STUDENT LEARNING ASSESSMENT REPORT

PROGRAM: Biology (B.S.)
SUBMITTED BY: Amanda Wright
DATE: 9/11/2019

Executive Summary: Description of Assessment Process

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

Goals	Learning Outcomes	Year of Last Assessment	Assessed This Year	Year of Next Planned Assessment
1. Students will be able to independently conduct and evaluate scientific research.	1. Students can formulate scientifically sound hypotheses	17-18	No	2019-2020
	2. Students can design and implement a research project	17-18	No	2019-2020
	3. Students can analyze data and draw conclusions	17-18	No	2019-2020
	4. Students can critically evaluate scientific literature	17-18	No	2019-2020
2. Students will be able to demonstrate effective oral and written scientific communication skills.	1. Students can develop coherent written arguments.	17-18	No	2019-2020
	2. Students can write using current scientific styles.	17-18	No	2019-2020
	3. Students can deliver effective oral scientific presentations	17-18	No	2019-2020
3. Students will understand the moral and ethical impact of sciences on their communities, both local and global.	1. Students will identify ethical dilemmas associated with current scientific innovations	new	Yes	2020-2021
	2. Students will follow ethical norms of scientific communication the final outcomes	new	Yes	2020-2021
4. Students will be able to integrate a range of scientific concepts and ideas.	1. Students can make connections between similar content ideas from different courses	new	Yes	2020-2021

Provide a <u>brief</u> description of the assessment process used including how results are shared and discussed and strengths, challenges, and planned improvements to the <u>process</u>, providing evidence of a culture of continuous improvement based on assessment. If there is something that is impeding your ability to implement improvements, please comment on those issues *(generally not more than two paragraphs, may use bullet points)***:**

We have had many changes to our assessment process in the past year and have plans for additional changes in the coming year. Our assessment results are shared and discussed in our first department meeting in September. Each faculty member is sent a copy of the report and the assessment coordinator shares a short presentation with the faculty during this meeting. Ideas for changes or improvements are discussed and assigned.

Strength: The new learning goals and outcomes are closely aligned with our mission as a department and we expose students to these topics are various points in our curriculum (introductory, intermediate, and capstone levels).
Challenges: Our major challenges remains to be sifting through a tremendous amount of data in an efficient, organized way. Specifically, we currently use the DAT rubric to assess many of our outcomes. We acknowledge some problems with consistency with this tool that we would like to address. In addition, the data collection and analysis from this tool is cumbersome and time-consuming.

Planned Improvements: For the upcoming year, we plan to put different measures in place for many of our outcomes that are simpler and more accurately reflective of our students' abilities. Our intention is to replace the DAT with an entrance exam or other metrics that would be appropriately reflective of students' abilities and easier to analyze. In addition, we plan to devise assessment tools for our undergraduate research experience. Several faculty have recently attended workshops on this topic and we believe we can receive grant support to develop these tools and, once they are in place, we could receive more external funding for our on-campus research experiences.

We are working as a department to make assessment more meaningful and less burdensome. This started with the overhauling of our goals and outcomes last year, and the re-writing of the exit exam and implementation of a new way to administer the exam using Socrative software that makes analysis easier. This academic year, we plan to continue to improve the process. Although we recognize there are still deficiencies and areas we need to improve upon, we believe we are consistently making the process better each year. With regards to curriculum development, we carefully analyzed our results from last year and decided to focus on reading of scientific literature to draw conclusions and analyze data. Many faculty have implemented assignments or modules within their classes to specifically help address these outcomes. In addition, in response to feedback from alums and our current students, we added 11 new minors to our program this past year to help better prepare students for graduate and/or professional schools.

Closing the Loop: Progress on Planned Improvements from Prior Year

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

Outcome	**Planned Improvement**	**Update** *(Indicate when, where, and how planned improvement was completed. If planned improvement was not completed, please provide explanation.)*
Students can formulate scientifically sound hypotheses.	Since we have included this skill as a core part of our program, we will continue to emphasize the ability to formulate hypotheses in our core curriculum. We will continue to implement and introduce new inquiry learning projects that require students to develop and test scientifically sound hypotheses at all levels of our curriculum.	We implemented a specific activity in Bio 151 that focuses on formulating and evaluating hypotheses. There is a renewed department wide commitment to ensure that all laboratory exercises and independent research is hypothesis-driven.
Students can design and implement a research project.	Given that this outcome was only partially met, this area will be a focus of ours in the coming year. We will purposefully and intentionally discuss the skills necessary to design appropriate research projects, particularly at freshmen and sophomore levels. Empowered with this additional knowledge and with increased confidence, we predict that, when given the opportunity to put it into practice, junior and senior students will perform better. It is our intention to increase continuity and provide consistent language and skill development across	We added an exercise in Bio 151 and a module in Bio 151L to specifically address designing a research plan. The idea is to engage students in research design early on their academic careers and build upon that as they progress. We are working to add build upon this skill in mid-level classes and will also be working to assess this during independent research projects. Developing the assessment tool for independent research has given us some challenges that we are working through.

Outcome	Planned Improvement	Update *(Indicate when, where, and how planned improvement was completed. If planned improvement was not completed, please provide explanation.)*
	the curriculum. In addition, we hope to involve more students in independent research projects with both faculty and upperclassmen mentors. These experiences will expose students to the skill of designing their own research projects and allow them the opportunity to carry out these projects under supervision.	
Students can analyze data and draw conclusions.	Based on the data presented here, we see that our students are struggling to meet our expectations in regards to data analysis and drawing conclusions. We recognize that these are difficult areas for students to master but we expect that our senior students would score higher in these areas. We will ramp up our focus on these areas specifically, incorporating assignments focusing precisely on these skills and techniques at all levels of our curriculum.	Expectations for lab reports are laid out clearly in BIO151L. As students progress, BIO262L (all sections) has implemented vigorous standards for lab reports and we provide the students with guidelines and detailed grading rubrics as feedback. Clear presentation of data is a critical skill, and we cover what makes good tables and figures in detail in BIO300.
Students can critically evaluate scientific literature.	Based on the data presented here, we see that our students are struggling mightily to meet our expectations in regards to evaluating and analyzing scientific literature. We recognize that these are difficult areas for students to master but we expect that our senior students would score higher in these areas. We will ramp up our focus on these areas specifically, incorporating assignments focusing precisely on these skills and techniques at all levels of our curriculum.	In BIO300, one of our mid-level WI courses, we have implemented the use the retracted MMR-autism paper as a case study throughout the semester. First, students learn about the peer-review and editorial process, and then the power of the scientific method to test hypotheses and correct false associations. We also spend a lot of time teaching students about primary versus secondary sources. We are also in the process of developing a seminar class designed, among other things, to address evaluating scientific literature.
Students can develop coherent written arguments.	Writing will continue to be an integral part of our curriculum and we will continue to emphasis scientific writing in all of our courses, not just our WI courses.	We continue to emphasize writing in all courses and are working on developing department-wide rubrics at all levels to better assess writing.
Students can write using current scientific styles.	Writing will continue to be an integral part of our curriculum and we will continue to emphasis scientific writing in all of our courses, not just our WI courses. We spend quite a bit of time discussing scientific writing styles in our Bio 300 course but we will work to emphasize this in other courses as well.	In BIO300, we cover the complete range of scientific styles. For research articles, we follow the style guidelines of the top publications. We have also implemented the use the MMR-autism case study to practice effective communication with a non-specialized audience. There has also been an increased emphasis on this in our introductory classes where we are designing workshops for lab report writing to teach good habits from the beginning.

Outcome	Planned Improvement	Update *(Indicate when, where, and how planned improvement was completed. If planned improvement was not completed, please provide explanation.)*
Students can deliver effective oral scientific presentations.	We have students give oral presentations throughout our curriculum and we will continue to emphasize this skill with our students. We will work to provide more immediate and useful feedback and provide opportunities for students to present their independent research as well as classroom research projects.	We already discuss poster presentations in BIO300, but we have added guidelines on oral presentations. A grading rubric for oral presentations was implemented in BIO272, which provided students with immediate, constructive feedback. We will be working this year to incorporate use of this rubric in other classes as well.

Provide a response to last year's University Assessment Committee review of the program's learning assessment report:
Comment: Well described. It would have helped to understand how you currently collate and sift through the data - which you described as challenging. The workshop was a good idea.

Response: The primary challenge of data acquisition and analysis lies in the DAT. The DAT results were previously submitted electronically or in paper format. This year, we did transfer all submissions to electronic, which did help. However, the DATs must be analyzed student by student and class by class, which is time-consuming and somewhat cumbersome. There are also reliability issues with the DAT as there is no norming process that is used to ensure consistency among reviewers. It is our intention this year to explore alternative measure to replace the DAT, which we also feel has reliability and consistency problems.

Comment: Goal #2 (oral and written skills) has corresponding outcomes for written skills, but none for the oral communications skills.

Response: There is a corresponding outcome regarding oral presentations (Outcome #3: Students can deliver effective oral presentations). It was assessed in the report but inadvertently omitted from the table in the beginning of the document.

Comment: The measures for outcome #3 for Goal #2 (oral communication) were not clear. How do you measure oral presentation skills through a written exam?

Response: We do use the DAT and the exit exam as direct measures and the GSS and Alumni surveys as indirect measures for the outcomes. We recognize the hesitation with using the exit exam as a measure to assess oral skills. The questions are designed to test a students' understanding of the difference between a written scientific report versus and oral presentation, which in our discipline are quite different. The exam questions we use for this assessment are below:

Written communication in science follows standards of technical writing. Such communication provides a platform to describe context for why an experiment is performed, give details of the experiment so it can be repeated, show a thorough analysis and provide conclusions that place your work in a broader scientific context. Oral presentations in science, however, are typically shorter and are intended to convey the high points of a result and publicize a particularly novel or exciting result. For the following statements, decide if it belongs in a written lab report or an oral presentation. If it belongs more in a written report, answer "a", if it belongs more in an oral presentation answer "b", if it should be done in both answer "c"

1) Convey **ALL** the details of your experimental design answer: A
2) Describe the **details** of what you did to analyze your data answer: A
3) **Briefly** describe your experimental design answer: B
4) Focus **PRIMARILY** on describing your results and conclusions answer: B
5) Reference all sources and previous studies answer: C

In this academic year, we do plan to propose an alternative rubric to assess oral presentations that can be used department-wide that will replace the DAT as a direct measure going forward.

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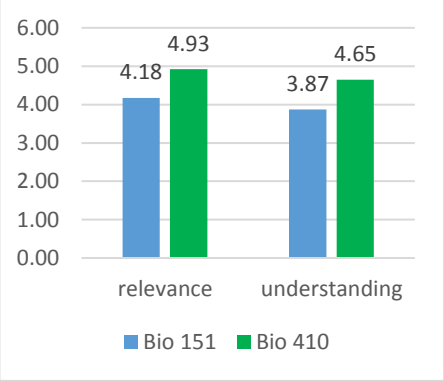
Outcomes Assessment 2018-2019

Goal 3: Students will understand the moral and ethical impact of science on their communities, both local and global.
Learning Outcome 1: Students will identify ethical dilemmas associated with current scientific innovations.

Outcome Measures *Explain how student learning will be measured and indicate whether it is direct or indirect.*	**Performance Standard** *Define the acceptable level of student performance.*	**Data Collection** *Discuss the process for collecting this data: who conducted the assessment, when, and how?*	**Result** *Did you meet your target? What was the result?*
Direct: DAT Rubric: Ethics: Relevance and Understanding (see appendix 1)	We expect to see an increase in the average DAT scores between first year and fourth year inquiry- based projects. Ratings of excellent receive scores of 4.5-5.0, good received a 3.25-4.5, fair receive 2.0-3.25, and poor receive less than 2.0. Excellent to good scores meet our performance standards.	The designated courses, BIO 151L General Biology Lab (freshmen), and BIO 410 Senior Seminar (seniors) all have specific research assignments in which we evaluate designated Discovery Assessment Tool (DAT) elements. Instructors for these courses assess each student project based on this rubric. Assessments were completed both Fall 2018 and Spring 2019. See the DAT attachment for the rubric. *NOTE: There was no corresponding assignment that assessed ethics at the junior level.*	In general, average DAT scores for ethical relevance increased from freshman year (Bio 151, 4.18) to senior year (Bio 410, 4.93). For ethical understanding, scores also increased from 3.87 (freshmen) to 4.65 (senior). Both sets of students scored in the good-excellent range for both measures. **This performance standard was met.** 
Direct: Exit exam questions 41-45 (see appendix 2)	70% of students will achieve a score of 60% or more on the pertinent questions corresponding to each learning outcome of the exit exam.	The exit exam was given to 23 biology students (graduating seniors) in Fall 2018 or Spring 2019 during their Senior Seminar exam time. The instructor for this course administered the exam using *Socrative* software and data was analyzed using Excel.	On average, 85% of biology majors scored at least 60% on this section (92% in Fall 2018 and 78% in Spring 2019). We are not quite sure why the percentage dropped in Spring 2019 but will monitor this result in coming years. **The performance standard was met.**
Indirect: Alumni Survey, "Determine the most ethically appropriate response to a situation" and "Understand the major ethical dilemmas in your field"	85% of respondents perceive their preparation as good or excellent.	The survey was sent to alumni from the biology programs and data was collected by the Office of Institutional Effectiveness. (n=17)	82.4% of alums responded they felt their preparation was good or excellent for both of these measures. **The performance standard was not met.**

Interpretation of Results

Analysis and Implications: *What does this result tell you about the extent to which your students achieved this outcome? What are the strengths and weaknesses that this result highlights, and what are the implications for your curriculum or your program?*

In general, our students performed well on this learning outcome and we believe this is a testament to the effectiveness of the ethical modules we have implemented in many of our classes. DAT scores were in the good to excellent range for both freshmen and seniors and we saw a slight increase from freshmen to senior year. In general, students scored very high on the exit exam questions with the exception of question 41, where only 38% answered it correctly in Fall 2018. Questions 41 reads as follows: "As scientists become adept at deciphering a person's genetic composition, we may be able to predict that a child will develop a serious illness by the age of 30. What is the best way to handle this situation?

a. Inform prospective employers of the person's genetic trait
b. Inform prospective insurance carriers of the person's genetic trait
c. Develop rules for ethical practice as to how and to whom genetic information is revealed
d. Inform relatives so that they may be aware of the trait
e. The best way is to do all of the above.

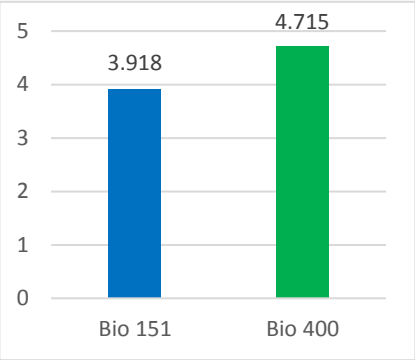
Most students incorrectly answered the question with choice "e." We will continue to emphasize ethical awareness via specific modules in our classes ranging from freshmen to senior students. Specifically, we will address more ethical practices around genomic medicine.

The area in which this outcome was not met was with our alumni. Only 82% of alumni felt well-prepared in this area. We believe this may be a function of which alumni completed the survey. This survey was sent to alumni one and five years out from graduation. The alumni from five years ago would not have the advantage of the newly developed ethical modules in our classes, thus, might not have been or felt as prepared in this area. We anticipate as more alums become the products of our new curriculum, we will see improved numbers in the outcome from our alumni.

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

We will continue to emphasize ethical relevance and understanding in our classes. We will work to emphasize ethical implications of genomic medicine through specific modules. The Center for Case Study Teaching in Science has case studies that will be added to the curriculum to address these issues.

Goal 3: Students will understand the moral and ethical impact of science on their communities, both local and global
Learning Outcome 2: Students will follow ethical norms of scientific communication.

Outcome Measures *Explain how student learning will be measured and indicate whether it is direct or indirect.*	**Performance Standard** *Define the acceptable level of student performance.*	**Data Collection** *Discuss the process for collecting this data: who conducted the assessment, when, and how?*	**Result** *Did you meet your target? What was the result?*
Direct: DAT Rubric: Ethics: Balance (see appendix 1)	We expect to see an increase in the average DAT scores between first year and fourth year inquiry- based projects. Ratings of excellent receive scores of 4.5-5.0, good received a 3.25-4.5, fair receive 2.0-3.25, and poor receive less than 2.0. Excellent to good scores meet our performance standards.	The designated courses, BIO 151L General Biology Lab (freshmen), and BIO 410 Senior Seminar (seniors) all have specific research assignments in which we evaluate designated Discovery Assessment Tool (DAT) elements. Instructors for these courses assess each student project based on this rubric. Assessments were completed both Fall 2018 and Spring 2019. See the DAT attachment for the rubric. *NOTE: There was no corresponding assignment that assessed ethics at the junior level.*	In general, average DAT scores for ethical balance increased from freshman year (Bio 151, 3.92) to senior year (Bio 410, 4.72) and scores for both groups were in the good-excellent range. **This performance standard was met.** 
Direct: Exit exam questions 46-50 (see appendix 2)	70% of students will achieve a score of 60% or more on the pertinent questions corresponding to each learning outcome of the exit exam.	The exit exam was given to 23 biology students (graduating seniors) in Fall 2018 or Spring 2019 during their Senior Seminar exam time. The instructor for this course administered the exam using *Socrative* software and data was analyzed using Excel.	On average, only 57% of biology majors scored at least 60% on this section (46% in Fall 2018 and 67% in Spring 2019). We not quite sure why we see such differences in the two groups but we will monitor this result in coming years. **The performance standard was not met.**

Interpretation of Results

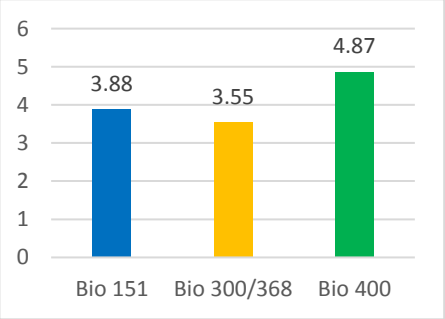
Analysis and Implications: *What does this result tell you about the extent to which your students achieved this outcome? What are the strengths and weaknesses that this result highlights, and what are the implications for your curriculum or your program?*

Overall, this goal was met using the DAT but not met with the exit exam metric. These two measures really assess different aspects of this outcome. While the DAT measures balance (for example, presenting both sides of an argument), the exit exam assesses students' knowledge of publication ethics (for example, authorship and ethics of data presentation). Regarding balance, our students seemed to do a good job of presenting different viewpoints and supporting those ideas with evidence from the literature. However, defining authorship for publications (questions 46 and 48) presented specific challenges for our students. This is an area that will be emphasized in our writing course and with those students who conduct independent research.

Discuss planned curricular or program improvements <u>for this year based on assessment of outcome:</u>

We will continue to emphasize ethical balance, presenting, clarifying, and supporting varying viewpoints in our classes. We will work to specifically implement an assignment or module regarding this topic in our mid-level writing class. In addition, we will design curriculum around authorship and ethics of data presentation at every level of our curriculum. As more students become involved in independent research (and as we develop assessment tools for our independent research objectives) we will work specifically to make sure students are receiving training on these important topics.

Goal 4: Students will be able to integrate a range of scientific concepts and ideas.
Learning Outcome 1: Students can make connections between similar content ideas from different courses.

Outcome Measures *Explain how student learning will be measured and indicate whether it is direct or indirect.*	**Performance Standard** *Define the acceptable level of student performance.*	**Data Collection** *Discuss the process for collecting this data: who conducted the assessment, when, and how?*	**Result** *Did you meet your target? What was the result?*
Direct: DAT Rubric: Project Planning, Analysis, Synthesis: Connections Among Ideas. (see appendix 1)	We expect to see an increase in the average DAT scores between first year and fourth year inquiry- based projects. Ratings of excellent receive scores of 4.5-5.0, good received a 3.25-4.5, fair receive 2.0-3.25, and poor receive less than 2.0. Excellent to good scores meet our performance standards.	The designated courses, BIO 151L General Biology Lab (freshmen), Bio300 or Bio 369 (mid-level) and BIO 410 Senior Seminar (seniors) all have specific research assignments in which we evaluate designated Discovery Assessment Tool (DAT) elements. Instructors for these courses assess each student project based on this rubric. Assessments were completed both Fall 2018 and Spring 2019. See the DAT attachment for the rubric.	In general, average DAT scores for connections among ideas increased from freshman year (Bio 151, 3.88) to senior year (Bio 410, 4.87). There was a slight unexplained dip (other than evaluator discrepancies) in the junior year (3.55). Scores for all groups were in the good-excellent range. **This performance standard was met.** 
Direct: Exit exam questions 22-26 (See appendix 2)	70% of students will achieve a score of 60% or more on the pertinent questions corresponding to each learning outcome of the exit exam.	The exit exam was given to 23 biology students (graduating seniors) in Fall 2018 or Spring 2019 during their Senior Seminar exam time. The instructor for this course administered the exam using *Socrative* software and data was analyzed using Excel.	On average, only 44% of biology majors scored at least 60% on this section (43% in Fall 2018 and 44% in Spring 2019). **The performance standard was not met.**

<u>Interpretation of Results</u>
Analysis and Implications: *What does this result tell you about the extent to which your students achieved this outcome? What are the strengths and weaknesses that this result highlights, and what are the implications for your curriculum or your program?*

Overall, this goal was met using the DAT but not met with the exit exam metric. Given our concerns with the reliability of the DAT and how poorly our students performed on the exit exam, we see this as a real growth opportunity for our department. Clearly, our

students are struggling to perform as we would like them to in this area. We believe, based on previous assessment reports, that students are successful at mastering subject areas individually but this result highlights that students are clearly having difficulty merging ideas from related disciplines, a skill we consider to be a hallmark of a Marymount Biology education. Integration of ideas will become a focus of our curriculum development in the upcoming academic year.

Discuss planned curricular or program improvements <u>for this year based on assessment of outcome:</u>

We will be working to integrate ideas across classes to better help students see how topics relate to one another. For example, we will be working to redesign the introductory biology curriculum so that students will see applications for chemistry and physics, implementing specific modules where students are asked to utilize knowledge from other classes to carry out an assignment. This will be a significant undertaking and require extensive redesign to our curriculum and perhaps addition of new courses. We will start small and expand based upon success and effectiveness of our strategy.

Appendix 1. Discover Assessment Table (DAT) Rubric

Discover Assessment Tool (DAT) + Ethics

The DAT was created to accommodate varied inquiry ("research") projects students will create throughout their educational experience at Marymount. Because the concept of research varies by discipline, this rubric was designed to be flexible enough to accommodate various conceptions of research, and to assess the learning outcomes of DISCOVER. Please rate each element on the scale of 1-5 (or N/A if not applicable to the assignment). You may just check the box that describes your rating on each element.

I. Central Question/Project Focus						
Element	**1**	**2**	**3**	**4**	**5**	**N/A**
Focus	Inquiry topic inappropriate, unfocused. Identifies issues that are too general or trivial	Inquiry topic somewhat appropriate broadly focused. Identifies somewhat relevant issues. States it in a general way that may lack focus	Inquiry topic somewhat appropriate broadly focused. Identifies relevant issues. States topic in a clear and somewhat focused way	Inquiry topic appropriate, focus appropriate. Identifies important and relevant issues. States topic in a clear and appropriately focused way		
Context	Demonstrates minimal attention to context, audience, purpose, and assigned task(s)	Demonstrates some attention to context, audience, purpose, and assigned task(s)	Demonstrates adequate attention to context, audience, and purpose and a clear focus on assigned task(s)	Demonstrates a thorough understanding of context, audience, and purpose that is responsive to the assigned task(s) and focuses all elements of the work		
II. Information Seeking, Selecting, and Evaluating						
Gather the Needed Information and Knowledge	Presents information from few, weak, or inappropriate sources	Presents limited information from relevant sources.	Presents adequate information from multiple, relevant sources.	Presents thorough and relevant coverage of existing knowledge		N/A
Evaluate Information and Knowledge	Evaluates information and its sources based on irrelevant criteria	Evaluates information and its sources based on a limited number of relevant criteria	Evaluates information and its sources based on a variety of relevant criteria	Evaluates information and its sources based on a wide variety of relevant criteria as they relate to a particular discipline		
Use of Information and Knowledge	Inadequately organizes and integrates information to support the project focus	Partially organizes and integrates information to support the project focus	Adequately organizes and integrates information to support the project focus	Effectively organizes and integrates information to support the project focus		

III. Project Planning, Analysis, and Synthesis						
	1	2	3	4	5	N/A
Design Process	Inquiry design suggests misunderstanding of methodology or theoretical framework	Inquiry design uses few elements of relevant methodology or theoretical framework	Inquiry design uses some elements of relevant methodology or theoretical framework	Inquiry design uses all elements of relevant methodology or theoretical framework		
Connections Among Ideas	Restates existing knowledge and makes no connections among ideas/evidence	Recognizes some connections among ideas	Integrates existing knowledge; connects information to problem	Connects information to problem and considers alternative ways of approaching the problem; reconciles contradictory or conflicting evidence		
Conclusions	States an ambiguous, illogical, or unsupportable conclusion. Provides a minimally developed rationale that demonstrates very limited understanding	States a somewhat clear and appropriate conclusion. Provides a partially developed rationale that demonstrates limited understanding	States a clear and appropriate conclusion. Provides a partially developed rationale that demonstrates adequate understanding	States and clear and insightful conclusion. Provides a fully developed rationale that demonstrates solid understanding.		
IV. Final Product						
Mechanics	Demonstrates non-idiomatic sentence constructions that sometimes impede meaning, but prose is usually readable, despite numerous errors	Demonstrates idiomatic prose that generally conveys meaning to readers with some clarity, although writing may include some errors	Demonstrates idiomatic prose that conveys meaning to readers with some measure of clarity and fluency with few errors	Demonstrates graceful, idiomatic prose that conveys meaning to readers with clarity and fluency and is almost error-free		
Content	Demonstrates consideration of simple ideas that are evident in some element of the work. Identifies unsupported and irrelevant implications of the work	Demonstrates attention to simple ideas that are evident in the work. Identifies relevant implications of the work	Demonstrates consideration of new ideas that are used to shape solid work. Identifies relevant implications of the work.	Explores complex ideas that are used to shape compelling work. Provides insightful implications of the work		

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Please rate each element 0 if completely lacking, on a scale of 1-5 if present, or N/A if not applicable to the assignment.

V. Ethics: Scientific, legal, social, political, religious, and/or moral issues that apply to the topic						
Element	**1**	**2**	**3**	**4**	**5**	**N/A**
Relevance	Provides unclear, incomplete or no connections between the issues and scientific concepts. ☐	Provides somewhat clear, complete connections between the issues and scientific concepts. ☐	Presents clear, complete connections between the issues and scientific concepts. ☐	Presents, clear, complete and insightful connections between the issues and scientific concepts. ☐		
Understanding	Identifies the relevant issues incompletely and in a confusing manner that demonstrates very limited understanding. ☐	Identifies the relevant issues in a somewhat complete and clear manner that demonstrates limited understanding. ☐	Identifies the relevant issues in a complete, clear manner that demonstrates adequate understanding. ☐	Identifies and expands upon the relevant issues in a complete, clear, nuanced manner that demonstrates a thorough understanding. ☐		
Balance	Presents only one side of dilemmas and viewpoints. Supporting content is lacking or poor. ☐	Presents dilemmas and different viewpoints in a somewhat equally balanced manner. Supporting content is somewhat adequate. ☐	Presents dilemmas and different viewpoints in an equally balanced manner. Supporting content is adequate. ☐	Presents dilemmas and different viewpoints in an equally balanced and persuasive manner. Supporting content is thorough and complete. ☐		
Implications	Presents a confusing or incomplete discussion about how the issues influence and connect to other topics. ☐	Presents a somewhat clear, complete discussion about how the issues influence or connect to other topics. ☐	Presents a clear, complete discussion about how the issues influence or connect to other topics. ☐	Presents a clear, complete, insightful discussion about how the issues influence or connect to other topics. ☐		

July, 2013

Sources used to revise the DAT were: Association of American Colleges & Universities VALE Rubrics for Written Communication, Information Literacy, and Inquiry and Analysis; Bowling Green State University Hypothesized Developmental Sequence Rubrics for Assessing Inquiry; James Madison University GSCI 165 *Blueprint for Life:* Genetics, Ethics and Society Vignettes – Discussion Guidelines.

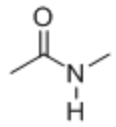
Appendix 2: Senior Exit Exam

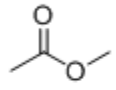
We have only included the portions of the exit exam that we analyzed in the outcomes addressed here. If the committee wishes to see the entire exit exam, we are happy to provide that.

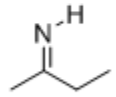
SENIOR COMPREHENSIVE EXAM – BIOLOGY & PHYSICAL SCIENCES

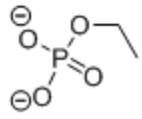
22) Which of the following is eliminated in the reaction which joins two monomers in polymer synthesis?
a. NH_4
b. H_2O
c. NO
d. CO_2

23) The secondary structure of proteins results from hydrogen bonding between two of which of the following functional groups? (answer A)

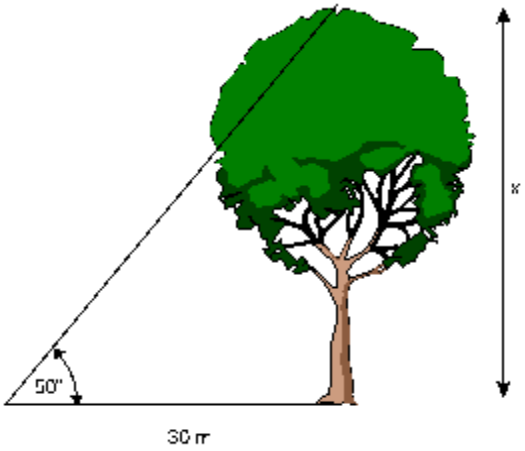
a. 

b. 

c. 

d. 

24) How would you determine the height of the tree in the figure below? You stand 30 feet from the tree. The angle between the tree and the ground is 90^0. The angle to the top of the tree is 50^0.



a) Height = 30 feet x sin (50^0)
b) **Height = 30 feet x tan (50^0)**
c) Height = 30 feet x cos (50^0)
d) Height = 30 feet / tan (50^0)

25) Following which checkpoint might you detect elevated levels of topoisomerase, DNA polymerase, and DNA ligase activity?
   a) **G1 checkpoint**
   b) G2 checkpoint
   c) M checkpoint
   d) any of the listed checkpoints are equally likely

26) Your boss gives you a sample of bacterial culture medium and asks you to determine the number of **living** bacteria in the sample. Which technique would give you the most accurate result?
   a) streak plate colony cultures
   b) growth cultures on selective-differential media
   c) turbidimetric method with a spectrophotometer
   d) **serial dilutions and colony plate counts**

Written communication in science follows standards of technical writing. Such communication provides a platform to describe context for why an experiment is performed, give details of the experiment so it can be repeated, show a thorough analysis and provide conclusions that place your work in a broader scientific context. Oral presentations in science, however, are typically shorter and are intended to convey the high points of a result and publicize a particularly novel or exciting result. For the following statements, decide if it belongs in a written lab report or an oral presentation. If it belongs more in a written report, answer "a", if it belongs more in an oral presentation answer "b", if it should be done in both answer "c"

31) Convey **ALL** the details of your experimental design answer: A

32) Describe the **details** of what you did to analyze your data answer: A

33) **Briefly** describe your experimental design answer: B

34) Focus **PRIMARILY** on describing your results and conclusions answer: B

35) Reference all sources and previous studies answer: C

41) As scientists become adept at deciphering a person's genetic composition, we may be able to predict that a child will develop a serious illness by the age of 30. What is the best way to handle this situation?

f. Inform prospective employers of the person's genetic trait
g. Inform prospective insurance carriers of the person's genetic trait
h. Develop rules for ethical practice as to how and to whom genetic information is revealed
i. Inform relatives so that they may be aware of the trait
j. The best way is to do all of the above.

42) Mary and John are working in a research lab together. Mary observed John entered data that was not accurate. She questioned John when she noticed that the numbers were not accurate. John proceeded to utilize the data and, after statistical analysis, he reported that his data was significant.
Mary should:
a. Ignore what she observed since she had made an attempt to correct the situation.
b. Speak to John's mentor and tell him/her what she observed
c. Tell other students what she observed so that they will support her concern.
d. Publish a comment about the inaccuracy of John's data on Facebook
e. None of the above are correct.

43) What ethical principle is supported by conservation biology?
a. Biodiversity is desirable for all living things, including humans
b. Extinctions due to human action are to be expected
c. Biodiversity has no value unto itself
d. Survival of the fittest
e. Nature is not guided by ethical principles, only biological, so no principles apply

44) A course in Ethics
a. **Provides guidance for students to make thoughtful decisions**
b. Provides rules for making decisions
c. Creates ethical individuals
d. Requires that students have the same religious beliefs in order to make ethical decisions
e. All of the above are correct

45) The IRB, the Institutional Review Board, at Marymount University is established to protect human subjects in research situations. The committee works to:
a. Assure University compliance with federal regulations
b. Create an institutional culture where responsible conduct is understood, supported and followed by Marymount students, faculty, staff and administration.
c. Provide guidance for the method of selection of human subjects and to assure that selection is equitable
d. Assure that informed consent is obtained and properly documented to protect human subjects
e. All of the above are roles of the IRB

46) An author of a scientific paper should
a. have provided substantial intellectual contributions to the study
b. have completed all of the work for the paper him or herself
c. take no responsibility for coauthor's integrity or ability
d. both a and b are correct
e. all of the above

47) When writing a scientific paper for publication, it is permissible to quote from an article you have previously published because it is your original work.
    a. True
    b. False

48) Which of the following should be included for publication in a scientific journal article?
    a. The principle investigator who is overseeing the project
    b. The lab technician who prepared all the solutions for the project
    c. The lab manager who typed the paper
    d. The undergraduate student who performed two experiments that were included in the paper.
    e. all of the above
    f. A & D only
    g. B & C only
    h. A, C, and D only

49) When preparing data for publication, it is permissible to ignore data that is inconsistent with or does not support your hypothesis without discussing your reasons for doing so.
    a. True
    b. False

50) Which of the following scenarios would be classified as deviations from ethical norms in scientific communication?
    a. Submitting the same paper to two different journals without informing the editors
    b. Including a colleague as an author in return for a favor
    c. Assigning a project to two students to see who finishes the project the fastest
    d. Both A and B are correct
    e. all of the above