

Lyman Briggs College Academic Program Review 2011-2012

LBC Academic Program Review Committee April 11, 2012

1.0. Introduction

1.1. *What is Lyman Briggs College?*

Founded in 1967 with the mission of bridging the divide between C.P. Snow's "two cultures" of the sciences and the humanities, MSU's Lyman Briggs College (LBC or Briggs) is a residential undergraduate college devoted to studying the natural sciences in their historical, philosophical, and social context. LBC is the longest-running program of its kind at a large U.S. research university. All under one roof, LBC offers science laboratories and classrooms; faculty and advising offices; and residential and dining facilities. Briggs offers its nearly 1900 students the best of both worlds: the close-knit, living-learning community of a liberal arts science college combined with the resources and opportunities of a great research university. The faculty—active and accomplished scholars whose primary focus is undergraduate education—span the sciences from astrophysics to zoology and also the fields of history, philosophy, and sociology of science (HPS). Students choose from over three dozen majors, coordinated with STEM¹ departments in three other colleges, and complement their technical coursework with an embedded HPS curriculum. For 45 years, Briggs has helped to liberally educate scientists to understand both the fundamental scientific and mathematical context of their disciplines and the societal context of science.

LBC prides itself on creating a learning environment that helps students develop into high achieving, science graduates. We have done this by using research-validated instructional methods to actively engage students in the process of science through our introductory science and mathematics courses and in the historical, philosophical, and social context of science through our introductory HPS course. Our students then take their upper-level science courses in our partner colleges (CNS, CANR, EGR) and continue to gain a better understanding of the nature of science through our upper-level HPS courses. The students finish their program with their capstone senior seminar, an interdisciplinary course that connects their STEM and HPS coursework.

1.2. *What is the mission of Lyman Briggs College?*

During 2008-09, Lyman Briggs faculty, staff, students, and alumni worked together under the guidance of LBC alumnus Kevin Ohl to create the College's mission statement, guiding vision, and specific objectives to realize the vision. The resulting documents are available online on the "About Lyman Briggs" page² and are linked to descriptions of current college projects related to the objectives. The LBC Mission Statement is:

Lyman Briggs College bridges the sciences and humanities through interdisciplinary teaching and research,

- *Sustaining an inclusive residential college environment within a major research university;*
- *Fostering collaboration between students, faculty, and staff, to advance scholarship, teaching innovation, and community engagement; and*
- *Inspiring students to become lifelong learners, engaged citizens, and effective leaders.*

The work to develop the mission statement also created a Vision for the College including:

- I. Promote a culture and curriculum that advances the critical understanding of science and society.
- II. Increase the reach and depth of our intellectual inquiries.
- III. Integrate personal and social responsibility with daily activities and professional practice.
- IV. Reflect the diversity of the national population.
- V. Foster internal and external partnerships to advance the mission of LBC.
- VI. Be an international model for residential colleges within research universities.

¹ All Acronyms can be found in Appendix 1.

² <http://www.lymanbriggs.msu.edu/parents/mission.cfm>

LBC's attempts to fulfill these vision statements can be read in the 2015 strategic plan.³

This program review will focus on three core areas within Lyman Briggs: the Briggs Curriculum, the Briggs Experience, and the Scholarship of Teaching and Learning. Across each of these dimensions, we will emphasize the value-added for students and alumni and how we promote inclusivity and embrace diversity.

2.0. The Briggs Curriculum

The LBC curriculum helps students build a core science foundation and combine it with a strong understanding of HPS. Students complete their introductory work in Lyman Briggs before typically completing a major through another department while taking upper level HPS courses. Briggs courses consistently employ active and cooperative learning while addressing real world questions. A more complete description of the Briggs curriculum can be found in Appendix 2. The informal curriculum builds upon this formal curriculum. Briefly, the major elements of the informal curriculum are undergraduate research, study abroad programs, internships, participation in registered student organizations, the NSF-funded BRAID project, and the NSF-funded S-STEM seminars. We will further discuss the major elements of the informal curriculum in section 3 on the Briggs experience.

2.1. How well do we do it, and who thinks so?

The success of the Briggs curriculum is most strongly demonstrated by the future paths of our students. Approximately 80% of Briggs graduates begin post-graduate studies immediately upon the completion of their MSU degree.⁴ This clearly demonstrates that post-graduate programs recognize the high quality of our students.

The strength and effectiveness of the Briggs curriculum has long been a paramount interest to Briggs faculty and is part of a long-standing expectation for incorporating research-validated teaching methods into student-centered classrooms. Assessment of the success of courses has involved evaluation by (a) students, (b) instructors, and (c) faculty peers. Historically, LBC has utilized the SIRS survey to gather student evaluations, and LBC courses regularly have earned very good SIRS composite factor scores. Recently, LBC faculty shifted to the Student Assessment of Learning Gains (SALG) survey⁵. This research-validated instrument shifts the focus of the assessment from one of general student experience to the benefits and gains that students attribute to the course. We expect that this new instrument will provide richer and more meaningful data to evaluate the efficacy of LBC classes.

Our students are also well situated to provide us information about the success of our program. In 2012, the faculty implemented a more thorough survey of the student experience as part of the APR process. The students overwhelmingly showed support for a number of the pillars of the LBC teaching model. Of the 446 respondents, 96.8% indicated that class size and 73.3% indicated that the inquiry-based nature of the Briggs labs added either "a great deal" or "a moderate amount" to their LBC experience. The Briggs student experience in introductory science courses may be expected to lead to subsequent stronger academic success; 92.8% indicated that their LBC STEM courses had a "moderate amount" or "great deal" of influence on their performance in upper-level STEM courses in their major. For both the class size and preparation questions, female students were significantly more likely to indicate a greater positive response (consistent with previous literature results). If we compare the performances of Briggs students to that of other university students across a variety of upper-level science courses, we find that the ratio of the median grades in organic chemistry, biochemistry, physiology, microbiology, and genetics for Briggs students to median grade of their non-Briggs counterparts varies from 1.05:1 to 1.18:1, with

³ <http://www.lymanbriggs.msu.edu/faculty/LBC-strategic-plan-2015.pdf>

⁴ Internal data collection indicates $\approx 80\%$, while the MSU destination survey indicates 60%. <http://careernetwork.msu.edu/destination-survey>. Our internal 2012 survey indicated that 91.2% of current LBC students have postgraduate educational goals.

⁵ www.salgsite.org

Briggs students consistently earning higher grades.⁶ Most dramatic is the difference between Briggs and non-Briggs students in organic chemistry. After controlling for incoming GPA and general chemistry class grades, Briggs students who took LBC chemistry typically earn a grade 0.22 points higher than university students with equivalent predictors. This improvement likely comes from a small organic chemistry module included in the Briggs introductory courses.

In addition to using student assessments, faculty members also evaluate the efficacy of our courses. Faculty members are required to reflect upon their courses every year through the annual review process as a means to consistently monitor their teaching effectiveness. Each faculty member also has a review committee of one or two other faculty members who yearly perform class observations. The reviewers are encouraged to evaluate the instructor utilizing the Reformed Teaching Observation Protocol⁷ (RTOP) instrument. This research-validated instrument assesses the characteristics of the classroom setting and provides a measure of how extensively research-informed practices are integrated into the learning environment. Lastly, most faculty members maintain teaching portfolios as a means for demonstrating the efficacy of their courses in promoting learning.

The strength of the Briggs curriculum is recognized frequently by non-LBC faculty in upper-level science courses across the university. Anecdotally, these professors often identify Briggs students by their deeper understanding of the introductory concepts and by their richer understanding of the scientific process and stronger communication skills. This is most notable in upper level laboratory classes, where LBC students demonstrate a practiced ability to write lab reports, while other students enter with far less experience.

2.2. What difference does it make whether we do it or not?

There have been many calls in recent years to improve the quality of science education and help fix the “leaky pipeline” of science students. Many capable, talented students—and disproportionate percentages of female and minority students—leave the sciences during the first and second year of college. The primary mission of Briggs is to provide students with a strong and supportive academic experience during this critical time. Our carefully crafted curriculum contains high-impact practices that increase the success and retention of our incoming college students with an emphasis on increasing diversity. We aim to produce graduates with the scientific knowledge and the necessary global perspective to be able to tackle the large problems facing our state, nation, and world.

Students personally benefit from the Briggs curriculum. Our courses are designed to help students not only learn the substantive content but also develop many other beneficial skills. Many of the Briggs courses include a focus on experimentation, data collection, and data analysis. Most classes also utilize significant group learning activities to help students develop the interpersonal skills needed to succeed beyond college. Further, the students regularly engage in intellectual discourse on course content, helping the students enhance their oral and written communication skills.

On an institutional level, Briggs adds value by attracting high caliber students to MSU to its unique learning environment.⁸ These students help build the strength and reputation of MSU through their presence and involvement across campus. Briggs is regularly recognized by external groups as a strong example of the successful use of high-impact learning practices, which garners MSU accolades for dedication to its students.

Many of the Briggs courses rely on partnerships with our students as part of the instructional team. These Undergraduate Learning Assistants (ULAs) work with the faculty to help run our courses. Much like the model long used by science research labs to involve highly promising students in undergraduate research early in their academic careers, we seek to engage these students in the teaching and learning of science. Through this process we hope to identify and foster in some students the same passion and

⁶ Data from annual College Metrics maintained by LBC.

⁷ http://physicsed.buffalostate.edu/AZTEC/RTOP/RTOP_full/

⁸ Briggs students have higher ACT scores and high school GPA than the university average.

desire to pursue teaching that others find in research. ULAs anecdotally indicate that they frequently reap a much deeper understanding of course content by becoming involved in the teaching of the subject, which can benefit them as they engage in subsequent upper-level courses. These ULAs also act as peer mentors for their students, sharing their own stories of struggle and success. The ULA program also provides a great opportunity for our students who are prospective teachers to engage with our faculty surrounding pedagogical questions in the classroom.

As we will discuss in greater depth in Section 4, the LBC faculty actively contribute to pedagogical research in the scholarship of teaching and learning (SoTL). LBC faculty members are performing SoTL research on STEM education to help position MSU as a global leader in STEM education research.

2.3. *Given our present status, how do we intend to change in ways that help us advance?*

LBC will build on the strength of the Briggs curriculum by:

- Developing a set of learning objectives for the entire LBC curriculum
- Increasing external awareness of the LBC model of science education

The individual courses comprising the Briggs curriculum each have been refined over the previous years through an influx of new faculty. However, as these courses have changed, there has not been consistent alignment toward a common set of learning objectives for the entire curriculum. This should be a major push for the refinement and improvement of the Briggs curriculum. Moreover, creating concrete learning objectives will encourage the Briggs community to expand upon the implicit learning objectives and priorities already laid out in the college's mission statement. This process will require the faculty to develop a set of learning objectives for all Briggs graduates. These expectations should be aligned within the context of MSU's Liberal Learning goals⁹ and reflect the mission and vision statements developed by the Briggs community.¹⁰ Subsequently, each course should identify which of the goals it is helping students achieve (identifying the specific assignments/activities that help students improve on their skills). Through this kind of process, the college can then determine if there are any goals which are not effectively being addressed and take steps to try to better assist students in achieving those objectives. Similarly, the college will be better able to identify those "cornerstone" classes that provide the necessary foundation for success as well as clarify the expectations of the "capstone" senior seminar course. The last, but just as important, step is to share this information with our students, helping them better understand what they should be getting out of each course and assess the extent to which they are achieving the expectations of the college and university beyond simply earning grades.

This set of clearly identified objectives will have four major benefits. First, this will allow Briggs to better recruit students. Being able to point to specific expectations will be a competitive advantage with both prospective students and parents, as we can clearly indicate the value added by the Briggs curriculum. Second, current students will benefit by better understanding what they should be gaining out of each course. Students will become more active participants in their education when they more clearly understand the expectations for each course. This may have secondary impacts on student enrollment by allowing Briggs to clearly indicate the value-added between the LBC and university versions of similar introductory science courses. Third, current students also will see how to market their own skills in the context of job seeking. They will have a clear list of learning objectives that they have accomplished and have specific activities that they can point to as evidence of their success. Fourth, a clear set of anticipated outcomes will allow Briggs and the university to better explain the value-added of our academic program to outside accrediting organizations and others that are pushing institutions of higher education to justify their relative cost and benefit.

⁹ <http://undergrad.msu.edu/learning>

¹⁰ <http://www.lymanbriggs.msu.edu/parents/mission.cfm>

LBC also should seek to become more broadly recognized for its curriculum and academic strength. The Briggs curriculum achieves many of the desired goals of interdisciplinary integration and student centered teaching that are often called for by national commissions and professional groups (e.g., PCAST's *Engage to Excel* 2012 report, the *Boyer Commission Report on Undergraduate Education*, the National Research Council's *BIO2010 Report* and *Rising Above the Gathering Storm*); however, it is not always immediately cited as such an exemplar. Further, LBC currently has one of the largest, most active, and intellectually diverse HPS faculties in the world, yet not many outside of MSU are aware of this. Thus, LBC should strive to become more widely recognized at a national and international level. This will require an active and intentional effort to publicize information about our highly successful undergraduate science program and the achievements of both faculty and students to wide audiences around the state, nation, and world. LBC should strive to be viewed as the "Oberlin of the Sciences," producing high quality science graduates who have the strength of a liberal arts education. It is imperative, however, that LBC strive to achieve this goal while still maintaining its open access policy in admissions.

2.4. How do we evaluate our future progress and success?

The success of our students will continue to be one of the best measures of LBC's success. However, we seek to continue to support the land grant mission of MSU, and we do not wish to simply create an exclusive environment. Briggs must continue to balance the needs of being open and effectively serving students from a wide range of backgrounds by providing students with a learning environment that challenges all of them to reach higher and higher accomplishments. This goal of serving a diverse student population will result in a wide level of incoming academic preparations.

The overall success of our students can be measured in a variety of ways. The first is through the graduation rates of our students, including from MSU, from Briggs, and within the sciences. Each of these rates speaks to the efficacy of a different aspect of Briggs. However, these measurements must not drive the decisions within Briggs. If the graduation rate becomes the sole measure of success, then there may be a pressure toward ensuring that only the best prepared students enter LBC. Therefore, it should be recognized that the success of LBC may be most effectively measured by comparing retention and graduation rates of specific subsets of students between LBC and the rest of the university. Similarly, LBC also should compare their rates with JMC and RCAH to look for ways to share strategies for retention and graduation within minority, first generation, and other at-risk student populations.

Lyman Briggs also needs to better assess the academic needs of the incoming and current students. Our goal of having Briggs effectively serve a diverse student population results in a wide level of incoming academic preparations. Briggs must actively develop methods to identify the needed skill sets to succeed at different courses and provide mechanisms by which students can both assess and then improve on the needed skills. Briggs also should strive to determine the destination of all of our graduates, whether in the workplace, graduate school, or professional school. This will position Briggs to be able to measure our longer range success by regularly surveying a subset of alumni to determine how we have effectively prepared them for their careers. This interaction should simultaneously help develop long-term relationships with our alumni and help Briggs evaluate the long-term efficacy of our curriculum.

Lastly, the proposed learning objectives should be used to evaluate the success of our curriculum. They will provide a map for evaluating the overall framework of the LBC curriculum and allow us to identify how well courses are aligned with the primary learning goals of LBC.

2.5. Diversity in the Briggs Curriculum

Historically, LBC was not known for the diversity of its faculty and students. Recently LBC has increased its efforts to promote inclusivity and embrace diversity in our curriculum in three major ways: who teaches our courses, what is being taught, and how it is being taught. We have performed other efforts not so tightly coupled to our curriculum, and we discuss those in Section 3.5.

In recent years, LBC has bolstered its efforts to achieve a more diverse faculty via utilizing “best practices” in hiring activities. We have publicized our open positions to wider audiences and intentionally sought applications from members of underrepresented groups. This has led to the hiring of several strong junior faculty who have increased the diversity of the STEM and HPS faculty. An increasingly diverse faculty offers a welcoming environment for prospective students and more varied role models to more effectively support a diverse student population.

Diversity is woven into the Briggs classroom. The “Introduction to HPS” course and our upper-level HPS courses have long been infused with substantive content on race, gender, class, and science. In recent years, the HPS faculty have integrated even more content on inclusivity and diversity into their courses, with topics such as gender inequality in science, the history of scientific racism, philosophy of race, and the evolving scientific understanding of sexual orientation. Similarly, the content in introductory science courses also explicitly addresses these issues. For example, in biology courses the difference between the biological basis for skin color is juxtaposed to the social construct of race. This infusion of diversity and inclusivity into science curricula is rare and benefits both majority and minority students.

The third way concerns how we teach our students. LBC faculty members regularly utilize an array of pedagogical techniques and assessment methods to appeal to a diverse group of learners. Research suggests science courses that include pedagogical approaches used in LBC such as active learning benefit all students, but disproportionately increase retention of underrepresented students.¹¹ Teaching staff members, including ULAs and GTAs, receive training to increase cultural competency. Cultural competency is discussed at faculty meetings, and resources for creating an inclusive learning environment are shared within the LBC community. The goal of these efforts is to create an inclusive learning environment that benefits all students.

Recently we have increased our efforts to make the LBC curriculum more accessible to students across a wider range of incoming preparations. Historically, freshmen with low math placement scores (LMP) were required to take biology (LB 144) in their first year rather than chemistry (LB 171) with most other freshman due to the math essential for success in LB 171. These students often took university chemistry (CEM 141) in the spring semester (with very limited success) or were only minimally engaged with the Briggs community until their second year. For the incoming class of 2006, only 24% of these students graduated compared to 89% of their more prepared peers. These LMP students include a disproportionate number of underrepresented minorities and many are first-generation college students. To help MSU better achieve its land grant mission of attending to the needs of all Michigan residents, LBC has been assessing and revising its curriculum since 2008 to ensure that these LMP students are better supported and retained in STEM majors. The biology and chemistry faculty now offer an interdisciplinary course every fall that provides these students with curricular enrichment, greater faculty contact, and an increased sense of community during their first semester on campus. In 2011, LBC also offered a special Briggs section of MTH 1825 to allow these LMP students to better connect with each other and build on the cohort experience that is a Briggs hallmark. LBC also was the lead college in the third MSU STEM day focused on assisting LMP students throughout the university. LB physics is planning on piloting a new online math prep course that may lead to greater success in LB 273/274 during the summer of 2012. Each of these changes has focused on engaging a portion of the LB community that may have previously felt disconnected. By bolstering connections to all of our incoming students, we are more likely to help each individual reach their own collegiate and career goals, along with helping MSU meet its undergraduate mission.

¹¹ Herreid, “Why Isn’t Cooperative Learning Used to Teach Science?”, *Bioscience*, 1998.

3.0. The Briggs Experience

The Briggs experience profoundly influences how students critically think about science and the world around them. Beyond the class experiences described in Section 2, the Briggs experience involves a wide range of co-curricular activities and interactions. Although the specific activities vary from student to student, the Briggs experience encompasses engagement with a community of students, faculty, advisors, and staff and includes individual and shared educational experiences. The typical Briggs experience includes living in a residential community, taking common classes with your hall-mates, engaging with faculty and staff outside of the classroom, and presenting your work in the LBC Research Symposium. For many students it also involves study abroad, undergraduate research, leading RSOs, class book debates, or working as a ULA. This community participation does not end with graduation, but rather continues through a lifetime of being a “Briggsie.” For a more complete description of the Briggs Experience, see Appendix 2.

3.1. How well do we do it, and who thinks so?

Lyman Briggs has developed a strong reputation within MSU and beyond through the creation of a distinctive Briggs experience. Additionally, LBC has a recruiter working in partnership with the Office of Admissions, MSU’s other two residential colleges, and Honors College to promote LBC in Michigan, nationally, and internationally. Robust evidence of the LBC reputation comes from our students, our alumni, and formal recognition from external organizations. Each year there is more student demand for the Briggs experience than we can accommodate; the incoming freshman class typically fills the allotted space in LBC by December. This is at least indirect evidence that incoming students view LBC as providing a value-added experience to their science education at MSU.

Anecdotally, many of our alumni have expressed great satisfaction with their Briggs experience, though a rigorous assessment of this has not yet been undertaken. For each of the graduating classes of 2008 to 2010, approximately 80% of LBC graduates have continued on to some form of post-baccalaureate education. This is indicative that a large number of our students have fostered an interest in continuing their education and have achieved a sufficient level of academic success to be accepted by a subsequent institution.

Active research is another key component of the Briggs experience. This is demonstrated through the consistent engagement of our students in scientific research. The annual LBC Research Symposium (initiated in 2007) has regularly involved over 700 student participants presenting research from faculty-led research labs, coursework, and honors option projects. Each year more than 70 LBC students participate in UURAF, with between 5 and 15 winning awards each year. The culture of research has been strengthened within the LBC student body, with the number of Professorial Assistants (facilitated by the Honors College) increasing from 37 in 2007 to 94 in 2010. LBC faculty also work closely with students in their research labs, involving nearly 70 undergraduates in research; of these, between 15 and 22 students coauthor papers each year and a similar number present results at regional/national conferences. These numbers testify to our efficacy in developing a culture of scientific research and investigation that reaches beyond the classroom.

External organizations that rank educational institutions or disseminate grant money also have favorably recognized the Briggs experience. Most notably, each year since 2005 *US News and World Report* has cited LBC as an outstanding example of an academic program that fosters student success. In both 2008 and 2009, this organization recognized LBC as a “Program To Look For.” Additionally, the National Science Foundation has recognized the value of the Briggs experience by awarding LBC two 4-year grants for a total of \$1.2 million—designated primarily for student scholarships—from its Scholarship in Science, Technology, Engineering and Mathematics (S-STEM) program in 2009 and again in 2012. For each grant, Briggs is partnering with the MSU Office of Financial Aid to administer 3-year scholarships to over thirty LBC students. For the first grant 80% of the recipients are from underrepresented groups in the sciences. The recipients also participate in regularly scheduled activities providing a wide-range of support. Scholars complete career exploration seminars in their sophomore

and junior years, which includes meeting with alumni in their field of study, discussion of career options, and visits to science-based industrial settings.

In support of MSU's focus on transitioning to a world-grant institution, LBC has made an intentional push toward the globalization of its own experience. The number of students pursuing study abroad experiences has more than doubled since 2001 with between 100 and 150 students participating in study abroad programs each year.¹² LBC introduced its first study abroad program in 2003 and has increased its own offering of study abroad experiences to five programs serving up to 67 students in a single year. LBC faculty members also have supported programs through the Freshman Study Abroad program with the Office of Study Abroad. The faculty also have demonstrated a focus on globalization with between 25% and 30% of LBC faculty members participating in funded international research each year between 2005 and 2010.

Lastly, our students have been directly recognized for their accomplishments. Lyman Briggs students have won prestigious national awards including the Goldwater (2012, 2010, 2008-2005), Knowles Science Teaching (2012), Truman (2006), Marshall (2005) and Udall (2006, 2005) Scholarships. We have also had an LB student represent Mexico at the Girls 20 Summit (2011). At the University level, 3-7 Briggs students have consistently been recognized with the Outstanding Senior Award each year, 2-4 typically earn the Board of Trustees Award, and our students have won the Featherstone Prize Competition (2006, 2005).

3.2. *What difference does it make whether we do it or not?*

LBC students primarily reap the value-added of the Briggs experience, which supports these students in their transition from high school to college and through to graduation and beyond. Evidence comes in terms of our high graduation rates, which reflect the support that the students receive through the strong residential learning communities cultivated within LBC. Although fewer than 50% of incoming college students interested in science actually graduate with a college degree in the sciences¹³, it is remarkable that approximately 70% of incoming LBC students graduate with a STEM major. Given our incoming class of 625 students, this equates to approximately 120 additional science graduates above an "average" institution helping to fill the expected 17% growth of STEM occupations between 2008 and 2018.¹⁴ LBC thus helps MSU meet the AAU's call to increase the number of STEM majors. Our success in combination with both the curricular and co-curricular experiences in LBC manifests in higher than average persistence and graduation rates as well. The second-year retention rates for the incoming classes between 2003 and 2008 were consistently around 95.5% and our 6-year MSU graduation rate for the LB classes entering as freshmen between 2001 and 2004 were between 82% and 85% (compared to 74-76% for MSU overall).¹⁵ LBC is also striving to help MSU increase its underrepresented minority graduation rate. Our efforts to promote diversity and inclusion have led to recognition by the Office of the Provost and the Office for Inclusion and Intercultural Initiatives (see section 3.5).

LBC actively recruits and attracts to MSU many highly talented students who are sought after both by our peer CIC institutions and by elite private colleges around the nation. In a 2012 survey of 508 current students, 12.2% indicated that they would not have attended MSU without Briggs, and another 52.2% indicated that Briggs greatly or slightly increased their likelihood of attending MSU. Faculty in many other departments subsequently benefit from these students' taking their courses and becoming involved in their research.

¹² CNS, nearly 3 times the size of LBC, has only had between 164 and 177 study abroad undergraduates in the past three years.

¹³ 2012 PCAST Report on Undergraduate STEM Education
<http://www.whitehouse.gov/administration/eop/ostp/pcast>

¹⁴ <http://www.esa.doc.gov/sites/default/files/news/documents/stemfinaljuly14.pdf>

¹⁵ The CNS rates are 80% and 77% respectively.

LBC's quality also has been able to help provide financial support to our students. Development efforts have allowed LBC to increase the number of available scholarships from 6 awards for a total of \$2,600 in 2007-08 to 72 awards for a total of \$15,800 in 2010-11—while increasing our endowment by over \$315,000 through the Spartan Scholarship Challenge. The Lyman Briggs Alumni Association also endowed scholarships that provided \$1,500 to students in 2011. That year also had the 29 NSF S-STEM scholars receive \$132,000 in additional scholarships. These scholarships, and other endowments that support a variety of programs, have allowed the college to surpass its first million dollars in endowed funds and help support our students. Donors helped LBC to meet the physical demands of a growing program through gifts in support of the renovation of the Holmes Hall west lower lounge into a senior seminar room and 6 faculty offices.

LBC is working to develop new kinds of relationships with industrial partners. Through an ongoing collaboration with ConAgra, LBC has twice offered a course entitled “The Science of the Foods You Love,” more casually called the “Popcorn Class.” This collaboration has resulted in LBC's providing an intensive undergraduate research opportunity to our students during the academic year. ConAgra has committed to \$200,000 in support for this course from 2012-2016. Additionally, LBC has discussed other potential kinds of collaboration such as having LB faculty leading food history or food ethics discussions with their employees or the creation of undergraduate Study Away programs. This relationship is providing a potential model for subsequent interactions with other industrial partners.

LBC faculty also benefit from a unique Briggs experience. The joint appointments with departments across campus help LB faculty connect with research scholars in their own field. The Briggs community provides a different connection that fosters interest and growth in teaching, research, and interdisciplinary work. Meanwhile, the faculty also bring their expertise in teaching and learning into their joint appointment departments. One example is the new Teaching Essentials Program for MSU STEM faculty. This program is a collaboration between LBC, CNS, ANR and EGR; three of the seven events in the first year involved having LBC faculty lead a workshop for peers from across MSU.

3.3. Given our present status, how do we intend to change in ways that help us advance?

LBC will build on the strength of the Briggs experience by:

- Extending the Briggs experience more intentionally to alumni
- Developing additional co-curricular experiences for our students with a focus on career exploration and preparation

While the Briggs experience currently benefits many in our student body, the LBC community will continue working to make the Briggs experience more beneficial to more of our students. The greatest area of potential advancement involves our relationship with our alumni. The transition from Lyman Briggs School to Lyman Briggs College yielded an opportunity to develop a greater connection with our alumni through the hiring of a development and alumni relations officer. This allows us to extend the Briggs experience beyond graduation to create a larger, more integrated community. A broader approach to alumni interactions will help engage our youngest alumni who are least likely to be able to provide financial contributions, yet allow us to start a long-term relationship with them. This will require LBC to develop a method for providing greater benefits to our alumni (e.g., making the *Briggantine* newsletter a venue through which alumni can share their own accomplishments with their classmates in addition to just providing news about the college).

Simultaneously, LBC should develop additional opportunities and resources for our students. The new campus neighborhoods and engagement centers provide a potential locus of resources for our students to explore. Connecting students and resources has often been one of the key roles of our advisors. They recommend activities and a timeline for students to prepare for their career or future education. Future additional resources might include the creation of electronic portfolios to house student work, easy networking with professionals in their desired field (a component of the S-STEM scholars program which has been highly beneficial), and career-oriented reflective statements (another highly beneficial S-STEM practice). The advisors could help students link these activities to the soon-to-be-

created LBC Learning Objectives, which would facilitate students' understanding of the important role that these co-curricular activities play in their career development.

The two goals of improving alumni relations and improving student resources could effectively be met through helping these two LBC constituents connect. The opportunity to network with professionals in students' desired fields can provide a great chance for our current students to engage with our alumni. Through the NSF-funded S-STEM program, we have had great experiences for both alumni and students when they can talk honestly about career paths and decisions.

The goal of developing the LBC reputation to be the "Oberlin of the Sciences" will require promotion of the LBC model broadly. This will require consistent efforts on the part of the faculty, staff, students, and alumni. The strength of LBC's SoTL research (describe in section 4 of this document) will certainly help raise the awareness of LBC. Further, the development of the research reputations of the currently junior faculty also will naturally help raise awareness of LBC. The college also should more actively promote its name and reputation. This should include producing works such as talks, articles, book chapters, and conference sessions that describe LBC or aspects of LBC. This should be facilitated by the new LBC Communications Officer position, which will be inaugurated in summer 2012.

3.4. How do we evaluate our future progress and success?

The impact of Briggs experience on students can be measured over the short-term or the long-term. Short term success is evidenced by numbers of students participating assorted activities, whereas many of the primary intended outcomes—the acquisition of technical scientific knowledge, the cultivation of scientific process skills, and the refinement of beliefs and attitudes about science and society—are difficult to directly measure in short-term time scales. However, these are the true markers of the success of LBC and the college needs to collect better outcomes data. Additionally, LBC should better measure the influence that LBC has in the involvement of students in scientific research and the long-term impact that LBC has on our alumni (and more broadly the LBC entering class).

For the short-term measures, LBC developed a set of metrics¹⁶ in 2009. These metrics provide a solid basis with which to evaluate the level of success of the Briggs experience, particularly in regard to our current students. From this information we have been able to track the support that LBC delivers to our student body annually (including a specific focus on underrepresented groups), including the approximately 3,000 hours of academic advising, the 700+ letters of reference written in support of our students, the 23 honors sections taught, and the 150-230 individual honors options overseen by our faculty. Yet, we lack a systematic and comprehensive process of gathering data from our students. Quality data on engagement in research, extra-curricular activities and attitudes toward science would provide LBC the ability to better evaluate its overall impact and success and yield useful data for publication on the efficacy of a living learning community such as Lyman Briggs. One method for collecting this type of data would be through the implementation of ePortfolios for the students. ePortfolios could grant students the ability to compile and document their work over their college career in a manner to market their demonstrable skills by linking them to the LBC Learning Objectives. This could also allow Briggs to effectively determine if it is meeting its own learning goals.

To measure long term success, LBC should strive to assess the impact of the Briggs experience among its alumni. Simple measures of alumni engagement including number and percentage of alumni donating, along with the donation amounts, are being tracked, though this provides only one measure of alumni satisfaction and only one type of alumni interaction. LBC should foster other means for alumni to continue interacting with the college which may include interactions with current students, talking about the Briggs experience with prospective students, and developing and/or publicizing internships and research positions for current students. Meanwhile, LBC should work to develop a better long-term assessment of the value added by the Briggs experience through surveys of our alumni (and also those students who began in LBC but who graduated from MSU with a non-LBC STEM major).

¹⁶ Internal LBC data.

Evaluating the increase of LBC's reputation will require adding metrics that measure the number of works that focus primarily on the development of the LBC reputation. LBC should also support faculty and staff as they look to create and publish such works. Further, LBC should position itself to receive nominations for national awards that focus on excellence in undergraduate science teaching for either individual faculty members or the college as a whole.

3.5. Diversity in the Briggs Experience

LBC has embraced the value of academic, cultural, and demographic diversity throughout the Briggs experience. From its founding in 1967, LBC was envisioned as a residential college where STEM and HPS ideas would be integrated to span the "two cultures" divide. LBC has valued the power of bridging the natural sciences and the social science and humanities to more effectively prepare students for dealing with the challenges of science-based real-world problems. LBC also has embraced diversity as a means for cultivating a richer educational environment. We believe that interactions with a wide range of individuals with diverse beliefs, values, and problem-solving approaches will improve student outcomes and help prepare students for tackling future world problems. These students are more likely to be able to be effective mentors for a diverse set of science practitioners. Creating this environment necessitates a demographically diverse student body and faculty. To this end, the Briggs community recently established a new standing committee—the Lyman Briggs Committee for Inclusivity (LBC Inc.)—to actively promote inclusive practices throughout all aspects of LBC governance. Our students also have created the long standing Briggs Multiracial Alliance and a newer Women in Science student group, which address and discuss issues with minority groups in the sciences.

LBC has many active projects aimed at *enhancing* its demographic diversity. In recognition of LBC's commitment to diversity, LBC was awarded \$50,000 in new recurring funds by the Office of the Provost in 2011 and a 2012 Excellence in Diversity Award from the Office for Inclusion and Intercultural Initiatives, becoming only the second college to ever earn this honor. LBC faculty currently manage three Creating Inclusive Excellence teaching and learning projects with the support of MSU's Office of Inclusion and Intercultural Initiatives. The first one focused on helping with the LMP students' transition into Briggs and was discussed in section 2.5. The second project involves a team of HPS and STEM faculty offering a Diversity in Science course in fall 2010, which integrated a service learning project and an inquiry-based learning project with a substantive focus on the challenges to and opportunities for greater inclusiveness and diversity in science. In collaborative teams, students gathered and analyzed survey data on respondents' beliefs and attitudes regarding diversity in science. These same teams organize a day-long science workshop for underserved K-12 students in the greater Lansing area, not only piquing the children's scientific curiosity but also providing them with positive role models for envisioning a science path into college. The third projects supports LBC in offering an Undergraduate Research Experience in Mathematics (UREM), a year-long program that offers research experiences in mathematics for an intentionally diverse cohort of undergraduate students. UREM provides a platform that simulates the experience of graduate training in the mathematical sciences at an early stage and helps students be more competitive for summer REU programs and internships. Students work on research projects, attend colloquia, and present their work at local, regional, and national mathematics conferences.

The LBC mathematics faculty also partner each summer with the MSU Louis Stokes Alliance for Minority Participation and the National Research Experience for Undergraduates Program (NREUP) of the Mathematical Association of America to offer a 6-week research program to an intentionally diverse cohort of undergraduate students from MSU and other universities. Such experiences greatly encourage undergraduates to persist in completing degrees in STEM fields and pursue graduate studies or careers in science. Over the past four years, the grants secured to support these programs totaled \$94,500. In addition the mathematics faculty were granted Research Experience for Undergraduates (REU) grants from the NSF and the National Security Agency to establish a Summer Undergraduate Research Institute in Experimental Mathematics (SURIEM, total funding is \$571,887). It is expected that 85 students selected from all over the nation will spend eight weeks in the summers of 2010-2014 at SURIEM.

Initial assessment of recent student trends suggests that incoming female LBC students graduate at a similar rate to their male counterparts. This is evidence that we are able to help female science students pass a critical point whereas most institutions lose female students from science majors at higher rates during the first and second years of college. Presently, minority students in LBC graduate at a slightly lower rate than their non-minority counterparts, yet at a higher rate than the MSU average. These data suggest that LBC is providing a broadly supportive environment that leads to a success across the demographic diversity of incoming students, but much still remains to be done.

Lyman Briggs College is participating in MSU's current "Advancing Diversity through Alignment of Policies and Practices" initiative, which is funded by a 5-year NSF grant with LBC faculty on the Faculty Advisory Board. As part of this effort, LBC faculty and staff have been striving to make our searches for new colleagues as open and inclusive as possible. A winter 2008 faculty meeting that focused on diversity issues led to the creation of a web page with resources about inclusive searches. In spring 2008, new language was drafted for our advertisements to make clear that working with diverse student populations is a key expectation for Lyman Briggs faculty; this has been used as a model by the MSU Office of Inclusion and Intercultural Initiatives. In spring 2009, the faculty wrote an explicit description of the teaching portfolio required as part of faculty job applications, to ensure that all candidates understand what is expected. All of these tools are proving valuable in our searches for new faculty and academic staff.

4.0. Scholarship of Teaching and Learning

The Scholarship of Teaching and Learning (SoTL) is a field of research that LBC has strongly embraced as a means for developing and engaging students in the culture of science. The Briggs curriculum, as discussed in section 2, consistently employs many research-validated high impact learning strategies. LBC is creating the kind of educational experience sought after in many calls for national reform (e.g., PCAST's *Engage to Excel* 2012 report, *Boyer Commission Report on Undergraduate Education*, the National Research Council's *BIO2010* Report, and *Rising Above the Gathering Storm*). Many aspects of utilization of SoTL in the classroom are described in Section 2 of this document.

Further, many of the faculty within Briggs have become active contributors to SoTL scholarship. The very nature of LBC means that it is an excellent laboratory for science education research. The students are highly engaged, they have close relationships with the faculty, they are a closed community where many students are taking the same classes, and the wide range of disciplines represented allows LBC to be a unique and, in many ways, ideal setting for SoTL research. For a more complete description, see Appendix 2.

4.1. How well do we do it, and who thinks so?

The inclusion of scholarly teaching in the classroom has led to the strong academic experience previously described in the Briggs curriculum and Briggs experience (sections 2 and 3 respectively). LBC faculty are engaged in a long-term effort to strengthen the core LBC courses by adopting research-validated educational techniques that help students acquire expert-level thinking skills. Examples of scholarly teaching include concept mapping linked to question creation by students, transformation of recitations into hands-on workshops, and incorporation of inquiry-based labs that stress experimental design as well as lab techniques. Thus, the evidence of strong academic success of our students and the external recognitions of the Briggs Curriculum provide tacit recognition of LBC's focus on SoTL. More directly, faculty engagement in SoTL research has become a cornerstone of the LBC research agenda. LBC faculty have increased the number of submitted and funded grants with a significant SoTL component over the past 5 years (averaging approximately 8 submitted and 4 awarded in each of the last 3 years). These awards provide external recognition of the quality of SoTL research within LBC. This increase in funding is reflected in a concomitant increase in teaching-oriented publications created by the LB faculty, with 10 education-oriented peer-reviewed publications in 2010-2011 alone. The strong interest in SoTL work has led LBC faculty of all disciplines to be recognized and supported by MSU's Lilly Teaching Fellows program and external programs such as the American Society for Microbiology's

Biology Scholars Program and the New Physics & Astronomy Faculty Workshops. Briggs faculty also serve on the MSU Faculty Advisory Boards of the Office of Faculty and Organizational Development and the Center for the Integration of Research, Teaching, and Learning (CIRTL).

LBC is in the process of placing itself more directly in the national spotlight of SoTL research by organizing the May 2012 Conference on Interdisciplinary Teaching and Learning. This conference provides a major opportunity for leading interdisciplinary SoTL scholars and practitioners from around the nation to discuss key issues in interdisciplinary teaching and learning, such as outcomes assessment, global engagement, and meeting administrative and institutional challenges. This conference also allows LBC an opportunity to showcase the LBC curriculum, experience, and ongoing SoTL scholarship to key scholars and administrators in the larger academic community. Financial support for this conference has come predominantly from the Provost's Office, though additional support is coming from a number of partner groups across campus and the nation.

LBC also has been recognized as a model for science education internationally. LBC is currently involved in MSU partnerships with Duhok University in Iraq and Monterrey Tech (Tec de Monterrey) in Mexico. Previously, LBC faculty and administration also have worked with Fukuoka Institute of Technology in Japan and Can Tho University in Vietnam.

4.2. What difference does it make whether we do it or not?

LBC views itself as a college that conducts experiments. As participants in science, we realize that ideas and methods can only be evaluated through real world experimentation. Thus, we actively bring our students into the experimental process not only in the laboratory, but also in the classroom. We encourage students to think critically about teaching and learning as a means to further develop their understanding of the scientific process. Further, recognizing that our students who will eventually become instructors are most likely to "teach as they were taught," we strive to include student-centered classroom practices, not only as a way to improve student learning, but also as a way to influence our future educators. Simultaneously, we strive to develop approaches to teaching and learning that can be implemented in other settings. Examples of these successes in the past include the BS 171/172 classes adopting the "Teams and Streams" laboratory model that was developed in LB 144/145, or the CEM 141/142 series adopting the recitation model initially implemented in LB 171/172.

Therefore, Briggs provides value by being a venue where new educational ideas can be tested on a reasonable scale. These models, if successful, can provide templates that can be implemented across MSU and in other institutions. One example is the NSF-funded BRAID project (Bringing Relationships Alive through Interdisciplinary Discourse) which has facilitated the implementation of interdisciplinary experiences for students throughout their introductory courses. The BRAID project has tested five different models for helping student make interdisciplinary connections in their classes and has induced many faculty to engage in serious discussions about science education. In addition to spawning the LBC Research Symposium and promoting interactions among faculty, the BRAID project currently supports two seminar courses each year focused explicitly on helping students make connections between the concepts in different courses. These seminar courses simultaneously provide an opportunity for faculty development. Other examples include the comparison of the SIRS and SALG instruments as student evaluation tools and the proposed pilot study investigating the ability of the upper-level HPS courses to meet the university's Liberal Learning goals. These projects have the potential to improve the student experience, not only in LBC, but across the campus.

LBC's focus on SoTL also helps to highlight larger campus issues. LBC has partnered with CNS and EGR to create the annual MSU STEM Workshop, which this year focused on how to better serve our low math placement students. This day-long workshop brought together interested faculty from across campus and from Lansing Community College to discuss methods to better address the needs of this population. As these students often disproportionately are our minority students, our ability to create a diverse science workforce requires us to find ways to better serve this population. Within this context, LBC faculty presented our approach to helping the LMP students' transition into the bulk of the LB curriculum through the LB 155 courses (discussed in section 2.5). Similarly, LB faculty also have been

instrumental in the re-evaluation of MSU's policy regarding how credit is awarded for AP biology scores, which led to a revision of that policy. An intercollege committee composed of LBC and CNS faculty and administrators examined the historical performances of students earning AP credit, and this resulted in a recommendation to revise MSU's current policy and may subsequently result in a publication from the data analysis.

As mentioned above, LBC has organized the May 2012 Conference on Interdisciplinary Teaching and Learning (CITL) to bring together leading scholars and practitioners in this area from around the nation. This will help move the national discussion about teaching and learning and simultaneously help develop LBC's external reputation in the area of SoTL.

4.3. Given our present status, how do we intend to change in ways that help us advance?

LBC will build on the strength of the Briggs Scholarship of Teaching and Learning by:

- Acting as an experimental SoTL lab
- Partnering with other MSU collaborators to advance STEM education

SoTL is already an important avenue of research in LBC. We should work to further develop this culture of SoTL experimentation more broadly within our classes. This will return LBC to its roots where it was known as a college with innovative educational practices. Students who are attending LBC should enter the college with awareness of emphasis on educational scholarship and should be prepared to be engaged in cutting edge experiments. This process will help students gain a greater ability to engage in metacognition on their own learning, preparing them to be better and more successful scientists and citizens. One example of an experiment involves assessing the ability of the LBC HPS courses to meet the goals set for the Integrative Studies in the Arts and Humanities and Integrative Studies in the Social Sciences. This planned pilot program would allow LBC students to use their required HPS courses to meet the university's integrative studies requirement. If such a program is successful, it will meet the Provost's goal of streamlining the curriculum by decreasing the total required credits, while simultaneously testing an approach that may be more broadly applicable to MSU.

There are changes that LBC should pursue to improve its setting for SoTL research. One step is to develop an overarching IRB that allows faculty to collect typical educational data from students in any LB class. This will help faculty collect research quality data for spontaneously developed educational experiments. For example, a faculty member who opts to add a discussion on study skills or insert a new approach to teaching phylogenetic trees currently must still obtain IRB approval to determine if these experiences enhanced student learning (these examples would both be deemed Exempt by the IRB.) Another avenue may be to create a collaboration or center for faculty engaging in SoTL research on the undergraduate science experience. LBC also should look to partner in meaningful ways with the Institute for Collaborative Research in Education, Assessment, and Teaching Environments for STEM (CREATE for STEM). Specifically, the development of an overarching assessment of the learning environment created within Lyman Briggs may provide a fertile area for research that will simultaneously help to increase the national recognition of Lyman Briggs.

4.4. How do we evaluate our future progress and success?

Our progress and success within SoTL will be most evidenced by continued dissemination of the innovations developed at LBC. This work will lead to a variety of publications and grants. Similarly, classroom experimentation in LBC will continue to provide insight for course decisions made within the other science courses. This may be driven through the expectations of our students or through peer-to-peer dissemination to the faculty in the other science colleges at MSU. Not all experiments will fully succeed as the nature of experimentation leads not only to the discovery of what works but also what does not work. This understanding must be reflected in the evaluation of LBC as a whole and, especially, the evaluation of individual faculty members. Through this process we will apply the rigor of the scientific

method to science education in a method that is highly visible to our student body, thus not only talking about how science occurs, but engaging them as active partners in the process.

Direct measures of SoTL productivity monitored by the LBC metrics should continue to include the number of SoTL publications, grants (submitted and received), total grant dollars from SoTL work, and IDC generated from SoTL activities. The measurement of the implementation of research-validated teaching practices in courses is much more challenging, but may in part be identified through measures of student success, or more coarsely through measures made by the Reformed Teaching Observation Protocol (RTOP). Similarly the proposed learning objectives may provide a framework through which implementation of research-validated techniques can be monitored.

4.5. Diversity in the Scholarship of Teaching and Learning

SoTL provides a key for being able to increase diversity in science. The current work with the low math placement (LMP) students is an avenue that will hopefully help us better understand how to serve these students, not only at MSU, but at institutions across the nation (see section 2.5). Research has shown that innovative teaching approaches often differentially impact minority and female students in a positive manner. Thus, the culture of SoTL created within LBC should help to create an environment that is more likely to lead to success among underrepresented students. Our SoTL work also extends into the co-curricular realm through undergraduate research, the S-STEM program, and faculty involvement in the ADAPP grant (all described in section 3.5). The level of success will become evident as we continue to monitor the success of our current interventions through the retention and graduation data of female and minority students.

5.0. Conclusions and Next Steps

Overall, LBC has worked hard to create an inclusive residential college that builds collaborations among our students, faculty, and staff. We have worked hard to help our students take the steps necessary to become lifelong learners, engaged citizens, and effective leaders. Yet achievement of our mission is not complete.

In the upcoming years, LBC should strive to make three specific advances:

1. Development of learning objectives for the entire curriculum and its sub-components
2. Strengthening of the Briggs experience through connections with our alumni
3. Increasing recognition of Lyman Briggs College through greater scholarship and dissemination of our achievements – especially in the scholarship of teaching and learning.

Achievement of these goals will require the earnest effort and attention of LBC faculty, staff, alumni, and students. The first steps in this process will require development of a clear set of learning objectives for all LBC graduates. The discussions to achieve this set of goals must engage the entire range of LBC stakeholders. Simultaneously, members of the LBC community should be encouraged to disseminate the successes of the LBC model across a wide range of venues and across the gamut of STEM communities.

Appendix 1: Acronyms Used in Lyman Briggs College Academic Program Review

AAU	American Association of Universities
BRAID	Bringing Relationships Alive through Interdisciplinary Discourse
CANR	College of Agriculture and Natural Resources
CIC	Committee on Institutional Cooperation
CITL	Conference on Interdisciplinary Teaching and Learning
CIRTL	Center for the Integration of Research, Teaching and Learning
CNS	College of Natural Science
CREATE for STEM	Institute for Collaborative Research in Education, Assessment, and Teaching Environments for STEM
EGR	College of Engineering
GPA	Grade Point Average
HPS	History, Philosophy, and Sociology of Science
IAH	Integrative studies in Arts and Humanities
IDC	indirect cost
ISS	Integrative studies in Social Sciences
LB	Lyman Briggs
LBC	Lyman Briggs College
LMP	Low Math Placement
MSU	Michigan State University
NSF	National Science Foundation
PCAST	Presidential Council of Advisors on Science and Technology
RTOP	Reformed Teaching Observation Protocol
SALG	Student Assessment of Learning Gains
SIRS	Student Instructional Rating System
SoTL	Scholarship of Teaching and Learning
S-STEM	Scholarships in Science, Technology, Engineering, and Mathematics
STEM	Science, Technology, Engineering, and Mathematics
ULA	Undergraduate Learning Assistant
UREM	Undergraduate Research Experience in Mathematics
UURAF	University Undergraduate Research and Arts Forum

Appendix 2

The following provides a more in-depth view of the current status of Lyman Briggs College in the three areas of 1) the Briggs Curriculum, 2) the Briggs Experience, and 3) the Scholarship of Teaching and Learning.

The Briggs Curriculum

The LBC curriculum helps students build a core science foundation through courses in biology, chemistry, math, and physics before they focus on a specific major. The initial courses in these disciplines not only introduce field-specific concepts, theories, and methods but also demonstrate the inter-relation of various scientific disciplines: e.g., how chemical principles underpin biological processes or how mathematical models can make sense of physical behaviors. These courses help students understand the nature of scientific reasoning, evidence, and knowledge, and instructors strive to demonstrate the relevance of course material to real world issues. Students discuss course material with each other at a conceptual and theoretical level to deepen their understanding and then engage in science together to generate new knowledge through course-based research projects. These introductory science courses strive to provide students with a solid foundation upon which to build further understanding by utilizing research-validated teaching practices including active and collaborative learning. Class sizes are designed to be smaller than the typical equivalent CNS course and to provide a greater level of individual attention from the faculty members. Most exams are predominantly open-ended, giving students the opportunity to explain their understanding. The introductory laboratory courses intentionally employ inquiry-based experiments to help students to understand the process of science. These experiments focus on the methods of science and scientific argumentation and not on pre-existing “right” answers that students are seeking to confirm. The laboratory courses strive to help the students learn how scientists communicate their work through the development of the skills necessary to write journal style lab reports that illuminate the thought process and scientific reasoning skills of the students. Students also begin to learn scientific presentations skills through the creation and display of research-based scientific posters. This highly diverse range of pedagogies helps reach all types of students and engage them in learning the basic skills essential for all scientists.

To further strengthen their scientific education, the Briggs curriculum includes three courses in the history, philosophy, and sociology of science: an introduction to HPS course in their freshman year and two upper-level, substantive HPS courses in their junior and senior years. In their initial HPS course, students are introduced to key questions, concepts, theories, and methods in HPS. After this, students extend and apply their foundational HPS knowledge to more advanced courses in the diverse fields of HPS of science, technology, environment, and medicine. This cluster of courses aims to help students gain a more complete understanding of the fields of science in which they are gaining technical proficiency (e.g., learning about the history of physics in an HPS course while they are learning the science of electromagnetism in a physics course). In particular, students critically examine how scientists ask and answer research questions and develop theories and methods within and across disciplines over time.

Throughout these HPS courses, instructors manage student-centered classrooms in which students confront their prior knowledge and reflect upon how and why they know what they know. HPS instructors regularly use an array of active learning techniques that span from a single class meeting to an entire semester. Facilitated by the instructor, students engage with each other to discuss and apply the course material to real-world issues of importance. Students perform collaborative inquiry-based learning projects and engage with the local community through service learning, while honing their written and oral communication skills. After completing the cluster of HPS courses, not only should LBC graduates have a better historical, philosophical, and sociological understanding of science, but they should be more capable intellectuals, have more marketable career skills, such as analytical reasoning and critical thinking, and be more empowered citizens prepared to be more active and effective participants in the public debates of the 21st century.

As they are completing their HPS coursework and their STEM-based coursework for their major, LBC students take their capstone senior seminar. This capstone experience—often an intensive, student-led, discussion-based course—formally integrates their STEM and HPS preparation and provides them with one last opportunity for independent inquiry during their Briggs experience.

The informal Briggs curriculum builds upon this formal curriculum. Briefly, the major elements of the informal curriculum are undergraduate research, study abroad programs, internships, participation in registered student organizations, the NSF-funded BRAID project, and the NSF-funded S-STEM seminars. We discuss the major elements of the informal curriculum in greater depth in APR section 3 on the Briggs Experience.

The Briggs Experience

The Briggs experience profoundly influences how students critically think about science and the world around them. More than just a set of classes, it involves engagement in a community of students, faculty, advisors, and staff and includes individual and shared educational experiences. This community participation does not end with graduation, but rather continues through a lifetime of interaction with classmates, faculty, staff, and alumni. Thus, the Briggs experience has a continuing influence on those associated with the program, leading most to strongly identify as “Briggsies.” These alumni then share their stories and help recruit prospective students to LBC to create future “Briggsies.”

A major aspect of the Briggs experience is the formal curriculum, which we discussed in APR section 2. Yet, the Briggs experience is much richer than just coursework. The residential college provides essential cohort-building experiences for LBC students. Housing the first year students in a single residence hall provides opportunities for students to develop strong relationships with colleagues that will last throughout their entire MSU career and beyond. These students also get to know more senior LBC peers who are working as ULAs or still residing in Holmes Hall. Such ties help foster a sense of community as the older students share their experiences and knowledge with younger students. This type of cross-cohort mentorship, which has long been a staple in bench science laboratories, is integral to the Briggs experience.

LBC’s living-learning community has additional features that promote student engagement. The inclusion of the LBC classrooms, faculty, and student services within Holmes Hall is critical to the Briggs experience, facilitating out-of-the-classroom interaction between community members. These informal interactions humanize the faculty and staff in the minds of the students, which facilitates mentoring relationships. Significant discussions take place during class times, advising appointments, office and walk-in hours, as well as informally in hallways, the cafeteria, and elsewhere throughout Holmes Hall. Similarly, the proximity of faculty from different disciplines within Holmes Hall also has a profound impact on the faculty-faculty relationships. The informal interactions that arise among scholars in close proximity have led to many new teaching and research collaborations such as the Diversity in Science Senior Seminar developed by a historian, two biologists, and a social scientist. These collaborations then yield new educational and research opportunities for LBC students.

Many Briggs students participate in a wide range of co-curricular opportunities that help foster learning and engagement in the Briggs community and beyond. Such activities include the LBC Research Symposium, the class book debates, community service, and LBC Speaker Series as well as involvement in primarily LB student groups (Briggs Multiracial Alliance, Women in Science, MSU STEM Alliance, etc.). Students also take part in shaping the future of Lyman Briggs and MSU through their involvement in governance (they serve on all LBC standing committees and in many MSU student groups) and through their participation in the faculty hiring process.

Scholarship of Teaching and Learning

Nationally, 90% of students who leave the sciences cite bad teaching as one of the primary factors in their departure. However, research from the field of the Scholarship of Teaching and Learning (SoTL) has helped identify practices that can help us change these discouraging patterns. “High impact” teaching and learning strategies can greatly increase student retention in science majors. Unlike science faculty

elsewhere, Lyman Briggs faculty have strongly embraced SoTL as a means for developing and engaging students in the culture of science. The Briggs curriculum, as discussed in APR section 2, consistently employs many of these high impact learning strategies. Student-centered learning practices are utilized in all classes. These include student-led discussions, inquiry driven laboratories, and active lectures with student response pads as a means of engaging students in making predictions and practicing newly learned skills. Our students increasingly recognize the benefit of these practices in their own learning.

Interdisciplinarity has been highlighted in many calls for reform of teaching and learning in science (PCAST's *Engage to Excel* 2012 report, *Boyer Commission Report on Undergraduate Education*, the National Research Council's *BIO2010* Report, and *Rising Above the Gathering Storm*). LBC faculty members implement our integrated interdisciplinary curriculum using research-validated pedagogical techniques and technologies that make students active participants in the classroom. This setting has made LBC-based projects highly competitive for a variety of externally funded projects. One example is the NSF-funded BRAID project (Bringing Relationships Alive through Interdisciplinary Discourse) which has facilitated the implementation of interdisciplinary experiences for students throughout their introductory courses. The BRAID project has tested five different models for helping student make interdisciplinary connections in their classes and has induced many faculty to engage in serious discussions about science education. In addition to spawning the LBC Research Symposium and promoting interactions among faculty, the BRAID project currently supports two seminar courses each year focused explicitly on helping students make connections between the concepts in different courses. These seminar courses simultaneously provide an opportunity for faculty development. LBC also promotes undergraduate research experiences through faculty mentoring, competitive research grants, inquiry-based classroom labs, and an emphasis on the acquisition of science process skills.

The culture of SoTL runs much deeper than simply influencing the design and execution of LBC courses. As mentioned earlier in APR section 2.1, Briggs faculty now employ research-validated instruments to better assess and evaluate our own teaching. Briggs formally adopted the Student Assessment of Learning Gains (SALG) in 2011 as the primary means for collecting student feedback about their course experiences. This instrument asks students to evaluate their improvement on specific skills, abilities, or knowledge. This shifts the assessment of the classroom from "teaching" to "learning" and better addresses the key question about the efficacy of classes: what did students learn? Similarly, the faculty now employ the Reformed Teaching Observation Protocol (RTOP) to assess the kind of learning environment that an instructor fosters within the classroom. This instrument provides a resource for mentoring committees and strengthens a culture that openly discusses challenges in promoting student learning.

Further, many of the faculty members within Briggs have become active contributors to SoTL scholarship. The very nature of LBC means that it is an excellent laboratory for educational experiments. The students are highly engaged, they have close relationships with the faculty, they are a closed community where many students are taking the same classes, and the wide range of disciplines represented allow LBC to be a unique and, in many ways, ideal setting for SoTL research.