

Cloning

4.6.2.5 · Inheritance, variation and evolution · revision notes

Four ways to produce genetically identical organisms: cuttings, tissue culture, embryo transplants and adult cell cloning, plus their benefits, risks and ethical objections. This is in GCSE Biology only, not in Combined Science. Expect 'describe the steps' and 'evaluate' questions.

Key facts

- Clone = genetically identical organism
- Cuttings: older, simple method used by gardeners; many identical plants from one parent
- Tissue culture: small groups of plant cells → identical plants; preserves rare species; used in nurseries
- Embryo transplant: split the cells of an early embryo before they specialise → transplant into host mothers
- Adult cell cloning: remove egg nucleus → insert adult body cell nucleus → electric shock → embryo → womb
- An adult cell clone is genetically identical to the animal that gave the body cell nucleus
- Main risk: no variation, so a disease could affect all the clones

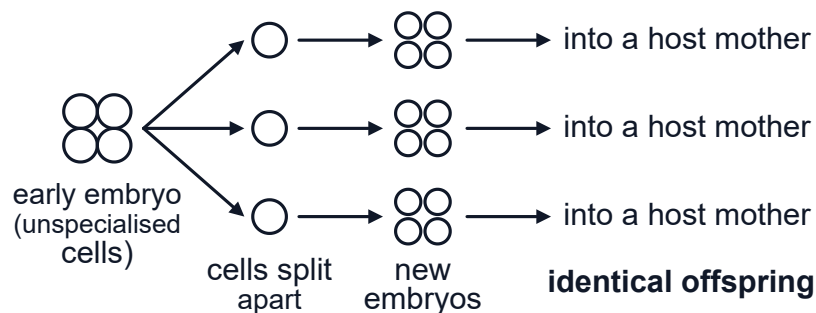
Notes

Cloning plants

- **Cuttings:** an older, simple method used by gardeners to produce many identical new plants from a parent plant. A piece of the plant, such as a shoot with leaves, is cut off and grown into a new plant.
- **Tissue culture:** small groups of cells from part of a plant are used to grow identical new plants, on a sterile medium containing nutrients and plant hormones.
- Tissue culture is important for **preserving rare plant species**, and is used commercially in **plant nurseries**.

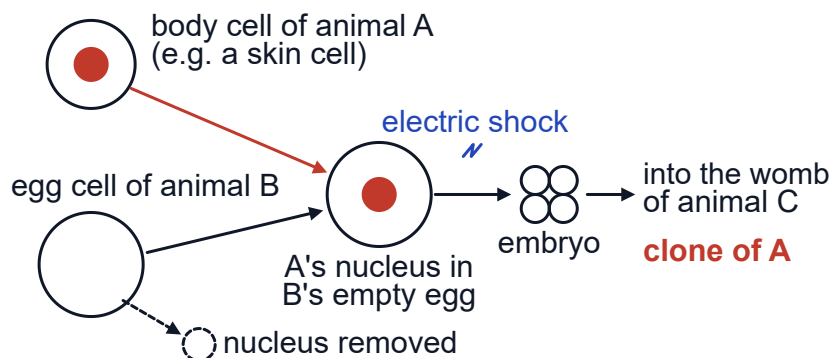
Cloning animals

- **Embryo transplants:** cells are split apart from a developing animal embryo **before they become specialised**, then the identical embryos are transplanted into **host mothers**. The offspring are identical to each other, but not to their parents.



Embryo transplants: one embryo split into several identical ones.

- **Adult cell cloning**, step 1: the **nucleus is removed** from an **unfertilised egg cell**.
- Step 2: the **nucleus from an adult body cell**, such as a skin cell, is inserted into the egg cell.
- Step 3: an **electric shock** stimulates the egg cell to divide to form an embryo. The embryo cells contain the same genetic information as the adult skin cell.
- Step 4: when the embryo has developed into a ball of cells, it is inserted into the **womb** of an adult female to continue its development.



Adult cell cloning: the clone is identical to the animal that gave the nucleus.

Benefits, risks and objections

- **Benefits:** many identical plants or animals with useful characteristics can be produced quickly; rare species can be preserved; cloned animals might be used to produce substances for medicine.
- **Risks:** clones have **no genetic variation** between them, so a new disease or a change in the environment could affect them all; some cloned animals have had health problems or shorter lives.
- **Objections:** some people have **ethical** objections, such as concern for animal welfare or fears that it could lead to cloning humans.

Don't lose marks

- ✗ Saying the clone is identical to the egg donor or the host mother. It is identical to the nucleus donor.

- ✗ Saying the egg is fertilised in adult cell cloning. It is an unfertilised egg cell, stimulated to divide by an electric shock.
- ✗ Saying calves from embryo transplants are identical to their parents. They are identical to each other.
- ✗ Forgetting that the embryo cells must be split before they become specialised.

More tips

Memory tricks

- Adult cell cloning in four words: out, in, shock, womb.
- A clone matches whoever gave the NUCLEUS.
- Embryo transplant offspring are copies of each other, not of their parents, because the embryo came from sexual reproduction.

Exam technique

- In 'describe' questions, give the steps in the right order.
- Use precise terms: unfertilised egg cell, nucleus, body cell, electric shock, embryo, womb, host mother.
- For 'evaluate' questions, include benefits, risks and an ethical point, then give a conclusion.

What each grade needs

What you need to be able to do, from the first marks up to the top grade.

Grade 3

Define a clone

An organism that is genetically identical to another.

Grade 4

Describe taking cuttings

Gardeners cut a piece from a parent plant and grow it into a new, identical plant.

Grade 5

Describe tissue culture and its uses

Small groups of cells from part of a plant are grown into identical plants, to preserve rare species or for nurseries.

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