



Report on the First Four Years: 2012-13 through 2015-16

Executive Summary:

Founded in August 2012 at the California Institute of Technology—Caltech—the Center for Teaching, Learning, & Outreach (CTLO) was created to enhance support for the Institute’s educational efforts, both undergraduate and graduate level, along with partnerships involving preK-12 schools and educators. The CTLO supports and assists Caltech instructors and researchers at all levels with instructional methods, technologies, course and curriculum design, assessment, and educational components of grant proposals. The CTLO also advises the institution on educational matters through committees, special projects, and convenings. Key accomplishments to date include:

- **Rapid uptake of new forms of support for teaching, learning, & outreach:** over 200 faculty (out of approximately 300) and over 800 graduate students (out of approximately 1200) worked with the CTLO in its first three years, plus more in year four, through individual consultations and group trainings, workshops, and events. Annual services now exceed peer institutions by a factor of two to four, scaled by enrollment.
- **Improved courses, student learning, and student experience:** through in-depth collaborations with instructors, options, divisions, and student leaders, the CTLO has helped implement redesigned courses and instructional methods that measurably increase student learning and satisfaction.
- **Expanded educational outreach footprint:** with the CTLO’s support, educational outreach has grown to reach over 12,000 local preK-12 students and teachers per year, thereby enhancing the science, technology, engineering, and mathematics (STEM) pipeline to college. This includes projects funded through NSF and other federal research grants, which the CTLO collaborated to design, implement, and assess.

While this start-up period represents excellent progress, maintaining momentum and deepening the collaborations with academic areas remain priorities, along with ensuring sustainable teaching, learning, and outreach support for the future. Early efforts driven by exploration and entrepreneurship must now transition toward measured sustainability and, in some cases, prioritizing among possible actions that would all be beneficial, but cannot all be pursued. The CTLO looks forward to continuing to support Caltech’s educational efforts in creative and evidence-based ways, and to ongoing collaborations with the many accomplished researchers and educators who comprise our unique community.

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I. Introduction:

The CTLO vision and mission—developed in consultation with undergraduate and graduate student leaders, the CTLO faculty advisory committee, President, Provost, and Vice Provost—have guided the CTLO’s work from its founding in fall 2012 to today.

In a short start-up period, CTLO has established itself as a well-known resource, demonstrating rapid growth in participation by all campus sectors. Engagement has gone beyond superficial levels and led to positive outcomes in terms of instructional quality on campus and educational outreach projects with local preK-12 schools and teachers. We have developed strategies that will help sustain these impacts in our next phase.

*Caltech’s **vision** is for our teaching and educational excellence to parallel our renowned research excellence.*

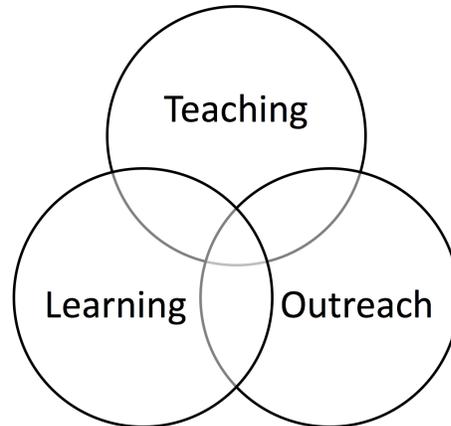
*The **mission** of the **Center for Teaching, Learning, & Outreach** is to work toward this vision by supporting instructors, enhancing student learning, and developing educational outreach.*

*CTLO is committed to fostering **innovation** and relying on **evidence** in all programs and services.*

CTLO Scope

The CTLO serves as a central point of contact for the Caltech community (faculty, students, staff, and others) on topics related to education. Many of our programs and services cross the boundaries between the categories in our title and mission in productive ways for our busy population:

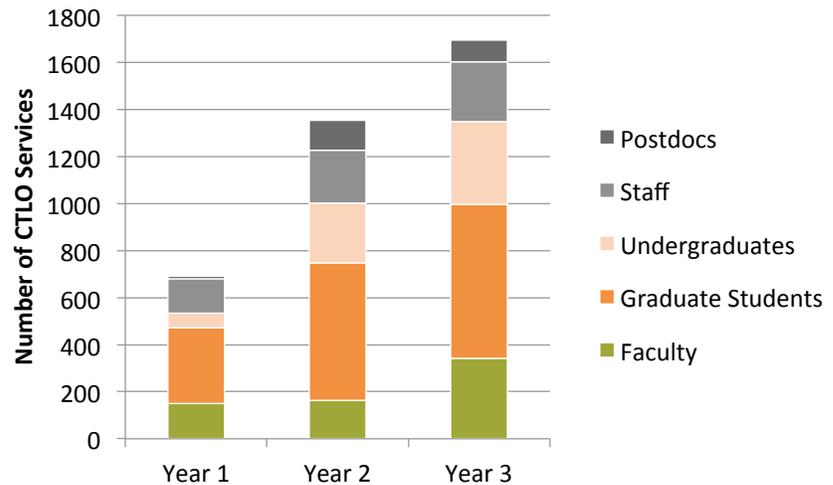
- **TEACHING:** Our efforts to support Caltech instructors (faculty, teaching assistants, and others) focus mainly on Caltech’s credit-bearing courses, but also include informal and extracurricular teaching. This work reaches beyond our campus through online courses and through events that connect themes in STEM education shared by pre-college and university settings.
- **LEARNING:** Our work to enhance student learning focuses on opportunities for Caltech students to grow as teachers, leaders, and mentors—now and in preparation for their futures. This often includes experiences in both university teaching and preK-12 educational outreach.
- **OUTREACH:** Our educational outreach work focuses on partnerships among Caltech and preK-12 schools, teachers, and students. This work regularly results in rich learning experiences for Caltech undergraduates, graduate students, and postdocs, who develop teaching and communication skills applicable in university instruction and research through their outreach involvement.



II. PROGRESS REPORT

a. Campus Engagement

During the first three years of operation, the CTLO provided approximately 3740 services¹ to campus members, including faculty (655 services), graduate students (1560 services), undergraduates (669 services), staff (628 services), and post-doctoral fellows (228 services). Annual services grew from 692 in year one (2012-13), to 1354 in year two



(2013-14), to 1694 in year three (2014-15). This level of annual service, scaled to institutional size, is approximately two to four times that of well-established and highly regarded centers for

The best part of TeachWeek [an annual, week-long celebration of teaching, featuring open classes, discussions, workshops, and talks] was the opportunity to share our interest in teaching with a diverse section of Caltech (students, postdocs, faculty, staff). It was especially interesting to hear the perspectives of other people who don't belong to your immediate group.

—Natalie Higgins, Doctoral Student, Engineering

teaching and learning at peer institutions nationally.² In addition to the high level of service, the CTLO provides significant opportunities for faculty, students, and staff to interact through events and programs, whether the topic is university-level teaching and learning, educational outreach, or the overlap between. Such interactions have great potential to contribute to ongoing improvements in the culture and climate of teaching at Caltech.

b. Faculty Engagement

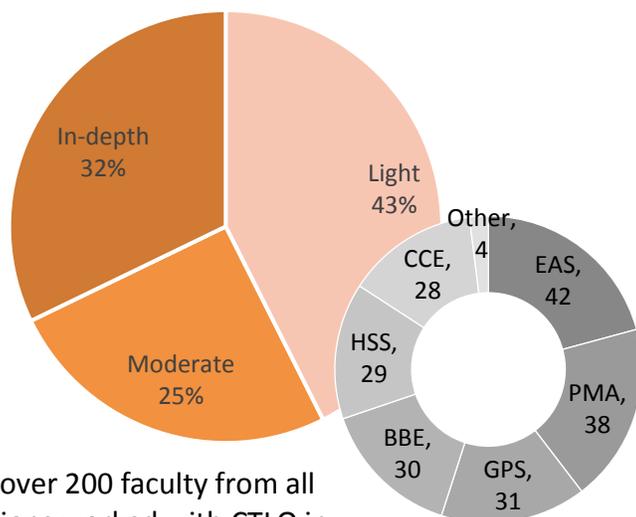
In the first three years of operation, the CTLO worked with 202 of Caltech's approximately 300 faculty, distributed across the six divisions (Biology & Biological Engineering—BBE, Chemistry & Chemical Engineering—CCE, Engineering & Applied Sciences—EAS, Geological and Planetary Science—GPS, Humanities and Social Science—HSS, and Physics, Mathematics, & Astronomy—PMA). Of those, 32% participated in an in-depth fashion (three or more events and/or multiple substantial consultations or services)—evidence of strong engagement with

¹ A service is defined as one individual instance of participation, whether in a group event or a one-to-one interaction. Some individuals receive multiple services.

² CTLO's annual services-to-student-FTE ratio is 0.8. The same ratio is 0.2 to 0.4 for similar centers at research-intensive, top-tier universities that publish comparable data.

educational efforts. Another 25% participated at moderate depth (two or more events and/or one substantial consultation), and the final 43% participated in one event or minor service.

The subject matter of faculty engagement has followed the sequence of the CTLO’s emphasis during start-up and underscores the productive nature of combining university-level teaching and learning and educational outreach under the same umbrella. During the first three years, 58% of participating faculty worked with the CTLO on topics related only to university-level teaching and learning; this aspect of the CTLO’s work started earlier than our educational outreach efforts, which began in 2013. 35% engaged with the CTLO on both university-level teaching/learning and educational outreach—a strong reinforcement for co-locating these services. 6% focused solely on educational outreach.



Just over 200 faculty from all divisions worked with CTLO in the first three years, over half of those at in-depth and moderate engagement levels.

At Caltech the majority of faculty engaged with teaching, learning, & outreach through the CTLO—62%—are full professors. We see light, moderate, and in-depth participation across all faculty ranks.

Participation by Faculty Rank	% of CTLO Participants	% of All Faculty
Professor	62%	72%
Asst. + Assoc. Prof. ³	24%	15%
Non-tenure track	14%	13%

The CTLO’s work with faculty in the first three years was dominated by individual consultations: of the 655 total services provided, 51% were in the form of one-to-one interactions between faculty and CTLO staff. This form of interaction has been a key to early success; it is flexible and in-depth, while addressing the faculty’s specific interests and needs—from course redesign, to educational outreach projects and proposals, to selecting and implementing educational technologies or creating massive open online courses (MOOCs). Within the past year, though, we have seen growing interest among faculty in group events, such as workshops and seminars on educational topics. Several of these have been planned in close collaboration with academic divisions and options, with events situated in regular and special departmental research colloquia series (e.g., Physics Research Conference, IST Lunch Bunch, Bioengineering Lecture Series; special seminars planned with CCE and HSS). The inaugural TeachWeek, a week-long and highly visible series of events on teaching in October 2015, drew dozens of faculty participants. In summer 2016, a

³ Caltech phased out the Associate Professor rank several years ago; there are only a few individuals retaining the title. Most of those represented here are Assistant Professors.

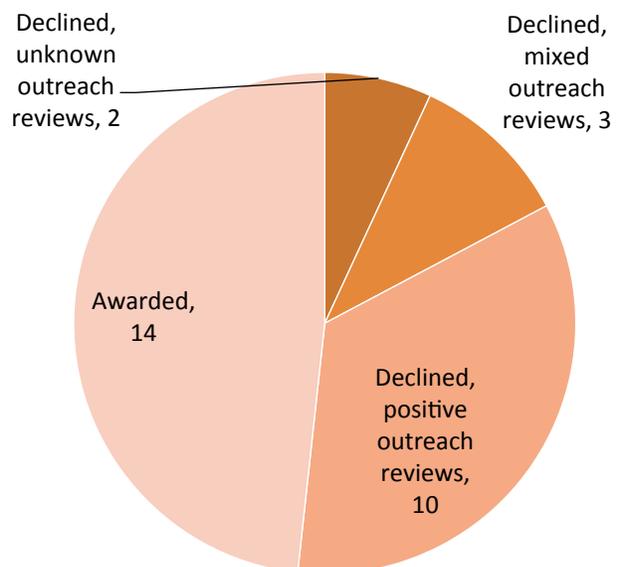
faculty summer short course entitled “(Re)Designing Your Class” was offered for the first time, with a cohort of 17 faculty participants.

Faculty members’ work on university-level teaching and learning has resulted in significantly redesigned and improved courses across all divisions. Outcomes include increased learning (as measured by comparisons of student performance on exams and assignments before and after course redesign), improved student experience (as reported on mid-course questionnaires as well as end-of-term student evaluations of teaching, called the Teaching Quality Feedback Report—TQFR), fewer concerns expressed by students to the undergraduate Academics and Research Committee (ARC), increased enrollment in redesigned courses, and greater faculty satisfaction with and interest in teaching.

Another key outcome of the CTLO’s work with faculty has been successful and positively reviewed research grant proposals. To date, the CTLO has consulted on educational outreach components of 38 research grant proposals (28 with faculty, 10 with research scientists and postdocs). These components often address NSF’s “broader impacts” criterion or similar requirements from other funding agencies. Of the 29 proposals with decisions rendered to date, nearly half were awarded, which is approximately twice the national average funding rate for NSF. Most of those declined had very positive reviews for the educational outreach portions: e.g., “comprehensive plan for education and public outreach”, “well integrated with the proposed research.” Reviewers in the “mixed outreach reviews” category mainly critiqued Caltech’s limited demographics (size and diversity of institute) or sought more detail.

CLTO has had an enormous impact on my teaching and research. A few years ago I decided to teach ec11 as a MOOC, as part of a Caltech experiment with these new technologies. To do this, I started working with Cassandra to learn more about what was known about how to teach effectively on different media. This led me to completely change the way I teach inside Caltech and on-line, and has resulted in sizable improved outcomes. For example, enrollment in ec11 nearly doubled, and objective measures of learning have increased by 20-30%.

– Antonio Rangel, Bing Professor of Neuroscience, Behavioral Biology, and Economics



Outcomes and reviews of 29 grant proposals with educational outreach components on which CTLO consulted, winter 2013 through summer 2016.

When I started [at Caltech], I wanted to continue the high school outreach program that I had been a part of for the past seven years. I contacted the CTLO for help. That one phone call set into motion a chain of events that has resulted in a successful summer internship program and highly reviewed “Broader Impacts” proposals on NSF funding applications.

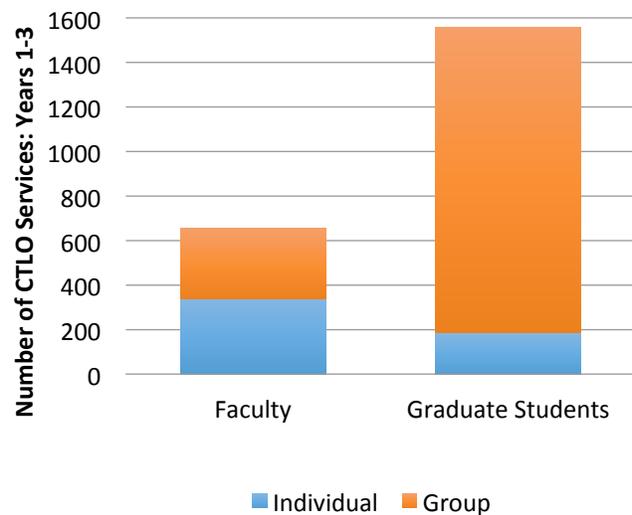
– Evan Kirby, Assistant Professor of Astronomy

c. Student and Postdoc Engagement

Graduate students, due to both their roles as Teaching Assistants (TAs) at Caltech and their interest in teaching-related professional development, have been the largest group of CTLO participants in the first three years of operation: 1560 services; 835 unique individuals (approximately 70% of the total graduate student population). In 2014-15 alone, the CTLO worked with 442 graduate students. Approximately 250 of those were incoming graduate students and attended the annual Teaching Conference during their orientation week (this fulfills Caltech’s TA training requirement for graduate students; those who do not plan to serve as a TA at Caltech attend sessions of general professional development interest). The remainder consisted of second year and higher graduate students participating in ongoing seminars, workshops, certificate programs, courses, and consultations. In contrast to faculty, whose services are dominated by individual consultations, 88% of services to graduate students were in the form of group experiences.

In addition to the Teaching Conference, which operates on a tiered mentoring model (a graduate student/postdoc committee is mentored by CTLO staff to plan sessions, which then guide other graduate students on teaching), these group experiences include participation in the Caltech Project for Effective Teaching (CPET) seminars and discussions. CPET is a graduate-student led group within the CTLO, formerly based in the Graduate Dean’s Office. CPET is able to respond to emerging graduate student interests and needs, and also advises the CTLO on programs and services for this population. Group participation also includes the approximately 20 students who enroll in the CTLO’s credit-bearing course offering, E110, “Principles of University Teaching and Learning,” each term it is taught. Graduates of the course often go on to hold leadership positions in CPET and/or the Teaching Conference, drawing on their in-depth understanding and knowledge base.

12% of graduate student services in years one through three, or 185 services, were in the form of one-to-one meetings. These individual consultations with CTLO staff included a variety of topics, as well as one-to-one aspects of the CPET



Through CTLO programs and course-specific consultations, I learned about how learning happens, how to create and assess student assignments, and how to implement effective teaching practices in recitations... Every session with the CTLO has been an excellent use of my time; whether a participant or planner, I have left each information-rich encounter with some new understanding about teaching and learning that I could implement immediately in my role as a TA and that I continue to reference as I learn new subjects and teach new students.

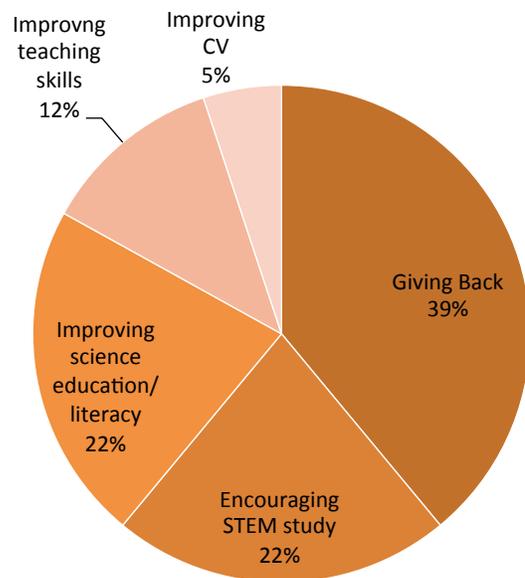
– Suzanne Kern, PhD (BBE, '14)

Certificate of Interest and Certificate of Practice in University Teaching. These certificate programs are unique in higher education as peer-review-based credentials on university teaching at the graduate level; the Certificate of Practice also includes a transcript notation upon graduation. Graduate students also meet individually for coaching and discussion to prepare them for participation in educational outreach. The CTLO's feedback supports them in applying active learning strategies appropriate to younger audiences and translating the essential aspects of their research for a variety of levels of scientific background, which they report to be a useful skill well beyond educational outreach alone.

Postdoctoral fellows are a smaller demographic for the CTLO; their participation is typically in the form of events open to the campus at large and in professional development opportunities targeted towards graduate students. The Caltech Postdoc Association regularly invites the CTLO to facilitate workshops on topics such as Teaching Statements for the academic job search, to which graduate students are also welcome. While classroom teaching by postdocs at Caltech is not common, postdocs regularly serve as mentors for undergraduate student researchers at Caltech. The CTLO, in collaboration with the Student-Faculty Programs Office, has addressed their needs for professional development through a series of summer seminars on undergraduate research mentoring. Graduate students and postdocs also overlap in involvement in Caltech's joint program for underrepresented researchers in the physical, mathematical, and engineering sciences with several peer institutions—the California Alliance for Graduate Education and the Professoriate—for which the CTLO led the Caltech professional development activities until 2016.

Undergraduates account for 669 services in the first three years and are involved with the CTLO in several ways. Approximately 40-60 undergraduates per term serve as TAs for the first time and participate in a required training consisting of a preparatory online module and an in-person workshop (enrollment is capped at 12 students for each workshop to ensure active participation by all). Those serving as TAs for special programs, such as summer term Math 0 and the Freshman Summer Research Institute (FSRI) for incoming Caltech students from underserved and underrepresented backgrounds, receive specialized training to prepare for these unique programs. Students in the Academics and Research Committee (ARC) look to the CTLO for mentoring and guidance on several programs, including course ombuds, who are enrolled students acting as liaisons with faculty for feedback in larger courses (the CTLO assists with training); course video recording (the CTLO hosts website and maintains administrative privileges); and the “course concerns” subcommittee (the CTLO helps students prioritize issues, problem-solve possible solutions, and communicate effectively with faculty). The CTLO typically consults with ARC students on design and implementation of the bi-annual Student Faculty Conference and on other projects and priorities.

Undergraduates, graduate students, and postdocs benefit from involvement in educational outreach, whether hosting fieldtrips, visiting classrooms, helping younger students learn to write code, mentoring young researchers, or working with elementary, middle, and high school teachers on creating activities and lessons. The CTLO's support for student/postdoc outreach has constituted approximately 10% of services to these populations. As we discovered in a 2013 survey, Caltech students approach educational outreach from a variety of perspectives, from altruism, to STEM-focused goals, to skills and credentials development. Indeed, Caltech student outcomes from educational outreach do include perceived gains in communication, teaching, and their own content knowledge. However, outcomes also tend toward much deeper forms of learning, which include contributing to their own persistence and experience in their chosen research fields, metacognitive understanding of their own learning, and grappling with larger issues of diversity and achievement in research fields. As local public schools serve mostly minority and low-income students, these issues are particularly important and visible in our civic environment.



Caltech student motivations (above), and self-reported learning outcomes (below) for those participating in preK-12 educational outreach. From a 2013 CTLO survey (33 responses).

“I was able to **improve my own teaching skills** and develop a **new kind of patience** with learning.”

“I have a **deeper understanding** of the material myself after answering all the students’ questions.”

“When I learn new things, I sometimes attempt to **imagine** how I could try to **explain it to my students.**”

“I enjoy **reflecting** on my own growth in college.”

“I feel **more fulfilled as a researcher** when I have shared my enthusiasm with others. Outreach also teaches me to **communicate** better and to **simplify** and **see my work fitting into a bigger picture.**”

“I’m definitely **more sympathetic to students who struggle.** I’ve come to realize that **socioeconomic issues** can certainly impact a child’s learning curve.”

– Caltech students on participating in PreK-12 educational outreach

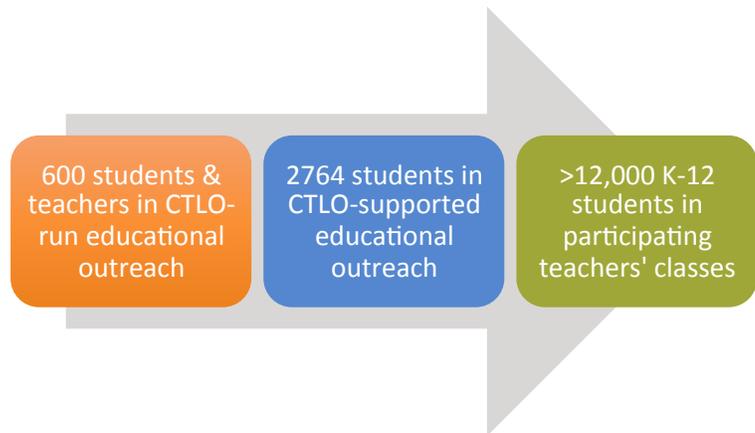
d. External Engagement

Educational outreach is a primary form of external engagement for the CTLO, involving direct interactions with preK-12 students and families, as well as advanced professional development opportunities for K-12 teachers, particularly about STEM teaching and the Next Generation Science Standards (NGSS).

In 2014-15, educational outreach programs supported and run by the CTLO directly reached over 3300 preK-12 students and teachers, and indirectly reached over 12,000 students taught by participating K-12 teachers, who benefitted from new curricula and methods gleaned in CTLO programs.

The CTLO's signature, home-grown programs such as the six-week Summer Research Connection and Community Science Academy, school-year Community Science Events for teachers (also involving Caltech faculty and students), and field trips hosted by the CTLO accounted for 600 students and teachers in 2014-15.

In 2015-16, these educational outreach efforts have continued to grow.



2014-15 CTLO educational outreach program impacts.

Importantly, the CTLO's work in the outreach arena supports the many separately funded Caltech projects and initiatives in preK-12 education, whether they have their own revenue models (e.g., the Public Events department's Reel Science, Science Saturday/Sunday), are grant-funded (e.g., Juice from Juice and Solar Army programs; the Seismo Lab outreach tours; and other programs initiated by PIs); are run by Caltech students (e.g., Coding Club undergraduates mentoring elementary kids in an after-school setting; Innworks summer camp,

Thank you so much for a truly unforgettable day!! It was so fantastic in every way. The girls were so excited and I have heard from their parents how much they loved it, and haven't stopped talking about it. I can't tell you how special it was for them to spend the day imagining themselves as future astrophysicists and astronomers...We are looking forward to continuing with pulsar searching this year!

– Monica Barsever, Teacher,
Alverno High School

run by Caltech students for local underrepresented and underserved middle school students), or involve an external educational organization conducting STEM enrichment programs on campus (e.g., Project Scientist, IDTech, and other summer camps). All of these programs can now access improved processes, documents, and model contracts and forms ensuring safety and compliance for minors on campus, and training for those involved in Caltech-run programs. In addition, the CTLO brings staff outreach coordinators across campus together several times per

year to exchange information, practices, and processes. CTLO staff also maintain close ties with local schools, especially the Pasadena Unified School District—both at the district level and through individual school and STEM curriculum contacts. These working relationships allow new and ongoing outreach efforts to involve students and teachers in more meaningful ways: e.g., matching Caltech PI/research group expertise with specialized PUSD “academies” or appropriate grade-level curricula. Ongoing collaboration also enables rapid turnaround for new educational outreach proposals, which are frequently endorsed through formal letters of support from schools and districts.

Another form of public engagement, Massive Open Online Courses (MOOCs), receive extensive support from the CTLO. These free online courses⁴, offered by Caltech, have enrolled over 630,000 students worldwide. For the faculty involved, goals include reaching broad and diverse learners, impacting research fields, and improving Caltech students’ experiences by leveraging the online technology to make in-person classroom interactions more productive and meaningful (many Caltech MOOCs have an associated on-campus class, with online components and in-person teaching).

Everywhere I go, multiple people thank me for the MOOC [Intro to Cryo-EM] and I believe nearly all newcomers to my field...have watched a lot of it. Those were without doubt among the most impactful hours and funds I’ve ever invested.

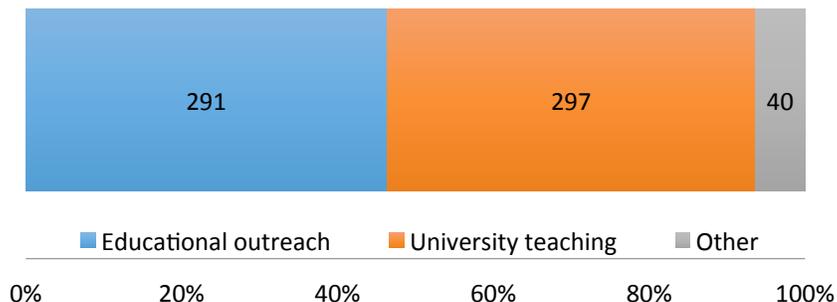
– Grant Jensen, Professor of Biophysics and Biology

The CTLO augments Caltech’s reputation for both university level and preK-12 educational outreach through selective participation in external organizations (e.g., those focused on local preK-12 education and national higher education teaching and learning), and by generating excellent press coverage (both Caltech stories and those published in external news sources). See <https://teachlearn.caltech.edu/about/News> for a comprehensive list of news coverage.

e. Staff engagement

Caltech staff participate in CTLO offerings at nearly the same level as faculty and undergraduates, but their pattern of engagement differs. CTLO provides services to staff related to educational outreach, including supporting and convening outreach coordinators and consulting on policies and programs related to preK-12 educational outreach.

Number of CTLO Services to Caltech Staff, Years 1-3



⁴ MOOC platforms with which Caltech is affiliated, Coursera and edX, charge a nominal fee for students to earn a “certificate” upon successful completion. However, content remains freely available and students who wish to seek a certificate and cannot afford the fee can request a scholarship or waiver. Caltech MOOCs do not confer course credit.

These outreach-related services account for nearly half of all the CTLO services to staff: 291 of 628 in years one through three. Staff from other offices (e.g., Deans' Offices, Academic Media Technologies, Human Resources, Student-Faculty Programs, Center for Diversity, Academic Options and Divisions) regularly request CTLO input, consultation, and contribution to events related to university teaching topics. Other requests address more general design and implementation of learning experiences on campus, such as those for staff and visitors.

III. SUMMARY AND PLANS

Analysis of work to date suggests that participation has been strong across constituencies and early outcomes have been favorable; based on nominations from faculty, alumni, and students, Caltech awarded the CTLO with the Institute's inaugural Team Impact Award in Spring 2016. In addition, internal evaluation of programs and services consistently yields very high rates of self-reported satisfaction and learning by faculty, staff, and student participants.

In the short amount of time that Caltech has had a Center for Teaching, Learning, and Outreach, the CTLO has had a tremendous positive impact on the educational quality at Caltech. They have benefited diverse members of the community, from students who are taking classes, to TAs who are learning how to be instructors, to faculty who want to improve their class, and to anyone who is interested in outreach.

– Faculty Nominator, Team Impact Award

Priorities for the CTLO's next phase include securing long-term funding and enhancing internal structures and process (e.g., for communication, planning, and data analysis). In the next one to two years, we seek to enhance visibility of positive outcomes for students and faculty, to deepen collaborations with academic divisions, to pursue customized educational development opportunities (e.g., discipline-based TA preparation, core curriculum faculty discussions), and to create new Caltech-specific resources such as online guides related to various aspects of teaching at the Institute. As educational outreach efforts continue to grow, we plan to emphasize sustainable, long-range programs and focus on enhancing Caltech students' communication and teaching skills through their involvement.

In terms of strategy, we will continue to use major events and requested talks to raise campus awareness of teaching, increase curiosity and interest in follow-up, and disseminate relatively easy-to-adopt teaching practices. Situating major events in academic settings that are convenient and meaningful for participants, such as department seminar series and division meetings, and involving Caltech faculty and students, as on panels/discussions, are strategies that have worked well and that we plan to continue.

Follow-up on increased awareness and interest with time-efficient, in-depth experiences that transform teaching and learning remains important: e.g., CPET certificates; short courses for faculty, students, and postdocs; longer workshops; book discussions and journal clubs; consultations and feedback.

As we have done during the first four years, we plan to keep building programs based on needs and interests, drawn from working closely with students and faculty (committees, advisory groups), and basing recommendations and consultation strategy on evidence & innovation.

In the area of educational outreach, we continue to emphasize building capacity, depth of knowledge, and community in working with K-12 teachers, so that educational changes are sustained and impact many students over a long period of time. We believe that diverse perspectives drive innovation, and therefore continue to bring more Caltech and K-12 instructors into contact with each other, through existing and new programs.

Longer term, the CTLO's work reveals interests and needs in the areas of instructional technology, educational research and assessment, and flexible learning space design. We hope to find ways to support these emerging requests in future planning.

APPENDIX A: CTLO Activities

The CTLO has developed programs and services based on evidence of effective practice and Caltech's specific needs and interests. Over the past several years, we have built a robust and flexible suite of activities, presented here to provide a sense of the scope of current work.

Programs

For Faculty/All:

- **TeachWeek** (started in 2015). A week-long, highly visible campus event with open classes, panels, guest speakers, and workshops, initiated at the request of the President.
- **New Faculty Workshop** (took over in 2012). Part of the Vice Provost's series of lunches and sessions for new faculty, we provide an introduction to resources for teaching and outreach, and a discussion of methods that are effective at Caltech. Before CTLO, the workshop was run by external guest presenters.
- **Faculty Short Course: (Re)Designing Your Class** (started in 2016). A multi-session experience in "backward design" for university courses.
- **Workshops and seminars** (started in 2012; special 2-year funding for high-profile guest speakers in 2015-16 and 2016-17). Independently and in collaboration with options and divisions, CTLO hosts one-time workshops and talks on educational topics of interest.
- **Book discussions and journal club** (book discussions started in 2014; journal club started in 2015). Discussions of foundational and new works related to teaching, learning, and educational outreach.
- **Workgroup on Educational Science and Technology, WEST** (started in 2013). Interest-based group focused on collaborative professional development

and educational projects, actions, and research.

- **Online Learning and Technology** (started in 2012). Liaison with external platforms and apps (e.g., *edX*, *Coursera*, *SKIES*); manage internal resources; provide training and professional development.

Mainly for Graduate Students; Some Undergraduates and/or Postdocs:

- **Teaching Conference** (started in 2013). This full-day conference occurs during graduate orientation week each fall and is open to the entire Caltech community.
- **Teaching Assistant Orientations** (started in 2012). Undergraduate TAs, and occasionally graduate TAs who miss the teaching conference, participate in small group workshops with a preparatory online module.
- **Specialized TA Workshops** (started in 2013). Custom workshops and trainings for Summer Math 0, Freshman Summer Research Institute TAs, and Core Math and Physics TAs. May include small-group practice teaching with feedback.
- **Caltech Project for Effective Teaching** (took over in 2012). Graduate student-led seminars, discussions, and certificates; originally housed in the Graduate Dean's Office.

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Mainly for Graduate Students (cont.)

- **CPET Certificates of Interest and Practice in University Teaching** (took over in 2012; added second certificate in 2015). Self-directed and customized professional development on teaching.
- **Course, “E110, Principles of University Teaching and Learning in STEM”** (started in 2013). 2-unit course enrolls mostly graduate students; culminates in individual projects.
- **Undergraduate Research Co-Mentor Series** (started 2015). With the SURF Office, a series for grad/postdoc and staff scientists on effective mentoring.

Mainly for Undergraduates:

- **Course Ombuds** (began advising 2012). A program of the undergraduate Academics and Research Committee (ARC). Course ombuds are students who serve as liaisons between faculty and other students, for feedback in larger/core courses. CTLO hosts trainings and discussions for ombuds.
- **Peer tutors** (started in 2014). A Dean’s Office program, CTLO provides training for peer tutors roughly once per year, upon request.
- **Course video recording** (began advising in 2013). Advise ARC and help maintain website for student-run course video recording.

Outreach Focused:

- **Community Science Events** (started in 2015). Large events for K-12 teachers, featuring a Caltech faculty seminar and a lesson/activity showcase by postdoc, grad, and undergrad volunteers.
- **Community Science Academy** (started in 2014). Six-week summer day program providing local teachers and high school students with community-relevant research experiences and exposure to advanced teaching and learning practices.
- **Community Science Academy International** (started in 2015). An enriching two-week science and engineering experience for international high-school students.
- **Summer Research Connection** (took over in 2014). Six-week summer program that embeds local teachers and high school students into Caltech research groups. CTLO adopted the program from the Division of Chemistry and Chemical Engineering after a grant ended in order to continue its impact and availability across Caltech divisions.

Services

General:

- **Feedback on teaching.** Confidential (if desired) and customized: may include observation, video recording, photography, surveys, coaching, etc.
- **Consultations.** Customized, expert consultations on all topics related to our mission: course design, instructional technology, teaching and learning methods, grant proposals with educational/outreach components (e.g., NSF Broader Impacts), outreach programs, and more.
- **Research & assessment.** Collaborate with faculty/others to gather data and assess student learning in courses and educational programs; provide data to divisions in advance of visiting committees.
- **Special convenings, presentations, and projects.** E.g., presentations for division faculty meetings; convenings of faculty who teach core courses and serve as freshman advisors; pilot projects such as TQFR improvements.
- **Advising of student groups.** Provide requested advice to student government and groups working on educational projects and initiatives (e.g., ARC, GSC, Student-Faculty Conferences, Innworks, Coding Club, Science and Engineering Policy at Caltech, and others).
- **External relationships.** Represent Caltech on local/national advisory

boards relevant to aspects of our mission, including university teaching, STEM education, and educational outreach; maintain excellent working relationships with partner organizations.

Outreach Focused:

- **Outreach implementation:** Collaborate with faculty and student groups/clubs to implement outreach programs for elementary, middle, and high school levels, in some cases fulfilling NSF broader impacts and other grant requirements.
- **Summer outreach with external partners.** Manage relationships with organizations like iD Tech, Project Scientist, Innworks, etc., including contracts, campus services, and distribution of scholarships to local underserved students.
- **Fieldtrips.** Host visits from local K-12 schools, including lab visits, demonstrations, discussions, etc.
- **Science nights and fairs.** Recruit and coordinate the involvement of campus outreach groups, clubs, and individuals at local K-12 school science events.
- **Competitions and events.** Support Caltech in hosting high-profile STEM events such as the Siemens Competition, Science Olympiad, Caltech-Harvey Mudd Math Competition, and Intel International Science and Engineering Fair.

APPENDIX B: Staffing, Affiliated Students, and Advisory Committee

CTLO staffing consists of the following positions. Each is 1 FTE unless otherwise noted, and all positions report to the Director unless noted.

1. Director: Cassandra Horii, Ph.D. (Reports to Vice Provost Cindy Weinstein)
2. Associate Director for Educational Outreach: Mitch Aiken, M.Ed.
3. Assistant Director for Instructional Practice & Technology: Jennifer Weaver, Ph.D.
4. Administrative Coordinator: Leslie Rico, B.A. (CTLO 0.67 FTE; Hixon Writing Center 0.33 FTE)
5. Office Assistant: Eleanor Race-Moore, B.A. (0.5 FTE)
6. Vacant: Program Coordinator for Educational Outreach, 1.0 FTE (reports to Associate Director for Educational Outreach)

This overall staffing level (scaled to institutional size) is consistent with peer institutions' centers for teaching and learning, though the scope of responsibility at the CTLO is significantly broader. Unlike peer institutions, the CTLO encompasses educational outreach and primary day-to-day campus responsibility for online education and MOOCs.

Several student leadership roles are affiliated formally and informally with the CTLO:

- Graduate student co-directors of the Caltech Project for Effective Teaching (CPET). Each receives a small stipend and spends a few hours per week organizing seminars/discussions and overseeing the CPET Certificate programs. The graduate co-directors are mentored by the Assistant Director. CPET convenes an informal graduate student committee, which advises the CTLO on graduate and TA programming.
- Undergraduate Academics and Research Committee (ARC). CTLO works closely with ARC on course ombuds and student-led course video recording, as well as advising ARC students who are seeking to improve courses and instruction. ARC advises CTLO on undergraduate programming.
- Teaching Conference Planning Committee. Convened annually during the summer, the committee plans the conference, leads sessions, and recruits additional session facilitators.

The CTLO's Faculty Advisory Committee meets approximately twice per year and consists of faculty from across the Divisions:

- | | | |
|---------------------------|--------------------------|---|
| ▪ Mike Brown (Chair), GPS | ▪ Christopher Umans, EAS | ▪ Ryan Patterson, PMA |
| ▪ Marianne Bronner, BBE | ▪ Morgan Kousser, HSS | ▪ Cindy Weinstein, HSS;
Vice Provost |
| ▪ Mitchio Okumura, CCE | ▪ Elena Mantovan, PMA | |