

Student Learning Assurance Report Academic Year 2014-2015

Report Date: 15 December 2015
School/College: Arts and Sciences
Department/Program: Biology
Person completing the Report: Brian Thornton, Scott Nunes

1. **Overview Statement:** Briefly summarize the student learning assurance activities that were undertaken this academic year, indicating:
 - a. which program learning outcomes were assessed this year.
 - b. who in your department/program was involved in the evaluation of the above learning outcomes

Assessment was led by the Biology Department chairs with input from Biology faculty members. This year is a transition year in which the Biology department is beginning to change its assessment strategy. Modifications to the Program Mission statement, Learning Goals, and Learning Outcomes were made and submitted through the Canvas "Faculty Leaders in Assessment" site.

This year the Department chose to focus on developing a sustainable technique for assessing the following learning outcome:

- 5) Demonstrate an awareness of the significance ethics plays in the biological sciences.

2. **Please Answer the Following Questions for Each of the Student Outcomes Assessed:**
 - a. **What did you do?**

Describe clearly and concisely how you assessed the learning outcomes that were evaluated this year (e.g., measures, research methods, etc.). [please use bullet points to answer this question]

- All Biology majors are required to take BIOL 310/311, Genetics and Genetics Lab. One of the key assignments for this course is an essay that combines technical writing on modern genetics techniques with an ethics thesis paper. See attachments for a full description of the assignment.
- 30 papers from the Spring 2015 offering of the course were randomly selected and uploaded to a Canvas site. The Canvas site was set up specifically for the purpose of carrying out Biology assessment. False "student accounts" were created and enrolled in the course, and the essays were submitted as assignments by the student "bda2015" (Biology Department Assessment 2015).

- Three faculty volunteers (Brian Thornton, Juliet Spencer, and Cary Lai) graded the essays according to a rubric. The course rubric for the essay evaluates both the ethical and technical writing in the paper, which would not be appropriate for this assessment method, since we are isolating our evaluation of Learning Outcome #5. A new rubric was developed (see attachments) that evaluated the papers on three criteria: strength and clarity of their thesis statement, strength and sophistication of their thesis argument, and scholarship in their choices of outside source materials. The faculty volunteers were asked to evaluate 10 student papers and determine a numerical score, share their comments on the papers, and in addition were invited to share their comments on the rubric itself and the use of the Canvas site for assessment.

b. What did the faculty in the department or program learn?

- A summary of the findings are included as an attachment. A paper that was scored as “satisfactory” in all three areas on the rubric would score 12/20 points (60%). The average rating for the papers was 13.3/20 (approximately 66.5%). Of the 30 papers, 5 scored below 12. Four papers scored an 18 or 19, while none scored a perfect 20/20.

- The comments included by one of the reviewers indicated that the use of references was often confusing or incomplete, or an over-reliance on direct quotes rather than paraphrasing/restating sources. Some of the papers also lacked a coherent thesis argument, or relied on flimsy or fantastical arguments.

- One reviewer commented on the review process itself, stating that it was a reasonable amount of work for during the semester, but that it could possibly be expanded to more papers if it were done over the summer. The reviewer also commented that the Canvas site was familiar and thus easy to use, though perhaps formatting of the assignment layout could have been changed to make grading slightly easier.

c. What will be done differently as a result of what was learned?

Discuss how courses and/or curricula will be changed to improve student learning as a result of the evaluation. Include a discussion of how the faculty will help students overcome their weaknesses and improve their strengths.

- To help students with properly citing and utilizing source materials in their papers, an improved set of guidelines will be developed for the Spring 2016 Genetics course. These guidelines will incorporate examples of good student

writing to demonstrate how source materials can be properly cited and paraphrased. Time will also be allotted to Genetic Lab sessions for discussion of scientific writing, and lab instructors will set aside time to workshop with student in the early stages of their paper research to improve the depth and strength of their final product.

3. Attach a copy of the components of the department/program student learning assurance plan that have been modified since its initial submission:

- a. Program Mission
- b. Program Learning Goals
- c. Program Learning Outcomes
- d. Program Learning Rubrics aligned with outcomes
- e. Curriculum map that shows the courses that pertain to the outcome

• Please see the attached documents “Biology Assessment Plan 2015” and “Biology Mission Goals Outcomes 2015” for the updated versions of the above documents. These were modified after departmental review in Spring 2015 and have been submitted previously.

Biology Learning Assurance Report 2014-2015
Biology Ethics Essay Evaluations

Introduction:

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Three faculty volunteers (Brian Thornton, Juliet Spencer, and Cary Lai) graded the essays according to a rubric. The course rubric for the essay evaluates both the ethical and technical writing in the paper, which would not be appropriate for this assessment method, since we are isolating our evaluation of meeting Learning Outcome #5. A new rubric was developed (see Appendix B). The faculty were asked to evaluate 10 student papers and determine a numerical score, share their comments on the papers, and in addition were invited to share their comments on the rubric itself and the use of the Canvas site for assessment.

The assignment handout for the Spring 2015 class is included at the end of this report, as is the rubric used by the evaluators for this assessment method. Note that a student ranked as "satisfactory" in all 3 areas that were evaluated would score 12/20 (60%).

The raw scores and evaluator comments are included on the following pages.

Paper #	Reviewer Comments:
1	The thesis statement was present but included vague language ("guidelines to people's legality") that weakened its impact. The bulk of the thesis argument was straightforward and conveyed good coverage of multiple perspectives on the argument. The conclusion was not compellingly stated, however. A variety of sources on the topic were cited.
2	No discernible thesis statement. The thesis argument was a bit meandering but covered a great deal of material, and cited a good variety of sources.
3	Strongly worded and clear thesis statement, the thesis argument wandered but included a lot of information, and a good number of sources were used.
4	Strongly stated thesis statement and well researched! The body of the thesis argument, however, lacked some nuance. Statements about risk of developmental abnormality carry a lot of weight when discussing applying the technology to humans, but when discussing it applied to research animals it should be weighed against the current practices in research animals. We already treat research animals in ways that we would find completely unacceptable in humans, so drawing a comparison between the two doesn't hold.
5	In all areas, the work was satisfactory but not exemplary. The thesis statement was present but could have been more clearly stated, falling back on ambiguous language. The body of the thesis argument touched on important points but failed to wrestle with the more complex questions, such as what qualifies as an enhancement. Similarly, the research on primary methods was good, but more ethical sources could have been applied.
6	A very strong paper; clear thesis statement, an extremely detailed thesis argument and citation of a variety of sources. Some soft reasoning used in the thesis argument section, but mostly very strong. An exemplary paper.
7	The thesis statement was vague, but present. The thesis argument had some severely flawed logical leaps, equating all fatalities from adverse drug effects to gene therapy's isolated fatalities. The reasoning toward the thesis position was unclear.
8	Overall a decently written paper, marred somewhat by incorrect word choices and grammar. Thesis statement was clear and held a firm position, and the thesis argument was relatively strong, although it bypassed some questions with platitudes (research must march forward) without adequate backing.
9	The thesis statement was not present where it should have been, making the focus of the paper unclear. The thesis argument was a bit basic overall but did touch on a wide variety of topic areas, and included some source material to back up these areas.
10	The thesis statement could have been expanded to give a preview of the argument. Overall, an excellent piece of writing, the thesis argument itself and sources cited were exemplary.
21	Thesis argument - thin and not clear throughout (3). Thesis argument (4) Facts were included, but arguments were not well connected to central argument. References (4) included, but missing in some sections

22	Thesis statement was clear (5), Thesis argument had supporting evidence, but student demonstrated poor understanding of basic forensic methods and made some arguments that made no sense (6). References were included but a lot of information was taken directly from textbook and there were far too many direct quotes (4).
23	thesis statement seemed broad and position was not clear (3). Thesis argument contained many examples, but these were not referenced and connection to central argument was weak (5) References (2) missing throughout, also the way refs are cited is confusing, looks like only 2 primary sources?
24	thesis statement clear on position (5) thesis argument included good examples but some of the arguments didn't connect to central idea (8) references - appropriate (5)
25	thesis statement - both sides seem to be discussed, position is not clear (3) thesis arguments were thin and seemed to rely on comic book scenarios and unfounded logic (4) references - were used but many facts and images lacked a citation (3)
26	thesis statement - clear (5) thesis arguments were generally weak and poorly developed, many ideas based on no facts at all (5) references (3) included, but many ideas needed external sources and citations
27	Thesis statement - (5) Clear from title, statement could have been worded better Thesis argument (7) Gave supporting data but fell short in final interpretation and relating back to overall argument. References- were included, appropriate (4) It was surprising what wasn't discussed...the classic ADA case and the original Lesch-Neyan syndrome papers
28	Interesting paper, but puzzling because I did not get a clear position from the student, also extensive use of direct quotes and poor explanations suggest low comprehension of genetics. Thesis argument (4) References (4) The student did obtain outside sources but many facts were stated without references.
29	The thesis statement was weak and did not indicate a clear position...saying that more research is needed is not a basis for argument (2) Not surprisingly, the thesis argument did not support the statement. There was no clear explanation of why more long term research is needed and it seems that long terms effects on both human consumers and the environment are a concern, although the specific research needed to make GMO foods safe is not discussed (4) References are included, but these are cited in different styles throughout and many facts that require references lack them (2).
30	Thesis statement was clear, appropriate background information was included (5). Thesis argument was very weak and poorly constructed, I was not convinced that gene therapy was a good thing nor did I understand any argument being made other than to describe studies done to treat cancer (4) References are cited in an inconsistent style throughout. Significant use of direct quotes, would expect a student at this level to be able to paraphrase. (3)

Comments from Cary Lai on use of the assessment method:

Experience with this assessment method:

- This Genetics ethics paper seems like a good choice for the department ethics assessment. Overall, I found the ethics topics that the students chose were interesting - usually relevant, current, and debatable topics. It seemed like the majority of the papers dealt with just a couple of themes (GMO's, forensics, gene therapy). Increasing the range of ethics topics that the students write about may be helpful.
- Grading 10 papers was a reasonable amount of work for each faculty member. I would have trouble finding time to grade much than this mid-semester. If this assessment was done during the intercession or the summer, I wouldn't mind grading more than this (30+ papers myself).

Comments about rubric:

- The students apparently were supposed to include a significant 'background' section: for example discussing the technology by which DNA is injected into plants when discussing the GMO controversy. There was no part of the rubric that covered this 'background' section.

Comments about using Canvas for assessment:

- This was a convenient way to access and grade the assignments. Because most all of the faculty is very familiar with using Canvas it should be straight forward them to use it for assessment grading
- When I was assigned all of the new assignments to grade, I received a flood of notifications by e-mail that I had a new assignment that is ready to grade. Turning off notification of each assignment that is ready would be helpful
- I used the SpeedGrader function on Canvas, which worked ok. The only downside is that instead of being able to go from one paper to the next using the left and right arrows in SpeedGrader, I had to return to the Assignments tab and then navigate back to the next paper to grade. I think this was based upon how the assignments were grouped. This was not too hard to do, just a little more cumbersome than normal.

Assignment: Ethics and Genetics

Of the various ethical dilemmas facing us as we move into the 21st century, a considerable number involve the field of genetics. As our understanding of heredity grows, so too does our power to predict biological outcomes, and in some cases to alter those outcomes to fit our needs. From tailored medications to prenatal screening, from genetically modified foods to criminal investigations, from gene therapy to the cloning of whole organisms, our understanding of genetics will inform and affect our lives in too many ways to predict. The questions of which technologies to use, and how to use them, will be defining questions for our world in the coming century.

As citizens, we can't afford to wait for someone else to tell us what to think about these issues. We will have to make our own decisions both in the public and in the private arenas, as consumers and as voters. Most reporting on scientific topics in the news is unreliable and heavily biased toward a particular point of view, distorted to fit either a personal agenda or, more often, a need to generate a profit by creating sensation and thus attracting more consumers.

The task is daunting. We can't expect to be able to prepare ethical positions ahead of time for every possible outcome or future technology. We don't know exactly what the future holds for genetics, or how it will be dressed when it arrives. What we can do, however, is stay informed, so that when we do face those questions, we're doing it with a solid understanding of the core questions, as well as the technical expertise to understand what it all means.

Assignment: Presentation/Paper on Ethical Questions in Genetics

You will take part in a group presentation on one of the following topics:

GMOs (Genetically Modified Organisms)

Cloning of Whole Organisms

Genetic Screening (DNA testing in adults)

Pharmacogenetics

Genetic Privacy

Gene Therapy

Forensic Genetics

Reproductive Genetics

Behavioral Genetics

Each group will consist of 3-4 students. The group will deliver a 12-15 minute presentation plus a few minutes of discussion afterwards. Each member of the group will also turn in a paper on the topic. The paper is more comprehensive and is to be written individually. Your papers will be graded separately but everyone in the group will receive the same grade on the presentation.

Presentation Guidelines:

Purpose: The primary goal of your presentation will be to provide a concrete example of genetic technologies that raise an ethical question for society or individuals. In the brief time available, you will introduce the broad area your group has chosen, you will describe one or two genetic technologies that are involved with such questions, and you will finish with one or two concrete examples of the kinds of ethical challenges that are raised. The end of your talk should include a few minutes to elicit questions from your audience and spur some discussion.

Each group of 3 or 4 people will choose one broad topic that covers an area where genetic advances have raised ethical questions. The presentations will be delivered in the last discussion section of the semester (see your syllabus for the exact date).

Format of presentation: Presentations will be about 12-15 minutes long followed by a brief (3-5 minutes) question and answer session. Each group member must participate equally in the presentation.

Visual aid: You must use some kind of visual aid in your presentation. This could be powerpoint, posters, or whatever else you can dream up that isn't simply you reading off of a note card. If using powerpoint, remember that it's far better to put up a relevant graphic with a few bullet points than to put your whole script on the screen. Make sure that the visuals used are relevant and help your audience remember the point you're trying to make.

Work out with your TA ahead of time any presentation tech (computer, projectors, etc) that your group will require.

Grading: Some important questions that will go into determining the grade:

1. How well did your talk highlight the specific ethical, social and/or legal questions posed by this particular area of genetic progress, or genetic history?
2. How informative was your talk? Did you provide enough information to ensure that the audience understands the technological innovation and the philosophical/ historical factors that underlie a potential conflict?
3. How organized and concise were you? **Going over time will result in a loss of points.** Were you sufficiently well prepared, clear and to the point that the audience was able to follow you, and stay interested?
4. How well did your presentation inspire discussion? Keep in mind who your audience is: your classmates. If they didn't understand your presentation, you failed to communicate about your topic.

Research: **Get started early!** If you put off preparations for the presentation (or the paper!) it will eat you alive. You don't want to be heading into the week before finals pulling all-nighters to get the presentation done.

Final hints: Remember that you sink or swim together, you all get the same presentation grade. Work together! You have plenty of time to prepare but you need to get started right away.

Paper guidelines:

General Information: Each member of the group will turn in their own position paper on the group's topic. The paper should be 10 to 15 pages (12 point font double-spaced, 1" margins) long (this length should exclude title pages, bibliography, and attached figures). See your syllabus for the due date for the paper. If you leave writing this paper to the last minute, you will probably regret it. Get it done early!

Format of paper: Your paper must include **ALL** of the following elements. I recommend that you split the paper into sections and label them to make it clear.

Title, Thesis and Introduction (1-2 pages)- The title gives insight into what your paper is about. You will begin with a broad introduction of your subject area to be discussed. You will conclude your introduction with a **clear statement of the thesis of your paper**, that is the position that you will ultimately argue for in your conclusion. For example, if you were doing a paper on Genetic Privacy, you could begin with a broad introduction of the question (*who has a right to our genetic information?*), and finish with your thesis (*"In this paper, I will argue that insurance companies should be allowed to have unfettered access to genetic information about their clients"*). Your thesis should be clear and concrete. Avoid vague statements, such as *"genetic information about babies is bad"*.

Genetics discussion (4-6 pages)- In this portion, you will explore the specific genetic technology or approach that impacts this question. In the above example, it might be something like the ability to link genetic markers with disease. You must use one or more **figures** to illustrate an example of the technology at work. This must be drawn or interpreted from one of your **primary sources** cited. See below for more details on figures and sources.

Thesis argument (4-6 pages)- Once the technology has been explained, explore the ethical question you have chosen. This should include three basic parts

- A. The main arguments in favor of your position.
- B. One or more arguments against your thesis.
- C. One or more rebuttals to the arguments against your thesis.

Conclusion (1-2 paragraphs)- A brief conclusion restating your thesis and summarizing your main argument.

Figures- A figure is any sort of artwork, chart, graph or image that helps demonstrate a point in your paper. Look at a journal article or your textbook for an idea of how figures should be used. This figure should be referenced in the text of your paper, and should include a figure legend that gives a brief description of what's being depicted. If the figure is adapted from another source the legend should also include the citation.

References- You must cite at least **three primary scientific sources**. A primary scientific source is an article that is the first published description of **scientific** work done by the authors themselves. In other words, a journal article presenting research is a primary source; a newspaper article describing the journal article is not. Similarly, most ethics papers do not count, as they are not scientific in nature (i.e. they do not make use of the scientific method to

reach their conclusions). Many people lose points because they did not use enough primary sources.

All sources must be cited properly in a bibliography at the end of your paper. Please use either APA or MLA format for your citations. The Gleeson Library website generally has citation guidelines available for you to view.

Please use a running header throughout the paper with your name and the title of your paper.

Advice on choosing a thesis argument: The assignment is to explore issues that are ethically challenging. If you find yourself studying technology that poses no ethical challenges, is NOT a good topic to base your paper around. Find the areas that are controversial, and that's where you'll find the good discussions.

Turnitin: All papers must be submitted to Turnitin via Blackboard by midnight on the date the paper is due. There will be a link under the assignments tab on Blackboard. You do not need to provide your instructor with a printed copy of the paper, it will be graded directly on Blackboard. Failure to submit your paper by midnight on the due date will result in an immediate loss of 25% from your final score. Papers turned in a day late (past midnight on the day after the due date) will lose 50% credit, and papers turned in two days late will receive no credit.

Grading: Some important questions that will go into determining the grade:

1. Was the topic sufficiently researched?
2. Was the paper well organized and coherent?
3. Was correct grammar and spelling used?
4. Was the discussion thoughtful, ideally with original insights into the topic?
5. Were at least 5 sources used and cited properly?

Research Tips: Get started early. You should use sources from the library in addition to online sources. **Wikipedia is not a valid source.** You may use it as a jumping-off point but you should view any information gleaned from Wikipedia with caution.

Suggestions: Journals such as *Science* and *Nature*, NPR programs such as *Science Friday*, newspapers such as the *New York Times*, magazines such as *National Geographic* or *The Economist*, web sites such as the National Institute of Health (NIH) or National Academy of Science (NAS). Do not rely on any one source for all of your information.

Plagiarism will not be tolerated on any part of this paper. This includes actions like taking another students' paper and changing words around... that does not count as "your own words". You are a university student and the work you produce should be scholarly work that you have created, on your own.

I highly recommend the following guide to writing ethics papers:

http://ethics.sandiego.edu/Resources/Analyzing_Arguments/MoralProblemsPapers.asp

2014-2015 Biology Department Learning Assurance: Ethics Essay Rubric

Criteria	Ratings			Pts
<p>Thesis statement: The assignment requires a clear thesis statement in the introduction, in which the student takes a firm position on an ethical question posed by a genetic technology.</p>	<p>Excellent Achievement: The thesis statement is clearly written in the introduction to the essay. For full credit the thesis statement must make the student's position unambiguous. Where the position requires some equivocation ("severity of genetic conditions should be taken into account") some brief indication of how such judgment calls will be made should be included. 5 pts</p>	<p>Satisfactory Achievement: The thesis statement is included in the introduction and states the student's position clearly. The thesis statement could have been improved by additional details, or it includes imprecise language or is vague in some way. 3 pts</p>	<p>Weak Achievement: No thesis statement is included in the introduction to the paper, or the supposed thesis statement does not actually state an ethical position. 0 pts</p>	5 pts
<p>Thesis argument: The main ethical argument should be well explained and should include both sides of the debate. It should also culminate in a well-explained thesis position.</p>	<p>Excellent Achievement: The thesis argument portion of the paper includes a clear description of the ethical dilemma(s) posed by one or more genetic technologies, and presents a nuanced and thorough set of arguments for two or more positions on the question(s) raised. Both sides of important issues are fully explored with the strongest possible arguments presented for both sides. The paper finishes with a clear explanation for why the student favors one set of arguments over the other. 10 pts</p>	<p>Satisfactory Achievement: The thesis argument portion of the paper describes arguments from both sides of the issue being explored with adequate detail. The thesis argument leaves out some minor or nuanced considerations, or glosses over some of the more difficult problems ("Who decides which genetic diseases are serious enough to warrant intervention, and which aren't?"). The paper finishes with a clear explanation for why the student favors one set of arguments over the other. 6 pts</p>	<p>Weak Achievement: The thesis argument is absent, or fails to consider an alternative viewpoint. Alternatively, the paper presents two arguments but fails to explain which argument should be favored over the other and why. 0 pts</p>	10 pts
<p>Research: The student's opinions should be bolstered by some examples from published resources, demonstrating that the student has increased their understanding of ethical issues.</p>	<p>Excellent Achievement: The student cites, quotes or paraphrases multiple sources for their ethical arguments. The student shows good scholarship in having researched existing positions on these topics, while also having contributed their own independent thoughts on the issue. 5 pts</p>	<p>Satisfactory Achievement: The student cites, quotes or paraphrases at least one source for their ethical arguments. The student demonstrates a good understanding of these arguments, but does not substantially improve or expand upon them. 3 pts</p>	<p>Weak Achievement: The student shares purely personal opinions without any evidence of having done any research on these ethical questions, or cites existing positions but misrepresents them in some way. 0 pts</p>	5 pts

Total Points: 20

Biology Undergraduate Mission, Goals, and Learning Outcomes

Department Mission Statement:

The core mission of the University of San Francisco is to educate students in the knowledge and skills required to succeed as professionals and as persons, while also teaching the sensitivity and values necessary to participate in a world shared by all people. The Department of Biology particularly emphasizes the core Jesuit value of advancing the freedom and responsibility to pursue truth and to follow evidence to its conclusion. In pursuit of these values, the faculty of the Department of Biology educates undergraduate students in current biological concepts, methodologies, and ethical practices in the laboratory and the natural environment to prepare them to succeed personally and professionally with the potential for advanced training in the sciences.

Program Goals:

Upon graduation, students who complete the degree requirements should be able to meet the following program goals:

- Understand the major biological concepts.
- Exhibit problem solving and analytical and communication skills as they apply to biological sciences.
- Understand and apply the scientific method and critical thinking in an ethical fashion to solve biological problems.
- Recognize the various career paths in the biological sciences.

Program Student Learning Outcomes:

- 1) Demonstrate both in-depth and broad knowledge of the concepts that comprise the biological sciences.
- 2) Apply the scientific process, including designing and conducting experiments and testing hypotheses.
- 3) Develop proficiency in laboratory techniques (such as light microscopy, gel electrophoresis, keeping a laboratory notebook, and understanding of principles of laboratory safety).
- 4) Demonstrate the ability to read, understand, and critically review scientific papers and prepare oral and written reports in a standard scientific format.
- 5) Demonstrate an awareness of the significance ethics plays in the biological sciences.

Biology Assessment Plan 2015

Program Student Learning Assurance Methods:

Assessment for Learning Outcome 1 (Comprehension of Biological Concepts)

Grades in coursework as indicated in the Program Learning Rubric. Grades in the following core courses will be tracked at the end of each year (105, 106, 212, 310, 414). Additionally, one field course and one laboratory course per semester will be randomly sampled and the grades from those courses will be evaluated.

In addition, the Department will develop a set of questions that cover the major topic areas that are taught in the Biology curriculum. The questions will be delivered by online quizzes given to students near the beginning of the semester in General Biology I, Cell Physiology, Genetics and Evolution. The questions will cover topics relevant to each of these classes and the scores of students will be tracked to determine acquisition and retention of information and concepts.

Assessment for Learning Outcome 2 (Understanding the Scientific Method)

Annually, grades associated with lab sections in General Biology I and randomly sampled upper division lab courses will be evaluated. In addition, every three years lab reports from upper division lab and field courses will be evaluated for the demonstrated application of the scientific method using an appropriate rubric.

Assessment for Learning Outcome 3 (Applied Lab Skills)

Annually, grades from randomly sampled upper division lab courses will be evaluated. Every three years electronic lab and field notebooks from upper division courses will be randomly sampled and evaluated for the successful demonstration of laboratory techniques using an appropriate rubric.

Assessment for Learning Outcome 4 (Scientific Communication Skills)

Every three years representative papers that review scientific literature will be randomly collected from upper division courses and reviewed using an appropriate rubric.

Assessment for Learning Outcome 5 (Ethics Awareness)

Every three years, randomly selected ethics papers from the Genetics course will be collected and evaluated using an appropriate rubric.

The Biology Department will use the collected data to devise and implement appropriate changes to the curriculum.

Program Student Learning Rubrics:

OUTCOME	Skills demonstrated via:	Weak Achievement	Satisfactory Achievement	Excellent Achievement
1) Demonstrate both in-depth and broad knowledge of the concepts that comprise the biological sciences.	Core courses and upper division elective courses (Lab, Field and Lecture courses); Exit Survey, Department quiz questions	Grades in core courses below a C. Unable to demonstrate basic comprehension of advanced topics in the biological sciences, grades in upper level courses in the Biology program below a C+. Graduates will not improve their scores on the Department Questions over their initial scores.	Able to demonstrate comprehension of advanced topics in the biological sciences, able to achieve a C to B grade in courses in the Biology program. Graduates will improve their scores on the Department Questions over their initial scores.	Able to demonstrate mastery of advanced topics in the biological sciences, able to excel in upper level courses in the Biology program (earning above a B in courses for the Biology program). Graduates will substantially improve their scores (30% increase or more) on the Department Questions over their initial scores.
2) Apply the scientific process, including designing and conducting experiments and testing hypotheses.	Lab courses	Unable to complete laboratory-based courses for Biology majors in the program. Grades in Biology laboratory core courses (BIOL 105, 106) and upper division elective lab courses below C. Randomly selected lab reports demonstrate poor or no understanding of the proper use of the scientific method.	Able to complete laboratory-based courses for Biology majors in the program. Grades in Biology laboratory core courses (BIOL 105, 106) and upper division elective lab courses in the C to B range. Randomly selected lab reports demonstrate the application of the scientific method, including the formation appropriate hypotheses, testing predictions, and stating reasonable conclusions.	Able to excel in laboratory-based courses. Grades in Biology laboratory core courses (BIOL 105, 106) and upper division elective lab courses above a B. Randomly selected lab reports demonstrate exceptional application of the scientific method. This would include all of the requirements for Satisfactory Achievement, but should additionally include proposals for future experiments based on their results.
3) Develop laboratory techniques (such as light microscopy, gel electrophoresis and keeping a laboratory notebook and understanding of principles of laboratory safety).	Lab courses	Unable to master techniques in laboratory-based courses. Grades in Biology laboratory core courses (BIOL 105, 106) and upper division elective lab courses below C. Randomly selected lab reports do not include adequate explanations of the laboratory protocols the students used in their courses, or provide no evidence that the protocols were successfully completed.	Able to demonstrate mastery of specific techniques in laboratory-based courses. Grades in Biology laboratory core courses (BIOL 105, 106) and upper division elective lab courses in the C to B range. Randomly selected lab reports include adequate explanations of protocols performed, as well as evidence of the success of those protocols.	Demonstrate superior lab skills in lab courses. Grades in Biology laboratory core courses (BIOL 105, 106) and upper division elective lab courses above B. Randomly selected lab reports provide highly detailed explanations of the protocols performed, and evidence of successful completion of those protocols with a quality adequate for publication in a scientific journal.

OUTCOME	Skills demonstrated via:	Weak Achievement	Satisfactory Achievement	Excellent Achievement
4) Demonstrate the ability to read, understand, and critically review scientific papers and prepare oral and written reports in a standard scientific format.	Papers, presentations, posters, essays	Unable to demonstrate literacy skills as applied to the biological sciences in upper division elective courses. Reports and/or presentations not in proper format with the majority of students earning below a C on writing/presentation assignments.	Able to demonstrate average scientific communication skills as applied to the biological sciences in upper division elective courses. Reports and/or presentations presented in proper format with the majority of students earning a C-B on writing/presentation assignments.	<p>Able to demonstrate mastery of scientific communication skills through upper division courses as applied to the biological sciences literature in upper division elective courses. Reports and/or presentations presented in superior format with students earning higher than a B on writing/presentation assignments.</p> <p>Students are participating in department/ college/ professional scientific presentation meetings.</p> <p>Students complete an honors thesis.</p>
5) Demonstrate an awareness of the significance that ethics plays in the biological sciences.	Papers	Ethics papers fail to consider ethical complications stemming from genetic technology, or do not adequately explore both sides of important ethical debates in the field.	Ethics papers communicate the ethical complications stemming from genetic technologies clearly, including a clear explanation of two sides of a relevant debate.	Ethics papers communicate a nuanced view on the ethical complications stemming from genetic technologies, including extensive and well-researched discussion of two or more sides of a relevant debate.

Program Student Learning Core Curriculum Map:

Learning Outcomes	105	106	212	310	ELECTIVES			414
	GEN BIO I	GEN BIO II	CELL	GENETICS	FIELD COURSES [†]	LAB COURSES*	LECTURE COURSES [‡]	EVOLUTION
1) Demonstrate both in-depth and broad knowledge of the concepts that comprise the biological sciences.	I	I	I	I	R, EC	R, EC	R, EC	R, EC
2) Apply the scientific process, including designing and conducting experiments and testing hypotheses.	I	I				R, EC		
3) Develop laboratory techniques (such as light microscopy, gel electrophoresis and keeping a laboratory notebook and understanding of principles of laboratory safety).	I	I				R, EC		
4) Demonstrate the ability to read, understand, and critically review scientific papers and prepare oral and written reports in a standard scientific format.	I	I	R	R	R, EC	R	R, EC	R, EC
5) Develop an awareness of the careers and professions available in the biological sciences and an understanding of the significance ethics plays in this field.	I	I		R, EC	R	R	R	

I = Introduced, R = Reinforced, EC = Extended Coverage

FIELD COURSES[†]: 324/325, 326/327, 328/329, 331/332, 335/336, 379/380, 381/382, 383/384, 390/391, 392/393; LAB COURSES*: 320/321, 333/334, 341/342, 346/347, 355/356, 362/363, 365/366, 385/386, 443/444, 458/459, 470/471, 481/482, 485/486, 498; LECTURE COURSES[‡]: 319, 330, 340, 345, 350, 359, 368, 370, 405, 420, 460, 4