

HARVEY MUDD COLLEGE  
Capacity and Preparatory Review

Report to the  
Western Association of Schools and Colleges  
Accrediting Commission for Senior Colleges and Universities  
July 2009





## THE HARVEY MUDD COLLEGE MISSION

Harvey Mudd College seeks to educate engineers, scientists and mathematicians well versed in all of these areas and in the humanities and social sciences so that they may assume leadership in their fields with a clear understanding of the impact of their work on society.

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## EXECUTIVE SUMMARY

In early 2006, Harvey Mudd College (HMC) decided, in consultation with WASC, to undergo a theme-based accreditation review. As the college completed its [Strategic Planning](#) process in the fall of that year, two themes emerged that were important to the institution and appropriate for an accreditation self-study: experiential learning and diversity. These are the themes we recommended in our [Institutional Proposal](#), which was accepted in 2007. The proposal was followed by an eighteen-month period of work by the faculty and administration, culminating in the creation of this Capacity and Preparatory Review report. This report forms the basis upon which we will be reviewed during our fall 2009 site visit, and describes our plans to make meaningful the next stage of our accreditation cycle, the Educational Effectiveness Review, which will be completed in 2011.

The experiential learning theme was a relatively obvious choice because of the college's decades-long commitment to this form of teaching and learning. We believe it is one of the college's strengths and that our community shares a common vision and interest in its practice. In choosing this theme, we were interested in understanding better one of HMC's core strengths, learning where its benefits were felt most strongly, and what aspects of it could be improved. Essay 1 discusses the findings of the experiential learning self-study, focusing on the Clinic and research experiences of HMC students. Looking forward to the Educational Effectiveness Review, we will concentrate our efforts on understanding the educational benefits of the college's required capstone experiences—Clinic and Senior Thesis—and the curricular precursors that make these experiences most successful.

The diversity theme grew from the Strategic Planning process of 2006-07. Through this process the need to increase diversity across the demographics of students, faculty, staff and trustees became even clearer than it had previously been. To increase diversity, however, we first needed to better understand the current climate for diversity and the experiences of underrepresented members of our community. It was with this goal of improved understanding that we proceeded to study diversity at the college as it exists today, with the intention of improving upon it in the

near future. Our findings, including that there are gender and ethnicity performance gaps in our Core courses, are discussed in Essay 2. In the Educational Effectiveness Review, we will continue and deepen the studies that led to these findings so that we better understand the academic performance of women and under-represented students at the college.

The topic of Essay 3 is student learning goals and outcomes in HMC's revised Core, particularly the writing curriculum, and in all departments. We describe recent revisions of our Core curriculum—which give students more flexibility and choice in the courses they take during their first three semesters at the college—and how changes will be assessed. The essay also describes efforts to strengthen assessment mechanisms in each department of the college. In our Educational Effectiveness Review we will report back on the assessment results from the new Core writing curriculum and from our departments.

This Capacity and Preparatory Review report documents the work completed to better understand and improve HMC; it reflects the seriousness with which we have undertaken our self-study, and demonstrates our readiness for the Educational Effectiveness Review.

As a final note, although it is traditional in Capacity and Preparatory Review reports to include in-line references to the standards and criterion for review (CFR), we have taken a different approach that is more appropriate to the structure of this review. Because the standards and CFRs are meant to guide the comprehensive assessment of an institution, and we are undergoing a more narrow theme-based review, we felt that merely using in-line references would not allow us to address the scope of the standards. Instead, we have included [Appendix III-E](#) where we address each standard and CFR in detail.

# INTRODUCTION

## I. Structure and Context for the Capacity and Preparatory Review

Harvey Mudd College (HMC) is the nation's foremost liberal arts college of engineering, science, and mathematics. The college's [Mission Statement](#), authored by HMC's founding president, Joseph B. Platt, articulates the goal of ensuring our students are educated to become leaders in their fields of study and to have a clear understanding of the societal impact of their work:

*Harvey Mudd College seeks to educate engineers, scientists, and mathematicians, well versed in all of these areas and in the humanities and the social sciences so that they may assume leadership in their fields with a clear understanding of the impact of their work on society.*

HMC's October 2007 [Institutional Proposal](#) describes the academic and social principles upon which the college was founded, and the manner in which the college's Mission Statement remains the framework by which the academic, co-curricular and administrative elements of the college are defined. The Institutional Proposal also summarizes how the HMC [curriculum](#), divided into the three components of the [Common Core](#), the academic [Major](#), and the [Humanities, Social Sciences, and the Arts](#) program, honors the mission of the college.

The Institutional Proposal also describes the administrative and academic governance structures in place at HMC, noting specifically the leadership provided by President Maria Klawe, the Cabinet, the Board of Trustees and the faculty. Additional documentation that illustrates the college's organizational structure (Appendix II-A) and key financial indicators (Appendix II-B) are appended to this report.

## II. Overview: HMC and its Core Commitment to Institutional Capacity

As stated in the 2008 *WASC Handbook for Accreditation*, HMC is required to demonstrate a commitment to institutional capacity; that is, we must demonstrate that we have the administrative and faculty structures in place to study the college's educational program, reflect on what we find, and modify our program accordingly. Further, we must illustrate that, "[HMC] functions with clear purposes, high

levels of institutional integrity, fiscal stability, and organizational structures to fulfill its purposes."

This Capacity and Preparatory Review report is comprised of three reflective essays - Experiential Learning at HMC, Diversity at HMC, and Assessment of Student Learning at HMC - as well as a collection of appended data tables, reports and other documents of reference that provide quantitative and qualitative evidence of the college's commitment to institutional capacity, and efforts to use this capacity to study its educational effectiveness.

## III. Responses to Issues Raised in Previous Action Letters

### A. [Visiting Team Report and Commission Letter](#): HMC's 2000 Reaccreditation

The faculty, staff, students and administration of HMC are fully aware of the importance of continued self-assessment and reflection as a means of maintaining our reputation as the premier liberal arts college of engineering, science, and mathematics. At the conclusion of HMC's reaccreditation visit in 2000, the WASC Commission letter recommended that the college "address issues of student culture," "encourage experimentation and innovation," and "continue to strengthen its progress on diversity." The Commission letter reinforced these points and highlighted other areas that the college needed to consider, including: 1) clarifying "institutional priorities and intended learning outcomes" for the leadership portion of the mission statement; 2) initiating regular program reviews as part of a comprehensive assessment system; 3) strengthening its leadership role in "innovative science and mathematics education" by looking at what other institutions are doing and embracing more experimentation in teaching and technology; and 4) continuing its resolve to encourage healthy social development in its students. HMC's 2007 [Institutional Proposal](#) (pp. 3-4) outlined and referenced all college-wide initiatives that had been implemented through fall 2007 to address the concerns posed by the Commission in 2000. Since fall 2007, we have continued to focus attention on these concerns:

- *Institutional Priorities and Intended Learning Outcomes* – A primary task given to the college's Assistant Vice President for Institutional Research (AVPIR) has been to assist the faculty in identifying and defining departments' academic goals, as well as intended student learning outcomes

at the department and, in some cases, course level. As of March 2009, the AVPIR has met with all seven academic departments at HMC, and together they have made significant progress toward revising and articulating goals and measurable student learning outcomes that will, in turn, inform annual assessment plans. These department goals, student learning outcomes and 2009-2010 assessment plans for each department are described in additional detail in Essay 3.

HMC's Assessment Committee is involved in most assessment and evaluation endeavors at HMC. For example, in spring 2008, the Assessment Committee oversaw the distribution of assessment surveys for students in senior research courses, and the updating of assessment tools used by Summer Research student participants. During the fall 2008 semester, the Assessment Committee focused on drafting an assessment and evaluation plan for the revised Core.

HMC's Engineering Department is required by ABET to maintain an assessment and evaluation program to monitor and evaluate student learning. To facilitate the gathering of direct measures, the department implemented an ambitious [Assessment and Evaluation Program](#) (AEP) in fall 2008 that is designed to acquire and assess student work across required Engineering's core offerings. The AEP focuses on what students are learning and provides information to the instructor on the course learning objectives. The AEP employs a three-year evaluation sequence for all core engineering courses that assists in the evaluation of educational (programmatic) goals. Each academic year, the AEP will target six courses, Clinic, and Seminar. Of the six courses, two courses will be rotated each year from science offerings. At the end of the three-year cycle, student learning in all core courses in the Engineering curriculum will have been assessed at least once.

- *Program Review* – In August 2008, the faculty of HMC adopted a revised set of guidelines that describe the academic review process on campus. The guidelines describe the purposes, components, and procedures for academic program reviews, and provide assistance to departments as

they plan, undertake, and interpret the results of their self-study.

As of January 2009, five of the seven academic departments at HMC completed departmental reviews. A component of each of these reviews included an assessment provided by academic professionals external to HMC. Links to the self-studies for [Computer Science](#), [Mathematics](#), [Physics](#), [Engineering](#), and [Humanities, Social Sciences, and the Arts](#), as well as reports by external review teams for [Computer Science](#), [Mathematics](#) and [Humanities, Social Sciences, and the Arts](#), are included here and throughout the electronic version of the CPR.

While the department reviews for Chemistry and Biology are pending, it is worth noting that the Chemistry Department is subject to annual review and accreditation by the American Chemical Society (ACS). A link to the 2008 report submitted to the ACS is included [here](#).

Focusing specifically on the Commission's recommendation that HMC consider program review efforts within the context of a comprehensive assessment system, we note several other initiatives that have contributed to our on-going curricular assessment efforts. Since 2006, the Assessment Committee has overseen the administration of an annual survey given to students at both the beginning and end of their participation in HMC's Summer Research program. This survey instrument was designed to measure the academic and personal skills gained from a summer research experience on campus. Augmenting this survey was a series of focus groups in the summer of 2008 with students who were completing their second or third summer research experience. HMC also participated in an alumni survey administered by the Higher Education Data Sharing (HEDS) consortium in spring 2008, with the goal of understanding in greater detail the professional, educational and personal impact an HMC experience had on Alumni.

Finally, an [evaluation](#) of HMC's Integrative Experience program, an interdisciplinary program implemented in fall 2000 with the goal of broadening students' understanding of the impact of technical work on society, was completed

in fall 2006, as was an [assessment](#) of the college's Summer Math program.

- *Innovative science and math education* - The recently approved changes to the college's Core curriculum are expected to improve our students' curricular and co-curricular experience. HMC's curricular innovations are informed by a careful study of comparison-group institutions' requirements, and internal deliberations on the matter, starting with the Strategic Planning process in 2006. Changes to the Core curriculum include an early exposure to biology and a new writing course team taught in a workshop format by faculty from different departments. These changes were implemented only after we completed a detailed study of the curricula of approximately twenty other institutions, and held detailed conversations with faculty at Cal Tech and MIT regarding their attempts to change their core curricula. Further, with an eye toward improved student mental health, as well as improved education, the college has eliminated all zero-unit graduation requirements for classes such as colloquium and physical education. Every student will have at least one unrestricted elective in each of their first three semesters at HMC. The full details of these changes, the reasons for their implementation, anticipated outcomes, and the plan for assessing the revised Core can be found in Essay 3, in the original [proposal](#) for changes to the Core curriculum, and in the [assessment plan](#) for the new Core.

The college has also advanced significantly on its use of and support for instructional technology in recent years. The most significant advances occurred in 2008: the college became a member of the National Institute for Technology and Liberal Education (NITLE), received a grant from the Fletcher Jones Foundation to fund an educational technology unit of the Computing and Information Services (CIS) department, and our CIS department received eleven tablet PCs available for loan to faculty and students. In addition to these very recent advances, CIS continues to support the Sakai system, and the Chemistry department owns a personal response system (a.k.a. "clickers") that

many faculty members (including those outside chemistry) use in their classes.

- *Diversity* - In response to the Commission's recommendation of an expanded focus on diversity on campus, HMC has continued to make significant progress toward the integration of initiatives structured to address this particular area of concern. The college's Office of Institutional Diversity (OID) has provided the leadership that has defined diversity as one of the primary emphases within the academic and co-curricular programming at HMC. Links to materials that document the training, mentoring and co-curricular programs at HMC since November 2007 are included [here](#).
- *Improving Student Social Development* - In an effort to improve the overall health and well-being of our students, the college established a new Assistant Dean position in the Dean of Students Office: The [Assistant Dean for Emotional Health](#). Now an established member of the HMC campus, the Assistant Dean has a background in counseling and is a first point of contact for students facing challenging emotional circumstances. The presence of this position has changed the conversation about emotional health on the campus to one of significantly greater openness, and has markedly improved our ability to meet students' emotional health needs.

#### IV. HMC's 2007 Institutional Proposal

HMC's pattern of self-assessment and review continued following the approval of its October 2007 Institutional Proposal. The [November 14, 2007 letter](#) from Barbara Wright, Associate Director of WASC, summarized three recommendations for the college's consideration. These included: (1) ensure that the college's Institutional Research Director, (whose hiring was imminent at the time of the proposal's approval) has the time to become acquainted with the college's data structures, has prioritization in place for the projects and functions for which the individual will be responsible, and plays a supporting role in the assessment of student learning; (2) send college representatives to the WASC retreat on student learning and assessment (January 31 – February 2, 2008), and to the WASC Academic Resource Conference (April 16-19, 2008) in order to build intellectual capital in the area of

assessment and to involve a critical mass of faculty in campus assessment efforts; and (3) in preparation for the Capacity and Preparatory Review, think more broadly about capacity, particularly as it pertains to “institutional structures, processes, and human resources to do the work outlined [in the proposal] as well as alignment of resources with goals.”

The WASC Steering Committee took these recommendations seriously and has addressed each in turn:

- (1) HMC’s AVPIR, Dr. Janel Henriksen Hastings, was hired in February 2008. In her first months at HMC, the AVPIR met with faculty representatives from most academic departments, and has spearheaded assessment and evaluation efforts for a number of academic and co-curricular initiatives, including: a series of faculty and staff forums on issues pertaining to race, ethnicity, gender and sexual orientation; 2008 Summer Research program; 2008 HEDS Alumni Survey; 2008 college Senior Survey; and the 2008 Beginning college Survey of Student Engagement (BCSSE). In addition, she co-chairs the WASC Steering Committee, and serves as the college’s Academic Liaison Officer (ALO) to WASC. HMC’s Director of Academic Operations, Eric Ditwiler, has provided significant support to the college’s WASC efforts, particularly in data collection and analysis in support of our thematic self-study. In addition, we have also hired an external consultant, Dr. Laura Kotovsky, who helped in reviewing and finessing all relevant data analysis that pertains to our CPR research.

Harvey Mudd College has been well represented at all assessment and student learning workshops hosted by WASC in spring 2008 and 2009. Christine Alvarado, Assistant Professor of Computer Science, and Dr. Hastings attended the 2008 WASC retreat on Assessment held in Irvine, California, January 31-February 2. In addition, our AVPIR represented HMC at the WASC Academic Resource Conference, held in San Diego April 16-19, 2008. Sarah Harris, Assistant Professor of Engineering, and Marianne de Laet, Associate Professor of Humanities, Social Sciences and the Arts, attended the WASC retreat on Assessment held in Honolulu, Hawaii, January 29-31, 2009.

- (2) HMC has been represented among members of visiting teams, and as presenters at WASC workshops. Jon Jacobsen, Associate Professor of Mathematics, served on a visiting team for Cal Poly Pomona in spring 2008, and was a panelist at the January 2008 WASC Assessment Workshop.
- (3) Three of the college’s standing faculty committees, the Curriculum Committee, the Campus Life Committee, and the Assessment Committee, collected and analyzed data to inform the essays on our two review themes, Essays 1 and 2. In these essays, careful consideration was given to issues of capacity as related to institutional culture, academic structure and delivery, and staffing. The essays address how the college can best proceed in developing additional academic and human resources, and rethinking academic and co-curricular processes in a manner that will enable HMC to achieve the goals outlined in our [Institutional Proposal](#) (Appendix II-C).

#### **V. Approach to the CPR in Relation to the Institutional Proposal**

The Capacity and Preparatory Review report continues the analysis of and reflections on the specific goals and hypotheses identified in the Institutional Proposal for the themes for HMC’s self-study: experiential learning (Essay 1) and diversity (Essay 2). The research questions presented in the Institutional Proposal for each theme are carefully addressed through research and analysis of relevant data and examples of best practices at other institutions. These essays are a distillation of reports provided by the college’s Curriculum Committee and Campus Life Committee, which were responsible for answering the research questions posed in the Institutional Proposal, assessing the validity of the related hypotheses, and summarizing the extent to which Harvey Mudd College has in place the capacity to fulfill institutional goals that relate to these themes.

A third reflective essay explores HMC’s efforts, to date, to develop and establish assessment and evaluation practices across the college. Essay 3 illustrates how we will assess recent revisions of the college’s Core curriculum, and student learning outcomes in each department.



## VI. Evidence of Campus-Wide Engagement in the Reaccreditation Process

As described in HMC's [Institutional Proposal](#), the college's engagement in the three-part reaccreditation process has involved representatives from all college constituencies: faculty, staff, administration, alumni, students, Board of Trustees, and members of the community both within and external to HMC.

- *2006 Strategic Plan:* The college's ambitious [Strategic Planning](#) efforts commenced in fall 2006 and culminated in an intensive, four-day campus-wide conversation that involved the participation of more than 400 faculty, staff, students and members of the larger Claremont community. Distilled directly from the conversations and forums presented during this intensive Strategic Planning, were the two institutional themes of Diversity and Experiential Learning, upon which HMC has based its Capacity and Preparatory Review and Educational Effectiveness Review.
- *WASC Steering Committee:* The WASC Steering Committee was appointed by the Dean of Faculty in March 2006, with the charge of planning for and drafting the college's Institutional Proposal. The Steering Committee continues to provide oversight and management of the college's accreditation review; it is currently comprised of the Dean of Faculty, the Dean of Students, the Chair of the Faculty, one faculty member who serves as Associate Dean, three faculty members representing different academic departments, and the Assistant Vice President for Institutional Research.
- *Faculty sub-committees:* To thoroughly address the two themes and research questions that frame this Capacity and Preparatory Review report, HMC's Assessment Committee, comprised of three tenured faculty members, the Interim Vice President and Dean of Students, the AVPIR, and the Director of Academic Operations, conducted a preliminary review of on-going assessment tools used by the college to determine potential sources of assessment data for the WASC themes. Specific work completed by the Assessment Committee in preparation for the college's Institutional Proposal included: (1) completing an inventory of

all surveys and assessment studies conducted at HMC ([Survey of Surveys](#)); (2) reviewing survey instruments from HERI, NSSE, BCSSE, FSSE studies for variables and data that address the themes experiential learning and diversity; (3) meeting with the HMC Curriculum Committee Chair to discuss WASC research questions on experiential learning; (4) reviewing data from recent Proctor Surveys related to diversity issues; and (5) drafting questions regarding experiential learning to be included on the 2008 senior exit survey.

The preparatory work conducted and completed by the Assessment Committee helped inform additional work of the two faculty subcommittees appointed to complete the research, data collection and analysis, and reflective analysis of these themes. HMC's Curriculum Committee collaborated on the analysis of the issues and research questions related to the theme of Experiential Learning; the college's Campus Life Committee provided the same for the theme of Diversity.

As a measure of faculty engagement in and commitment to the reaccreditation process, the WASC Steering Committee, the WASC Experiential Learning Working Group, the WASC Diversity Working Group, HMC's Faculty Executive Committee, Curriculum Committee, Campus Life Committee, Assessment Committee, Strategic Vision Curriculum Committee and Department Chairs Committee constituted the engagement of 36 HMC faculty members, or 43% of all tenured and tenure-track faculty at HMC ([WASC and HMC Standing Committee memberships, 2006-2009, Appendix II-E](#)).

- *Communications:* The WASC reaccreditation process has been a topic of discussion at monthly faculty meetings. Specifically, WASC-related presentations and discussions were held on: 1) February, 2007: WASC proposal review; 2) January, 2008: Report on the WASC proposal and process; and 3) December 2008, Report from the Steering Committee on CPR progress.

Harvey Mudd College's CPR report was shared with and reviewed by key groups of faculty, staff, administrators and students, and was presented to the faculty the week of March 23,

2009 through a series of small-group discussions, followed by a weeklong comment period. We believe firmly that HMC's Capacity and Preparatory Review report demonstrates the following:

1. HMC "functions with clear purposes, high levels of institutional integrity, fiscal stability, and organizational structures to fulfill its purposes" (WASC's Core Commitment to Institutional Capacity)
2. HMC is prepared to fulfill its obligations for the WASC *Educational Effectiveness Review*.

For this third phase of the reaccreditation process, HMC will demonstrate a strong commitment to WASC's Core Commitment to Educational Effectiveness by showing that the college has identified and implemented "clear and appropriate educational objectives at the institutional and program level" and employ processes of review, including the use of data, which assure our students are learning and performing at a level appropriate for the degree awarded. We discuss how this process will occur in the concluding reflective essay.

# Essay 1

## EXPERIENTIAL LEARNING AT HARVEY MUDD COLLEGE

### I. Introduction

Learning by doing has been a hallmark of the HMC experience since the founding of the college. HMC's Clinic Program has expanded to most majors; laboratory experiences are critical components in all sciences, in Engineering, and the Core curriculum; HMC students are leaders in the performing arts throughout The Claremont Colleges; and the college's [Summer Research](#) program is thriving. Recent [experiments](#) in open-ended laboratory<sup>1</sup> experiences in the first year, and in service learning opportunities<sup>2</sup> have met with enthusiastic responses from students and considerable attention in the wider STEM community. All of our graduates must complete a year-long [research](#) or [Clinic](#) experience. In sum, the HMC community believes deeply and fundamentally that Experiential Learning (EL) has a significant positive impact on our educational mission.

### II. Experiential Learning Theme: Overview, Process and Capacity, and Goals

#### A. Overview

In the *Journal of Experiential Education*, [Christian Itin](#) defines EL as "the change in an individual that results from reflection on a direct experience and results in new abstractions and applications<sup>3</sup>," The venues in which EL opportunities and activities take place at HMC are numerous; a partial list includes Clinic projects, undergraduate research, societal engagement and co-curricular experiences, [Study Abroad](#), tutoring peers in the [Writing Center](#) and the [Academic Excellence](#) programs, and open-ended course

<sup>1</sup> [G. R. Van Hecke, et al.](#), "An Integration of Chemistry, Biology, and Physics: The Interdisciplinary Laboratory," *J. Chem. Ed.*, **79**, 837 (2002).

<sup>2</sup> Data from the spring 2006 evaluation of HMC's Humanities 2 course, *Building Community*, show that service learning was among the most highly-regarded components of the course. Students ranked their service learning assignments the most useful in the fulfilling course objectives, which included but were not limited to: "Develop a Community of Learners," "Reflection on the relevance of Students' Lives to the Larger Society," "Development of Increased Self-Knowledge and Concern for Society," "Integrate Evidence from Readings, Discussions and Community-Based Experiences," and "Articulate Views in Oral and Written Channels."

<sup>3</sup> [Itin, C. M.](#) (1999) *Reasserting the Philosophy of Experiential Education as a Vehicle for Change in the 21st Century*. *The Journal of Experiential Education* 22(2), pp. 91-98.

projects including the visual and performing arts. This scope of experiences is too broad to be meaningfully studied in our accreditation review, so our focus will be on two of these activities: Clinic and under-graduate research. While any subset of HMC's EL activities are worth studying in detail, we focus on the Clinic and research experiences because of their longstanding traditions at the college, and because each of our students must participate in one these activities to meet HMC's graduation requirements.

#### B. Process and Capacity

To better understand the function, utility, and academic role that EL programming plays at the college, we developed and proposed a number of EL-related research questions in the college's 2007 [Institutional Proposal](#). When the Proposal was accepted in November 2007, the WASC Steering Committee and the Faculty Executive Committee asked HMC's Curriculum Committee to address these research questions. This process enabled us to obtain detailed answers to these questions and helped to broaden both faculty involvement with and buy-in of the accreditation process. The resulting study accomplishes two objectives in the context of our Clinic and undergraduate research programs: (1) it records HMC's current capabilities for assessing EL and reports on EL to the extent possible in light of those capabilities; and (2) it suggests institutional changes to improve HMC's ability to evaluate EL and its impact on students in the future.

#### C. Refining Program and Learning Goals for Experiential Learning at HMC

In the context of Clinic and undergraduate research, we identify three high-level goals for this review that we will use to refine the program and student learning goals of EL at HMC:

1. Articulate HMC's vision of EL and the benefits it provides to students
2. Improve institutional habits of collecting information on students' EL activities, accomplishments, and attitudes
3. Study these data and use findings to improve EL practices at the college

The goals, as stated above, are necessarily broad and reach across all academic activities at HMC. To ground the goals, the WASC Steering Committee defined the following eight research

questions to understand more clearly the role that EL plays at HMC:

1. What are the educational benefits of having participated in an academic-year or summer research program?
2. Are students' career choices affected by research experiences?
3. What are the educational benefits of the Clinic program?
4. Are students' career choices affected by Clinic experiences?
5. Is experiential learning effective for student education throughout all four years?
6. Are there specific educational benefits of earlier exposure to a research experience?
7. How does a student's choice of major affect their experiential learning opportunities?
8. Does HMC have the infrastructure and resources necessary to maintain and/or expand the experiential learning curriculum?

After exploring answers to these questions in this essay, we have decided that for the Educational Effectiveness Review we will assess our students' required capstone experiences, Clinic and Senior Research.

### III. A Review of Experiential Learning at HMC

#### A. Undergraduate Research

The research opportunities for undergraduates at HMC vary in scope across different departments. In the [Chemistry](#), [Physics](#) and [Biology](#) departments, most students complete a senior thesis project, though some choose to participate in Clinic instead of completing a thesis. In [Engineering](#) and [Computer Science](#) (CS), where students are required to participate in the Clinic program, students rarely have time in their schedules for research as extensive as a thesis, so they often participate in smaller research projects. In particular, the CS department has increased traditional research opportunities in response to the [2005 Computer Science Alumni Survey](#) data that suggested many alumni would have chosen to engage in individual research rather than Clinic. In Mathematics, the number of students who elect to participate in Clinic vs. thesis is relatively balanced, but the [Mathematics Clinic](#) is itself heavily research-focused. The visiting committee of the Mathematics 2002 self-study of 2002 noted in their [report](#) that the Mathematics Clinic program might be better termed the "Mathematics Research Clinic"

In conjunction with academic year research, Summer Research at HMC is typically an important stepping stone in the development of a student's research experience. Data from the [2006 and 2007 Survey of Summer Research](#) indicate that, on average, approximately 170 students, or 20% of the HMC student body, participate in on-campus summer research annually. Another fraction engages in off-campus research typically through Research Experiences for Undergraduates (REU) programs. Survey data also showed the majority of the HMC Summer Research students are entering their junior and senior years. Approximately 46% of 2006 and 2007 participants were female. Most students have a full year's worth of previous research experience, and 65% of respondents indicated that their summer research led to an academic year project.

#### *1. What are the educational benefits of having participated in an academic-year or summer research program?*

Among many other [benefits](#)<sup>4</sup> to students, undergraduate research helps in the development of critical thinking skills, refines oral and written communication skills, and gives students early exposure to potential professional pathways. In this section we aim to assess how these benefits manifest themselves through HMC's summer and academic year research programs.

While we believe strongly that students' experiences teach skills that help them succeed in their endeavors after HMC, much of our current data on the benefits of academic-year research, such as senior thesis projects, are anecdotal and indirect. We plan to examine this question further in our Educational Effectiveness Review (see Conclusion), but in this report we review HMC's current evidence as it seems to provide at least some support for the benefits of undergraduate research.

First, a large number of our students attend graduate school. Between 2000 and 2006, the percentage of HMC alumni attending graduate school after graduating from HMC increased from 27% to 44%. Data from the HMC [2002 Alumni Survey](#) suggest that 25% of HMC

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<sup>4</sup> [J. M. Osborn and K. K. Karukstis](#), "The Benefits of Undergraduate Research, Scholarship, and Creative Activity," found in "Broadening Participation in Undergraduate research: Fostering Excellence and Enhancing Impact," M.K. Boyd and J.L. Wesemann, editors, Council on Undergraduate Research, Washington, D.C., 2009.

graduates pursue careers in both academic and industry research environments. A [2008 report](#) by the Division of Science Resources Statistics at the National Science Foundation (NSF)<sup>5</sup> ranked HMC as the leader among private baccalaureate colleges in the U.S. in the percentage of graduates who go on to earn Ph.D. degrees in science and engineering (and was second to only the California Institute of Technology when all baccalaureate granting institutions are considered). The report traced the baccalaureate degree origins of science and engineering (S&E) doctorate recipients from 1997 to 2006, and ranked them by doctorate recipients per hundred. Harvey Mudd graduates earned doctorates at a rate of 24.9 per hundred, while the second ranked private baccalaureate college had graduates earning doctorates at 13.8 per hundred.

On the whole HMC alumni report that they are satisfied with their research experiences at HMC. Data from the [2002 Alumni Survey](#) illustrate that a remarkable 90% of the graduates believed they were well prepared for graduate school. The same survey suggests that 80% of the respondents believed undergraduate research to be an important factor to a good education; roughly the same proportion of respondents noted that research opportunities were available to them at HMC, with an increasing trend in these numbers since 1988.

In contrast, these data do not clarify or define the correct balance between academic year undergraduate research and coursework. The respondents to the [2002 Alumni Survey](#) rank the value of various facets of an HMC experience. At a ratio of 3:1, respondents favored the quality of education and coursework over research opportunities. Department self-studies and the [2006 Faculty Survey of Student Engagement](#) suggest that undergraduate research exacts costs on both faculty time and educational resources of the college. Clearly, a deliberate balance is needed in order to optimize students' experiences. While these statistics indicate that HMC has achieved this balance in recent years, more resources may be needed to maintain this balance in the future.

The fact that so many students participate in summer research, and that many of these students continue these projects during the academic year, suggests a positive experience

for the participating students. Indeed, data from the [2006 and 2007 Survey of Summer Research](#) suggest that summer research is more valuable to first and second year students than to upper-class students. Among other survey topics, students were asked to rate themselves on a list of research skills both at the beginning and at the end of the summer research program. Based on the deltas in these responses, the benefits of summer research were gauged significantly higher by students who had just completed their freshmen or sophomore year. Of course, many of the responses from the freshmen and sophomores may be unrealistically positive. On a scale from one (1) to five (5), where 5 indicates high aptitude in the corresponding professional skill, deltas ranged from 0.4 to 0.9 for returning and older Summer Research participants, and between 1.0 and 1.5 for freshmen and sophomores. To a certain extent, these numbers may be skewed by juniors' and seniors' increased awareness of the long process of developing as a researcher and being able to view their research skills within a broader professional context.

Normalizing for the effects noted above, we found that freshmen and sophomores attributed higher marks to achieved improvements in the following areas: 1) skills to use techniques and/or instruments necessary for research; 2) aptitude to read and research the literature; and 3) confidence level in interacting with faculty. In contrast, juniors and seniors evaluated more positively improvements in their ability to contribute valuable ideas in discussions with other researchers, and in their ability to write research papers. Data from questions asked of faculty research sponsors/advisors indicate that most students also made professional presentations of their summer work, and completed papers or reports.

## ***2. Are students' career choices affected by summer research experiences?***

Most students who participated in Summer Research stated that they were interested in attending graduate school; fewer students expressed interest in research outside academia or in work related to research in general. These results correlate with data described above, which suggest a positive relationship between undergraduate research opportunities and career choices in academia. Of course, these results could also reflect self-selection bias of students who chose to do summer research, so more study of the impact of student research on career choice is needed. To better assess the

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<sup>5</sup> <http://www.nsf.gov/statistics/infbrief/nsf08311/nsf08311.pdf>

Summer Research program at HMC, it will be necessary to achieve higher statistical accuracy with more student participation. Follow-up interviews could further flesh out these statistics with the stories of individuals' summer experiences. Overall, early indications suggest an overwhelmingly positive experience for the students with benefits to their professional research skills virtually across the board.

## **B. Clinic**

As noted earlier, a large fraction of HMC students participate in the Clinic program, usually instead of completing a senior thesis project. The majority of these students are in the Engineering and CS departments, where Clinic is required, but students from Mathematics and Physics also regularly participate in Clinic.

### **3. What are the educational benefits of the Clinic program?**

The data available suggest that Clinic's educational benefits include:

- Increased familiarity with professional practice
- Improved presentation and speaking skills
- Improved collaborative and team-based skills

#### *Development of professional practice*

Clinic not only offers a view of the professional world into which many HMC students enter after graduation, but the program immerses students—actively and authentically—in that world. Similar to the jobs many HMC graduates choose, Clinic offers a long-term, collaborative experience grounded in solving a real problem without a predetermined solution. Clinic emphasizes interacting with an external institution and professional liaison deeply invested in the outcome of the project. The recruitment, scheduling, and administration of Clinic projects is closely monitored by the Engineering, Math, Physics, and CS Clinic advisors. The Clinic Handbooks for [Engineering](#), [Physics](#), [CS](#), and [Mathematics](#) capture the remarkable extent to which students mature in their professional practice via self-management of the pressures of authentic deliverables and deadlines.

[Engineering exit assessments](#) show that students do perceive these benefits. Clinic is the cornerstone of the design curriculum,

statistically top-rated at “preparation for the practice of engineering.” In their 2005 survey, CS alumni strongly agreed with the more general statement, “Clinic was an important part of my education.” Perhaps more telling, Clinic was the curricular program most frequently cited in the open-ended alumni survey question asking, “What was most valuable about your HMC experience?”

Not only do faculty members evaluate Clinic outcomes, through both formative and summative assessment instruments, but so also do the projects' external liaisons. Feedback from Clinic sponsors in all departments, in the format reported in the [2006 CS Department's self-study](#) indicate that their sponsors' satisfaction is consistently high (4.2 on a five-point scale) both within departments requiring Clinic and even higher among Clinic-optional majors.

#### *Presentation and speaking skills*

The [HMC 2002 Alumni Survey](#) considered the goal that HMC build good “oral and written communication skills.” As stated in the report, interpretive summary of that survey's results was not wholly positive:

*Although 65% of respondents indicated that there was at least some emphasis on writing skills present while they were at HMC, only 46% of respondents indicated that there was an emphasis on oral communication skills. In addition, only 62% of those who listed communication as one of the skills they most needed for work said they had acquired that skill as a result of their HMC experiences.*

Echoes of this result also appear in departmental reviews. For example, in their [2005 survey](#), CS alumni reported an average score of 2.9 (on a scale from 1-disagree to 5-agree) in response to the statement, “the program enhanced my oral communication skills.” As one alum noted, “I don't feel that the program *harmed* my communication skills -- I just don't feel that it helped them in any way either.” As stated in the Mathematics Department self-study, “NSSE data show that most math majors do not believe that their experiences at HMC contributed to their ability to speak clearly and effectively.”

Other evidence, however, suggest that students might have understated HMC's role in developing speaking and presentation skills. The question, "How effective were the technical presentations of your team?" received Engineering and CS liaisons' highest satisfaction scores (4.3 out of 5) among the many facets of their Clinic projects they rated.

Students' self-evaluations of their Clinic presentations, as reported in the Engineering Department's [2003 ABET accreditation study](#)<sup>6</sup>, follow this pattern, with annual scores of 6.0, 5.7, and 5.8 (on a scale of 1-7) for being "prepared well" and "professionally presented." In addition, Engineering feedback between senior year's Clinic presentations yields scores of 13.1 and 12.5 compared to the first-year students' E4 presentation scores of 12.3 and 11.3 (out of 16) in the same years. These data suggest that Clinic may positively impact students' public speaking skills more than they recognize.

Presentation skills are an important component of overall professional practice, and the Clinic program emphasizes and evaluates public speaking more than some of the other facets of projects. The culminating Clinic event, Projects Day, is comprised of conversational poster presentations and formal talks to students, faculty, liaisons and the community to present the teams' work and findings. Written reports are also given significant attention: advisors and teams carefully monitor drafts, revisions, and final document deliverables. Yet it is public presentations, with their broader accessibility and fast feedback that inspire increased self-reflection and self-confidence in students.

#### *Collaboration and team-based skills*

Perhaps it is in this area that the Clinic's assessment mechanisms themselves most influence student growth. From the onset of the projects, student teams self-organize, and often an administrative manager defers the technical leadership to appropriate teammates, while she shoulders primary responsibility for scheduling, budget, deliverables, and workflow. During presentations, in written reports, and at the end of each term, students are asked to critique their own contributions as well as those of their peers. Such self-reflection, intra-team, and inter-team evaluations complement the carefully honed criteria for the faculty- and

liaison-assessed Clinic products listed above. Perhaps not surprisingly, then, students strongly credited the Clinic with increasing their "ability to be an effective team member." As with speaking and presentation skills, recent efforts seem to be paying off.

#### *Further assessment of the Clinic program*

Assessment data suggest that Clinic participation enhances students' professional maturity (as measured by increased self-confidence), presentation and speaking skills, and collaborative and team-based skills. The Clinic program carefully and continuously evaluates itself in order to meet the needs of students, the institution, and project sponsors alike. Another facet of Clinic that receives less official attention is its influence on faculty members. Recent [research](#) suggests that time spent by faculty on Clinic-like experiences correlates with "deep approaches to learning in their courses<sup>7</sup>."

HMC's Clinic program distinguishes itself from research experiences in that the former typically has a more applied emphasis. This distinction, though, is not absolute. The visiting committee who reviewed HMC's Mathematics department asserted that the Math Clinic "should be called the 'Mathematics Research Clinic' to emphasize that a mathematics Clinic project is research, no less than a thesis." Data from [Physics Clinic students' team-assessments](#) reinforce this sentiment: there, students rated their peers higher in "the quality of their technical work" than in characteristics such as "cooperativeness, initiative, quality of communication, reliability, creativity, and promptness." That said, it is worth noting that all of the ratings were high.

The college's existing evaluation instruments seek to gauge the success of Clinic and research separately. Very little data exist that compare student experiences between these experiential activities. Data from the [2004](#) and [2006](#) National Survey of Student Engagement studies offer a slightly different path, in that they disaggregate responses by academic major. Figures 1 and 2 show intergroup differences in students' assessment of "the extent of HMC's contribution to your ability to work effectively with others," and "the extent of HMC's contribution to your ability to speak clearly and effectively."

<sup>6</sup> The Engineering Department's 2009 ABET self-study will be made available to the visiting team at the time of HMC's October 2009 site visit.

<sup>7</sup> [Kuh, G. D., Chen, D., and Laird, T. F. N.](#) (2007) *Why Teacher-Scholars Matter* Liberal Education 93(4) Fall 2007, pp. 40-45

Figure 2. "What is the extent of HMC's contribution to your ability to work effectively with others?"

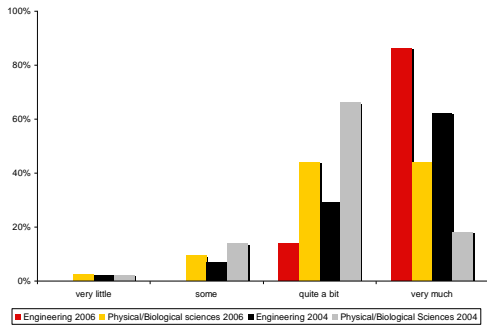
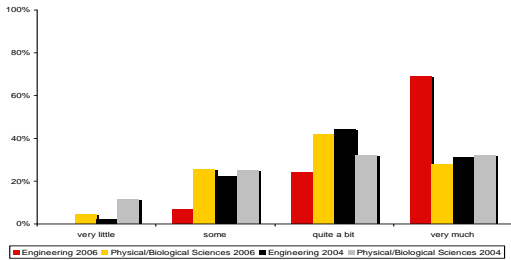


Figure 1. "What is the extent of HMC's contribution to your ability to speak clearly and effectively?"



Source: Report on HMC Mean Scores, National Survey of Student Engagement, 2004 & 2006

That Engineering students' distributions skew toward higher scores may be due, in part, to their Clinic experience and the engineering curriculum which has students working in teams and speaking publicly from the start (E4 and E80).

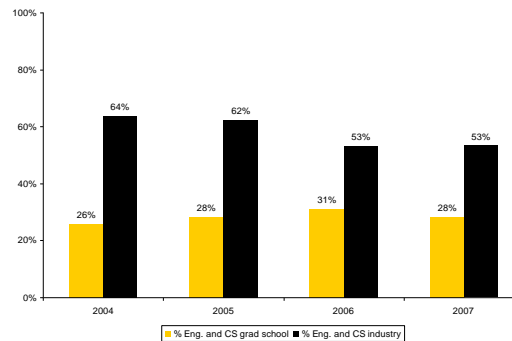
Some data suggest that Clinic does not synthesize students' skills as much as hoped. For example, the [2003 ABET Report](#) showed: 1) Engineering Clinic liaison surveys' lowest marks applied to students' "experimental skills," and 2) Engineering Student Clinic surveys also suggested only moderate satisfaction with how Clinic increased their "ability to apply material learned in other courses." While more recent and future data may further elucidate these results, the necessarily specialized nature of each Clinic project may be the most fundamental cause. While it is often difficult to quantify the project-specific knowledge gained by student teams on particular project, the final Clinic reports leave the strong impression of student learning.

#### 4. Are students' career choices affected by Clinic experiences?

It is certainly the case that Clinic experiences inform students' career choices. [Data](#) from the Office of Career Services do not distinguish between Clinic students and non-Clinic students in its tracking of post-graduation endeavors. It is possible, though, to use academic major as a closely correlated proxy.

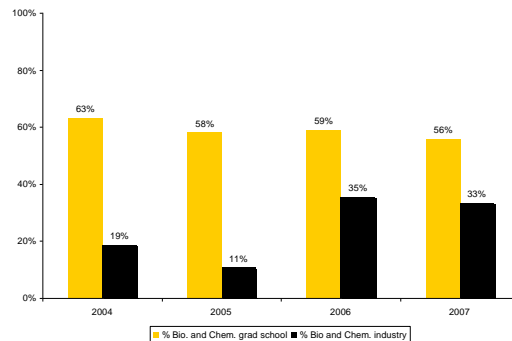
Comparing CS and Engineering students (all of whom complete a Clinic project) to Biology and Chemistry students (very few of whom participate in Clinic) over the past four years, it is not surprising that a larger portion of the latter group have chosen to pursue graduate school. These data are shown in Figures 3 and 4.

Figure 3. Initial post-HMC path of Engineering and CS majors



Source: Office of Career Services, 2008 Senior Survey

Figure 4. Initial post-HMC path of Biology and Chemistry majors



Source: Office of Career Services, 2008 Senior Survey

These correlations almost certainly do not reflect causal relationships; both the choice of experiential activity (academic major) and the choice of post-graduation activities (graduate school or employment) stem from students' interests, and our indirect assessment measures provide no way to discern which factor has more influence. Second, these indirect data reflect only students' first step after an HMC education. Many students enter graduate school after spending a few years working in a corporate or entrepreneurial environment; others make the same switch in reverse. Third, and perhaps most important, is the large variance of Clinic's impact on students' careers. Each year a few students find their Clinic sponsor a compelling fit, and are hired by that organization.



## C. The Effectiveness of Experiential Learning Activities

### 5. *Is experiential learning effective for student education throughout all four years?*

Available data suggest students benefit from the EL opportunities at HMC. The report of the visiting committee for the Mathematics Department evaluated the Math Clinic as highly effective for seniors and, indeed, regards this program as one “for which HMC should be known.” In another area, the positive experiences students have studying abroad continue to attract students to this program in significant numbers. In its recent [curriculum revision](#), the Humanities, Social Sciences and the Arts Department recognized the contribution of the study abroad program to the goals of the department by moving to an automatic waiver of one required departmental course if a student spends a semester in an approved study abroad program. Summer research is another area of EL that appears to be serving student needs well. The data collected from summer research surveys indicates clear, albeit uneven, benefits in students’ development of the skills involved in the conduct and dissemination of scientific research.

Finally, while Clinic experiences across the college win high praise from a large majority of students, not all students who participate in Clinic benefit from it or do so as much as they might from an alternative type of capstone experience. The report of the CS Department’s external review committee notes there is a significant portion of CS majors who believe that they would have been better served by the option of writing a thesis instead of doing Clinic.

### 6. *Are there specific educational benefits of earlier exposure to a research experience?*

At present, the college lacks data to support conclusions regarding the benefits of earlier exposure to EL opportunities. As noted above, there were differences in self-reported gains from research experiences between students in the first two years of HMC and those in their final two years. It is possible that these differences arise because older students have a broader context against which to compare their improvements. More generally, this result may point to experiential activities’ fundamental tradeoff: leveraging early enthusiasm is effective, particularly in the resulting momentum toward deeper study, but maximal

gains might come later, atop a foundation of coursework and context that academic experiences are more efficient at providing.

### 7. *How does a student’s choice of major affect their experiential learning opportunities?*

It is impossible to quantify the effectiveness and relative contribution of the many different forms of EL that comprise an HMC education. Some of the contributions are evident from the program reviews concluded in recent years by HMC’s departments of CS, Mathematics, and Physics. In Engineering and in CS, students’ signature experiential opportunities are likely their respective Clinic programs. Engineering Clinic is apparently highly effective for the vast majority of its students, as reported in the [2003 ABET Report](#). CS Clinic looks to be highly effective for students seeking employment after graduation, but less effective at serving the needs of students attending graduate school. The difference in effectiveness here is clearly attributable not to any intrinsic superiority of the [Engineering Clinic](#) program but to differences among the students pursuing each major. The Mathematics Department offers its majors a choice of Clinic or thesis, thus inviting students to select the mode of EL they deem most relevant to their future. Thus, while different modes of EL may not be equally effective, student choice seems to mitigate some of these differences. In Physics, it is laboratory research rather than Clinic that provide most opportunities for EL. The Physics department’s [self-study](#) acknowledges ambivalence among non-majors concerning the value of the physics lab component of the Core. However, this contrasts with the high marks that Physics majors give this same component and to the Physics program as a whole.

## D. Institutional Capacity for Experiential Learning

### 8. *Do we have the infrastructure and resources necessary to maintain and/or expand our experiential learning curriculum?*

Both the Clinic and research programs at HMC are integral components of the college’s EL curriculum, and every year the resources devoted to the Clinic and research programs meet the students’ needs—no student is ever denied the opportunity to participate in either a clinic or senior thesis project. Currently, however, the college’s infrastructure and resources are under pressure. For example, in 2007-2008 the Mathematics Department housed a Clinic team in a lab borrowed from

the Chemistry Department. The sub-standard space had ventilation problems and was designed for a different purpose. Further, faculty mentors for the Clinic teams were drawn from emeritus faculty and from Claremont Graduate University. The need for improved educational spaces and increased numbers of faculty is noted in [HMC's Strategic Plan](#); this issue will be a major focus of the coming capital campaign.

In the past, the Clinic Program has relied on instrumentation and general scientific infrastructure provided by research grants to the college and purchases in support of formal laboratory coursework. Occasionally there are holes in this infrastructure. For example, the Clinic directors perceive an urgent need for current-generation radio frequency instrumentation. The Clinic directors hesitate to take on Clinic projects in the area of GHz telecommunications because of the college's shallow instrument resources in this area. To expand the EL curriculum within engineering, the college should consider investing in infrastructure to support environmental testing, including thermal, shock, vibration and material, computer aided manufacturing, rapid prototyping, performance evaluation, and high speed systems and communications.

The [Global Clinic](#) is in its third year of a pilot phase with temporary funding to cover the Clinic expenses not covered by fees paid by the sponsor. The current charges to the sponsor cover out-of-pocket expenses, but are insufficient to support personnel, infrastructure and overhead expenses. In order for the Global Clinic to be a successful and sustainable EL program, significant funds will need to be raised to support and develop: (1) salary for staff and the director of Global Clinic; (2) overhead to pay for the costs associated with the departments who provide support and instrumentation for the Global Clinic; (3) infrastructure costs such as computers for the students, communication tools and travel; and (4) funding for Global Clinics that are foundation-based.

#### **IV. Practices that will Deepen HMC's Understanding of Experiential Learning**

The process of answering the research questions posed at the beginning of this essay has suggested several unobtrusive ways in which HMC faculty, students, staff, and administrators might track the impact of EL in the future. Before summarizing those suggestions, it is important to acknowledge

the lack of a cohort of HMC students who do not participate in EL activities. Every student at Harvey Mudd takes part in at least one year-long capstone experience, so we cannot generate within our student body the control group data needed for any curricular study of the capstone experience.

That said, in the next stage of our accreditation cycle we will narrow the focus of our experiential learning study to consider the educational benefits of the capstone experiences required of each of our students. We will tie the capstone experiences to specific student learning outcomes. Our efforts will fill in some of the gaps in our knowledge that remain as we conclude the second stage of our review, and may include studying the capstone experiences of our peer institutions, and assessing whether or not students who go through a capstone experience at HMC reap educational benefits such as:

- Enhanced ability to put classroom knowledge into practice
- Enhanced communication skills, both oral and written
- Enhanced technical skills within the discipline
- Enhanced development of personal initiative
- Increased confidence

Further, we will try to determine if students who complete a summer research or internship experience prior to their capstone experience display more growth in these educational outcomes. More qualitatively, are these students more likely to be involved in a professional activity such as writing a manuscript or attending a conference? If the answers to these questions are affirmative, should we ask all students at the college to participate in a summer research or internship experience? Do we have the faculty and facilities to support such an endeavor? Assessing the educational benefits of the capstone experience, and understanding what factors make it most effective, is an important next step for HMC.

## Essay 2

# DIVERSITY AT HARVEY MUDD COLLEGE

### I. Introduction

In its Mission Statement, HMC emphasizes the relationship between personal and social understanding. One of the many ways to implement this mission is to build a community that represents the larger society we serve. Doing so requires increasing the college's diversity. Fittingly, one of the six major themes to emerge from the college's 2006 Strategic Plan, [HMC 2020: Envisioning the Future](#), is "unsurpassed excellence and diversity at all levels." HMC is committed to creating a more diverse community in order to build a learning environment that both educates students in a culturally responsible setting and attracts and serves the complete pool of potential future scientists, mathematicians, and engineers. In particular, increasing ethnic diversity among the faculty, students, staff, and trustees – and creating a campus climate that is committed to the best learning opportunities for all members of such a diverse community – is critical to HMC's continued role in educating the next generation of leaders in science, technology, engineering and mathematics (STEM) disciplines.

Creating a campus that is equally accepting and supportive of all its members is consistent with the college's mission and [Honor Code](#). Since the early 2000s, HMC has developed new programs for education, advising and retention. Our work continues as we seek to promote discussions between people with different viewpoints and encourage training that will allow people to engage in positive and meaningful interactions. We seek a curriculum, culture and community that enable the success of exceptionally talented people from all backgrounds.

### II. Diversity Theme: Overview, Process and Capacity, and Goals

#### A. Overview

Over the last decade, the college has made significant progress in recruiting and retaining female students and faculty. In 2006-07 women comprised 29% of the student body compared to 20% on average in the 1990s<sup>8</sup>. In 2005,

<sup>8</sup> Harvey Mudd College, Office of the Registrar, Annual Enrollment Data

women made up 35% of the entering class; in 2007 female enrollments increased to 43%<sup>9</sup>. HMC has also increased the number of women faculty to 35% overall in 2008-2009<sup>10</sup>. This trend is particularly important when compared to the ratio of female faculty members teaching in the STEM disciplines at comparative institutions. [Data](#) compiled from 11 liberal arts colleges showed that, on average, 33% of all tenure-track faculty teaching in the STEM disciplines during the 2007-2008 academic year were female; at Harvey Mudd, this percentage was 32%. Further, HMC has a steady growth in the number of tenure-track female faculty: in 2007-2008, 44% of Associate Professors and 53% of Assistant Professors were female.

HMC's progress toward ethnic diversity within the student body has been slower. In fall 2008, African-American students comprised only 1.7% of the student body, and Hispanic students comprised 7% of all students at HMC<sup>11</sup>, despite data presented in the American Council on Education's [Increasing the Success of Minority Students in Science and Technology](#)<sup>12</sup> that show minority students enter STEM disciplines at the same per capita rate as all other student cohorts. Our goal is to address this imbalance because we believe that increasing the racial and gender diversity within the student body will create an improved learning experience for all students, instill in all students a greater awareness of the cultures, attitudes, and experiences of others, and prepare graduates to thrive in a global society.

#### B. Process and Capacity

To create a more diverse campus, one that thoughtfully evolves to meet the needs of our current and future faculty and students, a better understanding of diversity at HMC was needed. We posed a number of diversity-related research questions in the college's Institutional Proposal. Once the proposal was accepted, HMC's WASC Steering Committee and the Faculty Executive Committee asked HMC's Campus Life Committee (CLC) to address the research questions related to the diversity

<sup>9</sup> Harvey Mudd College, Office of the Registrar, Annual Enrollment Data

<sup>10</sup> Harvey Mudd College, Office of the Dean of Faculty

<sup>11</sup> Harvey Mudd College, Office of the Registrar, Annual Enrollment Data

<sup>12</sup> [Anderson, A., and Dongbin, Kim](#). Increasing the Success of Minority Students in Science and Technology. The Unfinished Agenda: Ensuring Success for Students of Color (4<sup>th</sup> in a series), American Council on Education, Washington, D.C., 2006.

theme. Consistent with the discussion in the [Institutional Proposal](#), and HMC's recent Strategic Planning process, the CLC chose to focus on diversity issues pertaining to race and gender. Research methods employed by both the CLC and other departments and committees that provided support for the exploration of this theme included the following:

- Collection and analysis of national benchmarking data relevant to diversity issues at HMC
- Consideration and examination of best practices (external to HMC) for recruiting and retaining a diverse community of students, faculty members, and trustees
- Engagement of all campus constituents, including faculty, staff, students, alumni and trustees, in discussions on the climate for diversity at HMC
- Identification of additional assessment tools and direct evidence needed to measure, gauge and ultimately achieve the college's emergent diversity goals

### **C. Program and Learning Goals for Diversity at HMC**

Diversity at HMC is explored in service to two larger institutional- and student-centered goals:

#### Institutional Goal:

- *Increase and sustain faculty, student, staff, and trustee diversity at HMC.* HMC is committed to developing a community of scholars whose racial, ethnic, cultural, and national diversity reflects the global community in which we live.

#### Student Learning Goals:

- *Improve students' understanding of the impact of their work on society.* As stated in HMC's [Mission Statement](#), HMC's goal of graduating students who understand the impact of their work on society will be more strongly inculcated in students who work closely and live with others from different groups within that society.
- *Improve students' leadership abilities.* As stated in HMC's Mission Statement, the college maintains the goal of graduating students who will assume positions of leadership in their fields. Students who work in a diverse environment may become better leaders in the future because they develop a broader cultural understanding while in college.

Using these institutional and student learning goals as a framework upon which to conduct this inquiry, the following research questions were established:

1. What is the pipeline for underrepresented students and faculty using traditional measures for admission or hiring at HMC?
2. Why don't underrepresented students enroll in greater numbers HMC?
3. Do HMC's curriculum, pedagogy, and/or research present obstacles to attracting and retaining diverse students and faculty?
4. What knowledge, skills and attitudes do diverse students need to succeed at HMC, both in the classroom and more broadly?
5. Which knowledge, skills and attitudes of traditional HMC students may be changed by the creation of a more diverse HMC campus?
6. What is the climate at HMC for underrepresented students, staff, faculty, and trustees?
7. How can we improve the culture for diversity at HMC for all students, staff, faculty, and trustees?
8. What has worked to increase the access, retention and success of underrepresented students at institutions similar to HMC?

### **III. An Exploration of Diversity at HMC**

#### **A. Pipeline: Access to an HMC Education**

##### ***1. What is the pipeline for underrepresented students and faculty using traditional measures for admission or hiring at HMC?***

*What are HMC's admission criteria?*

Academic admission criteria for HMC are rigorous. The median SAT scores at HMC (and middle 50% ranges) for the entering freshman 2008 fall cohort were as follows:

**Table 1. Mean, Median and mid-50<sup>th</sup> percentile range of SAT scores, fall 2008 first-year cohort<sup>13</sup>**

	Mean	Median	Mid-50 <sup>th</sup> %
Crit. Read.	718	730	670-770
Writing	713	720	680-760
Math I	763	770	750-800
Math II (Subject)	770	790	750-800

Table 2 illustrates that, when considering only national SAT data that reflect these ranges, the total combined eligible pool of African American, Hispanic/Latino and Native American students is approximately 2,000.

**Table 2. Number of students with high (750 to 800) SAT scores, by ethnicity, 2008<sup>14</sup>**

Exam	Black	Nat. Am.	Asian	Hispanic/Latino	White
Crit. Read.	305	77	4,670	1,518	16,204
Writing	272	79	16,142	1,854	19,581
Math	248	40	4,601	1,338	14,330

*Note: Hispanic/Latino includes Mexican/Mexican-American, Other Hispanic/Latino, and Puerto Rican*

Advanced Placement (AP) test data also show a limited number of minority students with advanced background in math and science. When considering only the participation of underrepresented students who took the Calculus BC, Chemistry and Physics B AP exams, their representation among the entire population of test-takers is very small. Data in Table 3 show that Black, Hispanic/Latino and Native American students are not well-represented among students who took AP exams in math and science in 2007, representing about 10% of the population. Data in Table 4 illustrate that the total number of underrepresented students earning a score of 4 or 5 on these exams represents approximately 500-2,500 potential minority applicants (depending on the test in question).

**Table 3. AP Test Takers, Percent by Ethnicity, 2007<sup>15</sup>**

	Biology (n = 110,367)	Calculus BC (n = 51,693)	Chemistry (n = 73,233)	Physics B (n = 43,311)
Black	5.92%	2.30%	4.60%	4.00%
Nat. Am.	0.04%	0.02%	0.04%	0.03%
Asian	19.30%	27.20%	22.25%	19.12%
Hispanic/Latino	8.60%	5.34%	7.17%	8.50%
White	59.40%	59.60%	60.30%	62.30%
Other	3.63%	3.10%	3.20%	3.11%

*Note: Hispanic/Latino includes Mexican/Mexican-American, Other Hispanic/Latino, and Puerto Rican*

**Table 4. Number of students with AP Test Scores of 4 or 5, by Ethnicity, 2007<sup>16</sup>**

	Biology	Calculus BC	Chemistry	Physics B
Black	829	355	321	131
Nat. Am.	111	70	58	35
Asian	10,311	9,031	6,925	2,909
Hispanic/Latino	1,589	1,107	760	449
White	25,975	18,630	14,530	8,706
Other	1,545	953	735	368

*Note: Hispanic/Latino includes Mexican/Mexican-American, Other Hispanic/Latino, and Puerto Rican*

*How would changing admission standards increase the potential pool of underrepresented applicants?*

There is a noticeable increase of potential applicants when students who receive SAT scores at the next tier are considered. While the number of White students approximately doubles for the Critical Reasoning and Math tests, the number of Latino and Black students more than triples, suggesting that there may be some untapped potential applicants who do not necessarily score as well on the SAT test as the average HMC student. In other words, a larger pool of potential students exists, but there remains the challenge of determining who among these lower-scoring students have the academic aptitude to thrive at HMC.

<sup>13</sup> Harvey Mudd College, Office of Admission

<sup>14</sup> The College Board, [2008 College-Bound Seniors Report](#)

<sup>15</sup> [AP Report to the Nation, 2008](#)

<sup>16</sup> [AP Report to the Nation, 2008](#)

**Table 5. Number of students with Mid-High Range SAT scores (650-740), by Ethnicity, 2008<sup>17</sup>**

Exam	Black	Nat. Am.	Asian	Hispanic/Latino	White
Crit. Read.	3,405	543	18,370	13,124	94,112
Writing	2,863	393	19,755	10,698	85,539
Math	3,275	662	36,258	16,038	116,232

*Note: Hispanic/Latino includes Mexican/Mexican-American, Other Hispanic/Latino, and Puerto Rican*

## **2. Why don't underrepresented students enroll in greater numbers at HMC?**

*Why do admitted students who do not enroll at HMC choose another school?*

For the past several years, HMC has participated in the [Admitted Student Questionnaire](#) (ASQ), an annual study administered by the College Board. Based on responses to the [2008 ASQ](#), the following variables were ranked highly by HMC matriculants as both a personal priority and strength of the college: Academic reputation; Special academic programs; Surroundings; Campus attractiveness; Arts/Humanities emphasis; Availability of merit scholarships; and On-campus housing. Aspects of the HMC campus that were not rated as highly among HMC matriculants included: Cost of attendance; On-campus activities; Off-campus activities; and Quality of social life.

*What financial aid packages are students offered at HMC and at comparative/peer institutions?*

An early hypothesis regarding reasons for which HMC has difficulty recruiting and retaining underrepresented students is that the college cannot adequately compete with the financial aid packages offered by competitive institutions. However, after careful study, we believe that financial aid is not a limiting factor for recruiting and retaining underrepresented students. To test the original hypothesis, [financial aid data](#) from AITU campuses, research universities and liberal arts colleges included in HMC's comparative cohort were gathered from the Integrated Postsecondary Education Data System (IPEDS). When considering federal, state and institutional grant aid, HMC offers anywhere from 16% to 90% higher (in dollar amounts) than other campuses.

The average total award for AITU schools in 2006-2007 was \$23,125, whereas HMC's average award was \$35,724. HMC's average total award was slightly lower than the average award offered by peer liberal arts colleges (\$36,107), and was slightly higher than the average award offered by comparative research universities (\$31,295). The data also show that HMC offers more grant aid and slightly less loan aid. The average loan for an HMC student for 2006-2007 was \$3,859, slightly lower than the average loans for AITU (\$5,588) and research universities (\$4,497), but higher than the average loan aid offered by liberal arts colleges (\$3,606).

*If HMC's pipeline of diverse students is narrow, do we have the financial resources to be competitive in attracting these highly sought after students?*

Comparing the financial aid awards provided by two of the leading research institutions with which HMC competes most directly – the Massachusetts Institute of Technology (MIT) and the California Institute of Technology (Cal Tech) – we see that HMC does not offer the most competitive financial aid in light of the total cost of attendance. These comparative financial aid data show that MIT has more financial resources with which to offer competitive and attractive financial aid incentives. However, comparative financial aid award data pulled from IPEDS, as well as responses to the Admitted Student Questionnaire, suggest that financial assistance is not necessarily a strong barrier to accessing a HMC education.

## **B. Curriculum: The Academic Experience at HMC**

### **3. Do HMC's curriculum, pedagogy and/or research present obstacles to attracting and retaining diverse students and faculty?**

*How does the HMC curriculum differ from that offered at other peer institutions?*

When considering whether the unique HMC curriculum creates opportunities or barriers to academic achievement among a diverse student population, it is important to understand what makes the HMC curriculum different from peer institutions. A [review](#) of the first-year curricula for students at eleven highly-selective institutions suggested that while many campuses known for their strong undergraduate STEM programs have established pre-defined core (or distribution) requirements for first-year

<sup>17</sup> The College Board, [2008 College-Bound Seniors Report](#)

students, their breadth of academic scope varies. The California Institute of Technology, Rose-Hulman Institute of Technology and Swarthmore college are three institutions who have identified a set of core courses and/or distribution requirements to be completed exclusively during a student's first two years at college. Other universities, including MIT, UC Berkeley, Brown, and Princeton require students to take courses from a variety of disciplines, including science, humanities, and writing, but do not require that these be completed during the first or second year. Still other peer institutions, including Pomona college and Stanford University, have created one-term (semester or quarter) courses for small groups of freshman cohorts, which typically focus on issues pertaining to the humanities, writing and rhetoric. As reported in the SVCC's revised Core [proposal](#), the committee concurred that the HMC Core, in comparison to peer institutions, was more rigid and extensive, and would benefit from streamlining in order to afford students greater electivity. A commonality among distribution requirements at all institutions considered in this curricula review was the inclusion of instruction in the areas of writing and humanities. HMC, then, is similar to its peer institutions in integrating humanistic and liberal arts studies into traditional STEM programming offered at competitive colleges and universities.

*What is the impact of the academic pipeline at HMC on women and underrepresented students?*

Obstacles to attracting students are often related to the academic pipeline established for first- and second-year students. Like many other highly selective institutions, HMC is faced with the challenge of recruiting and retaining students from traditionally underrepresented groups who are well prepared for the academic rigor of HMC. For example, it is known that HMC's calculus requirement is an obstacle to finding a ready supply of adequately prepared minority students. [Data](#) from the National Center for Education Statistics<sup>18</sup> suggest that, across the United States, the number of students from all race/ethnic backgrounds taking Calculus in high school has increased from 11.8% in 1998 to 13.9% in 2004, whereas the number of Black students taking Calculus has declined from 7.0% to 4.7% in this same period.

<sup>18</sup> [NCES\\_HSgrad\\_math.pdf](#).

Studies suggest that adding undergraduate research experiences, service-learning opportunities, and consideration of social and professional relevance to STEM curricula will help all students but especially women and students of color<sup>19</sup>. HMC has an extensive undergraduate research program and a nascent culture of service learning. While consideration of the social relevance of technology was one of the pillars upon which the college was founded, it has been an ongoing challenge to emphasize the importance of the social relevancy of the academic discipline to a population of students who otherwise are inclined to focus on the purely technical. Making our curriculum more accessible to people not of the majority culture will contribute to our ability to meet this stated goal.

It is well documented in the literature that both a gender and race gap exist in many STEM disciplines. Current research suggests women and underrepresented racial minorities (including Black, Latino and Native American) receive fewer [degrees](#) in many STEM disciplines<sup>20</sup>. National studies have documented an increased attrition of women in [computer science](#)<sup>21</sup> and [engineering](#)<sup>22</sup>, and a performance and attrition gap in physics<sup>23</sup>, while other reports have documented the so-called "digital divide" that disproportionately affects underrepresented minorities<sup>24</sup>, causing them to enter STEM fields in fewer numbers. These results are well known, and their origin is a topic of voluminous discussion in the literature.

To understand how HMC fits into this national picture, we completed a statistical study of the performance of men and women of different races and ethnicities in our Core curriculum. Variables included in this analysis were race, gender, SAT Math scores, SAT Verbal scores

<sup>19</sup> [Davis, C. Finelli, C. et al.](#) (2007). *Undergraduate Initiatives to Improve Diversity and Retention in Engineering*. University of Michigan.

<sup>20</sup> [NCES data tables](#): women and traditionally underrepresented minorities in STEM-related fields.

<sup>21</sup> [Cohon, J. M.](#) "Just Get Over It or Just Get On with It." *Women and Information Technology: Research on Under-Representation*. MIT Press (2006); ([http://www.cs.cmu.edu/~lblum/PAPERS/women\\_in\\_computer\\_science.pdf](http://www.cs.cmu.edu/~lblum/PAPERS/women_in_computer_science.pdf))

<sup>22</sup> [NSF data table](#): Undergraduate enrollment in engineering programs, by sex, race/ethnicity, and citizenship, 1995-2006.

<sup>23</sup> [Lauren E. Kost](#), et al., *Phys. Rev. ST*, **5**, 010101 (2009); [Mercedes Lorenzo](#), et al., *Am. J. Phys.*, **74**, 118 (2006)

<sup>24</sup> [Digital Divide Separates White, Minority Students](#), *Boston Globe*, [Sept 6, 2006](#). ([http://www.boston.com/news/education/k\\_12/articles/2006/09/06/digital\\_divide\\_separates\\_white\\_minority\\_students/](http://www.boston.com/news/education/k_12/articles/2006/09/06/digital_divide_separates_white_minority_students/))

and students' financial need<sup>25</sup>. Native Americans, Blacks, and Hispanics were combined into one group (underrepresented minorities), and students of either unknown or foreign origin are included into another group.

We found that SAT Math scores are positively correlated with most of the fourteen Core courses, whereas SAT Verbal scores have little or no correlation with academic performance. Likewise, a student's level of financial need also appeared to have little correlation with academic performance.

In contrast, either identifying as a traditionally underrepresented group or being female correlated with a somewhat lower grade in many Core courses (twelve of fourteen courses for the underrepresented minorities, and four of fourteen courses for females). However, in two of the lab courses, there was a positive correlation between female students and academic performance. For eight of the fourteen Core courses, there is no correlation (i.e., neither positive nor negative correlation) between being a female and grade in the class, and for underrepresented minorities this was true of two of the courses: E59 and Chem 26. (All results control for differences in an individual's standardized test scores and socio-economic status.) Further, [data](#) from the Office of Academic Affairs show that for the past seven years, eleven students have been awarded HMC's Platt Prize for the Outstanding Freshman, seven of whom were women.

These findings prompt us to study this issue in greater depth for our Educational Effectiveness Review. A first step in this study will be to conduct a similar statistical analysis of courses offered in the major. As we carry out these studies, it is worth reemphasizing that current results should be viewed in the national context: HMC's data are consistent with gender and ethnicity gaps seen throughout the U.S. Additional data analysis will help us better understand the ultimate causes of the gender and ethnicity gaps at HMC, and allow us to improve the educational prospects of all of our students<sup>26</sup>.

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<sup>25</sup> To calculate a financial need variable, HMC's Financial Aid office provided data on financial need as determined by the institutional methodology for entering first year students for the past four years. This number was then subtracted from the cost of attendance for the appropriate year to derive a number to represent what the student and family paid.

<sup>26</sup> One starting point for HMC's self-study of gender gaps may be the Carnegie Mellon University (CMU) study, which showed that the fraction of women entering CS at CMU was chronically near

#### ***4. What knowledge, skills and attitudes do diverse students need to succeed at HMC, both in the classroom and more broadly?***

Other indirect, yet diversity-focused, data are available to inform our study of the student experience at HMC. Data from the [2004 Proctor Survey](#) suggest that the overall opinion of HMC's diversity efforts by students was negative; this trend changed noticeably in the [2007 Proctor Survey](#), when the majority of students indicated that diversity is important for HMC. It is important that, as the college moves forward in its diversity program, there be a match between perceived importance and the efforts being undertaken. In this spirit, the college's Office of Institutional Diversity (OID), led by the Associate Dean for Institutional Diversity, provides the leadership that has defined diversity as one of the primary emphases within the academic and co-curricular programming at HMC.

#### ***5. Which knowledge, skills and attitudes of traditional HMC students may be changed by the creation of a more diverse HMC campus?***

Increased learning in a diverse environment is explained by the notion that one learns from both direct experience, and comparing different experiences. This has also been demonstrated by several research studies conducted by the Cooperative Institutional Research Program (CIRP) at UCLA; one study suggest that the benefits accrue disproportionately to white students while another purports that Black students do not see these gains. Another study found small but significant correlations between diversity and self-reported gain in engineering problem-solving ability. Empirical data also suggest that diversity experiences, such as attending cultural awareness workshops or having discussions about race issues, positively impact both self reported gains in, and performance on, standard assessments of critical thinking<sup>27</sup>.

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10%, but then jumped to over 40% after 1995 when a new curriculum was implemented.

<sup>27</sup> Pascarella, E. T., and P. T. Terenzini. *How college Affects Students, Vol. 2: A Third Decade of Research*. San Francisco: Jossey-Bass, 2005.



### C. Climate: Creating a Sense of Place within the HMC Community

#### 6. What is the climate at HMC for underrepresented students, staff, faculty and trustees?

HMC is committed to understanding the extent to which the climate on campus is conducive to the cultural, religious, racial, ethnic and national diversity that exists among students, faculty and staff. Evidence of this commitment is shown by the Offices of the Dean of Faculty, Dean of Students, and Institutional Research practice of conducting assessments of first year students, seniors, and alumni using a variety of instruments, including the annual HMC Proctor Survey, and the HMC Campus Climate Survey. National assessment instruments used at HMC include the Higher Education Research Institute's CIRP Freshman Survey and college Senior Survey (CSS), the National Survey of Student Engagement (NSSE), the Beginning college Survey of Student Engagement (BCSSE), and the Higher Education Data Sharing (HEDS) Consortium Alumni Survey. HMC also offered a series of diversity forums in 2007 and 2008, which focused on race and gender/sexual orientation. Approximately 25% of the faculty have participated in both forums, and 62% have participated in one<sup>28</sup>.

[HMC Campus Climate Survey](#) (2002-2005) – This survey was distributed to all HMC faculty and staff, and asked questions regarding perceived discrimination, and institutional commitment to cultural diversity. Data were analyzed by comparing the responses of “white” and “non-white” participants. There was very little change in data trends within the four-year period in which the Campus Climate Survey was conducted. Overall, faculty and staff perceived HMC as being committed to cultural diversity, with the administration being open to discussing complaints of racism. Both categories rated lower at a statistically significant level ( $p \leq 0.05$ ) by non-white respondents. Perhaps not surprisingly, significantly ( $p \leq 0.05$ ) more non-white respondents reported more incidents of racial/ethnic discrimination and stated that some college policies constitute discrimination.

*Higher Education Research Institute (HERI) College Senior Survey* (2002 & [2008](#)) – The Dean of Students Office administers the college Senior Survey (CSS). Comparison results are

provided by HERI for responses from students at “non-sectarian, four year” colleges and at all private four-year colleges. Approximately 162 students completed the 2008 survey instrument, yielding a response rate of 89%.

Several of the questions asked in the CSS address directly issues of racial and ethnic diversity on campus. In general, HMC students' responses were consistent with the responses of their peers, with a few exceptions: (1) more HMC students reported that they had a roommate of a different race/ethnicity, participated in race/ethnic student organizations, and socialized, studied and had intellectual conversations with students of a different race/ethnicity; (2) fewer HMC students reported that they heard faculty express stereotypes about racial/ethnic groups in class, were satisfied with the racial/ethnic diversity on campus, and had a much stronger ability to get along with people of different races and cultures.

*Higher Education Research Institute (HERI) Freshman survey* (1971-[2007](#)) – The HERI Freshman survey, also administered by the Cooperative Institutional Research Program at UCLA, is given to freshmen at HMC during their first weeks at college. Most recently, the CIRP freshman survey was administered to freshmen during the fall 2007 new student orientation program. Data from this study show that, in comparison with their peers at other colleges, HMC freshmen reported more frequent interaction with students of a race/ethnicity different from their own, and anticipated that they would continue to do so during their college years. This survey will also be administered to first-year students entering HMC in fall 2009.

[HMC Proctor Survey](#) (2007) – The Proctor survey is administered annually by the Dean of Students Office as an assessment of student proctors in the residence halls. In 2007, students were asked, “Why do you think diversity is important for Harvey Mudd?” An analysis of the free response data shows that 78% of students give a positive response (generally in favor of diversity initiatives on campus) while only 5% report a negative response. Positive responses included: “good for learning both intellectually and in personal development” (28%), “increases tolerance” (11%), and “reflects the real world” (9%). Some students feel strongly that HMC should not allow diversity to decrease the college's rigorous admission standards (6%), and only a

<sup>28</sup> Strategic Vision Diversity Committee 2007-08 [Report](#)

small number felt that diversity at HMC is not important (4%) or that HMC is going about addressing issues of diversity incorrectly (3%).

[GM Psychological Services Focus Group Report](#) (2005) – GM Psychological services interviewed groups of students, staff and faculty in small focus groups in 2005. A concern indicated by the consultants in their final report was the resistance and difficulty in scheduling focus group meetings, which perhaps compromised the validity of the research methods used. The total number of participants in all four sessions was 26 people, and no follow up interviews with participants occurred. The executive summary and conclusions stated within the GM Psychological Services’ report to HMC highlight a number of strengths within HMC in creating and maintaining a campus climate that is hospitable to diversity, as well as continued concerns faced by the college. The report notes, for example, that many students and some faculty feel that attempts to diversify either population have compromised the quality of an HMC education. In highlighting recommendations for the community to consider, the focus group report stated that the most important factors inhibiting further growth in diversity were time (e.g., overworked faculty, staff, and students), lack of communication regarding diversity efforts on campus, as well as meaningful dialogue between people, and the curriculum being so rigorous that it “fails to encourage social thinkers” (p. 23). The report also suggests a strong elitist attitude among both faculty and students which “prevents community members from being willing to consider other perspectives” (p. 23) and a lack of common vision for what diversity means.

Since the time of this report, HMC has offered diversity training programs, including staff-faculty forums and the multicultural ally program for students, which is coordinated through the OID. These offerings, and coordination and administration by the OID, were recommendations made within the focus group report that were implemented most visibly at HMC.

#### **D. Institutional Capacity for Diversity at HMC**

##### **7. How can we improve the culture for diversity at HMC for all students, staff, faculty and trustees?**

*What are the likely impacts of implementing a diversity awareness program for all members of the community?*

As students, staff, faculty and trustees become more aware of diversity, including the problems faced by minority students, and the challenges of recruitment and retention, it is likely that the racial/ethnic makeup of HMC will change. A number of committees over the past 15 years have studied this issue and made recommendations, summarized below.

[Student Experience Task Force](#) (1994-1995) – This committee’s 1995 report identified challenges that HMC still faces as an institution today, and recommended that HMC expand its admission pool given that the number of white students throughout the U.S. graduating from high school was projected to decline both as a percentage and as a raw number. This decrease, the committee suggested, would enable schools “which are able to identify, recruit, enroll and retain highly talented underrepresented minority students ... to maintain the quality of their student bodies in a contracting market” (p. 4). The report suggested that access to STEM education has been one of the best ways to improve one’s chances to access the “fortunate” category due to the increasing importance of technology in our society.

[Blueprint for Diversity](#) – The 1999 Blueprint for Diversity provided an outline for diversity efforts at HMC. Important recommendations included: (1) raising community awareness of diversity; (2) improving recruitment, enrollment, advisement, support and retention of diverse students, faculty and staff; and (3) identifying ways to integrate issues and theories pertaining to diversity into the content and delivery of the curriculum. The committee that drafted the Blueprint for Diversity was charged with developing more specific mechanisms to achieve these goals, and these were outlined in their 2002 report. While some of the recommendations made by this committee could be perceived as being “top-down” and administrative in oversight, many of the recommendations have already been implemented at HMC.

[Greater Expectations Report](#) (2004) – The Greater Expectations Report summarized the experiences of several senior staff and faculty

who attended a workshop on Diversity sponsored by the Association of American Colleges and Universities. A key finding shared at this workshop was that diversity interactions increase “active thinking, academic engagement, motivation, and academic and intellectual skills.” To incorporate these, it was suggested that more “Friday forum”-like activities take place. Many of the same goals and assumptions proposed by the Blueprint for Diversity were included in this report.

*Strategic Vision Planning, [Workshop #1](#) and [Workshop #2](#)* – Discussion and planning sessions focusing on issues of diversity were held as part of the 2006 Strategic Planning process. Ideas and recommendations came from students, faculty, staff, and trustees, and represented a more “bottom-up” approach that often works effectively within the HMC community. An important point raised during these sessions was that while some members of the HMC community felt that the campus climate is insular and unaccepting of difference, others found the campus climate to be welcoming. This might suggest that whether or not one belongs to any underrepresented group plays a significant role in the perception of the campus climate. Given these deep differences, changes in the campus climate will be slow and hard won. During the workshop, several ideas were raised to help begin the process.

*[Multicultural Forums for Faculty and Staff](#)* (2007 & 2008) – A number of action items emanated from Multicultural Forums for Faculty and Staff in 2007 and 2008, and were summarized by the Strategic Vision Diversity Committee and David Asai, Professor of Biology, who coordinated and facilitated these forums. These included recommendations in the areas of space, curriculum and hiring/retention.

#### ***8. What has worked to increase the access, retention and success of underrepresented students at institutions similar to HMC?***

Much information has been published about diversity programs at other institutions. These include a collection of seven Diversity Action Plans from institutions participating in a Howard Hughes Medical Institute (HHMI)-supported collaboration to address diversity in the sciences. We have not yet had the chance to fully analyze the data in these reports as they apply to HMC. The challenge we face is to sort through the large volume of case studies to pick

out strategies that would work in the STEM-focused environment of HMC.

#### **IV. Practices that will Deepen HMC’s Understanding of Diversity**

The process of answering the questions posed at the beginning of this essay revealed that a key issue in need of further research and analysis is the impact of gender and racial diversity on student learning at HMC. Specifically, more detailed analysis of the academic success of women and minorities beyond the Core curriculum will add to the college’s understanding of how the HMC curriculum creates or sustains gaps in the academic performance among different student cohorts. In addition, to help us understand academic progress for all HMC students, we plan to collect institutional data on admission, matriculation, retention and graduation rates.

It is important for us to expand the study of the gap in academic performance for women and underrepresented students in our Core curriculum in order to address, and eventually eliminate, these differences. Focusing specifically on the academic achievement of our students, the college will address the following questions for the Educational Effectiveness Review:

1. Are similar performance differences seen when data from upper-division courses are studied?
2. Do the recently approved changes in the Core curriculum help to mitigate these differences?
3. What are the best practices from around the nation that will help us close this performance gap at Harvey Mudd?
4. Do the college’s admission scores (“admit-codes”) correlate with student performance?
5. Are there differences in the admission, matriculation, retention and graduation rates of students who are female or underrepresented minorities?

## Essay 3

# ASSESSMENT OF STUDENT LEARNING AT HARVEY MUDD COLLEGE

### I. Institutional Goals: An Overview

The founders of Harvey Mudd College envisioned it to be a “liberal arts college of engineering and science.” HMC’s educational goals are based on the tradition of liberal learning which encourages the growth of broadly educated citizens, and promotes reflection, self-understanding, and a sense of self-worth in all students.

From this vision follow the institutional and educational goals defined by three key planning documents: (1) the college’s [Mission Statement](#), (2) the Strategic Planning summary, [HMC 2020: Envisioning the Future](#), and (3) the revised Core curriculum [proposal](#) and the educational priorities described therein.

The week of October 16, 2006 was set aside for the important task of institutional reflection, anchored in discussions of HMC’s Mission Statement. Over four days, more than 400 people including trustees, students, alumni, staff, faculty, parents and others listened to each others’ ideas, commented, reflected and made recommendations. Planning committees summarized the discussions and distilled them further for another series of workshops held during the annual retreat of the HMC Board of Trustees. There, 110 participants, including trustees, alumni, faculty, students and staff, discussed 23 topics over two days of workshops. The steering committee prepared the first-draft outline of the Strategic Vision, which was presented to the HMC community several times between November 16 and December 9. The six themes of the Strategic Vision are:

1. Innovation, leadership and impact, especially in engineering, science and mathematics
2. Focus on experiential and interdisciplinary learning
3. Unsurpassed excellence and diversity at all levels
4. Nurturing and developing the whole person
5. Global engagement and informed contributions to society
6. Improvement of infrastructure and resources to support HMC’s commitment to excellence and building community

During these Strategic Planning discussions, we identified many opportunities in which to study the wide range of artistic, spiritual, political, cultural, social, physical, emotional and professional interests through curricular and co-curricular activities at The Claremont Colleges. However, a key finding was that the lack of flexibility within the HMC curriculum makes it difficult for students to take advantage of these opportunities. For example, students must take over five courses each semester to graduate from HMC in four years. In addition, the rigidity and intensity of the curriculum frequently hinders the excitement that should be present in a learning environment, and deprives students of taking a larger share of responsibility for the direction of their education ([WASC Visiting Team Report, 1999](#)). Recognizing this, the Strategic Vision Curriculum Committee (SVCC) was charged with addressing workload and flexibility issues through a review and revision of the curricular model and a modification of the college’s culture to value achieving an appropriate work-life balance. The work pursued by this faculty committee was conducted in the spirit of ensuring that the level of intellectual rigor and excellence would be maintained and enhanced by any changes made.

The SVCC identified five educational priorities for the college:

1. Exercise technical expertise developed through rigorous foundational work and an emphasis on problem solving in learning communities
2. Appreciate and employ different kinds of knowledge and expressive sophistication as the basis for critical analysis and synthesis and self-examination
3. Serve society by addressing the complex problems of the world, creatively, passionately and humanely
4. Flourish in a multi-cultural community and global environment
5. Lead examined and meaningful lives

Using the Mission Statement, Strategic Vision goals, and educational priorities as a framework, we identified a series of student learning goals to be assessed, focusing primarily on student learning in the revised Core curriculum, in particular the new writing course, and in departmental programs.

## II. Assessment of the Revised Core Curriculum

For eighteen months the SVCC examined numerous aspects of the college curriculum. To build a better understanding of what we do at HMC, the committee examined the [curricula of eleven peer institutions](#), and discovered that the Core curricula of these institutions, including the California Institute of Technology (Cal Tech) and the Massachusetts Institute of Technology (MIT), are smaller in scope than the Core at HMC. Interviews were held with two HMC alumni who are currently on faculty at Cal Tech and MIT; both agreed that the current HMC Core was too rigid, and suggested the HMC Core could benefit from streamlining in order to afford students greater electivity and flexibility.

Data from a survey conducted by the faculty Curriculum Committee showed that approximately 82% of 331 students surveyed had an interest in taking foreign language courses, but that the current HMC first-year curriculum makes this difficult, if not impossible. Without an elective in the fall of the first year, only students who have advanced placement are positioned to take a language course. In addition, the meeting times for HMC's math and humanities Core courses typically created a scheduling conflict with five-day-per week language courses at the most popular times. [Surveys](#) completed by 64 rising sophomores taking Summer Math in 2008 confirmed students' desire for electivity in the first year. Among those surveyed, 72% would have found it valuable to have an elective in their first semester at HMC. Of those who saw such electivity as valuable, 35% indicated they might have used that elective to take a foreign language, 26% said they might have taken E4 or another engineering course, and other comments reflected interests in a wide variety of subjects in the sciences, social sciences, humanities, and arts. In light of the college's Strategic Vision and a desire to develop graduates who can flourish in a global environment, the SVCC saw the Core as an important place to direct curricular revision efforts.

Based upon a detailed [report](#) by the SVCC, the faculty of HMC approved the revised Core curriculum program at its meeting in October 2008. The SVCC was reborn as the Strategic Vision Curriculum Implementation Committee (SVCIC) which, at the February 2009 faculty meeting, provided a detailed update of the Core

[implementation plan](#), including a report on the new [writing curriculum](#).

As part of these reports the SVCIC, the Assessment Committee, and WASC Steering Committee established the following goals for the revised Core curriculum:

### *Core Goal 1: Demographic trends*

- Retain and graduate a greater percentage of the students that we enroll
- Attract, enroll, retain, and graduate a greater percentage of students who contribute to the diversity of the college, as measured by gender, ethnicity, and economic background

### *Core Goal 2: Benefits from increased electivity*

- Students will be more satisfied with their ability to choose courses that satisfy their interests
- Students will be more satisfied with their ability to shape their own academic programs
- The numbers of students participating in language study during their first year will increase
- Students will be able to create breathing space within their first two years to accommodate academic, social, or emotional needs

### *Core Goal 3: Preparation for the post-Core curriculum*

- Students will be as able to achieve success in their majors as they were prior to the Core reform
- Students will be more able to employ interdisciplinary thinking
- Students will be more proficient writers

Along with these goals, an assessment plan - including a description of possible assessment instrument - is provided in section 9 of the [SVCIC report](#). Additional, more specific learning goals are provided in the [report](#) describing the Core's new writing curriculum. We will focus on assessing the writing component of the new Core curriculum as we move into the Educational Effectiveness Review.

The writing course was selected because it captures many of the goals of our new Core curriculum, and it was designed with learning goals and student learning outcomes built-in. For instance, the course is by design interdisciplinary, as it is taught by faculty from

different departments who build the course around a topic of mutual interest. Writing captures many of the critical-thinking skills we value, and improved writing proficiency by our students is a major emphasis within the new curriculum.

The learning goals of the new Core curriculum were presented in the [report](#) by the Writing Course Subcommittee at the February 2009 faculty meeting, and they are reiterated here.

#### *Learning Objectives of the New Core Writing Course*

##### *Overall Course Objective:*

To teach students effective college writing strategies and conventions as the tools for critical inquiry through specific exercises in reading, thinking, and writing.

##### *Detailed learning objectives:*

Upon completion of this course, students will be able to:

1. Use informal writing to develop their thinking at different stages of inquiry
2. Deploy some main elements of persuasive and expository writing (see below) in formal papers
3. Recognize and use rhetorical purpose, voice, and audience analysis in academic reading and writing
4. Write clear, coherently structured papers that use appropriate evidence and diction toward fruitful intellectual discourse
5. Demonstrate understanding of some of the main cross-disciplinary similarities and differences in conventions of expression and article formats
6. Develop an effective writing process that includes repeated revision of writing
7. Make use of the feedback process, both as reviewers and as recipients
8. Identify passages in their writing that call for citation, attribution, or acknowledgment, and apply appropriate forms of citation where needed

Assignments will be designed to help students practice the following elements of persuasive and expository writing (singly or variously combined):

- a) Articulating the results of a line of inquiry
- b) Cogently defending a conclusion or point of view on a debatable topic
- c) Describing an object or process relevant to a topic of study
- d) Explaining difficult concepts

- e) Explaining why a project was or should be undertaken
- f) Synthesizing material toward a new conclusion
- g) Critiquing a scholarly paper
- h) Summarizing a body of work (for example, writing an abstract)

Determining whether we reach these student learning objectives will be the focus of the assessment of the new Core curriculum. Versions of the writing course will be piloted in the fall of 2009, and we will begin collecting baseline data for writing in the old curriculum at that time.

### **III. Assessment of Department Goals and Student Learning Outcomes**

Beyond the new Core curriculum and the writing course, it is the college's intention to establish assessment protocols for student learning in each department. To that end, we have spent the last year deciding how to best assess the educational effectiveness of our various departments' goals. Throughout the 2008-2009 academic year the seven academic departments at HMC worked with the Office of Institutional Research to identify department goals and student learning outcomes, and methods by which to assess them. Each department has reviewed, and in some cases revised, its academic goals and attendant student outcomes to reflect their current curricular and instructional priorities. Goals and learning outcomes for each academic department at the college are included in the electronic appendices as Appendix II-F.

The Office of Institutional Research is assisting the departments in structuring their assessment efforts by identifying one department goal to be assessed during the 2009-10 academic year. The intention is for each department to create an assessment schedule that will enable all goals to be assessed on an established cycle. With the assistance of the Office of Institutional Research and the Assessment Committee, departments are developing student learning outcomes associated with identified goals and are creating instruments to assess learning outcomes. Results from these initial assessment efforts will be in place for the Educational Effectiveness Review.

**Table 6. 2009-2010 Assessment Plans for Academic Departments**

<b>Department</b>	<b>Goal to be Assessed in 2009-10</b>
<a href="#">Biology</a>	Assessing the extent to which the department's Senior Research program develops students' skills in planning and carrying out independent research, data analysis and oral and written presentation.
<a href="#">Chemistry</a>	Assessing how or whether HMC students understand how the fundamental principles of chemistry are applicable to the solution of real problems in a variety of technical fields; students will demonstrate an appreciation of the contributions of chemistry to at least one (1) problem facing society.
<a href="#">Computer Science</a>	Collecting and tracking of enrollment in all CS courses during the 2009-10 academic year; mapping student-centered learning objectives for all CS courses to larger, overarching departmental goals; sampling student work, surveys and statistics to measure achievement of learning objectives; and coding, summarizing, quantifying and tracking student work to judge failure/success of departmental goals.
<a href="#">Engineering</a> (page 7)	Assessing eight (8) engineering courses during the 2009-2010 to measure for achievement of the department's five (5) key goals and objectives.
<a href="#">Humanities, Social Sciences and the Arts</a>	Assessing: (1) particular student learning outcomes linked to departmental goals; and (2) the departmental advising system.
<a href="#">Mathematics</a>	Measuring students' ability to apply mathematics in a variety of settings, specifically in terms of transferring mathematical skills and knowledge between disciplines.
<a href="#">Physics</a>	Assessing student learning outcomes linked to departmental goals and student performance in upper-division courses to inform any changes in the revised Core curriculum.

#### **IV. Summary of the Proposed Assessment of Student Learning**

We will assess the educational effectiveness of the new Core writing curriculum based upon the goals and learning outcomes described in its founding documents. This will give us insight into how well we are achieving some of our institutional learning goals. At the program level, we will assess student learning outcomes in each department of the college.

## CONCLUSION

### **Reflections on Our Efforts to Date and a Look Ahead to the Educational Effectiveness Review**

Through the self-study described in the previous essays of this report, we have generated many paths to an improved understanding of the education we provide at Harvey Mudd. Here, we narrow our focus to the topics and inquiries that we believe are most important to our campus today, and that are achievable, at least in part, by the time of the next phase of our accreditation cycle, the Educational Effectiveness Review. In the realm of experiential learning, we would like to improve our knowledge of the senior capstone experiences in which every student at the college must participate. We hope to learn what is educationally singular about these experiences, and what prior curricular experiences make them most fruitful. On the subject of diversity, we choose to better understand gender and ethnicity performance gaps at the college so that we can minimize them. Finally, we have recently voted to revise our Core curriculum, and we will begin phasing in this new programming in the fall of 2009. We plan to assess the educational effectiveness of the new writing curriculum based upon the goals and learning outcomes described in its founding documents. While the assessment of the Core curriculum will give us a perspective on how well we are achieving our institutional learning goals, we are also assessing student learning outcomes in each department at HMC.

The following is a summary of the activities Harvey Mudd College proposes to undertake for the Educational Effectiveness Review. These activities will be overseen by the WASC Steering Committee and the Office of Institutional Research, and will be supported in important ways by the Assessment Committee, the Department Chairs Committee, the Faculty Executive Committee, the Office of Admissions, the Writing Committee, and the Associate Dean for Undergraduate Research and Diversity.

#### **Experiential Learning: Essay 1**

In the next stage of our accreditation cycle, we will focus on understanding the educational benefits of the college's capstone experience, something required in every major, and the

curricular precursors that make it most successful. Our efforts will fill in some of the gaps in our knowledge that remain as we conclude the second stage of our review, and may include studying the capstone experiences of our peer institutions, and assessing whether or not students who go through a capstone experience at HMC reap educational benefits such as:

- Enhanced ability to put classroom knowledge into practice
- Enhanced communication skills, both oral and written
- Enhanced technical skills within the discipline
- Enhanced development of personal initiative
- Increased confidence

Further, we will try to determine if students who go through a summer research or internship experience prior to their capstone experience display more growth in these educational outcomes. More qualitatively, are these students more likely to be involved in a professional activity such as writing a manuscript or attending a conference? If the answers to these questions are affirmative, should we ask all students at the college to participate in a summer research or internship experience? Do we have the faculty and facilities to support such an endeavor?

#### **Diversity: Essay 2**

In the next phase of our review, we will deepen our study of the gap in academic performance for women and underrepresented students at HMC so that we can begin to close it. From the discussion in the Diversity essay, it is clear that women and underrepresented minorities have a different experience in the Core curriculum than do other students. To help close this gap, for the Educational Effectiveness Review we will answer questions such as:

- Are similar performance differences seen when data from upper-division courses are studied?
- Do the recently approved changes in the Core curriculum help to mitigate these differences?
- What are the best practices from around the nation that will help us close this performance gap at HMC?



- Do the college's admission scores ("admit-codes") correlate with student performance?
- Are there differences in admission, matriculation, retention and graduation rates of students who are female or underrepresented minorities?

### Student Learning: Essay 3

In the next phase of our accreditation review, we will begin data gathering and report on the assessment of our new Core writing curriculum: Is it meeting the goals and achieving the student learning laid out in its founding documents?

In the spring of 2009, a set of goals were established for the college's revised Core (section 9 of the [SVCIC report to the faculty, February 2009](#); page 3 of the [Writing Course Subcommittee's report](#)). Methods for assessing these goals, particularly the student learning goals of the writing course, are being developed through a collaboration between the SVCIC, the assessment committee, the Office of Institutional Research and the WASC steering committee.

We expect pilot versions of the new curriculum to start in the fall of 2009, and that the full curriculum will be in place for the 2010-2011 academic year. With this timescale in mind, we will assess the student learning outcomes of the writing curriculum that are detailed in Essay 3. They include the broad goal:

*To teach students effective college writing strategies and conventions as the tools for critical inquiry through specific exercises in reading, thinking, and writing.*

More detailed learning outcomes include:

- Use informal writing to develop their thinking at different stages of inquiry
- Write clear, coherently structured papers that use appropriate evidence and diction toward forceful intellectual discourse
- Develop an effective writing process that includes repeated revision of writing
- Make use of the feedback process, both as reviewers and as recipients
- Identify passages in their writing that call for citation, attribution, or

acknowledgment, and apply appropriate forms of citation where needed

- Articulate the results of a line of inquiry
- Cogently defend a conclusion or point of view on a debatable topic
- Synthesize material toward a new conclusion
- Summarize a body of work (e.g., writing an abstract)

Initial results of our assessment should be in place for the 2011 Educational Effectiveness Review.

In parallel with this evaluation of the new writing curriculum, departments are developing student learning outcomes associated with department goals, and are creating instruments to assess those outcomes. Results from these initial assessment efforts should also be in place for the Educational Effectiveness Review.

As a reminder, we again remark that it is traditional in Capacity and Preparatory Review reports to include in-line references to standards and criterion for review (CFR). We have not taken this approach. Because the standards and CFRs are meant to guide the comprehensive assessment of an institution, and we are undergoing a more narrow theme-based review, we felt that merely using in-line references would not allow us to address the scope of the standards. Instead, we have added [Appendix III-E](#), where we address each standard and CFR in detail.



