



Online Ethics Center
FOR ENGINEERING AND SCIENCE

Readings

Description

Part of unit 2 of the [Course on Genomics, Ethics, and Society](#), this section provides a number of readings on the ethics of genomics, synthetic biology, and microorganisms.

Body

Week 1: Readings on Synthetic Biology

Everyone should read **both** readings this week!

The first reading for this week discusses the social and ethical issues that would be raised by the creation of artificial cells (These don't yet exist.) The paper usefully characterises what artificial cells are and whether we should create them. The authors argue that intrinsic objections to the technology (such as that it's "unnatural") don't stand up to critical scrutiny. On the other hand, we don't have a realistic idea of what the consequences of creating artificial cells would be. So this leaves us with a decision about how to manage risks. The authors conclude that we need to be courageous about risk taking when the potential benefits are substantial.

Bedau, M. A., & Triant, M. (2014). Social and ethical implications of creating artificial cells. In R. L. Sandler (Ed.), *Ethics and emerging technologies*(pp. 562-574). New York: Palgrave Macmillan.

Questions for Reflection: Do the authors correctly identify all the intrinsic concerns there may be about the creation of synthetic cells? Are they right, in your view, to

reject these concerns? What's your view about their 'courageous' approach to 'decisions in the dark'? Are the decisions taken in quite as much dark as the authors suggest? Do you think their approach has the right amount of caution in relation to courage?

The second reading for this week comes from Amy Gutmann, the chair of the Presidential Commission for the Study of Bioethical Issues, which issued a report on synthetic biology in 2010. This report, for the Hastings Center, summarizes the work of the Commission and outlines some basic principles for the ethical analysis of emerging technologies, including synthetic biology.

Gutmann, A. (2011). The ethics of synthetic biology: Guiding principles for emerging technologies. *Hastings Center Report*, 41, 17-22.

Questions for Reflection: Clearly, those who constructed this report did not consider that intrinsic objections to undertaking synthetic biology should be taken seriously. Do you agree about this? Five principles are proposed. Do you think all five principles are necessary? Do you think they are sufficient? (For instance, there's no discussion of human rights here.) Do you think that "prudent vigilance" is sufficiently precautionary?

Week 2: Focus on Biofuels

Everyone should read Buyx and Tait and Tilman et al. **Graduate students only** are required to read the Nuffield Council on Bioethics chapter (of course, undergraduates are very welcome to read it!)

The Buyx and Tait and the Nuffield Council readings are related to one another. Buyx and Tait provide an overview of the ethical issues raised by biofuels in general, published in *Science* in 2011, and drawing directly on the Nuffield Council report chapter that follows. The Nuffield Council chapter is much more detailed and complex, and extends the arguments further.

Both texts concern the production of biofuels in general, not just by synthetic biology but also by conventional or genetically modified crops (which already have a segment of the fuel market). Biofuels in general have been promoted as a way to

reduce CO2 output from burning fossil fuels. However, crop-based biofuels raise many ethical issues, as these readings points out, with respect to food security, the environment, and human rights - and in some cases there's a question as to whether they really do contribute to reductions in CO2 emissions. These readings provide a context for thinking about synthetic biofuels in the broader field of biofuel production. The ethical issues raised here are also of broad importance in terms of the rest of the course - food security emerges in units 3 and 4; the environment in 5; and human rights and precaution throughout the course.

Buyx, A., & Tait, J. (2011). Ethical framework for biofuels. *Science*, 332, 540-541.

Nuffield Council on Bioethics (2011). Chapter 4 "Ethical framework" In *Biofuels: ethical issues*. UK. p.64-77 (Chapter 5 is interesting too).

This Nuffield Council report can be viewed/downloaded at

http://nuffieldbioethics.org/wp-content/uploads/2014/07/Biofuels_ethical_issues_FULL-REPORT_0.pdf

Questions for reflection: Do you think biofuels from conventional or genetically engineered crops, or from synthesized micro-organisms, provide good options for sustainable fuel supplies? Are they to be preferred to nuclear, solar or wind power, or should we be developing all of these possible resources? Do you think, given the situation with respect to climate change, there's an ethical duty to develop biofuels?

The second reading here develops these general arguments about the context in which biofuels must operate, if they are to be useful: they must provide energy, they must not conflict with food production, and they must not cause environmental harm or the loss of wild ecosystems.

Tilman, D., et al. (2009). Beneficial biofuels—the food, energy, and environment trilemma. *Science*, 325, 270-271.

Questions for reflection: Synthetic biofuels -produced in laboratories or factories - look, in principle, as though they may meet this requirement: they don't obviously require land-clearing operations, and they don't obviously compete with the the food supply. But is this analysis too simple? How much of a contribution do you think that synthesized biofuels would make to sustainable energy production? Are there ways in which they present environmental problems that conventional or GM biofuels do

not?

Recommended Supplementary Readings

Arnold, F. H. (2008). The race for new biofuels. *Engineering & Science*, 2, 12-19.

Gibson, D. G., et al. (2010). Creation of a bacterial cell controlled by a chemically synthesized genome. *Science*, 329, 52-56.

Nuffield Council on Bioethics (2011). Biofuels: ethical issues. UK.

Presidential Commission for the Study of Bioethical Issues (2010). New directions: The ethics of synthetic biology and emerging technologies. Washington, D.C.

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Synthetic Biology

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