



Online Ethics Center  
FOR ENGINEERING AND SCIENCE

# **Syllabus: Biology 611, Ethics of Emerging Technologies in the Life Sciences**

## **Author(s)**

Valerie Racine

## **Description**

Bio 611: Ethics of Emerging Technologies in the Life Sciences is a syllabus for a one credit graduate course. Taught at Arizona State University, Bio 611 attracts a mix of natural science and humanities graduate students and does not assume students will have substantial experience in ethics. Beyond exploration of the topic of ethics and emerging biotechnology, the course aims to develop the ability of students to analyze ethical issues through the incorporation of case discussion and case writing.

## **Body**

**Biology 611**

**Ethics of Emerging  
Technologies in the Life  
Sciences**

Semester  
Session, Dates  
Day, Time  
1 credit

Instructor  
E-Mail  
Phone  
Office  
Office Hours

Developed by Valerie  
Racine and Karin Ellison,  
Arizona State University,  
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## **Course Overview**

The phrase “emerging technologies” includes many different categories of technological innovation, such as biomedical and therapeutic technologies, reproductive technologies, human enhancement technologies, agricultural technologies, environmental and ecological technologies, and technologies in synthetic biology and artificial life. Emerging biotechnologies span across several fields or disciplines in the life sciences, including the study of biodiversity and conservation biology, developmental biology, genomics and genetics, neuroscience, and the study of biofuels and energy system transitions. The ethical analysis of emerging biotechnologies requires an inquiry into past, present, and possible future technological devices, their applications, and their ethical, social, economic, legal, political, and ecological implications. It also requires recognition of the fact that social and cultural values influence the research, development, and adoption of certain technologies over others as much as technological innovations drive social and cultural change.

# Learning Outcomes

In this course, students will learn how to identify the potential benefits and risks of particular emerging biotechnologies, as well as analyze crosscutting themes in the ethics of emerging technologies. These themes include: 1) the problem of uncertainty (assessing and managing risks), 2) issues in biosafety and biosecurity, 3) issues in the governance of science in democracies, and 4) competing views of justice and human flourishing. Students will be encouraged to incorporate different levels of analyses, critical perspectives, ethical principles, and competing values into a rigorous ethical analysis of an emerging biotechnology.

## Requirements

The assignments are readings, short response papers, and a case or book review. Natural science and engineering graduate students typically prepare a case, while graduate students in the humanities or social sciences typically prepare a book review. In week one or two of class, we will decide which formal writing assignment you will complete.

## Readings

The Course Schedule gives the reading assignments. Students must complete readings before each class so that discussion can draw on knowledge of the readings. The reading materials will be posted on BlackBoard, or come from Ronald L. Sandler's *Ethics and Emerging Technologies*, Palgrave Macmillan, 2014. A copy will be made available on reserve at the university library. It is also available from online booksellers.

## Response Papers

Each session students will write brief (1-2 pgs.) response papers on the assigned readings. These informal essays should state the argument of each piece assigned and raise two issues for discussion. At least one point should be positive—discuss

some fashion in which a reading for the week might serve as a model for scholarship. The response papers are due at each class session on paper.

## Cases

Each student is required to write a one-page narrative, which can be a summary of an actual event or a hypothetical case, and four pages of analysis. The analysis will follow a format that we will discuss during week one.

Drafts are due via BlackBoard AND in hard copy in class. Students will present their cases for class discussion. During the discussion, we will workshop the draft case. Final cases and case analyses, incorporating comments from class discussion, are due via BlackBoard one week after the last class meeting.

## Book Review

Students preparing reviews will write a four to five page book or article review of humanistic or social science scholarship on the unit topic. The idea is for students to explore the literature beyond that assigned for class. The review should be modeled on those in *Science and Engineering Ethics*, *American Journal of Bioethics*, *Technology and Culture*, *ISIS*, or another ethics or history journal. The work(s) you wish to review must be approved. If you don't know how to locate this kind of scholarship, I can give you tips. Students will also submit draft reviews for comments.

## Evaluation

|    | <b>Percentage</b> |
|----|-------------------|
| A+ | 98-100%           |

|     |        |
|-----|--------|
| A   | 93-97% |
| A-  | 90-92% |
| B+  | 87-89% |
| B   | 83-87% |
| B-  | 80-82% |
| C+  | 77-79% |
| C   | 70-76% |
| D   | 60-69% |
| E/F | 0-59%  |

Grades will generally be calculated as follows:

- Attendance, demonstrated knowledge of assigned readings, and thoughtful contributions to discussion: 20%
- 6 response papers: 30%
- Draft case or book review: 20%
- Final case or book review: 30%

I reserve the right to assign any student a final grade that is higher than merited by strict calculation based on academic criteria, such as improvement in grades over the semester or atypical and explainable

poor performance on a single assignment.

I only accept late assignments in rare circumstances. These include professional conflicts, traveling with a sports team, major and documented illnesses, personal or family crises, etc. Should any of these arise, you are responsible for discussing the circumstances with me ASAP, before the deadline is missed if possible.

Likewise, incompletes will only be given in extraordinary circumstances. To receive an incomplete, you would work with me to prepare a written agreement specifying how and when all work for the course would be completed. This agreement would have to be signed before I submit grades at the end of term.

## **Student Conduct and Academic Integrity**

Academic honesty is expected of all students in all examinations, papers, laboratory work, academic transactions, and records. The possible penalties include, but are not limited to, appropriate grade penalties, course failure indicated on the transcript as a grade of E, course failure due to academic dishonesty indicated on the transcript as a grade of XE, loss of registration privileges, disqualification, and dismissal. For more information, see <http://provost.asu.edu/academicintegrity>. Additionally, required behavior standards are listed in the Student Code of Conduct and Student Disciplinary Procedures, Computer, Internet, and Electronic Communications policy, and outlined by the Office of Student Rights and Responsibilities. Anyone in violation of these policies is subject to sanctions.

It would be especially pathetic to fail an ethics course for cheating!

Students are entitled to receive instruction free from interference by other members of the class. An instructor may withdraw a student from the course when the student's behavior disrupts the educational process per Instructor Withdrawal of a Student for Disruptive Classroom Behavior.

Appropriate online behavior, also known as netiquette, is expected. This includes keeping course discussion posts focused on the assigned topics. Students must

maintain a cordial atmosphere and use tact in expressing differences of opinion. The instructor may delete inappropriate discussion board posts.

The Office of Student Rights and Responsibilities accepts incident reports from students, faculty, staff, or other persons who believe that a student or a student organization may have violated the Student Code of Conduct.

## **Accessibility Statement**

In compliance with the Rehabilitation Act of 1973, Section 504, and the Americans with Disabilities Act as amended (ADAAA) of 2008, professional disability specialists and support staff at the Disability Resource Center (DRC) facilitate a comprehensive range of academic support services and accommodations for qualified students with disabilities.

Qualified students with disabilities may be eligible to receive academic support services and accommodations. Eligibility is based on qualifying disability documentation and assessment of individual need. Students who believe they have a current and essential need for disability accommodations are responsible for requesting accommodations and providing qualifying documentation to the DRC. Every effort is made to provide reasonable accommodations for qualified students with disabilities.

Qualified students who wish to request an accommodation for a disability should contact the DRC by going to <https://eoss.asu.edu/drc>, calling (480) 965-1234 or emailing [DRC@asu.edu](mailto:DRC@asu.edu).

## **Course Schedule**

### **Class 1: Introduction**

#### **Assigned Readings**

Sandler, R.L. "Introduction: Technology and Ethics," in R.L. Sandler (ed.). *Ethics and Emerging Technologies*. Palgrave Macmillan, 2014, 1-23.

Heitman E. "Using cases in the study of ethics," in R.E. Bulger, E. Heitman, and S.J. Reiser (eds.). *The Ethical Dimensions of the Biological and Health Sciences*. New York: Cambridge University Press, 2002, 349-363.

## **Class 2: Synthetic Biology**

### **Assigned Readings**

Gutmann, Amy. "The ethics of synthetic biology: guiding principles for emerging technologies." *Hastings Center Report* 41, no. 4 (2011): 17-22.

Wade, Nicholas. "Researchers say they created a 'synthetic cell'." *The New York Times* 20 (2010): 1-3.

Gibson, Daniel G., John I. Glass, Carole Lartigue, Vladimir N. Noskov, Ray-Yuan Chuang, Mikkel A. Algire, Gwynedd A. Benders et al. "Creation of a bacterial cell controlled by a chemically synthesized genome." *Science* 329, no. 5987 (2010): 52-56.

## **Class 3: Governance, Regulatory Guidance, and DIY Biology**

### **Case Study**

DIY Biology and the Case of the Glowing Plants

### **Assigned Readings**

Landrain, Thomas, Morgan Meyer, Ariel Martin Perez, and Remi Sussan. "Do-it-yourself biology: challenges and promises for an open science and technology movement." *Systems and Synthetic Biology* 7, no. 3 (2013): 115-126.

Ledford, Heidi. "Garage biotech: Life hackers." *Nature News* 467, no. 7316 (2010): 650-652.

Wolinsky, Howard. "Kitchen biology." *EMBO Reports* 10, no. 7 (2009): 683-685.



## Recommended Reading

The International Genetically Engineered Machine (iGEM) Competition. "Synthetic Biology: based on standard parts." igem.org. [http://igem.org/Main\\_Page](http://igem.org/Main_Page) (accessed April 22, 2016).

# Class 4: Intervening in "Nature" and Genome Editing

## Case Study

Genome Editing & the Ethics of CRISPR-Cas9

## Assigned Readings

Ledford, Heidi. "CRISPR, the disruptor." *Nature* 522, no. 7554 (2015): 20-24.

Lanphier, Edward, Fyodor Urnov, Sarah Ehlen Haecker, Michael Werner, and Joanna Smolenski. "Don't edit the human germ line." *Nature* 519, no. 7544 (2015): 410.

Jasanoff, Sheila, J. Benjamin Hurlbut, and Krishanu Saha. "CRISPR Democracy: Gene Editing and the Need for Inclusive Deliberation." *Issues in Science and Technology* 32, no. 1 (2015): 37.

## Recommended Readings

Cressey, David, and David Cyranoski. "Human-embryo editing poses challenges for journals." *Nature* (2015).

Baltimore, B. D., Paul Berg, Michael Botchan, Dana Carroll, R. Alta Charo, George Church, Jacob E. Corn, et al. "A prudent path forward for genomic engineering and germline gene modification." *Science* 348, no. 6230 (2015): 36-38.

Caplan, Arthur L., Brendan Parent, Michael Shen, and Carolyn Plunkett. "No time to waste—the ethical challenges created by CRISPR." *EMBO reports* 16, no. 11 (2015): 1421-1426.

# Class 5: Justice and Deep-Brain Stimulation

## Case Study

Deep Brain Stimulation Studies

## Assigned Readings

Schermer, Maartje. "Ethical Issues in Deep Brain Stimulation." *Frontiers in Integrative Neuroscience* 5 (2011): 1-5.

Tracey, Irene, and Rod Flower. "The warrior in the machine: neuroscience goes to war." *Nature Reviews: Neuroscience* 15 (2014): 825-834.

## Recommended Reading:

Unterrainer, Marcus, and Fuat S. Oduncu. "The ethics of deep brain stimulation (DBS)." *Medicine, Health Care and Philosophy* 18 (2015): 1-11.

# Class 6: Newborn Screening

## Assigned Readings

Paul, Diane B. and Jeffrey P. Brosco. "Epilogue. "the Government has Your Baby's DNA": Contesting the Storage and Secondary use of Residual Dried Blood Spots." In *The PKU Paradox: A Short History of a Genetic Disease*, 204-212. Baltimore: Johns Hopkins University Press, 2013.

Couzin-Frankel, Jennifer. 2009. Science gold mine, ethical minefield. *Science* 324 (5924): 166-8.

Sharp, Richard R., and Aaron J. Goldenberg. 2012. The ethical hazards and programmatic challenges of genomic newborn screening. *Jama* 307 (5): 461-2.

Couzin-Frankel, J. "Biomedicine. Newborn Screening Collides with Privacy Fears." *Science* 348, no. 6236 (May 15, 2015): 740-741.

# Class 7: Sustainability and Biofuels

## Case Study

Next-Generation Biofuels

## Assigned Readings

Buyx, Alena M., and Joyce Tait. "Biofuels: ethics and policy-making." *Biofuels, Bioproducts and Biorefining* 5,

Thompson, Paul B. "The agricultural ethics of biofuels: climate ethics and mitigation arguments." *Poiesis & Praxis* 8, no. 4 (2012): 169-189.

## Recommended Readings

Mortimer, Nigel. "Ethics for biofuels... and everything else." *Significance* 8, no. 3 (2011): 108-111.

Final, revised case or book review due

## Contributor(s)

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## Rights

Use of Materials on the OEC

## Resource Type

Instructor Materials

## Parent Collection

Ethics of Emerging Technologies in the Life Sciences

## Topics

Emerging Technologies

## Discipline(s)

