Cover: Alexandra Farthing ’17 displays sea urchins to “lab crawl” visitors in Dominic Poccia’s lab
Except where noted, all images of SURF participants were supplied by the students.
**Program Overview**

A passion to take part in the process of **scientific discovery**. Curiosity about the **daily life of a scientist**. The desire to establish a close relationship with an Amherst professor who can provide **advice about careers**. The chance to learn **lab skills and techniques**. These are just some of the reasons students become an Amherst Summer Undergraduate Research Fellow (SURF).*

Amherst’s 2015 SURF Program provided 32 rising sophomores and juniors with early, intensive research opportunities in STEM fields. All spent 10 weeks completing their projects and shared campus housing. As part of the wider campus research community, they participated in workshops, networking events, and social activities designed to help them forge relationships across disciplines and build community.

SURF Fellowships are in high demand, as hands-on research experience has become an increasingly valuable asset for students who hope to gain admission to graduate programs in STEM and medical school.

The program has served **over 530 students** since its inception in 1989 as a Howard Hughes Medical Institute-funded initiative. Our alumni tell us that the experience is formative: a retrospective assessment that surveyed former participants found that 73% continued to do research in the years after their research, and a majority reported that the program increased their desire to pursue an advanced degree in the sciences (survey conducted by SageFox, 2011).

While widely viewed as successful by participants and administrators, the shape and scope of the program in years to come is uncertain. **To learn more about the program’s future, see page 16.**

* The SURF Program was known as the HHMI Summer Program, during the period when it received funding from the Howard Hughes Medical Institute.
STUDENT PARTICIPATION

Make-up of participants:

- 50% rising sophomores/50% rising juniors
- 50% male, 50% female
- 16% self-identified as Black or Hispanic
- 16% first-generation students

IT TAKES A TEAM

Dozens of faculty and staff members across departments collaborated to put together the SURF program. Director J.P. Baird and SURF Coordinator Maureen Manning laid the groundwork for the application process for summer of 2015 and mapped out activities. Three post-baccalaureate fellows helped organize community-building activities. Workshops for the students were developed by staff from Information Technology (Andy Anderson), the Writing Center (Jessica Kem), and the Library (Kristen Greenland). Advancement (Martha Clark, Dana Miller, Jeanné Weintraub) documented activities, developed assessment tools, and stewarded donors who fund the program. A committee composed of faculty representatives from each science department and mathematics reviewed the applications and made recommendations for final placements. Additional science and mathematics faculty members volunteered to lead workshops and present talks.

A STREAMLINED APPLICATION PROCESS

A new online system helped to streamline the 2015 application process. The Simplicity Horizons application program provided students with a common portal to both the SURF Fellowships and Center for Community Engagement-administered summer internship application. Through Horizons, faculty were able to easily submit and retrieve their letters of recommendation, and review committee members could access the student essays, transcripts, and letters of recommendation required for the SURF application.

FACULTY PARTICIPATION

“The professors love their research and take the time to make sure you understand the field before jumping into lab work. They continue to assist you each step of the way.” Joshua Jiang ‘17

The distribution of SURF Fellowships among disciplines was dependent, to some extent, on the availability of faculty researchers to mentor students. For this reason, students were more likely to receive placements in the physical and life sciences than in mathematics, computer science, and statistics.
Twenty five faculty members mentored the Summer 2015 SURF students, who pursued projects in eight STEM research areas: biology, biochemistry/biophysics, chemistry, geology, neuroscience, mathematics, physics, and statistics.

**ASTRONOMY**

NICK COWAN, DARYL HAGGARD

**BIOLOGY**

ETHAN CLOTFELTER, CAROLINE GOUTTE, JILL MILLER

**BIOCHEMISTRY/BIOSPHYSICS**

DOMINIC POCCIA, ALIX PURDY, PATRICK WILLIAMSON
ASHLEY CARTER, SHEILA JASWAL

**CHEMISTRY**

ANTHONY BISHOP, SANDRA BURKETT, HELEN LEUNG, MARK MARSHALL, ELIZABETH YOUNG

**GEOLOGY**

DAVID JONES, ANNA MARTINI

**MATHEMATICS**

TANYA LEISE
J.P. BAIRD, JOSEPH TRAPANI

**NEUROSCIENCE**

**PHYSICS**

DAVID HANNEKE, LARRY HUNTER, WILL LOINAZ, JONATHAN FRIEDMAN

**STATISTICS**

EUNICE KIM

(Faculty member photos courtesy of the Amherst website and Noah Loving).
**Student Reflections**

All SURF participants completed an online Research Description and Reflection survey, in which they rated their satisfaction with program activities. The Fellows’ thoughtful insights and many suggestions for improving the program will inform the organization and development of activities for next year’s SURF program. Below are some excerpts from these surveys.

**The Excitement of Scientific Discovery**

Introducing students early in their academic path to the rewards of scientific research is a primary goal of the program.

“Finding a new phenotype within the male gonad of a worm, after hours of staring down the barrel of a microscope, was a very exciting experience.”

Joshua Jiang ’17

“Waiting to complete the experiments did make me feel even more excited to see the results. When I saw proof that my complementation had worked using the luxO insert, I was ecstatic, since it showed that all my work had not been for naught.”

Stephany Flores-Ramos ’17

Looking back, this is one of the happiest summers of my life. I woke up every morning excited about the project, both because my advisor is very encouraging and because studying physics is exciting.

Ellie Thieu ’18

The Fellows were often challenged by their mentors to come up with their own ideas for refining experiments and working through problems. This sense of ownership greatly contributed towards the excitement many students shared about their experience.

“Professor Young gave me the task of figuring out how to quantitatively measure chemical reduction in the glovebox. While we did talk about it and she gave me lots of guidance, this is a difficult experiment that has run into a number of issues. Trying to work these out has been exciting and has given me the chance to really think about the theory I was taught to try and devise a functional experiment.”

Aditi Krishnamurthy ’18
“Professor Carter gave me a lot of say in the direction of research would take. I really felt a sense of ownership of the project as I worked over the summer and this filled me with a surprising zeal. I suddenly really wanted to know the answer to this seemingly esoteric question.”  
Obinna Ukogu ’18

“As a student asked to design a new protocol for the lab, I had to troubleshoot many different components. Every step forward presented a new set of problems to tackle. From optimizing reaction chambers to modifying a plate centrifuge, I got to experience the engineering involved in biochemical research.”  
Alexandra Farthing ’17
(Photo by Maureen Manning)

**Skills and Techniques**

Mastering tools needed to collect and analyze data was typically the first step for Fellows. Most students also read scientific background papers and discussed these with their faculty mentors. They learned software programs such as MATLAB (numerical computation and visualization), Python (programming language), and DS9 (imaging program). Students also acquired skills in lab techniques, such as how to run a nuclear magnetic resonance (NMR) sample, how to perform surgery on rats, and how to run a schlenk (vacuum gas manifold) line.

“Reading scientific papers improved my understanding of how geochemists use chemical data to answer questions about Earth history, and discussing these papers with my professor made me appreciate how geochemists develop their methodologies and ultimately answer those questions.”  
Brian Beaty ’17

Wai Cheung Chan ’17 conducts research in the Bishop lab.  
(Photoby Maureen Manning)

Brian Beaty ’17 recording geology data in Nevada
Science Concepts

Hands-on SURF research both reinforced information students encountered in the classroom and in teaching labs, and provided an early introduction to advanced concepts, terminology, and theories. For example, students learned for the first time about astronomical coordinate systems and quantum rotational theory (concepts normally taught in upper-level chemistry courses).

“This summer has given me a new appreciation for the tables of bond lengths and angles in the back of my chemistry textbook!” Craig Nelson ‘18

“I learned how to design very specific questions and to decide what kinds of tests I needed to do on which data sets in order to answer them, how to identify factors that would likely be important covariates, and how to explain the results of statistical tests in the context of my work.” Victoria Luizzi ‘17

Career Insights

Working alongside faculty investigators provided SURF students with an early window into the life of a scientist. Many were surprised by the nature of the work.

“The thing that surprised me the most was how down-to-earth a lot of real-life problem solving actually is.” Nathanael Lane ‘18

“I finally understand what a day of a professor is like, and how much I am interested in doing research (a lot). It is the right learning experience at the right time, and therefore I am very happy with it. I now can explore other professions to compare my experiences to find my long term career.” Uyen Thieu ‘18

“I learned that research can be quite grueling when it comes to the day-to-day grind, but the whole experience is very satisfying at the end when your efforts have paid off.” Natalie Sun ‘18
**Personal Growth**

Students learned many life lessons as Fellows. The intensive experience tested their patience, fortitude, and ingenuity.

“This experience has taught me that there is still so much out there that I don’t know about many fields within chemistry, and I’d love to be able to continue to explore before settling into a specific long-term project.”

Joyce Wamala ‘17

“I had to learn humility and perseverance. It was imperative that I kept a detailed and consistent lab notebook.”

Leonard Yoon ‘18

“I learned how much motivation frustration and mistakes can give me.”

Sarah Teichman ‘18

**Academic and Career Outcomes**

The SURF experience helped students clarify whether to pursue a career path in research, and, for some, which discipline would be more fulfilling. Most students said they will continue with plans for a career in medicine or science.

“It definitely helped me to realize that I genuinely enjoy conducting research and doing lab work. Talking to Professor Miller and the research assistant in the lab this summer solidified my plans of applying to biology programs at graduate schools after graduating from Amherst.”

Veronica Voronina ‘17
“This experience was very reassuring for me that medicine and brain surgery is a path that I want to take. Additionally, now that I finally have experience in a lab, I can’t wait to get back into another one.”

Benaias Esayeas ’17

(Photoby Maureen Manning)

Other SURF Fellows learned that they are not drawn to the life of a research scientist:

“As much as I love science (and physics in particular!), I can’t envision myself devoting a career to it. It’s just not me. My internship has shown me research science’s inner culture, and, welcoming as it was, my exposure to it solidified my decision to follow a different path.”

Carolina Carriazo ’18

(Photoby Noah Loving)
PARTICIPANT SATISFACTION WITH SUMMER 2015 SURF ACTIVITIES

In their post-summer surveys, the Fellows expressed the most satisfaction with the Friday talks and the lab crawl. Social gatherings that took place in the Cohan dormatory were rated as the least successful.

A "lab crawl" was organized to give SURF students opportunities to present their research and to tour other labs. The event opened students’ eyes to other areas of research and disciplines. 83% of participants felt satisfied or very satisfied with this activity. As one student explained, “It is very easy to get so engrossed in your own research that you forget that other people are investigating amazing concepts as well. It was really great to see what everyone else was working on!” Statistics instructor Eunice Kim and post-baccalaureate fellows Juhyong (Katie) An ’15 and Dvij Bajpai ’15 cleverly arranged the schedule to ensure that all students had opportunities to view multiple labs in other departments.

As one student commented, “the planning kept everyone on time and the overall event ran smoothly.” Because students were organized into small groups and lab presenters were limited to five-minute time slots, student researchers learned to hone their “lightning talks,” as they repeated brief summaries of their research to each successive group—good practice for aspiring scientists.
LUNCHEON TALKS

Four Friday luncheon talks were held during the summer, including “Polyhedra: Plato, Archimedes, Euler,” (Professor of Mathematics Robert Benedetto); “Hacking at Worm Genes to Decipher the Molecular Mechanisms of Notch Cell Signaling,” (Professor of Biology Caroline Goutte); and “Electrons AND Protons, Oh my! Photochemistry of Proton-coupled Electron Transfer Reactions,” (Assistant Professor of Chemistry Elizabeth Young), and an (untitled) talk on biophysics research (Assistant Professor of Physics Ashley Carter).

Most students (92%) felt “satisfied” or “very satisfied” with the talks, although some students felt they lacked the level of specialized knowledge needed to understand some presentations.

GATHERINGS AND WORKSHOPS

Andy Anderson, Amherst’s Academic Technology Specialist, organized 18 gatherings and workshops to assist student researchers in developing a research process, performing data analysis, and honing communication skills. The Designing Posters workshop was strongly recommended to all SURF Fellows.

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The majority (83%) of SURF students attended the workshop on presenting posters, and 21%-34% of students took part in workshops on science-related software programs (Python, Excel, Mathematica, and AcoGIS). Workshops related to research habits and process drew the fewest SURF students (less than 10%). Feedback from students indicates that some would prefer shorter, more customized software program workshops. For example, geology students studying AcoGIS would have appreciated more instruction on program features relevant to mapping geologic formations and less time spent on functions related to urban planning that they are unlikely to use in their current research.
Professors Josef Trapani, Tanya Leise, and Jyl Gentzler led a Research Ethics luncheon discussion with students. This was the first time that students undertaking research in the social sciences and humanities took part in the workshop. Previously only students conducting research in STEM fields attended.

The three faculty members asked students to define ethics as it relates to research, to consider why taking detailed notes is important, and think about how they would handle outlier results. The group grappled with difficult questions related to authorship, and confidentiality. Discussions became lively as the students broke into small groups to explore three scenarios they might face as undergraduate researchers. Organizers felt the workshop succeeded in helping students realize that their response to ethical situations could have a serious impact on their future careers.

SURF Fellows presented their research at the fall poster session for student summer research held at the Powerhouse on September 11th. As they explained their research projects to multiple attendees, the students gained valuable practice in presenting their research to a lay audience.

At least 100 students, faculty, and administrators (including the Dean and Associate Deans of the Faculty) attended the event, which provided an exciting window into the range of undergraduate research taking place at Amherst.
COMMUNITY BUILDING ACTIVITIES

Community Building activities for summer 2015 met with a mixed response from SURF students. Students expressed appreciation for hikes to Mount Norwottuck, Mount Toby, and Mount Sugarloaf, bowling trips and other off-campus gatherings. They were less pleased with social gatherings organized to draw students together in the dorms (just 42% rated these as satisfactory). Weak coordination between different offices organizing summer program activities at the college also meant that some scheduled activities conflicted with other campus events.

![SURF students hike Mount Norwottuck in the Holyoke Range. Professor Josef Trapani, SURF Coordinator Maureen Manning, post-baccalaureates Dvij Bajpai ’15 and Katie An ’15 led the hike.](Photos by Josef Trapani.)

TESTIMONIALS

“This summer has opened my eyes to the never-ending possibilities of chemical research, and I cannot wait to investigate more of them in the coming years.” Craig Nelson ’18

“Thank you so much for funding the SURF program! This summer was my first undergraduate research experience. The breadth and depth of activities for the students—Friday luncheon talks, research workshops, even mountain hikes—astounded me and added so much to the laboratory experience.” Joshua Jiang ’17

“I looked up the details of the program on the website and I couldn’t believe it. Everything was being taken care of and structured in such a way that a participant in this program would be able to thoroughly give herself or himself to their research without much external worry.

I am extremely grateful to the people that made this whole experience possible. SURF was my first ever research experience and as such it had a monumental influence on the way I think and approach problems. It will also play a huge role in my career goals. I hope to one day be able to do the very same thing you did for me for others in my position. Thank you. Obinna Ukogu ’18

The SURF program at Amherst is the best introduction to formal academic research I could have received. My experience working closely with a professor and technician in an experimental physics lab was overwhelmingly positive, and the experience was influential in the career I hope to lead. Nathanael Lane ’18