For our project, we decided there were two main themes worth elucidating to the general public. First, the concept of genetically modified organisms (GMOs) is a hotly debated topic that although holds concerns worth considering, is often shrouded by paranoia caused by unscientifically based sources in the general public. GMO crops would serve as the crux in applying our findings to the general public. Therefore, we aimed to educate groups who have received little sound education on the topic but whose minds can be easily impacted by improper sources; we focused on children aged approximately 6 to 13 and senior citizens. Second, our project incorporates an understanding of photosynthesis that extends beyond the oversimplified “light” and “dark” reactions whose inaccurate representation can even permeate the college classroom. With the limits of photosynthesis in accordance to crop yield becoming a larger focus of scientific research, to avoid a similar lack of education that has led to conflicts surrounding misconception as well as prepare those whose lives will be most impacted by a need for higher crop yield, we aimed to educate the rising generations on photosynthesis and its limits.

**GMOs**

Older Adult Care Home:

Our audience was the residents of the Knolls of Oxford in Oxford, OH. The residents of the Knolls have varying levels of mobility, so we decided to use a [presentation](https://drive.google.com/file/d/1nh8FWvBTxW-hRDdvNeh1ZN2vz7nD4SWi/view?usp=sharing) to convey our information; a presentation is easily adaptable to different accessibility aids. The presentation presented information about what GMOs are, how they are made, and common examples and can be found here. Before the presentation began, we passed out notecards to residents for them to write down any questions. If a resident was not comfortable asking a question, or if they had a question after the presentation was over, they could write their question on the card. During the presentation, to encourage open dialogue, the residents were free to ask any and all questions about GMOs they had. To address questions residents were uncomfortable asking or weren't able to ask, we collected all notecards with questions at the end. These were then used to guide the creation of a pamphlet. The pamphlet goes over what we discussed in our presentation, some good sources for further understanding, and answers their common questions. This pamphlet was then delivered a few days later to the residents. By presenting what a GMO is and how they are beneficial we hoped to get feedback on what the older community thought about GMOs and if our presentation changed any opinions. Additionally we hoped to educate them on the common GMOs that they have likely been exposed to. Our audience members had a variety of backgrounds, some from scientific fields and some not. By having discussions with people from various backgrounds, we were able to gain insight on how not only older generations think about GMOs, but how different backgrounds interpret GMOs.

Educational Video:

We reached out to many educators who were excited to share and discuss GMOs with their classes. Knowing that there are still many restrictions in place for in person events we wanted to create something versatile where we could bring it to the classrooms or just share with the educators. This gave us the idea to create a video about GMOs that is educational yet would also guide the children through interactive activities. After providing the materials to educators we were told thank you and that “Virtual learning offers an instructional environment that is accessible and flexible for students and teachers. While virtual education is continually changing in its content and context, it is essential that we recognize its support to the traditional classroom setting, especially to the STEM related fields of study. By providing factual, rigorous, and engaging science e-learning experiences beyond the traditional school day or classroom, educators and students gain access to the world through discovery and synthesis. Such experiences foster a knowledge of the value of science fields through project-based initiatives and increased opportunities to exercise applicable skills not readily available in the conventional setting.” by Juile Robinson of the Hefner Museum in Oxford, Ohio. Even though we chose to pursue an online and asynchronous format, we still wanted to make it interactive. In order to explain how a GMO is made, we created a [paper cutting activity](https://drive.google.com/file/d/1rm-ucQy5TWya-WCYVEXvQ5spg4qCOizD/view?usp=sharing) for younger kids. The educators were provided with a printable version of the activity and the video walks them through the process. Students would be given a colored paper circle to represent a plasmid. They would then be able to cut part of the circle out to symbolize the nick in DNA required to insert new DNA. Then using another color they would need to cut a shape to fill the created gap. This represents taking DNA from one organism and putting it into the DNA of another, thus creating a genetically modified organism! By creating their own genetically modified organism we are allowing younger kids to gain a hands-on learning experience on how a GMO is created using two different organisms' DNA. This activity allows children themselves to go through the process of creating a GMO, albeit in a simplified form. Additionally, by showing children how GMOs are made, we hoped to give them a scientifically correct foundation to build their future knowledge of GMOs.

In order to show an unbiased representation of GMOs, we created a board game similar to chutes and ladders. This game was embedded into our powerpoint slides and demonstrated in our video. The chutes represent instances in scientific history where GMOs did not go as planned and the negative situations that would have happened if no GMOs had been used. The ladders are instances when GMOs were used to overcome problems. One of the key concepts in this lesson is that while GMOs can be used to harm humans, there are strict regulations in place to prevent that harm. We wanted to show a nuanced view of GMO use, even at the elementary school level.

This [video](https://drive.google.com/file/d/1nlqMEhc056Y4GzBRfKTDeoC40hHbA7rI/view?usp=sharing) was then shared with multiple education foundations including the Hefner Museum of Natural Science which does multiple education outreach to schools as well as the head of the Science department at the Talawanda school district. Since we were distributing these videos and materials to educators we ensured that we took into consideration the education standards of the Ohio Department of Education (ODE) and Next Generation Science Standards (NGSS). For ODE, the video most clearly fulfills Designing technological/engineering solutions using scientific concepts - Technology and Engineering. The focused audience is Grades 4-6. For NGSS, the video particularly addresses Appendix F of “Science and Engineering Practices” by providing actual interactive activities by which students can construct explanations of the problem, and design solutions for said problem.”

**Photosynthesis**

Frontiers article:

Finally, we also wrote an article that would help communicate the more complex but highly applicable recent discoveries involving the limitations of photosynthesis. Specifically, we summarized the findings of an article published by our PI and his laboratory for an age group of 8-12 in *Frontiers for Young Minds* (29). This Frontier’s journal has experienced scientists write about new research in a format accessible to young readers. Articles going through a peer review editorial process, specifically with review from a Science Mentor and a young student pair. Our article is currently titled “How does Photosynthesis Wake Up?” and is in the submission process, expected to be published within the next few months. A preprint version can be found with BioRxiv.