

## STUDENT LEARNING ASSESSMENT REPORT FOR BIOLOGY

**SUBMITTED BY: BARBARA KREUTZER**

**DATE: SEPTEMBER 29, 2016**

**BRIEFLY DESCRIBE WHERE AND HOW ARE DATA AND DOCUMENTS USED TO GENERATE THIS REPORT BEING STORED:**

THE DATA SUMMARY FOR THE 2012-2013 GRADUATING STUDENT SURVEY (GSS), THE ALUMNI SURVEY AND BIOLOGY DEPARTMENT EXIT EXAM HARDCOPIES ARE STORED IN THE DESK FILE DRAWER IN THE MARYMOUNT ADMINISTRATION/ASSESSMENT FILES OF THE FACULTY MEMBER WHO PREPARED THE REPORT. THE INTERNSHIP DOCUMENTS, HARDCOPIES OF COURSE DOCUMENTS AND ADDITIONAL DOCUMENTS ARE STORED IN HER OFFICE FILE CABINET, ARCHIVE BOX. THE ELECTRONIC DOCUMENTS FOR PREVIOUS LEARNING ASSESSMENT REPORTS, GSS AND BIOLOGY DEPARTMENT EXIT EXAM ARE STORED IN HER OFFICE COMPUTER IN THE DESKTOP MARYMOUNT/ADMINISTRATION/ASSESSMENT FILES AND BACKUP ELECTRONIC COPIES IN HER HOME COMPUTER UNDER DESKTOP/BARB/MARYMOUNTHOMEWORKINGUSE FILES/ADMINISTRATION/ASSESSMENT.

**PLEASE NOTE: BECAUSE THE PROGRAM REVIEW WAS IN 2013-2014, THIS REPORT IS THE ASSESSMENT FOR STUDENT LEARNING FOR 2013-2014, 2014-2015, AND 2015-2016.**

### EXECUTIVE SUMMARY

**List all of the program's learning outcomes:** (regardless of whether or not they are being assessed this year)

Learning Outcome	Year of Last Assessment	Year of Next Planned Assessment
1. Students will apply to a complex, current scientific problem, gained knowledge and experience.	2011-2012	2013-2014
2. In a professional setting, students will demonstrate ability to apply knowledge gained from their Biology and Physical Science major.	2011-2012	2013-2014
3. Students will demonstrate competency in basic scientific skills such as observing safe laboratory practices, calculating metric conversions and dilutions and making solution.	N/A (new learning objective)	2013-2014
4. Students will formulate hypothesis, design a project, and gather and analyze data to address a scientific question.	2012-2013	2017-2018
5. Students will display an understanding of ethical dilemmas and social issues and apply their understanding to situations in professional settings.	2012-2013	2017-2018
6. Students will demonstrate scientific literacy by their ability to use professional literature to make valid conclusions.	2012-2013	2017-2018

**Describe how the program's outcomes support Marymount's Mission, Strategic Plan, and relevant school plan:**

Our program has a strong commitment to Academic Excellence, as well as to promote career preparation within a liberal arts framework. Through the process of building a solid foundation of knowledge in the current field of biology, developing the student's ability to interpret primary research, and providing opportunities to hone their ability to apply what they have learned in a professional setting, we give them not only an excellent education but also the tools to become effective adult learners. The content of our introductory through advanced science courses provide the

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foundational knowledge and spark their interest in general biology, chemistry, physics, genetics, microbiology, parasitology, endocrinology, immunology, virology, biochemistry and environmental topics. These courses frequently contain modules which focus on ethical and social issues and were modified this year to meet new university and core learning requirements. The labs accompanying our introductory biology, chemistry and physics courses and our lab-based courses, Bio 368 Advanced Lab Research Methods and Bio 369 Advanced Molecular Biology, give the students a strong background in laboratory techniques and are a natural inquiry based learning tool. Students report back to us that they found these courses extremely helpful in internships, graduate research and entry-level jobs after graduation. Our required departmental internship is a cap-stone experience which allows the students to apply their knowledge in professional settings and provides a stepping-stone to jobs after graduation. Many of the projects in our introductory through advanced level courses require interpretation of primary research, group work and classroom presentations. Our departmental writing intensive course, Bio 300, hones the students' technical writing skills.

**Provide a brief description of the assessment process used including strengths, challenges and planned improvements:**

As direct and indirect measures of our student learning objectives, we use rubric and information from courses as our majors move through the program, selected questions from a senior exit exam, internship evaluations, and alumni and graduating senior surveys. , Some of the courses used are BIO 151-152 General Biology for Majors, BIO 300 Writing for Science, and BIO 410 Senior Seminar. We have several strong indirect measures, including selected questions from internship evaluations, the Graduating Senior Survey (GSS) and the University and Biology Department Alumni Surveys. Our direct measures include rubrics and required products from courses such as BIO 151-152, BIO 300 and BIO 410 and results from our exit exam. To validate and expand the direct measures, we use rubrics which incorporate a range of defined performance standards, such as very positive, positive, somewhat positive, mainly negative and mostly negative. In order to provide deeper insight into which aspects of the program could be changed to promote improved learning, we applying rubrics to selected products in key classes at the first, second, third, and fourth year to assess student learning as our majors move through the program.

Challenges and Planned Improvements

In order to better distinguish the Biology, B.S. student learning from the new Biochemistry, B.S. degree, we plan to re-examine our learning objectives in conjunction with writing the learning objectives for the new degree.

Although measures' scores for our student abilities to understand primary research readings stayed strong and increased in the measure's score which evaluated 'correctly understand data' and 'correctly make predictions', we saw a dip in the scores for the measure which evaluates 'correctly drawn conclusions' and 'making implications for further research'. We plan to focus on research reading activities which emphasize these less strong skills.

There were also a few additional concerns expressed subsequent to the 2012-13 Student Learning Assessment Report about which we also have planned improvements:

One subsequent concern was the files for the 2012-2013 assessment report were scattered among too many locations. The electronic and hardcopy files are now all stored in the office computer and file cabinet of the professor who prepared the report and backup electronic files are located in her home computer, as detailed on page one of the report. The final documents and appendices are posted for department use on the department Canvas site.

In response to subsequent concerns that Learning Objective 3 ("Students will demonstrate competency in basic scientific skills such as observing safe laboratory practices, calculating metric conversions and dilutions and making solution.") was not academic enough, we plan to re-evaluate this learning outcome as we are re-working our other learning outcomes.

Another concern expressed subsequent to the 2012-13 Student Learning Assessment Report was about the wording of the original Learning Objective 5. We re-wrote the learning objective as it reads in this report.

Additionally, there were concerns expressed about the use of the Science Club data for one of our Learning Objective 5 measures. We have removed that source of data and replaced it with more robust data from participation levels of students in other civic engagement activities.

A final concern expressed was about making better use of our exit exam to improve course material. To address this legitimate concern, we strengthened modules in course work that covered specific questions on the exam with which students typically struggle. Courses with the strengthened modules included BIO 151 and 152 General Biology for Majors, BIO 300 Writing for Science, BIO 368 Advanced Research Methods, and BIO 410 Senior Seminar.

In our cycle of assessment, we will assess these three learning outcomes this year:

Learning Outcome # 4, *“Students will formulate hypotheses, design a project, and gather and analyze data to address scientific questions,”* which was last assessed 2010-2011;

Learning Outcome # 5, *“Students will understand ethical dilemmas and make ethical decisions which apply to scientific topics,”* last assessed 2010-2011; and

Learning Outcome # 6, *“Students will demonstrate scientific literacy by communicating synthesis of knowledge and critical analysis of read scientific information,”* last assessed 2011-2012.

### **Describe how the program implemented its planned improvements from last year:**

#### Improvements implemented from the 2012-2013 Student Learning Report:

To evaluate important skills often required of our graduates, we removed a Learning Objective 3 which we had assessed for over six years and replaced it with, “Students will demonstrate competency in basic scientific skills such as observing safe laboratory practices, calculating metric conversions and making solution dilutions”. We developed and implemented direct measures and indirect measures for this learning outcome.

For Learning Outcome 4, “Students will formulate hypotheses, design a project, and gather and analyze data to address scientific questions. In response to alumni comments about poor lab facilities and lack of post-graduation employment, we intentionally monitored alumni response to our lab facilities and employment. As expected, with the move into the new Caruthers facility, alumni response to lab facilities is positive. However, alumni occasionally complained about current cutting-edge equipment some of the other institutions have which Marymount lacks. We feel it is imperative the department remains competitive with other area learning institutes by keeping and maintaining the equipment which allows students to learn and do innovative techniques and research. Some of these pieces of equipment include the NMR, fluorescent microscope, high speed centrifuge, and 3-D printer.

As predicted in the 2012-13 report, with the improving economy, post-graduate employment has improved.

To strengthen student learning as reflected in data concerning understanding primary research readings from the Exit Exam, we emphasized and incorporated additional readings in course modules.

We also continued to promote undergraduate research experiences. The NMR equipment was especially useful for student projects as there was often cross-over between research and course work experiences.

For Learning Objective 5, “Students will display an understanding of ethical dilemmas and social issues and apply their understanding to situations in professional settings.”

To better evaluate Learning Outcome 5, we extensively and successfully used an ethics rubric tool we designed and added to the DAT inquiry rubric.

For Learning Objective 6, “Students will demonstrate scientific literacy by communicating synthesis of knowledge and critical analysis of read scientific information.”

To improve our students’ scientific literacy, we implemented more research reading modules in courses. For finding appropriate sources of information, evaluating the quality of information, and developing a coherent written argument, scores improve dramatically from 56% to 85%.

**Provide a response to last year's University Assessment Committee review of the program's learning assessment report:**

The points which needed to be addressed from the 2012-2013 UAC response are indicated below. Due to our program review, this was the last time the committee reviewed our learning assessment.

The following table contains the UAC responses. The following text describes how the responses were addressed:

Table of UAC Responses.

<i>Critical Area 2 – Assessing Learning Outcomes</i>			
Outcome Measures	Met	Partially Met	Not met
Measures provided for each outcome	X	<input type="checkbox"/>	<input type="checkbox"/>
Points to consider in comments <ul style="list-style-type: none"> <li>• Makes evident connection between measures and learning outcomes</li> <li>• Uses direct and indirect measures appropriately</li> <li>• Identifies performance standards for each measure</li> <li>• Includes copy of instruments in appendix (rubrics, survey questions, or other relevant documents)</li> </ul>			
<i>Comments Use of longitudinal comparison data for tracking <u>improvement over time</u> on the DAT and Exit Exam measures is impressive.</i> <i>Indirect measures are not tightly tied to learning outcome #4. Ideas on how to make the Exit Exam more important to the students?</i> <i>For LO #5, it is not clear how you operationally define “participate and perform at an adequate level.” Maybe you need a few judges to assess if this is true?</i>			
Collection of student work and responses	Met	Partially Met	Not met
Collects student work and responses for each measure	X	<input type="checkbox"/>	<input type="checkbox"/>
Points to consider in comments <ul style="list-style-type: none"> <li>• Identifies origin of student work and responses (e.g. class numbers, portfolio, survey)</li> <li>• Identifies how student work and responses were collected</li> <li>• Identifies who collected student work and responses</li> <li>• Identifies number of participants</li> <li>• Illustrates that procedures are appropriate for outcome</li> </ul>			
<i>Comments Good idea to target alumni more directly.</i> <i>Maybe members of the science club are a self-selected group (maybe stronger students) and not a representative sample of majors? Numbers of students involved/participated in civic engagement?</i>			

Description of how the responses were addressed:

For Critical Area 2 – Assessing Learning Outcomes

Outcome Measures

“Indirect measures are not tightly tied to Learning Outcome #4.

(Learning Outcome #4 states, “Students will use their knowledge to define a scientific problem, design a project, gather and examine data, and draw conclusions about the project.”)

The indirect measures we used for learning outcome #4 are thoughtfully chosen skills from the Graduating Senior Survey (GSS) and the University Alumni Survey. Graduate confidence in all the areas covered by the skills is essential to defining and carrying out investigation of scientific problems in the professional world. We feel good to excellent confidence in the indicated skills as expressed on the GSS and Alumni Surveys do give a reasonable, although indirect, assessment of the learning objective according to the following rationales for the individual skills evaluated in the GSS and Alumni Surveys.

“*Conduct Research to Support a Position*” – Conducting a research project to support a position is a biologist’s standard activity done to use their knowledge to define a scientific problem, design a project, gather and examine data, and draw conclusions about the project.

“*Develop a coherent written argument*”- A crucial part of all the stated objectives in the learning objective for a scientific project is to develop and present a coherent written argument which reflects how conclusions drawn from the project are related to and supported by the project’s defined goals, design, procedures to gather and examine data, and how these support the stated conclusion.

“*Use quantitative/qualitative techniques within your professional field*”- The proper use of quantitative and qualitative techniques are the foundation upon which scientific problems are chosen, projects designed, data obtained and analyzed, and conclusions drawn.

“*Evaluate the quality of information (e.g. scholarly articles...)*”- Evaluating and understanding scholarly information is a crucial, initial skill for defining problems, designing projects and methods, properly performing procedures, drawing valid conclusions, and seeing relevant implications.

“*Find appropriate sources of information*”- This skill is closely linked to evaluation of the quality of information.

“*Solve problems in your field using your knowledge and skills*” – This skill statement seems to be well tied to the learning objective because this skill restates the learning objective itself and summarizes the skills listed above.

For Critical Area 2 – Assessing Learning Outcomes

“Ideas on how to make the Exit Exam more important to the students?”

Good question. To intentionally motivate student, we link student results to a contest in which the highest score and the highest score relative to GPA are awarded gift certificate prizes. The highest score prize is aimed at our high performing students. The highest score relative to GPA prize is aimed at our other students. Another inadvertent motivator is to get the scores tabulated in time for the interested students to find out their results. Although not perfect motivators, many of our students do respond positively to conscientious application of the motivators described.

For Critical Area 2 – Assessing Learning Outcomes

Outcome Measures:

“For LO #5, it is not clear how you operationally define “participate and perform at an adequate level.” Maybe you need a few judges to assess if this is true?”, and

Collection of student work and response:

Again with respect to Learning Outcome #5, “Maybe members of the science club are a self-selected group (maybe stronger students) and not a representative sample of majors? Numbers of students involved/participated in civic engagement?”

*(Learning Outcome #5 states, “Students will display an understanding of ethical dilemmas and social issues and apply their understanding to situations in professional settings.”)*

In order to address the committees concerns and our own about how to make Learning Outcome #5 operationally assessable, we rephrased the learning outcome from,

“Students will display an understanding of ethical dilemmas and social issues and apply their understanding to situations in professional settings,”  
to,

“Students will make informed, thoughtful ethical decisions about social issues related to science topic.”

We operationally defined the performance standard by defining and explaining the acceptable level of student performance according to percentages of acceptable student performance or measurable student improvement.

We changed one of the direct measures from participation in Science Club activities to the numbers (expressed as percentages) of students who were involved and/or participated in civic engagement.

### Outcome and Past Assessment

**Learning Outcome 4.** Students will use their knowledge to define a scientific problem, design a project, gather and examine data, and draw conclusions about the project. (Identified as an inquiry outcome.)

**Is this outcome being reexamined?** Yes No X

If yes, give a brief summary of previous results (including trends) and any changes made to the program.

### Assessment Activity

<u>Outcome Measures</u> Explain how student learning will be measured and indicate whether it is direct or indirect.	<u>Performance Standard</u> Define and explain acceptable level of student performance.	<u>Data Collection</u> Discuss the data collected and student population	<u>Analysis</u> 1) Describe the analysis process. 2) Present the findings of the analysis including the numbers participating and deemed acceptable.
<p><b>Learning Outcome 4 (research inquiry) Direct Measures</b>            In designated courses, we evaluated identified inquiry learning assignments using the Discover Assessment Tool (DAT) in designated courses and tracked student progress.</p>	<p>Students will improve in seven of the nine Discover Assessment Tool (DAT) elements which are evaluated from freshman, mid-level, and senior students</p>	<p>The designated courses, Bio 151L General Biology Lab (freshmen), Writing for Science 300, or Advanced Research Methods 368 (sophomores and juniors), and Senior Seminar 410 (seniors) all have specific research assignments in which we evaluate nine Discover Assessment Tool (DAT) elements. (See Appendix 1 for the Discover Assessment Tool with the elements and their ratings boldfaced.</p>	<p>1) The following are a brief description of the assessed assignments:            The Bio 151L Research Project which consists of an investigation and a written report; the Bio 300 Science Paper or the Bio 368 Research Project in which the student chooses a topic, develops and evaluates a premise; and the Bio 410 Senior Seminar in which all department seniors present a capstone research seminar. (See Appendix 2 for a detailed description of Bio 410 and the senior seminar.) Trained adjunct instructors did the evaluation in Bio 151, trained adjuncts and the course's biology faculty did the evaluation for BIO 300, and the course's biology faculty did the evaluation for Bio 300 and 410.</p> <p>2) Sixty-four (2013/2014), fifty-eight (2014/2015), and thirty-nine students (2015/2016) in Bio 151; thirty-one (2013/2014), twenty-five (2014/2015), and thirty-three (2015/2016) students in Bio 300 and Bio 368, and eighteen (2014), twenty (2015), and sixteen (2016) students in Bio 410 were evaluated. The average score for Bio 151L was 2.9 (2013/2014); 3.2 (2014/2015); and 3.4 (2015/2016). For Bio 300 was 4.0 (2013/2014); 4.3 (2014/2015); 3.3 (Bio368 2015/2016) and for Bio 410 was 4.2 (2013/2014), 3.7 (2014/2015), and 3.9 (2015/2016). See Appendix 3a for the data.            Overall steady improvement was noted in all nine elements (see Appendix 3c). The slightly lower scores for 410 (2014-2016) may have been due to the use of a slightly different scale in the DAT evaluations. We will address this when training the instructors who do the evaluations. We were pleased to see consistent improvement as our students moved through the program. <u>The performance standard was met</u> and performance was deemed acceptable.</p>

<u>Outcome Measures</u> Explain how student learning will be measured and indicate whether it is direct or indirect.	<u>Performance Standard</u> Define and explain acceptable level of student performance.	<u>Data Collection</u> Discuss the data collected and student population	<u>Analysis</u> 1) Describe the analysis process. 2) Present the findings of the analysis including the numbers participating and deemed acceptable.
<p><b>Learning Outcome 4 (research inquiry)</b></p> <p><b>Direct Measures, continued</b>            Research Interpretation section of the exit exam</p>	<p>55% of participating students will achieve a score of 50% or more of the available points on the research interpretation section of the Exit Exam.</p>	<p>The Exit Exam was given as an on-line survey, evaluated, and analyzed for our graduating seniors in 2014, 2015, and 2016.</p> <p>The Research Reading section consisted of four questions, #90 – #93 and Figure 1. Please see Appendix 4 for the Exit Exam questions and the figure and Appendix 5 for the Exit Exam Instructions and Introductory Script. A professor in the Biology and Physical Sciences Department administered the survey and assessment office scored the exam.</p>	<p>1) With the help of the Office of Institutional Effectiveness, we administered and analyzed a Research Reading Interpretation Section of the Exit Exam in mid-April to graduating seniors. A professor in the Biology and Physical Sciences Department, collected and analyzed the results. The percentage of students receiving 100%, 75%, 50%, 25% and 0% answers correct was calculated. The percent of students who answered the different questions correctly was evaluated.</p> <p>2) In 2013/2014, out of twenty students, one student (5%) received a 100%, one (5%) received a 75%, 9 (45%) received a 50%, 5 (25%) received a 25% and four (20%) received a 0%. In 2014/2015, out of 14 students, one student (7%) received a 100%, zero (0%) received a 75%, four (28%) received a 50%, six (43%) received a 25% and three (21%) received a 0%. In 2015/2016, out of 32 students, two (6%) received a 100%, two (6%) received 75%, eight (25%) received 50%, fifteen (47%) received 25% and 5 (16%) received 0%. (See Appendix 6.)</p> <p><u>The performance standard was met in 2014 but not 2015 and 2016.</u> In 2014, 55% of the students achieved a score of 50% or more. Those numbers have dropped to 35% (2015) and 37% (2016).</p> <p>A further analysis of the scores showed correct answers to most of the question have generally increased, but the question for synthesizing knowledge and drawing conclusions from data(#91) and especially critical analysis measured by drawing implications for further research (#92) significantly declined. See Appendix 7.</p>

<u>Outcome Measures</u> Explain how student learning will be measured and indicate whether it is direct or indirect.	<u>Performance Standard</u> Define and explain acceptable level of student performance.	<u>Data Collection</u> Discuss the data collected and student population	<u>Analysis</u> 1) Describe the analysis process. 2) Present the findings of the analysis including the numbers participating and deemed acceptable.
<p><b>Learning Outcome 4 (research inquiry), continued</b></p> <p><b>Indirect</b>            Biology Graduating Senior Survey (GSS) - Skills Preparation</p> <p>Biology Alumni Survey</p>	<p>70% of respondents perceive their preparation to be good or excellent.</p> <p>70% of respondents perceive their preparation to be good or excellent.</p>	<p>Individual graduating undergraduate seniors answered questions on the survey. The survey asked the student questions regarding their perceptions of their own academic skills on learning outcomes. Answers were rated 1 (poor) to 4 (excellent) preparation. The questions which pertained to this outcome were used in the assessment. Out of eighteen questions, six questions pertained (see Appendix 8 for the questions). The University administered and collected the survey and analyzed the results.</p> <p>Individual alumni answered questions on the survey. The survey asked the student questions regarding their perceptions of their own academic skills on learning outcomes. Answers were rated 1 (poor) to 4 (excellent) preparation. The questions which pertained to this outcome were used in the assessment. Out of about 18 questions, 6 questions pertained (see Appendix 9)</p>	<p>1) The Office of Planning and Institutional Effectiveness sent the analyzed results to a professor in the Biology and Physical Sciences Department, who evaluated the analysis. From the graduating undergraduate biology respondents, the mean percent of those who answered good or excellent preparation to pertinent questions was calculated.</p> <p>2) Out of fifteen responses in 2013/2014, 71% responded good or excellent on average to the selected questions. In 2014/2015 out of seventeen students 90% responded good or excellent on average to the selected questions and in 2015/2016, out of twenty-eight students, 68% responded good or excellent on average to the selected questions (see Appendix 8). Although there was a slight dip in 2015-16, the <u>performance standard was met</u>. We are pleased to see the satisfaction in preparation.</p> <p>1) The Office of Planning and Institutional Effectiveness sent the analyzed results to the professor doing the assessment in the Biology and Physical Sciences Department, who evaluated the analysis. From the graduating undergraduate biology respondents, the mean percent of those who answered good or excellent preparation to pertinent questions was calculated.</p> <p>2) Out of nine responses in 2013/2014, 74% responded good or excellent on average to the selected questions. In 2014/2015 out of fifteen responses, 71% responded good or excellent on average to the selected questions, and in 2015/2016, out of eleven students, 76% responded good or excellent on average to the selected questions (see Appendix 8). Although there was a slight dip in 2015-16, the <u>performance standard was met</u>. We are pleased to see the satisfaction in preparation.</p>

### Interpretation of Results

**Extent this Learning Outcome has been achieved by students** (Use both direct and indirect measure results):

Both direct and indirect measures indicate the learning objective has been well met. In addition to the measures, comments from the Graduating Senior Survey students regularly praised the excellent teaching, undergraduate research experiences, and professional relationships with professors. Such comments relate to and reflect on the success of the learning objective.

**Program strengths and opportunities for improvement relative to assessment of outcome:**

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We are pleased that our student inquiry ability, as indicated by the DAT scores, improves as they move through the program. However, the instruction quality for the instructors often administering the DAT evaluation has become more sporadic in the past two years as members of the department not directly involved with learning assessment took over the administration.

We are especially pleased with our graduating senior survey (GSS) and alumni survey results and comments since this indicates student perception of preparedness has continued to stay strongly positive due to improvements made in our program a few years ago. Regarding our students' ability to read and understand research papers as indicated by the Exit Exam Research Reading Section, although students' maintained ability to interpret data and apply the interpretation, our students could use more practice with synthesis of knowledge and the drawing of conclusions from data and, especially, critical analysis as measured by implications for further research.

To continue to foster strong inquiry abilities, we will promote research experiences in our program.

**Discuss planned curricular or program improvements for this year based on assessment of outcome:**

To improve the quality of our instruction for the instructors administering the DAT rubrics, we plan to return the instruction to the full-time faculty involved with the learning assessment to ensure consistent quality.

In order to strengthen student abilities to understand primary research reading, we will continue to offer research reading modules in our courses and emphasize the following aspects. To improve our students' ability to synthesize knowledge and draw conclusions from data and, especially, critically analyze and understand implications for further research from their research reading, we will emphasize these aspects in our course modules.

We will continue to promote meaningful research experiences in courses, undergraduate projects and elsewhere throughout our program.

### Outcome and Past Assessment

#### Learning Outcome 5:

**Students will make informed, thoughtful ethical decisions about social issues related to science topics.**

Is this outcome being reexamined? Yes No X

If yes, give a brief summary of previous results (including trends) and any changes made to the program.

### Assessment Activity

<u>Outcome Measures</u> Explain how student learning will be measured and indicate whether it is direct or indirect.	<u>Performance Standard</u> Define and explain acceptable level of student performance.	<u>Data Collection</u> Discuss the data collected and student population	<u>Analysis</u> 1) Describe the analysis process. 2) Present the findings of the analysis including the numbers participating and deemed acceptable.
<p><b>Learning Outcome 5 (ethical issues) Direct</b></p> <p>Student participation and responses to self-chosen civic engagement activities.</p> <p><b>Direct</b> We evaluated identified ethics and social issue assignments using the Discover Assessment Tool (DAT)-Ethics in designated courses and tracked student progress.</p>	<p>We will strive to have 70% of Bio152 General Biology for Majors and Bio 262 Genetics for Majors students participate in civic engagement activities. Students demonstrate thoughtful decisions about social and ethical issues by finding and participating in civic engagement activities of their choice which relate to the learning objective. They further indicate their understanding of the issues by written responses to the activity.</p> <p>Student DAT-Ethics Rubric scores will improve as students move through the major.</p>	<p>From 2014-2016, the instructors for Bio152 General Biology for Majors and Bio 262 Genetics for Majors collected civic engagement data which demonstrated informed, thoughtful ethical decisions about choices to participate in social issues related to science topics and responses to those activities. (See Appendix 10 for a fuller description.)</p> <p>From 2014 – 2016, the instructors of first year students in Bio151 L General Biology for Majors labs; second and third year students in Bio 300 Writing for Science; third and fourth year students in Bio 368 Advanced Lab Research Methods, and fourth year students in Bio 410 Senior Seminar applied the DAT-Ethics Rubric's elements to student assignments which have a focus on social and ethical science issues. See Appendix 1 for the DAT-Ethics Rubric elements, which are indicated by italics toward the end of the rubric. The adjunct instructors received training about how to use the rubric.</p>	<p>1) The percentage of students who participated in the Bio152 General Biology and Bio 262 Genetics activities in an engaged manner was calculated.</p> <p>2) In Bio 152, in 2013-14, 91% (51 out of 56) and in 2014-16, 90% (54 out of 60); and in Bio 262, in 2013-14, 85% (29 out of 34) and in 2014-16, 88% (57 out of 65) students demonstrated informed, thoughtful ethical decisions about choices to participate in social issues related to science topics and their responses to these activities. <u>The performance standard was strongly met</u> and the performance deemed acceptable.</p> <p>1) The average scores for Bio 151L, Bio 300 or Bio 368, and Bio 410 for each academic year was calculated by a faculty member.</p> <p>2) DAT-Ethics Rubric averages generally rose as the students progressed from freshmen to upper classmen. (See Appendix 10a and b.) <u>The performance standard was met</u> and the performance deemed acceptable.</p>



### Interpretation of Results

#### **Extent this Learning Outcome has been achieved by students (Use both direct and indirect measure results):**

The performance standards were met for all direct and indirect measures. The high successful participation rate in the civic engagement activities by first year students and the increase in DAT-Ethics scores as students move through our program from first year to upper class students indicate our majors have strongly achieved the learning outcome.

Our graduating seniors' confidence in their ability to determine the most ethically appropriate response and understand the major ethical dilemmas in their field further indicates their preparation to make informed, thoughtful ethical decisions about social issues related to science topics and reinforce our conclusion that our students strongly achieved the outcome.

Although our alumni's confidence met the performance standard and was deemed adequate, we feel the scores were artificially low. Some of the years assessed by the Alumni Surveys (05-06, 06-07, 09-10, and 10-11) had low confidence scores which our department has already successfully addressed by adding more ethics and social issues modules to your courses (see the 2012-13 Student Learning Report).

Because of extensive changes which have been made in our program, we also feel alumni surveys which go back to ten years ago do not yield as much useful information for us as more current surveys. This is true for the 2014 survey which included information from alumni who graduated in 2005-06. Although it is encouraging to see our program changes have yielded good results, data from a decade ago does not provide us with the information we need to make current changes.

#### **Program strengths and opportunities for improvement relative to assessment of outcome:**

We are encouraged to see our majors are informed, thoughtful, and ethical decision makers about social issues related to science topics and the graduating seniors and alumni expressed confidence in their abilities.

#### **Discuss planned curricular or program improvements for this year based on assessment of outcome:**

To ensure excellence in Learning Outcome 5, we will continue to emphasize and update ethical and social issue modules and topics in our courses.

### Outcome and Past Assessment

#### **Learning Outcome 6:**

Students will demonstrate scientific literacy by their ability to use professional literature to make valid conclusions. (Identified as an inquiry outcome.)

***Is this outcome being reexamined?*** Yes No  X

*If yes, give a brief summary of previous results (including trends) and any changes made to the program.*

### Assessment Activity

<u>Outcome Measures</u> Explain how student learning will be measured and indicate whether it is direct or indirect.	<u>Performance Standard</u> Define and explain acceptable level of student performance.	<u>Data Collection</u> Discuss the data collected and student population	<u>Analysis</u> 1) Describe the analysis process. 2) Present the findings of the analysis including the numbers participating and deemed acceptable.
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<u>Outcome Measures</u> Explain how student learning will be measured and indicate whether it is direct or indirect.	<u>Performance Standard</u> Define and explain acceptable level of student performance.	<u>Data Collection</u> Discuss the data collected and student population	<u>Analysis</u> 1) Describe the analysis process. 2) Present the findings of the analysis including the numbers participating and deemed acceptable.
<p><b>Learning Outcome 6 (scientific literacy)</b>  <b>Direct</b>            Research Interpretation section of the Exit Exam</p> <p><b>Comparison of Discover Assessment Tool (DAT) scores among freshmen, mid-level (sophomore and junior) and senior level classes were compared.</b></p> <p><b>Indirect</b>            MCAT ( Biological Sciences and Physical Sciences section)</p>	<p>An average of participating students will achieve a score of 50% or more of the available points on the Research Interpretation section of the Exit Exam.</p> <p>Students will improve in four of the six Discover Assessment Tool elements which reflect the assessed scientific literacy aspects.</p> <p>Students should achieve at or above the national average</p>	<p>The Exit Exam was given, analyzed and evaluated for graduating seniors (i.e. seniors who had taken all the topic courses covered in the exam) in Spring 2014, 2015 and 2016. The Research Reading section consisted of four questions. See Appendix 4 for the Exit Exam questions and figure and Appendix 5 for the Exit Exam instructions and introductory script.</p> <p>The courses, Bio 151 General Biology , 300 Writing for Science and 410 Senior Seminar, all have specific literature research assignments which we evaluated. Each element had five ratings. Average ratings were calculated for each element. (See Appendix 14 for the Discover Assessment Tool with the elements and their ratings in boldface.)</p> <p>Although encouraged to list MU as one of the institutions receiving their scores, we received no results from student or alumni MCAT tests. Our premed advisor usually collects the bulk of this information with some help through student conversations with the rest of the department faculty, but she received no feedback this year.</p>	<p>1) Describe the analysis process.            2) Present the findings of the analysis including the numbers participating and deemed acceptable.</p> <p>1) With the help of the Office of Planning and Institutional Effectiveness, a professor in the Biology and Physical Sciences Department administered and analyzed an on-line Research Reading Interpretation Section of the Exit Exam administered in mid-April to graduating seniors. The percentage of students who answered individual questions correctly was calculated and the percentage correct for each question was compared.</p> <p>2) Out of twenty students, in 2013-14, 55% answered greater than or equal to 50% of the Research Reading questions correctly; out of fourteen students in 2014-15, 36 % did, and out of thirty-two students in 2015-16, 37% did (see Appendix 13a). <u>The performance standard was met for 2013-14, but not for 2014 -15 and 2015-16.</u> Although we are not satisfied with the 2014-2016 scores, in 2016 the scores for the most challenging questions which concerned 'understanding implications' increased from 14% in 2015 to 28% in 2016 and especially 'making predictions' increased from 7% in 2015 to 22% in 2016. (See Appendix 13b.)</p> <p>1) BIO 151 L trained adjunct instructors, in BIO 300 both trained adjuncts and the course's faculty member, and in Bio 410 the course's faculty member applied the DAT's to the literature assignments. A professor in the department analyzed the results.</p> <p>2) When the data from a total of 161 students in BIO 151, 89 in Bio 300 and 135 in Bio 410 were analyzed, improvement from intro level to senior level students were seen in six out of six elements. 'Evaluate' and 'use information', 'connections among ideas', 'mechanics' and 'content' all showed the greatest improvement, followed by 'conclusions'. (See Appendix15 a and b.) <u>The performance standard was met</u> and learning deemed robust.</p> <p>1)No analysis was done. Previously, scores reported from students who took the exam were compared to their GPA's and national averages. A professor in the Biology and Physical Sciences Department, Barbara Kreutzer, reported and evaluated the most recent data, from 2007.</p> <p>2) No 2008-2009 scores were reported. We will change the way we are trying to collect this data. The last year students reported scores, 2007, eight students took the MCAT and reported scores to us. Six of these students had a GPA &gt; 3.4. The individual physical science (PS) score was consistently the same or below the biological science (BS) score. Of the six PS scores, three were below but within the SD of the national avg. Of the BS scores, one student scored above, one at, and two below but within the SD of the national average. It should be noted that our data always includes students who take the MCAT against our recommendation.</p>

<p><b>Learning Objective 6, continued.</b>  <b>Indirect Graduating Student Survey (GSS)</b></p>	<p>70% of respondents perceive their preparation to be good or excellent.</p>	<p>The survey asked the graduating biology majors questions regarding their perceptions of their own academic skills. We used the 2013-14, 2014-15 and 2015-16 surveys. Answers were rated 1 (poor) to 4 (excellent) preparation. Three survey questions pertained to the learning outcome. (See Appendix 16 for the questions). The University administered, collected, and analyzed the survey results.</p>	<p>1) The Office of Planning and Institutional Effectiveness sent the analyzed results to the professor doing the assessment in the Biology and Physical Sciences Department, who evaluated the analysis. From the graduating undergraduate biology respondents, the mean percent of those who answered good or excellent preparation to pertinent questions was calculated.</p> <p>2) Out of fifteen respondents in 2013-14, a total average of 77% rated their preparation as good to excellent. Out of 17 respondents in 2014-15, a total average of 92% rated their preparation as good to excellent, and out of 28 respondents in 2015-16, 69% rated their preparation as good to excellent. The total average for the three years is 79%, (See data in Appendix 16.) Student confidence for 'finding appropriate information' and 'evaluating information' was the highest in 2015 (100%). <u>The performance standard was met</u> and performance was deemed acceptable</p>
<p><b>Alumni Survey</b></p>	<p>70% of respondents perceive their preparation to be good or excellent.</p>	<p>The survey asked individual alumni questions regarding their perceptions of their own preparation for learning outcomes. We used the 2013, 2014 and 2016 surveys. Answers were rated 1 (poor) to 4 (excellent) preparation. Three questions which pertained to this learning outcome were used in the assessment. (see Appendix 17 for the questions). The University administered and collected the survey and analyzed the results.</p>	<p>1) The Office of Planning and Institutional Effectiveness sent the analyzed results to the professor doing the assessment in the Biology and Physical Sciences Department, who evaluated the analysis. From the alumni undergraduate biology respondents, the mean percent of those who answered good or excellent preparation to pertinent questions was calculated.</p> <p>2) Out of thirty-five total respondent (nine from 2014, fifteen from 2015 and eleven from 2016), a total average of 78% rated their preparation as good to excellent. This was higher than the last assessment, in 2010 - 2012, which had an average of 55.6%. There was a steady increase in average values through the assessment period (75%, 76% and 85%, respectively). Student confidence for 'finding appropriate information' and 'evaluating information' were the highest scores. (See data in Appendix 17.) <u>The performance standard was strongly met every year.</u></p>

### Interpretation of Results

#### **Extent this Learning Outcome has been achieved by students** (Use both direct and indirect measure results):

According to the direct measure, 50% or more students answering half or more of the Research Reading Questions on the Exit Exam, in 2013-14, then there was a drop to 36 or 37%.

According to the other direct measure, student DAT scores steadily improved as they progressed through the major and seniors had average scores of good to excellent in all the rubric items used as measures.

According to the indirect GSS and University Alumni measures, almost 80% perceived their ability to use professional literature to make valid conclusions was good or excellent. We are proud of the confidence our graduating seniors and alumni express.

#### **Program strengths and opportunities for improvement relative to assessment of outcome:**

Scientific literacy includes understanding material that runs the gamut from lay persons' science to experts'. Overall, students do well in finding appropriate information, understanding and critically analyzing scientific writing and improved as they moved through the major.

Although initially, research reading skills were adequate as indicated by the exit exam, there was a definite drop in the last two years of the assessment. According to the analysis for Learning Object 4, most of the decline centered on the student's ability to synthesize knowledge and draw conclusions from data and, especially, critical analysis measured by the ability to make implications for further research.

We are encouraged student skills as measured in the DAT's improved as students went from through their freshmen to senior year.

The students' perception of their ability to use professional literature was strongly confident as reflected in their GSS's.

Our alumni scores improved too, however, please note, *Biology Majors were most probably mixed with other majors* (one student had a job as an Accountant, another worked in textile) in the alumni survey we received, thus making the results inaccurate. It would have been better to receive survey results for Biology Majors only, in order to better understand the progress our Department has made. We will monitor this learning objective and expect alumni data to improve.

Especially encouraging is our graduates' perception of their preparedness to find and evaluate sources of information. We have stressed this in course modules throughout the program and have had librarians come to talk and give workshops to freshmen and mid-level students. We will continue with both activities to maintain the graduates' high level of preparedness.

#### **Discuss planned curricular or program improvements for this year based on assessment of outcome:**

In classroom modules with research readings, we will focus on the students' ability to synthesize knowledge and draw conclusions from data, and critically analyze data to draw implications from data.

Based on DAT, GSS, and University Alumni survey information, we will continue to provide engaging and robust scientific literacy modules in our courses.