Chapter 35 Growth and development

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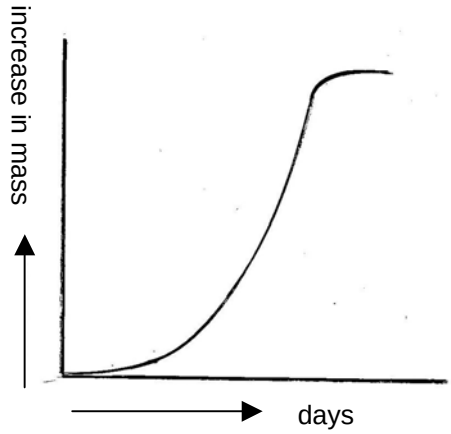
1. **a** Depending on the scale you chose, the graph would look something like this.



b It is, in fact, sigmoid. The sigmoid curve is characteristic of population growth rather than increase in mass. Nevertheless, the growth, in this case, could reflect the increase in the population of cells.

The onset of the stationary phase is very abrupt and perhaps shows the insect's metamorphosis after which growth ceases.

2. The cell would have to increase in size and develop fine processes from its surfaces which become capable of conducting nervous impulses and producing neuro-transmitter substances at their endings. With motor and sensory neurones one of these processes would become very long and narrow, leaving the nucleus in the cell body.

3. **a** At year 1 boys and girls weigh abut 7 kg. At age 5 boys weigh 20kg and girls weigh 16 kg (average 18). The average growth over this period is 18-7kg =11 kg.

b At age 10 both sexes weigh about 33kg so the average growth is 33-11kg = 22kg.

4. **a** The advantage is that you are measuring dry mass, which shows the increase in living matter and its derivatives in an organism without having to account for short-term changes in the weight of water in the tissues.

b The disadvantage is that the organism has to be destroyed in order to obtain this figure.

5. The ratio of head to body at 2 years is about 12/52 (approx. 23%) and at 20 it is 8/52 (approx. 15%).

6. The caterpillar increases greatly in size and colouration up to the pupal stage, which becomes a completely different shape. In becoming a butterfly, the inset has developed a distinct thorax and abdomen, three pairs of jointed legs, a pair of antennae and, of course, wings.

7. Although cell division is taking place rapidly in the shoot tip, the cells remain small and without vacuoles. Just behind the shoot tip, the cells develop vacuoles which extend the cells mainly longitudinally in line with the main axis. This is the region of most rapid increase in length.

Chapter 36 Movement and locomotion

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1. Muscular system, skeletal system and nervous systems. (Indirectly also breathing and circulatory systems).

2. The legs marked with arrows have just moved forward. They now remain stationary to support the beetle while the other three move forward together.

3. The tail fin continues the sideways thrusts of the body to give a final flick to the forward propulsion.

The median fins (dorsal, ventral and anal) reduce the sideways roll of the body.

The paired fins, (pectoral and pelvic) control the upwards or downwards direction of movement and assist in the turning movements.

4. The extensor muscles are the ones which thrust against the ground to produce the forward motion. The flexors only have to restore the limb to its flexed position.

5. **a** To achieve lift during flapping flight the large flight muscles (pectoral) contract and pull the extended wing downwards. Air resistance to this movement and the air-flow pattern over the wing produces lift.

b During gliding flight the bird has to lose height with its wings extended, relying on the air flow over the wing surface to achieve lift. Prolonged lift can be achieved only by making use of upward air currents.

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1. Provided that the plant can reach water and receive sunlight, it can make all the food it needs while staying in the same place.
2. Sexual reproduction produces seeds which may be dispersed over great distances.
3. Sleep movements might help to decrease transpiration (at night?) or reduce frost damage. They might prevent loss of pollen at times when insects are not active.
4. Folding leaflets could be a protective measure in tropical rain. It could make the leaves unattractive to herbivores or inaccessible to insects.

Chapter 37 Sensitivity

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1. **a** (i) Roots respond to the directional 'pull' of gravity by growing towards it.
(ii) Shoots respond to direction of light by growing towards it and to the direction of gravity by growing away from it.

b (i) *Positively phototropic*; shoots.
(ii) *Positively geotropic*; roots.
(iii) *Negatively geotropic*; shoots.

2. **a** The whole plant does not move. Only the shoots grow towards light.

b The root does not bend. Tropisms are growth movements. The root tip changes its direction of growth and grows downwards.

3. A clinostat is the only way that a unidirectional stimulus can be applied equally to all sides of a root or shoot and thus
act as a control in tropism experiments.
4. The outline of the stem will be something like this.
The first curvature is now in a non-growing part of the stem
so the next curvature will take place at the growing point.

5. As soon as the root and shoot emerge they will be exposed to the one sided stimulus of gravity. The root will respond by growing downwards and the shoot will respond by growing upwards.
6. The result would depend on the relative 'strengths' of the two stimuli. If the light stimulus were the stronger the shoot would grow downwards (the positive phototropism overwhelming the negative geotropism). Since the stimulus of one-sided gravity cannot easily be altered the result would depend entirely on the light intensity. At low light intensity the shoot would grow upwards, (negative geotropism more effective than weak phototropism).

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1. **a** Light suppresses the extension of the shoot but makes the leaves turn green.

b In positive phototropism, the unidirectional stimulus of light could suppress the growth of the shoot on the illuminated side. This would have the effect of causing the shoot to grow towards the light source.

2. You could set up the apparatus as in Fig. 37.6 but remove the tip of one of the radicles and leave the other as a control. The radicle without its tip should not show a change of direction of growth.

The snag is that by removing the radicle tip you could also remove the source of dividing cells so that growth stops altogether. You could try reducing the size of the cut region, till you get to less than 1mm.

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1. **a** The wasps appear to be attracted to the smell of food, particularly fruit and sugary substances.

b In this case the wasps seem attracted to the light and try to reach it by flying to the windows.

2. It may be that the water makes the choice chamber cooler on that side and this slows the woodlice down. Although we cannot detect it, there may be a volatile chemical in the silica gel which makes the woodlice move more rapidly.

3. The control would be to make conditions in both chambers the same by excluding both water and silica gel. If illumination is even or the experiment conducted in darkness, there should be no overall change in the distribution of the woodlice.

4. Set up the choice chamber in such a way that one half is in darkness. Alternatively, illuminate the chamber from one side in case the direction of light has an effect.

5. Most animals which move freely, travel in the direction of their long axis. So it is the front end of the animal which first encounters any stimulus: smell, light, sound etc. The front end of the animal is therefore where the sensory organs will be most effective. This arrangement will have evolved over millions of years, becoming more obvious as the sense organs became more sophisticated.