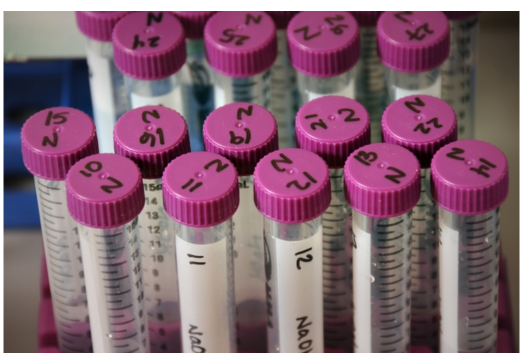
Best Practices for Communicating Genetic Engineering & Biotechnology in Food

NC STATE EXTENSION

Key Terms

- **Biotechnology —** "refers to the field of science where genetic material, living organisms, cells, and biological systems can be studied or used to create products and technologies" (Grieger et al., para. 1)
- **Genetically modified —** an organism that contains DNA that has been artificially changed in order to have a desired characteristic (Merriam-Webster, n.d.-b)
- **Genetically engineered —** refers to biotechnologies used to cut up and join together genetic material (DNA) in an organism in order to change one or more of its characteristics (Merriam Webster, n.d.-a)
- **CRISPR-Cas —** Clustered regularly interspaced short palindromic repeats (also known as CRISPR); works with the Cas protein "cut out" sections of an organism's DNA to make targeted adjustments to characteristics of the organism (Chen et al., 2019)



Overview

Genetic engineering in agriculture and its resulting genetically engineered products or genetically modified organisms (GMOs) have been hot topic issues in the U.S. food system since the mid-1990s. Genetic engineering is the use of biotechnology tools to change an organism's genetic makeup by introducing, removing, or modifying specific genes and this process can introduce new desired plant traits or enhance existing ones (Grieger et. al., 2024). Through genetic engineering, genetic materials from other living things like bacteria have been used to make some crop varieties pest-resistant, disease, herbicide, and drought-tolerant, more nutritious, among others. This technique of improving crops is different from selective breeding which is the more common method of crop improvement. In selective breeding, two plants are crossbred to create superior offspring while genetic engineering, on the other hand, allows scientists to directly modify a plant's genes to introduce the desired traits (NASEM, n.d.)

Although research by several U.S. and international scientific institutions like the U.S. Food and Drug Administration, European Food Safety Authority, World Health Organization, and Food and Agricultural Organization says currently available genetically engineered foods are as safe to consume as their non-genetically engineered counterparts (Grieger et. al., 2024; Evanega et. al., 2022), the public remains skeptical. A landmark report by the National Academy of Science, Engineering and Medicine which compared health trends in North America, where GMOs are popular and Europe where such foods are rare, found no differences in patterns of diseases like diabetes, cancer, kidney failure, gastrointestinal problems, obesity, celiac disease, autism, or food allergies (NASEM, 2023). Laboratory research on the components of genetically engineered crops and their effects on laboratory and farm animals also demonstrated that consuming these crops does not impact the health of these animals worse than conventional seeds (NASEM, 2023). A Pew Research Center study revealed that 88% of American Academy of Arts and Sciences (AAAS) scientists regard GMOs as generally safe as their conventional counterparts (Pew Research Center, 2015). But that same study showed only 37% of the public considers GMOs as safe. Besides safety issues, some consumers point to risks to environmental sustainability, biodiversity, and food sovereignty, among others, as reasons to avoid GMOs (Raman, 2017).

Gene editing is an emerging genetic engineering method of crop enhancement used to edit an organism’s genetic material and does not always involve using another organism’s DNA or genetic material (Chen et. al., 2019; Grieger et. al., 2024). The most popular gene editing method involves the use of the CRISPR system which “acts like a pair of ‘molecular scissors’ to cut an organism’s DNA in a precise location and either insert a new sequence of DNA, delete a piece of DNA, or substitute one piece of DNA for another piece” (Grieger et. al., 2024). Some scholars have expressed hope gene editing would likely receive a more favorable public reception than GMOs because a lot of agricultural products currently being developed using gene editing do not involve introducing DNA from other living organisms (Evanega et. al., 2022; Zhu et. al., 2020). So, how can extension agents effectively engage farmers and consumers on such a contentious science? Below are some suggestions.

Participatory and Dialogue-Based Communication

In recent years, science communication practice has moved toward a more participatory approach to engaging people in scientific conversations. Science communication traditionally relied on a deficit model of communication, where scientists were the “knowledge holders” and used linear modes of communication, without opportunities for two-way communication, to deliver information through fact-based communication styles (Pouliot, 2009). This approach has been found to have limited efficacy compared to dialogue-based or participatory engagement models of science communication. Thus, there has been a turn in science communication practice to move away from the idea that scientists should fill an information gap in the public, but rather actively strive toward seeking the perceptions and concerns of the public and inputting those feedback-based findings into the research and development process (Metcalfe et al., 2022). One emerging model, relevant for communicating about genetic engineering technologies, is the Responsible Research and Innovation (RRI) framework.

The RRI framework aims to facilitate dialogue and debate around emerging technologies, especially those embedded in public controversy, to address not only stakeholders' perceptions of risk but also concerns related to the purposes and motivations of the research itself (Stilgoe et. al., 2017). RRI has the potential to facilitate communication and engagement around emerging biotechnologies like CRISPR (Kuzma & Cummings, 2021; Middleton et. al., 2024). Many biotechnology developers are concerned with consumer perceptions of gene editing and its impact on the future of the technology (including public backlash and regulatory barriers) due to controversies surrounding public perceptions of genetic modification (Kuzma & Cummings, 2021).

The RRI framework consists of four phases (Framework for Responsible Research and Innovation, 2023): anticipate, reflect, engage, and act.

- **Anticipate** refers to describing and analyzing both intended and unintended impacts that might emerge from the research and development process for the technology.
- **Reflect** involves understanding the purposes and motivations underlying the technology development research, highlighting potential areas of ignorance, driving assumptions, and potential social dilemmas and transformations.
- **Engage** fosters a process of dialogue, deliberation, and debate with stakeholders about the potential visions and impacts of the technology across social, environmental, and economic systems.
- **Act** involves using the above stages to influence the direction of the research and innovation process itself.

Using the RRI framework, developers and academics working in the genetic engineering space see potential for greater dialogue and inclusion of public input to address issues of consumer acceptance and technology prior to product commercialization. However, few agricultural science communication strategies effectively incorporate RRI principles, continuing to rely on linear communication models that have limited efficacy in moving the needle of public opinion. Increasingly, science communication literature points to the need for active engagement with a variety of stakeholders to enhance communication efforts through dialogue-based and participatory models of communication (Metcalfe, 2019, 2022). Thus, finding entry points for participatory communication is critical for extension to position itself as a leading communicator in this space.

Extension agents can create avenues for technology developers to anticipate, reflect, engage, and act in ways that ensure farmers and consumers have enough information on genetic engineering technologies to make informed decisions.

Additional Best Science Communication Practices

Outside of the RRI Framework, there are other practical steps extension agents can take to ensure effective and responsible communication about genetic engineering. Extensionists would sometimes set up outreach engagements, meetings, presentations, and talks with farmers about genetic engineering. At times, farmer and consumer groups invite extension agents to give such talks. What should an extension agent do before, during, and after the talk? Here are some ideas:

First, communication about biotechnology can be more effective if the message is tailored to the audience's perspective and highlights what they value most (Mitsopoulos, 2012). Communication should not always be from the perspective of the extensionist or science communicator. It would be helpful to send out pre-engagement surveys to hear from potential audiences about what they believe and know about biotechnology and focus more on that during communication sessions. If a survey is not possible, briefly checking updated research through Google Scholar or other mechanisms can help you see what recent information has been published on the topic. This can help inform your message strategy. You can also reach out to NC State Extension's Food Systems Communication specialist for guidance. Also, you can reach out to some of the farmers who have confirmed their attendance and have informal conversations with them to get a broad sense of farmers' perspectives and expectations for the talk. Never walk into a talk without first understanding your audience.

Additionally, when communicating about biotechnology, don't just be a speaker. Engage in meaningful conversations. Bear in mind that as a communicator, providing more information often does little to change consumers' perceptions, and overwhelming people with data can sometimes strengthen existing beliefs, even if those beliefs lack scientific support (AgBioResearch, 2018). The communication shouldn't be a unidirectional flow of information from the extensionist to the farmer or consumers but rather bidirectional or multidirectional, where diverse publics should be able to communicate their perceptions, concerns, etc. When audience members speak, communicators should listen and engage. Key listening techniques for communicators addressing biotechnology include **paraphrasing**—repeating back a person's position to confirm understanding; **reframing**—addressing the issue from a different perspective to promote consensus or clarity; and **summarizing**—briefly capturing a person's viewpoint to demonstrate active listening (AgBioResearch, 2018). Also, use narrative communication tools, like storytelling, analogies, metaphors, and visuals to increase comprehension, engagement, and better recall of content over time (ISAAA, 2023; Yang and Hobbs, 2020). Use human elements in your presentations and share real-life experiences and personal anecdotes when communicating about biotechnology to make the topic more relatable and engaging for your audience.

If possible, use a values-based messaging approach when communicating about biotechnology to ensure effectiveness. Values-based communication is a strategic approach to sharing scientific information that acknowledges the shared values, attitudes, outlooks, goals, and worldviews of the audience (Alliance for Science, 2023). In this approach, the communicator identifies shared values and interests to create a foundation for constructive communication and collaboration. People may disagree on whether it is a good idea to grow genetically engineered corn varieties or their conventional counterparts. However, hardly will people disagree on values-driven objectives like sustainability, resilience, food and nutrition security, local empowerment, environmental protection, humane treatment of animals, and reducing food waste, among others. As an extensionist who wishes to communicate about genetic engineering, start the conversation from these broad values-driven standpoints, and gradually bring in specific issues relating to the techniques.

Also, as mentioned earlier, consumers have concerns about the safety of genetic engineering technology, even if there is no scientific basis for that. They also have concerns about whether they can trust the technology developers, whether regulatory authorities are doing their jobs well, possible impact of the technology on the environment, among others. Extensionists communicating about the technology should not ignore such concerns when they come up (Ruth & Rumble, 2019). Show empathy, acknowledge these concerns, and attempt to address them if you can. The way to acknowledge a concern is to make the one raising them feel heard and make them aware you appreciate their concerns. Communicators must understand the nature of the genetic engineering controversy and recognize the underlying issues and differing viewpoints (ISAAA, 2013), even if they can’t address them all. A good communicator should acknowledge concerns and subjective opinions about such contentious technologies and discuss them openly with the audience. While doing this, the communicator must examine their own biases on the subject and ensure that is not overly clouding their judgment on the issues in discussion. But don’t be afraid to respectfully push back on false narratives when some audience members bring them up. Make it clear in a respectful manner that to the best of your knowledge, that information is false. This is important to stop the spread of misinformation and disinformation.

Finally, all the basic principles we use in everyday communication could be used when communicating genetic engineering. Avoid using technical jargon. Break down complex issues into simple and shorter parts. Communication, whether verbal, visual, or written, should be structured in a way that’s easy to understand and easy to digest (Sleboda and Lagerkvist, 2022; Stanton et. al., 2021). Analyze previous communication efforts to identify what worked well and what didn’t and apply these to improve future interactions. Regularly seek feedback and self-reflect to enhance your ability to convey information clearly and fairly. Show authenticity, respect, politeness, and honesty in your delivery. Prepare ahead but admit it when a question comes up and you don’t have an answer. Point the questioner in the right direction or commit to providing the answer at a later time and make sure you deliver on the commitment. Also, build relationships and not only seek to convey information. After the speaking engagement, send thank you notes and avail yourself as a resource the audience can count on if they need more information. The best communication happens when relationships have been built and your audience trusts you.

References

AgBioResearch – Michigan State University (Aug. 15, 2018). *Walking the GMO tightrope: Communicating effectively on a divisive subject*. ↲

Alliance for Science (2023). *AfS Gene Editing toolkit*. Boyce Thompson Institute, Cornell University. ↲

Chen, K., Wang, Y., Zhang, R., Zhang, H., & Gao, C. (2019). CRISPR/Cas genome editing and precision plant breeding in agriculture. *Annual Review of Plant Biology, 70*, 667-697. ↲

Evanega, S., Conrow, J., Adams, J., & Lynas, M. (2022). The state of the 'GMO' debate - toward an increasingly favorable and less polarized media conversation on ag-biotech? *GM Crops & Food, 13*(1), 38–49. ↲

Framework for responsible research and innovation. (2023, March 16). UK Research and Innovation. ↲

Grieger, K., Loschin, N., Barnhill, K., & Gould, F. (2024). *Let's talk about genetic engineering: A guide to understanding genetic engineering and its applications in food, agriculture, and the environment*. NC State Extension Publication. ↲

ISAAA - International Service for the Acquisition of Agri-biotech Applications (March 15, 2023). *10 tips to effectively communicate biotech for scientists*. ↲

Kuzma, J., & Cummings, C. L. (2021). Cultural beliefs and stakeholder affiliation influence attitudes towards responsible research and innovation among United States stakeholders involved in biotechnology and gene editing. *Frontiers in Political Science, 3*. ↲

Metcalfe, J. (2019). *Rethinking science communication models in practice* [Doctoral dissertation, Australian National University]. Open Research Repository.

Metcalfe, J., Gascoigne, T., Medvecky, F., & Nepote, A. C. (2022). Participatory science communication for transformation. *Journal of Science Communication, 21*(2), E. ↲

Middleton, L., Shao, A., Cate, A., Haugen, J., & Li, N. (2024). An enthusiastic but uncertain welcome: Coverage of risks, benefits, and social contexts of CRISPR technology in U.S. agricultural news 2012-2022. *Journal of Applied Communications, 108*(2). ↲

Mitsopoulos, D. (2012). *Effective communication about genetically modified foods towards consumer acceptance* [Masters Thesis]. Wageningen University & Research. ↲

NASEM - National Academies of Sciences, Engineering, and Medicine (2016). *Genetically* *engineered crops: Experiences and prospects*. The National Academies Press. ↲

NASEM (n.d.). *Based on science: Foods made with GMOs pose no special risks*. National Academies of Sciences, Engineering, and Medicine. ↲

Pew Research Center (Jan. 29, 2015). *Public and scientists' views on science and society*. Pew Research Center. ↲

Pouliot, C. (2009). Using the deficit model, public debate model and co-production of knowledge models to interpret points of view of students concerning citizens' participation in socioscientific issues. *International Journal of Environmental and Science Education, 4*(1), 49–73. ↲

Raman, R. (2017). The impact of genetically modified (GM) crops in modern agriculture: A review. *GM Crops & Food, 8*(4), 195–208. ↲

Ruth, T. K., & Rumble, J. N. (2019). Consumers' evaluations of genetically modified food messages. *Journal of Applied Communications, 103*. ↲

Sleboda, P., & Lagerkvist, C. J. (2022). Tailored communication changes consumers' attitudes and product preferences for genetically modified food. *Food Quality and Preference, 96*, Article No 104419. ↲

Stanton, J., Rezai, G, and Baglione, S. (2021). The effect of persuasive/possessing information regarding GMOs on consumer attitudes. *Future Foods, 4*, Article No 100076. ↲

Stilgoe, J., Owen, R., & Macnaghten, P. (2017). Developing a framework for responsible innovation. In *The ethics of nanotechnology, geoengineering, and clean energy*. Routledge. ↲

Yang, Y., & Hobbs, J. E. (2020). The power of stories: Narratives and information framing effects in science communication. *American Journal of Agricultural Economics, 102*(4), 1271–1296. ↲

Zhu, H., Li, C. & Gao, C. (2020). Applications of CRISPR–Cas in agriculture and plant biotechnology. *Nature Reviews Molecular Cell Biology, 21*, 661–677. ↲

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