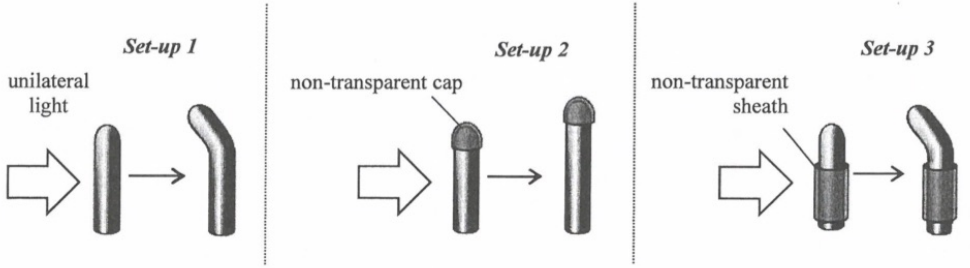
25. Darwin performed some experiments on the study of the phototropic response of coleoptiles of young seedlings. The coleoptile in each set-up was exposed to a unilateral light source and the appearance of the coleoptiles after three days are shown below:

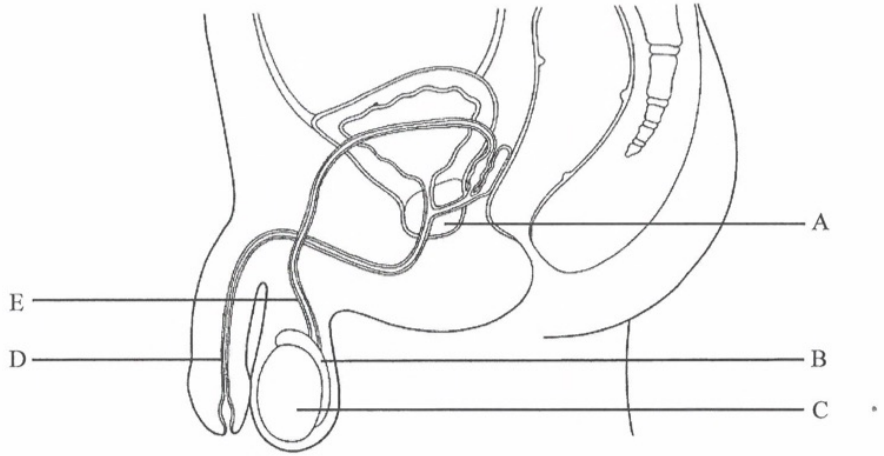


Which of the following can be deduced from Darwin's experiment?

(1) Auxins is produced from the tip of the coleoptile.
(2) The coleoptiles show positive phototropic response.
(3) The tip of the coleoptile detects the direction of light.

A. (1) and (2) only
B. (1) and (3) only
C. (2) and (3) only
D. (1), (2) and (3)

2. The diagram below shows the human male reproductive system and its associated structures:



(a) In which structure does meiosis take place? Give your answer using the letters in the diagram. (1 mark)

(b) State the functions of structures A and B respectively. (2 marks)

(c) Vasectomy is an operation for achieving permanent contraception in males.

(i) Using the letters in the diagram, state the structure which is affected in this contraceptive method. (1 mark)

(ii) What is the biological basis of this contraceptive method? (2 marks)

DSE M.C. Questions - Growth and development
(sort by difficulty)

Challenging

2018 Q.29 (28%)
Which of the following substances contribute(s) most to the increase in biomass of plant?

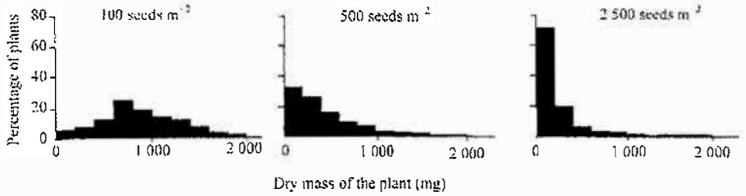
A. Water
B. Oxygen
C. Minerals
D. Carbon dioxide

2019 Q.30 (18%)
Which of the following parameters is best used for recording the growth of a potted germinating seedling over a period of time?

A. The dry mass of the seedling
B. The fresh mass of the seedling
C. The total surface area of the seedling's leaves
D. The time taken for the seedling's first leaf to appear

Average

Directions: Question 13 and 14 refer to an investigation described below. Pots were planted with seeds at densities of 100, 500 and 2500 m^{-2} respectively. The soil, water and lighting conditions were similar for each pot. The dry masses of mature plants are shown in the following graphs:



2012 Q.13 (54%)

The investigation was most likely performed to study

A. the effect of symbiosis.
B. the effect of competition.
C. the success rate of seed germination.
D. the optimum density for seed germination.

2012 Q.14 (61%)

Which of the following best describes the effect on the plants as the density of seeds planted increases?

A. biomass of individual plants is reduced
B. genetic variability of the plants is increased
C. dry masses of plants are normally distributed
D. leaves become smaller and stems get thinner

2015 Q.28 (59%)

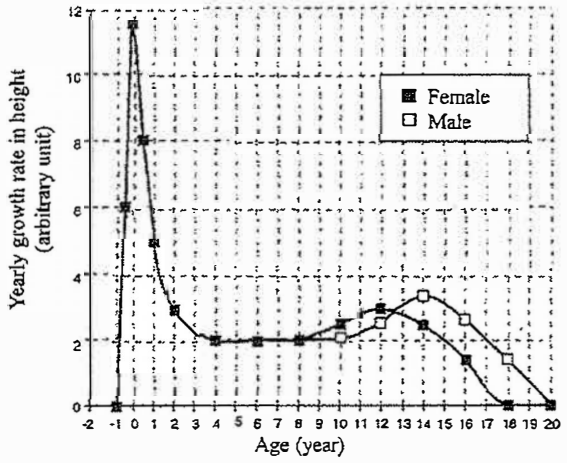
Which of the following parameters is best for measuring the growth of the broad bean after germination?

A. the length of the shoot
B. the area of the leaves
C. the weight of the embryo
D. the volume of the cotyledon

Average

2019 Q.31 (45%)

The graph below shows the growth rate of humans:



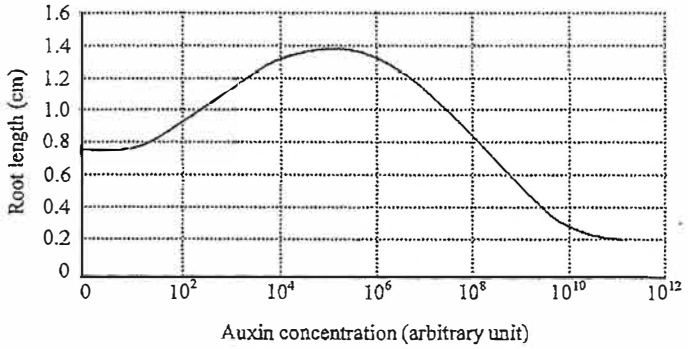
Which of the following can be deduced from the graph?

A. The brain grows rapidly from age 0 to age 4.
B. There is no more changes in growth for males after age 20.
C. The duration of adolescence is the same in males and females.
D. Growth of the reproductive organs begins at age 10 in females.

Easy

2015 Q.29 (91%)

The graph below shows the average root length of germinating seeds irrigated with different auxin concentrations?



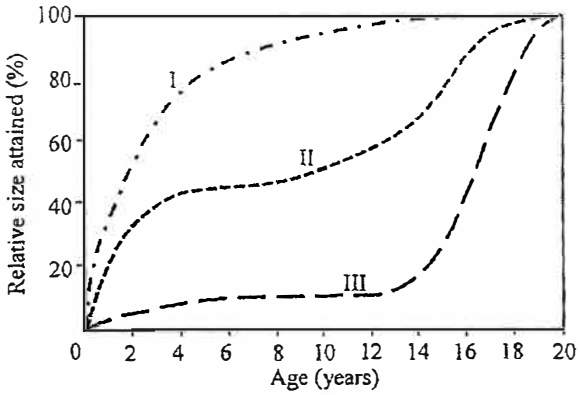
Which of the following can be deduced from the above graph?

A. Auxins promote the elongation of the root.
B. Auxins promote cell division that results in the elongation of the root.
C. Auxins promote water absorption that results in the elongation of the root.
D. Different concentrations of auxins result in differences in the extent of root elongation.

Easy

2017 Q.24 (87%)

The graph below shows the growth curves of the head, reproductive system and the whole body in humans:



Which of the following combinations correctly identifies curves I, II and III?

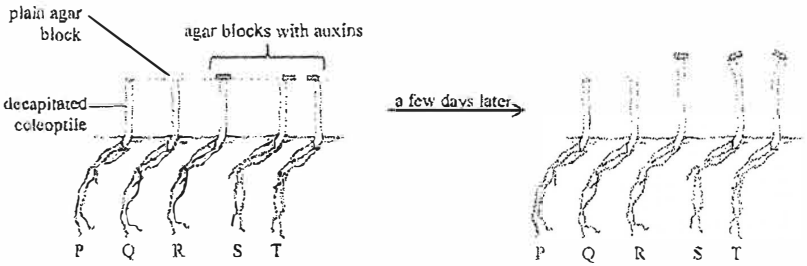
	I	*II*	*III*
A.	whole body	reproductive system	head
B.	head	reproductive system	whole body
C.	head	whole body	reproductive system
D.	reproductive system	whole body	head

2020 Q.26

26. On which of the following parts of the root can root hairs be found?

A. root cap
B. region of elongation
C. region of cell division
D. region of differentiation

Directions: Questions 27 and 28 refer to the diagram below, which shows an investigation into the effect of auxins on the growth of plant shoots:



27. Which of the following serve(s) as the control set-up(s) in this investigation?

A. P only
B. R only
C. P and Q only
D. Q and R only

2020 Q.28

28. Which of the following conclusions can be drawn based on the results of the investigation?

A. The tip of the coleoptile produces auxins.
B. Auxins stimulate the growth of coleoptiles.
C. The coleoptile shows positive phototropism.
D. Coleoptiles stop growing when the tip is removed.

Answers

Challenging

2018	2019
29 [D]	30 [C]

Average

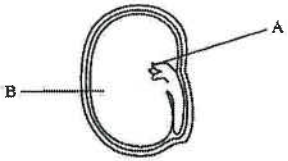
2012	2015	2019
13 [D]	28 [A]	31 [C]
14 [A]		

Easy

2015	2017	2020
29 [D]	24 [C]	26[D]
		27[C]
		28[B]

CE - 2004

1. (b) The diagram below shows a section of a seed:



(i) (1) Name structure A. (1)
(2) What organs will A develop into during seed germination? (2)

(ii) During germination, amylase activity is detected in region B. Explain the importance of amylase activity to the growth of the seedling. (4)

(iii) The dry mass of the seedling decreases in the initial stage of germination but starts to increase after one week. Explain the increase in dry mass of the seedling in the later stage. (3)

CE - 2006

10. (a) In a study of the growth of mung bean seedlings, two samples of mung bean seeds were grown under the same conditions except that one sample was kept in daylight while the other in darkness. The same number of seedlings was collected from each group every 6 days. The average dry mass of the seedlings of each group was determined and the results are shown below :

Time of growth (day)	Average dry mass of seedlings (g)	
	In daylight	In darkness
0	0.81	0.80
6	0.65	0.65
12	0.57	0.52
18	0.79	0.41

(i) Explain the change in the average dry mass of the seedlings in both daylight and dark conditions from day 0 to day 12. (3)

(ii) From day 12 to day 18, how do the seedlings grown in daylight differ from those grown in the dark in terms of the change in the average dry mass? Account for this difference. (4)

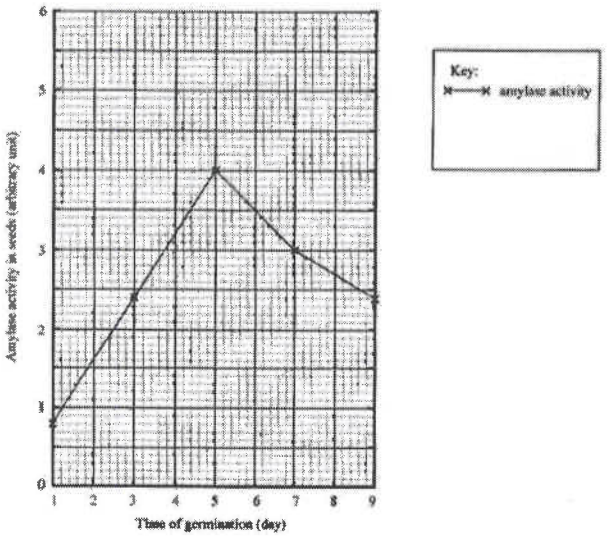
(iii) Suggest why the dry mass of seedlings was measured instead of the fresh mass in this study. (1)

CE - 2010

8. (b) A study was conducted to find out the change of amylase activity and the amount of reducing sugars in seeds during germination. The seeds were washed with water and soaked in dilute sterilizing solution for 10 minutes. They were then rinsed with distilled water and germinated under suitable conditions. The results of the study are shown in the following table.

Time of germination (day)	Amylase activity in seeds (arbitrary unit)	Amount of reducing sugars in seeds (mg/100g)
1	0.8	6.8
3	2.4	10.8
5	4.0	11.6
7	3.0	7.2
9	2.4	6.4

(i) The data on amylase activity in seeds is plotted on the graph. Present the data on the amount of reducing sugars in seeds on the same graph and give a title to the completed graph. (4 marks)



(ii) With reference to the data from day 1 to day 5, describe and explain the relationship between the amylase activity and the amount of reducing sugars in seeds during germination. (2 marks)

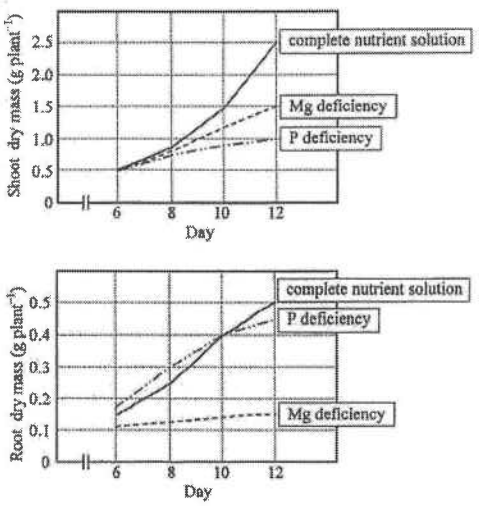
(iii) The amount of reducing sugars in seeds in day 9 is lower than that in day 3 even though the amylase activity in seeds in these two days are the same. Suggest a reason for the lower amount of reducing sugars in day 9. (1 mark)

(iv) State *two* uses of reducing sugars in the seeds during germination. (2 marks)

HKDSE – 2016 1B

9. To study the effect of mineral deficiency on shoot and root dry masses, bean plants were grown in a complete nutrient solution (a solution containing all essential nutrients for growth) or a nutrient solution without either phosphorus (P) or magnesium (Mg) for 12 days respectively. The dry masses of shoot and root were then measured. The results are shown in the graphs below:

Key: complete nutrient solution
P deficiency
Mg deficiency



(a) Briefly describe how the dry mass of a plant can be determined. (2 marks)

(b) The leaves of the bean plants grown under Mg deficient conditions appeared yellow.

(i) Why did the leaves appear yellow? (1 mark)

(ii) Use this phenomenon to explain the results of the shoot dry mass and root dry mass of the bean plants under Mg deficient conditions. (3 marks)

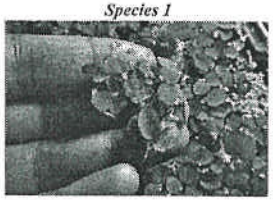
(c) (i) Explain the difference in the overall dry mass of the plant grown under P deficient conditions and that in the complete nutrient solution. (2 marks)

(ii) It was hypothesized that P inhibits the export of photosynthetic products from leaves to roots. Use this hypothesis to explain the results of the shoot dry mass and root dry mass of the bean plants under P deficient conditions. (3 marks)

HKDSE – 2021 1B

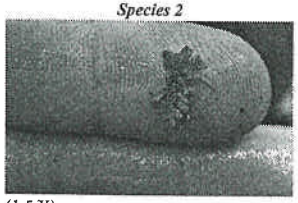
9. The photographs below show the appearances of two species of free-floating, freshwater plants, Species 1 and Species 2:

Species 1



(0.58 X)

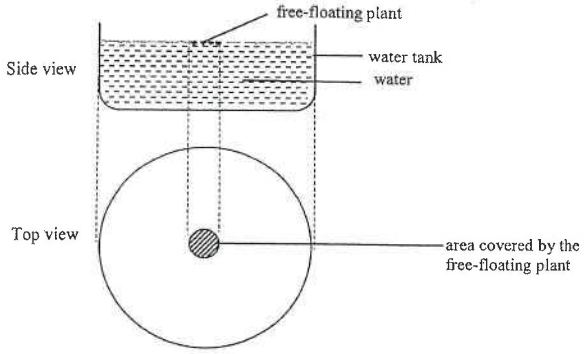
Species 2



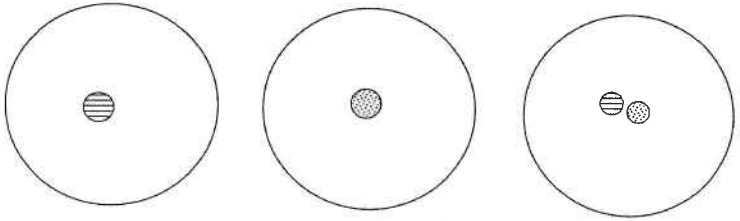
(1.5 X)

To study the interaction between these two plant species, each species was grown either alone or together with another species in a water tank for 50 days. Each species covered 10% of the area of water surface at the beginning of the experiment. The experimental set-up and design are shown in the following diagrams:

Experimental set-up:

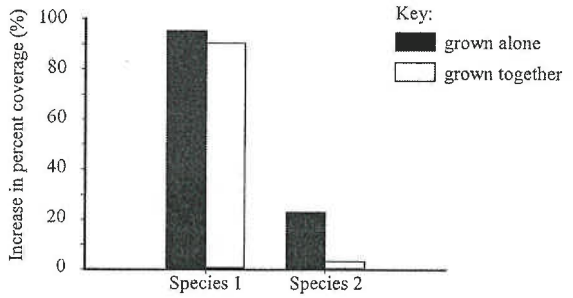


Experimental design (top view):



Species 1 grown alone | Species 2 grown alone | Species 1 and 2 grown together

The percent coverage of each plant species was measured at the beginning and at the end of the experiment. The increases in the percent coverage are shown below:



(c) The table below shows two other methods of measuring plant growth and whether these methods would be feasible in this experiment. Complete the table by giving justifications for the feasibility of the methods. (2 marks)

Method	*Feasibility*	*Justifications*
Fresh weight	Feasible	
Number of leaves	Not feasible	

Past Papers Marking Scheme – Growth and development

CE - 2004 Q.1 (b)

(i) (1) *plumule 1
(2) stem and leaf 1, 1

(ii) Amylase hydrolyses the starch stored in the seed 1
into maltose / sugar 1
which is used for forming new cells 1
and for respiration / release of energy for the growth of the seedling 1

(iii) The seedling has developed green leaves 1
The rate of photosynthesis of the leaves is greater than the rate of respiration of the seedling 1
so there is a net gain in the amount of organic substances / new cells are produced 1

CE- 2006 Q.10 (a)

(i) The average dry mass of both samples decreases from day 0 to day 12 1
because the stored food in cotyledon / seed 1
is used in respiration / is broken down to carbon dioxide and water 1

(ii) The average dry mass of the seedlings grown in daylight increases from day 12 to day 18, while that of seedlings grown in darkness continues to decrease 1
because under daylight, the seedlings have developed green leaves 1
for photosynthesis 1
The rate of food production is faster than the rate of food consumption 1
resulting a net gain in dry mass

(iii) The dry mass shows the actual biomass / organic matter of the seedlings /
The water content of the seedlings varies and hence the fresh mass cannot indicate the actual growth 1

CE- 2010 Q.8 (b)

8. (b) (i) Title (T): Change in amylase activity and amount of reducing sugars in seeds during germination (1)
Correct plotting and joining of all points (P) (1)
Correct key or labeling of curve (K) ($^1/_2$)
Correct labeling of axis with unit and appropriate scale(L) ($1\ ^1/_2$)

(ii) When the amylase activity increases, the amount of reducing sugars in seeds increases (1)
because more starch is being broken down by amylase to form reducing sugar (1)

(iii) More reducing sugars are consumed in day 9/ less starch (food storage) is available for amylase activity in day 9/ more reducing sugars are transported away from the seed in day 9 (1)

(iv) For energy release for the growth of the embryo (1)
For forming structural component of new cells (e.g. cellulose) for growth (1)

HKDSE – 2016 1B

9. (a) • dry the harvested plant in an oven at around 100°C (1)
• until a constant mass is obtained upon repeated weighing (1) (2)

(b) (i) • without magnesium, chlorophyll cannot be formed (1), leaving the leaves yellow (1)

(ii) • without chlorophyll, the rate of photosynthesis of the plant is lowered (1)
• as a result, there is not enough food produced for the growth of plants (1)
• therefore, both the shoot and root dry mass are smaller than that of the control / that grown in complete nutrient solution (1) (3)

(c) (i) • the overall dry mass of the plant under P deficient conditions is much smaller (1)
• because P is necessary for the formation of protein / nucleic acids / ATP (1) which are important for growth (2)

(ii) • without P, more photosynthetic product is transported from leaves to root (1)
• as a result, the shoot dry mass is a lot lower than that of control (1)
• while the root dry mass maintains more or less the same (1) (3)

11 marks