

# Gene Editing: A CRISPR Take on the Future

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In November 2018, two twin girls were born in China. What makes this birth rather extraordinary is not the birth itself, but rather how it thrust the world into awareness of the possibility of modifying genes. The twins were the first to have their genes edited, namely the *CCR5* gene, which is believed to confer resistance to HIV in humans (Raposo, 2019). Society was already aware of gene editing, but it favored modifying vegetables, meat, and other organisms. This discovery sparked society's interest in gene-editing possibilities for humanity, made possible by the new CRISPR-Cas9. CRISPR (Clustered Regularly Interspaced Short Palindromic Repeats) itself is relatively new. However, the rate of its growth requires scientists to assess its capacity and whether it should be used at all. It is this notion that has led faculty member Dr. Karen Kirk to create a new biological inquiry course at Lake Forest College. The new gene editing course, BIOL 140, explores not only the basis of CRISPR and its molecular foundations, but also the ethical dilemma regarding when and why the tool should be used.

Taught as one of the many Biological Inquiry Seminars, Gene Editing does not just explain the mechanisms of the technology but also its real-world applications and considerations. Dr. Kirk has "always been fascinated with molecular biology," she said, "and we did not have any courses like that here." Her passion for genes and the prospects that follow CRISPR's potential motivated her to create a course here for students who share similar interests. These problems can be better handled by students who receive early exposure to them, so they can brainstorm solutions. The course teaches students about genetic modifications we are more accustomed to, such as GMO foods and vaccinations. However, it also opens the door to new and experimental uses of CRISPR. This takes the shape of "designer babies," the curing of decade-long diseases such as malaria, and the side effects of free editing. With a combination of discussions and readings, the course places special emphasis on presentations, making it Speech-Intensive.

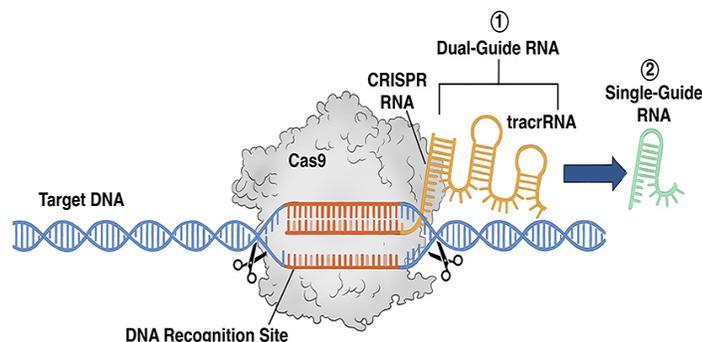
While all students are free to take this course, it has a prerequisite of introductory biology, BIOL 120. Most students who take this course are science majors fulfilling a biological inquiry credit or have a passion for gene editing. "It was actually interesting to see how people took different technologies from different times into one," says Diana Frankiv, a Biology Major who took the course her first year. The course focused on a set of readings and engaged students through debates and group presentations. "I found myself asking," stated Yasna Qureshi, "who sets the rules? Should it be each country individually, but then what about the dark market, and no one would know the consequences of that?" The introduction of moral dilemmas in this subject gives students a head start on how to approach similar conflicts in their future careers, making the class both educational and applicable. The use of CRISPR has ushered in a new era for science, but one we must approach only when we are ready.

The origins of CRISPR are relatively recent, with the Nobel Prize in Chemistry awarded only in 2020, making it crucial to have a coherent understanding of its consequences before using it on people. CRISPR was initially discovered during an immune response in *Escherichia coli*. While the scientists at the time were unaware of what this discovery would lead to, they proposed that it could be used in medical research. The reason it was so successful was that CRISPR loci have a "high degree of polymorphism in different strains of the same species of pathogenic bacteria" (Gostimskaya, 2022). Research continued to grow as scientists dove into the potential of these findings, and CRISPR repeats are now seen in most genomes of archaea and bacteria. Currently, scientists are highly motivated to use this device to cure diseases and save lives. Students learn about these positive uses and how they came to be throughout this course.

Unfortunately, even if these edits can be inherited, there is a wall of technical and ethical difficulties facing them before this can be accomplished.

Although it can be easy to focus on the good that CRISPR can do, its application can be a slippery slope if not handled carefully. Malaria-resistant mosquitoes, cancer treatment, and food modifications are all positive outcomes of CRISPR taught in the class. However, this ideal would assume there is no safety risk associated with it and that the decision to use CRISPR is ethical. While most scientists who spoke at the International Summit on Human Gene Editing agree that germline genome editing should not be used for clinical reproductive purposes due to the risks, other instances are more grey. As we approach the modifications, it can be easy to shift from a therapeutic to an enhancement-focused approach (National Human Genome Research Institute, 2017). On top of these risks, there are potential accessibility gaps and consent conflicts, where regulation and guidelines are key.

Throughout history, scientists have developed tools for the betterment of humanity—such as nuclear energy, medicine, and genetically modified foods. While the intentions were in the right place, technology has a way of being taken and used for alternative utilization by other groups or causing unanticipated incidents. These concerns, on top of the obligation to act and help others, lend themselves to numerous debates. Gene Editing ensures students ask the right questions. Why do we use this technology? How can we make it better? With this mindset and preparedness from Dr. Kirk's course, future scientists continue to nobly push the boundaries of science.



**Figure 1. CRISPR-Cas9 system.** The following image above depicts the mechanism of the CRISPR-Cas9 system that has been used for current gene-modifications (Doudna 2024).

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