Genetically Modified Organisms (GMO) Debate: The Rainbow Papaya

SDG focus

☒ Goal 2 - Zero hunger
☒ Goal 12 - Responsible consumption and production

What did you do?

First, students were introduced to how microorganisms are widely genetically modified (GM) themselves for the benefit of society (e.g. to produce insulin or industrial enzymes) or harnessed to develop GM crops. Then, students were surveyed about their general feelings about GMOs and what they value most in terms of sustainability. Finally, students were randomly assigned roles (e.g. scientist, environmental activist, organic farmer, papaya farmer, FDA regulator, etc.) in a structured debate about the genetically modified Rainbow papaya, which was introduced to Hawaii to save the crop from Papaya Ringspot Virus in the 1990's. Through the debate, they were introduced to the potential benefits and disadvantages of GM crops for sustainable agriculture, including climate- or pest-resilient strains, reduced pesticide use, general issues with corporate control over seeds, improved farming efficiency, control of GM strains, and potential impacts on local biodiversity.

What were the benefits and outcomes?

1. Prior to the debate, most students had a slightly negative view of GMOs from the media, and, in terms of sustainability, they valued increasing local food security and reducing chemical use. After the activity, many students commented that they no longer viewed the technology as inherently bad and realize many of the issues used to demonize GMOs (e.g. monoculture, chemical use, and seed patenting) are, in fact, ubiquitous problems in agriculture. Ultimately, they recognized that the pathways to sustainability are diverse, and GM crops are one option for addressing specific goals.
2. Though the debate uses a Hawaiian case study, there was a significant focus on how GM crop use can potentially reduce global demand for agricultural land (e.g. strains with higher yield), reduce local nutritional deficits (e.g. Golden rice), reduce waste by increasing efficiency or reducing impacts of pests (e.g. Rainbow papaya), increase climate resilience (e.g. drought-tolerant strains), reduce chemical use (e.g. Bt strains), etc.
3. Issues that *are* unique to GMOs (e.g. spread of GM varieties to other areas, increased glyphosate use, etc.) were teased out and discussed. After the activity, there was a general understanding that GM crops may not always be the best approach for sustainable agriculture, particularly when considering cultural farming practices or potential environmental impacts.

What barriers or challenges did you encounter in embedding sustainability into your learning and teaching practice and how did you overcome them?

1. The class only has two lecture hours a week, so this was difficult to integrate into lecture time.

- To compensate, students prepared for their roles outside of class and without formal assistance from the Instructor, which meant some were more prepared than others. However, the bigger personalities in the class compensated and this was a really fun activity—all students became really engaged in the discussion. Some students even dressed up or made props!
- The wrap-up was also shorter than I would have liked. The students really wanted to discuss how their feelings had shifted (or not shifted) based on each of the discussion points.

2. Due to time constraints, the debate replaced some lecture content about the general role of microorganisms in industry and agriculture. Although GMO technology itself stems from microbes, agricultural sustainability felt a *little* outside the scope of a typical microbiology course. Nevertheless, it's a "hot topic" and I think the students benefitted from the debate.

3. Not everyone would agree that there are both benefits and disadvantages to employing GMOs in sustainable agriculture and there is enormous potential for biases surfacing from the Instructor or students when doing an activity like this. Thus, it was critical to have very thorough, pre-prepared character bios for the students, which clearly outlined their viewpoints, example questions they might ask, and questions they might get asked. In practice, the debate was very balanced and required little direction from the Instructor.

What are your conclusions and recommendations for others?

Overall, the debate worked well to introduce a complicated and contentious topic, and students stated that they had a better understanding of how sustainable agriculture might have different meanings to different stakeholders and how GM crops might help or hinder specific sustainability goals.

In this instance, the debate was performed by a close cohort of students that were open to acting their part and being outspoken with their colleagues. However, I think this activity may be more challenging in group of students that don't know each other or are generally more reserved. I would recommend adjusting this type of activity to suit the class dynamics.