

Exercise walk-through

16.3.1

Flower structure, pollination, fertilisation and germination

IGCSE Biology

You must be able to

- identify and draw the **sepals** 萼片, **petals** 花瓣, **stamens** 雄蕊, **filaments** 花丝, **anthers** 花药, **carpels** 心皮, **style** 花柱, **stigma** 柱头, **ovary** 子房 and **ovules** 胚珠 of an insect-pollinated flower, and state the function of each
- identify and describe the anthers and stigmas of a wind-pollinated flower, and distinguish the **pollen grains** 花粉粒 of the two kinds
- describe the structural adaptations of insect-pollinated and wind-pollinated flowers
- describe **pollination** 传粉 as the transfer of pollen grains from an anther to a stigma, and distinguish self-pollination from cross-pollination
- discuss the effects of self- and cross-pollination on a population, in terms of **variation** 变异, the capacity to respond to a changing environment, and reliance on **pollinators** 传粉者

You must be able to

- state that fertilisation occurs when a pollen nucleus fuses with a nucleus in an ovule, and describe the growth of the pollen tube
- investigate and describe the conditions needed for germination: water, oxygen and a suitable temperature

1

The method

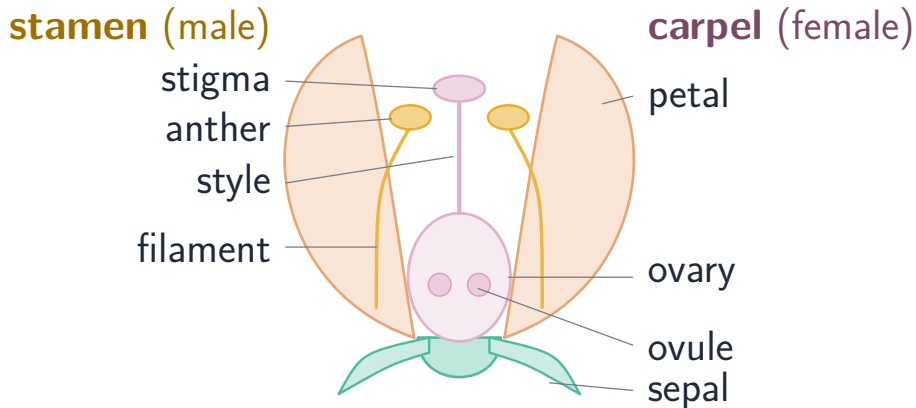
Method — Every part, with its one function

part	function
sepal	protects the flower while it is still a bud
petal	large and brightly coloured, to attract insects
stamen = filament + anther	the male part; the anther makes pollen grains , and the filament holds it in place
carpel = stigma + style + ovary	the female part
stigma	the surface that receives pollen grains ; sticky in an insect-pollinated flower
style	the stalk the pollen tube grows down
ovary	contains the ovules
ovule	contains the female nucleus; becomes the seed 种子 after fertilisation

Method — Every part, with its one function

- Every one of the **structures** listed in the table has exactly **one** function to state, and the exam asks for the structures listed there by name.
- Marks come from the **pairing**, not the name. “Anther – makes pollen” is the answer; “anther” alone is not.

Method — Every part, with its one function

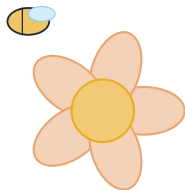


Method — Insect-pollinated or wind-pollinated?

	insect-pollinated	wind-pollinated
petals	large, brightly coloured, scented	small, green, or absent
nectar 花蜜	present, to attract insects	absent
anthers	inside the flower, so an insect brushes them	hanging outside , so the wind shakes the pollen out
stigma	inside , small and sticky	outside , large and feathery , to catch pollen from the air
pollen grains	larger , fewer , sticky or spiky so they cling to an insect	smaller , very many , smooth and light so they are carried by the wind

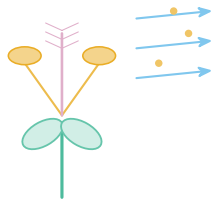
- Every row is an **adaptation to how the pollen travels**. Say what the feature does, not just what it looks like.

Method — Insect-pollinated or wind-pollinated?



insect-pollinated

bright petals, scent + nectar;
sticky, spiky pollen



wind-pollinated

small dull petals; anthers &
stigma hang out; light pollen

Method — Self-pollination and cross-pollination

- **Self-pollination:** pollen goes from an anther to the stigma **of the same flower**, or of a different flower **on the same plant**.
- **Cross-pollination:** pollen goes from an anther to the stigma of a flower **on a different plant of the same species**.

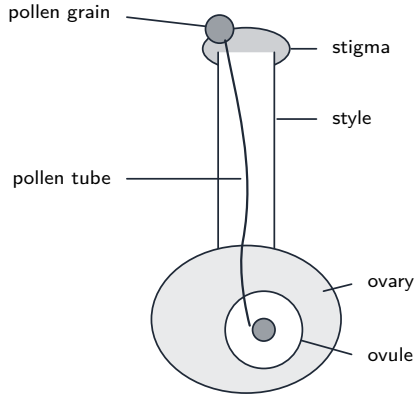
Method — Self-pollination and cross-pollination

	cross-pollination	self-pollination
variation in the offspring	more – the two parents have different alleles	less
responding to a change in the environment	better : a varied population is more likely to contain individuals that survive a new disease or climate	worse
reliance on a pollinator	depends on an insect or on the wind	does not need one, so it still works when pollinators are scarce

Method — From pollination to fertilisation

- 1 A pollen grain lands on the **stigma** – that is **pollination**, and nothing has grown yet.
 - 2 The grain grows a **pollen tube** down through the **style**.
 - 3 The tube reaches the **ovary** and enters an **ovule**.
 - 4 The **pollen nucleus fuses with a nucleus in the ovule** – that is **fertilisation**.
 - 5 The fertilised ovule becomes a **seed**, and the ovary becomes the fruit.
- Pollination and fertilisation are two different events, separated by the growth of the tube. Using one word for the other is the most common lost mark on this unit.

Method — From pollination to fertilisation



Pollination is the transfer of a pollen grain from an *anther* to a *stigma*. It happens before anything grows.

Fertilisation is the fusion of a *pollen nucleus* with a *nucleus in the ovule*, at the bottom of the tube. The two words are not interchangeable.

Method — What a seed needs to germinate

A seed needs exactly three things: **water**, **oxygen** and a **suitable temperature**.

- **Water** softens the seed coat and lets **enzymes** work, so the stored food can be digested and used.
- **Oxygen** is needed for **aerobic respiration**, which releases the energy for growth.
- A **suitable temperature** is needed because the enzymes work best at their optimum; too cold and they work too slowly, too hot and they are **denatured**.
- The experiment removes **one** condition per tube, and the tube with all three is the **control**. That is what makes each result mean something. $\triangle$ It says nothing about **light** – every tube had the same light, so the investigation cannot test it.

Method — What a seed needs to germinate

A seed needs exactly three things: water , oxygen and a suitable temperature



A damp cotton wool,
air, warm room

germinates



B *dry* cotton wool,
air, warm room

does not germinate



C boiled water under
a layer of oil, so *no*
oxygen; warm room

does not germinate



D damp cotton
wool, air, *in a fridge*

does not germinate

A is the control: it has all three conditions. Each of the others is missing exactly **one**, so when it fails to germinate you know which condition mattered.

2

Practice

Practice 2.1 ■ 2 marks

Name the part of a flower that makes pollen grains, and the part that receives them.

Solution 2.1

Method: Every part, with its one function — p.5

Worked steps

- the **anther** makes pollen grains **B1**
- the **stigma** receives them **B1**

Practice 2.2 ■ 2 marks

State the function of the sepals and the function of the petals of an insect-pollinated flower.

Solution 2.2

Method: Every part, with its one function — p.5

Worked steps

- the **sepals** protect the flower while it is a bud B1
- the **petals** are large and brightly coloured, to **attract insects** B1

Practice 2.3 ■ 4 marks

Describe **two** ways in which a wind-pollinated flower differs from an insect-pollinated flower, and explain each difference.

Solution 2.3

Method: Insect-pollinated or wind-pollinated? — p.8

Worked steps

- any **two** differences, each with its reason:
- a wind-pollinated flower has **small, green petals** or none (B1) – it does not need to attract insects (B1)
- its **anthers hang outside** the flower (B1) – so the wind can shake the pollen out and carry it away (B1)
- its **stigma is large and feathery** and hangs outside (B1) – so it catches pollen carried in the air (B1)
- other acceptable pairs: no nectar; smaller, lighter, smoother pollen grains, produced in far greater numbers

Practice 2.4 ■ 2 marks

State the difference between pollination and fertilisation.

Solution 2.4

Method: From pollination to fertilisation — p.12

Worked steps

- **pollination** is the transfer of a pollen grain from an **anther to a stigma** (B1)
- **fertilisation** is the fusion of a **pollen nucleus with a nucleus in an ovule**, which happens later, after the pollen tube has grown (B1)

Practice 2.5 ■ 2 marks

Describe what is meant by self-pollination.

Solution 2.5

Method: Self-pollination and cross-pollination — p.10

Worked steps

- pollen is transferred from the anther to the stigma of the **same flower** **B1**
- or to the stigma of a different flower **on the same plant** **B1**

Practice 2.6 ■ 3 marks

State the **three** conditions a seed needs in order to germinate.

Solution 2.6

Method: What a seed needs to germinate — p.14

Worked steps

- **water** (B1)
- **oxygen** (B1)
- **a suitable temperature** (B1)

3

Exam-style

Exam-style 3.1 ■ 1 mark

Which feature is typical of a wind-pollinated flower?

- A** large, brightly coloured petals
- B** nectar at the base of the flower
- C** anthers hanging outside the flower
- D** a small, sticky stigma inside the flower

Solution 3.1

Method: Insect-pollinated or wind-pollinated? — p.8

- A large, brightly coloured petals
- B nectar at the base of the flower
- C anthers hanging outside the flower 
- D a small, sticky stigma inside the flower

Worked steps

C

- anthers hanging outside let the **wind** shake the pollen out and carry it away **B1**
- **A**, **B** and **D** are all ways of attracting an insect and getting pollen onto it, so they belong to an insect-pollinated flower

Exam-style 3.2 ■ 6 marks

An orchard contains many apple trees of the same variety. Bees carry pollen between them.

Exam-style 3.2 (a) ■ 2 marks

Describe what is meant by cross-pollination.

Solution 3.2 (a)

Method: Self-pollination and cross-pollination — p.10

Worked steps

- pollen is transferred from the **anther of one plant** to the **stigma of a flower on a different plant** **B1**
- of the **same species** **B1**

Exam-style 3.2 (b) ■ 2 marks

Explain one advantage of cross-pollination to a population of apple trees.

Solution 3.2 (b)

Worked steps

- the two parents have different **alleles**, so there is more **genetic variation** among the offspring **B1**
- a varied population is more likely to contain individuals that can **survive a change in the environment**, such as a new disease or a change in climate

B1

Exam-style 3.2 (c) ■ 2 marks

Explain one disadvantage of cross-pollination compared with self-pollination.

Solution 3.2 (c)

Worked steps

- cross-pollination depends on a **pollinator** – here the bees – to carry the pollen between trees **B1**
- if few bees are present, few flowers are pollinated, whereas a self-pollinating plant needs no pollinator at all **B1**

Exam-style 3.3 ■ 12 marks

A student investigated germination. She put ten cress seeds into each of four test tubes and left them for a week.

tube	conditions	number of seeds that germinated
A	damp cotton wool, air, 20 °C	9
B	dry cotton wool, air, 20 °C	0
C	boiled water under a layer of oil, 20 °C	1
D	damp cotton wool, air, 4 °C	0

Exam-style 3.3 (a) ■ 2 marks

State which tube is the control, and explain why it is needed.

Solution 3.3 (a)

Method: What a seed needs to germinate — p.14

Worked steps

- tube **A** (B1)
- it has **all three** conditions, so it shows that the seeds are alive and able to germinate; without it, a tube in which nothing germinated would prove nothing (B1)

Exam-style 3.3 (b) ■ 2 marks

Explain what tubes **A** and **B** together show.

Solution 3.3 (b)

Worked steps

- the only difference between A and B is the **water** (B1)
- seeds germinated in A but not in B, so **water is needed** for germination (B1)

Exam-style 3.3 (c) ■ 2 marks

Explain why the water in tube **C** was boiled and then covered with a layer of oil.

Solution 3.3 (c)

Worked steps

- **boiling** drives the dissolved **oxygen** out of the water **B1**
- the **oil** layer stops oxygen from the air dissolving back in, so the seeds have no oxygen **B1**

Exam-style 3.3 (d) ■ 2 marks

One seed germinated in tube **C**. Suggest why.

Solution 3.3 (d)

Worked steps

- a little dissolved oxygen may have been left in the water, or the oil layer may not have covered the surface completely **B1**
- so that one seed had just enough oxygen to respire and begin to germinate **B1**

Exam-style 3.3 (e) ■ 2 marks

Explain why no seeds germinated in tube **D**.

Solution 3.3 (e)

Worked steps

- 4 °C is **too cold**, so the seed's **enzymes** work far too slowly **B1**
- the stored food is not digested quickly enough to supply the growing seedling, so germination does not happen in a week **B1**

Exam-style 3.3 (f) ■ 2 marks

The student concluded that seeds need light in order to germinate.
Explain why her results do not support this conclusion.

Solution 3.3 (f)

Worked steps

- **light was not a variable** in the investigation: every tube was kept in the same light **B1**
- to test light she would need two tubes alike in every other way, one in the light and one in the dark, so these results give no evidence about light at all **B1**