

# Cloning

The process of creating an identical copy of a cell, tissue, or organism. The copy is called a clone. There are different methods of cloning of plants and animals.

## Methods of Plant Cloning

► **Plants** can be cloned in 2 ways:

1. Cutting
2. Tissue Culture

### 1. **Cuttings:**

Cutting from parent plants can be used to make **genetically identical** copies of the **parent plant**. This method is a quick and simple method and has been used by gardeners for many years.



1 Spray mother/donor plant a few days before taking cuttings



2 Make a sharp diagonal cut below a leaf node



3 Dip cutting into Clonex Rooting Gel then straight into Root Riot cube



4 Spray with Clonex Mist until roots develop, then feed with Clonex Clone Solution

### 2. **Tissue Culture:**

► **Tissue culture** also known as **micropropagation**. It allows you to clone many plants at the same time.

► This process involves:

I. Obtaining very small pieces of plants called **explants**.

II. Growing the explants **in vitro (outside a living organism)** using sterile **agar jelly**. This jelly contains nutrients and plant hormones.

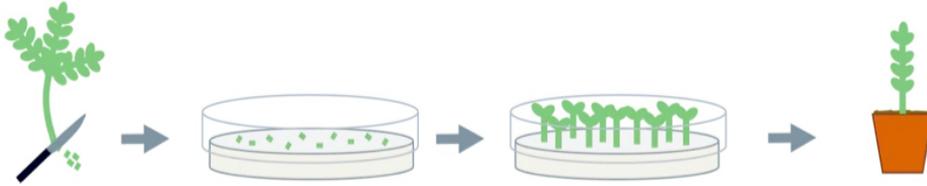
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III. The cells grow into small masses of plant tissue (**callus tissue**).

IV. This tissue grows and forms **plantlets**. These plantlets can then be transferred to **potting trays**, where they develop into full plants.

- Tissue culture is often used to **preserve** rare plant species or grow lots of plants in **nurseries**.



Explants are extracted from the plant.

Explants are grown in a petri dish with agar growth medium and hormones.

Explants grow into little plantlets, each genetically identical to the parent.

Plantlets are transferred into soil so they can continue to grow.

## Methods of Animal Cloning

Animals can be cloned by 2 methods

1. Embryo Transplantation
2. Adult cell cloning

### 1. Embryo Transplantation

- Animals can be cloned using embryo transplants. In this process, the animals are cloned through a method that begins with **sexual reproduction**.

- The process for embryo transplants are below:

I. **Egg** cells from one animal with **desirable traits** are artificially fertilised with **sperm cells** from another animal with desirable traits.

II. Then, the **zygotes** are allowed to develop into **early embryos**.

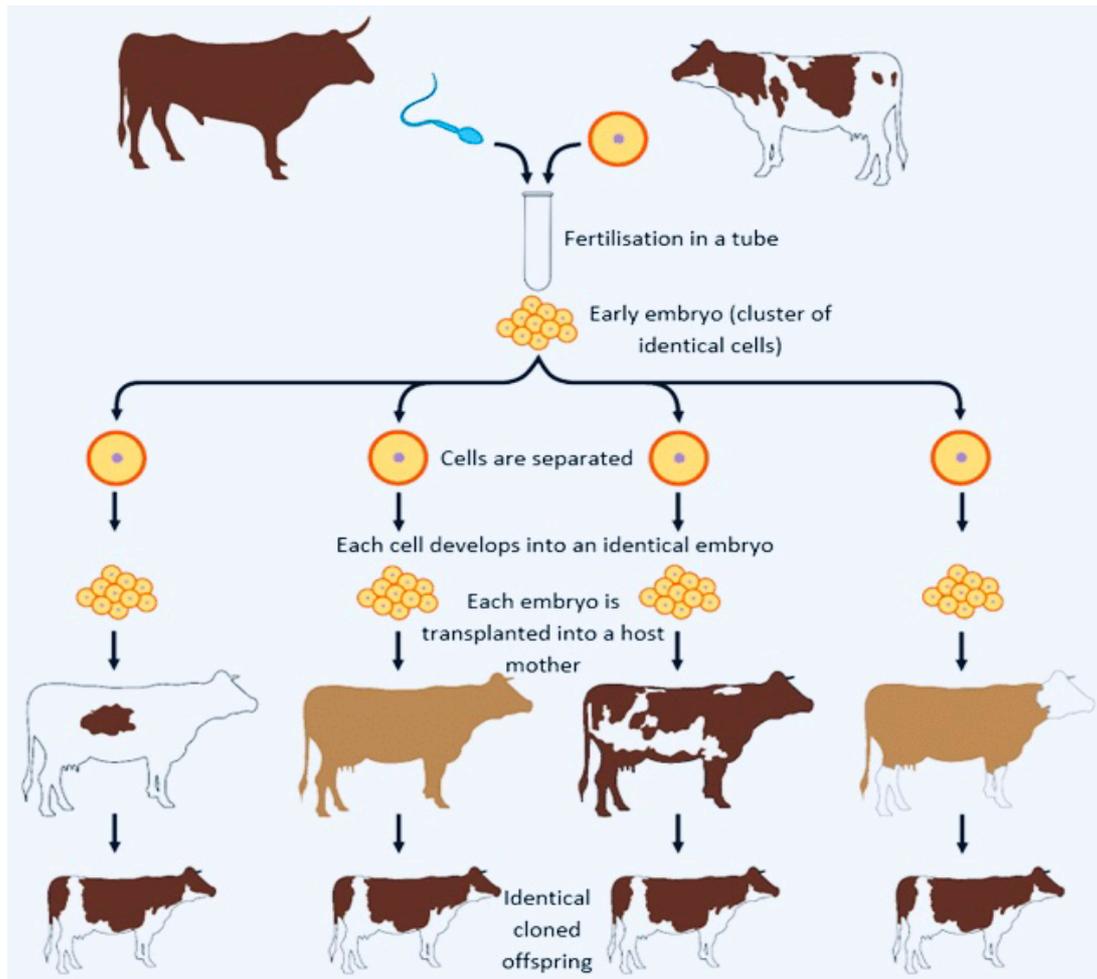
III. The early embryo is divided into multiple embryos before the cells become **specialised**.

IV. These identical embryos are transplanted into **different host mothers**, where the embryos will grow and develop.

V. The host mothers will give birth to identical offspring, which are **clones** of each other.

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- Animal cloning aims to achieve superior characteristics, but embryo cloning isn't always the preferred method. Since it starts with a sperm and an egg, there's no certainty that the offspring will consistently exhibit the desired traits.



## 2. Adult-Cell Cloning

- The first mammal to be cloned was a sheep called Dolly, in 1996, using adult-cell cloning.
- An advantage of adult-cell cloning is that we are able to clone animals with desirable traits.
- The process of adult-cell cloning:
  - I. Remove a cell from the adult animal.
  - II. Separate the nucleus from the cell (which contains the genetic information of the cloned animal)

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III. Take an **unfertilised** egg cell from an adult female of the same species and remove the nucleus.

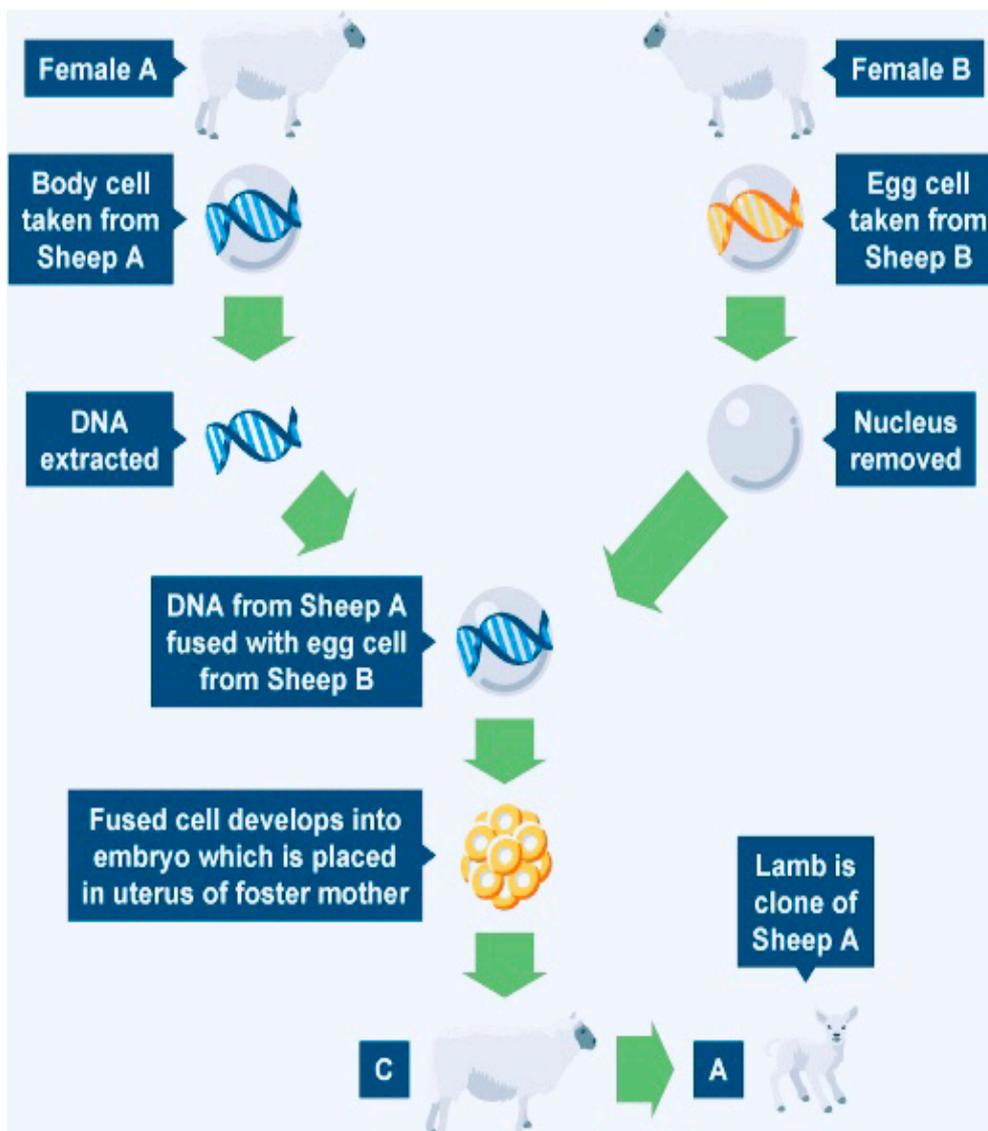
IV. Take the nucleus from the original adult cell and insert it into the egg cell.

V. After inserting the nucleus from the original adult cell into the unfertilised egg, the egg cell now contains only the genetic information of the animal intended for cloning.

VI. Administer a small **electric shock to the egg cell**. This stimulates the cell to divide by mitosis, leading to the formation of an embryo.

VII. Insert the embryo into a **surrogate mother** to continue development.

VIII. When the animal is carried to term, the host mother will give birth to a clone that is genetically identical to the original adult animal.



► **Advantages of Adult Cell Cloning:**

- **Produces animals with desired characteristics:** cloning can produce animals that are transgenic and primed to produce **required proteins** for the body. As clones are produced, they will have the **exact genetic information** as the parent cell, so the required characteristics can easily be chosen. Hence, they can be used to produce human proteins. **For example, cows and sheep** can produce milk containing useful human proteins, chickens can produce proteins in their egg whites and antibodies for illnesses like arthritis can also be produced through this method.

- **Helps prevent extinction:** it can be used to save animals from **extinction**. **Endangered species** can be cloned, in order to increase the population and then can breed to continue growing animals.

► **Disadvantages of Adult Cell Cloning**

- **Difficult process:** Adult cell cloning is a difficult process and requires lots of intense effort.

- **Reduction in genetic variation:** As genetically identical organisms are produced, there is an increased risk of reducing the genetic variation. This will reduce the size of the **gene pool** and lead to an increase in the incidence of **genetic diseases**.

- **Ethical issues** – there are ethical queries. Are humans playing God by cloning? Will the cloning of animals finally transition into the cloning of humans?