey, thereby facilitating comparisons across time.

If we are successful in changing department and college culture, we should also see measurable changes in our faculty composition, the nature of their work, and their job satisfaction. We have identified ambitious but realistic goals for the four colleges during the five years of the CEOS project:

- retain all 38 of our current female Assistant Professors through to promotion and tenure;
- of the 80 faculty the four colleges expect to hire, one-third should be women;
- at least 6 of those new faculty should be African-American, Hispanic, Asian-American, or Native-American women
- at least 5 women should be hired at the rank of Professor, with two into endowed chairs;
- encourage all of our 37 female Associate Professors to enhance their dossiers with a view to promotion to Professor;
- appoint at least 3 additional women to be Associate Deans and Chairs, with at least two in each of the colleges;
- increase entrepreneurial activity by 50% among women faculty.

We will also monitor grant proposals submitted, grants awarded and other measures of career success (e.g. membership on editorial boards, review panels, election to office and honors conferred by prestigious societies). The quantitative data for our colleges, readily available from our institutional Data Warehouse, will be compiled into an annual report to the President's Council on Women and the Provost.

Specific assessment activities for our programming include:

- a) Training for Deans and Chairs on transformational leadership (years 1 and 2): Progress will be monitored and evaluated using records of participation, informal interviews, a transformational leadership questionnaire, and document analysis.
- b) Action Learning Teams (years 3-5): Basic data will be derived by monitoring participation and analysis of portfolios maintained by the team. Each team will be asked to set its own short and long term goals, with measurable outcomes. Progress toward these goals will be evaluated through independent assessment of portfolios, interviews with team members, and interviews with non-team faculty focus groups. When these teams are re-formed in year 4 to cut across colleges, we will reformulate our assessment design accordingly.
- c) Peer Mentoring Circles for Women Leaders: Evaluation will take the form of monitoring participation and focus group discussions. Issues identified in focus groups will become benchmark targets for subsequent years. We will ask participants to keep a journal from the peer mentoring circles, and to submit to CEOS a reflective essay once yearly on their experiences.
- d) CEOS Entrepreneurship Program: Women will be asked to commit to the full two-year program, and we will track participation throughout that period. CEOS Entrepreneurs will keep portfolios, and analysis of these portfolios will be the major source of information for evaluation against the stated goals of the training curriculum. Once a year we will ask participants to write a reflective essay on their experiences, planning for their projects, and interactions with mentors. Finally, we will work with our Office of Technology Licensing to track intellectual property products resulting from the individual projects.
- e) National Workshops on Entrepreneurship for Women in STEM. Objective data on participant demographics and previous entrepreneurship activity will be collected during the registration process. We will ask participants to fill out detailed questionnaires during/after the workshop to assess their utility.

Data analysis and interpretation. OSU does not report data separately for the STEM fields, and we will pool data across the four colleges for our analyses. The resulting data will be analyzed and reported in comparison with the institution as a whole on annual and summative bases. The corpus of qualitative data

will include records of project sessions, focus groups, and interviews, questionnaires, and portfolios. All focus groups will be recorded and coded in relation to the model; qualitative data will be analyzed beginning with terms used in the conceptual framework and program description sections of this document, and following themes that emerge in the process of analysis. Computer Assisted Qualitative Data Analysis Software (NVIVO 7) will be used. We will establish preliminary benchmarks at the start of this project by collecting information on departmental and college climate and culture and other variables based on the timetable provided below. All appropriate IRB approvals and/or exemptions will be obtained before the start of the project.

VI. Management Plan

Principal Investigator: Dr. Joan Herbers, Dean, College of Biological Sciences, has led campus-wide efforts to develop flexible career policies and improve diversity. She also serves on the Board of the Association for Women in Science. As PI she will supervise the ADVANCE Program Director and oversee staffing, resource allocation and compliance to the terms of the award. She will provide quarterly reports on the project's status to the Provost and the President's Council on Women.

Co-PIs: Dr. Jill M. Bystydzienski, Professor and Chair, Department of Women's Studies, conducts sociological research on women in STEM. She was a Co-PI on the ADVANCE award at Iowa State University prior to coming to OSU. She currently chairs the President's Council on Women. Dr. Bystydzienski will work closely with the PI to assure integration of all project components including internal and external assessment.

Dr. Anne Carey, Associate Professor of Earth Sciences and Associate Dean in the College of Mathematical and Physical Sciences, is her college's representative and will be involved in all phases of the work. Dr. Carey is a graduate of our PPLI program

Dr. Suzanne K. Damarin is Professor of Educational Policy and Leadership at Ohio State. She will work on data collection, analysis, evaluation and assessment of the project, particularly instrument design and qualitative data analysis.

Dr. Anand Desai, Professor, John Glenn School of Public Affairs; will work on data collection, analysis, evaluation and assessment of the project, particularly quantitative analysis of complex systems.

Dr. Anne V. Massaro, Organization Development Consultant, Human Resources will oversee the leadership development programs.

Dr. Carolyn J. Merry, Professor and Chair, Department of Civil and Environmental Engineering and Geodetic Science, will be responsible for developing the workshops on CEOS entrepreneurship; she is also her college's representative

Dr. Jean Sander, Professor and Associate Dean in the College of Veterinary Medicine, is her college's representative and will be involved in all phases of the work

CEOS Project Leadership: The PI, Dr. Joan M. Herbers, has overall responsibility for the CEOS Project. She will communicate regularly with other deans and University leadership, as well as be responsible for reporting to the National Science Foundation and other ADVANCE institutions.

A full-time Program Director will be recruited from among the faculty in our four colleges. The Director will have immediate responsibility for coordinating workshops, interfacing with colleagues in The Women's Place and Human Resources, and overseeing the multiple programs we envision. We have an individual in mind for this position, and she will be available in October 2008. The Program Director will be assisted by a full-time Program Assistant and student hourly workers.

CEOS College Council: The Deans of the four participating colleges are Dr. W.A. Baeslack (ENG), Dr. Thomas Rosol (VET), Dr. Matthew Platz (MAPS), and the PI, Dr. Joan Herbers (CBS); supporting letters from the first three are included in the Supplementary Materials. These Deans will be participants in the academic leaders workshops, and will develop their own Action Learning Teams. They will be responsible for overseeing the participation of all chairs in their respective colleges in CEOS leadership

activities. The four deans and all of the chairs will constitute the College Council that will meet quarterly to discuss the project.

CEOS Advisory Council: The PI and Co-PIs will be joined by Deb Ballam, Director of The Women's Place; Glenda LaRue, Director, Women in Engineering Program, College of Engineering; Jean Schellhorn, Director of Technology Licensing; Michael Camp, Director of the Center for Entrepreneurship; Georgina Dodge, Office of Minority Affairs; and Brenda Brueggeman, Director of the Disability Studies Program. The CEOS Advisory Council, which includes members from seven colleges and four support offices, will convene quarterly to provide direction, assess progress, address problems, and disseminate information about the project. The Program Director will serve *ex officio*.

CEOS Research Team: Co-PIs Bystydzienski, Damarin, and Desai, together with graduate research assistants, will be responsible for data collection, analysis, assessment and evaluation of the ADVANCE initiatives, and for publication of research results. Release time from teaching is requested for these three faculty members.

CEOS External Advisory Board will include six experts on issues of institutional transformation:

- Dr. Sharon R. Bird, Associate Professor, Sociology Dept. Iowa State University, Co-PI on ISU's ADVANCE project; her research focuses on women and men academic STEM faculty and gendering of work organizations.
- Dr. Carolyn Mahoney, President of Lincoln University, an historically Black institution. Dr. Mahoney holds a Ph.D. in Mathematics from Ohio State.
- Dr. Farah Majidzadeh, CEO, Resource International. Dr. Majidzadeh operates and owns her engineering consulting company based in Columbus.
- Dr. Patricia Rankin, Professor of Physics, University of Colorado-Boulder; PI on UC's LEAP ADVANCE project.
- Dr. Sue Rosser, Dean, Ivan Allen College of Liberal Arts, Georgia Institute of Technology, Professor of Public Policy and of History, Technology and Society; PI on Georgia Tech's ADVANCE award.

The External Advisors will visit campus once per year to give advice on major program decisions, including dissemination of efforts beyond OSU. Dr. Bird will coordinate information sharing between Iowa State and Ohio State regarding department-level interventions.

External Evaluators will be brought to campus in years 3 and 5. Chosen in consultation with the NSF ADVANCE Program Directors, the External evaluators will conduct reviews of our interventions and research programs and provide advice about mid-course correction (year 3) and help us plan for carrying forward our program of transformation at the end of the project (year 5).

VII. Sustainability

Our efforts build upon existing programs at the Ohio State University, and the cross-college Action Learning Project Teams will guide further institutional efforts to achieve comprehensive equity. We will use the lessons learned from CEOS to develop training in transformational leadership for all deans and chairs at OSU. That training will be incorporated into existing venues, as well as to form the basis for new workshops for academic leaders. The projects outlined here have the strong support of the top administration in the University; see supporting letters from President E. Gordon Gee and Provost Joseph Alutto in the Supporting Documentation. Project CEOS therefore meets the five criteria outlined by Rosser (49) for effective long-term institutionalization: 1) CEOS is an outgrowth of current practices; 2) our leadership team cuts across the institution, including administrators, support offices and numerous colleges; 3) our project builds upon recent policy reform and programming initiated through the President's Council on Women and the Office of Human Resources; 4) the Deans are committed to the transformational leadership framework we propose and thus are willing to challenge their deep

assumptions and practices; and 5) the institution has committed substantial cost-sharing to the project, as outlined in our Budget Justification.

VIII. Plans for sharing best practices

Like other ADVANCE institutions, we will develop an informative and interactive web page for our project. This web page will have two target audiences: members of the OSU community who wish to learn more about the project, and external audiences, especially institutions that wish to glean best practices. The CEOS website will provide details of program development, research results, electronic newsletters, achievements, and archived presentations.

Our Research Team will collect and analyze data from the project. That research will form the basis for presentations at major disciplinary and interdisciplinary conferences, including AAAS, AWIS, SWE, WEPAN, and NWSA, as well as at the annual ADVANCE meetings. Research from this project will be submitted to scholarly journals including *Journal of Women & Minorities in Science & Engineering*, *Sociology of Education Journal*, *National Women's Studies Association Journal*, *Journal of Technology Transfer*, *Race, Ethnicity & Education Journal*, *Research in Higher Education*, and *Research in Organizational Behavior*. We anticipate that at least two graduate theses will result from the research outlined here.

Inter-institutional dissemination between OSU and a currently funded ADVANCE institution, Iowa State, will be enhanced by annual teleconferences between the two schools, coordinated and facilitated by Dr. Sharon Bird (Iowa State). Additionally, members of the OSU ADVANCE Team will participate in the Flexible Careers conference at Iowa State in fall 2008.

In years 4 and 5, we will offer a national workshop and webcast on Entrepreneurship for Women Scientists. Participant costs for 25 and then for 35 women to attend this 3-day workshop, based on the CEOS Entrepreneurs project, are built into the CEOS budget.

IX. TIMETABLES

PROGRAMMING

	YR 1	YR 2	YR 3	YR 4	YR 5
Deans and Chairs workshops	Once/ quarter	=>	=>	=>	2-3 / quarter
Mentoring Circles (once/month)	1 st Cohort	=>	=> 2 ND Cohort	=> =>	=> =>
Entrepreneurship Workshop	1 st Cohort	=>	2 nd Cohort	=> 3 rd Cohort	=>
Action Learning Teams		Initiate	=>	=>Reorganize across colleges	=>
National Workshop on Entrepreneurship				•	•

ASSESSMENTS

	Group monitored for Evaluation Purposes (schedule of events in cells)				
Evaluation/ Monitoring Activities	Dean/Chairs	Action Learning Teams	Circles of Women Leaders	Entrepreneur training	All Faculty
Participation	annually	annually	annually	annually	
Benchmarking	annually	annually			
Climate /Policy Questionnaire	Years 1, 3, 5				Years 1, 3, 5
Portfolios		Maintained		Throughout	

		by team members		cohort years	
Focus groups			Annually	Cohort exit Years 3, 5	Years 2, 4, 5
Transformational Leadership Questionnaire	Year 4				
Interviews	Years 2, 5				
National Workshop Assessment				Years 4,5	
Other Evaluation Activities					
Policy Analysis	Monitor department and college self-governance documents for updates				
Personnel	Monitor changes in personnel for gender, ethnicity, and ability status: faculty by rank, leadership positions				
Productivity	Monitor publications, grants, entrepreneurial activity, other variables as defined				
CEOS project	Monitor project participation, completion of planned activities, etc by External Advisory Team (annually) and external evaluator (years 3,5)				

X. RESULTS FROM PRIOR NSF SUPPORT

PI JMH was PI on IBN-0110482; (changed to IBN-0321898 when JMH moved to Ohio State) titled “Coevolution between slavemaking ants and their hosts”, running 8/1/01 – 12/31/05; total budget, including REU supplements \$328,458. This project has resulted in 11 publications in refereed journals (see Biographical Sketch for details), 2 talks at international conferences, 7 talks/posters at national meetings, and myriad other presentations to academic and lay audiences. A Final Report is on file.

Co-PI JMB was PI on 0094556, 3/15/01-5/31/03, \$55,257. **Title:** Retention of Women Graduate Students and Early Academics in STEM. The award funded a conference at Iowa State University on barriers to women and minorities in STEM. Resulting publications: Bystydzienski, J.M. *NWSA Journal* special issue, (Re)Gendering Science Fields. 16/1 Spring, 2004; Bystydzienski, J.M. & Bird, S.R. (eds.). *Removing Barriers: Women in Academic Science, Technology, Engineering and Mathematics*. Bloomington: Indiana University Press, 2006.

Co-PI CJM is co-PI on NSF – Environmental Biology (DEB-0410336), 9/1/2004 – 2/28/2009, \$1,399,923. **Title:** BE/CNH: Interactions among human, biological, and physical processes within large lake ecosystems. The award is funding an interdisciplinary team to study the biocomplexity interactions among the physical, chemical, biological, social, and economic components of a large-lake ecosystem. Resulting publications: M.E. Seidelmann and C.J. Merry (2007) Use of Landsat imagery for evaluation of land cover/land use changes for a 30-year period for the Lake Erie Watershed, CRSSASPRS 2007 Specialty Conference, Our Common Borders – Safety, Security, and the Environment Through Remote Sensing, 28 October-1 November, Ottawa, Ontario, Canada, p. 24-35; Merry, C.J., M. Seidelmann and G. Ahn (2007) Land use/land cover mapping of northern Ohio for use in biocomplexity studies (abs.), 2007 Ohio GIS Conference, 12-14 September, Columbus, Ohio, p. 26; Seidelmann, M. (2006) Use of Landsat imagery for evaluating land cover / land use changes for a 30-year time period for the Lake Erie Watershed, unpublished master’s thesis, The Ohio State University, Columbus, OH.

Co-PI AEC is PI on GEO EAR 0309755, “Factors Controlling Chemical Weathering in Regions of Very High Physical Weathering Rates,” \$301,693 for August 1, 2003 to July 31, 2007, with no-cost extension to July 31, 2008. This project has resulted in 6 publications in refereed journals (see Biographical Sketch), two B.S. theses (one completed, one underway), two M.S. theses, one Ph.D. dissertation (currently underway) and multiple talks and posters at national and international meetings.