BIOFACTS

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Freecall: 1800 631 276
www.biotechnology.gov.au

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Arguments For and Against Genetic Modification

This fact sheet discusses some of the issues to bear in mind when thinking about biotechnology and genetic modification, and summarises the key arguments used for and against gene technology and its applications.

Like any other subject, this research has its technical terms. If you are not sure of the meaning of some of the words used, consult our glossary.

Is genetic modification natural?

The Argument For	The Argument Against
• Genetic engineering is just another step along the path of genetic improvement, which began with people selectively breeding plants and animals thousands of years ago. • Genetic technology is really no less natural than existing technologies currently used in 'conventional' agriculture, including the use of specially selected varieties, pesticides, herbicides and fertilisers. • Adding one new gene is a tiny change to the overall genetic makeup of a living thing. Many plants and animals have tens or hundreds of thousands of genes. In contrast, conventional breeding technology involves the transfer of many genes. Because thousands of genes are moved around in traditional breeding, you end up with all sorts of other features as well as the characteristic that you want. Due to the large numbers of genes transferred, the odds of transferring something unintentionally (whether it's a gene for a natural toxin or for susceptibility to disease) are much higher with conventional breeding than with genetic technologies. Traditional breeders also spend much time doing further crosses of new varieties to eliminate the unwanted characteristics from the additional genes. Modern gene technology is much faster, as these 'back-crosses' are usually unnecessary, and it is also usually easier to	• Genetic modification is not natural. The deliberate selection of genes and their transfer between species that are sometimes completely unrelated only happens very rarely among plants and animals. Gene technology is quite different from the agricultural techniques that have gone before, because these mainly involved crosses within a species or between very close-related species. • Any species has evolved with its genes working together. Genetic modification can arbitrarily upset a functioning group of genes. It is, in effect, tampering with complex systems that we still don't fully understand. The highly evolved and delicately balanced system of genes in any higher plant or animal is complex and could easily be changed in ways that we cannot predict. There is often little control over where the genes are inserted. The inserted gene could disrupt the functioning of other genes nearby. Also, tiny changes inside just one gene could have huge consequences on the organism as a whole.

Will this affect my health?

The Argument For	The Argument Against
• As with any new technology, gene technology does pose potential risks. In light of this, there are strict guidelines controlling the manufacture, release and use of genetically modified organisms. The Australian Government, through various regulatory agencies, approves and monitors the use of gene technology. • The Gene Technology Act 2000, which came into force in June 2001, established the Gene Technology Regulator (Regulator), who is responsible for regulating all 'dealings' with GMOs in Australia, including contained laboratory research, and releases of GMOs into the environment. The regulator must not approve applications unless they are satisfied that any potential risks can be managed to protect public health and safety, and the environment. • With respect to genetically modified food, the Australia New Zealand Food Authority (ANZFA) requires thorough testing of all genetically modified (GM) foods prior to them being able to be sold. ANZFA states that all GM foods approved for release in Australia are at least as safe as their conventional counterparts - offering all the benefits of conventional foods, with no additional risks. These tests include examining whether the food has additional allergens or toxins as a result of the genetic modification process. • While genes for antibiotic resistance have been used as 'markers'- the antibiotics involved are not usually those used in medicine. Studies are continuing on investigating how easily these could move into bacteria. In considering this issue, the World Health Organization has concluded that the risks of antibiotic resistance gene transfer to be very small. Nevertheless, as a safety measure different marker systems are being developed. Several alternatives using genes that code for a colour change in the resulting organism, or using genes that allow the new organism to use specific chemicals as food sources.	• Added genes could make 'safe' plants produce toxins or allergy-causing substances. Also, we can't predict what might happen when groups of genes are broken up by the insertion of 'foreign' genes into a plant. • As genetically modified foods are quite new, we're not quite sure what the long term effects of these foods will be. • Another health worry comes from the fact that scientists usually insert a marker gene along with the 'target' gene into the plant. The marker gene enables them to find out whether the target gene has been taken up into the modified plant. Often these marker genes actually make a substance that destroys certain antibiotics. If such an antibiotic resistance gene moved from a GM plant to a bacterium that causes human disease, that antibiotic may no longer be useful for treating the disease. • Traditional breeding techniques have already given us larger harvests and better crops. There is still more that can be done using these tried-and-tested methods without resorting to risky new technologies.

How will it affect the environment?

The Argument For	The Argument Against
• GM crop plants can be made so that their cultivation has much less impact on the environment. For example, GM plants designed to carry the gene for the production of a natural insecticide, for example, Bt cotton, can cut the use of sprayed pesticides on farms, which is good news for many species that were previously affected by traditional pesticide spraying. In addition, in the case of Bt cotton, there seems to be no overall effect on the plant from producing the insecticide. While some are concerned about the development of resistance to pesticide via the use of pest resistant cotton, this is already a common problem in agriculture, and farmers using crops that are not GM must still regularly change the types of pesticide sprayed in avoid the emergence of resistance. • The idea of herbicide resistance in GM plants is that the modified plants are made resistant to a relatively benign chemical, which can then be sprayed in larger doses so that it is effective against weeds without having to use far more toxic compounds. These crops also permit more time efficient spraying practices, allowing farmers to spray an entire crop to kill weeds growing within the crop area. Current research carried out by the Waite Institute, at the University of Adelaide, suggests that the transfer of genes to weed species and related crops is actually very small. In addition, precautionary steps, such as the use of 'buffer' zones around genetically modified crops, can be used to reduce the risks of gene transfer even more. • Some of the major advantages of the technology for agriculture and the environment are that crop plants can have genes from hardier plants added to them, thereby allowing them to tolerate salinity, drought or poor soil. This means that agriculture need not always use the best land or damage non-agricultural species in the area. • One of the main problems of agriculture is applying fertilisers which then find their way into streams and others areas, upsetting natural ecosystems. Some plants, such as clover and 'legume' crops, don't need nitrogen fertiliser as they have the special natural ability to take nitrogen from the air. By transferring genes from these plants, it could soon be possible to make common crops able to do this too, greatly reducing fertiliser use. That's good for farmers' pockets as well as for the environment.	• Concerns have been raised that genetically modified crops could have a negative impact on the environment. Possible negative effects of Bt cotton need to be identified. Can Bt pesticides 'leak' out of the plant through juices produced by roots, for example, perhaps affecting organisms that live in the soil? Also, pest-resistant plants may affect non-target insects, in addition to than the pests they are designed to affect. • What's to stop genes from a GMO spreading into other closely-related species? If closely related weeds breed with a herbicide tolerant crop species (and many of the worst agricultural weeds are related to the crop in which they appear), then the weeds could acquire the gene for resistance to the weedkiller, creating weeds which are herbicide tolerant. • Farmers will still be faced with pests becoming resistant to pesticides, even if they are engineered into crops. Therefore, GM crops don't offer much advantage over existing ways of dealing with pests. A better approach would be to manage the pest problem as part of the broader ecology of an area, which would mean changes in farming practices and the way in which farming relates to the wider natural environment rather than a technological 'quick-fix'. • The use of herbicide tolerant crops may encourage farmers to use more herbicide. In addition, the companies that produce herbicide tolerant crops often manufacture the corresponding herbicide - locking framers into a single supplier. • Some people are excited by the prospect of being able to grow plants which are more tolerant to drought or poor soils, but what additional damage will we cause to these already marginal lands by using them for intensive agriculture?

Will it help provide more food in the World?

The Argument For	The Argument Against
• One of the most exciting applications of gene technology is the eventual development of plant types that are more nutritious, yield bigger harvests, but at the same time are more resistant to disease and to stresses like drought. Domestic animals would also become more productive, and make more from less. • Countries whose lands were previously too poor to be used for agriculture would be able to grow their own food, leading to increased food security. All this would help greatly with feeding the ever-increasing number of people in the world. Crops able to produce harvests even in harsh environments are being developed. These could be of great value in many poorer nations where climate and poor terrain restrict crop-growing, and would also help reduce the amount of land being cleared for use in agriculture.	• Feeding the world is more to do with politics and economics than agriculture. There are food surpluses in wealthy countries. But poor countries and poor people can't afford to buy this food. • They're unlikely to be able to afford GM plant varieties or food derived from those new varieties any more than they can afford to buy food or crop seeds at the moment. The much-publicised promise of new crop varieties feeding the world in the Green Revolution of the 1970s still hasn't eliminated starvation. • We shouldn't forget that a lot of the work on gene technology is coming from big companies. Are they doing this research more for their own profits than to benefit the world?