Experiential Learning is in our DNA

The Campaign for Harvey Mudd College
Research that involves students is not a unique Harvey Mudd College invention. Many colleges and some universities have well-established programs of student research participation. Our claim to distinction...is that every student who graduates has had research or design experience.

—JOSEPH B. PLATT, HARVEY MUDD COLLEGE: THE FIRST TWENTY YEARS
INCE ITS FOUNDING, Harvey Mudd College’s faculty and students have embraced hands-on, collaborative learning across the curriculum. Founding President Joseph Platt and the first faculty member, J. Arthur Campbell, created a unique vision of learning science and engineering through actual practice as well as through the integration of the humanities, social sciences and the arts. As additional faculty members joined the College, they continued to embrace and expand on this concept.

Harvey Mudd’s mission calls us to educate engineers, scientists and mathematicians, within the context of the humanities, social sciences and the arts, so they may assume leadership in their fields with a clear understanding of the impact of their work on society. Since the College’s earliest days, research has stood as a critical component of fulfilling this mission.

Today, students across all departments take advantage of high-impact experiences during the year through undergraduate research, internships, service learning and independent study projects that naturally build on our intense academic program. Summer research and experiential learning opportunities further enhance our students’ experiences and offer them wonderful opportunities to explore more deeply topics of particular interest. These summer opportunities immerse students in research and real-world problem solving in a way rarely seen at the undergraduate level and further build on the experience they gain working on projects throughout the academic year.

Students explore current and relevant research alongside faculty mentors, they publish their findings in leading scholarly and academic research journals, and they share their work with fellow researchers at conferences around the world. As a result, passions are ignited and career pathways are discovered, reinforced or redefined. Students gain confidence and experience, and they find more direct paths to leadership in their chosen fields.
Summer Research
We educate passionate problem solvers.

Harvey Mudd’s curriculum is already rich with hands-on, experiential teaching and learning methods throughout the academic year and, in addition, all students complete a research thesis or clinic project prior to graduation. However, for students drawn to Harvey Mudd College—students who are vigorous in their pursuit of knowledge—this isn’t enough. That’s why our students pursue additional, focused opportunities during the summer to explore real-world projects that bring their education to life and ignite their passions. One of the largest programs where students and faculty can partner in this endeavor is our Summer Undergraduate Research Program.

Research began at Harvey Mudd as early as 1960, when a National Science Foundation grant to the Chemistry Department supported six students working with faculty during the summer. By the end of the College’s second decade, there were well-established research programs in chemistry, mathematics and physics. Today, Harvey Mudd is widely recognized as a leader in undergraduate research and, despite its size, spends roughly $3 million dollars per year on cutting-edge research—the vast majority of which directly involves students.

Whether pushing the boundaries of scientific discovery in the quest for new knowledge or exploring new options to enhance medical treatments, manufacturing or sustainability, Harvey Mudd students partner with faculty to use summer research to find new solutions to today’s most pressing problems. The program allows students to work with a faculty member in her or his lab to begin serious exploration around a particular research challenge. And these students aren’t working on well-crafted “case studies”; summer research invites students into active and ongoing projects where they collaborate with faculty to discover new knowledge in real time. Faculty members, in turn, gain the energy and enthusiasm of young collaborators who can awaken new pathways of discovery in existing research projects.

Through these experiences, students develop and grow to become more thoughtful scientists and researchers. They also go beyond studying a specific scientific discipline and learn new approaches that transform them into true problem solvers. With these proven skills, our students are accelerated on a path to success as they graduate and continue on to industry, graduate school and virtually any challenge that awaits them.
Seeing Through the Smog

Students in Professor Lelia Hawkins’ lab tackle tough atmospheric chemistry questions, exploring how air pollution impacts climate change. They collect smog particles from a rooftop sampling inlet and measure organic carbon and optical properties. They also generate mimics for smog particles to determine how light and oxidants impact those same properties as particles pass in and out of clouds and fog. In addition to bulk measurements, students can look at individual pollution particles and mimics with an Atomic Force Microscope.

“Studying how particle shape and stiffness change helps us understand how quickly pollution interacts with clouds and fog, as well as with oxidants,” says Hawkins.

Some students work directly with fog water to measure carbon and light absorption. Because the weather doesn’t always cooperate, Hawkins’ lab recruited engineering students to construct a fog chamber, allowing students to simulate fog on real ambient particles.
Mudd’s MOOCs Help STEM Grow

The “MyCS: Middle Years Computer Science” program, which recently received a three-year grant from the National Science Foundation, focuses on middle school students from groups underrepresented in computer science.

To broaden the reach of this program, Harvey Mudd students worked in summer research positions to help develop training materials for two Massive Open Online Courses (MOOCs)—one on MyCS and another focusing on Physics titled “How Stuff Moves”—as well as to build the online courses. Both courses may be accessed online at www.edx.org/school/harveymuddx.

The summer research project, under the direction of Zachary Dodds, Leonard-Johnson-Rae Professor of Computer Science, and Michael Erlinger, Csilla and Walt Foley Professor of Computer Science, was led by Elly Schofield ’13 (pictured at left).

“At its heart, computer science is as much about creativity as it is about analytical problem-solving,” Schofield said. “We want our course to reflect that creativity and to show students encountering CS for the first time that the field is not only useful, but also exciting, with a lot of opportunities to make one’s own unique mark on technology.”

Program partners include Claremont Unified School District, Chiefess Kamakahelei Middle School in Lihue, Hawaii, and the Pomona Unified School District. Developed in 2010, the curriculum has continued to reach broader audiences of teachers and their students through regular summer workshops, which include the assistance of students engaged in summer research.
An Eye Toward Curing Blindness

Elizabeth Orwin ’95, professor of engineering and chair of the department, directs the Engman Fellowship Program in Bioengineering, which trains students in Biomedical Engineering research and device design.

Her lab’s main research focus is in the area of tissue engineering, specifically applied to the study and development of an artificial corneal construct. The goal of the project is to create tissue that could replace the corneal tissue that causes blindness. This would allow Orwin and her team to study the effects of new drugs and laser treatments so that there would be no need for animal testing.

“It’s an interdisciplinary project,” Orwin says. “I put together teams of students from different disciplines. We’ve got one integrated problem that we can look at from all these different angles. The students teach each other; some are better in the lab, some are better in the shop, and some are better managers or theorists. It makes the work stronger.”

Orwin views her students both as peers and collaborators in her research lab. “This is a mini-graduate school experience,” she says. “They get a lot of freedom. I love it when they go out and find new ideas. I expect them to contribute to the research and to the direction of the project.”

He’ll Be Counting Stars

Tyler Holland-Ashford ’15 has clear goals for the future: study astrophysics in graduate school, allowing him to further his understanding of the field and how it relates to physics as a whole, and work at a research institute—possibly Carnegie Observatories—which he worked at last summer. He credits physics Professor Ann Esin for the inspiration.

“I did research under Professor Esin. I continued a project worked on by Eric Baxter ’08 from three to four years ago on the evolution of T Tauri (less than three million years old) stars,” says Holland-Ashford.

“I examined and modified code to model the period of evolution of such stars. I added a method to account for varying magnetic fields in the stars and was working on accounting for the age spread of the stars when the semester ended.”

In addition to his research at Harvey Mudd and Carnegie Observatories, he’s also volunteered with the Claremont After-School Program to tutor fourth through sixth graders in math and English, helping with homework and reading skills.
Battling AIDS Through Service and Science

Professor Karl Haushalter’s course, “AIDS: Science, Society and Service” combines the scientific aspects of the HIV infection and its treatment with the exploration of broader, community-based socioeconomic issues. Each week, the course sessions alternate between a science day, where students learn topics such as how the virus replicates and how different treatments function, with a social context day, which looks at the context of the disease and the current race and health disparities involved in its treatment.

The community service component involves students working with local HIV/AIDS agencies and nonprofits to design a service-related project. Haushalter also runs a research lab exploring new gene therapy approaches for treating HIV/AIDS. Students have an opportunity to take the course and participate in community service activities as well as to conduct research in the summer to further deepen their scientific knowledge. Alumni of the course have gone on to pursue AIDS research, vaccine development and HIV prevention work in the U.S. and Africa.
Studying Bacteria and Our Genes

Bacteria respond to changing environments by regulating gene expression, a mechanism that allows them to propagate—and perpetuate disease—across changing environments. Biological study has found that specific cell proteins in bacteria help regulate large suites of genes in response to specific environmental changes.

Student researchers in Professor Dan Stoebel’s lab are taking a nuanced approach to understanding how these regulatory proteins affect gene expression—and ultimately how bacteria thrive.

These molecular biologists create new lab strains that allow them to control amounts of a specific protein and observe the effects of those amounts on gene expression. Recent advancements, such as the development of tools to simultaneously measure the expression of all genes in the genome using DNA sequencing technologies, allow them to compare a bacteria strain that contains a given regulatory protein with a strain that lacks it and in a single experiment determine all of the genes regulated by the protein of interest.

“The explosion of this work has left us awash in a sea of data,” says Stoebel. “What we need now are better ways to analyze and think about those data.”
Teaching Teachers to Teach

Marisol Beck ’17 of Walla Walla, Washington, did her summer computer science research with a team of eight other students working under Professor Colleen Lewis.

“We worked to create the website CS Teaching Tips, which was designed for CS educators to use when they are looking for specific tips on how to teach concepts or how to integrate certain ideas into their classrooms,” Beck says.

“It was really fun to work with other students, and I learned a lot about website design. I also learned many things about Computer Science that I hope to use while grutoring (grading and tutoring) this fall.”

Beck, a computer science major, plans to go straight into industry. While she initially thought she would land at Google, she is now considering Quantum Computing. “I’m pretty interested in the work that the Quantum Group at Oxford is doing, so I’m hoping to apply there for graduate school,” she says.

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Elegant Solutions

Maxfield Comstock ’16 is a joint math and computer science major who worked in Professor Mohamed Omar’s research lab last summer.

Their research entailed looking at Hamiltonian cycles in graphs, representing the cycles algebraically and seeing what can be learned from them. Comstock took the algebraic encoding of the cycles in a graph and put the information into a software program that used computer code that he wrote.

“Using this method, we can get results without having to compute by hand,” says Comstock, a Seattle native, who has been interested in math since elementary school.

“Math to me is very elegant,” Comstock says. “There are a lot of big ideas that fit together really well, and when you study math, even the most difficult, unintuitive ideas, you can eventually see how they really are based on something pretty simple.”

Comstock looks forward to a summer internship to add to his research experience. He plans to apply to graduate school then attain a research position and publish his findings.

Printing Up Something Sweet

Honey bees perform the “waggle dance” to achieve a healthy diet by telling fellow bees where to find particular kinds of flowers. Dancing helps the group direct more bees to the best patches of flowers—but, by concentrating solely on the best ones, they might also limit the variety of their diet. To address these questions, researchers interfered with the bees’ dancing and studied how their pollen diet changed.

Allison Schubauer ’15 of Sacramento, California, worked with biology Professor Matina Donaldson-Matasci. They designed and built an artificial feeder that would count the number of bee visits. Schubauer created models and used a 3-D printer to create various components of the feeder.

“I’d never used a 3-D printer before, so it was really exciting to see my model of a flower turned into a real object the first time,” she says. “We tested the iterations of our feeder design on a nearby domestic bee colony, and I remember the excitement I felt when the first bee found our feeder and drank from it.”

“What we found,” says Donaldson-Matasci, “is that the dance actually doesn’t affect the diversity of their daily diet, but it does make it more consistent from day to day. This suggests that the bees are able to use the dance to help focus on particularly good flower patches day after day, without compromising the diversity they need within each day.”
of Harvey Mudd graduating seniors had at least one summer research experience while a student.

Building a Better Sound

Ana Villa ’16 of Oakland, California, has worked with Professor Bill Alves on a research project involving gamelan, a form of traditional ensemble music of Java and Bali in Indonesia, made up predominantly of percussive instruments.

“I simulated gamelan pieces using SolidWorks and Abaqus in order to find alternate ways of making the instruments,” Villa says. “I also worked in the machine shop designing pieces and creating an instrument made with steel conduit.”

After completing summer research, Villa also met a Mills College professor and his assistant so she could learn more and discuss the gamelan research being conducted by the Mills team.
A Focus on Fusion

Kevin Eades ’16 of Hobart, Washington, is a physics major with a keen interest in aerospace engineering and fluids. The NSF funded, high-energy laser research he began with Professor Tom Donnelly as a sophomore continued through summer. They researched interactions between micron-size spheres and high-intensity lasers—a system with applications for laser-driven fusion.

“During the school year we created a deposition technique to create monolayers of hexagonal close-packed spheres on silicon substrates,” Eades says.

“Then, we took these to the University of Texas at Austin and blasted them with high-intensity lasers to observe electron energies from multi-pass heating processes. The whole year and summer of research was fantastic—with a great professor and an excellent research team. We had a lot of fun in Texas and learned a lot about experimental physics research and about our project in particular. It gave me a good idea of what experimental physics work is like. It was an amazing experience that will help me greatly in deciding where to go in my life in terms of a career.”

“The whole year and summer of research was fantastic—with a great professor and an excellent research team.”

Kevin Eades
These programs provide powerful learning experiences for students and bring tangible benefits to the Harvey Mudd community and to the community at large.”

“Seeing how different the health situation is in countries like Tanzania that don’t have the resources we have makes me want to do more,” says Klein, who sees herself one day working for the Centers for Disease Control or the World Health Organization. “My dream job would actually be one of those people working on Ebola in Africa right now.”

Examples include the Donald and Dorothy Strauss Internship for Social Understanding and the Ben Huppe ’14 Memorial Internship for a Sustainable World. The Huppe Internship allows students to pursue internships in areas such as renewable energy, “green” technologies, and environmental sustainability, and/or use technology to solve problems of under-served populations domestically or internationally.

Engaging the Community
Through the Office for Community Engagement, Harvey Mudd offers students the chance to pursue summer work opportunities by providing stipends to support them as they pursue unpaid internships with small-to medium-sized nonprofit organizations.

A Global Health Quest
The Donald and Dorothy Strauss Internship for Social Understanding is a 10-week summer internship program designed for students interested in working with a community service organization.

Emma Klein ’17 says that her amazing host family and many new friendships were among the best aspects of her internship in Tanzania. In fact, her ‘homestay’ father regularly sends emails asking when she will return for a visit.

Klein ’17 worked with Support for International Change, lived in a rural village and helped with HIV education and awareness.

Emma Klein ’17 (second from right) helped with HIV education and awareness as part of her summer internship.

Gabriela Gamiz
Director, Office of Community Engagement
Because summer research and experiential learning are so critical to making a Harvey Mudd education—and a Harvey Mudd alumnus—so distinctive and so valuable in a world of continual challenges and changes, the College’s faculty has identified this as one of the top fundraising priorities for The Campaign for Harvey Mudd College.

By investing in this program, individuals, corporations and foundations enable the College to expand opportunities for its students, while securing a more lasting base of funding for these critical research opportunities to offset fluctuations in grant support. In this way, we can continue to ensure generations of students have opportunities to impact society through research and community engagement as passionate problem solvers.

There are a number of opportunities for you to personally invest in the future of experiential learning at Harvey Mudd College. The primary opportunity is to fully fund student stipends, which provide funding for students to pursue summer research positions, community engagement, curricular development project work or internships. These stipends—ranging from $5,000 to $7,000 per student—empower Harvey Mudd students to deepen their learning, engagement and impact. Similar opportunities exist to create faculty stipends supporting the faculty members engaged with our students in these valuable and life-changing experiences. In addition to the stipend option, gifts can also be directed in support of lab supplies and materials as well as project-related travel.

Your investment in experiential learning at Harvey Mudd can be used to establish a permanent, named endowment that provides perpetual support to the College, or it can be provided through annual gifts that are fully expended in the year they are given. Your gift can be in general support of experiential learning—thus, used within this area as most needed—or it can be directed to support a specific number of students and/or faculty; a preferred category of experience (e.g., summer research and community engagement or curricular development projects); or a preferred area of research.

Learn more

To find out how you can support experiential learning at Harvey Mudd College, contact:

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