Issue Overview: Gene editing

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TOP: DNA strand BOTTOM: Graphics courtesy of Bloomberg.

Humans have been manipulating genes for thousands of years. Long ago, early civilizations realized that certain features of crops, animals and humans themselves were hereditary. Today, scientists are in the process of mapping all human genes. They are learning about which genes control which features. With this knowledge, they can alter DNA codes to change particular features. For years, this was both challenging and not always successful. But a new technology is changing that.

Crispr is a gene-editing system. It is so simple and powerful that it promises to change mankind's relationship with genetics. Supporters believe it could help control pests that destroy crops, grow more food and get rid of human diseases. Others worry that it could be used to make designer babies, dangerous mutants and biological weapons.

DEFINITIONS

germline cells
The cells that pass genes from parents to children

gene
A unit of information passed down from parent to child that determines some of the child's traits, or qualities

hereditary
Traits, or qualities, that are determined by genes and are passed down from parent to child

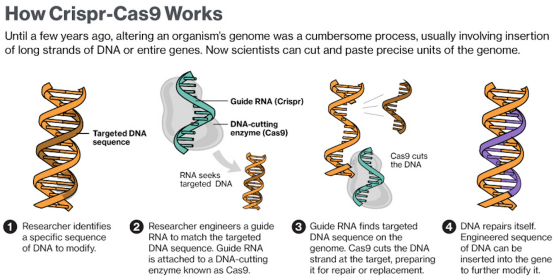
The Situation

Labs and companies in at least 83 countries are experimenting with Crispr. They hope to kill off harmful mosquitoes and grow stronger crops. One group of scientists is trying to produce special eggs for people who are allergic to them. Another group is even trying to bring back a woolly mammoth.

The experiments getting the most attention relate to human disease. Scientists have used Crispr to repair a mutation that causes blindness and to remove viruses from immune cells. In late 2015, scientists published results on the first successful use of Crispr to treat grown animals. They were able to repair a gene in mice with muscular dystrophy. This is a disease the causes muscles to break down. After the treatment, the animals' muscles became stronger. These experiments suggest that gene-editing cures could eventually be used to treat humans.

Some labs are using Crispr to experiment with human germ-line cells. These are special cells that pass genetic material to children. Such experiments are very controversial. In 2017, a U.S. science and medicine group decided it was ok to use technologies like Crispr if it helped avoid serious diseases and disabilities.

The Background



Crispr is a simple immune system that fights off invaders. Japanese scientists first noticed it in bacteria nearly 30 years ago. It is made up of chains of genetic code broken up by pieces of genes from past invaders. These gene pieces help bacteria find the invaders when they appear again. This allows Crispr to slice through them.

For a long time, scientists did not understand how Crispr worked. They did not see how the system could chop through and replace DNA. In 2012, scientists at the University of California, Berkeley published a breakthrough paper. They discovered how to make "guides" that allow Crispr to skim along DNA. The "guides" help Crispr target the right spot to make a slice. Soon afterward, another group of scientists found a way to use Crispr in human cells.

Any scientist with simple skills and the right equipment can use Crispr. This creates enormous room for both scientific breakthroughs and misuse. The gene-editing system isn't perfect, at least not yet. It often makes unintended cuts in DNA, with unknown effects.

The Argument

Using Crispr to treat people who are already sick is not controversial. But germ-line editing is another matter. This practice raises huge questions with no easy answers. Should scientists alter DNA that is passed on to children? It could be the only way to get rid of certain genetic diseases. But if something goes wrong, the results will affect future generations who were not involved in the decision.

Some worry that germ-line editing could be used for nonmedical reasons. For example, scientists could make babies that are superintelligent. Other people think this might be a good thing. They say that supersmart people could produce ideas and inventions that improve life for everyone.