

Assessment Report
Biology Department
June 17, 2015

To Whom It May Concern:

During the 2014-15 academic year, the Biology Chair met individually with Sarah Goodwin and Lisa Christenson to discuss a strategy for conducting a programmatic assessment in the year ahead. The Biology department has committed to a wholesale redesign of the major- from gateway to capstone courses, exo-bio requirements, goals for student learning in the major and assessment of the efficacy of our courses and program. Discussions surrounding this redesign were the focal point of our department initiatives this past year.

As a guide to our process, we drew heavily on the broad recommendations outlined the 2010 *Vision and Change in Undergraduate Biology Education (V&C)*, and the 2014 *BioCore Guide: A Tool For Interpreting The Core Concepts of Vision and Change for Biology Majors*. Though early in it's design, our new curriculum promises a significantly more integrated program, with clearly articulated goals for student learning that will provide a solid framework from which assessment of student learning and curricular revisions can emerge.

A National Science Foundation funded, programmatic assessment tool, aligned with the conceptual framework of *Vision and Change* and the BioCore Guide, called BioMAPS (Masuring Achievement and Progress in Science) is currently under development by a multi-institutional team of investigators. In order to refine and validate it's efficacy, this tool is dependent upon the participation of Biology programs, instructors and students from a wide range of institutions within the United States. Once validated, it will be available to institutions that seek to track undergraduate biology majors' understanding of core concepts (as aligned with the recommendations of V&C) *as they progress* through the major. Skidmore's Biology program was invited to participate in piloting the first iteration of this programmatic assessment tool, which took place in the Spring of 2015. Participation in the development of this assessment tool is particularly appealing to us in that we are able to garner a sense of student performance and the efficacy of our program before and after implementation of our new curriculum.

This assessment report then has two parts. Part I is a summary of our progress on curricular reform that was initiated in the Spring of 2014, specifically, the revised mission statement and goals for student learning in the major. Part II is a summary of our participation in the validation of the BioMAPS Assessment Tool.

Respectfully Submitted on Behalf of the Biology Department,

Patricia Hilleren,
Associate Professor of Biology
Skidmore College

Part I: Curricular Reform- Articulation of Mission and Student Learning Goals

Our curricular reform began with the development of a clearly articulated department mission that explicitly states our goals for student learning. After discussions, writing and revision that took the better part of a calendar year, we achieved 100% consensus on the adoption of the following text.

Biology Department Mission Statement and Goals for Student Learning

Biologists develop and test scientific models that deepen our world's understanding of life. The pace with which Biology changes (new knowledge, new methods and new technology) is matched only by the speed and depth of its integration into society. Biological expertise is needed, to an unprecedented degree, to address many of the most pressing challenges associated with living in today's world. Toward that end, our overarching goal, embedded within the framework of a liberal arts education, is to educate Skidmore students in a manner that empowers them to be able to successfully pursue any challenge as it relates to the sciences, health professions, industry, environment and society. Our mission then, is two fold:

1. To provide a strong curricular foundation in biology enhanced by direct experience with creative, original biological research, as a means to prepare students (majors/minors in Biology as well as the other life sciences) for graduate and health professional programs or careers in biology and related fields;
2. To provide compelling exploration courses, available to *any* student, that will introduce representative method and content of biology, provide a basis for a lifelong interest in science, and help to guide exploration of the relationships between science and society.

We strive to offer a modern, rigorous and effective program of education and training that is informed by the vision and recommendations of the leading scientific institutions (National Science Foundation, Howard Hughes Medical Institute, National Institutes of Health, and the American Association for the Advancement of Science). We employ a teacher-scholar approach in which our teaching is heavily informed by our own scholarship. We utilize a diverse range of classic and innovative teaching pedagogies to cultivate student learning across the curriculum. Laboratories associated with our courses offer students *bona fide* experience and training in scientific design, methodology and execution, interpretation and communication.

Our commitment to excellence in teaching is matched by an unwavering commitment to student engagement in biological research-the *doing* of science. Professors in Biology lead compelling and productive research programs, engaged in diverse and modern areas of biological research, which leverage traditional laboratory model organisms, exotic and local species and ecosystems. Many of these research programs have garnered highly competitive external grants to sustain and expand the lines of investigation. In collaborations with faculty, our students work in well-equipped research laboratories, the

Skidmore Microscopy Imaging Center, and the adjacent 500+ acre North Woods. They explore fundamental molecular and cellular processes, structure - function relationships, behavior and ecology, and evolutionary patterns. It is within these research laboratories and environments that we most successfully mentor and train the next generation of scientists.

Graduating majors in Biology will:

1. Possess an integrated understanding of life across all levels of organization (from molecules to ecosystems) supported by a conceptual framework that includes: evolution; energy/matter transformation; information flow; structure/function relationships, and systems-level computational modeling.
2. Possess hands-on experience with a suite of contemporary lab and field-based techniques and technological innovations using department resources that serve to explore biological systems across multiple levels of organization.
3. Be proficient in posing testable hypotheses; in designing properly controlled experiments with appropriate methods, techniques and statistical analysis; in executing the work; and in accurate interpretation of the experimental results.
4. Have developed the skills to effectively communicate experimental results and the significance of those results in both a narrow and wide context- via written and oral contributions to scientific journals, conferences, departmental seminars, and on-campus programs.
5. Have directly experienced the collaborative nature of science in the design, execution and reporting of research.
6. Have direct experience and training in the critical review of original biological literature (scientific journal articles, research proposals, research seminars);
7. Be equipped to explore and articulate connections between biology and other disciplines within and beyond the natural sciences, in the spirit of the liberal arts tradition.

Plans for Assessment of Student Learning in the New Curriculum

The department has briefly discussed plans to embed assessment into the course curricula at the introductory, mid and upper level. We have not yet worked out the details of this assessment- that will be a focus of our discussion in the AY15-16. In the interim, will continue to work with the development of the BioMAPS Programmatic Assessment Tool (see below).

Part II: BioMAPS Programmatic Assessment of Student Learning in Biology

PURPOSE, SCOPE AND METHODOLOGY OF THE BioMAPS ASSESSMENT TOOL.

The BioMAPS administrative team is developing a general biology programmatic assessment tool that aligns with the core principles and concepts of Vision and Change to be used by Biology departments to monitor the progression of students through the Biology major. In brief, a series of multi-part questions are developed and validated that aim to measure a student's ability to utilize knowledge of the core principles and concepts in Biology within a range of difficulty and sophistication. Students are provided a link to the online assessment, and once logged in, are randomly assigned a total of 15 multi-part , multiple-choice questions. The assessment requires approximately 45' to complete.

As part of the development process for this assessment tool, a diverse set of institutions (universities, colleges, liberal arts institutions and 2-yr community colleges) was recruited to pilot the first iteration of the test. The purpose of the initial pilot was to collect data on the quality of the questions being designed, including whether the questions were able to distinguish between high and low achieving students and if the questions cover a range of difficulties from easy to challenging. The initial large scale (>2600 participants) pilot took place in the Spring of 2015. After evaluation and revision of the initial pilot, a second, follow-up pilot will be conducted in the Fall of 2015.

It is anticipated that the final version of the BioMAPS Assessment tool will become freely available to any institution interested in using it within the next year or two.

SKIDMORE BIOLOGY PARTICIPATION

In February of 2015, the Skidmore Biology faculty teaching at the 200-and 300-level were informed by the Dept. Chair of the opportunity for their students to participate in the BioMAPS Assessment Pilot and there was genuine enthusiasm for participation among the faculty. As a result, ten different Biology courses at the 200 and 300 level were enrolled in the BioMAPs pilot including: BI242 Molecular Biology; BI244 Comparative Vertebrate Physiology; BI245 Principles of Genetics; BI247 Cell Biology; BI252 Topics in Evolutionary Biology; BI309 Microbial Genetics; BI316 Animal Behavior; BI337 Plant Biochemistry and Physiology; BI351 Topics in Biology-Parasites, Epidemiology and Health; and BI378 Senior Capstone. A total of 84 students representing majors in Biology (53), Chemistry (7), Environmental Studies (8) Neuroscience (6); Exercise Science (2); Psychology (2), and others (6) were enrolled in the 10 Biology courses and thus, were eligible to participate in the assessment pilot. Of these 84 students, 29 were seniors, 17 were juniors, 34 were sophomores and 4 were freshman.

After enrolling in the assessment pilot, individual course instructors were contacted via email by the BioMAPS administrators. Course instructors were asked to contact the BioMAPS administrator to 'activate' the assessment for their course and to designate a

week-long time period during which the students in their courses would have electronic access to the BioMAPS assessment website. That email was followed up with an email from the Biology Chair to alert all participating instructors to the notification and to encourage their continued participation. Course instructors were provided with a unique URL that they would then provide to their students. Most of the Biology instructors gave access to the assessment during the week of April 11th-17th.

Student participation in the assessment was voluntary, and was not awarded any course credit. In some cases, faculty provided time during lecture or lab for students to complete the assessment, in other cases, students were asked to take the assessment on their own time- outside of class. In at least one case, the course instructor did not 'activate' the assessment tool- and these students were not given the opportunity to participate. Of the 84 students originally eligible to participate in the assessment, 39 students did not participate, 6 students started the assessment but did not complete it, and 39 students completed all 15 questions, and thus were included in the assessment analysis.

Of the 39 Skidmore students that completed the assessment, 27 were Biology majors comprising just 3 seniors (20% participation rate), 5 juniors (21% participation rate) and 19 (58% participation rate) sophomores. Biology majors must declare one of three concentrations (General or Integrative Biology (INT), Molecular Cell Biology and Genetics (MCB/G); or Ecology, Evolution and Behavior (EEB). Of the 39 Biology students, 21 students were MCB/G; 4 were INT; and 2 were EEB.

Participation levels by course helped to explain the skewed participation rates- by class level. Two of the 300 level courses had zero student participation, another – the senior capstone class had just 1 of 15 students complete the assessment. The assessment for at least one of these courses was not 'activated' by the instructor. In the case of the capstone- the course was activated late- during the last study week of the semester before finals.

Course #	Student Enrollment	% of Students in Course That Completed the Assessment
BI242	12	100%
BI244	5	60%
BI245	14	78.6%
BI247	10	20%
BI252	7	0%
BI309	8	100%
BI316	11	18.2%
BI337	14	0%
BI351	6	0%
BI378	15	6.7%

*66 students were enrolled in just one of the courses participating in the assessment; 17 students were enrolled in two; 2 students were enrolled in 3 courses

RESULTS OF THE SPRING 2015 BIOMAPS ASSESSMENT PILOT

Analysis of the results of the first assessment pilot is currently underway by the BioMAPS administrative team.

In mid-July, we were provided with the breakdown of the aggregate scores from Skidmore and the larger cohort of more than 2600 participants. This information is detailed below.

We are still awaiting the breakdown of responses to particular questions that are aligned with the core principles and concepts of the Vision and Change as articulated thru the BioCore Guide. This, more sophisticated analysis, will provide us with a snapshot of specific areas of strength and weakness that could inform our program development.

Bear in mind that this assessment tool is still under development. The results of this pilot will guide changes for the second iteration of the assessment tool to be conducted in the Fall of 2015. Thus the 'robustness' of the information below should be interpreted with caution- particularly since the number of Skidmore participants within individual categories is very low.

PARTICIPANTS:

More than 2600 students nationwide participated in the first pilot of the BioMAPS assesment tool during the Spring of 2015. Of these, 39 students were from Skidmore College and 27 identified as Biology majors.

OVERALL SCORE:

The overall student performance score (correct responses) was 65.81%; Skidmore student's overall performance score was 73.17%; Skidmore Biology Major's performance score was 73.4%

SCORES BASED ON COURSE LEVEL:

The overall performance in lower division courses (at the 200 level and below) was 64.89%; Skidmore student's performance at the lower division was 71.8%.

The overall student performance in higher division courses (at the 300 level and above) was 71.15%; Skidmore student's performance at the higher division level was 76.4%

SCORES BASED ON EXPERIENCE

NUMBER OF COLLEGE BIOLOGY COURSES TAKEN	OVERALL STUDENT SCORE-PERCENT CORRECT	SKIDMORE STUDENT SCORE-PERCENT CORRECT
1	60.88%	68.72%
2-4	67.06%	70.21%
5-7	70.02%	79.05%
8 or more	72.89%	81.86%

SKIDMORE MAJOR BREAKDOWN BY CLASS LEVEL

GRADE LEVEL	ALL SKIDMORE STUDENTS	BIOLOGY MAJORS
SOPHOMORE	70.81%	71.5%
JUNIOR	80.35%	79.9%
SENIOR	72.89%	78.1%

SUMMARY

The Skidmore students who participated in the assessment performed favorably relative to the entire cohort- with scores ranging on average 5-7 percentage points higher than the cohort. That said, there is clearly room for improvement in the overall performance of our students. We look forward to receiving the more sophisticated, disaggregated analysis on the mastery of each of the core concepts and principles as that will provide us with a snapshot of the strengths and weaknesses of our current program.

This assessment tool is being developed to help institutions measure the progress of it's students in their understanding of Biology as defined by the core concepts and principles articulated in the BioCore Guide- and therefore one would expect that the overall scores will increase with exposure to greater levels of Biology coursework and class level. We do observe that trend within the Skidmore cohort of students-though the low numbers of participants (e.g. Senior Biology Majors) does not give much confidence in the result.

Unfortunately, compliance or participation in the assessment at both the level of the course instructor and the student was disappointing- less than half of the eligible students actually completed the exam. Instructors who chose to provide time for the assessment during class time had the highest participation rate. We will need to develop a better mechanism to insure that eligible students have both the opportunity and the will to participate. We plan to participate in the 2nd iteration of the BioMAPS Assessment in the Fall of 2015.

References:

American Association for the Advancement of Science (AAAS). Vision and Change in Undergraduate Biology Education: A Call to Action. Washington, DC; 2011.

Brownell SE, Freeman S, Wenderoth MP, Crowe AC. BioCore Guide: A tool for interpreting the core concepts of Vision and Change for biology majors. CBE - Life Sciences Education 2014; 13: 200 - 211.

August 27, 2015

Dear Pat,

We appreciate your excellent work on this assessment and your planning for next year and beyond. Your report this year shows an enormous step forward, both in establishing a new mission and goals and in taking part in the national BioMAPS project.

As before, we are responding to the department and program reports with particular attention to the ways faculty are framing learning goals; analyzing student work directly (and also considering indirect information such as surveys and interviews) to see how well they are meeting our goals; discussing the results together; and making use of the results to change courses, requirements, and/or pedagogies. The standards for accreditation require that we regularly analyze our students' work directly.

As always, the key is to do assessment that you find meaningful. Everything lines up behind that. The goals that you have established are clearly meaningful and important, and are both broad and deep. Studying how well your students are meeting those goals should be of real interest to your department.

Student Learning Goals: You led your department in a curricular reform that began with the development of a new mission statement with explicit goals for student learning. Congratulations on getting 100% of the faculty to approve the new statement and the learning outcomes – a great achievement!

Assessments—Direct: Skidmore students taking a variety of biology courses participated in the pilot BioMAPS assessment, an NSF-funded effort to track students' understanding of core concepts as they progress through the biology major.

Assessments—Indirect: None this year.

Results: The results of the BioMAPS assessment showed that Skidmore students scored favorably compared with over 2600 students at other 2- and 4-year schools in the United States, but the results also show room for improvement in the Skidmore students' scores.

Discussion, implementation: You are waiting for a breakdown of the BioMAPS scores by category, and you plan to use these results to determine the strengths and weaknesses of the program. You will also seek a way to get better participation, as less than half of the eligible students completed the exam.

Looking ahead: The department will discuss the details of assessment of the new curriculum during the upcoming year, while you continue to work with the BioMAPS assessment tool. Please let us know if we can help in any way as you work to embed assessment into the new curriculum.

Overall: Again, congratulations on making great strides in reforming the Biology curriculum! And the Skidmore Biology department's involvement in the NSF-funded BioMAPS program is an exciting development that we hope will provide useful information as you implement the new curriculum. Your leadership has been key. Great work!

Sincerely,

Lisa Christenson and Sarah Goodwin