Section 1: Where do I start?

1.1 WHAT IS GM?	**Genetic Modification (GM) involves moving genetic material from the cells of one organism to those of another, be they related or unrelated.**
Views for	GM provides a valuable new tool, for example, in plant breeding. GM makes it possible to move genes into new crop varieties to make significant and targeted improvements (eg insect or disease resistance) where this is difficult or impossible by traditional plant breeding. GM is possible because DNA and the way that genes work are universal.
Views against	A scientific definition alone cannot convey the real meaning of GM and the way it is being applied. GM marks a radical departure in our use of living things for commercial purposes, and a fundamentally different way of breeding plants and animals. The greatest concerns arise when GM involves crossing species barriers, creating organisms that would never arise in nature, to be used for industrial purposes in the wider environment.
1.2 WHERE AND HOW IS GM DONE?	**GM is initially a laboratory process. A common soil bacterium that naturally transfers genes into plant cells is the preferred method for producing new GM crops, although there are other techniques. Isolated cells or tissues from the plant are treated with the bacterium containing the new genes. The bacteria are then removed and plants grown from cells containing the new genes.**

Views for	Regulatory authorities require companies producing GM plants to submit scientific evidence for the exact changes produced, as part of the package of information required for product approval. The genes used in the modification are identified with molecular precision using a wide range of biotechnological methods. A large number of new GM plants are produced and then tested and selected over several generations to identify particular plants that show only the desired effect. These plants must also exhibit an absence of 'side effects', and must show stable inheritance of the new gene from one generation to the next. GM crops are more thoroughly tested and evaluated than those from traditional plant breeding programmes. GM crops have been tested since the early 1980s in many hundreds of trials and are now grown on nearly 60 million hectares around the world annually. They have performed as expected and have been widely adopted by farmers in both developed and resource-poor countries.
Views against	There is little control on where the gene inserts itself into the host DNA. Scientists have shown that a gene's position in relation to other genes has an effect on what it does, therefore GM *must* lead to unpredictable and possibly harmful results. Scientists do not know enough about gene interactions to prevent such harmful effects occurring and laboratory testing may not detect all changes. The effects of releasing genetically modified organisms into the environment could be unpredictable. GM crops have only been released into the environment on a large scale in the last several years. No one knows at this stage what will be the long-term effects.
1.3 CAN ANYTHING BE MODIFIED?	**Everyone agrees that, in theory, any living thing with genes can be modified – including us.**

Views for	In plants and micro-organisms, GM techniques and products are now well established. For instance, many GM enzymes are currently used in the UK for food processing (eg to make vegetarian cheese). Recent advances in genetics, which have provided the genetic codes of two plant species and several micro-organisms, are now opening up possibilities for a much wider range of products. GM techniques are used routinely in medical research to investigate the causes of disease and disability. Although human gene therapy holds promise to tackle a variety of inherited disorders, it has proved difficult to find a generally acceptable method of delivering genes so that they reach large numbers of target cells in an individual patient.
Views against	The ability to break species' boundaries is a strongly negative feature of the technology. The technology has high failure rates and errors can arise. Only 1 per cent of GM animal embryos produced survive and there is a high incidence of death and abnormalities seen just before and after birth. In one case, experimental gene therapy trials in humans were halted when two subjects developed leukaemia. Genetic engineers working on plants, even when successful, have little control over where the GM transgene ends up in the chromosome of the receiving plant. This can have a significant impact on the final crop variety as it can interfere and influence how the plants' existing genes behave. This can be very unpredictable.

1.4 WHEN DID GM START?	**GM techniques are based on scientific discoveries made in the 1950s. Research into molecular biology in the 1970s resulted in the first GM plants being bred during the early 1980s.** **GM technology began in the laboratory, as part of the scientific exploration of genetics in the 1970s. As science, industry and agriculture realised what a powerful tool it could be, the private sector and government also funded research and development. The first GM plants were bred in the 1980s, and the first commercial crops were grown on a large scale in 1996.**
Views for	GM technology has developed under strict regulatory guidelines since its inception in the 1970s. These guidelines were put in place because people working on GM recognised the need for safeguards.
Views against	The involvement of scientists and industry in driving GM forward, and their motivations, may compromise testing, and the overall emphases in research. The GM industry has focused the direction of research to develop products that are primarily commercially profitable, rather than any that are needed socially.
1.5 DOES GM WORK?	**People agree that GM does work as a technique, and that a significant number of GM crop plant and micro-organism products have been produced. People however disagree about whether it 'works' in a wider context and in the long run.**

Views for	It is generally acknowledged that some of the gene transfer methods could be more efficient, but with the testing that is an integral part of all plant breeding, they produce crops that are reliable. As a result, many GM crops are being grown across the world, and this clearly shows that GM works. GM plants are potentially very useful, e.g. plants that produce medicines or have increased vitamin content. GM crops have great future potential. To date, no one has shown that any harmful side effects have occurred following cultivation of GM crops, suggesting that the process of testing allows for both predicted and unpredicted interactions to be picked up.
Views against	It depends on what you mean by 'work'. The process is haphazard, 90 per cent of all attempts to modify organisms fail, and some experiments and trials have to be halted because side effects emerge. This is partly due to the instability caused by the inserted gene. What's more, GM doesn't deliver on its extravagant promises, and won't 'work' in the long run because it will do more harm than good, to us and to the environment.
1.6 ARE CHEMICALS INVOLVED?	**Chemicals are involved in the laboratory creation of GM organisms. Some GM crops have been designed for use with a particular chemical spray.**
Views for	People should remember that all living things and all foods are made of chemicals. No new chemical constituents will be found in the new crop variety except for the introduced DNA itself and any gene product. Some GM crop products are designed to reduce the use of chemical sprays, others to allow use of more environmentally friendly chemicals. Others do not require any different chemical treatment from their non-GM equivalents.

Views against	Chemicals, such as herbicides, are used when growing GM crops. Chemical spraying is not in itself GM (and is used on conventional crops) but it is part and parcel of the questions surrounding GM crop development. Most current GM crops have been developed to resist insect change or to tolerate herbicides, allowing farmers to spray without damaging their crops. This will allow farmers better control of weeds, removing potential food sources for wildlife living in and around farmland. In comparison with some older herbicides, the herbicides used with GM crops may appear relatively benign, but they may still be harmful to our health and the environment.
1.7 ISN'T IT A NATURAL PROCESS?	**GM allows us to make changes in organisms that would not happen in nature. This has different implications depending on your point of view.**
Views for	GM relies on the inherent ability of cells and organisms to incorporate inserted genes into their genetic make-up. Many of our major food crops have no exact equivalent wild relative and have been developed and selected by man. In this sense, these crops are not 'natural' either. GM offers greater precision in identifying and selecting for desired qualities than traditional methods. For all crops – GM or not – survival is largely determined by the farmer, not by nature. Field tests have shown that, in the wild, both GM crops and traditional domesticated crops tend to be less fit than other plants and rapidly disappear from these habitats in the absence of a farmer.

Views against	It is 'unnatural' to bring together genes from quite different species that would never mix. This is what makes GM a quite different process from traditional breeding – with poorly understood consequences. An important difference is the speed and scale of changes being made. The same genes (for herbicide tolerance) are being used in many crops and multiplied on an enormous scale across the world. Safety monitoring is being left behind in the rush to gain financial returns.
1.8 WHAT CROPS ARE ALREADY GM?	**Globally, the four main GM crops being grown commercially are soybean (36.5 million hectares, or more than 62 per cent of the global soybean area), maize (19 per cent), cotton (13 per cent) and oilseed rape (5 per cent).** **In 2002, GM crops grown worldwide covered twice the land area of Britain (58.7 million hectares), a 12 per cent increase on 2001 and this figure is growing rapidly. By land area, the vast majority (99 per cent) of GM crops are grown in four countries: the US, Argentina, Canada and China, with the US accounting for around two-thirds of the world total.** **GM crops are also commercially grown in Australia, Bulgaria, Columbia, Germany, Honduras, India, Indonesia, Mexico, Romania, South Africa, Spain and Uruguay.** **Globally, approximately 6 million farmers in these 16 countries (7 developed; 9 developing) grow GM crops, with 75 per cent of these farmers coming from the developing world.**
1.9 WHAT GM FOODS ARE AVAILABLE?	**Currently, food ingredients from varieties of GM soya, maize and oilseed rape have been approved for food use in the European Union although very little is actually used. No fresh GM produce has been approved for sale or consumption in the UK.**

	Elsewhere, dozens of GM food crops have been approved for growing and use in at least one of the 16 countries that have commercialised GM crops.
Views for	Some supermarkets, in response to campaigning groups, withdrew GM products from their own brand products. This led to others following suit for competitive reasons. The majority of processed foods in the US, Canada, Japan and Argentina and increasingly in other countries include GM ingredients.
Views against	The current UK voluntary agreement limiting the commercial growing of GM crops in the UK, plus the labelling of GM-derived ingredients in food, has come largely in response to public pressure led by high-profile campaigns. Public rejection of GM has led most UK food retailers to remove GM products and foods with GM ingredients from their own brand products.
1.10 WHAT ABOUT NEW GM PRODUCTS?	**People disagree whether the wide range of possible new crops will either be successfully grown, or bring the benefits claimed.**
Views for	Biotechnology researchers are actively working to develop GM crops that will bring commercial, agricultural and health benefits. A wide variety of new crops in development aim to increase pest and disease resistance, improve food value and provide other commercially useful benefits. GM crops aim to help producers to increase their yields whilst reducing inputs. This is of course especially helpful in developing countries. GM products such as Golden Rice and Golden Mustard are being developed that are enriched with beta carotene, which humans convert to vitamin A. This could help in the fight against vitamin A deficiency which can lead to blindness in developing countries. Research is also being carried out into GM crops with

	higher levels of nutrients, such as iron, zinc and calcium, to help reduce dietary deficiencies. GM technology can also help to reduce allergens such as those found in peanuts or wheat. Other GM crops in development include products with increased levels of phytonutrients that can lower blood cholesterol levels, or remove anti-nutrients, which can cause negative health effects.
Views against	Many claims by the biotechnology industry about the future are unsubstantiated, as few experimental GM crops are succeeding – because their development is proving much more difficult than was imagined. GM companies have promised a variety of new products for many years such as rice with more vitamins and fruit that will rot more slowly, but they are either far from being commercially grown or have been withdrawn. Non-GM plant breeding could bring similar benefits without the hazards. Many of the 'improvements' associated with these GM crops, such as salt tolerance and increased vitamin content, may be obtained through traditional breeding methods. Others may prove too difficult to manage in the field. There are already examples of problems, eg when GM pharmaceutical crop residues contaminated a non-GM food crop in the USA.
1.11 WHO PRODUCES GM FOOD?	**No GM crops are grown in the UK, except experimentally, but GM crops are currently commercially grown in a couple of EU countries, predominantly Spain. Around the world, companies, academics and government institutions are variously involved in development of GM crops. A relatively small number of companies account for the vast majority of sales of current commercially grown GM crops.**
Views for	Seven million farmers are growing GM crops, over 75 per cent of them in developing countries, and there

	is a real demand. GM offers real benefits to those farmers in helping them to grow more food. Negativity about multinationals and profits is misplaced. Examples from China and India show that governments and public bodies have developed GM independently. China has approved more GM plant products than any other country; most of these have been developed by their own government scientists. Of the GM crops in the pipeline and coming to market, the vast majority are being developed by small to medium-sized enterprises, universities, governments and other non-corporate institutions. The realities of commercialisation mean partnerships are frequently entered into with large companies in order to help commercialise these products.
Views against	The domination of a few large global GM companies is of major concern. There are only five corporations involved in GM crop development on any scale – Monsanto, Syngenta, Bayer CropScience, Du Pont and Dow. Monsanto produce over 90 per cent of the GM crops currently being grown commercially. These companies put untoward pressure on countries and individuals to open up their markets and buy their products. The effect is to close down the exploration of alternatives. GM companies charge a technology fee for their seeds. They also tie farmers into using the herbicides, for example, to which the crop is tolerant.
1.12 WHO EATS GM FOOD?	**Anyone who lives in or visits a country which allows the marketing of GM food products is likely to have eaten GM foods or derivatives. This includes the European Union.**
Views for	The chances are, all of us may have eaten some GM food ingredient at some time, especially if we have been to the US, where GM food products have been widely used since 1996.

	Public 'concern' about GM food is not as widespread as the pressure groups suggest. GM products remain almost exclusively absent from supermarket shelves, due largely to perceived consumer demand and supermarkets' competitive interests. This denies people choice. The Food Standards Agency's (FSA's) 'Citizen's Jury' concluded by a 9:6 majority that GM foods should be allowed in the UK.
Views against	In the USA, where most GM food is produced, there is no labelling. The majority of the GM soya and maize will be used in animal feed which is also not labelled there. In other countries, such as South Africa and India, GM cotton is the main or only GM crop – and this is not eaten. People in the US and Canada have been eating GM foods since 1996, though because companies do not have to label GM foods there, many consumers were unaware of this and did not have the opportunity to object. Foods and animal feed containing GM ingredients, largely grown in North America, have the potential to be traded right around the world. Current EU laws state that food that contains over 1 per cent of GM ingredients has to be labelled as containing GM, but derivatives of GM food, such as processed oils, do not have to be labelled. The Food Standards Agency's Citizen's Jury, while concluding by a majority that GM foods should be available to buy in the UK, agreed unanimously that more time is needed to understand the long-term implications of GM crops before farmers start to grow them in the UK and that growing GM crops in the UK would be irreversible and might eventually reduce choice.
1.13 DO WE EAT GM UNKNOWINGLY?	**There is no way of telling if a food contains GM ingredients by tasting it, and there are different**

	attitudes to when and how to label foods to inform consumers. **Different countries take different positions on labelling of foods containing GM foods or derivatives from them (eg oil from GM maize). In the US, labelling is not mandatory. In the UK and the rest of the European Union, food must be labelled if it contains more than 1 per cent of GM ingredients. In future, EU law is likely to require that any food that contains more than 0.9 per cent of products of GM *origin* must be labelled.**
Views for	Labelling of GM is not a question of safety, but of consumer choice. Labelling regulation to allow consumer choice has been in place for years in the EU. The extended traceability and labelling regulations currently being drafted in the EU will include all products of GM origin, regardless of the presence of DNA or protein. This will further enhance the ability of consumers and farmers to decide if they want to buy food or feed produced from a GM crop, or not. Despite years of consumption by hundreds of millions of people, no health impacts have been identified. This prompted the World Health Organization (WHO) to state recently that there are no "…scientifically documented cases in which the consumption of these foods has had negative human health effects." International experts generally agree that the food safety risks for foods from genetically modified crops are no more than from their non-GM counterparts. The Royal Society concluded that there is no evidence that GM foods cause specific allergic reactions.
Views against	Strict controls are essential to allow informed consumer choice. At the moment it is difficult to track the origin of food ingredients because trade is worldwide and GM and non-GM foods and derivatives may be mixed together. However, systems to do so can and are being put in place, and are welcomed by both consumer and retailer. So far, the health effects of eating GM food are not being monitored.

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