

Genetic Engineering

1.6



Genetic Engineering

Learning Outcomes:

1. Genetic information can be transferred from one cell to another artificially
2. To understand the stages involved in genetic engineering to produce a product useful to mankind (e.g. Insulin)

Genetic Engineering

- It is possible to transfer genes from one organism to another. For example, genes from human cells can be placed into bacteria. This allows the bacteria to make substances which are useful to humans.
- This process is called genetic engineering.

Advantages of Genetic Modification

Genetic modification of organisms can produce:

-Higher crop yield

-More fruit per plant

-Resistance to pesticides and diseases

-Extend shelf-life

-Important chemicals (e.g. insulin) for therapeutic purposes

Examples

- The anti-freeze gene, found in a species of fish called a Flounder, can be spliced and inserted into strawberries.

Animal \longrightarrow Plant
(reprogrammed)



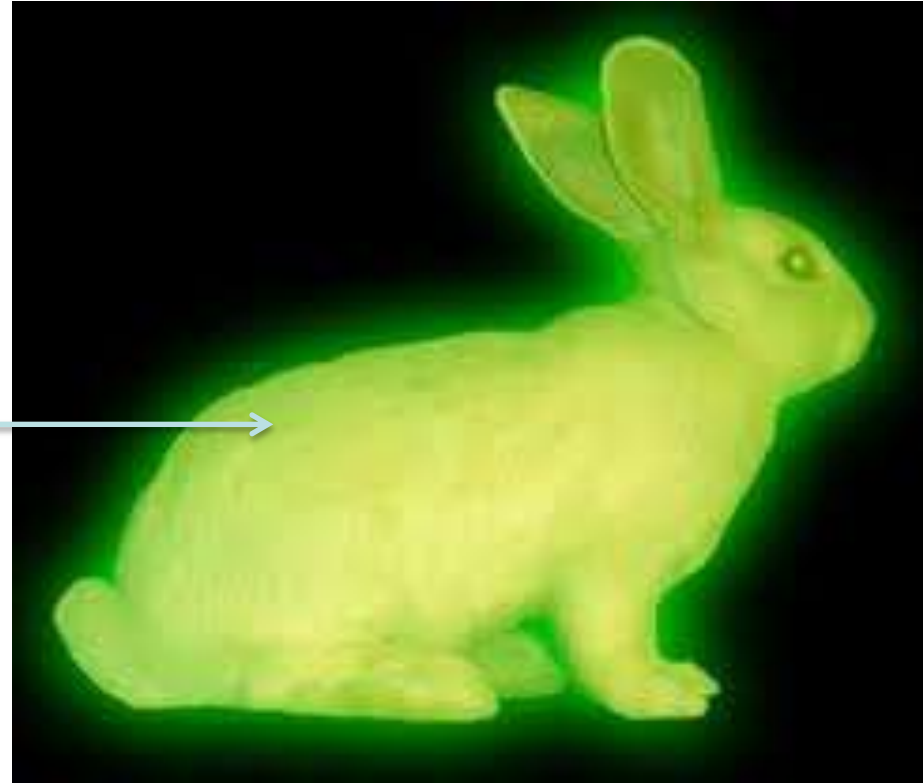
- An insect-killing toxin gene, found in a bacterium, into maize, cotton or Rape seed.

Bacteria \longrightarrow Plant
(reprogrammed)



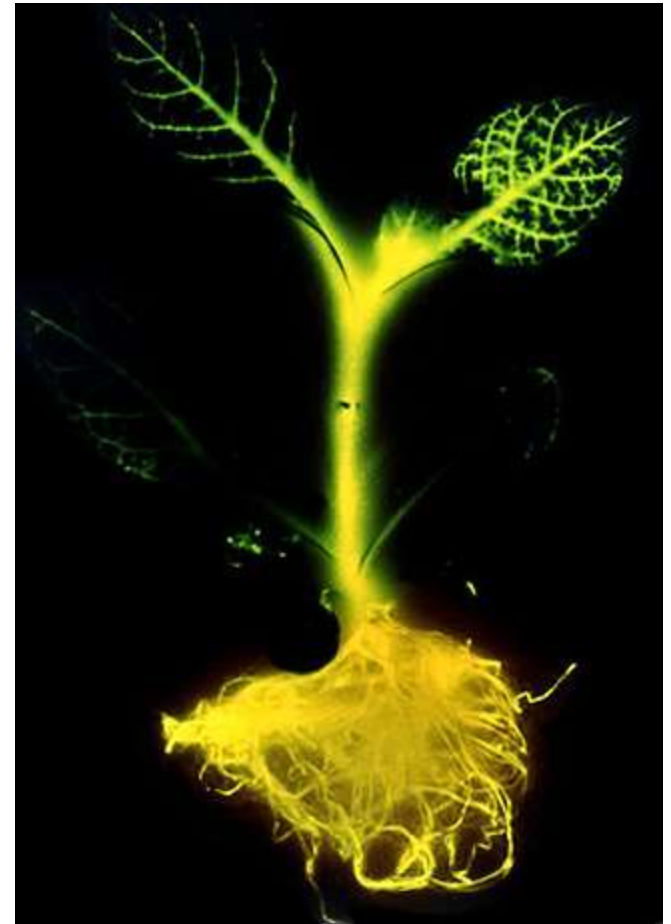
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Bioluminescent



GM crops

- Tobacco plants that glow in the dark when they need watering have even been produced.



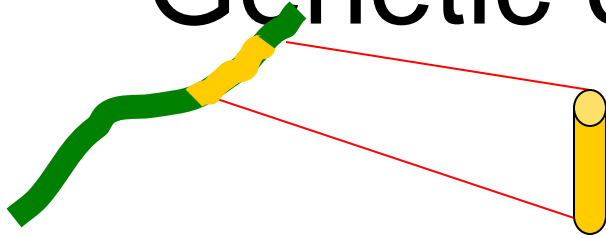
Why use Bacteria?

1. Multiply rapidly so product is produced quickly.
2. Manufacture large quantities of a desired product.

Insulin Production by GM

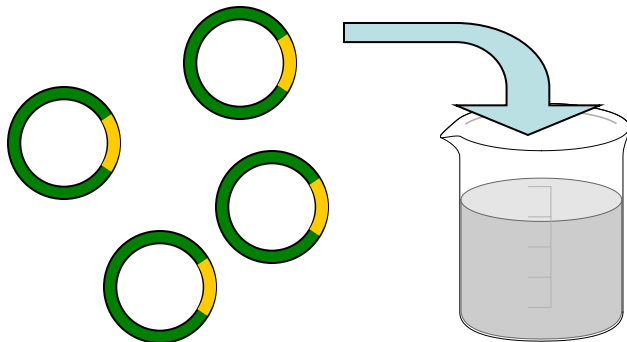
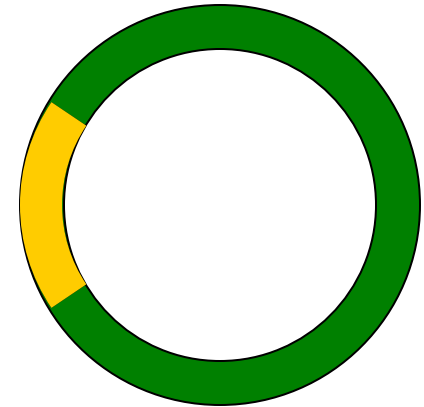
- Insulin is a hormone produced by the pancreas to help control blood sugar levels.
- Diabetics can't produce enough insulin and often need to inject it.

Genetic engineering - Insulin



Step 1: Using ENZYMES "cut out" the part of the human chromosome that is responsible for producing insulin.

Step 2: Using another enzyme cut open a ring of bacterial DNA (a "plasmid"). Other enzymes are then used to insert the piece of human DNA into the plasmid.



Step 3: Place the plasmid into a bacterium which will start to divide rapidly. As it divides it will replicate the plasmid and make millions of them, each with the instruction to produce insulin. Commercial quantities of insulin can then be produced.

How can bacteria produce human insulin?

Bacteria can be genetically engineered to produce human insulin.



Click "**start**" to find out how.

start



Activity

- Page 35 – 36
- Copy out the diagrams into your jotter
- Use a different colour for the:
 1. Human chromosome;
 2. Bacterial plasmid;
 3. Insulin gene.

Genetic Engineering-steps

1. Gene of insulin is selected.
2. Gene is cut out of chromosome using special enzyme (endonuclease).
3. Plasmid is removed from bacterial cell.
4. Circular plasmid DNA is cut open.
5. Gene is inserted into plasmid and the circle is re-inserted using another enzyme (ligase).
6. Plasmid is inserted into bacterial cell.
7. Bacteria replicate all containing plasmid and genes of interest.
8. All bacteria will then produce desired product using information from gene of interest.

What is the sequence of events in making bacteria produce a human protein?

1

The bacterium is added to a fermenter and replicates.

2

The gene is inserted into the plasmid.

3

The gene is removed with enzymes.

4

The gene for the human protein is identified.

5

A bacterial plasmid is cut open with enzymes.

6

The bacteria produce the required protein.

7

The modified plasmid is inserted into the bacterium.

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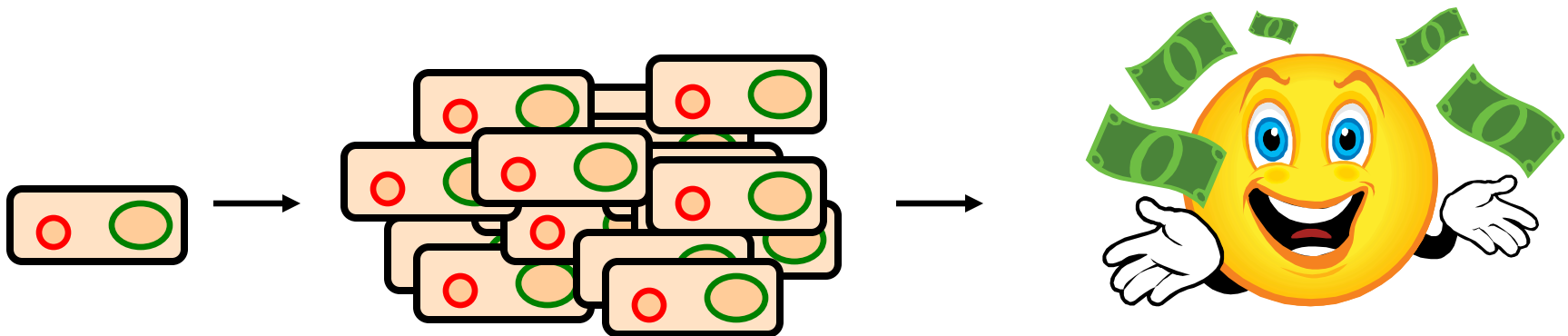
C

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Genetic Engineering-applications

- Once a bacterial cell has been reprogrammed it can reproduce under optimum conditions to make billions of cells that will produce huge quantities of the required product.
- The product can then be isolated, purified and sold.



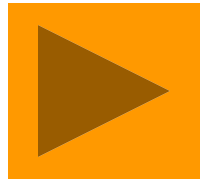
Other Examples

- Human Growth Factor –
- Hormone made usually by the pituitary gland. Given to children who do not produce enough to prevent reduced growth and Dwarfism.

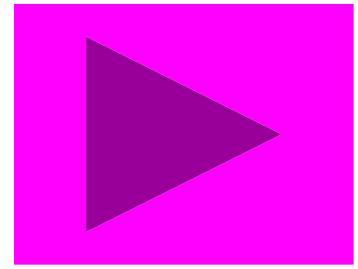
- Factor VIII –
- Chemical present in blood that helps clotting of blood at wounds.

Genetic Engineering-applications

- Example 1- Insulin
 - Insulin is a hormone (protein) required by humans to control blood sugar levels.
 - It is usually made by cells in the pancreas however diabetic people cannot produce insulin and it must be taken artificially.
- Example 2- Human Growth Hormone
 - HGH is required by humans to control normal growth and development.
 - It is made by cells of the pituitary gland but again can be injected by children who do not make enough by themselves.



Need for Insulin

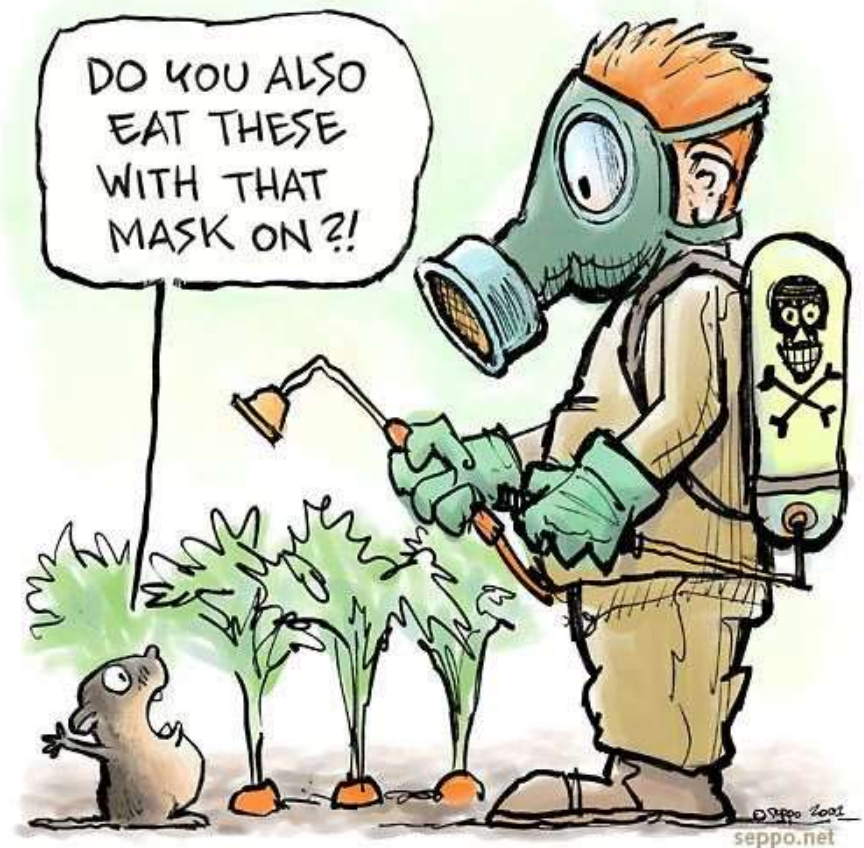


- Previously insulin was isolated from pigs and cattle.
- This is not the same as human insulin and caused allergic reactions in some.
- Production in this way could not keep up with the demand as diabetes is becoming more common in older generations and people are living longer therefore more insulin is required.

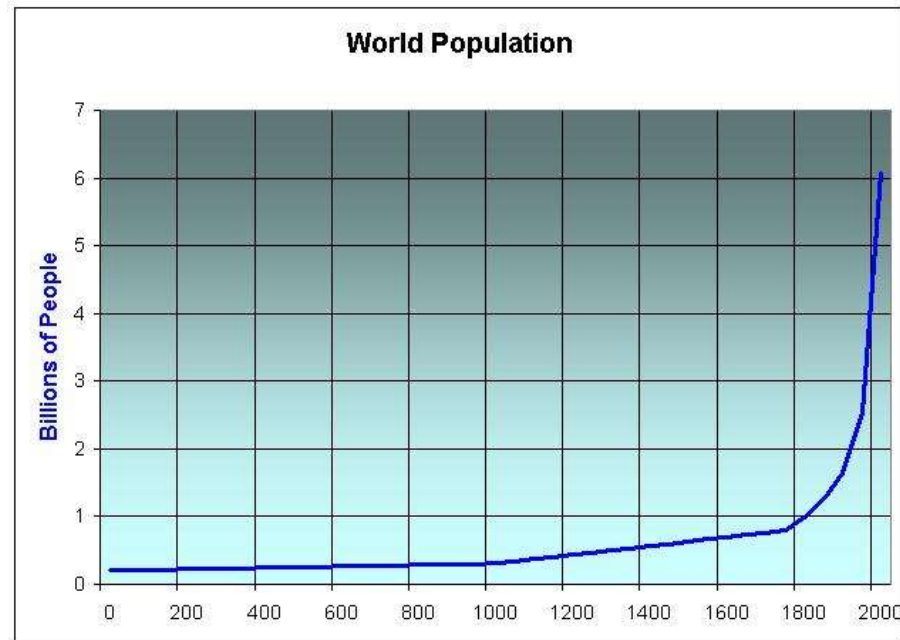
- Genetic modification has been used in food production for many years. It involves the transfer of genes to crop plants. These plants are known as GM crops.



- Some GM crops are resistant to certain herbicides (weed killers) while others are resistant to insect pests.



- There are strong arguments for and against genetic modification of crop plants. GM crops generally have increased yields, useful for feeding a growing population.

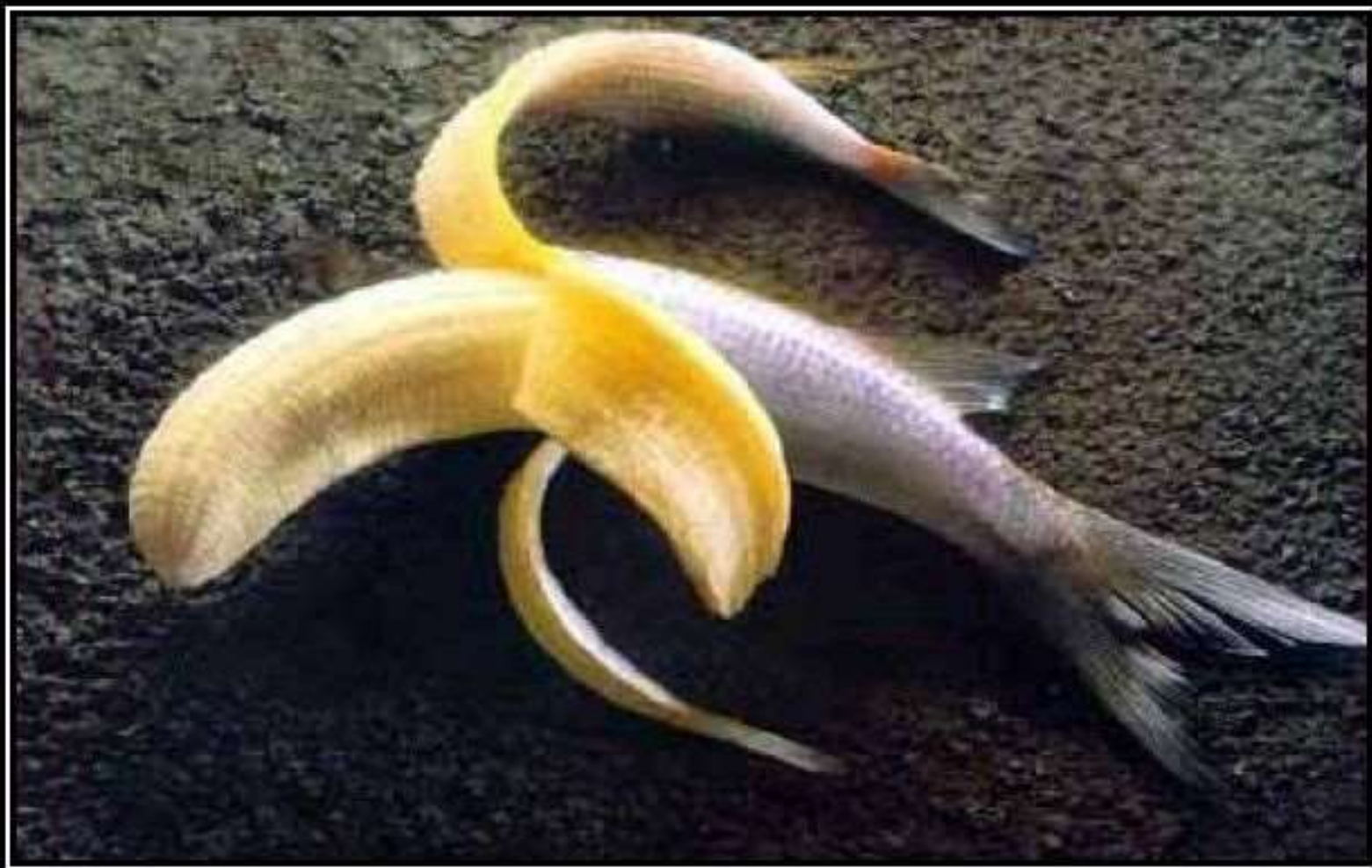


- However, some people are excited by the almost limitless possibilities of genetic modification, while others believe the process is unethical and should be banned.



- There are concerns about the effect of GM crops on wild flowers and insects, and whether eating GM food may harm human health.





GENETIC ENGINEERING

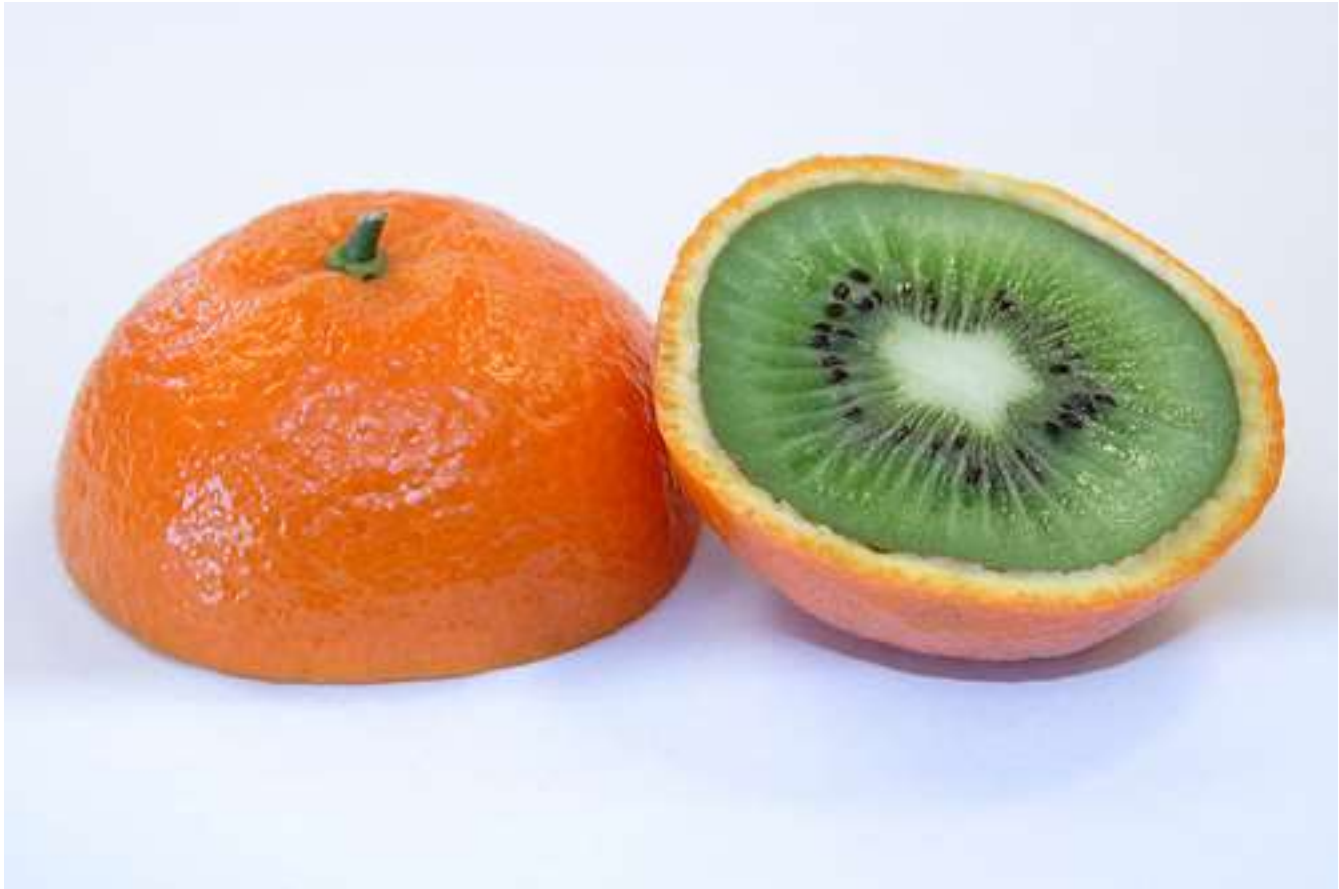
A Perfect Day for Bananafish



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GM Animals - glofish



GM Animals



Spider Goat



GM Animals - glofish









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cama



Liger



Frogdile

Title: The use of Genetic Engineering to produce...

- Write a report on either:
 1. Transgenic (GM) crops;
 2. Transgenic (GM) animals.

The report should be 50 - 100 words.

- (a) You should first define/describe the process of genetic engineering (the biological application);
- (b) Give examples of the application in use (e.g Insulin production in humans...);
- (c) Then, go on to outline the impact of this application on the environment/society. This could be a negative, positive impact or both.

You could use one/some of the examples below in your report:

- golden rice, less toxic rape seed oil, tomatoes with longer shelf life, blight resistant potatoes.
- bird resistance to bird flu.