



Science Teacher Paul Zahller's Impact Inside the Classroom ... and Out

Five years ago, the technology applied in the MICDS autotroph biological design class did not exist. This year, **Upper School Science Teacher Paul Zahller** introduced his class to the ground-breaking CRISPR-Cas9 tool. The gene editing technology uses a set of molecular scissors to cut or edit the DNA that already exists in a plant. The technology is different from older genetic modification techniques that insert foreign DNA into the chromosome to create genetically modified organisms (GMOs).

In the lab, Mr. Zahller's class applied the capabilities of CRISPR-Cas9 to bacteria. They had a string of bacteria that lacked a certain gene that would help it tolerate living in a hostile environment. By editing that gene in the lab, students engineered a "super bacteria" that could survive toxins, ultimately enabling it to exist in that same, previously hostile environment.

The class went on to discuss the implications of this ground-breaking biotechnology. "Part of what we're after is demonstrating the simplicity of the technology. It's amazing, but it's also potentially horrifying," shared Mr. Zahller. The class acknowledged that these small changes to genes and DNA could have an astronomical impact. On the other end of the spectrum, Mr. Zahller shared that CRISPR-Cas9's potential is "the most exciting technology ever discovered for biology."



Mr. Zahller doesn't confine his teaching to the classroom and the lab. He's regularly out in the community, sharing his experience and insights. This year, he was part of a panel discussion for the Bioscience Career Pathway held at the Bio Research and Development Growth (BRDG) Park at the Donald Danforth Plant Science Center. Mr. Zahller discussed inquiry- and project-based STEM education and its role in developing key competencies for future problem-solving careers. The panel also discussed how technology such as artificial intelligence, machine learning, data science and bioinformatics is revolutionizing the efficiency of farms around the world. Agricultural innovation will be necessary to meet the growing demand for food, since by the year 2050 the human population is projected to be nearly 10 billion. Guests included educators and superintendents from across Missouri.

He's also reached out to other organizations, like the Donald Danforth Plant Science Center, a neighbor of MICDS, and a lab with the University of Reading in the United Kingdom.

Danforth is working on a project to establish millet seed as a model organism for testing. For human health and disease, mice are used as a model organism. Plant researchers need model organisms, too, especially when it comes to developing new crops that will help feed the world. Millet uses a pathway for photosynthesis that is the same as most major crops grown around the world, which makes it a suitable model organism. Since Mr. Zahller's goal is to bring authentic work and a solution-oriented optimism to his classroom, it was a good fit to collaborate with Danforth and the University of Reading Lab.

The U.K. project involved converting 3D renderings of pollen grains. Mr. Zahller's students had the renderings from a lab at the University of Reading 3D printed to 10,000 times their actual size. Students then studied the morphology of each, creating different grain solutions based on pollen design.

Paul Zahller brings cutting-edge technology such as CRISPR-Cas9 into the lab at MICDS.

Mr. Zahller considers his program to go beyond basic plant biology; it's investigative plant science and he challenges his students to ask fundamental questions first. They start by looking at the biggest problems facing our world and our society. Some of these problems are open-ended: no one has yet figured out the answer. Mr. Zahller then pulls them into the Danforth projects, which allows them to "put their hands on real materials." They learn autonomy and to fail comfortably, which are two skills Mr. Zahller says are more important than learning content-based science. "Science is changing rapidly," he said. "When they graduate from college in five years, it'll be completely different." Along the way, ethical concerns are discussed and debated for every project.

Mr. Zahller's enthusiasm is contagious. Between the School's news about his work in the classroom and his willingness to speak in the community, he's fielded requests to share information with organizations and schools across the country. Two years ago, he taught a graduate class at Lindenwood and invited students to shadow for a day.

"I try to be really open about sharing the material because we need to prepare an army to do this work," he said. "There are a lot of problems this generation will have to solve that are unique and weren't faced by past generations." In the meantime, he strives to bring a focus on humanity to the classroom, incorporating cross-disciplinary studies with social sciences and literature.

How will it pay off? "This is the first year," Mr. Zahller shrugged. Then he grinned. "But kids are choosing to study environmental science and plant science in college in increasing rates!" Perhaps someday an MICDS alum will turn what they started learning in Mr. Zahller's classroom into a solution that helps feed the world.