Term Information

Effective Term	Spring 2017

General Information

Course Bulletin Listing/Subject Area	Biology
Fiscal Unit/Academic Org	Introductory Biology - D0326
College/Academic Group	Arts and Sciences
Level/Career	Undergraduate
Course Number/Catalog	2367
Course Title	Biology and Society
Transcript Abbreviation	Biology & Society
Course Description	A writing-intensive course in which students analyze biological principles to cooperatively research, develop and communicate positions for societal action to address biological problems of the contemporary world.
Semester Credit Hours/Units	Fixed: 3

Offering Information

Length Of Course	14 Week, 12 Week
Flexibly Scheduled Course	Never
Does any section of this course have a distance education component?	No
Grading Basis	Letter Grade
Repeatable	No
Course Components	Recitation, Lecture
Grade Roster Component	Lecture
Credit Available by Exam	No
Admission Condition Course	No
Off Campus	Never
Campus of Offering	Columbus, Lima, Mansfield, Marion, Newark, Wooster

Prerequisites and Exclusions

Prerequisites/Corequisites	1101 (101), or 1102 (102), or 1113 (113) and 1114 (114), and Eng 1110, and Soph standing or above
Exclusions	

Cross-Listings

Cross-Listings

Subject/CIP Code

Subject/CIP Code	26.0101
Subsidy Level	General Studies Course
Intended Rank	Sophomore, Junior, Senior

Requirement/Elective Designation

General Education course:
Level 2 (2367); Biological Science

Course Details

Course goals or learning objectives/outcomes

- Apply, analyze, and synthesize the basic facts, principles, theories and methods of modern biology.
- Use quantitative reasoning to evaluate scientific claims and articulate a position on a currently relevant scientific topics using validated scientific information.
- Find and evaluate sources of reliable scientific information related to primary and secondary literature in relevant biological and aligned disciplines.
- Work in a group to formulate societal policy options addressing currently relevant scientific topics of opportunity or concern.
- Demonstrate through critical analysis, discussion, and written work the ability to communicate a scientific idea effectively to peers from a diverse range of disciplines and interests.
- Effectively deliver an oral presentation demonstrating ability to communicate a complex scientific concept.
- Improve and build upon one's written work based on feedback provided by instructors and peers.
- Identify societal impacts of biological advancements.
- Evaluate the impact of technological developments on society and their consequences.

Content Topic List

- Writing skills
- Scientific writing
- Antibiotic resistance
- Biodiversity
- Cancer
- Biodiversity
- Climate change
- Genetically modified organisms
- Stem cells / cloning

Attachments

- Biology 2367 Assessment Plan.docx: Assessment Plan
  (GEC Course Assessment Plan. Owner: Andrews,Adam Lee)
- Biology 2367 Sample Syllabus.docx: Syllabus
  (Syllabus. Owner: Andrews,Adam Lee)
- Biology 2367 GE Justification.docx: GE Justification
  (Other Supporting Documentation. Owner: Andrews,Adam Lee)
- Proposal to Create Biology 2367 – Biology and Society.docx: Revised Course Proposal
  (Other Supporting Documentation. Owner: Andrews,Adam Lee)
- Appendix G - CriticalThinking.pdf: Proposal Appendix G: Critical Thinking Rubric
  (Other Supporting Documentation. Owner: Andrews,Adam Lee)

Comments

- See 3-23-16 e-mail to M. Misicka. *(by Vankeerbergen,Bernadette Chantal on 03/23/2016 12:31 PM)*

Workflow Information

Status	User(s)	Date/Time	Step
Submitted	Andrews,Adam Lee	03/09/2016 01:48 PM	Submitted for Approval
Approved	Misicka,Matthew Alan	03/09/2016 02:11 PM	Unit Approval
Approved	Fink,Steven Scott	03/10/2016 08:09 AM	College Approval
Revision Requested	Vankeerbergen,Bernadette Chantal	03/15/2016 08:46 AM	ASCCAO Approval
Submitted	Andrews,Adam Lee	03/18/2016 10:17 AM	Submitted for Approval
Approved	Haddad,Deborah Moore	03/18/2016 12:02 PM	Unit Approval
Approved	Fink,Steven Scott	03/18/2016 03:02 PM	College Approval
Revision Requested	Vankeerbergen,Bernadette Chantal	03/23/2016 12:32 PM	ASCCAO Approval
Submitted	Andrews,Adam Lee	04/01/2016 01:19 PM	Submitted for Approval
Approved	Haddad,Deborah Moore	04/01/2016 01:25 PM	Unit Approval
Pending Approval	Fink,Steven Scott	04/01/2016 01:25 PM	College Approval

Proposal to Create *Biology 2367 – Biology and Society*
3 credit hours

Catalog Description: A writing-intensive course in which students analyze biological principles to cooperatively research, develop and communicate positions for societal action to address biological problems of the contemporary world.

In an op-ed in the Los Angeles Times in 2000, Dr. Craig Venter, who led the effort to sequence the human genome, famously claimed that, "If the 20th century was the century of physics, the 21st century will be the century of biology." One year later, Congress passed and President George W. Bush signed the No Child Left Behind act that effectively required every state to develop K-12 education standards, including those for science content. As a result of this and subsequent legislation, especially at the state level, virtually every student matriculating at an American college or university today has taken at least three basic science courses in middle and high school. No longer must today's colleges and universities introduce every entering student to potentially novel fields like the sciences. Rather, General Education science courses can and should prepare college graduates to fulfill their responsibilities as scientifically literate citizens in our democracy. Accordingly, we propose a post-introduction biology course that facilitates the development of undergraduate reasoning skills through the cooperative learning exercise of developing and communicating in writing and presentations policy positions that address biological problems of the contemporary world.

Science, particularly in the field of Biology, is advancing so rapidly that it is not surprising the general public struggles to keep up, much less understand. Society as a whole is often slow to accept scientific discoveries, particularly in the United States. As we must recognize that the general public are the voters who elect policy makers, it behooves us to ensure that our students are given the skills to not only comprehend the ever-changing scientific discoveries of the day, but to research an issue and effectively communicate a position on that issue. To that end, we are proposing to create a Biology Level 2 Writing Course with an issue focus. Our intent is to capitalize on core foundational material general education students learn in our introductory courses and further that learning with enhanced abilities in communication of those topics. The course will employ a case studies approach, providing rich opportunities for students to discover the methods of modern science, recognize that science is an evolving body of knowledge, describe the inter-dependence of scientific and technological developments, recognize the social and philosophical implications of scientific discoveries, and understand the potential of science and technology to address problems of the contemporary world. The case studies approach will also facilitate our goal of helping our students to learn communication skills. Sample topics include cancer, genetically modified organisms, biological impacts of climate change, cloning, biodiversity, and antibiotic resistance. A unifying theme of the course will be the scientific literacy needed to effectively communicate difficult scientific topics to individuals outside of scientific disciplines: a goal valuable to both science and non-science majors.

The case studies approach will also provide instructors flexibility to address topics relevant to students and of interest to them, thereby expanding the range of faculty members interested in offering sections of the course in the future. It is our hope that this flexibility will recruit faculty to present the course. We envision eventually having a group of instructors at the main and regional campuses sharing case study ideas and materials and keeping the course

current and relevant, as we do with other courses offered by the CLSE. One of the draws for faculty to teach upper level courses is the freedom to create content of their own interest, as opposed to the broad outcomes and topics required in the broad survey introductory courses. The intended structure of this course offers some level of incentive.

We intend that this course meet General Education requirements for two areas: *Natural Sciences* and *Level Two Writing and Communication*. The General Education Natural Science requirements will be fulfilled as follows. The lecture material and topical research will illustrate the principles of modern science. The topics and course structure will provide opportunities to examine the development of scientific insights and idea, e.g. from Mendelian genetics, to the discovery of chromosomes, to the identification of DNA as the genetic material, to the discovery of the structure and function of DNA, to the application of these insights into genetically based medicine and genetically modified organisms or GMOs. In *Appendix D*, we lay out a more detailed plan for the potential topic of GMOs, including content objectives and assessment. The survey nature of many introductory courses often preclude such opportunities to examine how currently relevant issues (e.g. use of GMOs) first began. The applied nature of scientific discoveries leads to technology, which in turn leads to the heart of the course. We aim to have students understand the implications of the scientific discoveries on society. We have structured the entire course and its components to focus on the historical develop of a few core ideas, how those ideas pose opportunities and possible risks for society today and a consideration of the types of policy ideas necessary to develop and regulate it.

To ensure that students come to the course with some background in Biology, we will be imposing a prerequisite of either Biology 1101 (*Introductory Biology*), or 1102 (*Human Biology*), or 1113 and 1114 (sequence for Biology majors). As we intend 2367 to be open to students of any major, we need only that student will have been exposed to the breadth of Biology, which any of these prerequisites would do. We would anticipate students to come to the course with *at minimum* a non-majors understanding of the fundamentals of genetics, cell structure, ecology, energetics, and evolution. Biology 1101 and 1102 approach these subject areas in very different ways, but both do cover the essentials and would therefore be acceptable as prerequisite courses. While a single semester of 1101 or 1102 will be sufficient, students who have taken both 1113 and 1114 will have also been exposed to the necessary fundamentals in all of these areas. The focus of 2367 content will not be below the understanding of Biology majors' experience, however, as we intend 2367 to focus more on the societal application of the content. The presumed mixture of science and non-science majors in the course is to our benefit, as it will further the varied perspectives brought to the cooperative learning groups.

The Level Two Writing and Communication requirement will be met with policy papers. The writing of the policy paper will involve an iterative approach to writing, with individual and group components. Trained instructors and peers will provide feedback on draft papers at several stages in their development. The collaborative group approach meets our learning goals in multiple ways. Not only do cooperative groups provide built-in peer review opportunities, but it also increases diversity of perspectives on case topics such as antibiotic resistance and global climate change. By intentionally assembling our cooperative groups to maximize diversity (using information on the class roster: year, major, and gender) we intend to facilitate opportunities for our students to hear viewpoints alternative to theirs and to clarify and defend their own views, especially when they are at variance with their group mates. We have had success with this approach in other CLSE courses and find it generates much more opportunity to compare and evaluate divergent. In addition to the internal peer review within the group, we

will also plan for peer reviews among working groups in each recitation. The development of the issue papers will have students research a biological concept, formulate a position, and express it effectively to someone without a scientific background. This approach requires the ability to uncover the most salient points of an issue and deliver them clearly thus indicating deep understanding of the topic. Students will develop their positions/papers by searching relevant primary, secondary, and popular media depending upon the information needed and the positions taken. For example, to understand the difficulty inherent in proposing a particular position on Global Climate Change, students may need to examine newspapers, blogs, and other digital resources. We will expect students to include effective visual elements in their written presentation, whether original or well-chosen from the literature.

Each student in the course will make an oral presentation providing an opportunity to practice and improve oral communication skills. Students will present during one of the three topic modules and will provide a short presentation on their position for that topic. An opportunity for peers and the instructor will follow each presentation. Instructors will provide feedback on the quality of the presentation and the student's ability to provide a solid justification of the position they present.

We will use multiple assessment methods to ensure that students achieve our learning outcomes. We will measure quantitatively, the core scientific principles and success of student writing using analytic rubrics to gauge student effectiveness at communicating the topic, improvement based on feedback, accuracy of scientific understanding, and ability to think critically. Qualitatively, we will use the Student Assessment of Learning Gains (SALG) at the end of the course. This survey will ask students to respond to a series of Likert and open-ended questions about the gains made in each of the General Education outcomes as well as the course outcomes. This tool has been implemented in all CLSE courses for nearly a decade, providing us with a wealth of assessment data that has been critical to our improvement of courses and instructor professional development.

The course will include a lecture component taught by a faculty member. The lecture will meet for 110 minutes each week, initially as a section of 50-100 students, though scalable to larger capacities. Teaching Associates will lead required recitation sections of 20-24 students that meet once per week for 80 minutes. This number can effectively divide students into working groups of 4 while providing a manageable grading load for the TA. While initially we are proposing only a face-to-face offering of this course, we envision the possibility of future offerings in a distance learning environment. New technology, especially Canvas, is making the collaboration necessary for achieving our outcomes a reality while not degrading the learning environment.

The Center for Life Sciences Education is proud of our professional development opportunities aimed at the instructors of all levels who teach with us, from Undergraduate and Graduate Teaching Associates to Lecturers and Professors. For Teaching Associates assigned to this course, we will require a series of workshops before or at the beginning of the course aimed at effective grading and feedback on writing assignments. These workshops will be in addition to the ongoing training throughout the course that will come in the form of weekly staff meetings, observation, feedback on grading.

Appendix A: Natural Science Learning Outcomes and Justification
(*See Attached*)

Appendix B: Biology 2367 Course Learning Objectives
(*See Attached*)

Appendix C: Assessment Plan
(*See Attached*)

Appendix D: Sample GMO Module
(*See Attached*)

Appendix E: Sample GMO Issue Paper Rubric
(*See Attached*)

Appendix F: Sample Course Syllabus
(*See Attached*)

Appendix G: *Critical Thinking VALUE Rubric*
(*See Attached*)

Appendix A: Natural Science Learning Outcomes and Justification

Natural (Biological) Science Goals:
Students understand the principles, theories, and methods of modern science, the relationship between science and technology, the implications of scientific discoveries and the potential of science and technology to address problems of the contemporary world.

Expected Learning Outcomes:

1. Students understand the basic facts, principles, theories and methods of modern science.
2. Students understand key events in the development of science and recognize that science is an evolving body of knowledge.
3. Students describe the inter-dependence of scientific and technological developments.
4. Students recognize social and philosophical implications of scientific discoveries and understand the potential of science and technology to address problems of the contemporary world.

Level Two Writing and Communication Goals:
Students are skilled in written communication and expression, reading, critical thinking, oral expression and visual expression.

Expected Learning Outcomes:

1. Through critical analysis, discussion, and writing, students demonstrate the ability to read carefully and express ideas effectively.
2. Students apply written, oral, and visual communication skills and conventions of academic discourse to the challenges of a specific discipline.
3. Students access and use information critically and analytically.

Students in Biology 2367 will achieve the natural science objectives through an investigation of applied scientific methods and discoveries, the evolving nature of which have led to technological developments. Students will be introduced to the concepts of a series of case studies involving discoveries in current biological and applied literature, and it will be up to students to work collaboratively with peers to research the topic, recognize the societal implications, and develop issue statements to promote management or restrict the use of those technologies. The iterative writing process will promote student communication skills through regular feedback on writing and oral presentations, while the required collaboration with peers will allow students the opportunity to engage in academic discourse and peer review in these current biological topics.

Appendix B: Course Learning Outcomes

To demonstrate scientific literacy, successful students in the course will be able to:

1. Apply, analyze, and synthesize the basic facts, principles, theories and methods of modern biology.
2. Use quantitative reasoning to evaluate scientific claims and articulate a position on a currently relevant scientific topics using validated scientific information.
3. Find and evaluate sources of reliable scientific information related to primary and secondary literature in relevant biological and aligned disciplines.
4. Work in a group to formulate societal policy options addressing currently relevant scientific topics of opportunity or concern.
5. Demonstrate through critical analysis, discussion, and written work the ability to communicate a scientific idea effectively to peers from a diverse range of disciplines and interests.
6. Effectively deliver an oral presentation demonstrating ability to communicate a complex scientific concept.
7. Improve and build upon one's written work based on feedback provided by instructors and peers.
8. Identify societal impacts of biological advancements.
9. Evaluate the impact of technological developments on society and their consequences.

Appendix C: Assessment Plan

GE Expected Learning Outcomes	**Methods of Assessment** **Direct methods are required. Additional Indirect methods are encouraged.*	**Level of student achievement expected for the GE ELO.** *(for example define percentage of students achieving a specified level on a scoring rubric)*	**What is the process that will be used to review the data and potentially change the course to improve student learning of GE ELOs?**
Writing and Communication Level 2			
ELO 1 Through critical analysis, discussion, and writing, students demonstrate the ability to read carefully and express ideas effectively	• The position paper for the first and third module will use an analytic rubric with specific line items addressing the quality of written communication. (*See paper objectives 1, 2, 5, 6, 9, 10, 11, and 12)* • The short paper will also use a similar rubric.	We will expect students to achieve on average a 70% score on an analytic rubric associated with each paper to be considered to have achieved this outcome.	Data from the Student Assessment of Learning Gains survey will be reviewed, in conjunction with data pulled from the scores on line items of the paper rubric criteria. Based on this data, we will discuss what happened, what went well, and what we want to work on. This will allow for a data-driven plan for future offerings.
ELO 2 Students apply written, oral, and visual communication skills and conventions of academic discourse to the challenges of a specific discipline.	• The position paper for the first and third module and short paper will use an analytic rubric with specific line items addressing the efficacy of written communication. (*See paper objectives 1, 2, 6, and 7)* • The oral presentation will assess the quality of presentation and ability to present a position clearly with justification.		
ELO 3 Students access and use information critically and analytically	• A line of the position paper rubric will address the source of information used and the level of critical thinking presented in the paper. (*See paper objectives 1, 2, 3, 4, 7, and 7)*		

GE Expected Learning Outcomes	**Methods of Assessment** **Direct methods are required. Additional Indirect methods are encouraged.*	**Level of student achievement expected for the GE ELO.** *(for example define percentage of students achieving a specified level on a scoring rubric)*	**What is the process that will be used to review the data and potentially change the course to improve student learning of GE ELOs?**
Natural Sciences			
ELO 1 Students understand the basic facts, principles, theories and methods of modern science.	• The position paper for the first and third module will use an analytic rubric with specific line items addressing the accuracy of scientific information presented, as appropriate to each topic. (*See paper objectives 1, 2, and 3)* • The short paper will also use a similar rubric.	We will expect students to achieve on average a 70% score on an analytic rubric associated with each paper to be considered to have achieved this outcome.	Data from the Student Assessment of Learning Gains survey will be reviewed, in conjunction with data pulled from the scores on line items of the paper rubric criteria. Based on this data, we will discuss what happened, what went well, and what we want to work on. This will allow for a data-driven plan for future offerings.
ELO 2 Students understand key events in the development of science and recognize that science is an evolving body of knowledge.	• The problem statement of the position papers will require students to address how the scientific issue has come to be a problematic entity worthy of discussion. (*See paper objectives 3 and 4)*		
ELO 3 Students describe the inter-dependence of scientific and technological developments.	• The position paper will require students to address how scientific discoveries will be furthered into technology. (*See paper objectives 1, 2, and 4)*		
ELO 4 Students recognize social and philosophical implications of scientific discoveries and understand the potential of science and technology to address problems of the contemporary world.	• The position papers will require students to address the possible issues that arise from scientific or technological development. (*See paper objectives 1 and 5)*		

2367 Course Expected Learning Outcomes	Methods of Assessment	Level of student achievement expected for the Course ELO.	What is the process that will be used to review the data and potentially change the course to improve student learning of Course ELOs?
Course Learning Outcomes			
ELO 1 Apply, analyze, and synthesize the basic facts, principles, theories and methods of modern biology	• The position paper for the first and third module will use an analytic rubric with specific line items addressing the quality of written communication. (*See sample paper objectives 2, 3, and 4)* • The short paper will also use a similar rubric.	We will expect students to achieve on average a 70% score on an analytic rubric associated with each paper to be considered to have achieved this outcome.	Data from the Student Assessment of Learning Gains survey will be reviewed, in conjunction with data pulled from the scores on line items of the paper rubric criteria. Based on this data, we will discuss what happened, what went well, and what we want to work on. This will allow for a data-driven plan for future offerings.
ELO 2 Use quantitative reasoning to evaluate scientific claims and articulate a position on a currently relevant scientific topics using validated scientific information.	• See Item #1, 5, and 7 of the sample paper rubric. Both the position and short papers will expect students to cite validated data from reliable scientific sources.		
ELO 3 Find and evaluate sources of reliable scientific information related to primary and secondary literature in relevant biological and aligned disciplines.	• The sample paper rubric items #1, 7, and 8 will be used to assess students' ability to utilize validated resources.		
ELO 4 Work in a group to formulate societal policy options addressing currently relevant scientific topics of opportunity or concern.	• The group-written option statement will require students to cooperatively develop possible policy options to address areas of concern.		
ELO 5 Demonstrate through critical analysis, discussion, and written work the ability to communicate a scientific idea effectively to peers	• The sample paper rubric items #2, 5, 8, 9, 10, and 11 will all be used to assess students' ability to synthesize and communicate clearly an idea which they have researched.		

from a diverse range of disciplines and interests.			
ELO 6 Effectively deliver an oral presentation demonstrating ability to communicate a complex scientific concept.	• The oral presentation of policy options will be utilized to assess oral communication skills.		
ELO 7 Improve and build upon one's written work based on feedback provided by instructors and peers.	• Each position paper will be based on 5 written assignments, with the final a cumulative piece. Item #13 will be used to assess integration of feedback.		
ELO 8 Identify societal impacts of biological advancements.	• This item is directly assessed by the paper rubric #4.		
ELO 9 Evaluate the impact of technological developments on society and their consequences.	• This item is directly assessed by the paper rubric #5, 6, and 7.		

Appendix D: Sample GMO Module

The debate over the production, use, and labeling of Genetically Modified Organisms remains contentious, with American policy differing significantly from that of, for example, the European Union. Public perception of GMOs, particularly in our food sources, varies with many Americans unaware of the extent of the use of GMOs. To that aim, we will put forth a course module to expand understanding of the techniques and uses of GMOs, with an aim of having students propose public policy regarding the limitations on their uses.

The lecture portion of the course will take students through the history of the related discoveries, through current technology, and eventually to current and future research areas. The lectures will guide students through active learning to be able to answer the questions below as preparation for writing their papers.

- What is a GMO?
- How do GMOs affect security?
- How do GMOs affect climate change?
- What is the prevalence of Genetically Modified Organisms in US food?
- What is the prevalence of Genetically Modified Organisms in world food?
- How do GMOs differ from traditional breeding?
- How long have we been breeding plants in a 'natural' way?
- What is the history of agriculture?
- What kind of selective changes occur during domestication?
- Are all plant crosses 'natural'?
- How does variance arise in a population?
- How does variance persist in a population?
- How do we get new combinations of traits?
- How do traditional breeding and transgenic technology differ?
- How do we transfer a 'desired trait'?
- How is it possible to move genes among different organisms?
- What are some potential benefits of transgenic crops?
- What are some potential risks of transgenic crops?
- What policy options exist with GMOs?
- What is the nature of modern agricultural technology?
- What is (and is not) in food labels?

The papers we will be asking students to write will require synthesis of many (all?) of these questions to demonstrate adequate comprehension of the module's topic and its implications to society. As illustrated in the rubric for the final paper (See *Appendix E*), graders will be specifically looking for a student's ability to communicate the scientific methods of how a genome can be modified. We will expect students to explain the technology developed as a result of the genetic manipulation. Lastly, students will propose a policy for regulation of GMOs by listing the ability of the GMO technology to address problems of the contemporary world. We will also expect students to address the the problems that may be created by the technology as well, and how such public policy would combat those problems. Students will be expected to write a series of cumulative papers to address the topic of Genetically Modified Organisms. The prompts for each are below.

Problem Statement

You will write a 1-2 page paper introducing the topic of Genetically Modified Organisms. In this introduction, you will need to identify a brief history of the field and how those discoveries have led to the current need for public policy regulating Genetically Modified Organisms. Be certain to cite all sources used. Your audience in writing this paper would be to a well-educated non-scientist, such as a legislator or NGO executive.

Option Statement

You will work with your collaborative group to research 4 possible policy options that could be implemented regarding Genetically Modified Organisms. For each option, you will lay out a case as to why this would be a value option to society, what problems the option solves, and what the potential pitfalls will be. You should expect each option to be written with its justification in 400-500 words. Be certain to cite all sources used.

Preferred Policy Statement

This paper will utilize the Problem Statement written individually, now incorporating feedback from your instructor, as the introduction to the paper. Then, you will individually choose one of the options your group proposed and flesh it out beyond the 500 words your group wrote. Further justify the option as the best chosen from your group's list by providing evidence from appropriate literature and data to support your position. Finally, you will expound on how an opponent to your policy would argue against it, along with your counter-argument to those criticisms. Citations for all sources are critically important to validating your argument. Again, your audience in writing this paper would be to a well-educated non-scientist, such as a legislator or NGO executive.

Peer Review

Peer Review is an essential element of the scientific process. You will be randomly assigned the PPS of a fellow student of which you will offer peer review. In your review, you will not only look for issues with mechanics such as grammar and spelling, but more importantly you will attempt to poke holes in the author's argument in order to assist them in making the paper stronger. Your critiques should not be personal, but do need to be critical. You will be graded on the quality of your feedback to your peer.

Final Issue Paper

Having received feedback from your Instructor and Peer Review, you will be expected to take your Preferred Policy Statement and revise it. You will be scored according to the rubric [See *Appendix E*] on how well you synthesize the Biological facts, explain the technology that is being developed, and justify both the solutions and problems that technology creates. An element of the score will be based on how you incorporate the feedback you received on earlier drafts.

Appendix E: Sample GMO Final Issue Paper Rubric

The rubric below is a general form we will use, which can be slightly modified depending on the specific module topic (see items 4, 5, and 6). Modifications may include additional requirements specific to particular topics. The criteria below represent general outcomes we would expect of any issue paper.

Objective	VALUE	CRITERION	Excellent (100-90%)	Good (90-70%)	Fair (70-50%)	Poor (<50%)	POINTS AWARDED
1	20 points	**Provide evidence of carefully read research literature**	Paper synthesizes researched material.	Paper demonstrates reasonable understanding of literature, with minor confusions.	Paper demonstrates many misunderstandings about the literature.	Paper demonstrates little evidence of understanding of the literature on which the paper is based.	
2	20 points	**Express scientific facts effectively and clearly**	Demonstrates clear and effective communication of the ideas.	Demonstrates effective communication, with not more than a couple instances of lack of clarity.	Many instances where communication of ideas is muddled or not effective.	Paper shows little or no effort at effective communication.	
3	20 points	**Demonstrate knowledge of how genomes can be modified.**	Scientific information is accurately represented.	Minor misconceptions presented as scientific fact.	Several instances of misinformation presented.	Demonstrates lack of understanding of scientific principles, showing little research or invalid ideas.	
4	10 points	**Identify the technological developments that have come about as a result of the genetic revolution**	Author identifies several technological developments with adequate explanation of each.	Author provides some list with adequate explanation, but needs additional developments.	Author provides a list with minimal explanation.	Author provides only a list or no explanation of the developments in technology.	
5	10 points	**Demonstrate critical thinking about the implication of using GMOs on society**	Provides strong explanation of the interaction of technology and society using quantitative	Shows some evidence of critical thinking*, but a couple ideas are introduced without thorough explanation.	Many ideas are introduced and some are explained, but many are left without evidence of adequate critical thinking*.	Shows little evidence of critical thinking*.	

			data to support position. Shows evidence of critical thinking.*				
6	20 points	**Use appropriate illustrations to support position**	Uses required number of illustrations. All add value to the position. All are well explained.	Uses less than the required number of illustrations. OR Some illustrations chosen do not add substance to the position. OR Illustrations are not fully integrated into the discussion.	Fewer than required number of illustrations and not well integrated into the substance of the paper.	No illustrations provided or illustrations provide no substance to the paper.	
7	20 points	**Use appropriate sources to validate position**	All sources are reliable and validated. Appropriate number of sources used.	Appropriate number of sources used. No more than one citation from a non-validated source.	Missing at least one required source. Multiple citations come from non-validated sources.	More than one fewer than required number of references. Multiple sources are not reliable or validated.	
8	10 points	**Provide proper citation for sources used in the paper**	All sources are cited in proper format including in-text citations.	All sources are properly cited in references, but a small number of instances with missing in-text citations.	All sources are listed in reference section. Some in-text citations, but much of the text lacks citation. Some errors in format of citations.	Missing some sources of information in reference section. Improper formatting used repeatedly. Few or no in-text citations provided.	
9	10 points	**Use logical flow and transitions throughout the paper**	Logical progression of ideas throughout the paper. Strong organization.	Logical order of ideas. A few weak transitions.	Some jumping around of ideas. Weak transitions.	Paper reads as fragmented with little flow or transition. No logic in the flow of the ideas.	
10	10 points	**Clear and effective introduction**	Author provides a reasonable introduction and thesis; sets direction for the paper.	Author provides some justification, but weak thesis statement.	Author provides minimal introduction, and no thesis statement or direction.	Author provides little or no direction or thesis for the paper.	

11	10 points	**Clear and effective conclusion**	Author provides a comprehensive summary of the issue, solution, and justification	Author provides some conclusion but leaves out some aspect of the paper (i.e. no summary, no solution, or no justification)	Author provides minimal summary of the paper or provides new information not contained in the paper.	Author provides little or no summary of the paper.	
12	20 points	**Use proper grammar, spelling, and punctuation**	No errors	No more than 1-2 total errors	3-5 errors	More than 5 errors	
13	20 points	**Integration of review comments**	Author integrates valuable feedback from instructor and peer review.	Author makes some use of feedback, but ignores some valuable feedback	Author makes little use of feedback	Author ignores all use of feedback	

TOTAL out of 200 _____
Scale out of 60 points _____

*See *Appendix G* for a published rubric of Critical Thinking, which will apply to all assignment and be provided to the students.

Appendix F: Sample Syllabus
Biology 2367: Biology and Society
Spring Semester 2017

Lecturer:

Course Coordinator: Adam L. Andrews
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Class Meeting Schedule:

Lecture: TR, 55 minutes each, Location TBA
Recitation: 80 minutes weekly; Consult your official BuckeyeLink schedule for which section you are to be attending.

Course Materials:

- Required
  - *Writing Science in Plain English*, by Anne Greene. 2013, ISBN: 978-0226026374
  - *The Chicago Manual of Style (16th Edition)*, 2010. ISBN: 978-0226104201
  - Internet Access (Carmen is an integral part of this course. You must activate your OSU email account to have access to Carmen.)
- Recommended: Any recent general biology textbook for reference toward background material.

Prerequisites:

Required: English 1101, and [(*Biology 1113 and 1114)* OR *Biology 1101* OR *Biology 1102*]
Required: Minimum sophomore level standing

Course Philosophy and Structure:

Scientific discoveries, particularly in the field of Biology, are coming so rapidly that it is not surprising that the general public struggles to understand them, much less keep up. Society as a whole is often slow to accept these discoveries. As we must recognize that the general public are the voters who elect policy makers, it behooves us to ensure student have the skills to not only comprehend the ever-changing scientific discoveries of the day, but to communicate effectively a researched position on the topic. The course will be broken into modules, with each module structured similarly. The lecture portion of the course will focus on instruction of applied biological content. The content level of the course will be appropriate for both non-biology and biology majors given the required prerequisite of some core content. The recitation portion of the course will break students into small working groups to collaboratively develop a position on the topic.

GE General Education Goals & Objectives

Students who successfully complete this course will fulfill the following GE goals and objectives:

Level Two Writing and Communication Goals:
Students are skilled in written communication and expression, reading, critical thinking, oral expression and visual expression.

Expected Learning Outcomes:

1. Through critical analysis, discussion, and writing, students demonstrate the ability to read carefully and express ideas effectively.
2. Students apply written, oral, and visual communication skills and conventions of academic discourse to the challenges of a specific discipline.
3. Students access and use information critically and analytically.

Natural (Biological) Science Goals:
Students understand the principles, theories, and methods of modern science, the relationship between science and technology, the implications of scientific discoveries and the potential of science and technology to address problems of the contemporary world.

Expected Learning Outcomes:

1. Students understand the basic facts, principles, theories and methods of modern science.
2. Students understand key events in the development of science and recognize that science is an evolving body of knowledge.
3. Students describe the inter-dependence of scientific and technological developments.
4. Students recognize social and philosophical implications of scientific discoveries and understand the potential of science and technology to address problems of the contemporary world.

Students in Biology 2367 will achieve the natural science objectives through an investigation of applied scientific methods and discoveries, the evolving nature of which have led to technological developments. Students will be introduced to the concepts of a series of case studies involving discoveries in current biological and applied literature, and it will be up to students to work collaboratively with peers to research the topic, recognize the societal implications, and develop issue statements to promote management or restrict the use of those technologies. The iterative writing process will promote student communication skills through regular feedback on writing and oral presentations, while the required collaboration with peers will allow students the opportunity to engage in academic discourse and peer review in these current biological topics.

Biology 2367 Learning Outcomes:
To demonstrate scientific literacy, successful students in the course will be able to:

1. Apply, analyze, and synthesize the basic facts, principles, theories and methods of modern biology.
2. Use quantitative reasoning to evaluate scientific claims and articulate a position on a currently relevant scientific topics using validated scientific information.
3. Find and evaluate sources of reliable scientific information related to primary and secondary literature in relevant biological and aligned disciplines.
4. Work in a group to formulate societal policy options addressing currently relevant scientific topics of opportunity or concern.
5. Demonstrate through critical analysis, discussion, and written work the ability to communicate a scientific idea effectively to peers from a diverse range of disciplines and interests.
6. Effectively deliver an oral presentation demonstrating ability to communicate a complex scientific concept.
7. Improve and build upon one's written work based on feedback provided by instructors and peers.
8. Identify societal impacts of biological advancements.
9. Evaluate the impact of technological developments on society and their consequences.

Grading and Evaluation:
Your mastery of the course material will be based on Issue Papers (a mixture of individual and group work), and recitation activities totaling 700 points.

Issue Papers:
The first and third module will have a set of four papers totaling 225 points per module. These papers will build upon one another, with the final version of the issue paper incorporating each of the previous papers.

Problem Statement: Written individually, this one-page paper will lay out the scientific discovery and why it poses an issue for society. (30 points)

Group Option Statement: Written as a group, students will identify four possible actions to solve issues surrounding the scientific discovery and identify the likely consequences of each in 3-4 pages. (50 points)

Issue Paper: Each student will choose one of the identified options from among those in the group and will expand upon it to a 6-7 page work. Included in this paper will be the problem statement, the option and consequences, and the counterarguments illustrating where the chosen policy is likely to receive criticism. The **first** and **final** drafts of the paper will be each be worth 60 points.

Peer Review: The quality of your peer review feedback to another student on their work will be assessed on the basis of 25 points.

The second module will feature a short writing assignment of 2-3 pages, which will ask students to research a short opinion about the modular topic. The first draft and final draft will each be worth 50 points. The quality of feedback provided in peer review will be assessed out of 25 points.

Oral Presentation: Each student will present his or her ideas on one of the three modules to the recitation section. The class will have the opportunity to question the student on the position. Grades will be assigned out of 45 points based on the quality of the presentation and the ability to effectively communicate the position and justification.

Recitation Activities: 5 written assignments to be completed during or immediately following recitation as indicated in the schedule below. These assignments are designed to direct research and writing skills with regard to the writing assignments. (15 points each = 75 points total)

Student Assessment of Learning Gains (SALG): This survey will be administered during the last week of the course. (5 points)

Final Grades: Your final grade will be based on the percentage of the 700 points that you earn during the course of the semester, as indicated below. Please note that we do not grade the course on a curve and *Carmen* does not round averages up to the next nearest percentage point, so 92.11% and 92.97% both earn the grade of A-.

Grade Scale

93-100%: A	80-82.9%: B-	67-69.9%: D+
90-92.9%: A-	77-79.9%: C+	60-66.9%: D
87-89.9%: B+	73-76.9%: C	≤59.9%: E
83-86.9%: B	70-72.9%: C-	

Posting of Grades: All grades will be posted on Carmen; you will have 10 working days to challenge any grade or inquire regarding any unposted grade; after that time, grades are final. To challenge or inquire about exam grades contact the Program Assistant. All other assignments questions should be addressed to your TA.

Late Assignment Policy: Due dates and times will be adhered to strictly. Late assignments will not be accepted.

Section Changes: All section changes and adds are done by the Course Coordinator. Due to the need to keep up-to-minute availability of seats in each recitation, the lecturer and TAs are unable to sign any permission forms.

Academic Misconduct: It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term "academic misconduct" includes all forms of student academic misconduct wherever committed, illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct http://studentlife.osu.edu/csc/. We will adhere to this policy.

- Unless otherwise specified for a particular assignment, all submitted work should be a student's own unique effort. Collaborative efforts are not permitted unless expressly sanctioned for a particular assignment.
- Using others' verbatim words without the use of quotation marks ***and*** citation is plagiarism. Paraphrased work requires citation to denote the use of others' ideas. Copying other's words without quotation while using citations is still considered plagiarism.
- Use of any technology during a quiz or exam (including but not limited to cell phones, smart watches, headphones, electronic dictionaries, etc.) is strictly prohibited.

Diversity and Inclusion: The Center for Life Sciences Education promotes a welcoming and inclusive environment for all students and staff, regardless of race, age, religion, gender, ethnicity, national origin, disability, or sexual orientation. There is no tolerance for hateful speech or actions. All violations of this policy should be reported to the OSU Bias Assessment and Response Team (BART, www.studentaffairs.osu.edu/bias).

Sexual Harassment: OSU and the CLSE consider sexual harassment to be unacceptable behavior that destroys opportunities for learning. While all members of the staff involved in this course have been trained in the OSU sexual harassment policies and procedures, this is not true for all OSU students. Please report any concerns about questionable or unwanted behavior to the lecturer or Mr. Andrews.

Accommodation of Special Needs: Students with disabilities that have been certified by the Office for Disability Services will be appropriately accommodated and should inform the course coordinator, Adam Andrews as soon as possible of their needs. Please do this within the first week of the semester. Only the course coordinator is authorized to sign ODS forms. Please fill out those parts of the proctor sheet forms that are to be completed by the student before bringing the form for signature. This will help us ensure that your individual needs will be met appropriately and fairly. The Office for Disability Services is located in 150 Pomerene Hall, 1760 Neil Avenue; telephone 292-3307, TDD 292-0901; http://www.ods.ohio-state.edu/.

Issue Resolution: The CLSE believes that student concerns are usually most effectively addressed by the staff closest to the situation. Therefore, students are ordinarily expected to address issues or concerns with their TAs first. If the issue cannot be resolved by your TA, or for some reason you feel that you absolutely cannot address your concern with your TA, please feel free to contact Adam Andrews, or Assistant Director Matt Misicka.

Tentative Lecture and Recitation Schedule (subject to change as events dictate):

Week	Date	Lecture Topic	Recitation	Assignments
1	1-9	Introduction Scientific Literacy	Group Formation and Expectations	Plagiarism Assignment
2	1-16	Scientific Writing	Exploring the Primary Literature vs. Secondary Literature	Research Assignment
3	1-23	Module 1: Genetic Engineering	Recitation Activity 1	M1 Problem Statement Due by 1/29
4	1-30		Write M1 Group Options Statement	Group Options Statement due by 2/5
5	2-6		Oral Presentations	1st Draft M1 Position Paper Due by 2/12
6	2-13		Peer Review of M1 Position Paper	
7	2-20	Module 2: Antibiotic Resistance	Recitation Activity 2	Final M1 Position Paper Due by 2/26
8	2-27		Fall Break – No recitations	
9	3-6		Oral Presentations	Short Paper Draft Due 3/12
SPRING BREAK - March 13-18				
10	3-13	Module 2	Short Paper Peer Review	Short Paper Final Due 3/19
11	3-20	Module 3: Global Climate Change	Recitation Activity 3	M1 Problem Statement Due by 3/26
12	3-27		Write M3 Group Options Statement	Group Options Statement due by 4/2
13	4-3		Oral Presentations	1st Draft M1 Position Paper Due by 4/9
14	4-10		Peer Review of M3 Position Paper	
15	4-17		Recitation Activity	Final M3 Position Paper Due by 4/23
16	4-24		No recitations	SALG Due by 4/24

Critical Thinking VALUE Rubric

for more information, please contact value@aacu.org

Association of American Colleges and Universities

The VALUE rubrics were developed by teams of faculty experts representing colleges and universities across the United States through a process that examined many existing campus rubrics and related documents for each learning outcome and incorporated additional feedback from faculty. The rubrics articulate fundamental criteria for each learning outcome, with performance descriptors demonstrating progressively more sophisticated levels of attainment. The rubrics are intended for institutional-level use in evaluating and discussing student learning, not for grading. The core expectations articulated in all 15 of the VALUE rubrics can and should be translated into the language of individual campuses, disciplines, and even courses. The utility of the VALUE rubrics is to position learning at all undergraduate levels within a basic framework of expectations such that evidence of learning can by shared nationally through a common dialog and understanding of student success.

Definition

Critical thinking is a habit of mind characterized by the comprehensive exploration of issues, ideas, artifacts, and events before accepting or formulating an opinion or conclusion.

Framing Language

This rubric is designed to be transdisciplinary, reflecting the recognition that success in all disciplines requires habits of inquiry and analysis that share common attributes. Further, research suggests that successful critical thinkers from all disciplines increasingly need to be able to apply those habits in various and changing situations encountered in all walks of life.

This rubric is designed for use with many different types of assignments and the suggestions here are not an exhaustive list of possibilities. Critical thinking can be demonstrated in assignments that require students to complete analyses of text, data, or issues. Assignments that cut across presentation mode might be especially useful in some fields. If insight into the process components of critical thinking (e.g., how information sources were evaluated regardless of whether they were included in the product) is important, assignments focused on student reflection might be especially illuminating.

Glossary

The definitions that follow were developed to clarify terms and concepts used in this rubric only.

- Ambiguity: Information that may be interpreted in more than one way.
- Assumptions: Ideas, conditions, or beliefs (often implicit or unstated) that are "taken for granted or accepted as true without proof." (quoted from http://dictionary.reference.com/browse/assumptions)
- Context: The historical, ethical. political, cultural, environmental, or circumstantial settings or conditions that influence and complicate the consideration of any issues, ideas, artifacts, and events.
- Literal meaning: Interpretation of information exactly as stated. For example, "she was green with envy" would be interpreted to mean that her skin was green.
- Metaphor: Information that is (intended to be) interpreted in a non-literal way. For example, "she was green with envy" is intended to convey an intensity of emotion, not a skin color.

Critical Thinking VALUE Rubric

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Evaluators are encouraged to assign a zero to any work sample or collection of work that does not meet benchmark (cell one) level performance.

	Capstone	**Milestones**		**Benchmark**
	4	3	2	1
Explanation of issues	Issue/problem to be considered critically is stated clearly and described comprehensively, delivering all relevant information necessary for full understanding.	Issue/problem to be considered critically is stated, described and clarified so that understanding is not seriously impeded by omissions.	Issue/problem to be considered critically is stated but description leaves some terms undefined, ambiguities unexplored, boundaries undetermined, and/or backgrounds unknown.	Issue/problem to be considered critically is stated without clarification or description.
Evidence *Selecting and using information to investigate a point of view or conclusion*	Information is taken from source(s) with enough interpretation/evaluation, to develop a comprehensive analysis or synthesis. Viewpoints of experts are questioned thoroughly.	Information is taken from source(s) with enough interpretation/evaluation to develop a coherent analysis or synthesis. Viewpoints of experts are subject to questioning.	Information is taken from source(s) with some interpretation/evaluation, but not enough to develop a coherent analysis or synthesis. Viewpoints of experts are taken as mostly fact, with little questioning.	Information is taken from source(s) without any interpretation/evaluation. Viewpoints of experts are taken as fact, without question.
Influence of context and assumptions	Thoroughly (systematically and methodically) analyzes own and others' assumptions and carefully evaluates the relevance of contexts when presenting a position.	Identifies own and others' assumptions and several relevant contexts when presenting a position.	Questions some assumptions. Identifies several relevant contexts when presenting a position. May be more aware of others' assumptions than one's own (or vice versa).	Shows an emerging awareness of present assumptions (sometimes labels assertions as assumptions). Begins to identify some contexts when presenting a position.
Student's position (perspective, thesis/hypothesis)	Specific position (perspective, thesis/hypothesis) is imaginative, taking into account the complexities of an issue. Limits of position (perspective, thesis/hypothesis) are acknowledged. Others' points of view are synthesized within position (perspective, thesis/hypothesis).	Specific position (perspective, thesis/hypothesis) takes into account the complexities of an issue. Others' points of view are acknowledged within position (perspective, thesis/hypothesis).	Specific position (perspective, thesis/hypothesis) acknowledges different sides of an issue.	Specific position (perspective, thesis/hypothesis) is stated, but is simplistic and obvious.
Conclusions and related outcomes (implications and consequences)	Conclusions and related outcomes (consequences and implications) are logical and reflect student's informed evaluation and ability to place evidence and perspectives discussed in priority order	Conclusion is logically tied to a range of information, including opposing viewpoints; related outcomes (consequences and implications) are identified clearly.	Conclusion is logically tied to information (because information is chosen to fit the desired conclusion); some related outcomes (consequences and implications) are identified clearly.	Conclusion is inconsistently tied to some of the information discussed; related outcomes (consequences and implications) are oversimplified.