IGCSE BIOLOGY • EXERCISE SHEET

16.3.1 Flower structure, pollination, fertilisation and germination

Name: _____ Class: _____ Date: _____ **Total: 34 marks**

KEY WORDS pollination 传粉 • seed 种子 • stigma 柱头 • anther 花药 • germinate 萌发

Objective

Sheet 16.3 had two questions on this unit; the syllabus has twelve statements. This sheet is the rest of it: every part of a flower **with its function**, how a **wind-pollinated** 风媒 flower differs from an **insect-pollinated** 虫媒 one, the difference between **self-pollination** 自花传粉 and **cross-pollination** 异花传粉 and what each does to a population, the growth of the **pollen tube** 花粉管 to fertilisation, and the conditions a seed needs to **germinate** 萌发. This sheet covers syllabus 16.3.

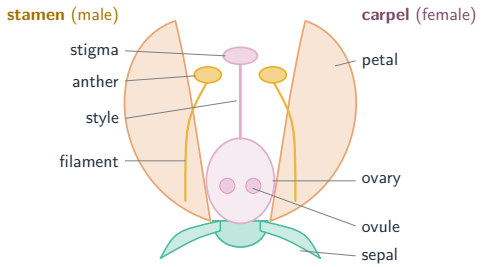
You must be able to:

- 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
- 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 Worked examples

Study these first. Each one shows a **method** that a question later on this sheet needs.

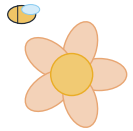
■ Every part, with its one function



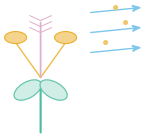
part	function
sepal	protects the flower while it is still a bud
petal	large and brightly coloured, to **attract insects**
stamen = **filament** + **anther**	the male part; the **anther makes pollen grains**, and the filament holds it in place
carpel = **stigma** + **style** + **ovary**	the female part
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

- 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.

■ 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

	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

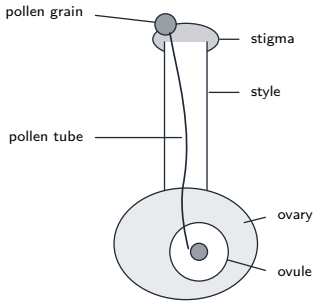
- Every row is an **adaptation to how the pollen travels**. Say what the feature does, not just what it looks like.

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**.

	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

From pollination to fertilisation



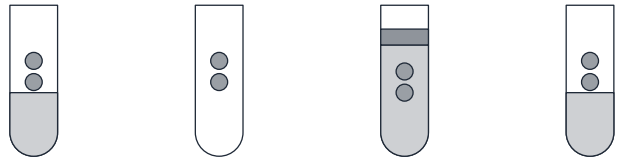
Pollination is the transfer of a pollen grain from an *anther* to a *stigma*. It happens before anything grows.

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.

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.

What a seed needs to germinate



A damp cotton wool, air, warm room	**B** *dry* cotton wool, air, warm room	**C** boiled water under a layer of oil, so *no oxygen*; warm room	**D** damp cotton wool, air, *in a fridge*
germinates	**does not germinate**	**does not germinate**	**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.

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. △ It says nothing about **light** – every tube had the same light, so the investigation cannot test it.

2 Practice

Now use the methods above.

2.1 Name the part of a flower that makes pollen grains, and the part that receives them. [2]

2.2 State the function of the sepals and the function of the petals of an insect-pollinated flower. [2]

2.3 Describe **two** ways in which a wind-pollinated flower differs from an insect-pollinated flower, and explain each difference. [4]

2.4 State the difference between pollination and fertilisation. [2]

2.5 Describe what is meant by self-pollination. [2]

2.6 State the **three** conditions a seed needs in order to germinate. [3]

3 Exam-style questions

3.1 Which feature is typical of a wind-pollinated flower? [1]

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

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

(a) Describe what is meant by cross-pollination. [2]

(b) Explain one advantage of cross-pollination to a population of apple trees. [2]

(c) Explain one disadvantage of cross-pollination compared with self-pollination. [2]

3.3 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

(a) State which tube is the control, and explain why it is needed. [2]

(b) Explain what tubes **A** and **B** together show. [2]

(c) Explain why the water in tube **C** was boiled and then covered with a layer of oil. [2]

(d) One seed germinated in tube **C**. Suggest why. [2]

(e) Explain why no seeds germinated in tube **D**. [2]

(f) The student concluded that seeds need light in order to germinate. Explain why her results do not support this conclusion. [2]

Solutions

Each answer shows the steps, then the **result**.

2.1

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

2.2

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

2.3

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

2.4

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

2.5

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

2.6

- **water**
- **oxygen**
- a **suitable temperature**

3.1 C

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

3.2

(a)

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

(b)

- the two parents have different **alleles**, so there is more **genetic variation** among the offspring
- 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

(c)

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

3.3

(a)

- tube **A**
- 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

(b)

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

(c)

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

(d)

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

(e)

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

(f)

- **light was not a variable** in the investigation: every tube was kept in the same light
- 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