Genetically Modified Organisms

Carolyn McAlear, Palmetto Ridge High School, Naples, FL

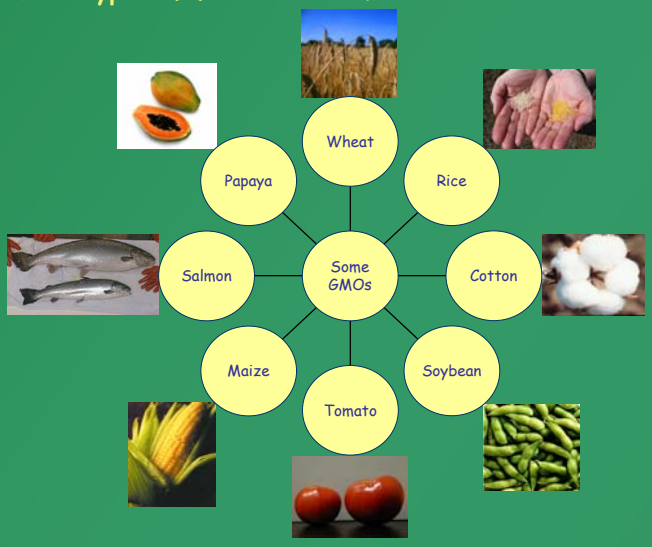
What are Genetically Modified Organisms?

Generally, genetically modified organisms are any organism that has had their genome modified. This could be done by traditional breeding methods. Most of the food we eat has been modified by traditional methods. An example is corn, by selecting the biggest, most productive kernels we have gone from teocinte to our modern maize. Genetically modified or engineered organisms (GMOs or GEOs) are organisms that have a gene from another cultivar or a completely different species inserted into their genomes that could not be inserted through traditional methods.

Why would we make GMOs?

GMOs or GEOs are made to improve crops or livestock . They can be used to increase yield, resist herbicides, resist pests or pathogens, contain more nutrients, allow a flower to smell, improve flavor of foods, grow more quickly, contain medicine or vaccines, or be drought, heat or cold tolerant. All of these things could help feed our ever growing population. Drought resistance would allow farming in more arid regions where traditional agriculture has been nearly impossible, and almost constant famine is the result. Engineering insect resistance into plants would allow for less pollution because insecticides would not need to be sprayed and kill harmless and or beneficial insects that do not destroy crops. Added nutrients could help stop malnutrition in areas where a grain like rice is the main staple.

What types of foods and animals are involved?

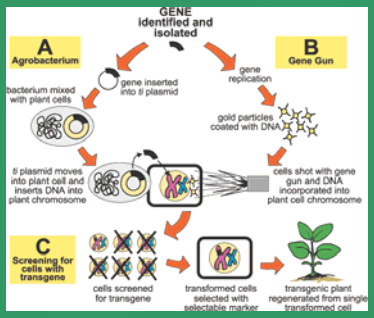


Why People are Scared of GMOs

Many people think that GMOs are unnatural because scientists move genes from one organism to another. They think gene combinations that do not exist in nature could cause unforeseen problems down the road such as cancer or gene products could build up as toxins in the body. Some are scared that pollen transfer from GMOs to other plants will transfer the genes into other species resulting in new characteristics like herbicide resistance that were originally engineered into the GMOs. This could allow weeds to become greater pests. Pollen transfer could also happen between non GMO plants or organic varieties and their GMO sister plants. Organic farmers are afraid of losing their organic certification or that their consumers will not trust their product anymore should this happen.

How are GMOs made?

Genetically modified or engineered organisms are made by finding a gene that could be useful called a gene of interest. This is the most difficult and time consuming part of the process. Once a gene is located and its function described, then it needs to be isolated. Once isolated, it needs to be replicated either by polymerase chain reaction, or inserted into a plasmid vector and grown up in bacterial cells.



Then, if choosing option A for plants, it would be grown up with *Agrobacterium tumifaciens*. This bacterium has a specific plasmid, the *ti* plasmid, that inserts itself into the plant chromosome, transferring the gene of interest into the plant genome. In this vector is a type of selection such a antibiotic resistance or a gene that transcribes a protein that fluoresces. This selection allows you to visualize the cells have been transformed and those which have not. The transformed cells are cultured and grown up on a medium then transplanted and stimulated to grow as entire plants.

How are GMOs regulated and approved?

The USDA in their Animal and Plant Health Inspection Service or APHIS acts under the Federal Plant Pest Act to determine the possibility of a transgenic becoming a pest. Common crops, like maize, only have to notify APHIS that they're going to field test or transport the transgene, but they can only do it if: the gene is stably integrated into the genome, it's non-pathogenic to humans or animals, unlikely to be toxic to non-target organisms, and has little risk of creating new plant viruses. Field testing is usually conducted in many locations over several years. The spread of transgene must be minimized and kept out of the food supply.

The Food and Drug Administration (FDA) must determine the safety of food under the Federal Food, Drug, and Cosmetics Act. They require consultations with the plant developer, reviewing nutrition and safety information, and will request more data depending on the source. If genes come from a known allergenic source, then many more tests will be required to determine allergenicity of the transgene. Other tests could be required if the transgenic crops contained known toxicants, altered nutrient levels, new substances or antibiotic resistance markers. Once these concerns are addressed, the FDA issues approval.

If plants are pest resistance, like Bt, they are also regulated by the EPA as they contain "plant pesticides." Three laws allow the EPA to test these plants: the Federal Insecticide, Fungicide, and Rodenticide Act, the Federal Food, Drug, and Cosmetics Act, and the Toxic Substances Control Act. They look at data about the protectant including how the plant protectant works and where it is expressed, environmental effects, determine toxicity of genes and gene products by testing on animals, and may design a "resistance management plan."

Lastly, in order to make a transgenic plant commercial, researchers ask APHIS for non-regulated status. Data on the introduced gene is necessary to insure there is no toxicity and no allergenicity. Ecosystems need to be protected from transgene spreading to other crops and wild relatives. Both APHIS and the FDA have the authority to halt sale of a GMO at any time if the food is unsafe or becomes a pest.

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