

20. Nastic Responses (page 27)

- (a) Thermonasty (b) Photonasty
- Tropisms are usually slow growth responses in response to an environmental stimulus. The direction of the growth response is determined by stimulus direction. Nastic responses are independent of the stimulus direction and are usually quite rapid movements.
- (a) Disturbance causes a change in membrane potential to the cells of the pulvinus. The cells pump potassium ions out of the cytoplasm of the cells. Water follows osmotically, causing a sudden loss of turgor in the cells supporting the leaf(lets) bases. The leaf(lets) collapse.
(b) Collapsing the leaves suddenly reduces leaf exposure to browsers and may expose unpalatable or thorny stems or dislodge small insects. If the disturbance is caused by strong wind, leaf collapse reduces the leaf surface area and so conserves water.
- Lowering the leaves at night prevents accumulation of dew on the leaf so minimises leaf damage while the leaf is not photosynthesising (especially important if temperatures are lower and accumulated water might freeze).
- (a) The hairs must be touched several times in quick succession in order for the leaf to close, preventing a false trigger.
(b) Carnivory provides nitrogen, an essential element, which is in poor supply in boggy, nutrient poor environments in which the plants live.

21. What You Know So Far: Orientation in Space (page 29)

Summary is entirely the student's own.

22. NCEA Style Question: Migration (page 30)

- Sooty shearwaters undertake a long-distance migration from sub-Antarctic New Zealand to the sub-Arctic during the southern hemisphere winter. They return to New Zealand waters for the southern hemisphere summer to breed and raise their chicks. The purpose of the shearwater's migration is to obtain sufficient food. Food production in the Arctic oceans is higher than that of the southern oceans from May to October, so it is beneficial for the birds to undertake the migration. The energy gained from this feeding is greater than the energy used during the migration, and the survival chances of individuals are improved.

From the flight patterns of the two migrating birds shown, it appears likely that the birds use prevailing trade wind currents to migrate to their destination. This would help them to conserve energy during the flight. The birds may also be using magnetic, sun and/or star compasses to navigate which would allow them to navigate during both the day and night and shorten their migration time.

Sooty shearwaters are often seen behind fishing trawlers hunting for food scraps. They may be becoming tangled in fish equipment as they hunt for scraps of food from the back of the fishing vessels, which could explain their drop in numbers.
- The sooty shearwater begins the return journey in October because this is the beginning of the northern hemisphere autumn. At this time, the Arctic days become shorter (fewer daylight hours) and the weather becomes progressively colder and more stormy. In contrast, the southern hemisphere is entering spring, the days are becoming longer and the weather is improving. The production of the southern oceans also begins to increase, becoming more productive than the autumnal northern hemisphere oceans. It is better (better food and more equable physical environment) for the sooty shearwaters to return to the south than it is to stay in the north. Breeding starts around December and by returning to the southern hemisphere in October the birds can recover and make mate selections. Productivity of the southern oceans reaches its peak during chick rearing, so there is plenty of food to support the growth and development of the chicks.

23. NCEA Style Question: Plant Responses (page 31)

- Auxin
- Etiolation occurs when a plant is grown in the absence of light. Plants showing etiolation have long, weak stems (because the walls of the cells are weak), and yellow leaves and stems.

When plants are grown in sunlight, the growing tips of a plant bend towards the light. By growing towards the light, the plants can maximise light exposure and therefore their ability to make food by photosynthesis. This response is called positive phototropism and it is mediated by the plant hormone auxin. Auxin is produced in the meristems and moves down the stem of the plant. Auxin causes the cells to elongate. In sunlight, auxin is deactivated so that only the cells on the shaded side of the plant elongate, and this causes the tip to bend towards the light (maximising light exposure). In the absence of light, auxin is not deactivated, and all the cells elongate, which is why the plant appears to grow rapidly in the dark.

Etiolation is a survival mechanism to help seedlings grow towards the light and increase their chances of becoming established. Seedlings covered by soil or leaves respond to the dark by growing rapidly upwards until they are in the sunlight, (where they can begin to photosynthesise).

24. KEY TERMS AND IDEAS: Orientation in Space (page 32)

- (a) Phototropism (c) Nastic response (nasty)
(b) Gravitropism (d) Auxin
- (a) Sun compass navigation (delete others)
(b) No
- (a) The stem shows positive phototropism, the roots show negative phototropism.
(b) Light.
(c) Positive phototropism of the stems encourages the plant to turn up and grow towards the sunlight (necessary for food manufacture). The negative phototropism shown by the roots encourages the roots to grow away from the light (usually down into soil) where they obtain moisture and nutrients.
- dispersal (C), kinesis (F), migration (E), navigation (B), taxis (A), tropism (D).
- (a) Dispersal
(b) Dispersal is usually in one direction only, whereas a migration usually occurs on a seasonal basis for specific purpose (e.g. breeding).
(c) Lack of food.
(d) The locusts disperse to find new food sources to maintain the growing population. If they didn't disperse, the population would run out of food and decline rapidly due to lack of food.

25. Astronomical Cycles (page 33)

- (a) **Cue:** Produces the solar year and seasons (four seasons in temperate climates, wet and dry seasons in the tropics, long periods of daylight and darkness at the poles. **Period:** 365.25 days.
(b) **Cue:** Produces the lunar month. **Period:** 29.5 days. Gravitational pull on the oceans creates tidal cycles (the cue) with a period of 12.2-12.4 hours.
(c) **Cue:** Produces Earth day. **Period:** 23 h 56 min.
- (a) Points away from the sun (more time in dark).
(b) Points towards the sun (less time spent in dark).
- Environmental cues can be used by organisms to establish and/or maintain a certain pattern of activity. Environmental cues are usually cyclical and predictable and can be used to keep internal rhythms from straying in their periodicity and synchronise important life cycle events, e.g. the sleep wake in response to sunlight.

