

## 2016-17 Student Learning Assessment Report, Academic

<b>Program:</b> Biology (BS)	<b>Degree:</b> Major	<b>Department Head:</b> James Angstadt	<b>Submitted By:</b> James Angstadt	<b>Date Submitted:</b> 06/22/2017	
<p><b>Mission:</b></p> <p>The Biology Department seeks to develop in each student an appreciation of the science of biology at all levels of study (molecular, cell, whole organism, and populations), which is understood and integrated in terms of Darwinian evolution. This is accomplished through a rigorous, broadly based, laboratory-intensive curriculum taught by faculty who are dedicated, first and foremost, to enriching the learning experience of their students. In addition to a biology core curriculum, all students take additional courses in the areas of cell/molecular biology, physiology, morphology, and organismic/population biology. A major emphasis of our program is to encourage critical thinking and an active engagement in the biological sciences. We do this by keeping class sizes small and including a laboratory experience as an integral component of most courses. Many laboratories incorporate independent research projects where students creatively build on fundamental concepts and techniques to address interesting biological questions. The program further encourages and reinforces independent research skills by offering credit for on-campus Independent Research courses mentored by departmental faculty or off-campus Science internships in Biology. In order to accomplish these pedagogical goals, the department hires only broadly-trained faculty who also possess expertise in a particular biological discipline. Faculty members are encouraged to establish and maintain active research programs in order to remain current in their disciplines, enthusiastic about their courses, and to provide independent study opportunities for students.</p>					
<p><b>1. Major/Program Student Learning Outcomes</b> Students will be able to...</p>	<p><b>2. Phase</b></p>	<p><b>3. Assessment Procedures</b> (Planning/ determining)</p>	<p><b>4. Assessment Results</b> (Collecting/ analyzing)</p>	<p><b>5. Use of Results</b> (Discussing/ using results)</p>	<p><b>6. Determining if changes impacted student learning</b></p>
<p>1. Demonstrate an understanding of the process of science and develop an appreciation of contemporary issues in biology.</p> <p>Criteria: (How do you know students are achieving learning outcome?) At least 80% of students scoring 70% or greater on Final Exam.</p>	<p>Planning Collecting Discussing</p>	<p>Method: (ex. tests, presentations, research paper) Evaluate results of Biol 190 Final Exam. Focus is on "understanding science"</p> <p>Using a Sample of Students? Yes</p> <p>If yes, describe your sample. All students in 4 sections of Biol 190</p>	<p>These results are from 2013-2014</p> <p>Final quiz in this course assesses a basic understanding of topics covered throughout the semester, which focus on the scientific method. Specific topics that students learn about include scientific</p>	<p>The statements below are from the report for 2013-2014</p> <p>The department is satisfied that students completing this course, which is required of all biology majors, are gaining a basic, but comprehensive, understanding of the scientific method and the means by which scientists communicate their research findings.</p>	

		<p>When does assessment occur? Fall 2013 and Spring 2014</p> <p>How often does assessment occur?</p>	<p>hypotheses and models, experimental design, basic statistics, methods of data analysis and presentation, understanding and searching scientific literature, writing a primary research paper in the sciences, and oral presentation of research findings.</p> <p>N= 76 students 100% met the standard. 38/76 scored in the A range 28/76 scored in the B range 10/76 scored in the C range</p> <p>Learning Outcome Met? (Based on Criteria) Yes</p>		
<p>2. Demonstrate competence with equipment and experimental methods.</p> <p>Criteria: (How do you know students are achieving learning outcome?) At least 80% of students scoring 70% or greater on lab intensive, graded tasks.</p>	Impact	<p>Method: (ex. tests, presentations, research paper) Lab skills test and lab practical exams</p> <p>Using a Sample of Students? No</p> <p>If yes, describe your sample.</p> <p>When does assessment occur?</p>	<p>Fall 2014 Neurobiology Biol-440 Lab skills test – students graded on an array of practical skill demonstration and written questions. Learning Outcome Met? (based on Criteria) <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Only 74% of the students met the criterion for success.</p> <p>Spring 2015</p>	<p>Fall 2014 Neurobiology Biol-440 In fall 2015, we will attempt to improve lab skill learning by offering students a review/practice session a day or so prior to administering the quiz.</p> <p>Spring 2015 Gen Bio for Social Sciences Biol-140 In the fall of 2015 we will emphasize the importance of attending the review sessions already offered to prepare for this assessment.</p> <p>Spring 2015 Gen Bio II Biol-120 Many of our freshman scored</p>	<p>Fall 2015 Biol-440. There was a 19 percentage point increase in students who met or exceeded the standard. Thus, use of results led to improved student performance for this group of students.</p> <p>Fall 2015 and Spring 2016 Gen Bio IIA for Social Sciences Biol-140 6 lab sections total. There was a 17 percentage point increase in the number of students who met or exceeded the criterion. This indicates that our use of results improved student learning for this group of students.</p>

How often does assessment occur?

General Biology for Social Sciences Biol-140 Practical exam requires students to identify structure and function of organs in dissected specimens, answer questions about cardiovascular function, interpret histology images, and demonstrate ability to solve biomechanics problems.

Learning Outcome Met? (based on Criteria)  
 Yes  No  
Only 74% of students met the criterion for success.

Spring 2015 General Biology II Biol-120 Lab practical exam. Students were presented with questions at 40 stations, in which they were asked to identify various biological specimens. Students were also asked questions pertaining to mammalian and plant physiology as well as to calculate and evaluate statistical results from a stream analysis.  
Learning

exceptionally well on this assessment – over 13% with grades of 93% or higher. The rigor of this assessment must be maintained in order to properly prepare students for their sophomore level biology courses. To help improve the results, we will increase our efforts to encourage effective study habits.

Spring 2016, General Biology II, Biol 120

This year, only 62% met the criterion for success. Again, some students (17%) scored in the A range on the assessment. Given that the assessment is essential the same, we believe that this result is most likely to reflect a decline in the quality of incoming students.

Spring 2016 General Biology II, Biol 120

Our efforts here were less successful, with a decline in the percent of students meeting the criterion for success. We believe this results is most likely to reflect a decline in the quality of incoming students.

Outcome Met?  
(based on  
Criteria)  
 Yes  No  
Only 74% of  
students met the  
criterion for  
success.

Fall 2015  
Neurobiology  
Biol-440  
Lab skills quiz  
93% of students  
met or exceeded  
the criterion for  
success.  
Thus, use of  
results led to  
improved student  
performance.  
Criteria were met.

Fall 2015 and  
Spring 2016  
Gen Bio IIA for  
Social Sciences  
Biol-140  
6 lab sections  
total.  
91% of students  
met or exceeded  
the criterion for  
success. Criteria  
were met.

Spring 2016  
General Biology II  
Biol-120 Lab  
practical exam.  
This year 144  
students took the  
exam.  
Learning  
Outcome Met?  
(based on  
Criteria)  
 Yes  No

Overall for the  
2015-16 year, 187  
out of 251 (74.5%)

			met the learning outcome		
<p>3. Develop independent research skills and an ability to apply basic mathematical techniques in the biological sciences.</p> <p>Criteria: (How do you know students are achieving learning outcome?) At least 80% of students scoring 70% or greater on selected tasks</p>	<p>Planning2+ Collecting Discussing Impact</p>	<p>Method: (ex. tests, presentations, research paper) One or both of the following: a. assess performance on selected exam questions that test for competence in this skill. b. Evaluate student performance on projects or written assignments that requires</p> <p>Using a Sample of Students? Yes</p> <p>If yes, describe your sample. Students in various biology courses.</p> <p>When does assessment occur? Throughout the academic year</p> <p>How often does assessment occur? Throughout the year</p>	<p>Fall 2015 General Biology I BIOL-110 Students read an article on recent hominin ancestors, obtained background information on the subject and interpret data from the literature. Assesses independent research skills. Learning Outcome Met? (based on Criteria) <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No</p> <p>Two lecture sections (n= 55 students). 91% of students met the criterion for success.</p> <p>Fall 2015 General Biology I BIOL-110 Two lecture sections (n= 55 students). Exam question where students had to calculate the carrier frequency of an allele given a population at Hardy-Weinberg</p>	<p>Fall 2015 General Biology I BIOL-110 Two lecture sections (n= 55 students). Exam question where students had to calculate the carrier frequency of an allele given a population at Hardy-Weinberg equilibrium. Learning Outcome Met? (based on Criteria) <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Only 49% of students met the criterion for success.</p> <p>This assessment result is a bit misleading because the question was worth only 3 points, and students received a score of 1, 2 or 3. Thus, the student needed a perfect 3/3 to meet the criterion. Nevertheless, Dr. Harbison plans to incorporate additional classroom activities to try and improve student understanding of the relevant concepts.</p> <p>Fall 2015 General Biology I BIOL-110 Genetics exam questions requiring calculation of expected phenotypic ratios or allele frequencies in a genetic cross. Learning Outcome Met? (based on Criteria) <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p> <p>Only 35-39% of students met the criterion for success. This was the first time that Mr. Rapp taught general biology lecture. If he does it again, he will add class activities that challenge students practice this sort</p>	<p>General Biology continues to be a focus of our assessment and intervention efforts. The two assessments that did not meet our criterion for success for this goal last year are part of a broader trend in declining General Biology student performance that we have observed over the past several years. We did not see any marked improvement in student's understanding of mathematical concepts relevant to General Biology I, so we are in the process of implementing a multi-year intervention focused on four of the five Biology Department Student Learning Outcomes (SLO). The first part of this assessment was completed in Spring 2017 across all sections of General Biology II, and a report on those findings is provided in "Use of Results" for the Biology Department's 4th SLO ("Know the important facts and concepts relevant to the discipline"). A similar intervention will be conducted in Fall 2017 with the aim of improving student performance across SLOs 1, 3, 4, and 5 in our introductory biology sequence.</p>

equilibrium.  
Learning  
Outcome Met?  
(based on  
Criteria)  
 Yes  No

Only 49% of  
students met the  
criterion for  
success.

Fall 2015  
General Biology I  
BIOL-110  
Genetics exam  
questions requiring  
calculation of  
expected  
phenotypic ratios  
or allele  
frequencies in a  
genetic cross.  
Learning  
Outcome Met?  
(based on  
Criteria)  
 Yes  No

Only 35-39% of  
students met the  
criterion for  
success.

For this sample,  
across the 3  
assessments, 60%  
of students met  
the criterion. For  
Biol 110 the  
criterion was not  
met.

Fall 2015  
General Biology  
for Social  
Sciences  
BIOL-140  
Lab data analysis  
exercise required  
calculation of  
retinal ganglion

of calculation. However, Mr. Rapp is  
not assigned to teach general  
biology lecture next fall.

cell receptive field characteristics.

Learning

Outcome Met?

Yes  No

97% of students met the criterion for success.

Fall 2015

Plant Ecology

BIOL-240

Analyze and then present data from a field experiment.

Learning

Outcome Met?

(based on

Criteria)

Yes  No

100% of students met the criterion for success.

Fall 2015

Plant Ecology

BIOL-240

Students were given materials (seeds to study root growth and floating aquatic plants) and they had to design an experiment, analyze the data and then write a full research report.

Learning

Outcome Met?

(based on

Criteria)

Yes  No

100% of students met the criterion for success.

Fall 2015

Marine Ecology

BIOL-400

Series of final

exam questions  
that evaluate  
student  
understanding of  
experimental  
design and their  
ability to interpret  
recently published  
data on community  
ecology in a coral  
reef.

Learning  
Outcome Met?  
 Yes  No  
85% of students  
met the criterion  
for success.

Fall 2015  
Biochemistry  
BIOL-420  
Scientific paper  
reporting results of  
an independent  
lab project: MALDI  
mass spectrometry  
to assess protein  
content in  
commercially  
available protein  
supplement.

Learning  
Outcome Met?  
 Yes  No  
100% of students  
met the criterion  
for success.

Fall 2015  
Biomechanics  
BIOL-450  
Independent  
Research Project  
Design

Learning  
Outcome Met?  
(based on  
Criteria)  
 Yes  No  
100% of students  
met the criterion  
for success



Fall 2015  
Biomechanics  
BIOL-450  
Final Exam –  
course  
emphasizes  
quantitative skills  
and thus the final  
exam is a useful  
means of  
assessing our  
students' ability to  
apply  
mathematical  
techniques to  
solving problems  
in the biological  
sciences.

Learning  
Outcome Met?  
(based on  
Criteria)  
 Yes  No  
94% of the  
students met the  
criterion for  
success.

Fall 2015  
Ecology BIOL-225  
Reports  
describing the  
results of an  
independent  
research project  
and three short  
data analyses from  
field experiments;  
involved data  
analysis and  
statistics (ANOVA,  
t-test, chi-square)

Learning  
Outcome Met?  
(based on  
Criteria)  
 Yes  No  
100% of students  
met the criterion  
for success.

Fall 2015  
Ecology BIOL-225  
Exam with strong  
emphasis on  
ecological  
modeling and  
mathematical  
approaches to  
understanding  
predator-prey  
dynamics,  
population size  
fluctuations, and  
resource  
competition  
models  
Learning  
Outcome Met?  
(based on  
Criteria)  
 Yes  No  
92% of students  
met the criterion  
for success.

Spring 2016  
Animal Physiology  
BIOL-430  
Evaluation of Data  
collection, analysis  
and presentation  
for a class project  
collecting  
information on  
vasoconstriction or  
dilation of the  
finger as a function  
of temperature.  
Learning  
Outcome Met?  
(based on  
Criteria)  
 Yes  No  
96% of students  
met the criterion  
for success.

Spring 2016  
Biology of the  
Vertebrates  
BIOL-230  
Short report

describing the results of a bird foraging experiment; involved data analysis and statistics (ANOVA, t-test)

Learning Outcome Met? (based on Criteria)

Yes  No  
100% of students met the criterion for success.

Spring 2016  
Biology of the Vertebrates  
BIOL-230

In-class exercises where students to grapple with concepts introduced in lecture. Most of these involve graphing, interpreting quantitative results from primary literature, and working with ecological metrics (e.g., estimating population sizes from mark-recapture data)

Learning Outcome Met? (based on Criteria)

Yes  No  
92% of students met the criterion for success.

Spring 2016  
Evolution  
BIOL-265  
Homework

assignment requiring calculation of predicted population allele frequencies based on a "PopGen" simulation of genetic drift effects.

Learning Outcome Met? (based on Criteria)

Yes  No  
100% of students met the criterion for success.

Spring 2016 Developmental Biology BIOL-335 Long-term laboratory research project consisting of initial proposal (with revisions), design experiment, carry out experiments (with 3-4 trials), collect and analyze data. Students present results in a written report, a brief oral report and a poster.

Learning Outcome Met? (based on Criteria)

Yes  No  
100% of students met the criterion for success.

Fall 2015 and Spring 2016 Combined Biol-190 Writing and Research

Skills for Biologists  
(3 sections  
combined)

Oral presentation  
based on analysis  
of the scientific  
literature.

Learning  
Outcome Met?  
(based on  
Criteria)

Yes  No  
100% of students  
met the criterion  
for success.

Fall 2015  
General Biology  
for Social  
Sciences  
BIOL-140

Lab data analysis  
exercise required  
calculation of  
retinal ganglion  
cell receptive field  
characteristics.

Learning  
Outcome Met?

Yes  No  
97% of students  
met the criterion  
for success.

Fall 2015  
Plant Ecology  
BIOL-240

Analyze and then  
present data from  
a field experiment.

Learning  
Outcome Met?  
(based on  
Criteria)

Yes  No  
100% of students  
met the criterion  
for success.

Fall 2015  
Plant Ecology  
BIOL-240

Students were given materials (seeds to study root growth and floating aquatic plants) and they had to design an experiment, analyze the data and then write a full research report.

Learning

Outcome Met?  
(based on  
Criteria)

Yes  No

100% of students met the criterion for success.

Fall 2015

Marine Ecology  
BIOL-400

Series of final exam questions that evaluate student understanding of experimental design and their ability to interpret recently published data on community ecology in a coral reef.

Learning

Outcome Met?

Yes  No

85% of students met the criterion for success.

Fall 2015

Biochemistry  
BIOL-420

Scientific paper reporting results of an independent lab project: MALDI mass spectrometry to assess protein

content in  
commercially  
available protein  
supplement.  
Learning  
Outcome Met?  
 Yes  No  
100% of students  
met the criterion  
for success.

Fall 2015  
Biomechanics  
BIOL-450  
Independent  
Research Project  
Design  
Learning  
Outcome Met?  
(based on  
Criteria)  
 Yes  No  
100% of students  
met the criterion  
for success

Fall 2015  
Biomechanics  
BIOL-450  
Final Exam –  
course  
emphasizes  
quantitative skills  
and thus the final  
exam is a useful  
means of  
assessing our  
students' ability to  
apply  
mathematical  
techniques to  
solving problems  
in the biological  
sciences.  
Learning  
Outcome Met?  
(based on  
Criteria)  
 Yes  No  
94% of the  
students met the  
criterion for

success.

Fall 2015  
Ecology BIOL-225  
Reports  
describing the  
results of an  
independent  
research project  
and three short  
data analyses from  
field experiments;  
involved data  
analysis and  
statistics (ANOVA,  
t-test, chi-square)  
Learning  
Outcome Met?  
(based on  
Criteria)  
 Yes  No  
100% of students  
met the criterion  
for success.

Fall 2015  
Ecology BIOL-225  
Exam with strong  
emphasis on  
ecological  
modeling and  
mathematical  
approaches to  
understanding  
predator-prey  
dynamics,  
population size  
fluctuations, and  
resource  
competition  
models  
Learning  
Outcome Met?  
(based on  
Criteria)  
 Yes  No  
92% of students  
met the criterion  
for success.

Spring 2016  
Animal Physiology



BIOL-430  
Evaluation of Data  
collection, analysis  
and presentation  
for a class project  
collecting  
information on  
vasoconstriction or  
dilation of the  
finger as a function  
of temperature.  
Learning  
Outcome Met?  
(based on  
Criteria)  
 Yes  No  
96% of students  
met the criterion  
for success.

Spring 2016  
Biology of the  
Vertebrates  
BIOL-230  
Short report  
describing the  
results of a bird  
foraging  
experiment;  
involved data  
analysis and  
statistics (ANOVA,  
t-test)  
Learning  
Outcome Met?  
(based on  
Criteria)  
 Yes  No  
100% of students  
met the criterion  
for success.

Spring 2016  
Biology of the  
Vertebrates  
BIOL-230  
In-class exercises  
where students to  
grapple with  
concepts  
introduced in  
lecture. Most of

these involve graphing, interpreting quantitative results from primary literature, and working with ecological metrics (e.g., estimating population sizes from mark-recapture data)  
Learning Outcome Met? (based on Criteria)  
 Yes  No  
92% of students met the criterion for success.

Spring 2016  
Evolution  
BIOL-265  
Homework assignment requiring calculation of predicted population allele frequencies based on a "PopGen" simulation of genetic drift effects.  
Learning Outcome Met? (based on Criteria)  
 Yes  No  
100% of students met the criterion for success.

Spring 2016  
Developmental  
Biology BIOL-335  
Long-term laboratory research project consisting of initial proposal (with

revisions), design experiment, carry out experiments (with 3-4 trials), collect and analyze data. Students present results in a written report, a brief oral report and a poster.

Learning Outcome Met? (based on Criteria)  
 Yes  No  
100% of students met the criterion for success.

Fall 2015 and Spring 2016 Combined Biol-190 Writing and Research Skills for Biologists (3 sections combined)

Oral presentation based on analysis of the scientific literature.

Learning Outcome Met? (based on Criteria)  
 Yes  No  
100% of students met the criterion for success.

Among all courses except Biol 110, the criterion for success was met. Of a total of 446, 435 (97.5%) met the criteria.

When combined with the results of Biology 110,

			<p>across all courses where the assessment occurred, 468 of 501 students (93%) met the criterion.</p> <p>Learning Outcome Met? (Based on Criteria) Yes</p>	
<p>4. Know the important facts and concepts relevant to the discipline.</p> <p>Criteria: (How do you know students are achieving learning outcome?) At least 80% of students scoring 70% of greater on selected tasks.</p>	<p>Collecting</p> <p>Discussing</p>	<p>Method: (ex. tests, presentations, research paper) Evaluate student performance on exams, papers or projects.</p> <p>Using a Sample of Students? Yes</p> <p>If yes, describe your sample. Students in various biology courses.</p> <p>When does assessment occur? Throughout the academic year</p> <p>How often does assessment occur? Throughout each semester</p>	<p>*****</p> <p>Fall 2016 General Biology I BIOL-110</p> <p>Final grades from lecture portion of course, includes exams, quizzes, and assignments, all of which are focused on facts and concepts essential to success in the biology major.</p> <p>Learning Outcome Met? (based on Criteria) <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No</p> <p>Six lecture sections (n=172). Only 63% of the students who enrolled met the criterion for success on the lecture portion of the course. Lab grades were higher on average. Many students</p>	<p>Of the 17 individual assessments reported for the 2016-2017 academic year, 11 exceeded the criterion for success. Five of the six assessments with less favorable results were all quite close to exceeding the criterion for success (with the percentage of successful students ranging from 70%-78%). Given that most of our assessments are purposefully designed to be challenging (e.g., final exam questions that require detailed and accurate responses), seeing a handful of assessments dipping below our metric for success is not especially worrisome. For those five assessments, we will monitor student progress over the coming academic year and will be prepared to adjust teaching strategies if continued student decline is observed.</p> <p>One course in which the assessment was well below our metric for success is General Biology I, where only 63% of students met the criterion for success. We attribute this to declining college preparedness among the pool of incoming prospective biology majors and have discussed various ways to improve student performance without sacrificing academic rigor. One</p>

dropped the course, and they are included in these numbers.

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Spring 2017  
General Biology II  
BIOL-120

We conducted a study skills intervention for General Biology II students in Spring 2017 based on the approach outlined in the book "Teach Students How to Learn" by Sandra McGuire. The intervention took the form of a study skills workshop that was offered between exams 2 and 3. Students from all sections were invited to participate. We examined performance on Exam 2 vs Exam 3 for students who attended vs. those that did not attend the workshop. Overall, students who attended the intervention improved their scores by a median of 1.9 points, compared to only 0.3 points among students who did not attend. A full report on this intervention is provided under "Use of Results."

strategy we have attempted is summarized in the report below. The complete report (with figures) is available in the Assessment Report Repository.

\*\*\*\*Siena College Department of Biological Sciences\*\*\*\*  
\*\*\*\*Report on a Study Skills Intervention for General Biology Students\*\*\*\*  
\*\*\*\*May 2017\*\*\*\*  
\*\*\*\*Report By Dr. Sarah Berke\*\*\*\*

Helping unprepared students pass introductory science courses is a challenge at many colleges and universities nationwide, and Siena College is no exception. In March 2017, the Biology department piloted a study skills intervention for students enrolled in Biol 120, the second semester of our introductory biology sequence. The intervention was based on a study skills workshop outlined in the book Teach Students How to Learn by Sandra McGuire (Stylus publishing, 2015). It was offered between the second and third exams of the semester, and students from all sections were invited to participate. Out of 120 students enrolled in the course, 69 attended the workshop. Here we assess whether the study skills intervention helped to improve student performance. Overall, students were enthusiastic about the workshop. While effects on student performance were marginal at best, there is evidence that the workshop helped some students to make great strides, and helped to offset slippage in performance on the final exam.

\*\*I. Student Attitudes\*\*

We asked students (1) whether they felt that the workshop was helpful, and (2) if they would recommend it to their peers, both on a scale of 1 to

\*\*\*\*\*

Spring 2017  
General Biology  
for Social  
Sciences  
BIOL-140  
Exam question  
asking students to  
explain the  
physiology of the  
knee-jerk reflex,  
integrating  
information from  
the nervous  
system and  
musculoskeletal  
system.

Learning  
Outcome Met?  
(based on  
Criteria)  
 Yes  No

Two lecture  
sections (n=55).  
85% met the  
criterion for  
success.

\*\*\*\*\*

Fall 2016  
Advanced  
General Biology  
BIOL170  
Final exam  
scores. Final  
exams require  
students to be able  
to integrate  
material from  
multiple units and  
apply concepts  
learned in class to  
novel situations.

Learning  
Outcome Met?  
(based on

5, with 1 being low. This assessment  
was conducted after students took  
the final exam, and therefore  
excludes students who withdrew  
from the course before taking the  
final. We chose to wait until after the  
final to assess this, because we  
wanted students to be able to reflect  
on their overall performance in the  
second half of the course when  
responding.

Overwhelmingly, students felt that  
the workshop was helpful (68%  
answering 4 or 5). Even more  
strongly, they would recommend it to  
their peers (77% answering 4 or 5).

\*\*II. Effects on Study Habits\*\*

Students who took the final exam  
were asked to indicate which study  
skills they used in preparing for the  
exam. The checklist, taken from  
skills covered in the workshop,  
included:

- Previewing material before class
- Reviewing material after class
- Engaging in a "Power Hour" of  
intense study several days each  
week
- Weekend review sessions
- Forming a study group
- Reviewing what you missed on  
passed exams
- Mind mapping or concept mapping  
of course material
- Flash cards

Out of 111 students taking the  
exam, 109 claimed to have used at  
least one of these techniques; the  
median number reported was 4.  
Interestingly, the workshop had no  
discernable effect on self-reported  
study habits, as shown in the table  
below. The exceptions were that  
more students who attended the  
workshop reviewed their past  
exams, and more used flash cards.  
This is especially interesting given

Criteria)  
 Yes  No

One lecture section (n=23). Only 78% met the criterion for success.

\*\*\*\*\*

Fall 2016  
Research and Writing Skills for Biologists  
BIOL190  
Final quiz. This quiz evaluates the students understand of what goes into each section of a science paper, the use of scientific sources, graphing, and statistics.

Learning Outcome Met? (based on Criteria)  
 Yes  No

One lecture section (n=16). Only 75% met the criterion for success.

\*\*\*\*\*

Fall 2016  
Ecology BIOL-225

Average exam scores across three exams covering facts and concepts in ecology. Exams include multiple choice, short

that these skills were minor points in the workshop, which focused more extensively on previewing, reviewing, and power-hours.

One might expect students who used more study skills to perform more strongly on assessments. However, we see no such pattern. This highlights the limited value of self-reported study data: a student who claims a particular skill may not have used it frequently or effectively. Interestingly, students who claim the greatest number of study skills are the only group to consistently perform below average. This may indicate that some low-performing students are desperately trying many techniques to improve their performance, but perhaps not implementing any of them well. Alternatively, some low-performing students may harbor unrealistic beliefs about their own study habits.

\*\*III. Effects on Performance\*\*

Limitations and Sources of Bias

Before evaluating the workshop's effect on student performance, we should recognize some limitations. First, this was a one-time, one-hour intervention—we should not expect it to work miracles. Second, we have no way of truly knowing what students did when they were studying. Students who attended the workshop undoubtedly varied in how well they incorporated the study strategies we discussed. If some students were helped a great deal, but others did not effectively change their habits, then no overall statistical pattern would emerge. At the same time, students who did not attend may have improved their study habits independently, perhaps by taking advantage of other resources on campus or by asking their professor for advice. Finally, the very highest-performing students by and

answer, and fill in the blanks.

Learning Outcome Met? (based on Criteria)  
 Yes  No

One lecture section (n=13). Only 77% of students met the criterion for success.

\*\*\*\*\*

Spring 2017  
Biology of the Vertebrates  
BIOL-230

Average exam scores across three exams covering facts and concepts in vertebrate biology. Exams include multiple choice, short answer, and fill in the blanks.

Learning Outcome Met? (based on Criteria)  
 Yes  No

One lecture section (n=27). 85% of students met the criterion for success.

\*\*\*\*\*

Fall 2016 and Spring 2017  
Molecular

large did not attend the workshop, because they did not feel the need (and because we encouraged the lowest performing students to attend by offering extra credit on a sliding scale that offered virtually no incentive for top students to attend). This means that the group of workshop attendees is significantly biased towards lower-performers.

To account for this bias, we analyzed the change in exam scores from before the intervention (mean of exams 1 and 2) versus the final exam. There was also a third exam after the intervention and before the final; patterns for the third exam were similar to the final but murkier, and are not shown. This bias might imply that students who did not attend the intervention had a lower scope for improvement than their counterparts – an A student can easily slip, but cannot improve by more than a few points. By the same token, a very low-performing student has ample room for improvement but may be unlikely to decrease their performance by more than a few points. This asymmetry in scope is itself a potential source of bias. However, by visually examining individual student trajectories for both groups, we can see that both groups include a wide range of performances, and that the direction and magnitude of the slopes shows little clear relationship to the pre-intervention performance. Therefore, change in performance from exams 1 & 2 to the final exam is a reasonable indicator.

#### Effects on Performance

It does appear that the intervention had a modest but encouraging effect on student performance. Overall, students who attended the intervention improved their scores by a median of 1.9 points, compared to



Genetics  
BIOL-260

Average grades across all four exams given covering important facts and concepts across all subfields in genetics.

Learning Outcome Met? (based on Criteria)  
 Yes  No

Three lecture section (n=85). 82% of students met the criterion for success.

\*\*\*\*\*

Fall 2016  
Ornithology  
BIOL-270

Exam 2 grades. This exam focused on bird physiology, communication, migration and navigation and was a combination of multiple choice, questions interpreting graphs and data, short answers, and long answers.

Learning Outcome Met? (based on Criteria)  
 Yes  No

Three lecture section (n=15). 93% of students

only 0.3 points among students who did not attend. This difference is marginally significant by a one-sided t-test ( $p = 0.077$ ). Furthermore, the proportion of students showing improvement was higher for workshop attendees, while the proportion of students who slipped on the final exam was greater among non-attendees.

We saw that students who improved by 5 or more points were more likely to have attended the workshop. Students who slipped by 5 or more points were statistically similar in number between the two groups.

\*\*IV. Conclusions and Future Directions\*\*

It appears that the intervention had a modest but real influence on student performance. Given that it was a one-hour workshop offered late in the school year, this may be surprising. Student performance is influenced by a wide variety of factors, and student ability to implement skills learned in a single workshop is undoubtedly quite variable. Seeing any pattern at all is therefore quite encouraging.

In Fall 2017, we plan to run the workshop again shortly after the first General Biology exam is handed back. In Teach Students How to Learn, McGuire reports that interventions are most effective after the first exam of the freshman year, when students are first confronting the fact that college is harder than high school. By administering the intervention late in the school year, we may have encountered some degree of learned helplessness – many of the poorest performing students had already changed their major, and noticeably “checked out” of their biology courses. We are hopeful that earlier intervention may

met the criterion for success.

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Spring 2017  
Developmental  
Biology BIOL-335  
Final exam scores. Final exams require students to be able to integrate material from multiple units and apply concepts learned in class to novel situations.

Learning Outcome Met?  
(based on Criteria)  
 Yes  No

One lecture section (n=32). 88% of students met the criterion for success.

\*\*\*\*\*

Fall 2016  
Histology  
BIOL-340

Exam 1 was a mixed format exam (multiple choice, short answer, etc) that evaluated students' knowledge of the rudiments of tissue histology: structure and function of four major tissue types and their variants.

be more effective. We will also encourage instructors to reinforce the workshop material in the classroom throughout the semester. We will monitor student performance closely, and may offer a supplementary workshop to further reinforce these ideas later in the first semester, perhaps after the second exam.

Learning  
Outcome Met?  
(based on  
Criteria)  
 Yes  No

One lecture  
section (n=32).  
91% of students  
met the criterion  
for success.

\*\*\*\*\*

Spring 2017  
Genomics and  
Bioinformatics  
BIOL-400

Average grade for  
two project  
reports. These  
reports required  
students to  
analyze genomic  
datasets and  
discuss how their  
results fit into the  
overall research  
aim of the course,  
synthesizing  
various facts and  
concepts.

Learning  
Outcome Met?  
(based on  
Criteria)  
 Yes  No

One lecture  
section (n=11).  
91% of students  
met the criterion  
for success.

\*\*\*\*\*

Fall 2016  
Biochemistry  
BIOL-420  
Assessment 1:

Final exam  
grades.

Learning  
Outcome Met?  
(based on  
Criteria)  
 Yes  No

One lecture  
section (n=24).  
Only 75% of the  
students met the  
criterion for  
success.

Assessment 2:  
Proteomics  
research paper

Learning  
Outcome Met?  
(based on  
Criteria)  
 Yes  No

One lecture  
section (n=24).  
100% of the  
students met the  
criterion for  
success.

\*\*\*\*\*

Spring 2017  
Animal Physiology  
BIOL-430  
Exam question  
from the course  
final addressing  
concepts of  
thermoregulation  
and definitions of  
variables used to  
quantify or model  
thermoregulation.

Learning  
Outcome Met?  
(based on  
Criteria)

Yes  No

One lecture section (n=30). No. Only 70% of the students met the criterion for success.

\*\*\*\*\*

Fall 2016  
Neurobiology  
BIOL-440  
Final course grades (includes both lecture and lab)

Learning Outcome Met?  
(based on Criteria)  
 Yes  No

One lecture, two lab sections (n=21). 90% of students met the criterion for success. It is perhaps noteworthy that the criterion was not met for any of the individual course exams or based on the the mean score for all exams combined. Lab points (paper and project) allowed those students below the C- level based solely on exam scores to raise their final course grade. Finally, it is worth noting that seven student had a final grade in the

B range, two students earned an A-, and the top two students in the class had final averages of 0.97 (A). What's different this year was the relatively large number of students performing poorly on exams (about 1/3 of the class).

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Fall 2016  
Comparative  
Biomechanics  
BIOL450

Assessment 1:  
Final exam scores.

Learning  
Outcome Met?  
(based on  
Criteria)  
 Yes  No

One lecture  
section (n=24).  
92% of students  
met the criterion  
for success.

Assessment 2:  
Group projects in  
which students  
must read a  
primary paper and  
present the data  
and conclusions  
as a short ~10 min  
movie.

Learning  
Outcome Met?  
(based on  
Criteria)  
 Yes  No

			<p>One lecture section (n=24). 96% of students met the criterion for success.</p> <p>***** SUMMARY *****</p> <p>Among all courses except Biol 110, the criterion for success was met. Of a total of 456 students, 388 (85%) met the criteria.</p> <p>When combined with the results of Biology 110, across all courses where the assessment occurred, 496 of 628 students (79%) met the criterion. This is right at the threshold of the criterion for success.</p> <p>Learning Outcome Met? (Based on Criteria) No</p>		
<p>5. Demonstrate critical thinking by successfully applying fundamental biological concepts to novel scenarios.</p> <p>Criteria: (How do you know students are achieving learning outcome?) At least 50% of students meet or</p>	<p>Planning</p>	<p>Method: (ex. tests, presentations, research paper)</p> <p>Track performance on selected exam questions from a course in one of the four major course areas or genetics. Instructor identifies an exam question that requires critical thinking and reports the re</p>	<p>Learning Outcome Met? (Based on Criteria)</p>		

<p>exceed standard (Score 70% or greater).</p>	<p>Using a Sample of Students? Yes</p> <p>If yes, describe your sample. Evaluate students in selected courses with an emphasis on upper level courses</p> <p>When does assessment occur? Throughout the academic year.</p> <p>How often does assessment occur? Throughout the academic year.</p>			
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