

Aim: Investigate the effect of light on the growth of newly germinated seedlings.

## Equipment



**Independent variable** → Light intensity

**Dependent variable** → Seeding height

**Control variables** →

- Plant species
- Time
- Volume of water
- Temperature
- Number of seeds and distribution

### What is happening?

In darkness, plants can grow taller to 'try and reach' for light due to the accumulation of auxin at the tip.

In the absence of light, auxin stays in the tip (where it is produced) and accumulates, promoting cell elongation.

### Phototropism

Light from one direction results in an uneven distribution of auxin, with more on the unlit side. In partial sunlight, auxin will accumulate on the shaded side, therefore the stem bends towards the light.

## Method:

They should be damp but not in excess water

### Preparation

1) Soak three equal bits of cotton wool in equal amounts of water.

2) Distribute the cotton wool evenly between the three petri dishes.

3) Place ten mustard seeds in each dish, using forceps if required.

4) Put the dishes in a warm place. From now they must not be distributed or moved.

5) Allow the seeds to germinate.

Water daily with a fixed equal volume of water in each dish.

Typically need a day or so to germinate, depending on temperature

6) Once germinated, remove excess seedlings and ungerminated seeds so that each dish has the same number of seedlings.

7) Measure the height of each seedling in mm.

8) Move each petri dish to one of the following:

- Darkness
- Partial sunlight
- Full sunlight

If there is no 'partial sunlight' location, alternate day on windowsill with a day in a dark cupboard.

9) Measure the height of the seedlings for at least five consecutive days. Record heights in three separate tables, one for each location.

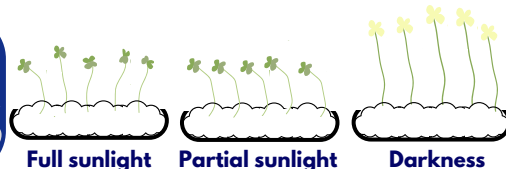
## REQUIRED PRACTICAL 8 PLANT RESPONSES

### Sources of error

Unequal exposure to sun amongst seedlings in the same petri dish

Small sample size

Temperature may affect growth



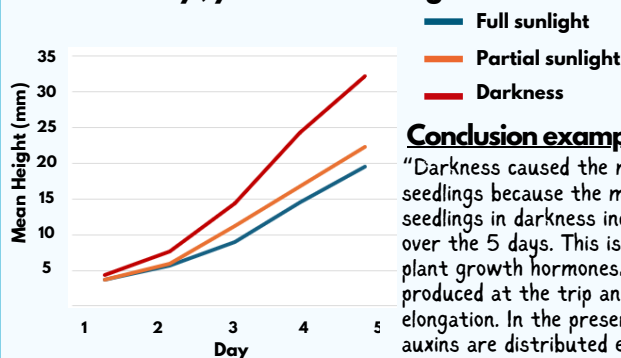
### Analysis of Results

a. Calculate the mean height of seedlings each day.

E.g. Day 1:  $(4+5+5+6+5+6+4+4) \div 8 = 4.87$

b. Plot a graph:

- x-axis - 'Day', y-axis - 'Mean height in mm'



### Conclusion example

"Darkness caused the most growth in seedlings because the mean height of seedlings in darkness increased the most over the 5 days. This is because the plant growth hormones, auxins, are produced at the tip and promote cell elongation. In the presence of light, the auxins are distributed evenly throughout the plant. However, in the absence of light, they accumulate at the tip, causing the plant to grow taller. This means when plants germinate underground, they grow rapidly to reach the require light for photosynthesis."

"The height of seedlings is similar for full sunlight and partial sunlight because chlorophyll is efficient at absorbing light energy so plants don't need full sunlight to grow, but it may grow unevenly in partial light depending on the direction of the source."

### Alternative - Investigating Effect of

#### Gravitropism

##### Summary -

- Set up two petri dishes with the same number of mustard seeds.
- Once germinated, place one on a clinostat and the other to a support on its side and leave in complete darkness.
- Record direction of growth of the shoots and roots.

Auxin has opposite effects in shoots and roots.

Root grows more on the side with less auxin - towards the force of gravity

Auxin gathers on the lower side  
Roots - High levels inhibit root cell growth

Shoots - High levels make cells grow more

Auxin gathers on the lower side  
Shoot grows more on side with the most auxin - away from force of gravity

Clinostat - rotates the shoots to cancel out the effects of gravitropism

Location: Windowsill (Full sunlight)									
Day	Height of seedling (mm)								Mean
	1	2	3	4	5	6	7	8	
1	3	2	5	4	2	4	4	5	3.63
2	5	7	6	6	5	5	4	7	5.63
3	9	10	11	10	10	8	7	7	9.00
4	13	14	15	16	13	13	15	17	14.50
5	19	20	22	24	22	19	21	9	19.50

Seedlings grown in the dark will have small and yellow leaves because they cannot photosynthesise in the dark but use up their energy stores whilst attempting to grow towards the light.

# Exam Style Questions - Plant Responses

1) Table 1 shows the data collected for the growth of seedlings grown in full sunlight by a group of students

Day	Height of seedling (mm)					
	1	2	3	4	5	Mean
1	2	3	4	5	1	3
2	6	7	7	6	4	6
3	10	8	8	7	9	8.4
4	11	9	10	9	12	A
5	13	14	12	12	13	10.6

a) Calculate the mean height of the seedlings on Day 4 (A). (1 mark)

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Table 1

b) The seedlings in the box curved as their grew. Suggest how the students accurately measured the length of each seedling. (1 mark)

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2) A group of students investigated the effect of light intensity on the growth of seedlings. To do this, they set up petri dishes with mustard seedlings and once germinated. Placed them at different distances away from a lamp.

a) Give two factors the seedlings will compete for in each petri dish. (2 marks)

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3) Name two variables you would need to keep the same when investigating the effect of direction of light on the growth of mustard seedlings. (2 marks)

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4) A group of students investigated growth responses in plant roots. They designed the following method:

1. Grew three of the same type of seed until roots were at least 0.5cm long
2. Placed the seeds in a Petri dish prepared with lightly moistened cotton wool with each root point in a different direction.
3. Set the Petri dish upright in a dark cupboard.
4. Left the Petri dish for three days.

Predict the direction of growth of the root growth after three days. Give one reason for your prediction. (2 marks)

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5) A group of students are given newly germinated mustard shoots. They cover half with foil caps and make no changes to the other half. After 3 days directly under a lightbulb, the students placed the shoots in a box with a single hole in for light to get through and left them for 3 days.

Predict what will happen to the shoots in the box. Explain your reasoning. (4 marks)

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a) Calculate the mean height of the seedlings on Day 4. (1 mark)

**One mark - 10.2mm**

Table 1

b) The seedlings in the box curved as they grew. Suggest how the students accurately measured the length of each seedling. (1 mark)

**One mark for any one of the following;**

- Straighten the seedling and measure
- Measure with a flexible ruler
- Use a piece of string to determine the seedling length, then measure length of string with a ruler.

2) A group of students investigated the effect of light intensity on the growth of seedlings. To do this, they set up petri dishes with mustard seedlings and once germinated. Placed them at different distances away from a lamp.

a) Give two factors the seedlings will compete for in each petri dish. (2 marks)

**One mark for any of the following, maximum two marks:**

- Minerals/ions/salts
- Light
- Water
- Space

3) Name two variables you would need to keep the same when investigating the effect of direction of light on the growth of mustard seedlings. (2 marks)

**One mark for any of the following, maximum two marks:**

- Number of seeds
- Types of seeds
- Temperature
- Amount of water available
- Light intensity

4) A group of students investigated growth responses in plant roots. They designed the following method:

1. Grew three of the same type of seed until roots were at least 0.5cm long
2. Placed the seeds in a Petri dish prepared with lightly moistened cotton wool with each root point in a different direction.
3. Set the Petri dish upright in a dark cupboard.
4. Left the Petri dish for three days.

Predict the direction of growth of the root growth after three days. Give one reason for your prediction. (2 marks)

**Mark One - Grow down/longer**

**Mark Two - Towards gravity/gravitropism/geotropism**

5) A group of students are given newly germinated mustard shoots. They cover half with foil caps and make no changes to the other half. After 3 days directly under a lightbulb, the students placed the shoots in a box with a single hole in for light to get through and left them for 3 days.

Predict what will happen to the shoots in the box. Explain your reasoning. (4 marks)

**One mark for each of the following, maximum of four marks:**

- Exposed/normal shoots grow and bend towards the light
- Covered shoots would grow straight
- Auxin moves to unlit side of shoots so cells on unlit side are stimulated to grow faster (causing shoots to bend towards the light until evenly lit again)
- Sensitivity to one-sided light in shoot tip
- Covered shoots have no change in auxin concentration/distribution.