Access & Scaffolding Student Learning in a Growing Summer Undergraduate Research Program

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INTRODUCTION

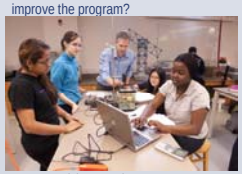
Smith College has a mission of "preparing women of promise for lives of distinction," enrolling over 2,500 women from 48 states and 70 other countries. Research is a core practice of scientific education at Smith. We are guided by a shared understanding that best-practices pedagogies and faculty-student research collaborations are high impact educational practices that will result in optimal learning and future success for our students (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 almost 50 years of a vibrant SURF Program. Our students present their research in many venues, including at several annual campus-wide exhibitions, public honors thesis presentations, and at disciplinary regional, national, and international professional meetings. At least one undergraduate student is a co-author on a third of science faculty members' peer-reviewed scholarship (Smith College Institutional Research, 2014).

Ever since its 1967 start, SURF has been a cornerstone of Smith's science education. In 2015, 143 students participated in SURF supervised by 61 faculty mentor-advisors in science, mathematics, and engineering. While some Smith undergraduates in the humanities and social sciences conduct summer research with faculty, they do so outside the SURF Program.

By many assessment measures, SURF is a very successful program with strong student benefits and outcomes. Between 2007 and 2012, five external and internal assessment reports on SURF Program outcomes were undertaken: Pederson-Gallegos (2007, 2009), Lopatto and Trosset (2008), Hakim et al. (2012), and Brodigan (2012). As Lopatto and Trosset (2008:25-26) put it: "All reports indicate that students who do research make gains in learning about research, gains in research skills, working with a mentor, learning a topic in depth, belonging to a learning community, improvement of writing and speaking skills, learning to think and act like a scientist, and growth in self-confidence. In addition, all studies report that undergraduate researchers clarify or confirm their career goals while improving their credentials for jobs and post-Smith graduate education." Hakim et al. (2012) find that SURF participation appears associated with doubling the likelihood of completion of graduate degrees. Brodigan (2012) finds that 2007-2010 SURF students have a higher percentile-GPA rank after controlling for SAT and admission ratings than peers in the sciences. Our SURF students continue to take the SURE III survey at the end of every summer and annual results of this survey remain consistent with the data collected and analyzed in previous studies. These Smith assessment studies were comparable to broader studies about the benefits of summer research, including Lopatto (2004, 2007), Seymour et al. (2004), and Bauer and Bennett (2003).

While we are proud of the successes of our SURF Program as reflected in assessment studies, we are also conscious that the program has experienced a number of changes in the past five to ten years. We ask ourselves:

- What are the changes, and how, if at all, do they challenge our program?
- Is the program as successful as it should and can be?
- Are we still asking the right assessment questions?
- Are there innovations in administration and programming that might strengthen and improve the program?



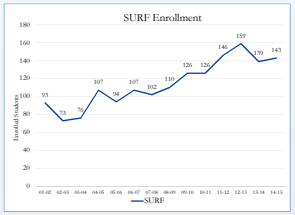
Engineering lab research.

Summer field research.

SIZE AS AN AIM AND AS A CHALLENGE

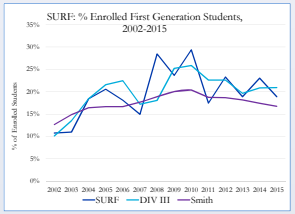
Our SURF Program has increased in size (number of participants) by approximately 50% in the last decade (**Figure 1**). The increase can be attributed to increased demand (the number of Smith students majoring in the sciences has increased from approximately 30% to 40% of all undergraduates in approximately the same period); greater emphasis on undergraduate research in the science curricula (this is part of a shift in pedagogy toward more student-centered, high impact practices at Smith and observed more generally, AAC&U, 2011); and successful grant-raising to support summer undergraduate research (a series of HHMI grants to Smith College have expanded funding available to support SURF stipends). We want Smith science students who can benefit from SURF and are ready to collaborate with faculty on research to participate: this suggests an open door. However, there are limits on size that are linked to faculty resources and the availability of financial support.

Figure 1: SURF Student Enrollment, 2002-2015



Source: Smith College Institutional Research, Clark Science Center.

Figure 2: SURF Student Enrollment – First Generation Participation



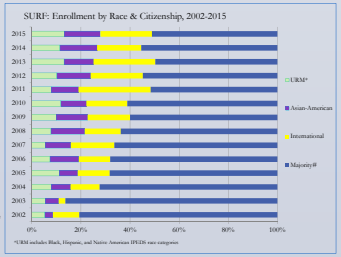
Source: Smith College Institutional Research, Clark Science Center.

Size always presents challenges to an undergraduate research program: Is it sustainable in funding and faculty participation? Once the program reaches a certain size, what impact does it have on student and faculty expectations about participation? Does it become "normal" for students to participate? If a program establishes a long history, what impact does it have on the wider curricula? Is summer assumed to be the time when certain types of teaching and learning occur? If a program sustains itself over a long period, what impact does that history have on potential funders if and when circumstances change? Does the program seem institutionalized, even if its funding is insecure?

In 2014, over 50% of Smith College's SURF Program funding came from endowed departmental and institutional sources. The balance was met from "softer" funding: end-dated institutional grants, student research stipends built into faculty grants, and other college sources. With an annual program budget of over $500,000, it is a relief to the program administrators to have approximately half of financial requirements in recurrent funding but an annual worry about how and if the balance will be pieced together. The fact that funds are drawn from 35 separate funds and sources means that it takes some time each year to see the size of the forest rather than the individual trees. Availability of funding limits the number of student participants in the program. For many years, supply of supervision and available stipends was reasonably well balanced with the number of students applying for places on the SURF Program. In recent years, student demand has begun to outstrip supply by 10-20%, i.e. 15-20 students - each with a willing supervisor - are unable to secure SURF stipends.

As the size of the SURF Program has grown, faculty availability to supervise undergraduate researchers under existing arrangements has become more and more a matter for concern. There is a long and strong tradition in the sciences at Smith of faculty and undergraduate collaboration on research, but there is a growing sense of approaching the limits of faculty capacity to supervise students in the summer. Full-time faculty in the sciences at Smith number 85. This summer, 61 faculty act as SURF mentors.

Figure 3: SURF Student Enrollment – Diversity of Participants by Race and Citizenship



Note: Internationals are non-domestic student participants; all other categories are domestic. Source: Smith College Institutional Research, Clark Science Center.

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DIVERSITY AS AN AIM AND AS A CHALLENGE

As its first principle of excellence, the Association of American Colleges and Universities' *Liberal Education & America's Promise* (AAC&U, 2011) initiative tells us to "aim high—and make excellence inclusive." For Smith's sciences at Smith, we are guided by understanding that persistence and the best scientific thinking emerge from healthy climates that promote and value a diversity of perspectives.

Smith College has long demonstrated a commitment to the education of a diverse population. In 2013-14, 18% of entering students were first-generation college students, with two in ten students receiving Pell grants. The fall 2014 entering class included 33% domestic students of color. An increasing number of Smith students are international. (Data drawn from internal Smith Registrar's statistics; Speaking of Smith, 2015.) A 2014 *New York Times* calculation located Smith as the fourth most economically diverse among US top colleges (Leonhardt, 2014).

The socioeconomic backgrounds, race, and citizenship of Smith science students have changed as the College has changed. As a generalization, participants in the SURF Program have become more diverse, too. **Figure 2** shows both first-generation science majors (Division 3) and SURF Program participants in higher percentages than the College as a whole. **Figure 3** shows the percentages of SURF Program participants who are domestic underrepresented minorities (URM) and Asians-Americans rising along with the number of international students. From 2002 to 2015, the percentage of SURF Program participants from non-majority groups rose from 19% to 49%. Over the same period, the absolute numbers of SURF participants who were URMs and international students rose from 5 and 10 to 19 and 30, respectively.

These data raise the question whether SURF has adapted appropriately to its new population. For example, is access to the program equally open to students from different socioeconomic backgrounds? Is a SURF stipend (currently $3,800 for a ten week program) adequate for a Pell grant recipient to support herself for the summer and, perhaps, make a personal contribution to the costs of next year's education? Is the SURF stipend adequate for the international student on financial aid with limited legal options for part-time work to support herself? Are housing, meal plans, and co-curricular support suitable for the heterogeneous SURF population?

There are further dimensions of diversity in the SURF Program population. All twelve science majors are well represented in the program. Rising sophomores, juniors, and seniors all participate in the program in substantial numbers (**Figure 4**). As a consequence, students participate in SURF with substantially different preparation for research; individual faculty mentors can have substantial teaching and supervision to bring less experienced researchers up to speed; and some labs establish layers of peer mentors to assist with teaching and supervision of less experienced researchers. The success of several new course-based research experience (CBRE) courses aimed at first-year students has tended to reinforce the number of rising sophomores who wish to participate in SURF.

The substantial and increasing measures of diversity that we observe in our SURF student population underline matters that need our attention if we want to support our heterogeneous students. Prominent among these are better financial support and developing effective mentorship models for more junior students.

Figure 4: SURF Student Enrollment by Class Year

	SURF % Enrollment by Class Year			
	Sophomore	Junior	Senior	Ada
2002	19.1%	37.1%	38.2%	5.6%
2003	18.0%	34.4%	39.3%	8.2%
2004	10.8%	35.4%	53.8%	0.0%
2005	21.5%	28.0%	50.5%	0.0%
2006	11.1%	39.5%	48.1%	1.2%
2007	15.8%	35.8%	44.2%	4.2%
2008	22.8%	32.6%	43.5%	1.1%
2009	16.3%	52.0%	30.6%	1.0%
2010	25.4%	33.9%	39.0%	1.7%
2011	20.7%	40.5%	38.0%	0.8%
2012	23.9%	38.8%	35.8%	1.5%
2013	20.9%	32.0%	43.8%	3.3%
2014	20.5%	35.4%	43.3%	0.8%

Notes:
1. Year of SURF enrollment is matched to the following year's census; for example, a rising sophomore in SURF of summer 2014 would be represented as a sophomore in the the 14-15 Fall census.
2. Ada – Ada Comstock Scholars are mature baccalaureate students who typically study part-time and therefore do not match precisely the conventional sophomore, junior, senior cohort definitions.

Source: Smith College Institutional Research, Clark Science Center.

Figure 5: Strategic Plan Priorities in the Sciences Smith College, 2015

Strategic Directions
→ Ensuring access for all
→ Engaging with the world
→ Developing knowledge and skills
→ Fortifying agency and identity

Source: Smith College, Division 3, Vision for the future, 2015.

SCAFFOLDING STUDENT LEARNING

As Smith College's SURF Program has grown and become more diverse, more attention has been directed at how faculty and administrators can work in concert to scaffold student learning during and around the SURF Program itself. Part of the impetus is practical: how can administrators and professional advisors help support faculty mentors as they do research with students during the summer? It is a fine balance. The main focus of attention and commitment of time must be on the research happening in labs or in the field. But, are there general topics and activities that could be offered that would complement and reinforce the work that individual faculty mentors do with their students?

Another part of the impetus is principled: the sciences at Smith completed a strategic plan in 2014 in which "developing knowledge and skills" – including the deep knowledge gained from undergraduate research – goes hand-in-hand with "fortifying agency and identity" as scientists (**Figure 5**). We want to find opportunities to work with students on exercises designed to help them develop the more general tools and knowledge that will help them refine their paths to graduate school and a profession, able to articulate for themselves precisely what "being a scientist" means for them.

Two steps have been taken to explore how better to scaffold student learning in the SURF Program.

- *Talking About Science Series (TASS)*. SURF has long had a social program designed to build community among SURF participants. This summer we have begun a pilot collaboration between the Wurtele Center for Work & Life; the Lazarus Center for Career Development; and the Clark Science Center. Twelve students funded by our HHMI grant are participating in a program that includes exercises in reflection about scientific work and motivation; presentations; writing personal statements and CVs; and planning next steps toward graduate school and practicing science as a professional. Based on feedback from the pilot group and their faculty mentors, we plan to expand the program in summer 2016.
- *Reviewing our assessment of SURF Program benefits*. We have started to review our internal working list of top benefits from SURF from the perspective of student participants and faculty mentors for those benefits that are most open to co-curricular programmatic reinforcement. This analysis will help us as we build our plans for the detailed follow-up and expansion of the TASS pilot.

This work of thinking about how to enhance SURF Program learning and student benefits, as well as making sure that our program assessment continues to ask relevant questions of participants, will help us to keep the SURF Program fresh. These administrative and programmatic initiatives will complement continuing activities to make funding and program size stable. In all of these ways, the SURF Program will remain a vital part of science pedagogy at Smith College.

REFERENCES

Association of American Colleges & Universities (2011) *Liberal education and America's promise*. Washington, DC: Author. Retrieved from http://www.aacu.org/leap/documents/Introduction_to_LEAP.pdf

Bauer, K.W., & Bennett, J. S. (2003). Alumni perceptions used to assess undergraduate research experience. *The Journal of Higher Education*, 74(2), 210-230

Brodigan, D. (2012) *Smith College Science Pipeline Programs*, 15pp, unpublished report.

Hakim, T., Horton, N., Rowen, C., and Ly, M. (2012) Does participation in the Smith Summer Research Fellows (SURF) program increase your odds of attaining an advanced degree? *Celebrating Collaborations*, Retrieved http://www.smith.edu/events/docs/collaborations/2010/presentations/MTH-169.pdf

Leonhardt, D. (ed.) (2014) The Upshot: The most economically diverse top colleges, *The New York Times*. Retrieved http://www.nytimes.com/interactive/2014/09/09/upshot/09up-college-access-index.html?_r=1&abt=0002&abg=1

Lopatto, D. (2004) Survey of Undergraduate Research Experiences (SURE): First findings. *Cell Biology Education*, 3, 270-277. Retrieved http://www.ncbi.nlm.nih.gov/pmc/articles/PMC533131/pdf/i1536-7509-3-4-270.pdf

Lopatto, D. (2007) Undergraduate research experiences support science career decisions and active learning. *CBE – Life Sciences Education*, 6, 297-306. Retrieved http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2104507/pdf/cbe297.pdf

Lopatto, D. and Trosset, C. (2008) *Report on the Smith College Alumnae Survey*, 26pp, unpublished.

Pedersen-Gallegos, L. (2007) *Qualitative evaluation of the summer research program at Smith College*, 100pp, unpublished.

Pedersen-Gallegos, L. (2009) *Follow-up qualitative evaluation report for the Smith College summer research program*, 7pp, unpublished.

Seymour, E., Hunter, A-B, Laursen, S.L., & Deantoni, T. (2004) Establishing the benefits of research experiences for undergraduates in the sciences: First findings from a three-year study. *Science Education*, 88 (4), 493-534. Retrieved http://urca.msu.edu/files/userfiles/Establishing%20the%20Benefits%20of%20Research%20Experiences.pdf

Speaking of Smith, 2015. Smith College. Retrieved http://www.smith.edu/docs/cr/SpeakingofSmith.pdf.

Vision for the future, 2015. Smith College, Division 3, Summer Strategic Planning. Retrieved http://www.science.smith.edu/wp-content/uploads/2015/03/StrategicPlanDocumentFinal12_2014.pdf