

Vision for the Future, 2015

Summer Strategic Planning

Background, 2012-2014

Strategic planning in the sciences at Smith comes at a propitious time. In almost every Science, Technology, Engineering, and Mathematics (STEM) field, many fewer women than men pursue undergraduate degrees, with women's participation rates decreasing even further in STEM graduate schools and workplaces (Hill et al., 2010). At the same time that leaders in politics, education, and academia are calling for full representation of women across STEM fields (McDermott & Mack, 2014), increasing numbers of Smith students are attracted to the sciences. Forty percent of our current students have declared a science major, a rate at least double the national average for women. In disciplines in which women are most under-represented (e.g., computer science), our students major at rates up to three times the national average (National Student Clearinghouse, 2014).

A national leader in science research and education in a liberal arts setting, Smith College has a strong history of attracting

competitive external funding from prestigious organizations. Between 2003 and 2012, the National Science Foundation awarded Smith's faculty research grants in excess of \$18 million dollars—more than any of our peer institutions during that period. The Howard Hughes Medical Institute (HHMI) also recently awarded Smith a selective capstone grant in honor of our “sustained excellence and important contributions to science education.” Smith's mission as a women's college committed to access and diversity has made these educational efforts even more valuable, as we work to develop “inclusive excellence” (McDermott & Mack, 2014) that will help change the face of science.

This strategic planning report builds on our successes and looks to the future. It represents the culmination of a year-long self-study, informed by Science Planning Committee's white paper, *The Sciences at Smith: Vision for the Future 2015*, an all-division faculty-staff workshop in May 2014, weekly meetings of the summer strategic

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planning committee, as well as a series of open meetings with students, faculty, and staff about the committee's draft report. Inputs to the strategic plan ranged from informal conversations among staff and faculty to ideas highlighted by national task forces and published in the science education literature.

Smith's distinctive strengths and values as a liberal arts college ground this curricular vision for the future of the sciences. We believe that the priorities articulated here will enhance the education of all of our students, from those who take only one science course to those who major in a STEM field. It simultaneously highlights the crucial role of the liberal arts for our majors' success while emphasizing the importance of scientific literacy within the context of the liberal arts.

Our collective work with the ideas in this report has been vibrant and energizing as we imagine the future of the sciences. We look forward to further bold and thoughtful engagement with these ideas, as we work within and beyond the Division III community to achieve Smith's mission of "preparing women of promise for lives of distinction."

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OVERVIEW, VISION FOR THE FUTURE OF THE SCIENCES

Our Mission Statement

We cultivate the scientist in the next generation of women leaders so they can meet the challenges of our world.

Our Vision for the Future

The sciences at Smith will provide transformative opportunities for all students to engage with real problems while empowering them to generate innovative solutions that benefit our world. **Our graduates will change the face of science while purposefully building fulfilling lives.**

Strategic Directions

	<p>Ensuring access for all</p>	<p>Direction: The sciences at Smith will work to address disparities in gender, racial, and socioeconomic representation in the sciences by pairing rigorous learning expectations with robust support and community-building for our students.</p> <p>Principle: Persistence and the best scientific thinking emerge from healthy climates that promote and value a diversity of perspectives.</p>
	<p>Engaging with the world</p>	<p>Direction: The sciences at Smith will strive to engage our students with complex, real-world problems, ranging from local to global, that are often best understood through the multiple disciplinary lenses of the liberal arts.</p> <p>Principle: Interactions with bona fide scientific problems connecting our students to the larger world facilitate the best learning.</p>
	<p>Developing knowledge and skills</p>	<p>Direction: Through rigorous coursework and undergraduate research opportunities that connect the work of students with cutting-edge faculty scholarship, we develop student mastery of the key concepts and competencies of our disciplines.</p> <p>Principle: Best-practices pedagogies and faculty-student research collaborations will result in optimal learning and future success for our students.</p>
	<p>Fortifying agency and identity</p>	<p>Direction: The sciences at Smith will cultivate students' agency, confidence, and resourcefulness in learning while fostering their sense of identity as scientists.</p> <p>Principle: Students' mind sets, metacognition, and identity development are essential to learning as well as professional and personal fulfillment.</p>

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Strategic Direction I: Ensuring Access For All

The sciences at Smith will work to address disparities in gender, racial, and socioeconomic representation in the sciences by pairing rigorous learning expectations with robust support and community-building for our students.

The first principle of excellence from the Association of American Colleges and Universities' Liberal Education and America's Promise (LEAP; 2011) initiative is to "aim high—and make excellence inclusive" (p. 6). In the sciences, excellence through inclusivity is a critical need. Despite significant gains in women's participation in other workplaces and areas of education in the last 50 years, the loss of talented women, particularly from underrepresented groups, at every level of the science pipeline remains a concern in many STEM disciplines (Hill et al., 2010). Scholars argue that this underrepresentation is an urgent problem with broad societal implications. Preventing the loss of female talent at each juncture in the science pipeline would serve to foster innovation, increase our ability to address pressing global challenges, and even potentially serve to redress pay inequity across genders (Hill et al., 2010).

The sciences at Smith have already engaged in innovative and systematic efforts to improve access for all of our students, including our investment in the highly successful and continually growing Achieving Excellence in Mathematics, Engineering, and Sciences (AEMES) programs as well as the ongoing work of the Science Center Committee on Diversity (SCCD). These initiatives have demonstrated positive effects. Since the launch of AEMES' programming, gaps have dissolved between students traditionally underrepresented in the sciences and our other students on measures of performance and persistence in a number of aspects of the science pipeline. The College also recently adopted SCCD's recommendation that departments contemplate issues related to student access and diversity during decennial reviews. We are poised to build on this momentum with the expansion of AEMES programs, including welcoming our first STEM Posse cohort in the fall of 2015.

According to the American Association of University Women's seminal report, *Why so few?* (Hill et al., 2010), there are three broad sets of interrelated factors that contribute to women's underrepresentation in STEM fields, including bias, social and environmental factors, and most relevant to this report, the college environment. Because Smith College has made access and diversity a core institutional value, and because the sciences have successfully implemented programs that support students from a variety of backgrounds, we see promise and opportunity to build on our successes. We recognize that pedagogies and learning spaces must be infused with this strategic commitment. The ways in which we design introductory courses, articulate performance expectations, provide student feedback, relate our

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disciplines to real-world challenges, and communicate our notions of potential for, and talent in, the sciences all must work in concert to honor the value we place on access and diversity.

Guiding Principle

Persistence and the best scientific thinking emerge from healthy climates that promote and value a diversity of perspectives.

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Strategic Direction II: Engaging With the World

The sciences at Smith will strive to engage our students with complex, real-world problems, ranging from local to global, that are often best understood through the multiple disciplinary lenses of the liberal arts.

By engaging our students with the complexity of real world problems using the breadth of their liberal arts education, we prepare them to participate meaningfully in addressing society's challenges. Providing opportunities for students to engage with big questions and tackle real-world problems that connect their knowledge to solutions and action are essential principles of excellence in undergraduate education (AAC&U, 2011). In the sciences, educators have called for teaching disciplinary knowledge within a societal context, noting the importance of achieving conceptual understanding by expecting students to grapple with authentic scientific problems in the world (American Association for the Advancement of Science, 2010). Furthermore, every real-world challenge requires engagement beyond the limits of any one disciplinary perspective, with many sciences explicitly articulating that interdisciplinarity, across STEM fields as well as the humanities and social sciences, is integral to the success and dissemination of their work (AAAS, 2010).

We see opportunities for growth by harnessing the "power of the liberal arts" at Smith to the sciences' success in meaningfully engaging students with authentic and relevant societal questions. With a significant number of international students, the resources of the Lewis Global Studies Center, and increasing opportunities for our science students to study abroad, the sciences at Smith are well-poised to engage our students as responsible citizens of the world. We can build on the successes of the existing capstone experiences and integrative learning opportunities across our curriculum as well as at the College's Centers for Engagement, Learning, and Leadership in which our faculty, staff, and students partner with industry, government, and non-profit and community organizations to address real-world challenges. We need to invest further effort in even better integrating scientific knowledge with the surrounding world (Hill et al., 2010), while fostering connections across disciplines at and beyond the college in order to cultivate the curiosity and passion of our students and prepare them for the complexities of tomorrow. We also need to recruit and develop faculty who can both participate as active members of the international community of researchers and take broad-thinking, articulate, creative approaches to communicating research. Through such efforts, we can solidify and expand Smith's reputation as a "college of and for the world."

Guiding Principle

Interactions with bona fide scientific problems connecting our students to the larger world facilitate the best learning.

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Strategic Direction III: Developing Knowledge & Skills

Through rigorous coursework and undergraduate research opportunities that connect the work of students with cutting-edge faculty scholarship, we develop student mastery of the key concepts and competencies of our disciplines.

Helping today's students to develop information literacy and disciplinary expertise is increasingly challenging, given the rapid pace of scientific, technological, and methodological advances. As factual knowledge proliferates, our challenge as educators is to understand how best to cultivate our students' deep conceptual understanding in a field of study so that they can integrate information and transfer it to new situations (National Research Council, 1999), especially when teaching learners with varying levels of preparation. This confluence of factors has led leadership groups of educators and learning scientists to call for relevant, active, student-centered, and inquiry-driven courses that incorporate high-impact educational practices (AAAS, 2010; AACU, 2011; National Research Council, 1999, 2012; Rowlett, Blockus, & Larson, 2012).

Science teaching in higher education is at a revolutionary juncture, with calls to "rethink what we teach" (AAAS, 2010). Because Smith College's dedication to "learning, teaching, scholarship, discovery, creativity and critical thought" intersects with strong science faculty interest in understanding and applying best-practices pedagogies, we believe that it is time to examine our pedagogies, curriculum, and teaching spaces in order to ensure that we are preparing our students to adjust agilely to the ever-changing world during and beyond their time at Smith. The Sherrerd Center for Teaching and Learning brings together educators across the College to develop community around fundamental questions related to pedagogy and learning. Pedagogical innovations in the sciences include HHMI-funded course-based research experiences, PKAL/TIDES-supported curricular development in computer science, Davis Educational Foundation-funded faculty development seminars on knowledge building, as well as lively curricular conversations within departments and programs. We can further this work by embracing best-practices pedagogies grounded in the principles of the learning sciences and informed by sophisticated disciplinary expertise (AAAS, 2010; NRC, 1999; NRC, 2012). In the future, we imagine further faculty collaboration and opportunities for support as we work together within units to articulate, assess, and teach the essential concepts and capacities of a field. We also imagine flexible learning spaces in which educators work to identify the understandings and experience students bring to their classes and use formative assessments to make student thinking visible, allowing them ample opportunity to improve their ideas.

There is one area of high-impact educational practice in which the sciences at Smith have considerable expertise: research experiences and collaborative projects that reliably occur in research

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labs as well as the Science Center's five multidisciplinary research centers and demand the applied and integrative learning that deepens student engagement and learning (AAC&U, 2011). The sciences at Smith have a strong history of providing meaningful research opportunities to students, with a thriving honors program, active faculty research labs in which students participate as collaborators, and over 50 years of a vibrant Summer Undergraduate Research Fellowship (SURF) program. With at least one undergraduate student co-author on a third of science faculty members' peer-reviewed scholarship, and SURF participation doubling the likelihood of our students pursuing a graduate degree, we agree that challenging our students to work at the cutting edge of knowledge helps prepare them for their lives beyond Smith. Yet, there are ways in which we could further blur the distinction between our research labs and classroom spaces to make room in many of our courses for authentic, messy, open-ended exploration driven by student agency and curiosity. We need to maintain and build on Smith's storied tradition of excellent scholarship to recruit and develop faculty who can conduct world-class research, guide curricular changes with expert perspectives on disciplinary and interdisciplinary training and education, and invite students into current scientific research and thought. As we consider how best to infuse further research experiences into our science curriculum, we are inspired by opportunities like these provided by our HHMI- funded course-based research experiences.

Guiding Principle

Best-practices pedagogies and faculty-student research collaborations will result in optimal learning and future success for our students.

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Strategic Direction IV: Fortifying Agency & Identity

The sciences at Smith will cultivate students' agency, confidence, and resourcefulness in learning while fostering their sense of identity as scientists.

In recent years, theories of teaching and learning have given increased attention to the ways in which students' academic performance and persistence are intimately tied to issues of identity, expectation, and naïve theories about intellect and expertise, all of which are strongly influenced by social and environmental cues. Attention to these factors is exponentially important when negative stereotypes about student learning exist, such as for women in STEM fields (Hill et al., 2010).

Teaching women in science explicitly about stereotype threat (Steele, 2010) and the importance of a "growth mindset" (Dweck, 2006) can help to inoculate against implicit bias as well as any discrimination or stereotyping that they might encounter while pursuing their interests in STEM fields (Valian, 1998) in the larger world. In addition, exposure to and interaction with role models of similar background can also promote women's persistence in the science pipeline (Bettinger & Long, 2005) and solidify their identity as scientists. These kinds of mentoring relationships can also provide the kind of material advice and support that helps students to navigate beyond obstacles and discouragement. Furthermore, effective educational environments develop students' skills in directing their own learning and assessing their progress in pursuit of a learning goal by fostering student metacognition. These metacognitive skills vary across subject areas and can only be developed in relation to discipline-based expertise.

Because the College is committed to "preparing women for rewarding lives" and the sciences have planned a *She is a Scientist* lecture series, jointly sponsored by the Science Center and the Lazarus Center for Career Development, we are well-positioned to connect with our network of accomplished alumnae and enhance our focus on the ways in which students' expectations and attitudes about learning as well as their sense of identity and belonging have demonstrable effects on their academic performance.

Guiding Principle

Students' mind sets, metacognition, and identity development are essential to learning as well as professional and personal fulfillment.

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Summary

The *Vision for the Future 2015* is firmly grounded in the values and commitments of Smith as a liberal arts college and articulates the ways in which the sciences here have translated these values and can imagine their future. The self-study's strategic directions provide a framework for organizing our resources and efforts. We believe that these priorities will enhance our work educating all of our students, from those who take only one science course to those who major in a STEM field.

Our next step will involve imagining a series of broad initiatives that hold promise for pushing the sciences at Smith in each of the directions identified by our strategic planning. We will elicit and generate imaginative ideas to help propel us forward. As we engage in these conversations, we expect that our efforts and programs will evolve with an understanding of our work's success and sustainability.

Moving forward, we also recognize the essential ways in which the College's infrastructure—equipment, facilities, budgets, personnel—is critical to the success of the sciences. We will work to determine how the institution's approach to asset management planning and principles might best support the directions of our strategic plan. In addition, we see how essential assessment efforts and expertise are to program development and defining success, for the College as well as our alumnae and students. We must continue to calibrate our efforts through formative, on-going assessment of our initiatives.

The ideas in this strategic are bold, yet they build upon the extraordinary strengths and distinctive values of our institution. We look forward to continued conversations with and beyond our division in order to fulfill the mission of Smith College to “educate women of promise for lives of distinction.”

November, 2014

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