Plant Anatomy

A Level

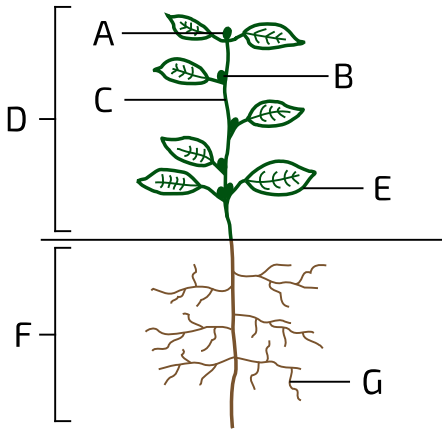

Figure 1: Diagram of plant anatomy. Structures A-D are above ground and structures F-G are below ground.

Part A Label the diagram

Match the names to the figure labels in the table below.

Label	Name
A	
B	
C	
D	
E	
F	
G	

Items:

stem | root | leaf | apical bud | lateral bud | shoot system | root system

Part B Organs

Which of the following are examples of plant organs? Select all that apply.

- [ ] leaves
- [ ] stomata
- [ ] flowers
- [ ] stems
- [ ] mesophyll
- [ ] phloem
- [ ] roots
- [ ] xylem

Part C Leaf tissues and structures

Match the structures to the descriptions in the table below.

Leaf structure/tissue	Description
	pores (usually on the underside of the leaf) through which gas exchange and water loss takes place
	tissue responsible for photosynthesis
	tissue responsible for transporting water into the leaf
	tissue responsible for transporting sugars out of the leaf
	waxy layer that covers the outside of the leaf and prevents too much water loss

Items:

cuticle | mesophyll | xylem | phloem | stomata

Types of Plants

A Level

The figure below shows a possible phylogenetic tree of plants.

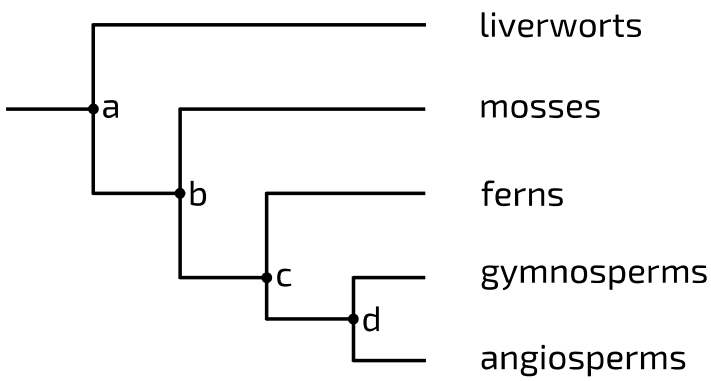

Figure 1: Plant phylogenetic tree. Nodes on the tree are labelled a-d. Ferns, gymnosperms and angiosperms are all "vascular plants" i.e. they contain a vascular system, unlike liverworts and mosses. The gymnosperms includes conifers (e.g. pine trees). The angiosperms are the "flowering plants", which make up the majority of plant species.

Part A Evolutionary relationships

Based on **Figure 1**, which of the following statements are correct? Select all that apply.

- [ ] liverworts are more closely related to mosses than they are to gymnosperms
- [ ] mosses are more closely related to angiosperms than they are to liverworts
- [ ] ferns are more closely related to mosses than they are to angiosperms
- [ ] gymnosperms are more closely related to angiosperms than they are to ferns
- [ ] node **a** represents the last common ancestor of liverworts and angiosperms
- [ ] node **b** represents the last common ancestor of ferns and angiosperms
- [ ] node **c** represents the last common ancestor of gymnosperms and ferns
- [ ] node **d** represents the last common ancestor of vascular plants

Part B Vascular vs non-vascular plants

The evolution of a vascular system allowed vascular plants to grow much larger than non-vascular plants.

Which of the following statements explain why? Select all that apply.

- [ ] the vascular system enables leaves to absorb carbon dioxide and carry out photosynthesis
- [ ] the vascular system provides mechanical support to the plant, which allows it to grow upwards away from the soil
- [ ] the vascular system enables the transport of water and minerals from the soil to the upper parts of the plant
- [ ] the vascular system enables leaves to limit their water loss
- [ ] the vascular system enables the transport of sugars from the leaves to the roots
- [ ] the vascular system allows the roots to absorb water and minerals from the soil

Part C Angiosperms vs gymnosperms

Angiosperms (flowering plants) are mostly pollinated by animals, whereas gymnosperms are mostly wind-pollinated. Each mode of pollination has its own advantages and disadvantages.

Match the type of pollination to the advantage in the table below.

Advantage	Pollination type
the plant does not need to spend energy and resources producing nectar	
the plant can spend less energy and resources producing pollen because it is transferred more directly and efficiently	
individual plants do not need to be as close together to ensure pollination	
the plant will probably be less affected by a reduction in ecosystem biodiversity	

Items:

animal pollination **wind pollination**

Part D Monocots and dicots

The angiosperms includes two large groups: monocots and dicots. These groups are named after differences in the embryos. Monocots typically have one cotyledon (embryonic leaf) whereas dicots typically have two.

The figure below shows some other typical differences between monocots and dicots.

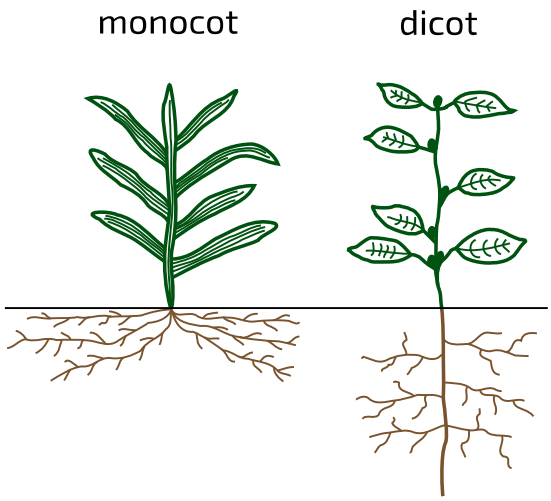

Figure 2: Monocot vs dicot anatomy.

Based on **Figure 2**, match the features to the angiosperm groups in the table below.

Angiosperm group	Feature
	one main root ("taproot") that grows deep into the soil
	one main vein that branches out into smaller veins in each leaf
	several main roots form a fibrous root system
	several parallel veins in each leaf

Items:

monocot **dicot**

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Leaf Structure

A Level

The diagram below shows a cross-section of a leaf.

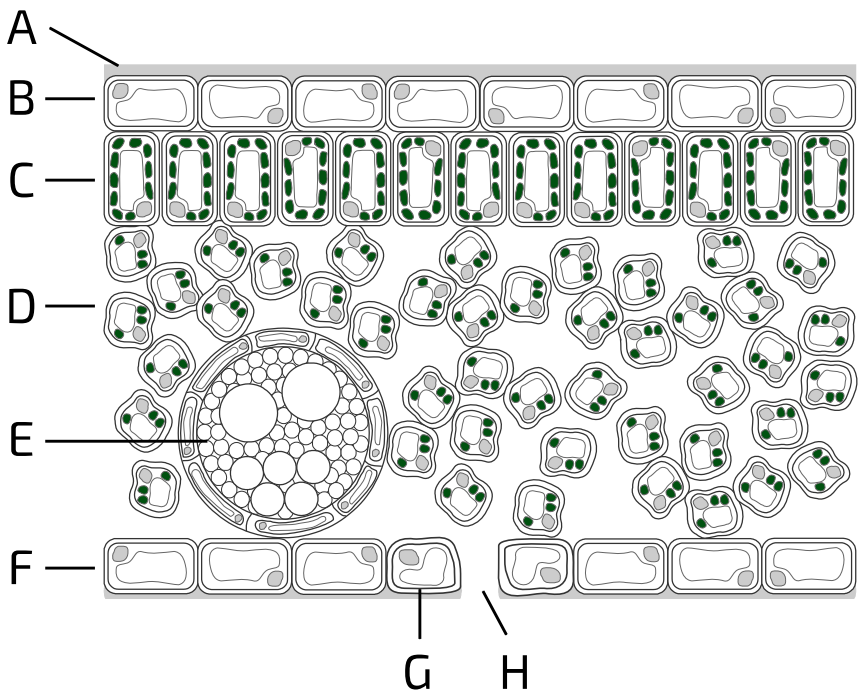

Figure 1: A cross-section of a leaf. Different structures/cells/tissues are labelled A-H. Structure E is a vascular bundle (leaf vein). The green organelles are chloroplasts.

Part A Structure A

What is the name of structure A, the waxy layer that covers the outermost layer of cells?

Part B Tissue B

What is the name of tissue B?

Part C Cell type C

What is the name of cell type C?

Part D Cell type D

What is the name of cell type D?

Part E Structure E

Which of the following are found in structure E in the leaf?

- [ ] guard cells
- [ ] phloem sieve tube elements
- [ ] anther
- [ ] xylem vessels
- [ ] root hair cells
- [ ] apical meristem
- [ ] phloem companion cells
- [ ] stigma

Part F Tissue F

What is the name of tissue F?

Part G Cell type G

What is the name of cell type G?

Part H Structure H

What is the name of structure H?

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Plant Hormones

A Level

Plant hormones (sometimes called "plant growth factors") are signalling molecules that help plants respond to changes in their environment.

Part A Hormone functions

Match the hormones to the functions in the table below.

Hormone	Function(s)
	promotes cell elongation
	promotes cell division
	promotes seed germination
	promotes fruit ripening and leaf abscission
	prevents growth of seeds and buds during winter, and closes stomata in low water conditions

Items:

gibberellins **cytokinins** **ethene** **auxins** **abscisic acid (ABA)**

Part B Apical dominance

In most plants, the main stem is much taller than the side stems (branches). This is known as apical dominance.

Which of the following statements explain how apical dominance is controlled? Select all that apply.

- [ ] auxins (e.g. IAA) are mainly produced in the apical bud
- [ ] auxins (e.g. IAA) are mainly produced in the lateral buds
- [ ] high auxin concentrations promote apical shoot growth
- [ ] high auxin concentrations promote lateral shoot growth
- [ ] high auxin concentrations inhibit apical shoot growth
- [ ] high auxin concentrations inhibit lateral shoot growth

Part C Flowering

Phytochrome is a pigment that acts as a hormone. When it absorbs light, it converts from an inactive to an active form. High levels of the active form then trigger the production of proteins that either activate or inhibit the expression of genes involved in flower development.

What is the term given to a protein that activates or inhibits the expression of a gene?

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Phototropism and Gravitropism

A Level

In most plants, the shoots exhibit positive phototropism (i.e. they grow towards the light) and the roots exhibit positive gravitropism (i.e. they grow towards the centre of the Earth). Both of these growth responses are regulated by indoleacetic acid (IAA), which belongs to a group of plant hormones called auxins.

Part A Phototropism

Indoleacetic acid (IAA) is mostly produced in the [ ], where high levels of IAA [ ] growth. This ensures that the plant grows upwards.

High light intensity causes IAA to be transported [ ] the light, causing the cells on the [ ] to elongate more. This causes the stem to bend [ ] the direction of light.

Items:

xylem vessels | apical bud | stimulate | inhibit | towards | away from | same side as the light | opposite side from the light

Part B Gravitropism

In the roots, high levels of IAA [ ] growth and low levels of IAA [ ] growth.

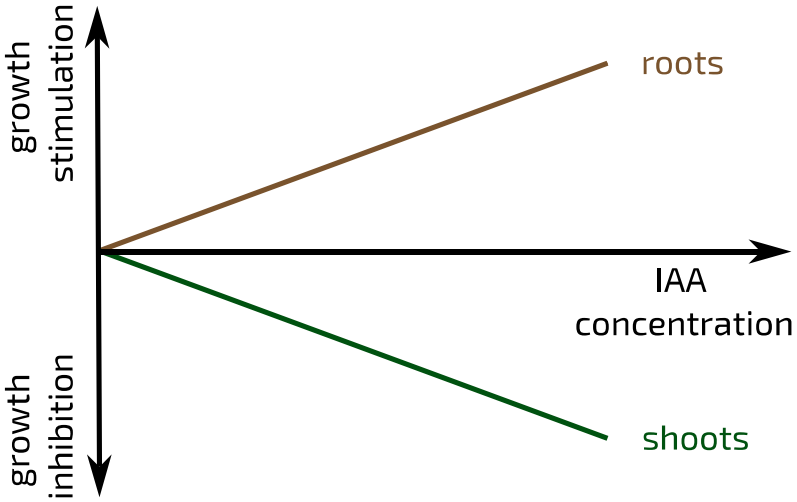
Gravity pulls IAA towards the bottom of the roots, which ensures the roots grow downwards. If a root does not run parallel to the direction of gravity, higher levels of IAA will accumulate on the bottom side. This will [ ] elongation of cells on this side. The low levels of IAA on the upper side will [ ] elongation of cells on that side. This will cause the root to bend [ ] the centre of the Earth.

Items:

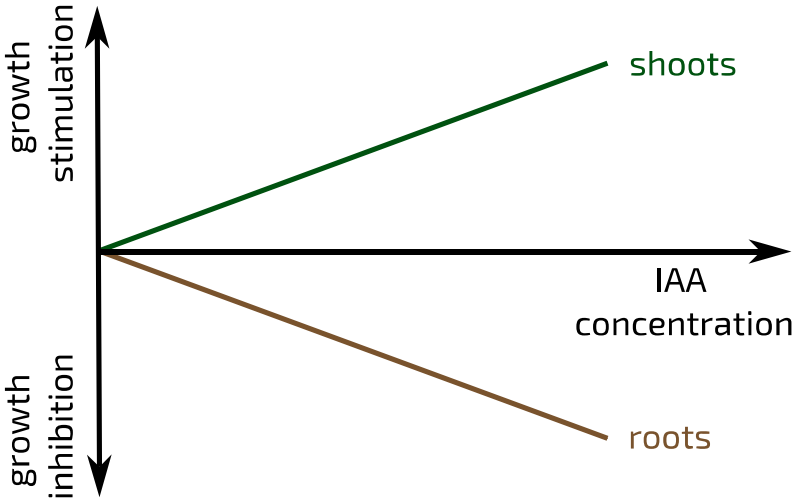
stimulate **inhibit** **towards** **away from**

Part C Roots vs shoots

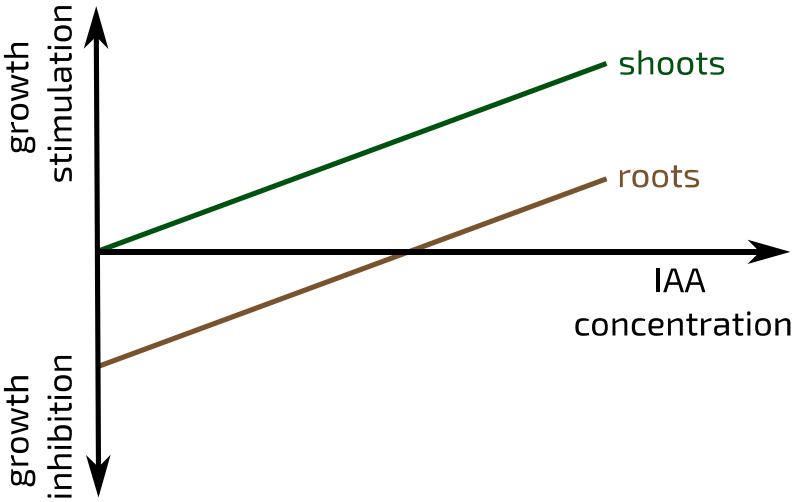
Which of the graphs below correctly shows the effects of different concentrations of indoleacetic acid (IAA) on roots and shoots?



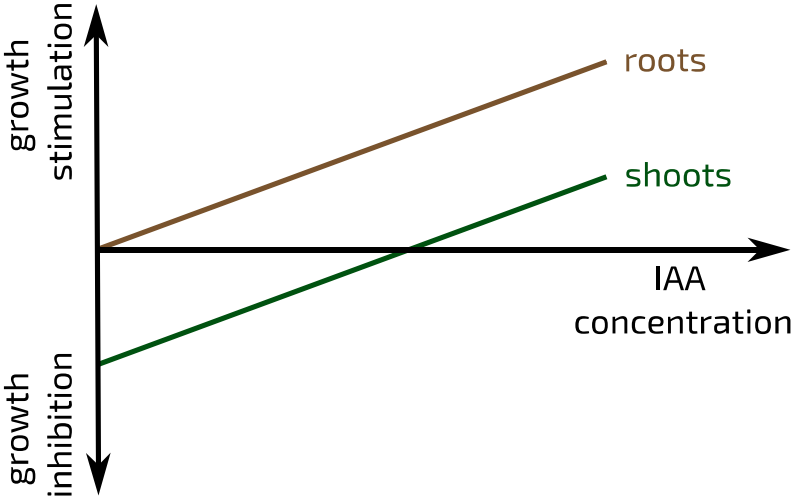
A



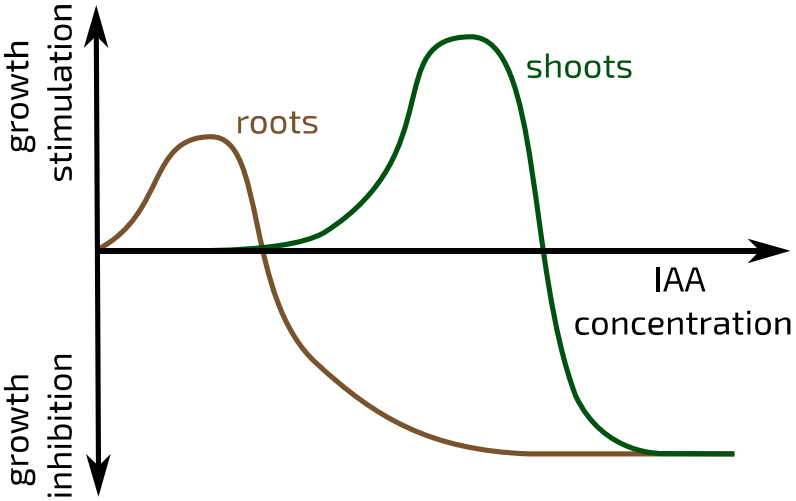
B


growth stimulation
shoots
roots
IAA concentration
growth inhibition

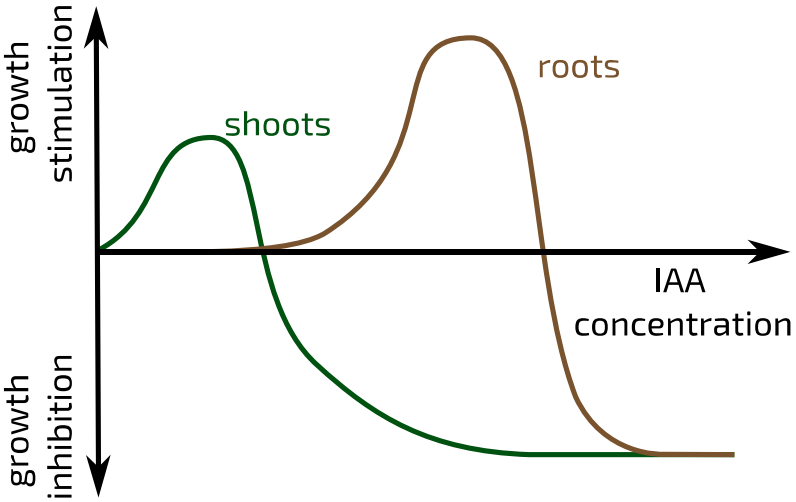
C


growth stimulation
roots
shoots
IAA concentration
growth inhibition

D


growth stimulation
shoots
roots
IAA concentration
growth inhibition

E



F

- Graph A
- Graph B
- Graph C
- Graph D
- Graph E
- Graph F

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Angiosperm Reproduction

A Level

The angiosperms are the group of plants that produce flowers. In most species, each flower contains both male and female gametes. The figure below shows the structure of a flower in cross-section and from above.

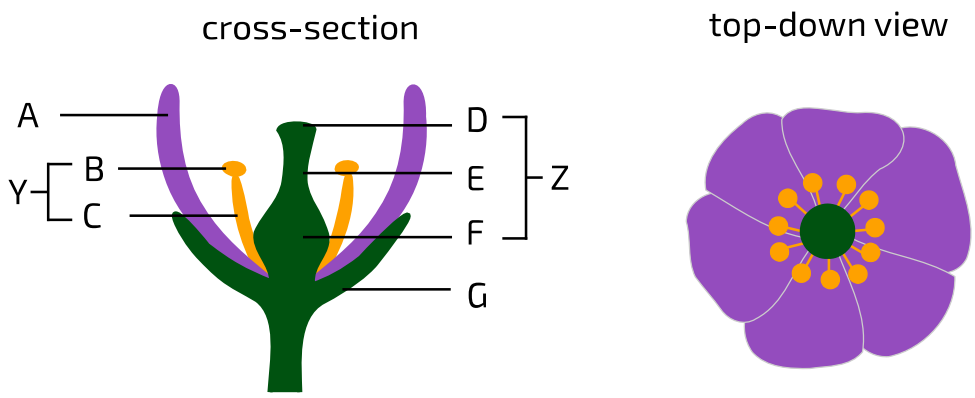

Figure 1: Structure of a flower. Left: cross-section side view, with different structures labelled. Right: the same flower from a top-down view.

Part A Flower anatomy

Match the structures to the figure labels in the table below.

Label	Structure
A	
B	
C	
D	
E	
F	
G	
Y	
Z	

Items:

anther | carpel | filament | ovary | petal | sepal | stamen | stigma | style

Part B Flower functions

Match the structures to the functions in the table below.

Function	Label
site of pollen production	
site of pollen deposition	
site of ovules	
brightly-coloured to attract pollinators	
protects the flower before it opens	

Items:

A B C D E F G

Part C Pollination

Pollination is the process by which pollen (which contains male gametes) is transferred to the stigma - usually of a flower of a different plant. In most angiosperms, this is done by insect pollinators. These insects receive nectar from the flowers.

What is the name for this type of interaction between two organisms, which is beneficial for both?

Part D Double fertilisation

When a pollen grain lands on the stigma of another flower, it forms a tube that grows down through the style and into the ovary. The pollen grain contains two haploid sperm cells. Both of these travel down the pollen tube into an ovule. One sperm cell fertilises the haploid egg cell to produce the diploid zygote. The other sperm cell fertilises **two** haploid "polar nuclei" in the ovule to produce a triploid endosperm. The endosperm protects the developing plant embryo and provides it with nutrition.

This whole process, which is unique to angiosperms, is called double fertilisation.

Peas (*Pisum sativum*) are angiosperms with a diploid chromosome number of 14.

How many chromosomes does a pea sperm cell have?

How many chromosomes does a pea zygote have?

How many chromosomes does a pea endosperm cell have?

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