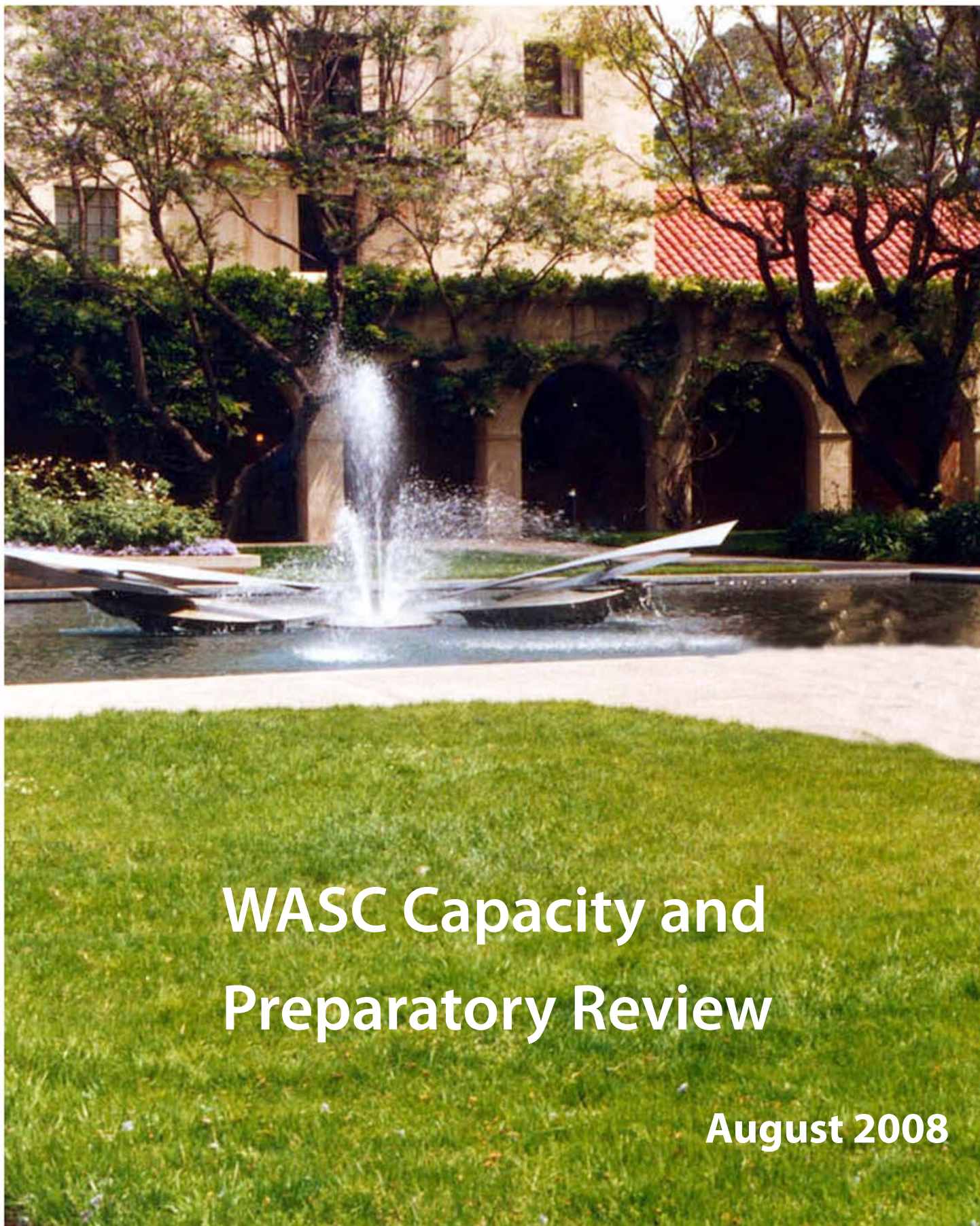




CALIFORNIA INSTITUTE OF TECHNOLOGY



# WASC Capacity and Preparatory Review

August 2008

# *Capacity and Preparatory Review Report*

Prepared by the  
California Institute of Technology  
for the  
Western Association of Schools and Colleges

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## Essay 1: *Introduction*

In September of 2006, the Western Association of Schools and Colleges (WASC) accepted [Caltech's proposal](#) for reaccreditation. The proposal stated that the reaccreditation process was coming at a timely juncture as President Jean-Lou Chameau was just arriving on the Caltech campus. Two years later, this review is part of an on-going process to enhance and sustain excellence in our educational and research programs. At his [June 2007 inauguration](#), President Chameau remarked,

Caltech students are unusually creative, intense, articulate, irreverent (which I love), sometimes a bit socially challenged, but never, ever dull. Yes, they can do math, physics, engineering, and biology better than nearly any other students in the world, but they are also musicians, Shakespearean actors, and chefs in training. ...Our undergraduate and graduate students are truly superb. ...I believe the most critical aspects of my tenure as president is to foster such unusual creativity and intellect. We must ensure that we have a foundation that sustains and enhances excellence and allows the Institute to remain a leader in creating new knowledge.

He went on to describe Caltech's small size as an important asset in research and challenged Caltech students and faculty to address some of the toughest problems facing society. Caltech's "small size and low student-to-faculty ratio should foster an unusual level of interaction between faculty and students—on the campus, in the classroom, and in the research laboratory. Caltech should provide the ideal student experience in a research university context where research and teaching are one and the same."

Since President Chameau's 2007 inauguration, Caltech has successfully completed a \$1.4 billion comprehensive campaign to construct three new buildings that will house state-of-the-art research facilities; to secure support for faculty and students, including the Summer Undergraduate Research Fellowships (SURF) program; and to increase the endowment for Caltech's future. In addition to the comprehensive campaign, the Caltech trustees formed the Student Experience Committee, a new committee that will allow Caltech's governing board involvement in oversight of our educational programs. The Council on Undergraduate Education has been formalized as an administrative committee to coordinate undergraduate educational activities to ensure the quality of the programs, and the President's Diversity Council has been created to oversee diversity efforts on campus. The Caltech undergraduates organized the first Student Experience Conference. The faculty endorsed a review of the undergraduate core curriculum, and the Caltech community formulated an Institute-wide educational objective—"to provide an outstanding education that prepares students to become world leaders in science, engineering, academia, business and public service"—plus several learning outcomes for the B.S., M.S., and Ph.D. programs. In September 2008, Caltech will enroll a record number of female undergraduates, including an incoming class of 40% women. This level of activity is a small part of Caltech's ongoing efforts to meet its goal of sustaining and enhancing excellence in education and research.

The [2006 proposal](#) to WASC outlined three themes for Caltech's review: undergraduate research, the Honor Code, and undergraduate education (including student workload and teaching effectiveness). Since the original proposal, the undergraduate education theme has

been refined to concentrate on the undergraduate core curriculum, as reflected in the [February 2008 memo to WASC](#). Together, these three themes are central to the Caltech undergraduate education and thus are appropriate choices as the focus of the WASC review.

This report for the Capacity and Preparatory Review was prepared by the WASC Steering Committee with support and input from the Council on Undergraduate Education, several ad hoc committees that were formed around the three themes, and Caltech's Faculty Board. The community was able to provide input to the process through the committees or through the accreditation website.

The report includes seven essays in addition to the introductory (Essay 1) and concluding remarks (Essay 9). Essays 2-5 outline the structure of Caltech's governance and policies; provide an overview of the Caltech community, including diversity efforts; and describe the processes used by Caltech to assess and plan its academic and research programs. Essays 6-8 outline the three themes and provide the foundation for the Educational and Effectiveness Review in 2010. All of the essays contain links to supporting documents and illustrate the mechanisms Caltech has in place to fulfill WASC's Criteria for Review (CFR). The appendices to this report also provides a listing of the CFRs referenced to the corresponding essay, the supporting materials, data exhibits, and the committees involved in preparing this report.

## ***Essay 2: Caltech Background and Governance***

### **2.1 Mission of the California Institute of Technology** ***[\(Criteria for Review 1.1, 1.4, 1.7, 2.1\)](#)***

The California Institute of Technology is an independent, privately supported university focused on research and education in science, engineering, and technology. As found on page 1 of the [Caltech Catalog](#) and in other public documents, such as the [Caltech Visitor's Guide](#):

The mission of the California Institute of Technology is to expand human knowledge and benefit society through research integrated with education. We investigate the most challenging, fundamental problems in science and technology in a singularly collegial, interdisciplinary atmosphere, while educating outstanding students to become creative members of society.

This statement of Caltech's institutional purpose expands the educational statement developed by Caltech's original trustees in 1921, "To train the creative type of scientist or engineer urgently needed in our educational, governmental, and industrial development." Caltech's mission statement and educational purpose guide our planning efforts and are embedded in all aspects of campus life.

Caltech is one of the world's major research centers, with world-class research facilities on campus and several major off-site facilities, including the Jet Propulsion Laboratory, the Palomar Observatory, and the W.M. Keck Observatory. Caltech is also a center of education and learning with an undergraduate student body of approximately 900 and a graduate student population of 1200. With a professorial faculty of 300, it is the only top-50 research university listed in the [U.S. News & World Report America's Best Colleges](#) to boast a 3-to-1

ratio of undergraduate students to professorial faculty.

Caltech is organized into six divisions: Biology (BIO); Chemistry and Chemical Engineering (CCE); Engineering and Applied Science (EAS); Geological and Planetary Sciences (GPS); Humanities and Social Sciences (HSS); and Physics, Mathematics and Astronomy (PMA). Caltech emphasizes research and education across traditional boundaries. Hence, there are faculty appointments, educational programs, and research endeavors that involve or combine [efforts from more than one academic division](#).

Caltech offers a four-year undergraduate program with options (majors) available in the sciences, engineering, humanities, and social sciences, plus an independent studies program. All options require students to complete the core curriculum (Essay 6), which is designed to expose students to a wide spectrum of intellectual pursuits. Students are strongly encouraged to participate in research (Essay 7). Caltech's research programs not only contribute to the advancement of science and technology, but they also add significantly to the intellectual vitality of our educational process. Finally, because work in the sciences and engineering is so critically dependent on collaboration and open communication, Caltech has a long history of maintaining an honor system that is applicable to scholastic and extracurricular activities and to relations among all members of the Caltech community (Essay 8).

Caltech also offers academic programs leading to the degree of Master of Science, the degree of Engineer in several engineering specializations, and the degree of Doctor of Philosophy. In the 1998 WASC review, Graduate Education was one of the three chosen topics. Although the graduate program is not one of the chosen themes for this review, we have included responses to the 1998 review in the description of the graduate program in Essay 3 and in the description of the diversity efforts of Essay 4.

## **2.2 Board of Trustees** [\(CFRs 1.8, 3.5, 3.8, 3.9\)](#)

As described in the [Bylaws](#) of the California Institute of Technology, "The activities and affairs of the California Institute of Technology shall be conducted by and all corporate powers shall be exercised by or under the direction of the Board of Trustees." [Caltech's Board](#) comprises 46 Trustees plus a variable number of Senior Trustees and Life Trustees. Trustees and Senior Trustees are voting members of the Board; Life Trustees do not vote. The specific powers and fiduciary duties of the Board include determination of policy; legal responsibility for the affairs of Caltech; review of reports for assurance that such policy is being executed; power to act in the event of an emergency; election, appointment, or removal of members of the Board, officers, and committee members; election of Senior Trustees, Life Trustees, Chairman Emeritus, and President Emeritus. The President of Caltech is an ex officio member of the Board.

Caltech's Board has eleven Standing Committees. These include the Executive Committee, the Audit and Compliance Committee, the Business and Finance Committee, the Buildings and Grounds Committee, the Development Committee, the Institute and Alumni Relations Committee, the Investment Committee, the Jet Propulsion Laboratory Committee, the Nominating Committee, the Student Experience Committee, and the Technology Transfer Committee.

The Business and Finance Committee is responsible for business and financial policies of the Institute, including long-range planning, the budget for capital expenditures, the annual operating budget, and building project cost estimates. The Audit and Compliance Committee annually appoints an independent auditor to examine Caltech's financial statements. [Caltech's Annual Report](#) includes financial statements and the auditors' report for the fiscal year to which the *Annual Report* applies.

The Student Experience Committee is the newest [Board committee](#), formed in fall 2007. The charge to this committee focuses on oversight of the student experience, including the assessment of whether the students' educational and research experiences are consistent with Caltech's educational goals and standards of excellence. The committee monitors and evaluates strategies for promoting the diversity of the student body and student recruitment, enrollment, and retention. This committee also interacts with students in both social and academic settings to gain insight and advice, and it monitors and assesses accreditation processes.

### **2.3 Caltech's leadership, administrative processes, and policies** [\(CFRs 1.3, 1.8, 2.8, 2.9, 3.3, 3.8, 3.10\)](#)

Caltech's eighth president is Jean-Lou Chameau, who assumed the position on September 1, 2006. The [administrative team](#) reporting to the President includes: the Provost (Professor Edward Stolper); the Vice President for Business and Finance (Dean Currie); Vice President for Development and Alumni Relations (Gary Dicovitsky); Vice President for Student Affairs (Professor Anneila Sargent); Vice President for Public Relations (Robert O'Rourke); General Counsel (Harry Yohalem); the Director of the Jet Propulsion Laboratory (Professor Charles Elachi); and the Secretary of the Board of Trustees (Mary Webster). The Provost is responsible for the academic budget; faculty appointments and promotions; and coordination of curriculum development. The chairs of the six divisions are Professor Elliot Meyerowitz (BIO); Professor David Tirrell (CCE); Professor David Rutledge (EAS); Professor Kenneth Farley (GPS); Professor Jonathan Katz (HSS); and Professor Thomas Tombrello (PMA). The chairs of the divisions report to the Provost, as do the three Vice Provosts—Professor Stephen Mayo (research), Professor Melany Hunt (academics), and Professor Edward Stone (special projects). As noted above, the Caltech administration includes approximately ten faculty members, most of whom continue to do research and teach in addition to their administrative responsibilities.

Faculty are an integral part of all aspects of campus leadership. Administrative committees, composed of faculty or a combination of faculty and professional staff, enhance the decision-making processes of the Institute. The Administrative Management Council (AMC), which reports to the President and includes the Provost, Vice Presidents, Vice Provosts, General Counsel, Chair of the Faculty (Professor Judith Campbell), and Secretary of the Board of Trustees, meets weekly to review issues, current events, and activities on the Caltech campus. The Institute Academic Council (IACC) is chaired by the Provost and includes the President plus the chairs of the divisions. This body meets monthly and oversees the hiring and promotion of all faculty members. The Institute Administrative Committee (IAC) is chaired by the President and is a larger group that meets quarterly; it comprises the membership of the AMC, the IACC plus the undergraduate Dean of Students (Professor John Hall); the Dean of Graduate Studies (Professor Michael Hoffmann); the Assistant Vice President for

Government and Community Relations (Hall Daily); the Associate Vice President for Human Resources (Julia McCallin); the Chief Information Officer (Richard Fagen); the Chief Investment Officer (Sandra Ell); and the Associate Vice President for Finance and Treasurer (Sharon Patterson).

The newest administrative committee reporting to the President is the [President's Diversity Council \(PDC\)](#), which is chaired by the Provost. This council oversees and assesses diversity efforts on campus, and is described along with specific diversity efforts in Essay 4.

In addition to the IACC, the Computing Advisory Committee and the [Council on Undergraduate Education \(CUE\)](#) report to the Provost. The CUE is chaired by the Vice Provost Melany Hunt and brings together faculty, students, and administration to oversee and improve the education of Caltech undergraduates. The CUE is composed of the Vice President for Student Affairs, the Dean of Students, the Master of Student Houses (Professor Catherine Jurca), the Registrar (Mary Morley), the Chair of the Faculty, the faculty chairs of several committees of Caltech's Faculty Board, plus three undergraduates including the chair of the Academics and Research Committee (ARC). In the 2007-08 academic year, the CUE reviewed and made recommendations on a range of academic issues, including follow-up to the Student-Faculty Conference, a proposed new bioengineering undergraduate option, and Caltech's electronic course feedback process. The CUE has also served as the primary forum for discussing academic issues associated with the WASC review process and for developing the institutional objectives and outcomes, as discussed in Essay 5.

The Provost's Office maintains and publishes the [Faculty Handbook](#), which provides an overview of the administrative policies, structure, and procedures, and the obligations and responsibilities of the Caltech faculty. The Faculty Handbook also outlines the [processes for faculty promotion and tenure](#). These processes begin in the faculty member's home academic division with the division chair recommending for or against promotion. This recommendation is then forwarded to the IACC for deliberation, leading to the Provost's recommendation to the President, followed by the President's recommendation to the Board of Trustees. The Trustees have responsibility for the final decision. According to the Handbook, "The promotion and tenure of faculty members are based on the candidate's excellence in research, scholarship, and teaching." The evaluation process includes obtaining reference letters from experts outside of Caltech regarding the candidate's research, teaching, and community service.

The Faculty Handbook describes the [obligations of the faculty](#) as follows: "Faculty members, in accepting appointments, undertake to uphold and promote the aims of the Institute. If they are on full-time appointments, their professional efforts should be directed primarily to teaching, research, and administrative work. As teachers, they should be effective in transmitting a knowledge of and interest in their disciplines and should keep abreast of current professional developments. Research should be of such caliber as to contribute to the advancement of their particular field. Faculty members should expect to carry their share of administrative and committee work. They should recognize that promotion will be based upon the extent to which these obligations are fulfilled, and that failure to meet these obligations may result in termination of appointment."

The Faculty Handbook includes a description of the appointments for research faculty, instructors, lecturers, and postdoctoral scholars. It includes Caltech's policy on research



misconduct and grievance procedures for faculty-related issues. Caltech publishes grievance processes for [staff](#) and [students](#), and an [Employee Handbook](#) that includes Institute policies and expectations. The essence of Caltech's honor system is evident in the publication [Doing Business the Caltech Way: An Ethics Handbook](#), which is distributed to all new staff and faculty.

## **2.4 Faculty Board** [\(CFRs 1.4, 3.11, 4.4\)](#)

Caltech's Faculty Board is the governing body for the faculty and is responsible for conducting all business of the faculty, as described in the [Bylaws of the Faculty](#). The Faculty Board consists of a chair, vice-chair, and secretary, each elected to two-year terms, along with a total of 18 representatives from all divisions and all faculty ranks, each elected to three-year terms. In addition, the six division chairs, the undergraduate and graduate Deans, the Vice President for Students Affairs, the Provost, and the President all serve ex officio. The Faculty Board meets monthly during the academic year. The Faculty Board minutes are communicated to all Institute faculty, and any faculty member can request to attend Faculty Board meetings. Two students representing the Associated Students of the California Institute of Technology (ASCIT) and two students from the Graduate Student Council (GSC) are invited to attend the monthly meetings.

The faculty is responsible for the admission of students and the establishment of academic standards; the establishment of curricula and approval of courses; the setting of degree requirements; the certification of students for degrees; and the setting of general standards to be met by the Institute's educational and research programs. Much of this business is performed through a set of [standing committees](#) that report to the Faculty Board. Among the standing committees is the Curriculum Committee, which serves to supervise the undergraduate curriculum, including the approval of all new undergraduate courses and new academic programs. The Graduate Studies Committee supervises the scholastic requirements of the graduate degree programs, including the approval of new graduate courses and programs. After new courses or programs are approved by the Curriculum or Graduate Studies committees, they must be approved by the membership of the Faculty Board. The Academic Freedom and Tenure Committee is responsible for the interests of faculty and postdoctoral scholars in matters pertaining to academic freedom and tenure.

## **Essay 3: *Our Community***

### **3.1 Undergraduates and undergraduate education** [\(CFRs 1.7, 2.2, 2.3, 2.5, 2.6, 2.10\)](#)

In fall 2007, the undergraduate population comprised 913 students with 634 men (69%) and 279 women (31%); this total included 231 incoming freshmen and 6 transfer students. Among incoming freshmen, the most popular intended areas of study are physics and astronomy (~20%), biological sciences or medicine (~15%), mathematics (~10%), chemical engineering (~10%), electrical engineering (~10%), mechanical engineering (~10%), and chemistry (~6%). Because of Caltech's emphasis on science and engineering, the distribution of entering students' interests differs from those of other highly-competitive private universities such as Carnegie Mellon, Harvard, Princeton, and Stanford (the [data](#) for these

four institutions are averaged from CIRP surveys tabulated by the Higher Education Research Institute). The distribution also differs from MIT's in that Caltech students are significantly more inclined to study physics, mathematics, and chemistry, and less inclined to study engineering than at MIT (data from the MIT website). Only rarely does a student enter Caltech intending to major in the humanities, social sciences, or geological and planetary sciences. Over the last ten years, the [interests](#) of incoming students have begun to shift with fewer students intending to major in physics and electrical engineering and a growing number of students interested in biology and chemical engineering.

Caltech offers a four-year undergraduate course of study with 25 "options" (majors) leading to the Bachelor of Science degree. The degree options are: applied and computational mathematics (ACM); applied physics (APh); astrophysics (Ay); biology (Bi); business economics and management (BEM); chemical engineering (ChE); chemistry (Ch); computer science\* (CS); economics (Ec); electrical engineering (EE); engineering and applied science (EAS); English (En); geobiology\*; geochemistry\*; geological and planetary sciences (Ge); geophysics\*; history (H); history and philosophy of science\* (HPS); independent studies; mathematics (Ma); mechanical engineering\* (ME); philosophy (Pl); physics (Ph); planetary science; and political science\* (PS). Within the EAS degree, there are three areas of concentration: computation and neural systems (CNS); environmental science and engineering (ESE); and materials science (MS); students may also elect to design a custom schedule of courses subject to requirements imposed by the EAS faculty. Within ChE, students select one of four tracks: biomolecular; environmental; process systems; or materials. The concentration within EAS or the track within ChE is recorded along with the student's option on the transcript and B.S. degree. A student graduating within the [independent studies program](#) must have approval for a proposed course of study from the Curriculum Committee. The options marked with an asterisk (\*) have been added since the WASC review in 1998.

Course work is available in each of these options with the exception of geobiology, geophysics, geochemistry, and planetary science, which are organized under geological and planetary sciences. Course work is also available in aeronautics (Ae); anthropology (An); applied mechanics (AM); art history (Art); biochemistry and molecular biophysics (BMB); bioengineering (BE); civil engineering (CE); control and dynamical systems (CDS); environmental science and engineering (ESE); English as a second language (ESL); film (F); humanities (Hum); information science and technology (IST); languages (L); law (Law); material sciences (MS); music (Mu); performance and activities (PA); physical education (PE); psychology (Psy); and social science (SS) although there are no undergraduate options in these fields.

Students may also elect to pursue a minor in selected areas (Ae, CDS, En, H, HSP, Pl, and structural mechanics). All of the minors have been added within the last five years.

After enrolling at Caltech, some students find [other fields of interest](#). At graduation, there are fewer students graduating in physics, mathematics, and biology than indicated an interest in these fields upon entry. Students migrate from these fields and enter computer science, the geological and planetary sciences, and some of the smaller options within the EAS division (including APh, ACM, CNS, ESE, MS). In addition, several students elect to major in fields within the HSS division (including Ec, BEM, H, and En). Moreover, students may also elect to [double major](#); the majority of the second options are from the HSS division. There is no

distinction in the requirements for the first and second majors. Typically, a Caltech student declares a science or engineering major, and then later adds the second major which is often within the HSS division. In total, approximately 15% of Caltech undergraduates receive a degree in the humanities or social sciences.

The requirements for each of the degree programs and minors are found in the *Caltech Catalog*. Most of the options require 486 units for graduation, with the exception of Ma (483 unit requirement), ACM (483 unit requirement), and ChE (519-531 units depending on the student's chosen track and level of chemistry completed for the core requirements). Most courses at Caltech are 9 units, meaning that a student is expected to spend 9 hours per week between class lecture and preparation, laboratory work, and homework. In 2008, the average Caltech B.S. student actually graduated with 506 units. Students graduating with one degree option took an average of 496 units (149 students); those with a minor (19 students) averaged 530 units; and those with a second option averaged 535 units (40 students).

At graduation, approximately 40 to 50% of the seniors graduate with honors, which requires that a student complete all degree requirements with a grade point average greater than 3.5 (on a 4.0 point scale), or be nominated by a faculty member based on outstanding undergraduate research. On average, students completing the requirements for two options (average GPA of 3.59/4.0) graduate with a higher grade point average than students graduating with one option (3.35/4.0). The average GPA for 2008 graduates was 3.40/4.0. Over the past 20 years, the [distribution of grades](#) has not changed.

Eighty percent of students entering fall 2004 completed their degrees in four years. In recent years, the 5-year [graduation rate](#) has varied from 86 to 88%. The 6-year graduation rate is typically from 88 to 90%. A recent survey of enrolled students who did not complete their degrees in four years offers a variety of reasons for the additional quarters in residence, including changing majors, poor advising and academic decisions, outside interests, enrollment in too many courses outside of the major, problems with physical or mental health, stress and academic burn-out, and the desire to take a year off and enjoy life. Student Affairs is currently conducting an analysis of undergraduates who leave Caltech without finishing a B.S. degree within six years.

For students entering in 2006 and 2007, the [primary reasons](#) that students described as “very important” in influencing their choice of Caltech are Caltech's academic reputation (90%), the fact that our graduates gain admission to top graduate schools (68%), and that our graduates get good jobs (64%). Fewer than 10% of Caltech's entering students cite Caltech's good reputation for social activities. Ninety-eight percent of entering students plan to receive an academic degree beyond the B.S. degree; approximately 70% of entering students expect to earn a Ph.D. [These percentages](#) are higher than at MIT and exceed the average percentages at Carnegie Mellon, Harvard, Princeton, and Stanford.

Of students graduating in 2007 and 2008, approximately 47% immediately went to [graduate school](#) and 40% have found employment or are seeking employment; the remaining students are either undecided or are pursuing other options. These numbers, however, vary significantly with degree option. Students graduating in the sciences and mathematics are more likely to immediately enter a graduate program than students in engineering, especially students with degrees in CS and ACM. Among all graduates, 90% still plan to receive an

advanced degree at some time in the future, with 55% anticipating studies leading to a Ph.D. These [educational plans](#) are reflected within the *Caltech Catalog* and in the catalog descriptions of each option's educational objectives.

A 2008 report by the National Science Foundation entitled, [Baccalaureate Origins of S&E Doctorate Recipients](#), computed the number of baccalaureate alumni who have gone on to receive a doctorate for colleges and universities across the country. In the study, the number of doctoral recipients between 1997 through 2006 was normalized by the number of bachelor's degrees awarded by the institution nine years earlier; nine years was the median time from bachelor's-to-doctorate receipt for science and engineering doctorates. The result of this computation was an average percentage of baccalaureate alumni who go on to receive a doctorate. By this measure, Caltech was the top baccalaureate-origin institution of science and engineering doctorate recipients across the United States. For every 100 Caltech baccalaureate recipients, an average of 35.2 have gone on to earn a Ph.D. across all science and engineering fields. This statistic is almost 50% higher than the second-ranked school.

### **3.2 Graduate students and graduate education** [\(CFRs 1.7, 2.2, 2.3, 2.6\)](#)

In fall 2007, Caltech's graduate population was 1,220 students, including 267 incoming students. Of this total, 29% were women, 71% were men, and 36% were international students. These graduate students are distributed across 26 different options in science, engineering, and social science. Unlike the undergraduate program, there are no graduate options associated with the humanities. There are three graduate degrees granted by Caltech—the Master of Science (M.S.), the Engineer's Degree, and the Doctor of Philosophy. In spring 2008, 128 M.S. degrees, 1 Engineer's degree, and 185 Ph.D. degrees were granted.

At Caltech, the [Master of Science](#) is a professional degree designed to prepare students for teaching, for further graduate studies, or for advanced work in industry. The M.S. degree requires one academic year in residence and the completion of a minimum of 135 units. The requirements for an M.S. degree can normally be completed in one year. Each option specifies the requirements for this degree, as found in the *Caltech Catalog*. Because the Caltech graduate program emphasizes research, several graduate options indicate in the catalog that the option [does not admit](#) students for work towards the M.S. degree. Approximately 85% of students receiving an M.S. degree immediately continue with advanced studies at the Institute; approximately 15% leave following completion of the M.S. degree.

The [Engineer's Degree](#) is a terminal degree awarded in Ae, CE, EE, and ME for students who desire advanced training that is more specialized than that found in the M.S. program and that places less emphasis on research than a Ph.D. The Engineer's Degree requires six quarters of residence and must include a minimum of 55 units of research culminating in an Engineer's thesis; the requirements vary slightly by option. Over the past decade, nine Engineer's Degrees have been awarded: seven in Ae, one in ME, and one in EE.

As stated in the catalog, the [Ph.D.](#) is conferred by the Institute "primarily in recognition of breadth of scholarship, depth of research, and the power to investigate problems independently and efficiently, rather than for the completion of definite courses of study through a stated period of residence." The *Caltech Catalog* summarizes the [process](#) for

admission to candidacy, thesis preparation, and the final oral examination. In addition, each graduate option specifies within the Catalog the option requirements for the Ph.D. The [Graduate Studies Committee](#) is charged with Institute-wide oversight of the graduate programs, including the admission of students to graduate standing.

The [doctoral degree](#) requires at least three academic years of residence beyond the baccalaureate degree. A doctoral student not admitted to candidacy by the beginning of the fourth year must petition the Dean of Graduate Studies before registering for further work. Any graduate student enrolled for a sixth year of study must also petition the Dean and provide a plan and schedule for completing the degree. The [average time-to-degree](#) is 5.4 years. This number, however, varies across the Institute from a minimum of 4.3 years within the HSS division to 6.3 years in the BIO division. These [durations](#) are shorter than the national graduate-school-time-to-degree of 6.7 years in physical science, 6.9 years in engineering, 7.0 years in life science, and 7.9 years in social science. Of the [graduate students who enter Caltech](#), approximately 72% eventually receive a Ph.D. degree; 20% leave Caltech with an M.S. or Engineer's degree; and approximately 8% leave without completing a graduate degree. These numbers also vary by option, especially in EAS, where several options (especially Ae and EE) have active terminal M.S. programs.

According to exit survey data, approximately 50% of the Ph.D. graduates immediately enter a postdoctoral position; approximately 20% accept a position in industry; 10% receive a tenure-track position; 5% continue in M.D. or J.D. programs; and approximately 15% are either undecided or seeking positions. The placement statistics change as students and postdoctoral scholars find permanent positions. One to three years post-graduation, approximately 25% have taken faculty positions, 30% are employed in industrial positions, 40% are postdoctoral scholars, and 5% are involved in other activities. Seven to ten years post-graduation, 40% are employed in industry or government laboratories, 42% are in faculty positions, 8% are involved in other activities, and 10% are still classified as postdoctoral scholars. This latter group may have found permanent positions, which may not have been tracked in the [placement data collected through the academic divisions](#).

In the WASC review of 1998, Graduate Education was one of the three chosen topics, and the WASC visiting team suggested improvements in [English preparation for graduate students](#). Currently, all incoming international students are required to take an English proficiency test. If students are found deficient in their ability to communicate in English, they are required to take a for-credit, graded course in English as a second language. Caltech also offers several non-credit courses in spoken English for academic purposes and everyday life, public speaking, pronunciation improvement, and writing. [These courses](#) are offered only to international graduate students. For incoming international graduate students, there is a one-week [international student orientation](#) (this orientation is in addition to either the undergraduate or graduate student orientation described in 3.4). This orientation provides for social interactions and introduces incoming students to American culture, the banking system, immigration policies, classroom experiences, and the Honor Code. During the academic year, ongoing programming is also provided, including educational, intercultural, and recreational activities.

### **3.3 The faculty, postdoctoral scholars, and staff** [\(CFRs 2.1, 3.2, 3.3, 3.4\)](#)

In fall 2007, the Caltech faculty was composed of 292 members of the professorial faculty (including 7 faculty members supported by the Howard Hughes Medical Institute); 53 research faculty (non-tenure track); 9 visiting professors, who teach at least one course while in residence at the Institute; 17 full-time instructors; 30 part-time lecturers, some of whom are hired for specific teaching assignments and may teach only one class in a given year; 9 other faculty (includes the university librarian and coaches); and approximately 200 visiting associates or Moore Distinguished Scholars, who are associated with other institutions and spend more than one month at Caltech for study or research.

Of the professorial faculty, approximately 83% are tenured, and nearly 40% of all professorial faculty have endowed chairs. Over the last three years, forty new faculty members have been hired; there have been 15 non-retirement departures; and 13 have retired. The Institute faculty is divided among the six divisions. In fall 2007, there were 32 professorial faculty in BIO; 37 in CCE; 78 in EAS; 32 in GPS; 47 in HSS; and 66 in PMA. Approximately 30 professorial faculty members have appointments in more than one division; these joint faculty members are counted in their primary division. Because many faculty members are associated with more than one option, Caltech does not count professorial faculty by option.

The [lecturers and instructors](#) are primarily concentrated in the HSS, EAS, and PMA divisions. Approximately half of all of the lecture courses taught by non-professorial faculty are humanities and social science courses. Most of the HSS lecturers and instructors teach courses in areas where Caltech does not have permanent faculty members, such as in foreign languages, art history, creative writing, and accounting. Within EAS, lecturers and instructors are associated with specific options in the division, and some teach one lecture or laboratory course per year. In the PMA division, there are several instructors supporting the teaching of mathematics courses; in physics, the lecturers often assist a faculty member in teaching a laboratory course. In addition, lecturers are also hired to teach performance and activities courses such as painting, debate, symphony orchestra, ceramics, and student publications.

In fall 2007, there were 606 postdoctoral and senior postdoctoral scholars (28% women; 72% men); nearly 60% were international. These scholars spend between a few months to several years on campus working closely with a professorial faculty member. The largest number of [postdoctoral scholars](#) is found in the BIO division (180 scholars), followed by CCE (120 scholars), EAS (107 scholars), and PMA (105 scholars). Caltech employs a total of 1968 full time staff (46% women; 54% men) and 258 part-time employees (56% women; 44% men). These numbers do not include the staff at the Jet Propulsion Laboratory.

Incoming staff and postdoctoral scholars are invited on a monthly basis to attend Caltech 101, an [orientation program](#) highlighted by a [video presentation](#), lunch at the Athenaeum, and a campus tour. The Provost's Office offers a series of [lunchtime orientation meetings](#) for new faculty members to introduce them to life as a faculty member at Caltech. In addition, faculty are offered workshops with a focus on enhancing teaching effectiveness. In 2007, an educational innovation fund was announced to provide resources and encourage new educational initiatives.

### **3.4 Student support services** [\(CFRs 2.11, 2.12, 2.13, 2.14, 3.6, 3.7\)](#)

Student support services are provided through a variety of campus offices. Many of these offices are found in [Student Affairs](#), including the Office of the Dean of Students, the Graduate Studies Office, the Master of Student Houses, admissions, athletics, career services, fellowships and study abroad, financial aid, the health and counseling center, housing, minority student education, music and performing arts, the registrar, and the women's center. In addition, students find advising and academic support through the six academic divisions, the [libraries](#), and [Information Management Systems and Services](#).

Student Affairs is charged with providing co-curricular support services and educational opportunities for students. As described in the [Student Affairs Annual Report](#), it is staffed by student affairs professionals plus four professorial faculty members (the Vice President, the Dean of Students, the Dean of Graduate Studies, and the Master of Student Houses). The mission of Student Affairs is to complement and enhance "the Institute's educational mission by ensuring a healthy and supportive environment that enables students to grow academically and personally in preparation for meeting current and future challenges." The offices within Student Affairs provide programs and services to support the recruitment, academic persistence, success, retention, and personal development of undergraduate and graduate students. Student Affairs provides opportunities for participation in the arts, athletics, fellowships, community service, study abroad, career development, and other learning opportunities outside the classroom.

In the last few years, Student Affairs has increased its focus on educating the community about services and support for students in crisis. Led by the counseling and health services, a committee developed a "[safety net](#)" model of support and held workshops for faculty and staff in each of the academic divisions and administrative units. Additionally, Student Affairs formed a committee that meets bi-weekly to review students of concern. By sharing information, this committee aims for the early identification of students who may be in crisis and in need of intervention and support. Several other campus-wide safety initiatives, such as the campus emergency notification system and the establishment of a crisis assessment team, contribute to the robust student support system centered in Student Affairs.

The 2007 Committee on the Caltech Student Experience and Student Affairs examined the structure, focus, and effectiveness of Student Affairs in relation to the undergraduate and graduate student experience (see Essay 5.1). Some of the recommendations made in this report have already been implemented and continue to drive campus improvement. To continue to excel in its mission, Student Affairs is currently undergoing a [self-assessment](#) of its work and its relation with Caltech students. Student Affairs has developed four broad learning outcomes for the offices that engage in student-centered programming. The learning outcomes involve interpersonal development, intrapersonal development, community development, and societal development. This self-assessment will impact the type and delivery of some programming within Student Affairs.

Undergraduate students are introduced to the support services through the [New Student Information Guide](#) and during [New Student Orientation Camp](#). All incoming students, including transfer students, are expected to participate. The first two and a half days of

orientation are held in an off-site location and include workshops on acclimating to college life, campus resources, student support, the Honor Code, campus policies, and the core curriculum. Faculty and upper-class student leaders also participate to provide incoming students with opportunities for informal discussion with Caltech veterans. Upon returning to campus, students meet with faculty to learn about the undergraduate options and to participate in a variety of social activities designed to promote student interaction.

New graduate students are provided with the [New Graduate Student Information Guide](#) and participate in a [week-long orientation](#) sponsored by the Office of Graduate Studies (see also the [Technique](#)). This orientation provides students with information about the Graduate Student Council, insurance matters, housing, finding a research adviser, and social activities. The week includes an introduction to Caltech's [Honor System](#) and the [Graduate Review Board](#). Some options and divisions also provide additional orientation activities for their incoming graduate students. In addition, there is a mandatory training session for all graduate students who will serve as [teaching assistants](#).

[Academic advising](#) of students is a responsibility of the faculty and the divisions, with support through Student Affairs. All incoming undergraduate students are assigned an adviser upon arriving at Caltech. During the orientation week, students meet with their adviser. The initial freshman adviser interacts with the student over the first academic year. In the spring term, students are asked to declare a major option, and then students are reassigned an adviser associated with their intended major. If necessary, students may change their adviser; this process can be facilitated by the Dean of Students, the registrar, or by the option representative (a faculty member responsible for academic issues within a given option). Students must obtain their adviser's approval of their course schedule each quarter. [Transfer students](#) are also assigned an adviser and receive assistance from the option representative, the registrar, and the Dean of Students in handling issues associated with transfer of credit.

For graduate students, the assignment of [faculty advisers](#) is handled by the options and the option representatives. The Office of Graduate Studies is also available for consultation regarding issues associated with advising and advancement to degree.

## **Essay 4: *Diversity and Climate***

### **4.1 Diversity within our community**

#### **[\(CFR 1.5, 2.2, 2.2a\)](#)**

In President Chameau's inaugural address, he stated that scientific challenges were not the only challenges facing Caltech. "In particular, our country still falls short of expectations when it comes to a diverse workforce in scientific and engineering disciplines. Caltech has made progress over the past year, and I'm pleased to report that more than 37% of the incoming freshman class will be women. We need to continue our efforts at all levels. Caltech should be proud not only for its leadership in science and engineering but also for its leadership in nurturing a diverse community of scientists and engineers."

During the 1998 WASC visit, the visiting committee encouraged Caltech to continue its efforts toward the recruitment and retention of women and underrepresented minorities



among the students and faculty; in addition, they noted that Caltech should focus attention on inclusiveness within the campus environment. As noted by President Chameau, Caltech has made strides in increasing the matriculation rates of women students. A similar focus now needs to be placed on increasing the applicant pool and matriculation rates of underrepresented minority students.

Since the last WASC review, the percentages of [undergraduate](#) and [graduate women](#) have increased from 25% and 23%, respectively, to 30.6% and 29.4% for fall 2007. In 2007, 37% of the incoming freshmen were women; in fall 2008 we anticipate 40% incoming women. Across various science and engineering disciplines, the percentages of Caltech undergraduate and graduate women are comparable to or exceed the [national percentages of women](#) in these fields.

For underrepresented minority students, the increases have been slower than for women. For fall 2007, 6.4% of our [undergraduates](#) and 5.6% of our [graduate students](#) were African American, Hispanic, Native Hawaiian, Native American, or Pacific Islander. At Caltech, the percentage of underrepresented minority Ph.D. recipients who are U.S. citizens or permanent residents is [comparable to national statistics](#) of U.S. doctoral recipients across most science and engineering fields. The corresponding percentages for Caltech's underrepresented minority B.S. graduates, however, are smaller than found on the national level and are smaller than found at other [highly competitive universities and colleges](#). Racial and ethnic diversity among our undergraduate population remains an ongoing focus for the Institute.

The percentage of international students is currently 9.3% at the undergraduate level and 35.7% at the graduate level. Across the Institute, the distribution of women, underrepresented minorities, and international students varies, which may be due to national trends and funding sources. However, these variations may also reflect and be influenced by option or division recruiting efforts, especially among the graduate students and postdoctoral scholars. Successful option- or division-level recruiting efforts should be expanded to other options or divisions at the Institute.

The [number of women professorial faculty](#) has steadily increased from 28 of 273 faculty (10.2%) in 1998 to an anticipated 47 of 293 faculty (16%) in fall 2008. Although the percentage of underrepresented minority professorial faculty members remains small (approximately 2.7%), the percentage has increased over the last 10 years. In addition, [Caltech's organizational chart](#) includes several female and minority faculty members and staff in its higher administration.

Regarding socio-economic diversity, Caltech admits domestic undergraduate students using a need-blind admissions policy. Approximately 11.5% of the undergraduate population receives [support from Federal Pell Grants](#). Over 70% of all undergraduates receive some form of financial aid or assistance. For 2007 graduates, the average indebtedness was \$6,268, [reported as the second lowest in the country in US News & World Report 2008](#). Beginning with undergraduates entering in fall 2008, most domestic students whose family incomes are \$60,000 per year or less will be offered a financial aid package that substitutes scholarship aid for loans. For the graduate population, 98.4% receive some form of aid, although this support is not typically tied to the student's financial resources.

## 4.2 Diversity efforts and supporting offices

Over much of the past ten years, Caltech's [Administrative Committee on Diversity and Minority Affairs \(ACODAMA\)](#) had overseen diversity issues on campus. ACODAMA was also supported by the efforts of the [Diversity Progress Group \(DPG\)](#), which was a work group reporting to the President's Office that organized campus diversity retreats and programming. Under the leadership of President Chameau, the ACODAMA and DPG committees were recently replaced by one oversight body—The [President's Diversity Council](#). This Council is chaired by Caltech's Provost and includes members of the administration, faculty, staff, and student body. As described at a recent meeting of the Faculty Board, the President's Diversity Council is intended "to serve as the primary body for gender and diversity issues on campus, with power to initiate, monitor, and assess programs as directed by the President." Currently, the Diversity Council is overseeing an assessment effort of some of Caltech's formal recruitment and outreach programs, which are described below. In addition, the Council will be working with the undergraduate admissions office, the Freshman Admissions Committee (a Faculty Board committee), and the Office of Graduate Studies to strengthen our recruitment and retention of underrepresented minority students.

Caltech has a number of campus offices that also promote and encourage [campus diversity](#). The [Office of Minority Student Education \(MSE\)](#) works to support the overall diversity goals of the Caltech campus associated with race and ethnicity. This office supports student success inside and outside of the classroom, and recruitment efforts through the [Young Engineering and Science Scholars \(YESS\)](#) program. YESS is a three-week summer residential program for exceptional underrepresented minority high school students and others who feel they would benefit from the program; it is designed to expose students to the excitement and rigor of scientific research. In the 2007 academic year, there were 459 applications for the YESS program, 38 (8%) were accepted for admission and 30 participated. Of the 30 who participated, 15 applied for admission to Caltech, 11 were admitted, and 6 will matriculate in fall 2008. In addition, one student was admitted to Caltech after completing the junior year of high school. The MSE office also supports the [Freshman Summer Research Institute \(FSRI\)](#), which is a pre-freshman program targeting underrepresented minority matriculants for participation the summer prior to their first academic term.

The [MURF program](#), supported by the Student-Faculty Programs Office, provides summer research opportunities for talented undergraduates with the aim of increasing the representation of underrepresented students in science and engineering graduate programs. [Participation in MURF](#) provides excellent preparation for students interested in subsequently pursuing a Ph.D. In 2007, 108 students applied for the MURF program and 20 students participated; this number has dropped from a high of 33. From 2003 to 2007, 12 MURF students entered Caltech's graduate programs.

The Office of Graduate Studies, in conjunction with some divisions, has offered the [GradPreview](#) program, a three-day visit to campus that includes interactions with Caltech faculty and students, lab tours, and seminars about graduate study and research. Over this past academic year, Caltech has also arranged for visits by groups of undergraduate minority students from targeted schools and engaged a graduate recruiter to help in identifying minority students interested in specific graduate options.

The [Women's Center](#) is charged with serving the entire campus community, including students, scholars, faculty, and staff. The Women's Center supports academic and professional development, provides information and support, and contributes to and leads efforts to support diversity and gender-equity initiatives on campus. This office sponsors a women-mentoring-women program for female graduate students and postdoctoral scholars, a graduate women's weekly discussion group, a first-year women's series, and alumnae-student networking luncheons.

Caltech's international populations are supported by the [International Student Programs \(ISP\)](#) and [International Scholar Services \(ISS\)](#) offices. Both are part of a joint effort to serve the international students, staff, and faculty, and to manage legal immigration matters for incoming international students and postdoctoral scholars. In addition, the offices offer students a range of support services and resources, including transactional help and individual care with respect to addressing cultural and institutional problems.

The YESS, FSRI, MURF, and GradPreview programs have been most recently supported through a combination of internal funds and a grant from the [Moore Foundation](#). The Moore Foundation has also provided fellowships for graduate student and postdoctoral scholars from underrepresented populations. Caltech has also received support from the Alfred P. Sloan Foundation's Minority Ph.D. program for graduate fellowships, and Caltech and the Sloan Foundation are currently negotiating a new pilot program for minority postdoctoral fellowships to begin in January 2009.

### **4.3 Climate and inclusiveness**

As noted by the 1998 WASC visiting committee, campus life and environment are key components to inclusiveness and diversity on campus. Beginning in 2004, ACODAMA and DPG began a process to develop a [statement of community](#). ACODAMA and DPG held focus groups and discussions to gather input from the entire campus community. The preamble to the Statement on Community reads, "The Statement of Community strives to articulate the values and standards that are important to the success and health of our campus. It was developed with input and feedback from the campus community, and as a 'living' document, will continue to develop and grow as our community does the same."

The Statement continues, "We acknowledge that a multitude of perspectives is essential to all we do. As a community, we understand that civility and mutual respect for diversity of background, race, ethnicity, sex, gender, gender identity, socioeconomic status, religion, nationality, sexual orientation, age, disability, and marital and family status are critical." It also connects with Caltech's Honor Code (see Essay 8): "We are committed to honor and integrity in all areas of work and campus life. Guided by these principles and the Institute's Honor Code, members of our community are expected to treat one another with respect and dignity." In 2006, the Statement was endorsed by Caltech's Faculty Board and the Board of Trustees.

The Caltech community supports an inclusive and diverse environment and offers diversity programming, student groups, and activities. One source of programming is the [Cultural Programming Group \(CPG\)](#), comprising representatives from the Women's Center, Minority Student Education, International Student Programs, and the Caltech Y. This group plans and

implements Institute-wide programs, such as a week dedicated to Martin Luther King, Jr. and Semana Latina, a week dedicated to Latino heritage. CPG regularly works with student groups as well as other campus departments to identify, promote, and engage the Caltech community on a range of cultural and current issues.

Caltech has a support group for students who identify as lesbian, gay, bisexual, transgendered, or questioning (LGBTQ). The [LGBTQ](#) working group is dedicated to increasing visibility and raising awareness of LGBTQ issues at Caltech. The working group organizes programming, advises [PRISM](#) (the Caltech student group), and manages services at Caltech that include a library, a discussion group, and LGBTQ orientation events.

Caltech hosts over a 100 different [student clubs and organizations](#), including religious and cultural groups, special-interest groups, and chapters of national societies such as the National Society of Black Engineers and the Society of Women Engineers.

## ***Essay 5: Institutional Review and Planning Processes***

### **5.1 Feedback and review processes** [\(CFRs 2.7, 2.10, 4.3, 4.4, 4.5, 4.7, 4.8\)](#)

Caltech uses a combination of mechanisms to evaluate its academic and research programs and issues of general concern to the Institute. Our review processes include a formal visiting committee program, ad hoc committees, and Student-Faculty Conferences; these review processes receive input from surveys, data collection and analysis, and informal one-on-one discussions. These processes provide Caltech with on-going feedback and review.

The visiting committee process is currently scheduled on a three-year cycle for each of Caltech's six divisions. Each visiting committee is appointed by the President and generally has about 12 members, half of whom are members of Caltech's Board of Trustees and half of whom are distinguished faculty members from universities around the country or industrial experts with backgrounds that balance the composition of the committee. The chair of each visiting committee is a Caltech trustee. The [function of the visiting committee](#) is "to assess the Institute's research and teaching programs to affirm their strengths, and to identify weaknesses and opportunities." The visiting committees meet on campus for about two days and include meetings with the President, the Provost, and the Chair of the division. The divisions generally schedule a half day of presentations from division faculty members and time to meet with groups of undergraduates, graduate students, and postdoctoral scholars. In preparation for the visiting committee, the division submits a background briefing book that contains a white paper written by the Chair reviewing the division's current activities and programs for both research and teaching, the division's strategic plan for the future, actions taken in response to previous visiting committee reports, and other issues to be addressed by the committee. The briefing books also include an analysis of the age distribution of the faculty and plans for future hiring, information on the student populations and courses taught by the division, and some financial data. The faculty members within the divisions are generally engaged in the preparations for the visiting committees; the reports from the visiting committees are distributed to the faculty in the divisions and a report is presented at a meeting of the Board of Trustees.

In recent visiting committee reports, the feedback from the [visiting committees](#) on the quality of our educational programs has varied in content and focus across the divisions. In the future, the divisions will provide information to the visiting committees on their processes for assessing their educational programs. The visiting committees will be asked to review the assessment process and to provide their own feedback on the quality of the educational programs. Because diversity is also a significant goal at Caltech, the visiting committees will also be asked to review the division's progress and programs associated with diversifying the student body and the faculty. The comments from the visiting committees will also be reviewed through the Student Experience Committee, which will allow the issues to be evaluated at a high level across the Institute.

In addition to the visiting committee process, Caltech also sponsors a [Student-Faculty Conference](#). This one-day conference is organized by the undergraduate [Academics and Research Committee \(ARC\)](#) with support from faculty, Student Affairs, and the Provost's Office. These conferences have traditionally been held every other year and provide a forum for students and faculty to discuss academic and student life issues. The faculty is asked to excuse students from classes on the day of the conference so that they are able to attend.

The last Student-Faculty Conference was held April 5, 2007. The morning sessions included reports from the several student and faculty subcommittees, on such topics as the [honor code; workload, student morale, and student-faculty interactions; undergraduate research; undergraduate education](#) including teaching quality, feedback to faculty, teaching assistants, class attendance and faculty advising; and the [core curriculum](#). Depending on the interests and focus of the subcommittee, some student and faculty members may have collected data, conducted surveys, or analyzed student behavior. The morning sessions allowed for presentations by the subcommittees followed by time for discussion from members of the audience. The afternoon sessions at the Student-Faculty Conference involved several breakout [sessions focusing on issues specific to undergraduate options](#), such as specific lecture and laboratory courses, option requirements, and overall curriculum. In many of the sessions, students took notes about the discussion and wrote a final report. This past year, the ARC has also conducted an analysis of the [follow-up to the 2007 Conference](#). Some of the follow-up issues have been discussed and considered through the CUE.

Caltech also uses ad hoc committees to examine and evaluate particular issues. In 1999, the chair of the Faculty Board appointed an ad hoc committee to examine issues of gender inequity and related concerns for Caltech professorial faculty. This committee met with each woman faculty member and a similar number of male professors; the male professors were at similar stages in their career and in similar fields as the women faculty members. The data from these interviews allowed the committee to compare the experiences of male and female faculty members across the Institute. When the committee issued its [report](#) in December 2001, there were 31 women on the faculty and no women in senior administrative positions. As described in Essay 4, there has been significant progress in increasing the number of women on the faculty and in women assuming leadership roles.

In 2003, another ad hoc committee appointed by the Provost considered the possibility of creating an Office of the Dean for Undergraduate Studies to oversee the undergraduate academic program. Although an additional Dean was not recommended, the ad hoc committee did recommend the formation of the [Council on Undergraduate Education \(CUE\)](#), which has been formalized as an administrative committee reporting to the Provost.

In 2007, President Chameau and Acting Vice President for Student Affairs John Hall formed an ad hoc committee to look at issues involving the [Student Experience and Student Affairs](#). The committee, composed of students, staff, and faculty, had a broad charge to look at the key aspects of the undergraduate and graduate student experience and to make recommendations on how to improve these experiences. The committee issued their report in October 2007, outlining ten broad recommendations, including the role of the Provost's Office in overseeing academics, the need to reevaluate the core curriculum and the academic environment, and suggestions for several offices within Student Affairs. The committee also recommended that Caltech reaffirm its educational philosophy and its commitment to excellence in education, undergraduate research, and mentoring.

This report formed the basis of the March 2008 Student Experience Conference. This half-day conference was organized primarily by ARC with support from faculty and staff. The undergraduate student leaders selected three topics of interest: the quality of teaching, advising, and student-faculty interactions; the "Caltech syndrome" – a term used to describe academic burn-out; and issues involving student life within the undergraduate House system. After the conference, the students prepared a [comprehensive report summarizing the discussion and recommendations](#) of the conference.

To gather information on student goals, satisfaction, and future plans, Caltech annually surveys incoming freshmen, graduating seniors, and graduate students. Beginning in 2006, the surveys were updated to include questions on issues pertinent to the accreditation process. The data from these surveys are used in the discussions at the Student-Faculty Conference, in CUE discussions, and in other internal evaluation processes. The data regarding [post-graduation plans of Caltech alumni](#) are shared each year with the Board of Trustees.

Caltech also has a course evaluation process, the Teaching Quality Feedback Reports (TQFR). In prior years, most divisions used a paper feedback process. By fall 2008, all of the divisions will have transitioned to the electronic process, in which the results are posted online and can be viewed by anyone within the Caltech domain. These reports are done at the conclusion of each quarter. Some divisions distribute hard copies of the results to their faculty members.

Because of Caltech's small size, the faculty and administration often use less formal methods for feedback. When President Chameau started at Caltech, he wanted input and feedback from the faculty. Rather than conducting a survey, he embarked on a process to [meet with each of the professorial faculty members](#) over coffee, for lunch, or for an informal office chat. From these individual meetings, President Chameau was able to hear the range of issues within and between the divisions, as well as the concerns of both junior and senior faculty, and to listen to the aspirations and concerns of all of the members of the Caltech faculty.

This informal style is also a hallmark of the interactions between Caltech faculty and administration and the Caltech students. In many classes, especially courses within the core curriculum, there is a student ombudsperson, who serves to provide immediate feedback to the instructor on issues that may arise in homework, lectures, or with teaching assistants. The Dean's Office provides funds for faculty to take students in their classes out to lunch. The Master of Student Houses organizes a series of option-level teas for undergraduate students

and faculty in a particular option as well as student-faculty lunches in the undergraduate Houses. ASCIT administers funds for students to take faculty to lunch and Student Affairs funds a program that allows students to invite faculty to dinners in the student Houses. Communication between faculty and students also happens through research interactions.

## **5.2 Strategic planning processes**

[\(CFRs 3.5, 3.11, 4.1, 4.2, 4.3\)](#)

Caltech has a continuing process for strategic planning at the Institute and division levels. Individual divisions formulate strategic plans as a mechanism for charting new facilities, new areas for faculty hiring, and changes to the graduate and undergraduate degree programs. Because of the distinct characteristics of each of the divisions, the specific mechanisms vary, with some divisions using a formal strategic planning process and some using an ongoing standing committee.

Several divisions, including GPS and EAS, have periodically developed formal strategic plans that discuss opportunities and needs in faculty hiring, teaching, facilities, and other academic areas. As an example, the EAS division developed a [strategic plan](#) in 2000-02 that identified a number of specific objectives for the division. This plan was developed through a series of faculty meetings and approved by the EAS Division Advisory Group, which represented all of the academic programs in EAS. The plan was executed and monitored by the Chair working with the EAS Division Steering Committee, a smaller group of faculty with oversight of the undergraduate academic programs and major research centers.

Other divisions, such as CCE and PMA, perform many of their planning activities through faculty committees with rotating membership. As an example, in the CCE division, a long range planning and staffing committee works with the Chair to identify areas of growth for the division and also provides input on all new appointments and promotions within the division. A space committee is responsible for providing input to the Chair regarding space needs in the division and for considering requests from faculty for additional space. Regardless of how the strategic plans for the divisions are developed, these plans are regularly reviewed through Caltech's visiting committee process, as described above.

At the Institute level, much of the strategic planning is done by the Institute Academic Council (IACC) and the Institute Administrative Council (IAC). In preparation for the [comprehensive campaign](#), the IACC participated in extensive discussions during 2000-02 regarding Institute priorities. The goal of this campaign was to raise the resources required for Caltech to continue to be one of the top research and educational institutions in the United States. The results of the discussions regarding Caltech's priorities and needs were documented as part of the campaign and included strategic objectives for research activities, teaching facilities, and scholarships. This plan was discussed and reviewed frequently by the IACC and the IAC as the campaign was carried out in 2003-08.

With the arrival of President Chameau and the successful completion of the comprehensive campaign, the Institute is starting a new strategic planning process to articulate the next set of academic and research opportunities and challenges. The President and Provost have appointed an ad hoc [Aims and Needs Committee](#) to formulate broad institutional issues that will be of importance in the next five to ten years. In addition, smaller committees have been appointed by the Provost to look at critical research directions that span divisions, including

energy, bioengineering, global environmental science, and scientific medicine. Each division is preparing a strategic plan. This information will serve as input into an Institute-wide plan.

### **5.3 Processes for institutional objectives and outcomes**

[\(CFRs 1.2, 2.3, 2.4\)](#)

During the 2007-08 academic year, the CUE engaged in a process of developing Institute-wide educational objectives and learning outcomes with input from the various Caltech constituencies. Currently, Caltech's website and catalog include a statement of our goals and directions for our educational programs, beginning with Caltech's original 1921 mission statement – "To train the creative type of scientist or engineer so urgently needed in our educational, governmental, and industrial development." Although the sentiment of this statement has not changed over the past 87 years, the language has now been updated to encompass the various directions that our graduates take during their careers:

To provide an outstanding education that prepares students to become world leaders in science, engineering, academia, business, and public service.

In addition, Caltech's learning outcomes describe the attributes of our graduates:

- Caltech graduates can analyze, synthesize, and communicate ideas.
- Caltech graduates demonstrate integrity, personal and professional responsibility, and respect for others.
- Bachelor of Science graduates can identify, analyze, and solve challenging problems within and across science and engineering disciplines.
- Bachelor of Science graduates can apply their analytic skills to other areas of knowledge and understand issues important in our society.
- Master of Science graduates can apply advanced knowledge in a specialized area in preparation for professional careers.
- Doctor of Philosophy graduates can independently identify, analyze, and solve fundamental research problems with breadth and depth.

These statements were formulated through the CUE with input from the Graduate Studies Committee, the Core Curriculum Steering Committee, and the Faculty Board. The statements were announced on the WASC website and described in the student newspaper. With input from the various constituencies, the statements were revised. The final versions of the statements were presented at the [Faculty Board meeting in April 2008](#). The Faculty Board voted to approve the statements at that meeting.

The [educational objective and learning outcomes](#) are included in the 2008-09 Caltech catalog. These statements will be the basis of the assessment process for the Educational Effectiveness Review.

## **Essay 6: *Core Curriculum***

### **6.1 Overview of the core curriculum**

[\(CFRs 1.2, 2.2, 2.3, 2.4, 2.5, 2.10, 4.6, 4.7\)](#)



When WASC visited in 1998, the core curriculum was not one of the chosen themes; however, Caltech had just completed a major [review of the core curriculum](#). The WASC visiting committee described the core revisions as a “milestone achievement that has come after the careful deliberation characteristic of Caltech and has resulted in major changes reflecting the mission and goals.” The WASC visiting committee also suggested that Caltech continue to consider the revision of the Humanities and Social Sciences (HSS) core. Since 1998, the HSS requirements have been modified to encourage the breadth of freshman humanities selections and to provide for a greater range of offerings in the advanced humanities.

Since the 1996 review, the core curriculum has not had a comprehensive review. The previous review was in 1986. Hence, the faculty has proposed a thorough revisit of the core in conjunction with our WASC review. This Essay presents an overview of the current core curriculum, the processes and data that have motivated the faculty to revisit the core, and future assessment processes for the associated learning outcomes.

The Caltech undergraduate program requires that all students complete the core curriculum. As found in the upcoming [2008-09 Caltech catalog](#), “A Caltech education requires not just the depth of an option, but also considerable breadth in basic science, humanities, and social science. Caltech’s core curriculum prepares students for the interdisciplinary nature of contemporary research in science and technology. This encourages a culture of problem solving, collaboration, and communication while providing valuable experience in all fields of science. Significant study in the humanities and social sciences is an important component of Caltech’s core curriculum, giving our alumni the ability to navigate the societal, political, and economic factors that influence (and are influenced by) their work.” This description of the core complements the Institutional outcomes described in Essay 5.

Currently, the [core curriculum](#) consists of the following requirements: 5 quarters of mathematics (Ma 1 a, b, c; Ma 2 a, b for 45 units); 5 quarters of physics (Ph 1 a, b, c; Ph 2 a, b; total of 45 units); 2 terms of chemistry (Ch 1 a, b; total of 15 units) plus a chemistry laboratory (Ch 3a for 6 units); 1 quarter of biology (Bi 1 for 9 units); an additional laboratory course (for 6 units); a science “menu” course for 9 units, which can be chosen from astronomy (Ay 1), an environmental science course (ESE 1), a course on energy (Ch/APh 2), geology (Ge 1), and information science and technology (IST 1 or IST 4); a science writing course for 3 units (chosen from a list of courses arranged by the options); 3 classes in physical education for 9 units; and 12 courses split between the humanities and social sciences for a total of 108 units. The humanities and social sciences courses must span introductory and advanced topics and include two introductory humanities requirements and two advanced courses that involve significant writing assignments. In addition, all options at Caltech require students to take one course in oral communication for 3 units. These core requirements total to 258 units - more than half of the 486 units required by most Caltech undergraduate options.

During the summer before the freshman year, each entering undergraduate student is required to take [diagnostic exams](#) in [physics](#), in [mathematics](#), and in [writing](#). Based on the results of the physics and mathematics exams, [students are placed](#) in different recitation sections of Ma 1a and Ph 1a. Students with less preparation in mathematics are placed in Ma 1a Section 1 (for 12 units rather than 9 units) and may also be required to take an additional quarter of Ma 1 (Ma 1d, which is 5 units and offered winter term) and a course in problem solving (Ma 8

for 3 units and offered fall term). Students needing additional support in physics are placed into Ph 1 Sections 1 or 2; students who do well in the placement exam are placed in Ph 1 Sections 9 and 10. In recent years, the enrollment of students in Ma 1 Section 1 varies between 5 to 10% of the incoming freshmen. The enrollment of students in Ph 1 Sections 1 or 2 is typically around 15%; placement in Sections 9 or 10 is typically from 15-30% of the students. In addition, students with advanced coursework in mathematics and physics have the option of taking an additional placement exam that could allow the student to begin the mathematics or physics sequence at an advanced level.

For the [writing diagnostic](#), students are required to submit an essay, which is used to determine whether the student is prepared for the freshman humanities courses. Students who have not developed sufficient writing skills may be required to take introductory writing courses in addition to the core humanities requirements (En 1a, b English Composition for ESL Writers; En 2 Introduction to College Writing); approximately 10% of the incoming students are placed in these courses.

For entering students with a strong background in chemistry, the student may elect to take a [chemistry placement exam](#). Each year based on the placement exam results, a small number of students are excused from taking Ch 1a, b. These students may choose between two more advanced chemistry courses (Ch 21 or Ch 41) to fulfill the Institute's chemistry requirement.

The first two quarters of freshman year are graded on a pass-fail basis, which allows students coming from a variety of academic backgrounds and learning styles to acclimate to the Caltech environment and to adjust to increased workloads without the stress of grades. This P/F system also allows students to gauge how much time and effort is necessary for them to obtain the letter grade that they would like to obtain. At the end of the first term, students receive narrative comments through their Freshman Progress Report. At the end of the second term, the Freshman Progress Report also includes a "shadow grade" (i.e., A, B, C, D, or F) that is designed to give students feedback on their performance level without having an official grade recorded. To allow for one-on-one conversations, the Freshman Progress Reports are sent to the student's faculty adviser, to the deans, and to the student's Resident Advisor (RA). In the first two terms and subsequent terms, instructional faculty may also elect to provide midterm feedback (typically narrative comments) to the students. The midterm feedback is also shared with the student's faculty advisor.

The 1996 core review recommended changes to the number of units of required physics, mathematics, and chemistry courses, and an increase in the breadth of the science requirements by including biology and the selection of a menu course. In addition, this review also established the [Core Curriculum Steering Committee \(CCSC\)](#), which was later institutionalized as a formal faculty committee reporting to the Faculty Board. "The CCSC coordinates and supervises content and teaching of the core curriculum. The committee also monitors the performance of the core curriculum courses and devises improvements in the core." The committee includes at least one faculty member from each of the six divisions.

In recent years, the CCSC has tackled a number of issues. It worked to adjust the scheduling of [core courses](#) and [large courses](#) (greater than 25 students) to eliminate conflicts. The CCSC coordinated the due dates for homework so that the student workload could be distributed uniformly through the week. Approximately 3 years ago, the CCSC modified the ordering of the topics within Ma 2 a, b and Ph 2 a, b so that the material in these two courses was better

coordinated and linked. Currently, the CCSC is working with the registrar to improve the operation of the shadow grading system. In winter term 2007-08, shadow grades or narrative comments were given in 76% of courses; the CCSC is encouraging 100% participation.

## **6.2 Commitment to assess the core curriculum**

As described in Essay 5, Caltech employs a number of feedback mechanisms for internal review, including the Student-Faculty Conferences and exit surveys. At the [2007 Student-Faculty Conference](#), the core curriculum was a topic of one of the Institute-wide sessions. The students identified a number of issues with specific courses in the core involving workload, grading, course content, course conflicts, homework, and an assortment of other course-specific issues. From the recent [exit surveys](#), graduating seniors indicated that most students are less satisfied with the core science and mathematics courses and the freshman humanities courses than with their other requirements, such as their options requirements, advanced social science courses, or the advanced humanities courses. The one exception is students graduating with degrees in the PMA division. These students rated the core science and math courses with the same level of satisfaction as the courses within their options. Students across all divisions are satisfied to very satisfied with physical education (PE) and performance and activities courses (PA).

Although the CCSC has oversight of the core curriculum, it has not been charged with reviewing the success of the core in educating the Caltech undergraduates. A recommendation of the [2007 Committee on the Student Experience and Student Affairs](#) was that the faculty review the core curriculum. “In rethinking the core, the faculty should clearly articulate the purpose and goals of the core, the learning outcomes, and a process by which the success of the core curriculum can be assessed.” In addition, the report recommended that a restructuring of the core should leverage Caltech’s small size and low student-to-faculty ratio and provide research opportunities during the school year. The report also suggests that faculty members not previously involved in the core curriculum be an integral part of the review process.

The Caltech Faculty Board discussed the 2007 Student Experience report and issues related to the core curriculum at its [meeting on October 15, 2007](#). At this meeting, the Board voted to establish a task force to review the core curriculum broadly and report back to the Faculty Board in a reasonable length of time. At a separate meeting of the Caltech faculty in [November 2007](#), the Chair of the Faculty presented a draft charge for the core review to “define the purpose and goals of the core, the desired learning outcomes, and a process by which the success of the core curriculum can be assessed.” In addition, the task force is expected to provide “recommendations for energizing the curriculum through new content and/or approaches.”

## **6.3 Next steps**

The educational outcomes associated with the core will be linked to several of the Institute-wide outcomes, such as the analysis, synthesis, and communication of ideas; the identification, analysis, and solution of problems within and across science and engineering; and the application of analytical skills to other areas of knowledge, including issues important to our society. Breadth of knowledge across scientific fields and collaboration are also important components of the core.

to our society. Breadth of knowledge across scientific fields and collaboration are also important components of the core.

Over the next months, the Core Curriculum Task Force will be meeting regularly to address the following tasks:

- Formulating the learning outcomes associated with the core curriculum and whether these outcomes should be the same for every Caltech student;
- Recommending the curriculum that will support the learning outcomes;
- Defining mechanisms to assess the level of student achievement and the quality of the student experience;
- Recommending ways that research and/or independent activities can be brought into the core curriculum, especially at the earliest stages;
- Recommending other changes or enhancements to strengthen the core curriculum experience, such as technology in the classroom, increased student-faculty interactions, or variations in the pass-fail grading system.

## **Essay 7: *Undergraduate Research***

### **7.1 Introduction to undergraduate research at Caltech**

[\(CFRs 1.2, 2.2a, 2.3, 2.4, 2.5, 2.8, 2.11, 3.5, 3.6\)](#)

This essay will explore Caltech's capacity for providing adequate and meaningful opportunities for students to engage in undergraduate research and our ability to assess the educational impact of such experiences. In recent years the national focus on undergraduate research has grown in part due to the influential report of the [National Commission on Educating Undergraduates in the Research University \(or the Boyer Report\)](#) that highlights the unique role that research institutions can play in integrating undergraduates into the research endeavor. Through our curricular and co-curricular programs, Caltech has been a leader in this area for over thirty years. Our undergraduate research programs have served as a national model of success. Recently, Caltech ranked 6th in the *U.S. News and World Report* rankings and was selected as a [school with an "outstanding academic undergraduate research program."](#)

Caltech is well-positioned to offer students excellent research opportunities and classroom experiences that promote the integration of education and research. The low student-faculty ratio provides Caltech undergraduates with many opportunities to be involved in cutting-edge scientific research. Considering the Caltech professorial faculty and the postdoctoral population, there is at least one Ph.D.-level researcher for every undergraduate. Many of the postdoctoral scholars mentor undergraduates, and nearly the entire Caltech professorial faculty has mentored an undergraduate research project at some time in their career. Additionally, Caltech's relationship with the Jet Propulsion Laboratory further strengthens the research opportunities available to students. Forty to fifty Caltech students conduct research at JPL each summer.

Many students chose to matriculate at Caltech, in part, because of the perceived opportunities to do research. Of freshmen entering Caltech in fall of 2007, 88% were "very interested" or "extremely interested" in conducting research while at Caltech. A higher fraction – nearly

100% –responded that they “[expected to conduct research](#)” at Caltech. Over the past ten years, the number of freshmen conducting summer research has grown. Since 2004, over 35% of each freshmen class has been involved in a [summer research project](#). Each division offers opportunities for students early in their career, as well as throughout their academic experience, to engage in research under the mentorship of a faculty member.

At graduation, approximately 84% of our undergraduate students have participated in at least one [research project](#). Students can participate in research activities through [three different mechanisms](#). The first is by participating in the [Summer Undergraduate Research Fellowships \(SURF\)](#) program. The second is through the curriculum, by enrolling in research courses for academic credit or by completing a senior thesis. The third alternative is that students can do research for pay through a faculty member’s grants or contracts.

## **7.2 Summer Undergraduate Research Fellowship (SURF)**

For 30 years the [Summer Undergraduate Research Fellowships \(SURF\)](#) program at Caltech has been the primary vehicle for undergraduate research. The SURF program is modeled on the grant-seeking process and is centered on the collaboration between students and mentors. Students work with mentors to define a project and write a project proposal. A faculty committee reviews the proposals, and awards are made on the basis of reviewer recommendation, mentor enthusiasm, and available funding. Approximately [85-90%](#) of proposals by Caltech students are accepted each year. Students then carry out the work over a 10-week period, and at the conclusion, they submit a technical paper and give an oral presentation at [SURF Seminar Day](#), a symposium modeled on a professional technical meeting. One benchmark for SURF projects is the potential for publication in the refereed literature. From the [2008 graduating class](#), 25% of students single- or co-authored a manuscript in a peer-reviewed journal; 15% presented a talk at a professional conference; and 13% presented a poster at a professional conference.

SURF is administered by the [Student-Faculty Programs Office \(SFPO\)](#), and with the establishment of this office, undergraduate research has been institutionalized as one of Caltech’s core functions. In 1998, the WASC Visiting Team noted that “the SURF program is an essential part of the Caltech undergraduate research experience and therefore its future must be assured.” The SFPO reports to the Vice Provost and is supported by a faculty [Administrative Committee](#), whose members are appointed by the Vice Provost. This committee is charged with overseeing the academic rigor and administrative strength of the SURF program.

Students receive a \$6,000 award for their 10 weeks of research. The award was raised in 2007 after the SURF Administrative Committee reviewed the costs of housing, board, and the federal summer self-help contribution for students on financial aid. SURF awards are funded through annual gifts, named endowments, and a financial contribution from the mentor. In many cases the faculty mentor agrees to pay for half of the student’s award. The 1998 WASC visiting team also recommended that “efforts be continued to increase the endowment of the SURF program.” In response, the Institute made SURF one of the priorities in its recent capital campaign with a goal of increasing the SURF endowment by \$10 million. At this time, we have achieved 94% of this goal with the objective of reaching the SURF endowment goal by December 2008. This fundraising effort, together with the stability provided by the SFPO, provides resources and structures for the long-term

sustainability of SURF at Caltech.

Since 1979, over 4,800 Caltech students have participated in SURF. Participation in SURF began with 18 students and by the 1990s reached a “[steady state](#)” of 150-200 students per summer. Since 2000, the numbers have continued to increase, perhaps in part due to the financial growth of the program. Now, more than 250 Caltech students are awarded SURF fellowships each year and [75% of all students](#) have done at least [one SURF project by the time they graduate](#). Non-Caltech students also participate in the SURF program. Each year nearly 20% of the total number of SURFers are from schools across the country and world. These students add to the community of scholars on campus during the summer.

The majority of students conduct their SURF projects on campus. However, there is a growing number of SURF projects at the Jet Propulsion Laboratory and at other off-campus sites. Since 2003, four SURF Exchange programs have been developed to introduce students to the global nature of research. These programs are with the [National University of Singapore](#), the [Indian Institute of Technology, Kanpur](#), the [University of Iceland](#), and a consortium of universities in Hong Kong. To date, 24 students have participated in these exchange programs. Additionally, more students are seeking off-campus and international mentors. In many cases, these relationships are guided by Caltech faculty members who make suggestions for students to work with their collaborators at another school. In all cases, a Caltech faculty member serves as an associate mentor to ensure that the student has a solid research experience.

### **7.3 Academic-year research and research for pay**

Research experiences are integrated within the academic offerings at Caltech. Of the 25 options offered to students, 18 offer academic credit for undergraduate research, and 19 offer senior thesis credit. Students majoring (or double majoring) in several of the humanities options (En, H, HPS, PI) are required to do academic-year research and/or a senior thesis. Students doing a minor in CDS are also required to do a thesis. In engineering, several options (ChE, CS, EAS, EE, ME) require either a major design project or a senior thesis. The expectation is that most Caltech undergraduates will have participated in independent research or design projects before graduation.

In several of the introductory lecture and laboratory courses (such as Ay 1, Bi 1, Ge 1, IST 1, IST 4), faculty members introduce students to modern research techniques and methodologies. These courses reflect the longstanding view that all Caltech students should be familiar with the basic methods and procedures in a breadth of scientific disciplines. Additionally, several options have introductory research seminars (Ay 30, Bi 2, Ch 10, ChE 10, CNS 100, EAS 2, MS 110, Ge 10, and Ph 10). These seminars feature a different professor or visiting faculty member each week who present an introductory-level talk on their current research projects.

While fewer students participate in research during the school year than during the summer, nearly a third of students do conduct research during the academic year. [Of the 2008 graduating seniors](#), 35% did at least one term of research for credit. In 2007, 18% of the graduating class had completed a thesis; in 2008, 15% of graduating seniors did a thesis.

In addition, Caltech undergraduates can conduct research for pay through grants secured by

faculty members. Faculty may also hire eligible students through the federal work-study program. Approximately 3% of the 2008 graduating seniors participated only in paid academic year and non-SURF undergraduate research. Approximately 10% of students did both a SURF and a paid summer project during their time at Caltech and 9% did a SURF, academic-year research for credit, and paid summer research.

#### **7.4 Development of student learning outcomes**

This self-study has focused on identifying and establishing student-learning outcomes related to participation in undergraduate research. Undergraduate research assessment efforts have involved quantitative measures of participation, impact on graduation, academic success and post-graduation plans, and indirect attitudinal measures of student and faculty participants. The development of learning outcomes will enable direct assessment measures of the impact of undergraduate research on student learning.

These outcomes emerged out of a series of focus group conversations with students and faculty. The outcomes were discussed with faculty in Ay, Bi, Ch, ChE, and EAS and with the SURF Administrative Committee. They were then modified to reflect the discussion and feedback. In [June 2008](#), they were presented to the Faculty Board.

Through their participation in an undergraduate research project, students will be able to:

- Develop a research question, problem, or design;
- Apply basic principles and knowledge found in the literature related to the research question;
- Develop a research proposal to address or resolve a specific research question or problem;
- Apply and evaluate methodology throughout the project;
- Collect, interpret, and critique data in order to resolve a research question or evaluate a design;
- Communicate research findings;
- Appreciate what the process of scientific research entails.

#### **7.5 Capacity issues, assessment, and next steps**

Over the years, SURF has become synonymous with undergraduate research at Caltech. The SURF program has developed into a strong, institutionally supported effort that provides many opportunities for our students. However, over the past few years students have articulated a desire to do more research during the academic year. This topic invariably brings up questions of the rigor and demand of the current undergraduate curriculum.

Data from the [2007 SFC committee on Undergraduate Research survey](#) illuminate students' views and experiences around academic year research. Of the 361 respondents, the majority thought that conducting academic-year research was too difficult given the rigor of the average course load at Caltech. Furthermore, students believed that doing academic year research could negatively impact their GPA and lead to less participation in co-curricular activities. Students would like to see these challenges lessened so that they could do more research during the year. The committee offered several ideas to overcome these challenges.

First, research could be substituted for required lab courses. While this occurs in some options, some options do not allow it. In a comparable survey of faculty, they were split on whether or not they were in favor of the idea. The second idea was to reconsider what research could be contributed to the development of a senior thesis. The committee suggested that research completed during the sophomore and/or junior years be allowed to count towards the senior thesis. Finally, the committee suggested that there should be more emphasis on offering research for grades rather than on pass/fail.

Current assessment efforts indicate that students believe that research experiences have a positive impact on their academic and professional development. [On the 2008 exit survey](#), students were asked to what extent their undergraduate research experiences impacted various outcomes. The greatest impacts were noted in the following areas: understanding of the research process in the student's field (60%); connection to a faculty member (54%); clarification of one's academic path (57%); learning to conduct independent research (54%); and learning to work within a lab setting (54%). A smaller percentage of students noted a positive impact in the areas of learning ethical conduct in their field (25%); skill in effective communication (36%); and skill in science writing (35%). In addition, a [2004 campus study of Student Achievement](#) found that participation in undergraduate research has a positive effect on student morale. Seventy-nine percent of faculty also believe that undergraduate research significantly contributes to students' overall education and preparation.

In preparing for the Educational Effectiveness Review, these indirect assessment efforts need to be explored further through direct measures of student learning. The SURF program currently uses rubrics to evaluate student proposals, final presentations, and final papers. The academic options use course- or option-defined metrics for evaluating academic-year research. An analysis of the different assessment mechanisms and the results of these evaluations will be used to improve student learning associated with undergraduate research.

Undergraduate research is one of the hallmarks of a Caltech education, and Caltech has been successful in expanding opportunities for summer research through SURF. In moving forward, the undergraduate options and the academic divisions plan to explore ways that allow students the opportunity to do academic-year research. The learning outcomes associated with research are essential for all Caltech students. Hence, in preparing for the next review the Caltech faculty will engage in a discussion of increasing student participation to 100%, especially by including research in the academic programs.

## **Essay 8: *Honor Code***

### **8.1 Overview of honor system at Caltech** [\(CFRs 1.2, 1.5, 1.7, 2.2, 2.11, 4.6, 4.7\)](#)

This essay focuses on Caltech's capacity to educate the community about the Honor System, to respond to Honor Code violations, and to assess its efficacy. Although the emphasis of this review is on undergraduates and the Honor Code, the Honor Code is also applicable to the graduate-student population and to the broader Caltech community.

For almost 100 years, the [Honor Code](#) has been central to undergraduate life at Caltech (see also [Catalog page 32](#); [Faculty Handbook page 9/4](#); and the [Honor Code Handbook](#)). Now



summarized in the statement “No member of the Caltech community shall take unfair advantage of any other member of the Caltech community,” this code is embraced by our undergraduates. It allows for substantial student freedom and has been highly regarded throughout Caltech’s history. In a [2006 campus-wide survey](#) (completed by 82% of all undergraduates), 93% of the undergraduate respondents indicated that the Honor Code is effective. Anecdotal reports from alumni indicate that the Honor Code was a highly-valued aspect of their undergraduate experience; the Honor Code helps to foster a community that values integrity, personal and professional responsibility, and respect for others.

Because the Honor Code relies on the principle that students trust each other and, in turn, are trusted by other members of the community, the Honor Code has a broad influence on academic life. For example, faculty should [not proctor examinations](#), and students should be free to come and go as they please during the exam. Students take most quizzes and exams in their campus residences or in the library, and are expected to follow the time limits established by the professor. Often students turn in their exams, and the exams of friends, in open boxes outside professors’ offices. Students are encouraged to collaborate on homework and yet are trusted to turn in their own work. In addition to academics, the Honor Code guides students in [“their non-academic relations with any member of the community.”](#) The Honor Code handbook emphasizes that the Honor Code is relevant to interpersonal relations and thus is central to Caltech student life.

Since the last WASC review in 1998, violations of the Honor Code are now handled by two separate committees: the Board of Control (BoC) and the [Conduct Review Committee \(CRC\)](#). Academic dishonesty is dealt with by the Board of Control, a student group that investigates and makes recommendations on Honor Code violations to the Dean of Students. The CRC, introduced in 1999 after one year of discussion, is a group of students, faculty, and administrators who handle policy violations and non-academic violations of the Honor Code. In special circumstances, the Dean of Students and the Associate Dean also adjudicate matters related to Honor Code and/or policy violations. In addition, a new student position, the Honor Chair, was created to educate the community about the Honor Code.

In its 1998 report, the WASC team praised the Honor Code’s success in the academic realm and acknowledged its fundamental role in undergraduate life. However, the team also urged students to consider the role of the Honor Code outside of academics. They suggested that students consider how the Honor Code affects the way students treat each other. The team’s observations were considered in preparing for this WASC review.

## **8.2 Capacity to educate**

Education regarding the Honor Code takes place through formal and informal channels. As prospective students learn about Caltech, they read about the Honor Code in various [admissions materials](#). Applicants to Caltech are given a statement of the Honor Code and asked to respond to a question regarding ethical dilemmas that have challenged the applicant. Summer placement tests remind students that as members of the Caltech community they are permitted to take the exams under the conditions of the Honor Code. New students receive a copy of the [Honor Code Handbook](#) the summer before their first term at Caltech. During the required orientation, all freshmen participate in a two-hour Honor Code session supplemented by a plagiarism lecture by the director of Caltech’s writing center. This program is a central part of the orientation program.

Several weeks into the first term, freshmen attend another session in their Houses to review the Honor Code and to have an opportunity to ask questions about it. Throughout the year the resident associates (RAs) and the upperclass counselors reinforce the importance of the Honor Code as Caltech's standard for living together and doing honest work.

In 2007, student leaders increased their focus on Honor Code education and established a new position called the Honor Chair. The [Honor Chair](#) is a student government Vice President and is charged with providing education to the community about the Honor Code. In addition, the RAs are educated about the Honor Code annually in a meeting with the undergraduate leaders of the BoC and the CRC. Finally, focus groups and student/faculty conferences also contribute to a broader discussion and awareness of the Honor Code.

For faculty members, much of the education about the Honor Code is done informally by colleagues or through the orientation lunches for new faculty. New faculty also receive a copy of the Faculty Handbook, the Honor System Handbook, and *Doing Business the Caltech Way*, all of which contain information on the Honor Code. To improve faculty education, the Faculty Board approved a plan in May 2005 to have a [faculty Honor Code representative](#) in each academic option or small division. Although this recommendation has not been fully implemented, the Vice Provost is working with faculty leaders to ensure that it is in place by 2009. Students also educate faculty about the Honor Code. For example, in 2003 the Board of Control chair developed a template to help faculty present clear collaboration policies to their students. Such clarification helped reduce the number of "over collaboration" violations.

### **8.3 Capacity to respond to violations of the Honor Code**

Most violations of the Honor Code are reported by teaching assistants, faculty members, fellow students, and RAs; reports can be made by any member of the Caltech community. Academic violations are normally reported directly to the BoC. Other potential violations are reported to the [Routing Group](#); this group, which includes the Dean of Students and the students who lead the BoC and the CRC, decides which body will investigate and follow up on the reported violation. The Dean and Associate Dean respond to cases needing immediate action, and in cases involving infractions in which a formal judicial hearing is unnecessary.

The BoC procedures are described in the [ASCIT bylaws](#). The BoC chair and secretary are chosen in a campus-wide election; the student Houses each have one representative, and there are two at-large representatives. All of the members participate in an annual training. The BoC convicts students of Honor Code violations in approximately 25 to 35 cases annually (a total of 95 cases with 113 violations over the last 3 years). Their recommendations are forwarded to the Dean of Students, who has authority to [require a student to leave Caltech](#). On average each year, the Dean asks four students to leave Caltech for a period of time because of violations. All convicted students lose credit for the work that was done dishonestly. Students who are not asked to leave Caltech meet with the Deans and are placed on probation. Sometimes students are limited in the number of units in which they can enroll, and in most cases they meet with peers on the BoC for further education about the Honor Code. Violations vary with approximately [half of violations being acts of copying and plagiarism](#).

The Routing Group can also send policy violations and non-academic violations of the Honor Code to the CRC. The CRC is composed of student members, who are elected by each House, and faculty and staff members, who are invited to serve by the Dean of Students. The committee is co-chaired by a student chosen in a campus-wide election and by the Associate Dean of Students; members participate in [annual CRC training](#). Students and non-students have an equal vote. On average, there are 10 cases a year with 12 students being convicted. In the last three years, the CRC has recommended that three students be placed on indefinite leave. Other sanctions include probation, restitution, and education. For example, students involved in a hazing incident were required to meet with the Dean of Fraternities and Sororities at the University of Southern California to understand hazing laws. Students who appear to have problems with alcohol are referred for evaluation and subsequent treatment and normally are prohibited from future drinking of alcoholic beverages on campus, regardless of their age.

#### **8.4 Capacity to assess**

Since the Honor Code was chosen in 2006 as one of Caltech's themes for our WASC review, an Honor Code committee of faculty, students, and administrators has been meeting regularly. Through these discussions, this committee has developed plans for assessment through surveys and focus groups and has established learning outcomes.

In the spring of 2006 the BoC and the WASC Honor Code committee conducted a [survey](#) regarding the academic applications of the Honor Code. Eighty-two percent of all undergraduates responded (736 respondents out of 895 undergraduates). A presentation of survey results and analysis was a focus of the 2007 Student-Faculty Conference and was presented at the [Faculty Board Meeting in June 2007](#). The survey found that 26.6% of the survey respondents admitted to having violated the Honor Code at least once during their time at Caltech. While there is room for improvement, the percentage of students self-reporting violations is less than found at other colleges and universities with honor codes. [A study of college cheating by the Center of Academic Integrity](#) found that in schools with an honor code, 54% of students self-report serious cheating at least once in their college careers. Of the students responding to the Caltech study, 107 students (15%) had gone overtime on at least one exam (19 students reported going overtime 5 or more times); 106 students (14%) used resources improperly on at least one occasion (such as opening a book during a closed book exam; one student admitted to doing it five or more times); 24 students (3%) indicated that they copied another student's work on at least one occasion and one student admitted to copying another student's work more than five times. The Associate Dean presented further analysis of these results to the Faculty Board in [June 2008](#).

Faculty and students participated in several informal group meetings where the Honor Code was discussed to raise consciousness about it and to assess perceptions of how the Code is working [outside the classroom](#). At two meetings of randomly selected students and at two meetings with faculty volunteers, a [standard set of questions was discussed that explored Honor Code perceptions](#). In addition, each of the eight undergraduate Houses held a guided discussion to review the [non-academic applications of the Honor Code](#).

To understand the views of a larger number of undergraduates on this topic, the [2008 Caltech Honor Code and Nonacademic Issues Survey](#) was designed, piloted, and refined over a seven-month period in the fall and winter of 2007-08. The final survey, administered online

to all undergraduates in April 2008, consisted of questions that covered students' perceptions of the Honor Code and the general campus climate; perceived prevalence of antisocial nonacademic behaviors on campus and perceptions of these behaviors in the context of the Honor Code; students' preference regarding clarity and administrative oversight surrounding the Honor Code and nonacademic behaviors; and students' opinions on the relative importance of various factors leading to resolution of possible nonacademic violations.

The survey was voluntary and anonymous. A total of 513 students responded to the survey request (58% of the students). The survey sample is representative of the Caltech population in terms of gender, ethnicity, place of residence, and class. From the [responses](#) there is some degree of consensus on the Honor Code's applicability to social relationships, at least when they are construed broadly and positively. Over 80% of respondents felt that the Honor Code supports social relationships on campus and promotes a sense of community. Seventy percent of respondents reported that the Honor Code "directly influences" their own decisions and behaviors in nonacademic areas. It is important to note that this does not mean that the other 30% does not behave honorably; they may act based on their own moral code.

Students were asked about 19 acts that constitute possible Honor Code violations. There were wide variations that reflect differences of opinion on campus as shown in the focus groups, in committee meetings, and in the survey. For example, 91% of undergraduates indicated that theft of property is an Honor Code violation while only 37% indicated that selling illegal drugs on campus is a violation. For most of the 19 possible acts, the survey also showed significant positive correlations between a student's perception that specific acts constitute Honor Code violations and a student's perception that the Honor Code directly influences his or her own behavior. While students believe that most of the 19 acts would be Honor Code violations, they also indicate that these acts are not likely to be reported.

For nearly every act, there exists a negative and statistically significant simple correlation between frequency of "seeing/knowing about" the act and feeling that it constitutes an Honor Code violation. That is, the more students observe these kinds of acts, the less likely they are to feel that the Honor Code "often" or "always" applies. One possible explanation is that a "desensitizing" process is at work, i.e., students become desensitized to the Honor Code's applicability as certain acts become more visible or "normalized" in their day-to-day lives. Alternately, students who engage in these activities do not want to believe themselves to be violators of the Honor Code.

There are few between-class level or between-gender differences in attitudes towards the positive aspects of the Honor Code, the clarity of the Honor Code, and the importance of various factors in Honor Code violation resolution. Freshmen are, however, more likely to feel that the Honor Code's connection to nonacademic issues is clear. First-year students tend to "see" or "know about" certain acts less frequently than do older students; for acts involving drinking and drugs, first-year students tend to feel that the Honor Code applies more often/in more cases than do more senior students.

Women tend to be aware of sexual harassment and gender discrimination more than men; men, by contrast, tend to be aware of "taking unfair financial advantage of others" more so than women. There were significant gender differences in interpretation and application of the Honor Code on 5 of 19 acts; on all 5, women tend to feel that the behavior constitutes an Honor Code violation more than men do. Overall, women seem to have a stricter

interpretation of the Honor Code than men.

These responses and the discussions in the focus groups raise the issue of the Honor Code's applicability to Institute policies - especially those that students think have little to do with interpersonal relationships. The survey described above solicited open-ended comments. Comments about the CRC reveal that some students resent the involvement of faculty and administration with students in adjudicating matters having to do with the Honor Code. They may justify policy violations as long as the acts do not "take unfair advantage" of anyone. We will have planned and will work to resolve what types of violations should be reviewed by the CRC.

### **8.5 Learning outcomes**

In addition to the Institute learning outcomes, the Honor Code subcommittee developed learning outcomes for the Honor Code. These outcomes were accepted by the committee and were presented to the Faculty Board for comment in June 2008.

By living as a member of the undergraduate community at Caltech, the student will be able to:

- State the Honor Code;
- Understand how the Honor Code is commonly interpreted by the Caltech community;
- Apply the Honor Code to all aspects of life at Caltech;
- Integrate the values of the Honor Code into their definition of what it means to be an ethical scientist and citizen.

### **8.6 Next steps**

The Honor Code Committee will continue to meet in preparation for the Educational Effectiveness Review. As a result of information gained through focus groups and surveys, we plan to:

- Assess the learning outcomes of the Honor Code in order to identify where the Honor Code meets our expectations for learning and where we need to make adjustments;
- Analyze the results of the surveys to try to understand the most common types of violations and put plans into place to help reduce these violations;
- Encourage conversation among undergraduates about the applicability of the Honor Code to non-academic matters;
- Review and clarify the role of the Conduct Review Committee and communicate it to students.

## ***Essay 9: Summary of Caltech's efforts for the Capacity and Preparatory Review***

As noted in Essay 1, the Capacity and Preparatory Review comes at a time when Caltech's faculty, administration, staff, and trustees are focusing efforts to sustain and enhance excellence in our educational programs. Caltech enrolls talented students, who learn in an environment centered on research and the pursuit of new knowledge. After graduation, our

alumni use their education to pursue many different fields – becoming leaders in science, engineering, technology, medicine, business, and academia. As at any university or research center, we need to monitor and assess our programs to preserve and enhance their long-term health for future generations of Caltech students.

The preparation for this review has been informative, and our efforts have resulted in positive changes and improvements. As we prepare for the Educational Effectiveness Review, we envision continued development of our evaluation and assessment processes. Through our evaluation preparations, we anticipate strengthening our core undergraduate curriculum, our opportunities and availability for undergraduate research, and our commitment to educating students in a community of trust, openness, and concern for fellow classmates and community members.

The following paragraphs summarize Caltech’s essays and the mechanisms by which we fulfill WASC’s standards.

*Standard 1. Defining institutional purposes and ensuring educational objectives.* As described in Essay 2, Caltech has a clear and historic institutional purpose in education and research. Recently, we codified our educational mission by formulating educational objectives and learning outcomes for the B.S., M.S., and Ph.D. programs (Essay 5). Caltech is committed to maintaining a learning and research environment that welcomes and embraces diversity (Essay 4).

*Standard 2. Achieving educational objectives through core function.* In addition to the Institute-wide educational goals, we have developed learning outcomes for the undergraduate research experience (Essay 7) and for the Honor System (Essay 8). We are reevaluating the appropriate breadth and depth of the core curriculum and defining expectations for student achievement (Essay 6).

*Standard 3. Developing and applying resources and organization structures to ensure sustainability.* Caltech has sufficient resources and faculty to provide a unique environment that supports education coupled with research (Essays 2 and 3). The faculty, administration, staff, and trustees provide sufficient oversight and organizational structure to ensure the continued health of the Institute.

*Standard 4. Creating an environment committed to learning and improving.* Caltech has a series of processes for review and assessment as described in Essay 5. As we embark on an assessment of our educational programs, these processes will be refined and strengthened. The results of our analysis, data gathering, and assessment will be linked to our ongoing strategic planning at the Institute.