MONDAY
6th January 2003
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Science GENE STORIES — GM FOOD

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INTRODUCTION

Explore the history, future and science of GM food

- **Air your views on GM on our message board**
- **Is GM food bad for your health?**
- **Could GM food be the answer to world hunger?**
- **Find out how plants are genetically modified**
- **Will future cars run on GM fuel?**
- **Making money from GM**
- **Could GM cause new kinds of pollution?**

HIGHLIGHTS

Guess the missing words in the **GM Headline Game**

Find out if there are **GM crop trial sites** near you

Find out how a fish gene can be **added to a tomato**

Use the **GM Compass** to find out your position on GM issues

Explore our **Consumer Guide** to GM food

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GM SCIENCE

What is genetic modification?

Genetic modification involves altering an organism's DNA. This can be done by altering an existing section of DNA, or by adding a new **gene** altogether.

A new gene can be added from one individual to another from the same species, e.g. tomato gene into another tomato plant, or between individuals from two different species, e.g. tomato gene into a fish.

It's possible to transfer genes from one species to another from plant to plant, from animal to plant, from plant to animal or from animal to animal. This is because all genes, no matter where they come from, are made of the same material - **DNA**.

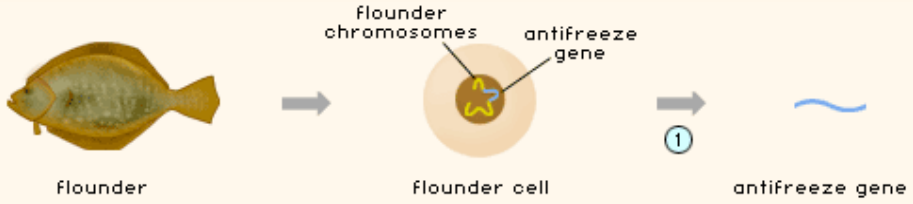
DNA

DNA contains the instructions needed for a living organism to grow and function.

How to add a fish gene to a tomato

Scientists have created a frost-resistant tomato plant by adding an antifreeze gene from a cold-water fish to it. The antifreeze gene comes from the cold-water flounder, a fish that can survive in very cold conditions. This is how it was done.

1. The flounder has a gene to make an antifreeze chemical. This is removed from the chromosomes within a flounder cell.



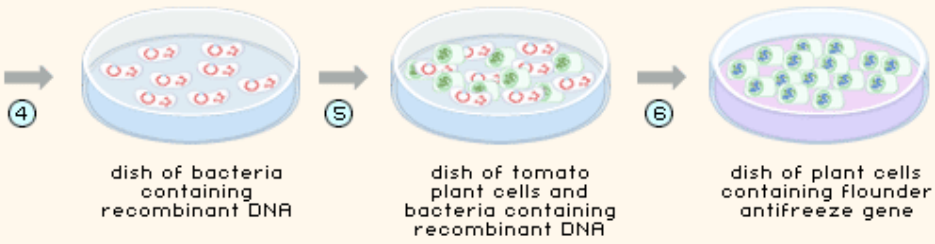
2. The antifreeze DNA is joined onto a piece of DNA called a plasmid. This hybrid DNA, which is a combination of DNA from 2 different sources, is known as recombinant DNA.

3. The recombinant DNA, including the antifreeze gene, is placed in a bacterium.

4. The bacterium is allowed to reproduce many times producing lots of copies of the recombinant DNA.

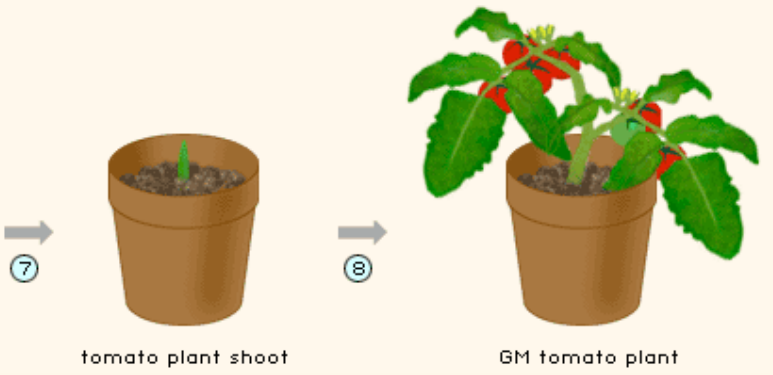
5. Tomato plant cells are infected with the bacteria. As a result, the antifreeze gene in the plasmid, in the bacteria becomes integrated into the tomato plant cell DNA.

6 Tomato cells are placed in a growth medium that encourages the cells to grow into plants.



7 Tomato plant seedling is planted.

8 This GM tomato plant contains a copy of the flounder antifreeze gene in every one of its cells. The plant is tested to see if the fish gene still works. Is it frost resistant? Yes it is.



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GM BEGINNINGS

Age of innocence

Humans have been modifying their food for thousands of years. Until the 20th century, this had to be done by breeding desirable characteristics into crops. This method requires a lot of effort and is rather imprecise.

Genetic modification has enabled us to add qualities to crops that no amount of traditional breeding could.

But in the 1960s, scientists made huge breakthroughs in their understanding of genetics. Many recognised that this new knowledge had the potential to revolutionise food production, creating huge benefits for the world.

The Green Revolution

In 1964, the International Rice Research Institute in the Philippines managed to breed new strains of rice that doubled the yields of previous types. This discovery spawned the Green Revolution, a worldwide farming movement that sought to end world hunger.

This movement aimed to bring high-yield crops able to thrive in harsh conditions to farmers in the developing world.

The Green Revolution dramatically increased the size of harvests and introduced modern farming methods throughout the world. But it couldn't end starvation. Instead, it created many problems of its own.

The fertilisers and pesticides used in this new method of farming caused water pollution, soil erosion and lowered soil fertility. They also harmed biodiversity and made farmers dependent upon chemical companies for their livelihoods.

Genetic engineering

By 1972, another revolution was underway. Biochemist Paul Berg at Stanford University discovered how to join together DNA from two different organisms, creating the first recombinant DNA molecule.

This breakthrough was followed the next year by a pioneering study in which scientists Stanley Cohen and Herbert Boyer inserted DNA from an African clawed toad into the *E.coli* bacterium.

However, as soon as the euphoria over these discoveries had subsided, many scientists began to question the safety and ethics of the research.

Plant Breeding
Breeding new plant varieties

The 1975 Asilomar conference in California was held to discuss these issues. Some biologists argued passionately for a moratorium, or freeze, on genetic research until the safety of the technology could be established.

However, this was not passed and the conference delegates agreed to continue research into genetic engineering. In order to dodge regulation of their research by outside bodies, scientists pledged to keep all recombinant DNA and genetically engineered organisms contained safely within laboratories.

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