

## DONOR

### NAME

Phyllomedusa Bicolor

Giant Leaf Frog

### KEY GENES

DRS B1

### PROPERTIES OF GENE PRODUCTS

B1dermaseptin protein kills bacteria and fungi.

### GM USE

To prevent blight and bacterial diseases in potato crops.

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## DONOR

### NAME

Bacillus Thuringiensis

Species of Bacterium

### KEY GENES

Cry

### PROPERTIES OF GENE PRODUCTS

Crystal protein kills caterpillars, maggots and beetles that eat the protein.

### GM USE

To make crops such as maize, cotton and soybean resistant to herbivorous insects.

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## DONOR

### NAME

Bos primigenius

Cattle

### KEY GENES

Cym

### PROPERTIES OF GENE PRODUCTS

Chymosin is a protease enzyme that curdles milk.

### GM USE

GM bacteria produces the enzyme which is purified and used to make cheese. Previously chymosin was extracted from the stomachs of calves so cheese made in this way was not acceptable to vegetarians. 80-90% of the cheese sold in Britain is made with GM bovine chymosin.

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## DONOR

### NAME

Agrobacterium sp

C4 Strain

### KEY GENES

C4 EPSPS

### PROPERTIES OF GENE PRODUCTS

EPSP synthase performs a crucial metabolic step in plant chloroplasts. The bacterial version is undamaged by glyphosate.

### GM USE

To make crops resistant to glyphosate so it can be used as a weed killer without harming the maize, cotton, or soybean crops.

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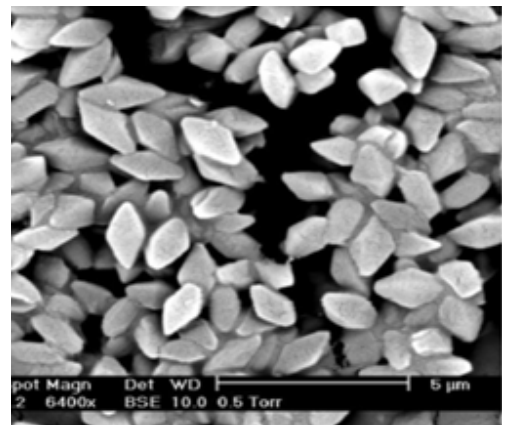
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## DONOR

### NAME

Bacillus Subtilis

### KEY GENES

cspB

### PROPERTIES OF GENE PRODUCTS

Cold shock protein B helps organisms metabolize normally during abiotic stress.

### GM USE

To produce higher yields for maize crops and produce a higher yield under drought conditions.

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## DONOR

### NAME

Nephila Clavipes

Golden Orb Weaver

### KEY GENES

MaSp

### PROPERTIES OF GENE PRODUCTS

High-strength silk fiber for webs.

### GM USE

Gene is switched on in mammary glands of GM goats to mass-produce the silk fiber for artificial tendons and ligaments and for bullet-proof vests and parachutes.

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## DONOR

### NAME

Hepatitis B virus

### KEY GENES

HBsAg

### PROPERTIES OF GENE PRODUCTS

Surface antigen of virus stimulates an immune response in humans if injected or given orally.

### GM USE

GM potatoes eaten raw in small quantities boost immunity to hepatitis B. This is an inexpensive and efficient way to deliver vaccines in developing countries

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## DONOR

### NAME

Aequorea Victoria

Jellyfish

### KEY GENES

GFP

### PROPERTIES OF GENE PRODUCTS

Green Fluorescent Protein glows under UV light.

### GM USE

The gene is extensively used as a marker to reveal which organisms have taken up a foreign gene and in which tissues in the gene is switched on. Spin-offs include Glo-Fish<sup>TM</sup>) and NeonMice sold as pets in the USA.

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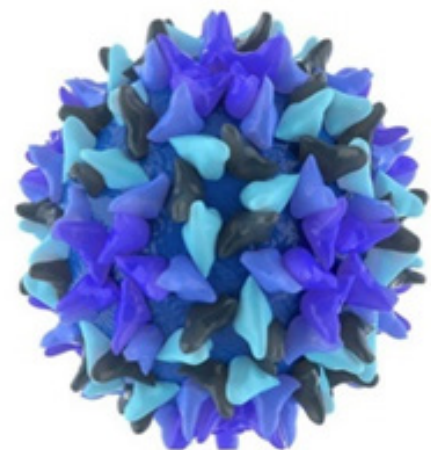
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## DONOR

### NAME

Homo sapiens

Human

### KEY GENES

Mutated version of BRCA1 and activated Ras oncogene.

### PROPERTIES OF GENE PRODUCTS

Cause cancer. The products of the normal versions of the genes repair DNA mutation and suppress tumors.

### GM USE

Creating cancer research models GM mice engineered to carry the mutant alleles are used to study cancer and treatments for cancer.

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## DONOR

### NAME

Homo sapiens

Human

### KEY GENES

Normal al-leles coding for insulin, lactoferrin, Factor IX, anti-thrombin III and gluco-sidase.

### PROPERTIES OF GENE PRODUCTS

Insulin controls blood glucose concentration.

Lactoferrin is an antimicrobial found in colostrum and milk.

Factor IX helps blood clot.

Anti-thrombin III stops blood clotting.

Glucosidase in lysosome function.

### GM USE

Pharmaceutical drugs

Insulin from GM bacteria treats diabetics.

Lactoferrin in GM rice treats diarrhea in children.

Factor IX from GM sheep's milk treats people with haemophilia B.

Anti-thrombin III from GM goats' milk is used as an anti-coagulant in surgical procedures. Glucosidase from GM carrot cells in culture treats people with Gaucher's disease.

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## DONOR

### NAME

Homo sapiens

Human

### KEY GENES

CFTR

RPE65

### PROPERTIES OF GENE PRODUCTS

CFTR protein allows normal mucus production in lungs and gut.

RPE65 protein is needed in rods and cones for normal vision.

### GM USE

Gene therapy

Normal CFTR allele is introduced into lung epithelial cells of cystic fibrosis patients.

RPE65 inserted into retinal cells of blind patients with Leber's Congenital Amaurosis restored sight.

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## DONOR

### NAME

Androctonus Austrails Hector

Species of arachnid

Scorpion

### KEY GENES

AaHIT1

### PROPERTIES OF GENE PRODUCTS

Toxic to insects but not harmful to mammals.

### GM USE

To kill insects on GM cotton crops.

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## DONOR

### NAME

Coat protein (CP) of Papaya Ringspot

Virus (PRSV)

### KEY GENES

PRSV HA 5-1

### PROPERTIES OF GENE PRODUCTS

Provide resistance to PRSV.

### GM USE

Confer resistance to PRSV.

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## DONOR

### NAME

Zoarcus americanus

Ocean Pout

### KEY GENES

Antifreeze glycoproteins or AFGP gene

### PROPERTIES OF GENE PRODUCTS

Permit survival in subzero environments.

### GM USE

The promoter for the antifreeze protein gene is used in conjunction with the growth hormone taken from a Chinook salmon, which leads to a higher concentration of the growth hormone in the blood, causing the genetically modified salmon to grow much more rapidly than it would naturally.

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## DONOR

### NAME

Polygalacturonase (PG)

### PROPERTIES OF GENE PRODUCTS

Antisense DNA keeps Polygalacturonase (PG), the major cell wall degrading enzyme of tomato fruit, from forming.

### GM USE

By inhibiting the development of PG, the fruit should stay fresher longer.

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## DONOR

### NAME

Agrobacterium tumefaciens

Species of Bacterium

### KEY GENES

CaMV 35S

### PROPERTIES OF GENE PRODUCTS

Code for coat protein (CP) encoding sequences from zucchini yellow mosaic virus (ZYMV) and the watermelon mosaic virus (WMV2).

### GM USE

Provides protection against these viruses.

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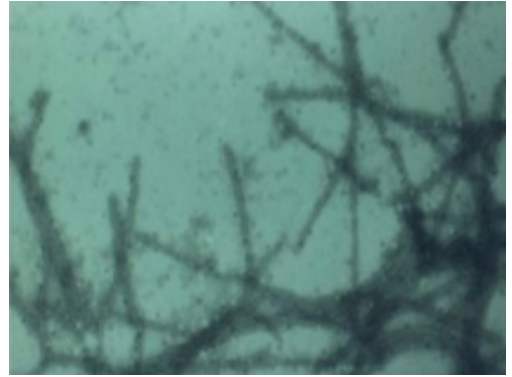




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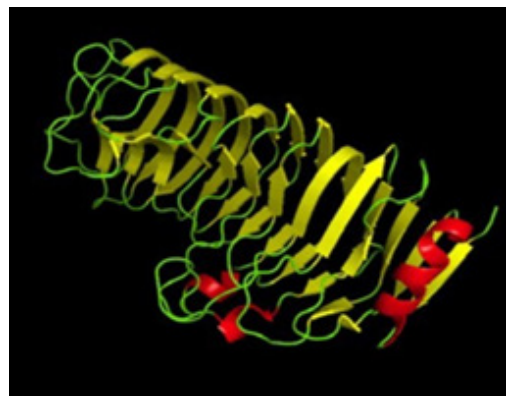
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## DONOR

### NAME

Agrobacterium tumefaciens

### KEY GENES

CP4 EPSPS (5-enolpyruvylshikimate-3-phosphate synthase) encoding gene.

### GM USE

Inhibits action of glyphosate, the key ingredient in RoundUp (Monsanto).

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## RECIPIENT

### NAME

Zea mays

Maize or Sweetcorn

### SUITABILITY AS A GM RECIPIENT

Major food source for animals and humans. Also a source of starch and sugars for processed food. Many insects attack the crop, its yield falls in drought conditions and the crop must be kept free of weeds.

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## DONOR

### NAME

Delta-12 oleate desaturase

### KEY GENES

gm-fad2-1; FAD2-1

### PROPERTIES OF GENE PRODUCTS

An antisense RNA strand is created to silence the formation of the enzyme that converts oleic acid into linoleic acid using the omega-6 desaturase encoding gene.

### GM USE

Inhibits conversion of oleic acid to linoleic acid, keeps oleic acid levels high for healthier oil.

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## RECIPIENT

### NAME

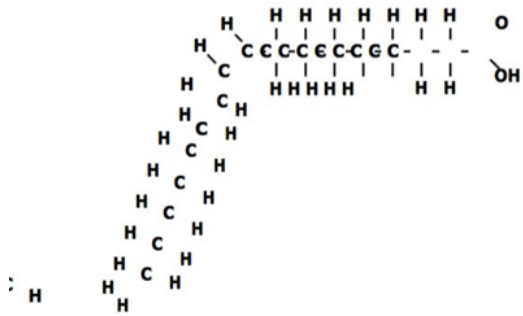
Gossypium hirsutum

Cotton

### SUITABILITY AS A GM RECIPIENT

Important crop for textile fibers but many insect pests attack it and the crop must be kept free of weeds.

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## RECIPIENT

### NAME

Glycine max

Soybean

### SUITABILITY AS A GM RECIPIENT

Major food source for animals and humans as a source of protein in processed food. Many insects attack the crop, and the crop must be kept free of weeds.

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## RECIPIENT

### NAME

Daucus carota

Carrot

### SUITABILITY AS A GM RECIPIENT

Field-grown crops generally have been found to be unsafe to use as vehicles for production of pharmaceutical drugs, but carrot cells grown in culture in bioreactors are a new 'expression platform' for human proteins that can be used as medical drugs.

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## RECIPIENT

### NAME

Solanum tuberosum

Potato

### SUITABILITY AS A GM RECIPIENT

Major carbohydrate food source in Europe and America. Potatoes are easy to grow and can give high yields but suffer from many diseases such as blight, which lower yields. They can be engineered to make vaccines, but these must be grown under cover to prevent gene flow to other potatoes and to stop antigenic potatoes accidentally entering the human food chain.

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## RECIPIENT

### NAME

Oryza sativa

Rice

### SUITABILITY AS A GM RECIPIENT

Major food source in Asia and a suitable vehicle for therapies like treating children with diarrhea (rice enhanced with human lactoferrin) and preventing vitamin A deficiency (genes from maize or daffodil and a soil bacterium).

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## RECIPIENT

### NAME

Capra aegagrus hircus

Goat

### SUITABILITY AS A GM RECIPIENT

Female goats produce plenty of milk. A gene is linked to a promoter to switch the gene on in the mammary glands, so that the protein product appears in the milk. So-called 'spider-goats' produce silk in their milk for medical and military application. Other GM goats produce a drug, human anti-thrombin III, used as an anticoagulant in surgery.

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## RECIPIENT

### NAME

Ovis aries

Sheep

### SUITABILITY AS A GM RECIPIENT

Female sheep produce plenty of milk. A gene for a pharmaceutical protein is linked to a promoter to switch the gene on in the mammary glands, so that the protein appears in the milk. Sheep have been used to make factor IX to treat sufferers of haemophilia B.

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## RECIPIENT

### NAME

Mus musculus

Mouse

### SUITABILITY AS A GM RECIPIENT

It is a genetic model organism with a well-known, fully sequenced genome. As a mammal its genome is very similar to that of humans. Mice are small so are cheap to feed and house. Many GM techniques applicable to humans or farm mammals are first tried on mice. Fluorescent GM NeonMice are sold as pets in the USA.

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## RECIPIENT

### NAME

Homo sapiens

Human

### SUITABILITY AS A GM RECIPIENT

People suffering from genetic diseases caused by two recessive non-functional alleles can be treated with gene therapy. The dominant functional allele is inserted into affected somatic cells. Trials have included treatment of cystic fibrosis and Leber's congenital amaurosis. The limitation on treating a human with another human allele is whether the cells that need the foreign DNA are accessible (e.g. lung epithelium) and stable (not replaced every few days).

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## RECIPIENT

### NAME

Rerio danio

Zebrafish

### SUITABILITY AS A GM RECIPIENT

It is a genetic model organism with a well-known, fully-sequenced genome. It is a useful, simple vertebrate for research. GM zebrafish expressing genes for fluorescent proteins are on sale in the pet trade in the USA marketed as Glo-Fish™.

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## RECIPIENT

### NAME

Escherichia coli

### SUITABILITY AS A GM RECIPIENT

GM bacteria divide rapidly in a fermenter to produce proteins like human insulin and bovine chymosin for cheese-making.

E. coli is a genetic model organism with a well-known, fully sequenced genome. Its plasmids are widely used as vectors. However, some strains of E. coli are pathogenic, and the GM process may involve inserting antibiotic resistance genes into the bacteria.

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## RECIPIENT

### NAME

Carica papaya

Papaya

### SUITABILITY AS A GM RECIPIENT

The papaya is cultivated in most tropical countries. However, it is susceptible to the Papaya Ringspot Virus (PRSV). Since 1992, PRSV has destroyed nearly all non-GMO papaya in Hawaii.

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## RECIPIENT

### NAME

Salma Salar

Salmon

### SUITABILITY AS A GM RECIPIENT

Wild salmon disappeared from many rivers during the twentieth century due to overfishing and habitat change.

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## RECIPIENT

### NAME

Fragaria x ananassa

Strawberry

### SUITABILITY AS A GM RECIPIENT

Strawberries grow in temperate climate regions which are capable of having low temperatures and frost.

Spring frosts cause damage to the flowers of the plant leading to poor yields and erratic fruiting. Frost on average causes millions of dollars in damages and drives up the price of the fruit for the consumer.

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## RECIPIENT

### NAME

Glycine max

Soybean

### SUITABILITY AS A GM RECIPIENT

Soybean oil is hydrogenated as a preservative to extend shelf life. High oleic oil does not need to be hydrogenated.

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## RECIPIENT

### NAME

Solanum lycopersium

Tomato

### SUITABILITY AS A GM RECIPIENT

Tomatoes are picked as green fruits and artificially ripened by ethylene treatment, which gives a ripe tomato color but not the full vine-ripened tomato flavor.

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## RECIPIENT

### NAME

Cucurbita pepo

Summer squash

### SUITABILITY AS A GM RECIPIENT

Viral diseases are a limiting factor to squash production, particularly during summer and fall months. Mosaic viruses include the cucumber mosaic cucumovirus (CMV), zucchini yellow mosaic potyvirus (ZYMV) and watermelon mosaic potyvirus (WMV2).

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**RECIPIENT**

**NAME**

**SUITABILITY AS A GM RECIPIENT**

**RECIPIENT**

**NAME**

Glycine max

Soybean

**SUITABILITY AS A GM RECIPIENT**

Soybeans chief rivals in the field are weeds. If the plant can resist herbicide spraying, the control of weeds is much easier



**RECIPIENT**

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