Asking the Tough Questions:

Caltech Center for Teaching, Learning & Outreach

In August of 2012, the Caltech Center for Teaching, Learning & Outreach was formed by the Office of the Provost to support university teaching and learning, along with K–12 and public educational outreach, under a unified umbrella. *ENGenious* interviewed the Center's director, Cassandra Horii, to learn more about its activities and her vision for the future.

***ENGenious*: Why was the Center created?**

Horii: When we think about Caltech, naturally we think about cutting-edge research. But our scientists and engineers also think long and hard, and care deeply, about their role as educators. You would not believe how some professors go into the classroom to practice, writing everything out on those boards and erasing it, to hone their lectures before students get to class. And, despite the fact that they've taught the course many times, others rewrite and rethink their notes every time they teach. Still others give of their time and expertise to reach out and work with students and teachers in public schools with limited access to research labs. These actions speak to the depth of commitment of our people. The Center for Teaching, Learning & Outreach was created to support the initiative of the faculty and to help make the educational part of Caltech's mission as exceptional as the research.

***ENGenious*: What is the role of the Center and whom does it serve?**

Horii: We bring the latest research in education and findings on new tools and technologies to three main groups: our faculty, our graduate students (who almost all serve as teaching assistants, TAs, at some point), and our undergraduates, many of whom also work as peer tutors, mentors, and TAs. Caltech doesn't have a school of education, so the Center also consults on institutional and policy structures related to teaching. Wherever teaching is happening, we are here to help!

***ENGenious*: How do you work with the faculty?**

Horii: Oftentimes we work with faculty in individual consultations. Teaching is a very personal act. In addition to one's unique perspective on the subject matter, it involves the self, the voice, and the whole person. We look for a match between what research suggests is effective and what will really work for the individual faculty member. That's why consultations are tailored; they're driven by particular goals, a point in the curriculum, what students are capable of, and the personalities involved. First, a Center representative such as myself would want to know what's going on. What are their teaching and learning challenges? What have they observed? Are they looking to change parts of a course or try a new type of assignment? Are they seeking a different way of involving or interacting meaningfully with students? Faculty also seek us out when writing proposals for new education-related endeavors—often in conjunction with their research proposals. In those instances, we provide models of what has worked well, both here and elsewhere. We can also help find a good "fit" between their research and local schools.

***ENGenious*: Do you attend their classes?**

We won't come to a class unless the instructor has requested it. But we absolutely can visit and give feedback on specific things. We have to remember that during class the instructor is attending to a great deal of information: the big ideas of the course, the specific class plan, details like handwriting or operating technologies in the room, plus the students' faces and reactions—for larger courses, dozens of them. It can be really helpful to have another set of eyes in the classroom. For example, we can take a look at how students are taking notes or observe how they direct their attention and thinking, in ways that are difficult to detect from the front of the room. This service has been quite helpful for the faculty we've worked with. The students can be a little intimidated by Caltech faculty, who are pretty amazing people. Students may not always speak up with their questions, or the instructor may hear from the outliers in the class and might not know if they represent the median or the wings. We at the Center can also survey students neutrally and give faculty an action-oriented summary of how students are learning and what they perceive in class, which the instructor can put together with how they see the students performing on problem sets. Then we work on specific strategies to help all of our students (who are also pretty amazing) to learn more effectively.

Cassandra Horii (left) with Mitchel Aiken and Melissa Dabiri

***ENGenious:* What are some of the challenges you have faced, and how are you overcoming them?**

Horii: The demands on Caltech faculty are immense, especially in their early career years, and they do not have a lot of extra time. To overcome this, we try to be very practical and emphasize that we want teaching to enrich their experience, to be as rewarding and nourishing for them as possible. We bring small groups of faculty together around common interests like teaching in the core curriculum. A short-term commitment might be a seminar or a workshop on a particular topic. It is well defined in time and space, lasting only 45-60 minutes, and provides a quick, useful introduction to new teaching methods. We also record some seminars and make them available after the fact so that they have a lasting impact beyond the 30 or 40 people who attend. I've even given a ten-minute talk to a group of faculty and TAs on the "top three things about learning" that they needed to know in order to effectively redesign a course. We don't always have to spend a lot of time to have an impact.

***ENGenious:* How do you help Caltech graduate students in their teaching roles?**

Horii: The vast majority of our graduate students serve as TAs at some point, if not for several terms. In addition to recitations and labs, they hold office hours and have a lot of direct contact with undergraduate

students. But they're often teaching for the first time, in front of very accomplished undergraduates who can be a bit intimidating—or at least perceived as such. One way we are helping is by partnering with the Graduate Studies Office to redesign the teaching orientation for graduate students to better serve their needs. On their way toward full-fledged academic and research careers, we also support graduate students in their leadership efforts on teaching by advising and co-sponsoring events with the Caltech Project for Effective Teaching (CPET), a grad student committee that plans seminars and programs. CPET paved the way for the Center—they started over five years ago and are still going strong. For graduate students who want a more in-depth experience, we've developed Engineering 110: Principles of University Teaching in STEM. By the end of this course, with some mentoring from the Center, they'll be well prepared to answer questions about the fundamentals of evidence-based teaching when they go on their faculty interviews and launch their careers.

***ENGenious*: Do you also work with Caltech undergraduates?**

Horii: Yes, our undergraduate students are frequently teaching as well, so we do a separate orientation for them as TAs three times a year. We help them practice expanding on ideas that may be obvious to them in order for their audience to understand, and we address the unique concerns that arise when teaching one's peers. Our Center also works closely with the Academic and Research Committee (ARC) of the undergraduate student government—the Associated Students of the California Institute of Technology (ASCIT). With ARC, we've implemented new training for undergraduate Course Ombudspeople, who are house-based student liaisons to faculty teaching larger courses, and continue to collaborate with ARC on other new ideas. We're excited to work more closely with Student Affairs to offer more support to Caltech peer tutors as well.

***ENGenious*: How is the Center different?**

Horii: Many research-intensive universities have centers for excellence in teaching and learning, some with 50 years of history in the field. The Caltech Center is unique because we don't limit our scope to higher education. We dedicate attention to effectively partnering with local K–12 schools and teachers beyond Caltech. For instance, Mitch Aiken, the Center's Associate Director for Educational Outreach, recently worked with a Caltech professor with a vision for working with local schools as part of a research program. The goal was to make sure that high-school and middle-school students have exposure to Caltech's cutting-edge science and engineering at the right time. The professor also recognized that graduate students in his lab needed to practice talking about their research: he didn't want a major research conference to be their first experience trying to explain fundamental concepts to a broad audience, so he wanted to get them involved. At the Center we get very excited about outreach, not just as a way to give back to the community but also as part of students' professional development and future careers, whether they are going into industry or into government labs. Scientists are increasingly public educators. One of our biggest hopes is that the Center's work not only improves teaching but makes teaching part of how Caltech students develop and prepare for their roles as public educators while at Caltech.

***ENGenious*: Where do you see the Center in five years?**

Horii: There is a tremendous potential here, just because people are used to being skeptical and asking tough questions. When it comes to Caltech, we dial it way up. We're far more technical. We can move much faster. Our pace could be completely different from any other institution's. I'm convinced; I've watched it happen already. I would never have predicted what we could do in the space of that ten-minute talk on the "top three things about learning." The whole group—graduate and undergraduate TAs included—got it instantly, and were soon giving each other sophisticated feedback based on the talk.

In five years, I would love to see it as commonplace for faculty and students to exchange ideas about how they are learning and teaching their science, alongside their research, so that it's not a secret piece of our identity. Our educational mission doesn't take away from the important research that we're doing; it fosters a conversation that is more public and helpful to our people and our community.

I would encourage Caltech teachers to continue to bring their scientific questioning and skepticism to the table, to think with us at the Center about evidence that will be convincing to them and to their students, and not to worry that the mystery of good teaching will disappear when we talk about it and understand it. Like they do with their research, they can be both passionate and knowledgeable about teaching and it will just get even more magical. E N G

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Visit teachlearn.caltech.edu.

The Franklin Thomas Laboratory of Engineering, the home of the Department of Mechanical and Civil Engineering as well as the office of the Chair of the Division of Engineering and Applied Science, is being upgraded to serve changing research and teaching needs. The renovated building will house state-of-the-art research and teaching laboratories that reflect the evolving focus of the department toward engineering a sustainable physical environment. The building will also include a new auditorium and will have an open layout that brings in natural light, integrates the building with the courtyard, and promotes collaboration. The architects, AC Martin, have incorporated many design features that reflect the innovative research that will be conducted within. The building will also recognize the generous support to the Institute of both the Gates Frontiers Fund, in memory of former Caltech trustee Charles Gates, and alumnus Jim Hall (BS '57) and his wife Sandy.