

Sexual and asexual reproduction, and reproduction in plants

Revision notes · Sexual and asexual reproduction, flower structure, pollination, fertilisation, seeds, germination and asexual reproduction in plants.

For Pearson Edexcel International GCSE Biology 4BI1 and Science (Double Award) 4SD0. **Biology only** is not in the Double Award and is only examined on Paper 2.

Sexual and asexual reproduction, and reproduction in plants Spec 3.1-3.7

Sexual and asexual reproduction Spec 3.1, 3.2

Sexual reproduction involves two parents. Each parent makes **gametes** (sex cells). A male gamete and a female gamete join in **fertilisation**. The offspring inherit genes from both parents, so they show variation and are genetically different from each other and from the parents.

Asexual reproduction involves only one parent and no gametes. The new cells are made by mitosis, so the offspring are **genetically identical** to the parent. Genetically identical offspring are called clones.

Sexual and asexual reproduction compared		
	Sexual reproduction	Asexual reproduction
Number of parents	Two	One
Gametes	Male and female gametes fuse	No gametes involved
Offspring	Genetically different from each other and from the parents	Genetically identical to the parent (clones)
Variation in the population	Lots of variation	Very little variation

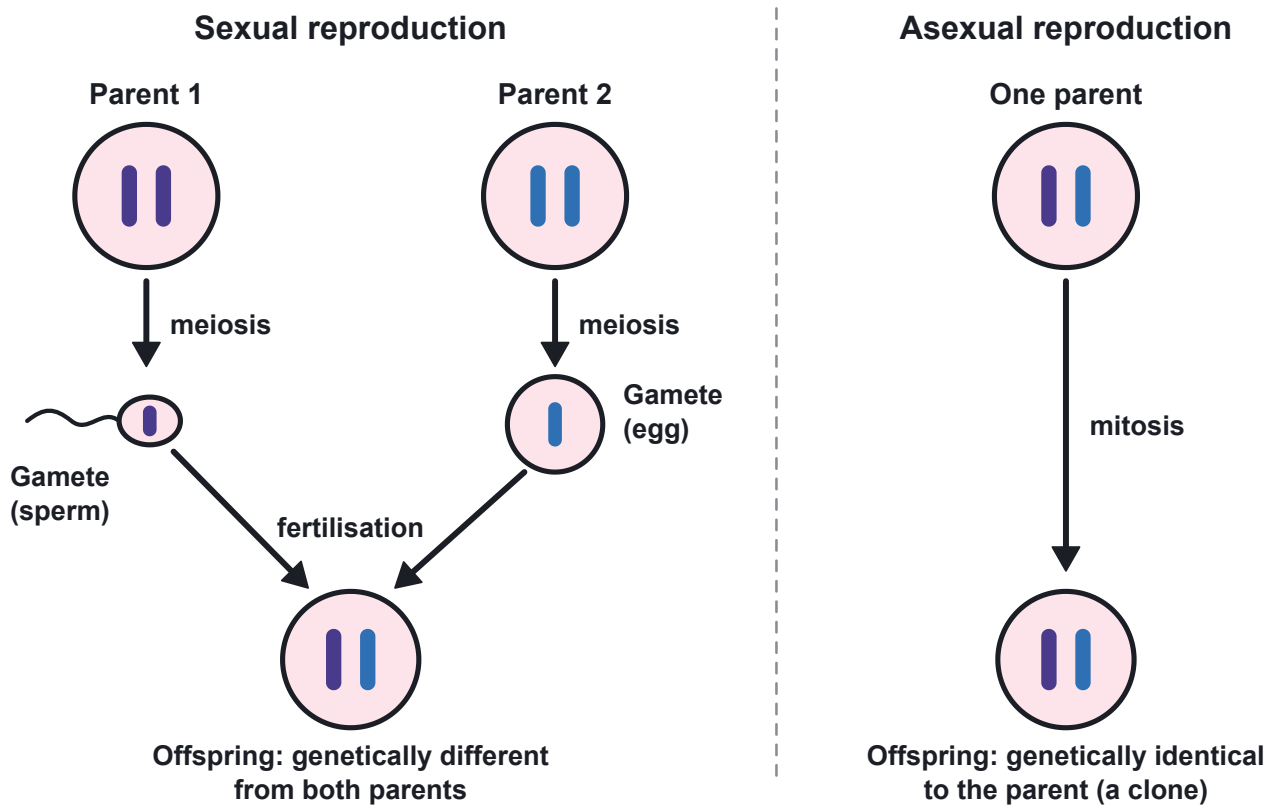
Common mistake: Do not write that asexual offspring are 'similar' to the parent. The mark is for 'genetically identical'.

Fertilisation

In fertilisation, the nucleus of a male gamete fuses with the nucleus of a female gamete. This produces a single cell called a **zygote**.

The zygote then divides again and again by cell division (mitosis). The ball of cells that forms develops into an **embryo**.

1. A male gamete fuses with a female gamete (fertilisation).
2. This produces a zygote.
3. The zygote undergoes cell division (mitosis).
4. The cells develop into an embryo.

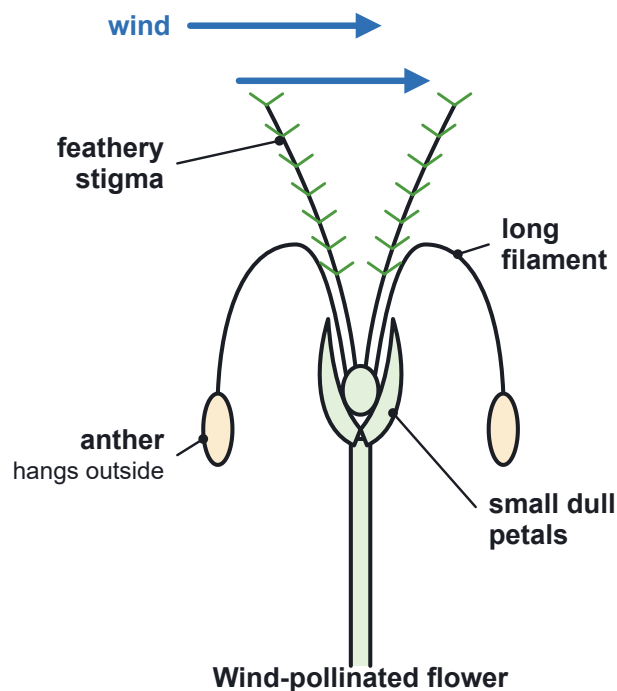
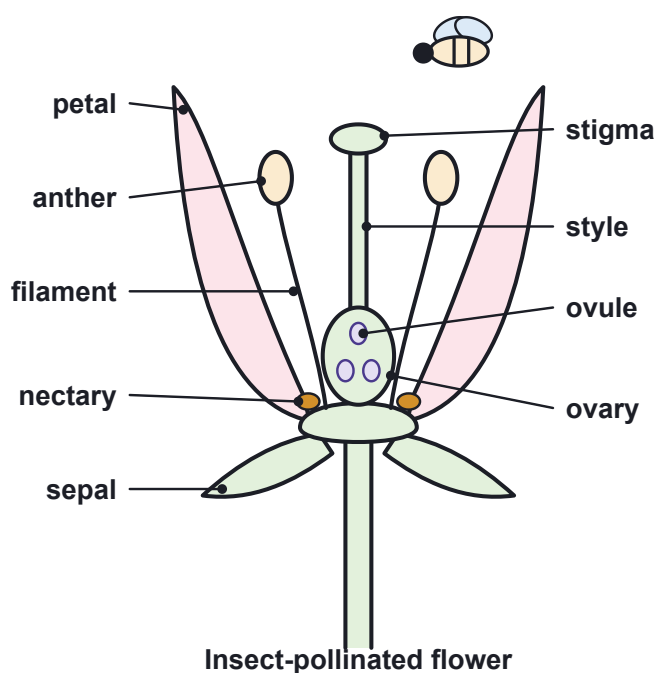


Sexual reproduction mixes genetic information from **two parents**; asexual reproduction makes **genetically identical** clones from one parent.

Insect- and wind-pollinated flowers Spec 3.3

The flower is the organ of sexual reproduction in a flowering plant. **Pollination** is the transfer of pollen grains from an anther to a stigma. Pollen contains the male gametes. The male part of the flower is the **stamen** (anther and filament). The female part is the **carpel** (stigma, style and ovary). Flowers are adapted to be pollinated either by insects or by the wind.

Parts of a flower	
Part	Function
Petals	Large and brightly coloured in insect-pollinated flowers to attract insects
Sepals	Protect the flower while it is a bud
Anther	Makes and releases pollen. Part of the stamen (male part), held on a filament
Filament	Holds up the anther
Stigma	Where pollen lands. The top of the carpel (female part)
Style	Joins the stigma to the ovary
Ovary	Contains the ovules
Ovule	Contains the female gamete (egg cell)
Nectary	Makes sugary nectar to attract insects



An **insect-pollinated** flower has large petals and nectaries inside; a **wind-pollinated** flower has **anthers and feathery stigmas hanging outside**.

Insect-pollinated and wind-pollinated flowers compared

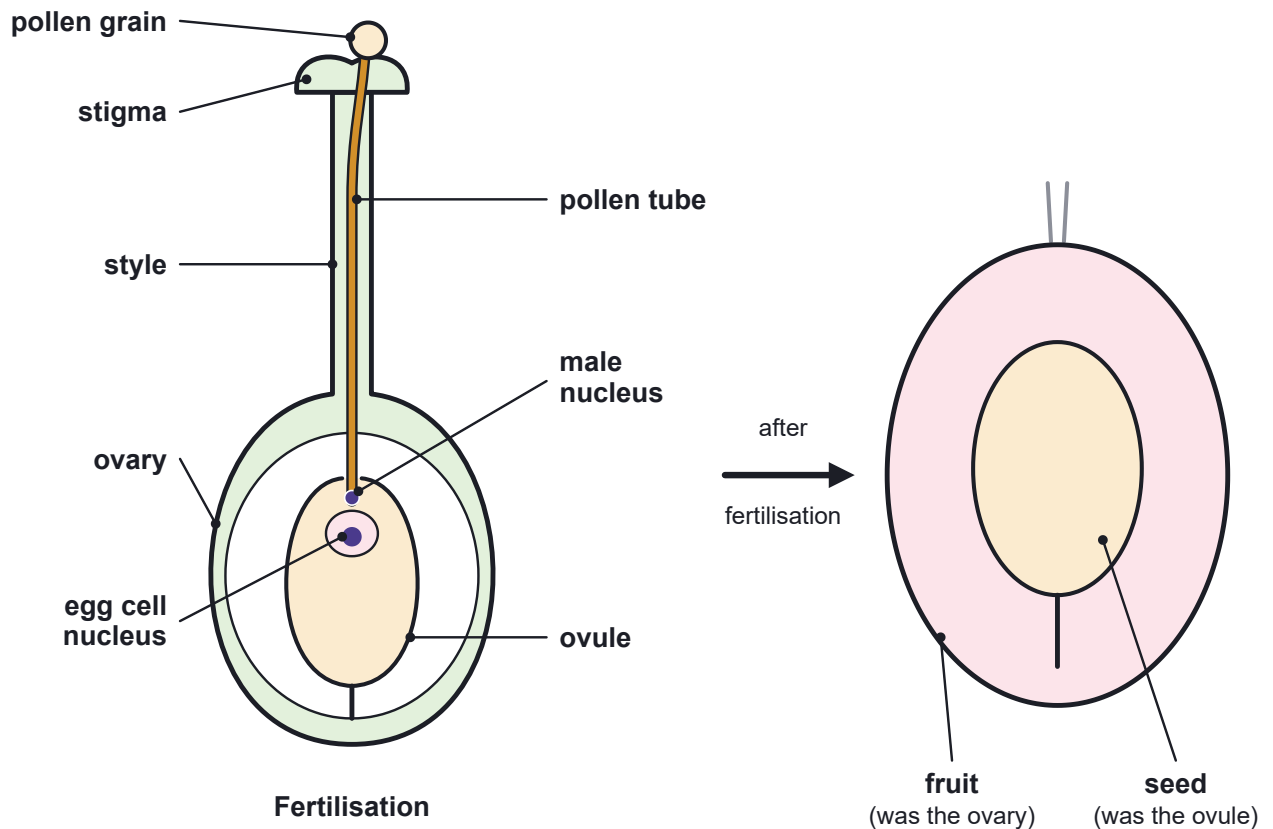
Feature	Insect-pollinated flower	Wind-pollinated flower
Petals	Large, brightly coloured and often scented to attract insects	Small, green or dull, or absent. No need to attract insects
Nectar	Nectaries make nectar as food for insects	No nectar
Anthers	Inside the flower, so insects brush against them	Hang outside the flower on long filaments, so the wind can blow the pollen away
Pollen	Sticky or spiky so it sticks to insects. Smaller amounts	Light and smooth so it is carried by the wind. Made in very large amounts
Stigma	Sticky and inside the flower, so pollen from the insect sticks to it	Large and feathery, hanging outside the flower, to catch pollen from the air

Exam tip: For an 'explain' question, give the feature and the reason. For example: 'feathery stigma (1) gives a large surface area to catch pollen from the air (1)'.

Fertilisation, seeds and fruits Spec 3.4

After pollination, a pollen grain on the stigma grows a **pollen tube**. The tube grows down through the style towards the ovary and into an ovule. The nucleus of the male gamete travels down the tube.

1. A pollen grain lands on the stigma (pollination).
2. A pollen tube grows out of the pollen grain and down through the style to the ovary.
3. The pollen tube enters an ovule.
4. The nucleus of the male gamete fuses with the nucleus of the female gamete (egg cell) in the ovule. This is **fertilisation**.
5. The fertilised ovule develops into a **seed**. The ovary develops into a **fruit** which surrounds the seed.



The **pollen tube** carries the male nucleus to the egg cell. After fertilisation the **ovule becomes the seed** and the **ovary becomes the fruit**.

Common mistake: Pollination is not the same as fertilisation. Pollination is the transfer of pollen to the stigma. Fertilisation is the fusion of the male and female gametes.

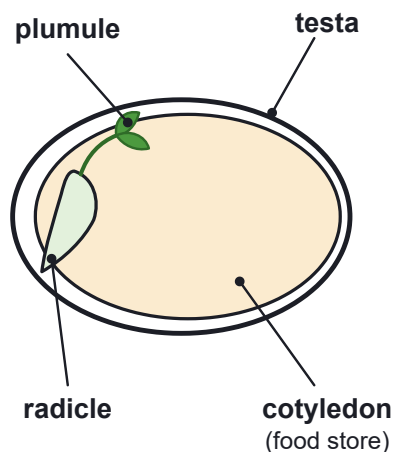
Germination and food reserves Spec 3.6

Germination is when a seed begins to grow into a seedling. A seed contains an embryo plant and a store of food. The **food reserves** are mainly starch and oils (fats), with some protein, stored in the cotyledons or in a separate food store.

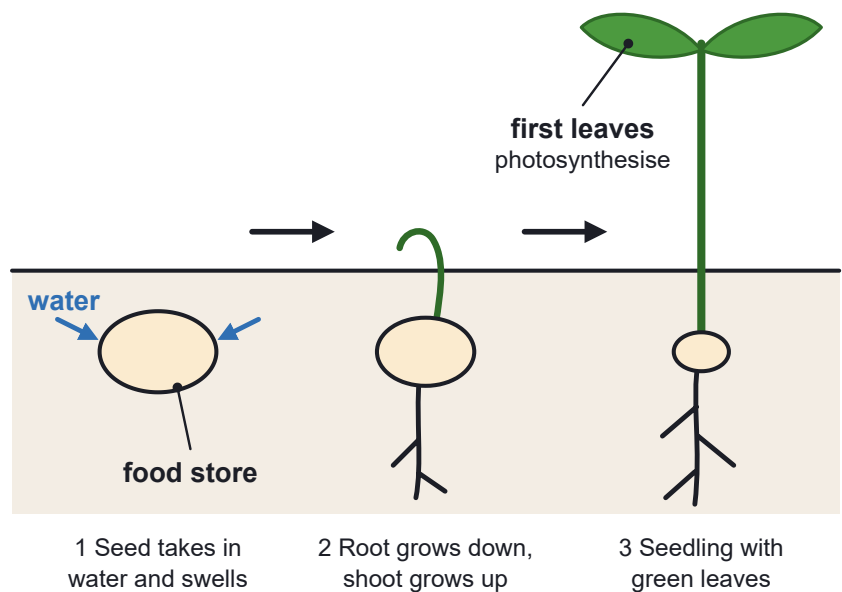
When a seed germinates, **enzymes** break down the stored food into smaller soluble molecules: starch to sugars, oils to fatty acids and glycerol, and proteins to amino acids. Sugars are used in **respiration** to release energy. The products are also used to make new cells for growth.

A young seedling cannot make its own food at first. It uses the food reserves until its first leaves have grown above the soil and can carry out photosynthesis.

1. The seed takes in water and swells.
2. Enzymes break down the stored starch and oil into soluble substances.
3. The root grows downwards and the shoot grows upwards, using energy from respiration.
4. The first leaves reach the light and start to photosynthesise.
5. The seedling no longer relies on the food reserves.



Inside a bean seed



Food reserves are used until photosynthesis begins

The seed's **food reserves** are used up as it germinates, until the first leaves can **photosynthesise**.

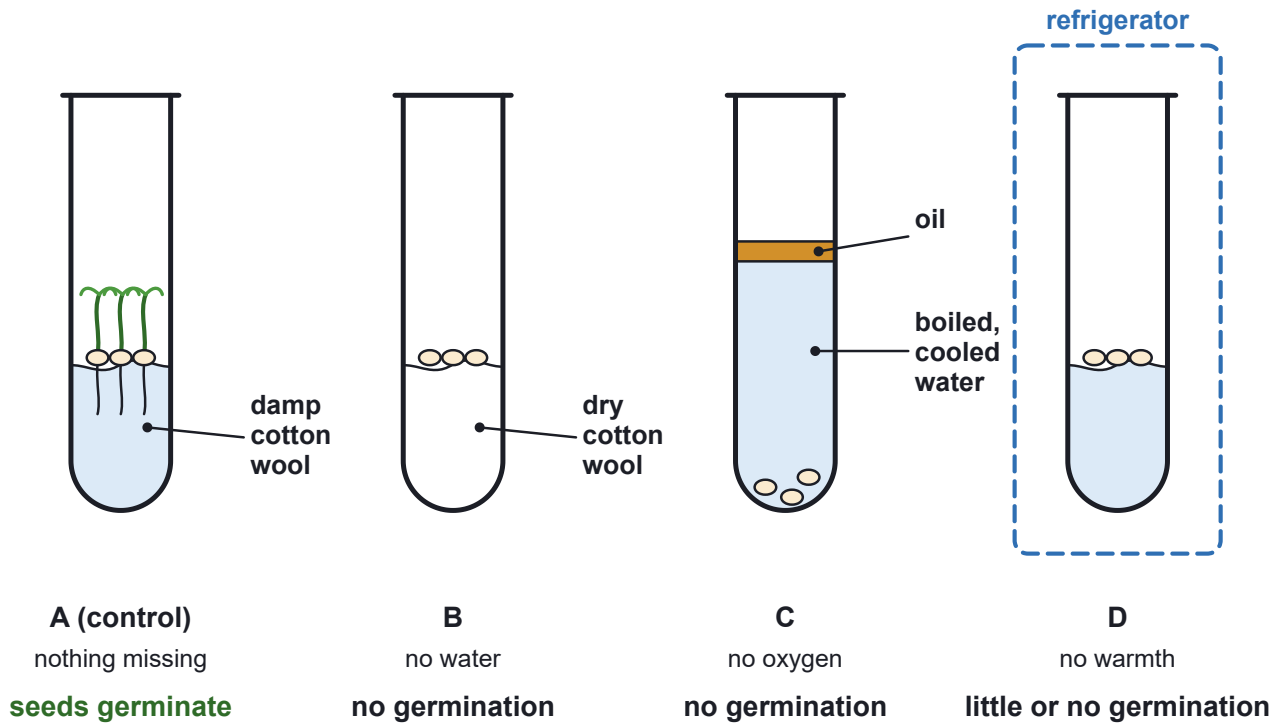
Exam tip: The dry mass of a germinating seed falls at first, because food reserves are used up in respiration and it cannot yet photosynthesise. Dry mass only increases once the leaves start photosynthesising.

Practical: conditions for germination Spec 3.5

Seeds need three things to germinate: **water**, **oxygen** (for respiration) and a **suitable temperature** (warmth, so that enzymes work). They do not need light or soil to start germinating.

Practical: Investigate the conditions needed for seed germination. Use identical seeds (such as cress or mustard) in four labelled test tubes or Petri dishes.

1. Tube A (control): damp cotton wool, seeds on top, left at room temperature. This has water, oxygen and warmth.
2. Tube B (no water): dry cotton wool, seeds on top, left at room temperature.
3. Tube C (no oxygen): seeds covered with boiled, cooled water with a thin layer of oil on top, left at room temperature. Boiling removes dissolved oxygen and the oil stops more entering.
4. Tube D (cold): damp cotton wool, seeds on top, placed in a refrigerator.
5. Keep tubes A, B and C in a dark cupboard at room temperature, because the inside of a refrigerator is dark. This way light is the same for all four tubes.
6. Leave all tubes for several days and count how many seeds have germinated in each (a root or shoot is visible).



Each tube lacks one condition. Only tube **A**, with water, oxygen and warmth, **germinates**.

Expected results

Tube	Condition missing	Result
A	None (control)	Seeds germinate
B	Water	No germination
C	Oxygen	No germination
D	Warmth	No germination or very little

- **Independent variable:** the condition being changed (water, oxygen or temperature), one at a time.
- **Dependent variable:** the number (or percentage) of seeds that germinate.
- **Control variables:** same type and number of seeds, same age of seeds, same amount of cotton wool, same time, and the same light (all in the dark).
- **Safety:** take care when boiling water and let it cool before adding the seeds, wash your hands after handling seeds (some are treated with chemicals), do not eat the seeds, and mop up any spills.

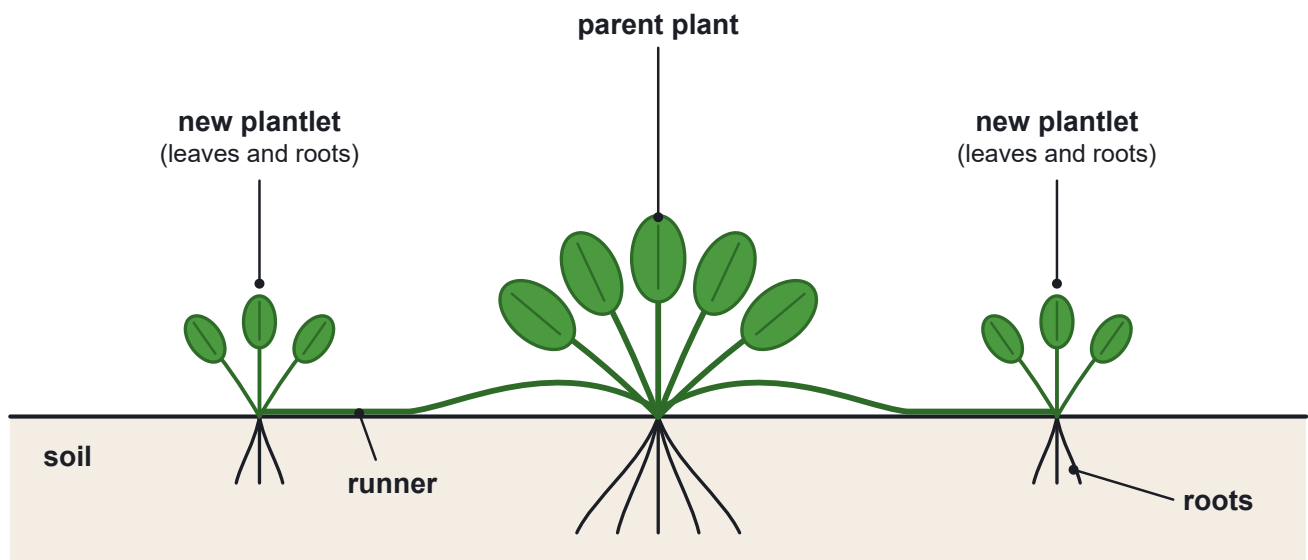
Exam tip: Change only one variable at a time. Tube A is the control, so you can say that the lack of one condition is the reason the seeds fail to germinate.

Asexual reproduction in plants Spec 3.7

Many plants can reproduce asexually. The new plants are **clones** of the parent. There are natural methods and artificial methods.

Natural method: runners

A strawberry plant grows **runners**. These are long stems that grow sideways along the ground. At intervals, roots and a new shoot grow from the runner, forming a new plantlet. When the runner dies, the plantlet becomes an independent plant that is genetically identical to the parent.



The new plantlets are genetically identical to the parent plant

Strawberry **runners** grow new plantlets that are **genetically identical** to the parent plant.

Artificial method: cuttings

1. Cut a short piece of stem from the parent plant, just below a node.
2. Remove the lower leaves.
3. Plant the cutting in moist compost.
4. Keep it moist and covered so it does not lose too much water.
5. Roots grow from the cut stem and a new plant develops, genetically identical to the parent.

Natural and artificial asexual reproduction

Method	Natural or artificial	Example
Runners	Natural: the plant does it without human help	Strawberry
Cuttings	Artificial: people do it to get new plants	Geranium, rose

Exam tip: Gardeners use cuttings to produce lots of plants with the same useful features as the parent, because the offspring are genetically identical.

Quick check

1. How many parents are needed for asexual reproduction?
2. What is pollination?
3. What does the ovule become after fertilisation?
4. Name three conditions needed for germination.
5. Give one natural and one artificial method of asexual reproduction in plants.

Quick check answers

Sexual and asexual reproduction, and reproduction in plants

1. One.
2. The transfer of pollen grains from an anther to a stigma.
3. A seed.
4. Water, oxygen and a suitable temperature.
5. Natural: runners. Artificial: cuttings.