

# Biological engineering

with Professor  
Jeffrey Catchmark

## Talking points

### Knowledge

1. What is a polysaccharide?
2. What are some of the benefits and disadvantages of plastics?

### Comprehension

3. Why did Jeffrey and his team focus on using cellulose and starch as their raw materials?
4. How did the team overcome challenges they faced?

### Application

5. The life cycle of any product tends to entail a cost to the environment, even if it is plant-based. How do you think the team might quantify this cost?
6. What criteria do you think makes a product 'sustainable' or not?

### Analysis

7. What do you think are existing commercial functions of cellulose and starch, given they are both produced in significant quantities?
8. "Change is difficult" in large commercial companies. Why do you think this is so?

### Synthesis

9. Imagine you are planning a short presentation that aims to convince a food packaging company to collaborate with Jeffrey's team. What can the team offer them, and what would the team want in return?

### Evaluation

10. Environmental groups commonly criticise commercial companies of 'greenwashing', which is when a company tries to convince consumers that they are more sustainable than they actually are. For instance, they may make a small part of their operations more sustainable and promote this change in a way that makes it seem like all their operations are more sustainable. What role do you think research teams like Jeffrey's can play in preventing this phenomenon, while maintaining good relationships with companies?

## Activity

Jeffrey emphasises the importance of ethical thinking within biological engineering. The field is pushing the frontiers of what is possible, raising new ethical quandaries, while also simultaneously needing to address the ethical questions that have affected science for centuries.

These questions include:

- Could new discoveries have unintended consequences?
- To what extent should animal testing be allowed in science?
- New discoveries are often patented as intellectual property, and the processes cannot be replicated by others. Does this limit who can benefit from them or incentivise researchers to discover new things?
- What sort of effects could a new discovery have on society?

Think about your own values and ethical compass. What are your initial opinions on the above questions?

Do some research to find out more of the ethical arguments surrounding each of these questions. You will discover that most of them are highly nuanced; while there are simple answers for some extremes (e.g., most people agree that cosmetics should not be tested on animals), the answer often tends to be 'it depends'.

Choose one of the following scenarios about a potential line of research. Think about how each of the questions above applies to the scenario and write a nuanced response. Include both your own opinion and the predicted opinions of other people in society. Reach a conclusion over whether you think the research should or should not be pursued, and if so, to what extent.

- Brain-powered machines — wiring machines directly to a person's nervous system to give them control over the machine's function. For instance, robotic limbs can be created for amputees. Other applications could include keyhole surgery, construction, or warfare.
- Using gene editing technology on human embryos before birth. This could be used to remove genetic conditions, provide immunity to certain diseases, or modify other gene-influenced traits such as appearance or physical ability.
- Genetically engineering a crop or farm animal to make it more productive. This could include making it resistant to pests or disease, making it create nutrients that benefit human health when consumed, or accelerating growth.
- Nanorobots that can enter the human bloodstream to treat disease, such as killing cancer cells, or delivering pharmaceutical products to a specific organ.

## More resources

- The Institute of Biological Engineering provides a useful introduction to the field: [www.ibe.org/resources/what-is-biological-engineering](http://www.ibe.org/resources/what-is-biological-engineering)
- This article from Forbes investigates the feasibility of cellulose film as an alternative to plastic food packaging: [www.forbes.com/sites/jamiehailstone/2023/03/29/can-cellulose-film-](http://www.forbes.com/sites/jamiehailstone/2023/03/29/can-cellulose-film-)

[make-food-packaging-sustainable-again/?sh=5fcd63153d50](https://www.youtube.com/watch?v=O6IENrRANxY)

- This video from CrashCourse provides a helpful introduction to biological, biomedical and industrial engineering:

[www.youtube.com/watch?v=O6IENrRANxY](https://www.youtube.com/watch?v=O6IENrRANxY)