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3

91603



916030



NEW ZEALAND QUALIFICATIONS AUTHORITY
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Level 3 Biology, 2017

91603 Demonstrate understanding of the responses of plants and animals to their external environment

9.30 a.m. Thursday 16 November 2017
Credits: Five

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of the responses of plants and animals to their external environment.	Demonstrate in-depth understanding of the responses of plants and animals to their external environment.	Demonstrate comprehensive understanding of the responses of plants and animals to their external environment.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

If you need more room for any answer, use the extra space provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–12 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

Merit

TOTAL

16

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QUESTION ONE

Tropism
(Nastic)
plant

Taxis
(kinesis)
animal

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Mānuka seeds.

www.amazon.co.uk/Manuka-tree-leptospermum-scoparium-seeds/dp/B01BP3WCGA

Mānuka seeds germinating.

<http://slideplayer.com/slide/5661375/>

Mānuka seedlings
after 2 months.

<http://www.treeproject.org.au/seedling-database/leptospermum-scoparium>

When the mānuka (*Leptospermum scoparium*) seed germinates below the soil surface, two different plant responses occur at the radical and plumule.

Mature mānuka trees release ^{root}leptospermone^{stem shoots}, a chemical that acts as a natural herbicide.

Discuss how the different responses that the mānuka plant displays in germination and early growth are beneficial to the survival of the plant.

In your answer:

- identify and describe the two different responses shown by the mānuka seedling as it germinates below the soil ^{geotropism}
- explain the type of interaction between the mature mānuka and other plants growing nearby, due to the release of leptospermone into the soil ^{allelopathy negative}
- explain how these responses occur below the soil as the mānuka germinates
- discuss the adaptive advantage of these two responses below the soil, and compare them with the response once the plumule is exposed to light.

You may use annotated diagrams as a part of your answer.

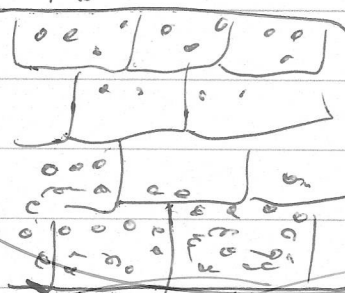
(At the radicle (roots) and plumule (shoots) of the seed in the ground two different responses occur. At the radicle ^{positive}geotropism^{negative} occurs, which orientates the roots soon to grow towards the ground in the direction of gravity, so that they can source water and nutrients from the soil. At the plumule there is a negative geotropism which orientates the soon-to-grow shoots towards the sunlight which will allow them to photosynthesize. Both responses are examples of Tropisms - long and prominent)

growth responses. As the manuka matures it releases leptospermane that act as a herbicide. This is an example of negative allelopathy between the manuka and the other plants nearby. By releasing leptospermane into the soil the mature manuka is killing off plants that would encroach on its space, and so it keeps itself available to have room to collect sun and photosynthesise more efficiently.

The germination of the manuka seed relies on the orientation from the geotropisms to be correct. The growth responses occur in the soil due to Auxins.

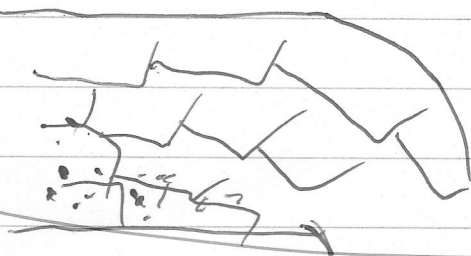
Auxins are a phytohormone that stimulate growth. The Auxins settle in cells at the base of the radicle, which causes too high a concentration of Auxin and inhibits growth rather than promoting it. The cells near the top with the lower but more effective amount of Auxin elongate, and this causes the roots to be orientated downwards and into a position in which they are able to grow.

Radicle



low Auxin concentration

high auxin concentration

Cell
Growth

Elongation promotes

cell elongation inhibited.

The adaptive advantage ~~to~~ of the positive and negative geotropisms below the soil are that they allow the seedling to be in the correct position to get water and nutrients enough to grow to the surface and get enough sunlight to photosynthesize. Without the correct orientation at the very start the plant is far less likely to survive to maturity because it will not have been able to get to ~~make~~ making its own food fast enough. Once the plumule is exposed to light, the job of the geotropism responses has been achieved since roots and shoots have grown enough for photosynthesis. The allelopathy ~~&~~ provides the advantage of ensuring that there is enough space for the manuka to grow to full maturity. By killing all nearby plants ~~the~~ with chemicals there will always be enough sunlight available and space for growth that the manuka will be able to reproduce best and continue the species. (1)

QUESTION TWO

ASSESSOR'S
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<http://www.nzbirdsonline.org.nz/species/sooty-shearwater>

http://www.teara.govt.nz/files/5484-enz_0.jpg

The sooty shearwater or mutton bird (*Puffinus griseus*) leaves New Zealand in the Southern Hemisphere's winter – summer in the Northern Hemisphere – and takes advantage of prevailing winds along different portions of their migration route.

When plotted on a map, their paths look like giant figure eights over the Pacific Ocean (see map above).

They are spectacular long-distance migrants, travelling north up the western sides of the Pacific and Atlantic Oceans at the end of the nesting season in March–May, reaching subarctic waters in June–July, where they cross from west to east, then returning south down the eastern sides of the oceans in September–October, reaching the breeding colonies in November. They do not migrate as a flock, but rather as single individuals, associating only opportunistically.

Recent tagging experiments have shown that birds breeding in New Zealand may travel 74 000 km in a year, reaching Japan, Alaska, and California, averaging more than 500 km per day.

Discuss why migration is important to the health and survival of the sooty shearwater.

In your answer:

- describe migration
- explain how the sooty shearwater might determine the time for migration, AND how they may navigate during migration
- discuss the costs and benefits of migration to the sooty shearwater.

Migration is the mass movement of many individuals of the same species in search of resources, mates, or more favourable climate. The sooty shearwater may determine the correct time to begin migration through the ~~use of~~ recognition of lowering temperatures due to the decrease in photoperiod during the start of winter. This decreasing of the daylight hours

There is more space for your answer to this question on the following pages.

1) prompts the sooty shearwater to seek warmer climates and so they travel to the northern hemisphere for the longer photoperiod and higher temperatures. During their migration they may use wind currents that occur due to the air pressure, in order to help them northward. They must also use an internal magnetic compass ~~to~~ on which they can detect the earth's magnetic field in order for them to fly correctly to the west for nesting season and then returning down to the east for breeding season. They are mostly flying over water, so certainly they use landmarks to find their way when close to their destination. But they may use the sun to navigate during their migration. The orientation of the sun between ~~from~~ east and west would allow the birds a guideline in which direction to travel to reach their nesting and breeding grounds. But furthermore, this form of navigation only works at ~~night~~ day, so at night they are likely to use ~~stars~~ constellations to ~~help~~ guide them in their migration. The migration process is long, and with the ~~birds~~ sooty shearwater travelling around 500 km a day there is great energy expenditure. The benefit of migrating is that it allows the shearwaters a place where they all may gather to find mates and raise young. This is vital for the continuation of the species as a whole and to continue each individual's genetic line. ||

(1) Reproduction is why migration is most important to the sooty shearwater. By crossing from east to west and south to north they are able to stay in warm temperatures that are beneficial for raising young and will increase the chance of the young surviving. ~~it also means that at the cost of migration is that it is so much energy.~~ The sooty shearwater flies over water, so no access to food for long periods of time so must have to build fat reserves to sustain their energy requirements over the journey. If they are insufficiently fed nourished the bird may fall out of the sky and die from exhaustion or malnutrition. There is also a chance of predation ~~from~~ ^{during} flight, and especially when nesting since it is done predictably each year. Nesting in large groups is a deterrent to predators though, but the shearwaters fly alone so run the risk of getting lost if they navigate incorrectly - but this is more unlikely - or if they are thrown off course by weather such as hurricanes or even just ~~high~~ fast winds. If they were to migrate together it would decrease the chance of dying alone and lost. But ultimately the migration must occur to continue the sooty shearwater species, ~~as~~ it is of utmost importance to the species' survival.

ASSESSOR'S
USE ONLY

M5

QUESTION THREE

ASSESSOR'S
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<http://howardcheek.photoshelter.com/image/I00005Pm3.HDRznI>

<http://cursa.ihmc.us/rid=1Q19NCQSR-1PH7VJX-2V1Q/flowering%20in%20plants.png>

Mānuka (*Leptospermum scoparium*) are long-day plants which flower in spring and into summer. Flowering in the mānuka plant is controlled by the phytochrome system. The flowers are used by beekeepers to produce mānuka honey. Honeybees (*Apis mellifera*) seek their food within a circumference of 3 to 4 km around their hive. The bees navigate from the hive to the flowers using different cues during the day.

Relate the role of the phytochrome system to the survival of the mānuka plant population.

In your answer:

- ✓ identify and describe the relationship between the mānuka tree and the bees mutualism
- ✓ describe the process of photoperiodism AND explain how the phytochrome system could work in the mānuka tree Pr Pfr
- discuss how photoperiodism in the mānuka tree provides an adaptive advantage to BOTH species.

You may use annotated diagrams to support your answer.

1) The relationship between the bees and mānuka tree is a mutualistic one. Both species benefit from this arrangement. The bee benefits since it has a nectar source, and the mānuka tree benefits because the bees act as pollinators and help continue ~~for~~ the reproduction of the species. Photoperiod is the relative length of day and night, photoperiodism is a response to the photoperiod to regulate flowering at the optimum time in relation to the plant's critical day length. The phytochrome system is based on two phytochromes: Phytochrome red ~~and~~ (Pr) and phytochrome free-red (Pfr). Phytochrome red is the active phytochrome.

1) That stimulates flowering during the day.

As such it is in higher concentrations during this time, but as the ~~day~~ night draws closer more of phytochrome free-red is produced.

This is the inactive phytochrome that inhibits flowering, and ~~since~~ these two phytochromes work on a shifting equilibrium throughout the ~~plant~~ day hours to regulate the ~~parameters~~ photoperiodism. Since the manuka is a long day plant the equilibrium is more shifted in the favour of phytochrome red which will cause the flowers to be grown when the ~~photoperiod~~ photoperiod becomes longer than the critical day length. The manuka will only produce flowers in spring and summer when the ~~days~~ photoperiod is larger than the critical day length.

The photoperiodism of the manuka provides an adaptive advantage to both itself and the bees through their mutualism. The bees act as pollinators for the manuka ~~the~~ tree. When the bee comes to collect nectar the pollen of the flower becomes stuck to it, this pollen is then shared with the next flower when the bee ~~visits~~ collects nectar from it. This allows for variation to occur within the manuka species and will create a genetic diversity that will prevent all of the species being killed off in the event of a disease.

There is more space for your answer to this question on the following page.

|| This increases the overall chance of the species survival and thus provides an adaptive advantage that is beneficial to the manuka. By only flowering during the day the manuka is saving energy for use since bees navigate by sun position and will not pollinate during the night. The photoperiodism conserves the manuka's energy. The bees gain an adaptive advantage from ~~the~~ having a food source available that will flower when they are most active in the summer and provide them with the nectar they need to continue their species. The mutualistic relationship derived from the manuka's photoperiodism ensures the survival of both bee and manuka populations. ||

M5

Subject:		Biology	Standard:	91603	Total score:	16
Q	Grade score	Annotation				
1	M6	<p>This student narrowly misses getting E7 in this question because they only explain the process of one tropism fully (in the radicle), so despite explaining 2 adaptive advantages well, they can't reach this grade. The student does identify and explain allelopathy however, which means that they can reach M6.</p> <p>If the student has responded fully to bullet point three of the question they would have explained both negative and positive geotropism which with the existing evidence would have allowed them to get into the Excellence criteria.</p>				
2	M5	<p>This student is close to getting E7, but fails to adequately link the costs and benefits to overall survival advantage. Although aspects of the migration are explained, there is no clear statement to indicate that the overall benefits outweigh the costs and how that is linked to overall survival advantage.</p> <p>Aspects of timing and navigation methods are described but not explained fully. More detail in terms of the processes would have allowed an M6 to be awarded.</p>				
3	M5	<p>Understanding of the technical aspects of the phytochrome system is not shown. A number of statements that are inaccurate prevents the award of credit for this part of the answer. Critical day length is also not explained. Despite these omissions, the student makes a strong case for the adaptive advantages and is awarded M5.</p>				

- This is a candidate who has done well in this standard because of their understanding of the adaptive advantages of the responses identified in these questions. There is lack of evidence of some of the detailed biology that drives them, but by relating the processes to their benefits, they have explained why the responses provide an adaptive advantage for the organisms in relation to their ecological niches.