Plant Anatomy

A Level

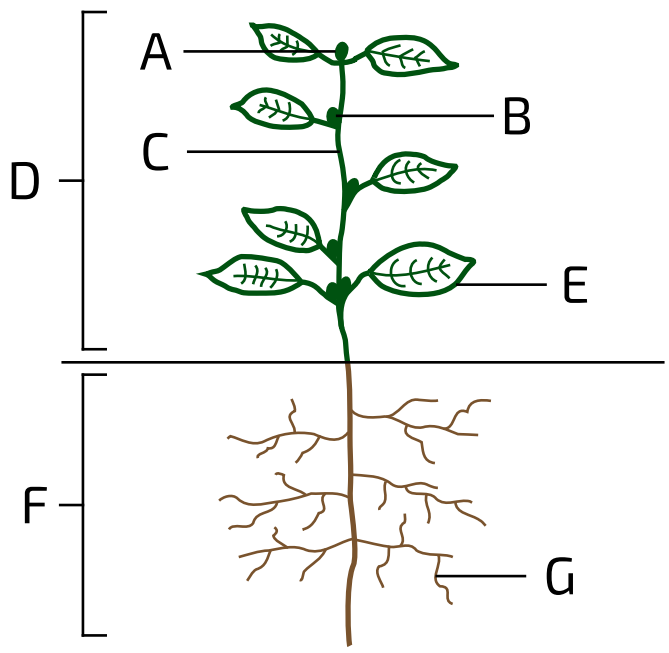


Figure 1: Diagram of plant anatomy. Structures A-D are above ground and structures F-G are below ground.

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.

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

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 **stomata** **xylem** **mesophyll** **phloem**

Created for isaacphysics.org by Lewis Thomson

Leaf Structure

A Level

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

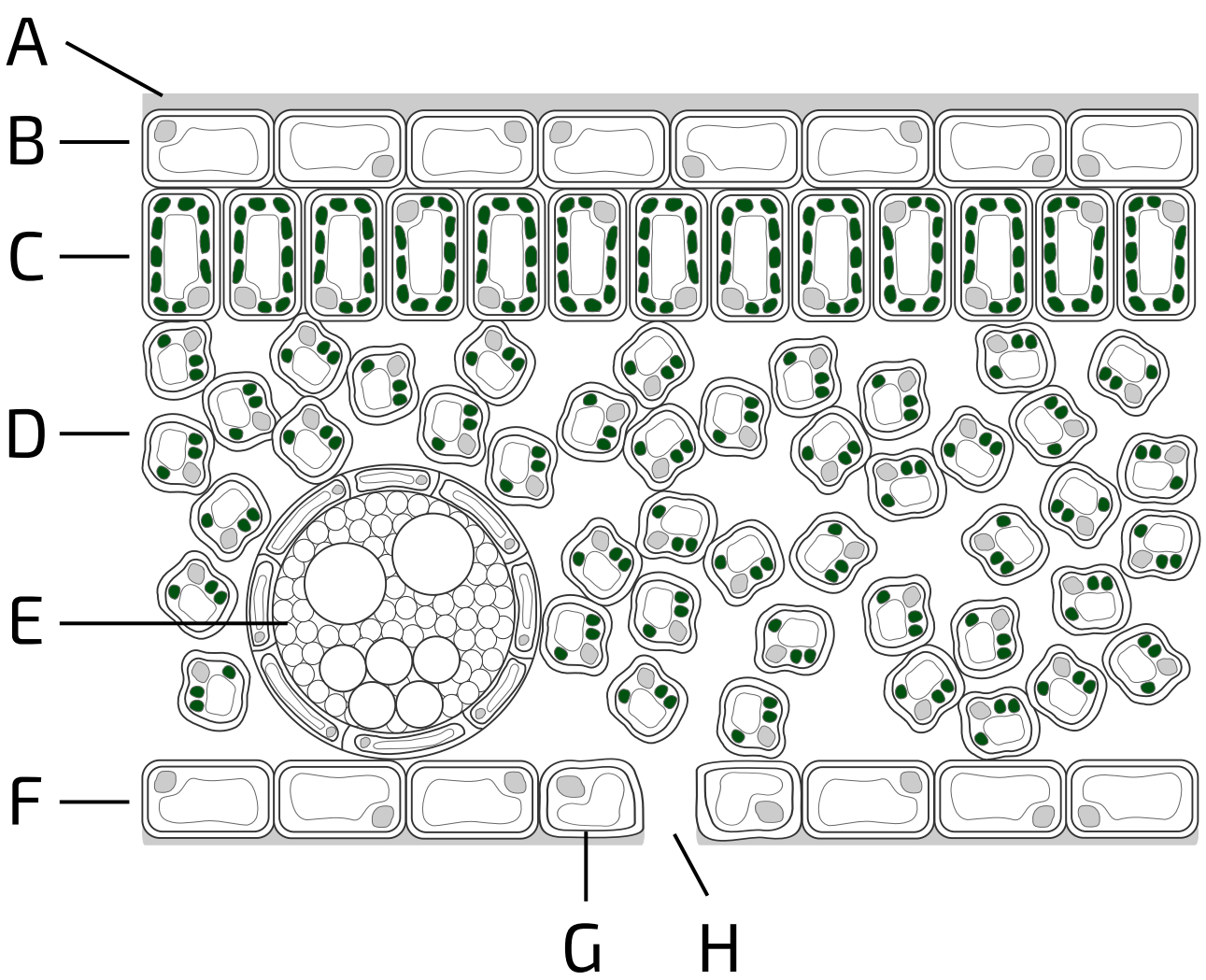


Figure 1: A cross-section of a leaf. Different structures/cells/tissues are labelled A-H. Structure E is a vascular bundle (leaf vein). The green organelles are chloroplasts.

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?

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

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?

Gameboard:

STEM SMART Biology Week 21 - Plant Growth & Reproduction

Stomata: Structure & Function

A Level

Stomata (singular: stoma) are pore structures found mostly on the underside of leaves. Their main function is to allow gas exchange between the inside of the leaf and the surrounding air, though they also play an important role in transpiration.

Figure 1 shows an open stoma on the left and a closed stoma on the right.

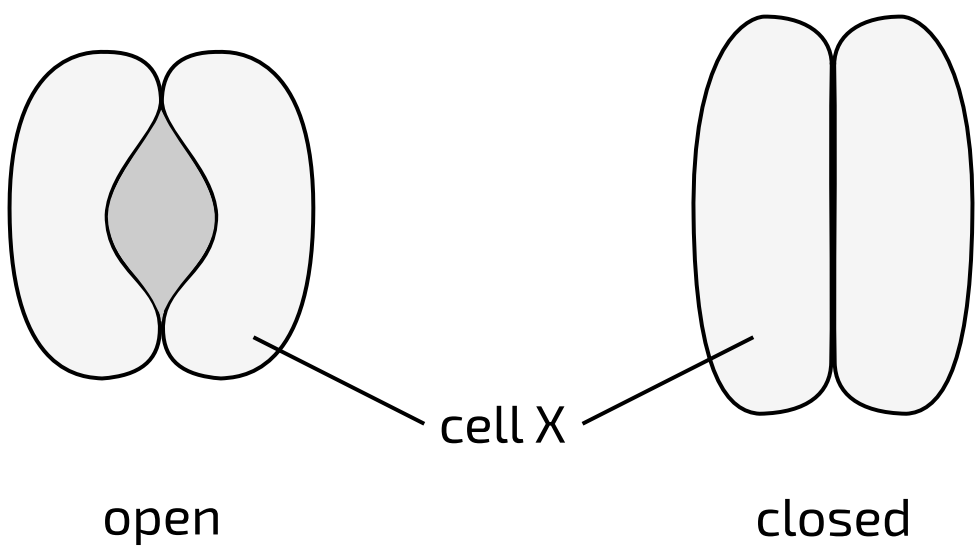


Figure 1: An open stoma (left) and a closed stoma (right).

Part A Cell X

What is the name of cell X in **Figure 1**?

Part B Diffusion directions

Fill in the blanks below to describe the diffusion of gases between a leaf and the surrounding air when leaf is in direct sunlight and the stomata are open.

- Oxygen will diffuse [ ] the leaf.
- Carbon dioxide will diffuse [ ] the leaf.
- Water vapour will diffuse [ ] the leaf.

Items:

into **out of**

Part C Opening stomata

In many plants, stomata are opened in response to high light intensity. ATP generated in the light-dependent reactions of photosynthesis are used to actively transport ions and other solutes into the guard cells.

Drag the items below into the correct order on the right to show how this causes stomata to open.

Note that not all of the items below are part of the correct sequence of events, and so you should not use all of the items below.

Available items

- guard cells become **turgid**
- guard cells become **flaccid**
- the water potential inside guard cells **increases** as a result of solute movement
- the water potential inside guard cells **decreases** as a result of solute movement
- water moves **into** guard cells by osmosis
- water moves **out of** guard cells by osmosis
- the stomatal pores **open**

Part D Closing stomata

In many plants, stomata are closed in response to low water levels. Abscisic acid (ABA) is released by root cells and travels through the xylem to the leaves. In the leaves, ABA binds to receptor proteins, resulting in ions and other solutes being exported out of the guard cells.

Drag the items below into the correct order on the right to show how this causes stomata to close.

Note that not all of the items below are part of the correct sequence of events, and so you should not use all of the items below.

Available items

- guard cells become **turgid**
- guard cells become **flaccid**
- the water potential inside guard cells **increases** as a result of solute movement
- the water potential inside guard cells **decreases** as a result of solute movement
- water moves **into** guard cells by osmosis
- water moves **out of** guard cells by osmosis
- the stomatal pores **close**

Created for isaacphysics.org by Lewis Thomson

Gameboard:
STEM SMART Biology Week 21 - Plant Growth & Reproduction

Physics. You work it out.

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:

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

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?

Created for isaacphysics.org by Lewis Thomson

Gameboard:
STEM SMART Biology Week 21 - Plant Growth & Reproduction

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.

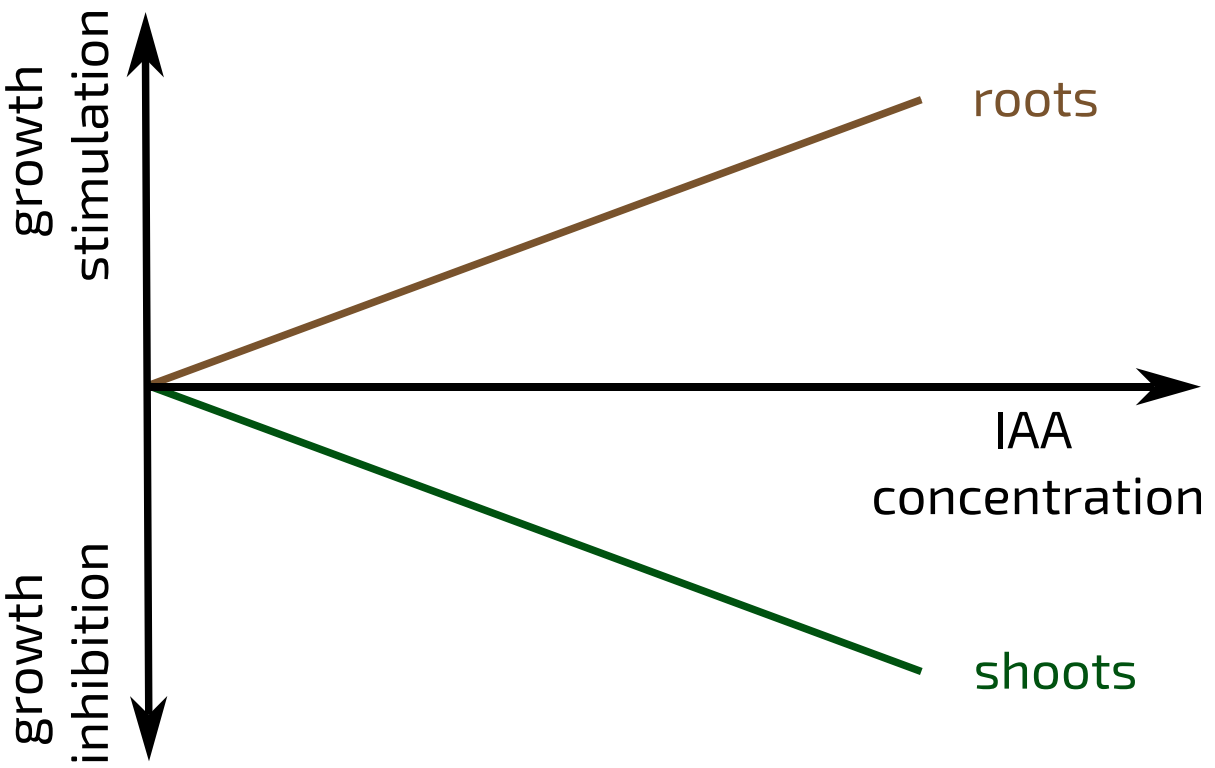
Gravity pulls IAA towards the bottom of the roots, which ensures the roots grow downwards. If a root does not run parallel to the direction of gravity, higher levels of IAA will accumulate on the bottom side. This will [ ] elongation of cells on this side. The low levels of IAA on the upper side will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

Items:

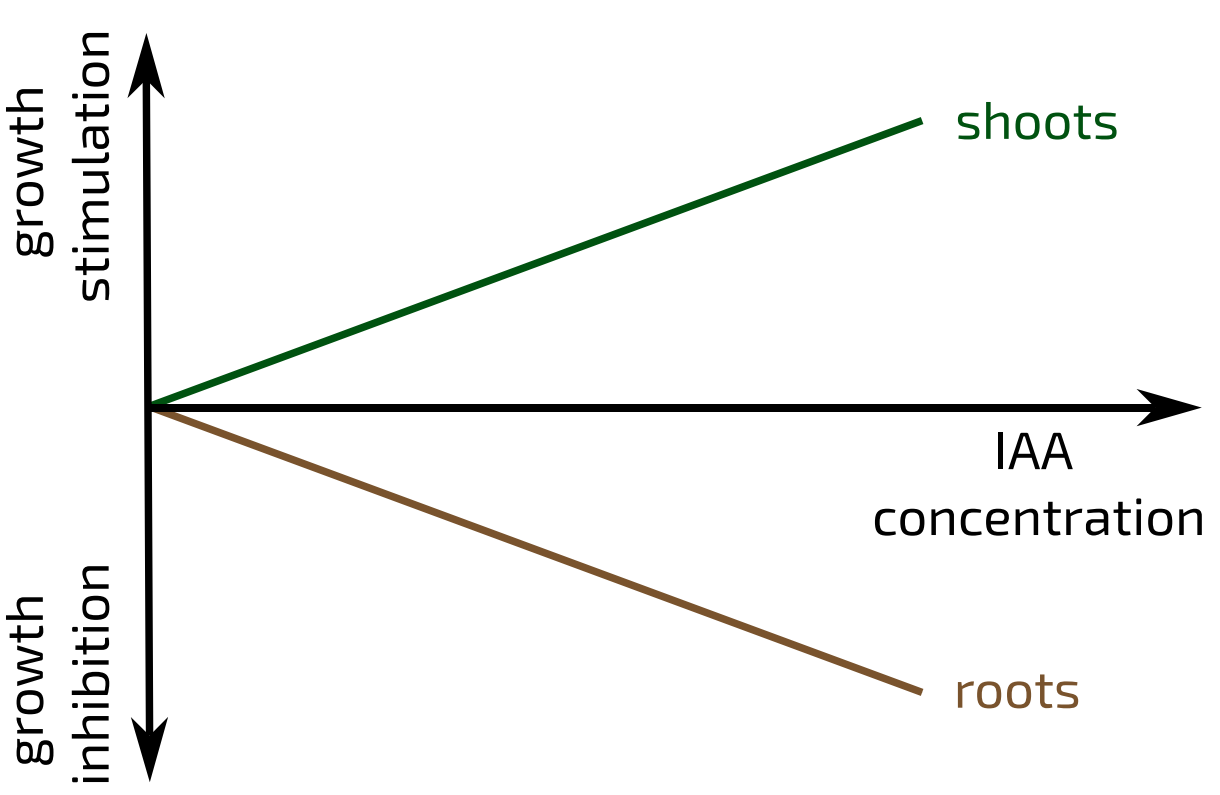
stimulate **inhibit** **towards** **away from**

Part C Roots vs shoots

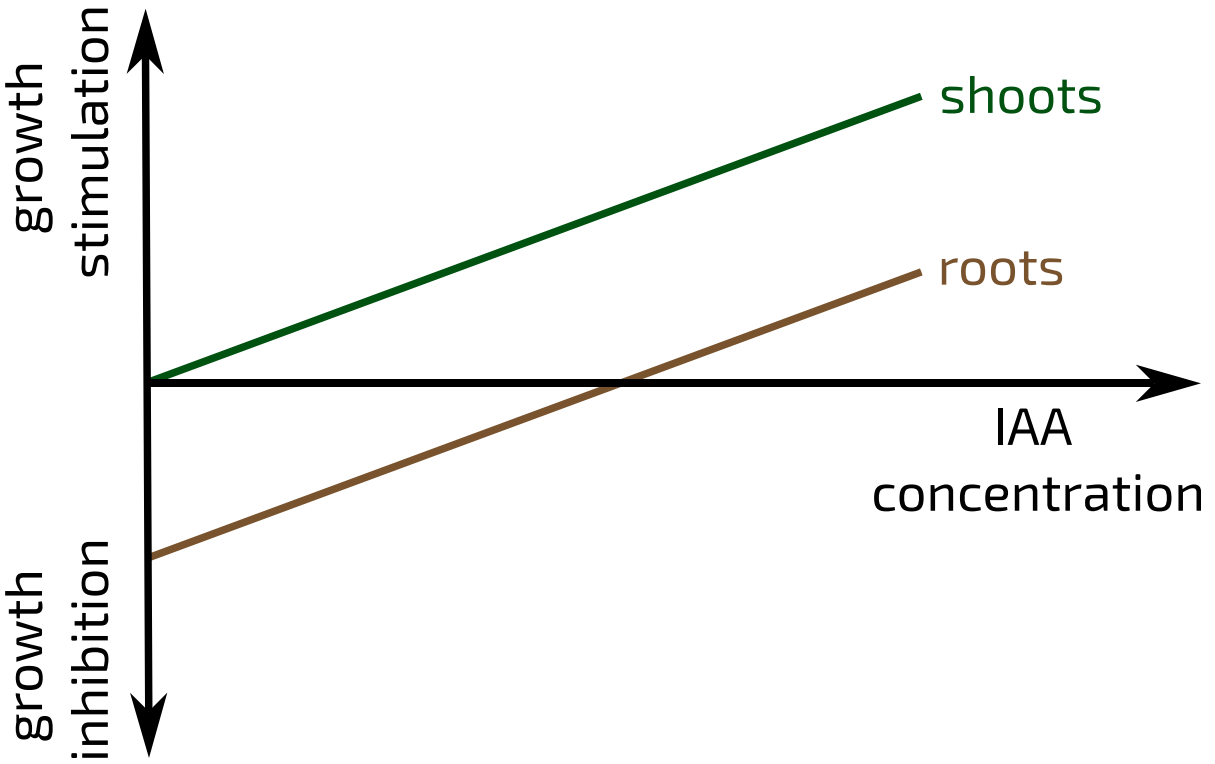
Which of the graphs below correctly shows the effects of different concentrations of indoleacetic acid (IAA) on roots and shoots?



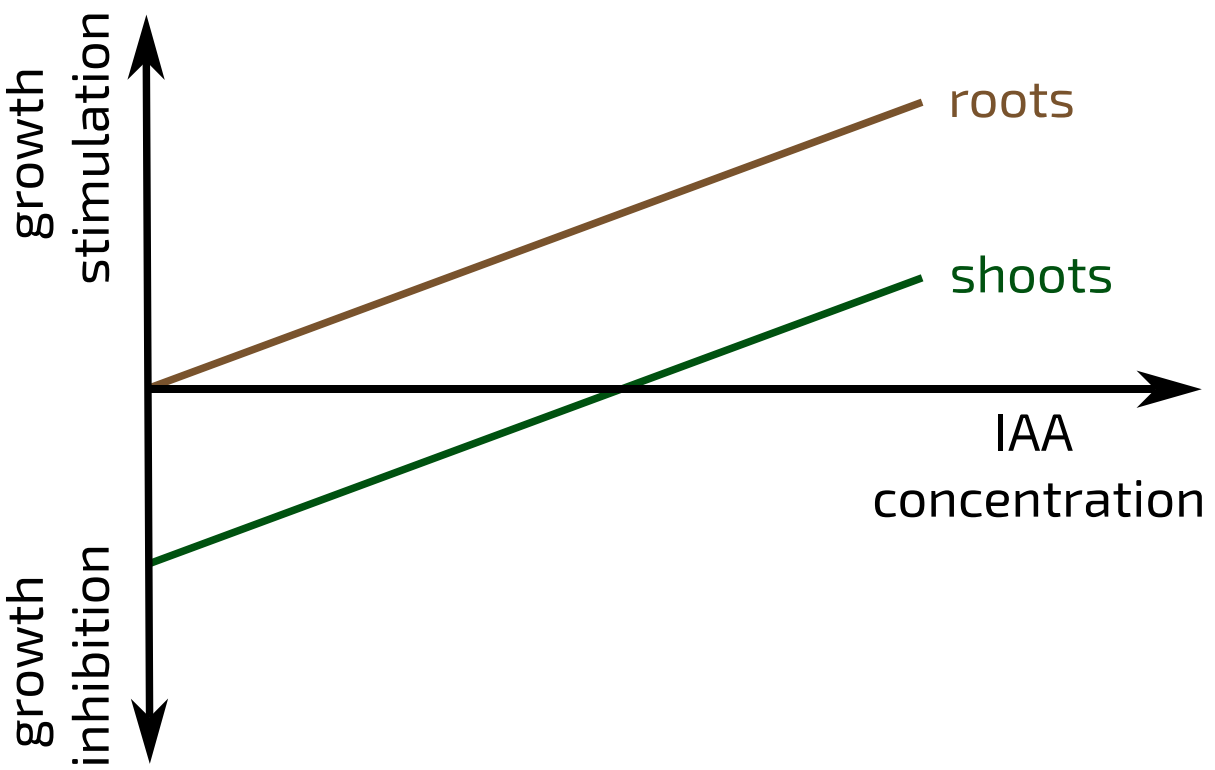
A



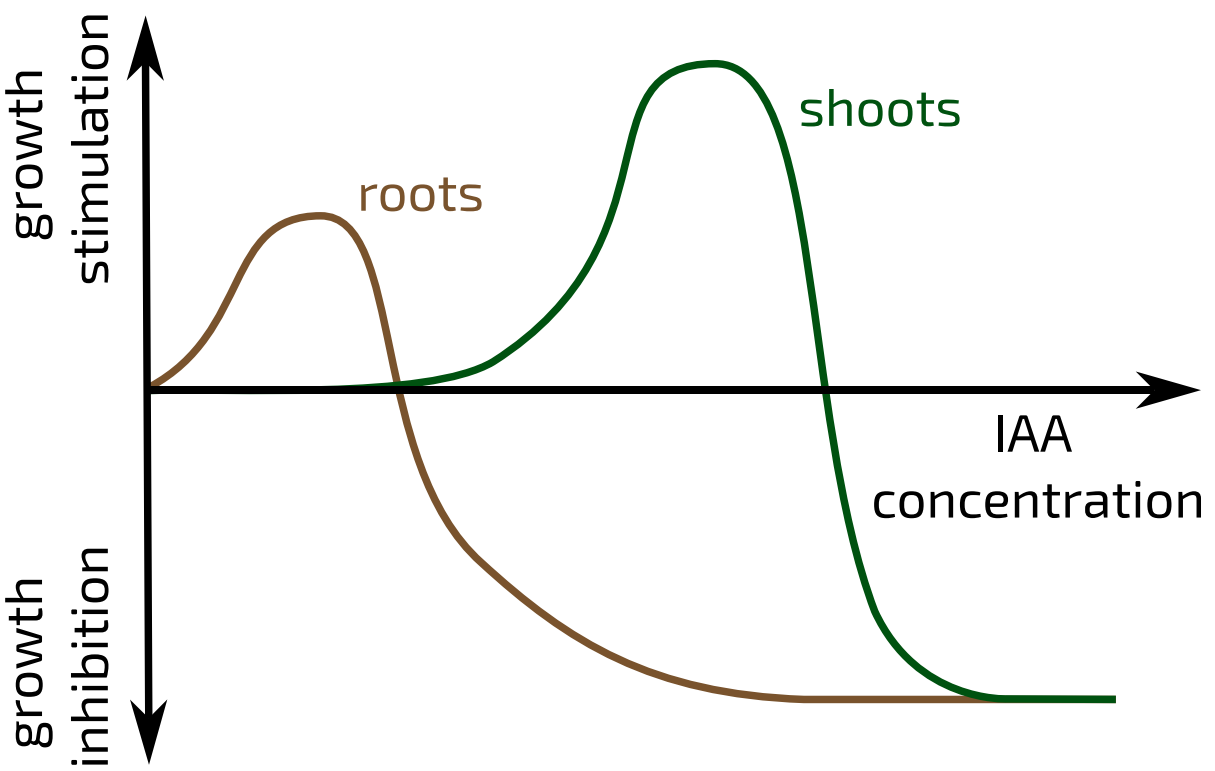
B


growth stimulation
shoots
roots
IAA concentration
growth inhibition

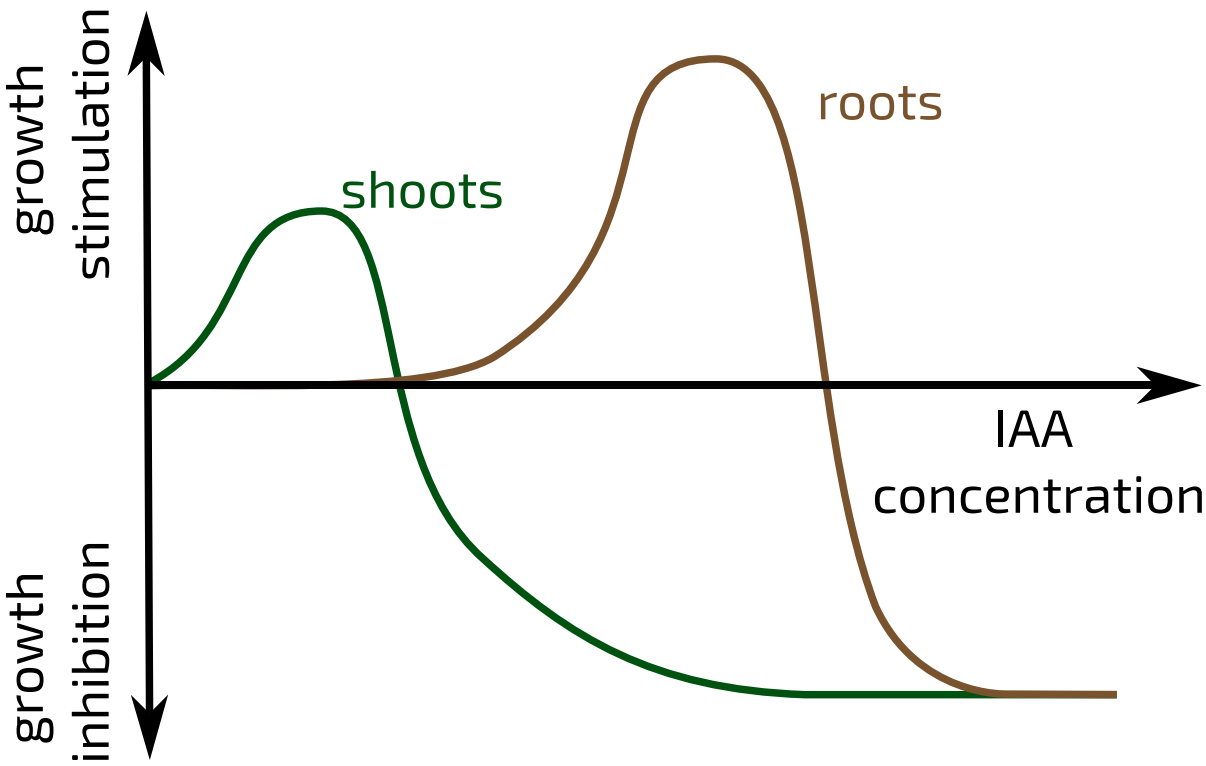
C


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

Created for isaacphysics.org by Lewis Thomson

Gameboard:
STEM SMART Biology Week 21 - Plant Growth & Reproduction

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.

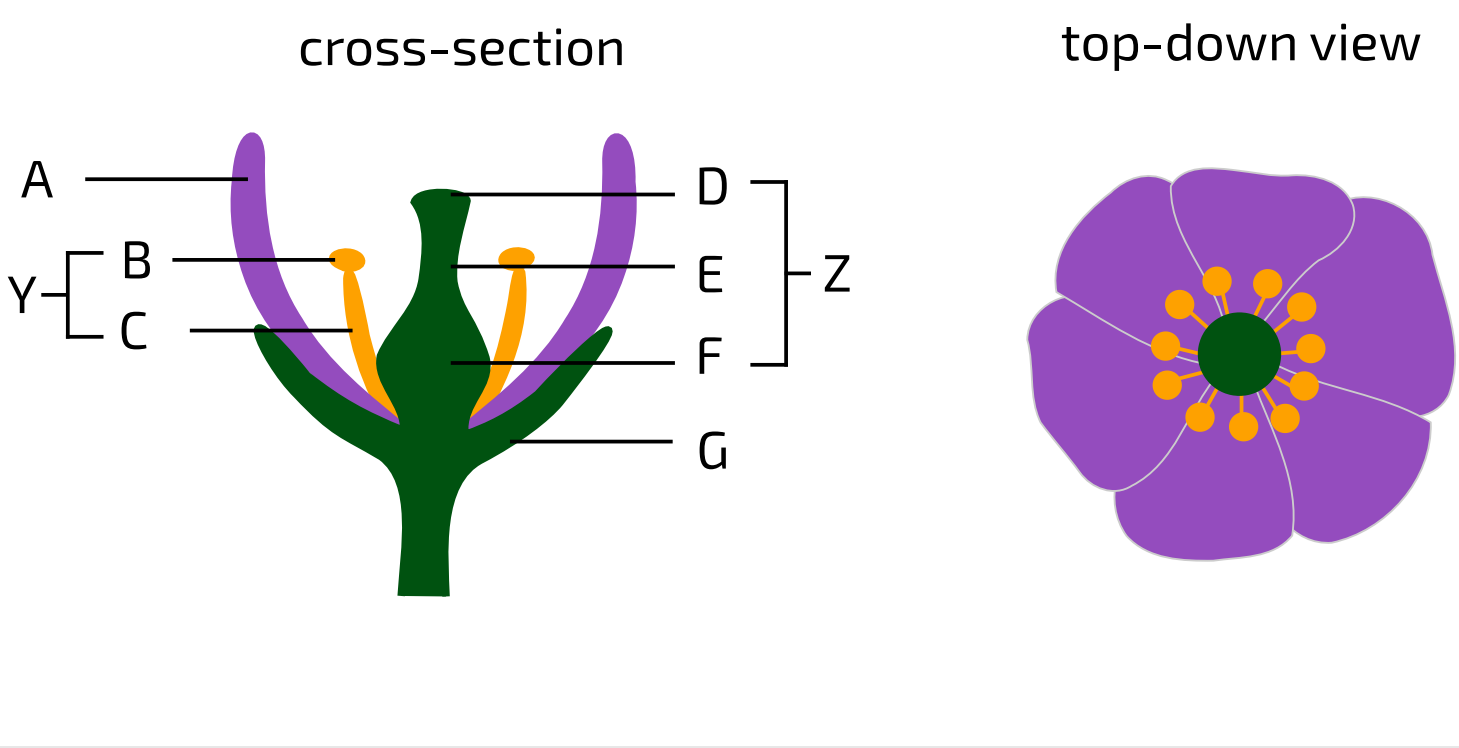


Figure 1: Structure of a flower. Left: cross-section side view, with different structures labelled. Right: the same flower from a top-down view.

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?

Created for isaacphysics.org by Lewis Thomson