Artificial cloning in plants

People may want to clone a plant deliberately, that is produce lots of identical new plants. Cloning of plants has many important commercial implications: it allows a successful variety of a plant to be produced commercially and cheaply in a short space of time and on a massive scale.

**Cuttings**

The simplest way to clone a plant involves taking a cutting. A branch from the parent plant is cut off, its lower leaves removed and the stem planted in damp compost. Plant hormones are chemical messengers produced in glands and carried by the blood to specific organs in the body. These hormones are often used to encourage new roots to develop. The cutting is usually covered in a clear plastic bag at this stage to keep it moist and warm. After a few weeks, new roots develop and a new plant is produced. The method is easy enough for most gardeners to do successfully.

**Tissue culture**

Another way of cloning plants is by tissue culture, which works not with cuttings but with tiny pieces from the parent plant. Sterile agar jelly with plant hormones and lots of nutrients is needed. This makes tissue culture more expensive and difficult to do than taking cuttings.

**Artificial cloning in animals**

People may want to clone an animal deliberately. Just like the cloning of plants, the cloning of animals has many important commercial implications. It allows an individual animal with desirable features, such as a cow that produces a lot of milk, to be duplicated several times. But the process is more complex than it is with plants.

**Embryo transplants**

A developing embryo is removed from a pregnant animal at an early stage, before the embryo’s cells have had time to become specialised. The cells are separated from one another. They are then grown for a while in a laboratory and transplanted into host mothers.
When the offspring are born, they are identical to each other and genetically related to the original pregnant animal. They are not related to their host mothers because they contain different genetic information.

**Adult cell cloning**

Adult cell cloning involves several steps:

1. the nucleus is removed from an unfertilised egg cell and discarded
2. the nucleus is removed from an adult body cell and injected into the egg cell
3. an electric shock is applied to make the egg cell begin to divide to form an embryo
4. while it is still a ball of cells, the embryo is inserted into the womb of an adult female
5. the embryo continues to grow and develop

The new individual is genetically identical to the animal that donated the nucleus from one of its body cells.

The cloning process of 'Dolly the sheep'

Dolly the sheep was the first mammal to be cloned using adult cell cloning. She was born in the UK in 1996 and died in 2003. She was produced using the nucleus from an udder cell, but other cells such as skin cells may also be used.

**Genetic modification**

Genetic modification, or GM for short, is not the same as cloning. Although cloning techniques are used in genetic engineering, the two things should not be confused. This table shows some of the differences.
Key differences between cloning and genetic engineering

<table>
<thead>
<tr>
<th>Cloning</th>
<th>Genetic engineering</th>
</tr>
</thead>
<tbody>
<tr>
<td>produces exact copies</td>
<td>produces a unique set of <strong>genes</strong>: The basic unit of genetic material inherited from our parents. A gene is a section of DNA which controls part of a cell's chemistry - particularly protein production.</td>
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<tr>
<td>genes copied within the same species</td>
<td>genes can be swapped across species</td>
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How it works

Certain enzymes, proteins which speed up chemical reactions, can cut pieces of **DNA** [DNA: The material inside the nucleus of cells, carrying genetic information. DNA stands for Deoxyribonucleic Acid. ] from one organism, and join them into a gap in the DNA of another organism. This means that the new organism with the inserted genes has the genetic information for one or more new characteristics. For example, the organism might produce a useful substance, or be able to carry out a new function. We say that the organism has been **genetically modified**.

Genetic modification works in animals, plants and microorganisms. For example, new genes can be transferred to crop plants to make GM crops. Some GM crops are resistant to certain herbicides (weed killers) while others are resistant to insect pests.

The animation shows how the method can be used to produce bacteria that make insulin. This is a human hormone and valuable to people with diabetes. Bacteria reproduce quickly, so a lot of insulin can be made quickly.

Problems

There are strong arguments for and against genetic modification of crop plants. GM crops generally have increased yields, useful for feeding a growing population. Tobacco plants that glow in the dark when they need watering have even been produced.

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.