Genetic Engineering for Health Care

Replicating microbes

Genetically-engineered microbes, such as bacteria and yeast, can easily be replicated on a large scale.

Tanks called **fermenters** or **bioreactors** are used. These enable the microbes to be grown, or ‘cultured’, at optimum pH, temperature and nutrient levels.

The product can be continuously removed and purified.

Producing insulin with bacteria

How can bacteria produce human insulin?

Bacteria can be genetically engineered to produce human insulin.

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

start

Genetically-engineering bacteria

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 removed with enzymes.
3. The modified plasmid is inserted into the bacterium.
4. The gene is inserted into the plasmid.
5. A bacterial plasmid is cut open with enzymes.
6. The gene for the human protein is identified.
7. The bacteria produce the required protein.

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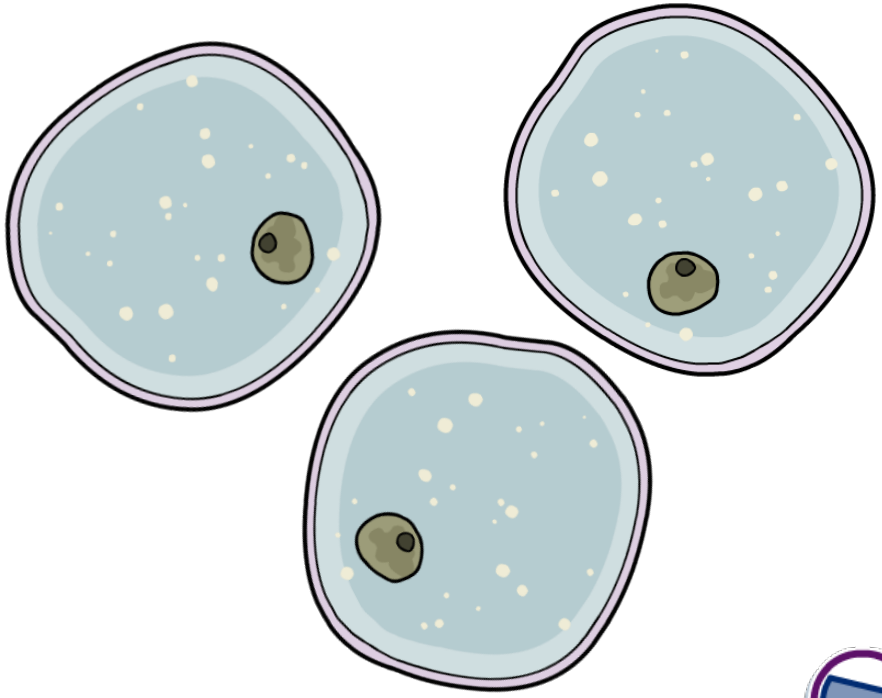
C solve

Alternatives to bacteria

Genetically-engineered bacteria are unable to make proteins that are identical to those found naturally in humans, despite having human DNA.

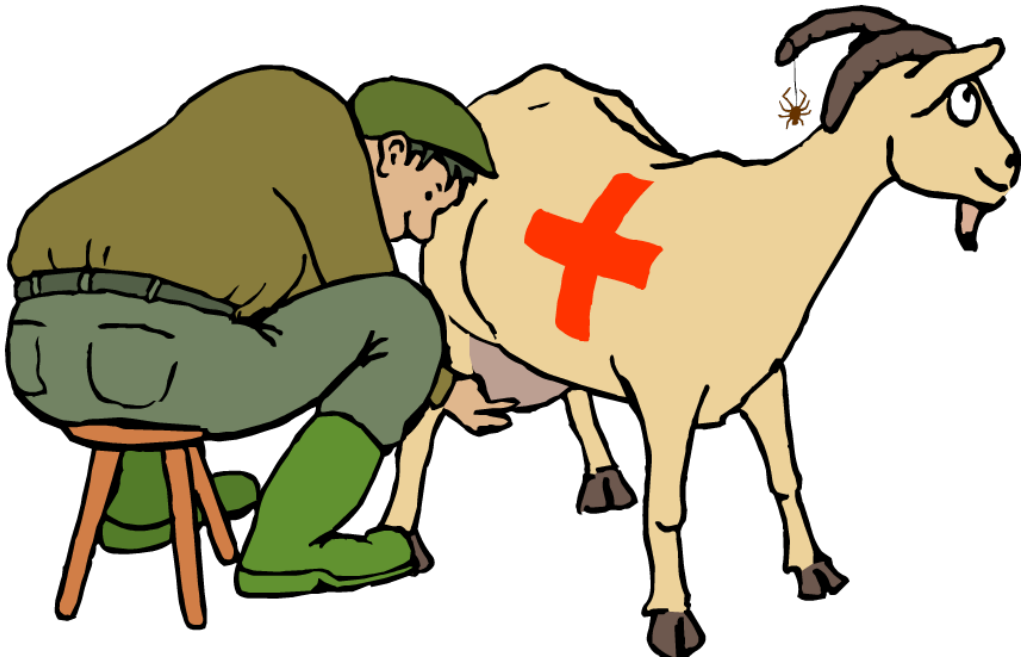
This is because the *way* in which bacteria make proteins is different to the way that mammals make proteins.

A better way is to use genetically-engineered **mammalian cells** grown in industrial bioreactors. These produce proteins that are identical to the ones found in humans.



What is transgenics?

Foreign DNA, including DNA from humans, can be inserted into animals. This is called **transgenics**.



The protein encoded by the DNA can then be produced in a specific tissue of the transgenic animal at a specific time.

This method produces higher levels of antibody, more easily and cheaply, than by using genetically-engineered bacteria or mammalian cells.

Transgenic goats

For example, the gene for a human antibody can be introduced into goats.

Additional controlling DNA is also introduced, so the human antibody is only produced in the goat's mammary gland at a certain time.

The antibody is then expressed in the goat's milk, where it can be purified and used to treat diseases.

Which came first?

The eggs of this transgenic chicken contain a human antibody that could one day help to treat skin cancer.

What advantages does this method of producing antibodies have?

Do you think it is right for animals to be genetically engineered to help treat human diseases?