

Caltech students are using  
new programs, internships,

and funding sources to turn their  
entrepreneurial dreams into  
reality.

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### Eight Steps to Launching a Start-up While at Caltech



**1.**  
Come up with an idea.

When someone suffers a stroke, it is a race against time to save as much of their brain as possible. A patient's fate is based on how long it takes to transport them to the hospital, scan their brain, analyze the results, and, finally, provide a diagnosis and treatment. "During all this time, the brain is dying. The person's outcomes are directly proportional to how much time you can save in diagnosing and treating them," says Shane Shahrestani (MS '19, PhD '21), a student in the Caltech-USC MD/PhD program.

When he enrolled as a graduate student in medical engineering at Caltech, Shahrestani hoped to find a faster diagnostic solution for stroke patients. For his thesis, he developed a portable device that first responders could carry and use to discover blood-flow blockages in the brain, allowing them to begin treating a stroke before a patient gets to the hospital for a full MRI or CT scan. That idea turned into Pasadena-based start-up StrokeDx, co-founded by Shahrestani, where he continues to refine his invention while finishing medical school.

Shahrestani credits the culture of Caltech, and specifically the Andrew and Peggy Cherng Department of Medical Engineering, for helping him become a student entrepreneur. The department, he says, exposed him to an interdisciplinary group of researchers with expertise in developing medical devices, while its curriculum gave him the practical tools he needed to launch a start-up in the biomedical sphere.

"All the professors in the medical-engineering department have a lot of experience developing intellectual property," he says. "You're learning engineering, but you're also learning medicine, and you're learning the regulatory framework. You're learning what the FDA looks for in devices. You're learning how to get the right patents."

### So You Want to Start a Business?

**2.**  
Talk to your principal investigator and OTTCP about how the idea could become a business.

As Shahrestani and StrokeDx demonstrate, student entrepreneurship is thriving at Caltech. And there are opportunities in this realm at both the undergraduate and graduate levels, says Julie Schoenfeld, one of the Institute's two entrepreneurs in residence (EIRs) at Caltech's Office of Technology Transfer and Corporate Partnerships (OTTCP). Schoenfeld represents the physical sciences, while Jay Chiang is

the EIR in life sciences. "My job is to help people figure out how to take what they're doing in the lab to the next level and bring it out into the marketplace," Schoenfeld says.

OTTCP hosts an array of services and resources to support entrepreneurship at the Institute and to promote science and engineering knowledge created by Institute researchers, in part by developing partnerships with industry through the creation of new ventures. For example, the Caltech Seed Fund operated by OTTCP not only provides funding to help promising Caltech-affiliated start-ups get off the ground, but also connects business-minded undergraduates with internships at these new companies.

Meanwhile, the Institute's newly formed co-investment agreement with private venture capital fund Wilson Hill Ventures helps to launch new start-up companies that spring from labs on campus and at JPL, which Caltech manages for NASA. The Institute has a new innovation center near campus that provides space for nascent start-ups, like StrokeDx.

Case Cortese, OTTCP's director for innovation, new ventures, and entrepreneurship, says the office can answer a host of questions from nascent entrepreneurs. OTTCP, she adds, manages the intellectual property, handles the process of drafting and filing the patent, negotiates licenses with a start-up, and works with the EIRs to mentor the start-up teams. "If we have a student who is looking to start a company, we will listen to what their story is, what kind of help they are looking for, what they need," Cortese says. "And then we will source that help for them."

Support may come from programs such as the Rothenberg Innovation Initiative (RI2), which provides support for Caltech's signature brand of high-risk, high-reward ideas. The Institute's new Initiative for Caltech Students will work to increase support for entrepreneurship as well. (See "Best in Class," page 28.)

Schoenfeld says Caltech can connect with students to deploy these services in three basic ways. The first avenue is through patentable ideas and other kinds of intellectual property submitted to OTTCP. When Schoenfeld is alerted to something promising by the licensing team, she reaches out to the creators directly. The second way is much simpler: "People just call in and they say, 'Look, I'd like to start a company. Can you help me out with this?'" Lastly, she proactively seeks out students who may have untapped ideas in market sectors in which abundant investment dollars are available, such as sustainability.

**3.**  
Work with OTTCP to protect the IP, primarily via patents.

### Making the Pitch

"Ever since I was an undergrad," says Andrew Singletary (PhD '22), co-founder of a new company called 3Laws Robotics, "my friends and I, including the now co-founder of the company, talked about doing a start-up, and we always had tons and tons of ideas."

Singletary worked on his graduate research on robotics safety systems in the lab of Aaron Ames, Bren Professor of Mechanical and Civil Engineering and Control and Dynamical Systems. Singletary says he never thought the work he published during his graduate career could be the basis of a new company—until Schoenfeld approached him about the possibility. Then Singletary reached out to Thomas Gurriet (PhD '20). "It started off like, 'Hey, OTTCP has been reaching out to me. Why don't we talk to them and see if it's realistic and possible?'" Singletary says.

Once Singletary and Gurriet started to learn more, they raced to get 3Laws Robotics, which designs nonlinear control systems that ensure the safety of real-world robots, off the ground. With Singletary's graduation looming, Schoenfeld helped them pitch the idea to venture capitalists in the spring of 2022 and launch the company by summer, a breakneck pace for starting a new business.

Connecting with potential investors is an important part of the process for those trying to make the leap from student to entrepreneur. And, says StrokeDx's Shahrestani, that process is often also a lesson in the power of persistence. In Shahrestani's case, shortly after Schoenfeld showed him how to craft a compelling presentation to pitch his start-up, known as a pitch deck, the COVID-19 pandemic hit and led to an economic downturn that spooked many investors. "You don't realize how much goes into a start-up until you're actually doing it," he says. "My co-founder [Alexander Ballatori] and I probably did 300 or 400 pitches over the span of a year."

Though fifth-year graduate student Mackenzie Strehle is nearing the end of her PhD journey in the lab of Mitchell Guttman, professor of biology and biological engineering, the long trek to becoming a successful start-up founder is still mostly in front of her. Strehle got her first entrepreneurial experience in 2021 when she applied to OTTCP for an internship at Caltech start-up Tychon Technologies, headed by two Caltech faculty members: Mikhail Shapiro, professor of chemical engineering and medical engineering and a Howard Hughes Medical Institute Investigator; and Azita Emami, Andrew and Peggy

**4.**  
Outline a business plan and identify your competitors and market.

Cherng Professor of Electrical Engineering and Medical Engineering and director of the Center for Sensing to Intelligence.

When she began to consider launching her own company one day, Strehle found inspiration and direction from the mentorship of Helen McBride, formerly Caltech's EIR for life sciences.

"Helen was really transformative for me in thinking about how I might actually make my own start-up and pursue this path later," Strehle says. "That led to me talking a little bit more with Mitch Guttman about potentially starting a company based on some of the work that we do in the lab."

That work focuses on small-molecule drug therapies that target RNA. Although most modern drugs target particular proteins, a vanishingly small percentage of the human genome actually encodes for proteins, Strehle notes. Techniques to target RNA instead would open up a host of new medicinal avenues.

"There's this unexplored and unmet need for designing therapeutics in this biological space that not a lot of people have really done right now," she says. "In our lab, we are really good at mapping where RNAs exist in the cell, and also how they behave and interact with other molecules. We can do this in a high-throughput sequencing-based method that distinguishes us from other labs. We're hoping we can leverage this technology to figure out how we can identify small molecules that might actually act on RNA."

**5.**  
Write a pitch deck with help from OTTCP to sell your idea.



Undergraduate **Brian Nguyen** (left) with entrepreneur-in-residence **Julie Schoenfeld**.

## Learning the Ropes

Thanks in part to the hands-on education Caltech undergraduates receive, the Institute's culture of entrepreneurship is fostered among them much as it is with graduate students. Before she ever arrived on campus, Joy Shi, a third-year computer science undergraduate from Rockville, Maryland, had already launched a nonprofit called Integirls, which offers math competitions and problem-solving contests for high school girls and nonbinary students. Then, at Caltech, she got a crash course in what it takes to run a start-up.

After Shi's first year, she became a part of the Caltech Seed Fund's first class of interns and found herself working at a Caltech-affiliated start-up under the guidance of Maria Spiropulu, the Institute's Shang-Yi Ch'en Professor of Physics. Despite having nearly no previous background in quantum science,

Shi became immersed in high-end research.

"I knew just a little bit from articles on it and watching YouTube videos," she says. "But as a freshman, I was immediately interacting with and working with people who are literally at the forefront of this field."

During the internship, Shi learned the ropes of project management while also reading up on leading-edge research in quantum networking and computing. She helped company leaders revamp a pitch deck as they sought additional investment for the start-up.

Brian Nguyen, a fourth-year undergraduate at Caltech studying electrical engineering, also got an early start in seeing the world from an entrepreneurial point of view. "In my first year, I wanted to understand how the medical system works, so I shadowed the neurosurgery team at NYU Langone Health," he says. "There, I saw how inefficient tools and processes limited a talented team from achieving its full potential. This experience sparked a desire to build tools to improve health care at scale."

Nguyen fulfilled that desire when, after his third year at Caltech, he landed a Seed Fund internship to work for StrokeDx. While Shahrestani and Ballatori came from a primarily medical background, Nguyen says his engineering-focused outlook led him to insights that helped bolster the company and its mission.

"Engineering is the science of creation," he says. "As an engineering student, you study math and physics to ensure you don't waste time building something that violates a fundamental law in the universe. In practice,

once those rules are satisfied, you have to learn how to make trade-offs. You have to question your constraints and systematically test where your ideas fail. Now apply that framework to business. How do you use technology to eliminate the biggest risks to your company? At a start-up, you cannot afford to be slow and wrong. Over the summer, I created a lightweight data-logging module that monitors our sensor's performance. This allowed my team to rapidly test improvements to our device. Ultimately, this translates to building a better product in a fraction of the time and cost."

7.  
Find a location for your start-up and do the legal paperwork to incorporate it.

## Next Steps

For Singletary, the launch of 3Laws Robotics was a triumph—but only the first of what he hopes will be many. He says that while he knew the technology was proven, in the first six months of the company's life he had to learn how to talk less and listen more—to

hear what potential clients needed and then explain how 3Laws Robotics technologies could meet those needs. "The big idea with start-ups is that if you develop in a vacuum only what you think you need to develop, you're going to develop the wrong thing," Singletary says. "You have to develop alongside your customers."

The big leap for most students-turned-entrepreneurs is not the science and engineering but the art of running a business, says Schoenfeld. Strehle, a self-described "bread-and-butter academic," has begun to look far and wide for advice and wisdom about becoming a CEO, including seeking out members of the Caltech community who have previously made the jump. She also took advantage of the Institute's online Coursera courses. She took classes in such salient topics as start-up valuation methods and industrial biotechnology.

Shahrestani is now living twin lives, establishing StrokeDx while finishing medical school; he will graduate in 2023 and has plans to become a practicing neurosurgeon. "We're writing grants; we're pitching to people; we're writing new intellectual property; we're working with our engineering teams and building out these new devices," he says. "So far, it's been a lot of fun. It's super busy, but at the end of the day, this is exactly what I'm interested in, and I don't want to be doing anything else." 📍

8.  
Launch your company.

6.  
Pitch idea to potential investors, including Caltech funding sources.

## Entrepreneurial Caltech Alumni Buoy Pasadena's Start-Up Scene

When Steve Mayo (PhD '87), now the Bren Professor of Biology and Chemistry and Merkin Institute Professor, joined the Caltech faculty in 1992, he already had experience in translating his laboratory research into a commercial company. While a student in the 1980s, he created Molecular Systems Inc. (now **Biovia**, which creates software products to aid researchers in molecular modeling, data science, and other fields). So, when one of his first graduate students, Bassil Dahiyat (PhD '98), wanted to create a start-up based on his work in protein engineering, Mayo became both an academic and entrepreneurial mentor. With Mayo's help, Dahiyat launched the life sciences company **Xencor** and became its president and CEO.

"It was very daunting," Dahiyat says. "What Steve did is just to say, 'It's possible.'"

A quarter-century later, Xencor is one of the anchors of what has become an innovation ecosystem in Pasadena, developing therapeutic antibody and cytokine treatments for cancers and autoimmune disorders. The advantages of living in Southern California have always helped Dahiyat attract people with life sciences expertise to the area. And now that Xencor is one of several established biotech firms in town, the positive effects of being part of an innovative community have begun to snowball.

While Silicon Valley is known for innovations in software and computing and "Silicon Beach" on the west side of Los Angeles focuses on digital content and film, the ecosystem centered around Pasadena has become a hub for start-ups in what Andy Wilson, executive director of the Alliance for SoCal Innovation, calls "frontier technologies." These include solar energy, telescopes, batteries, and artificial intelligence.

After Michael Amori (MS '07) completed his master's degree, the sunshine and quality of life kept him in town. "Honestly, I just loved Caltech, and I also just loved the climate in Pasadena," he says. "I thought it was a great place to raise a family." His closeness to campus also provided the spark for **Virtualitics**, an AI-driven data visualization start-up headquartered on Lake Avenue that he co-founded with **Ciro Donalek**, a computational staff scientist at Caltech's Center for Data-Driven Discovery (CD3). The two met through **George Djorgovski**, professor of astronomy and data science and director of the CD3, whom Amori met at a Caltech alumni event.

The minds behind **Miso Robotics**, a start-up with a host of Caltech connections, design and test the company's robotic fry cooks and other kitchen-based robots in the heart of Pasadena. When co-founder and chief research officer **Ryan Sinnet** (BS '07) helped start Miso in 2016 along with partners including the company's vice president of hardware engineering **Rob Anderson** (BS '16), the founders chose Pasadena due to its proximity to the robotics research at Caltech, which has its locus in the Center for Autonomous Systems and Technologies. The firm has also teamed up with **3Laws Robotics**, co-founded by **Andrew Singletary** (PhD '22), to safely manage and optimize the motion of its cooking robots. Today, Miso routinely hires new employees and interns from the Institute because of its robotics focus.

"What does it take to build a start-up in a new space or even just a competitive business? I think it takes the best people and the right people who have to have a certain skill set," Sinnet says. "And Silicon Valley being kind of saturated, a lot of people are interested in these opportunities here."

