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NZQA | Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Level 3 Biology 2025

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

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.

Check that this booklet has pages 2–16 in the correct order and that none of these pages is blank.

Do not write in the margins (////). This area will be cut off when the booklet is marked.

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

QUESTION ONE: Phytochrome system

Poinsettia (*Euphorbia pulcherrima*) are short-day plants. New Zealand native plants are mostly long-day plants, and they flower during summer, when the days are long and the nights are short.

Plant growers use their knowledge of photoperiodism and the phytochrome system to cause poinsettia to flower during the New Zealand summer.

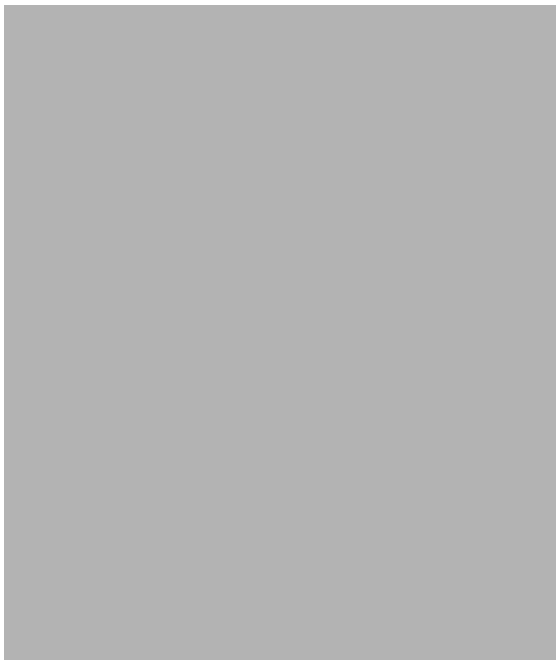

Figure 1: Poinsettia growing in a commercial greenhouse.

Figure 2: The effect of light and dark hours on short-day plants.

Discuss the phytochrome system, and justify why plant growers in New Zealand change the light and dark hours to make short-day plants, such as poinsettia, flower during a New Zealand summer.

In your answer include discussion of:

- a definition of photoperiodism
- the difference between a short-day and long-day plant, referring to Figure 2 above
- how the phytochrome system influences flowering in short-day plants.

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QUESTION TWO: Honey bee behaviour

The honey bee (*Apis mellifera*) is a diurnal insect. Foraging for pollen is linked to their circadian rhythm. Honey bees rely on environmental cues to orientate themselves to their home hive and to their surroundings. They use the Sun's position in the sky as a compass to help determine direction. They have been known to forage for up to 5 km from the hive but can always find their way home, even when clouds cover the Sun.

Figure 3: Honey bee foraging.

During a total solar eclipse, honey bees experience darkness when they usually wouldn't. Biologists monitored honey bee foraging activity on a normal day (no solar eclipse) and the day of a total solar eclipse (when the moon completely covers the Sun).

Figure 4: Foraging activity compared between a normal day and a total solar eclipse day.

Discuss the behaviour of honey bees on a normal day and on the day of a total solar eclipse, using the information above.

In your answer, include discussion of:

- a description of diurnal circadian rhythm, linked to the honey bees' ability to use the Sun as a compass
- the environmental cues honey bees use to find their way home on sunny days and overcast days
- the foraging activity of honey bees on a total solar eclipse day compared to a normal day
- why some honey bees continue to forage during the darkness of a total solar eclipse.

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QUESTION THREE: Behaviour in grey wolves

The grey wolf (*Canis lupus*) is a social animal that lives in groups of approximately 2–20 individuals called a pack. The pack is made up of closely related individuals that form a hierarchy.

Agonistic behaviour such as dominance displays, submissive displays, and threat behaviours are important in the hierarchy.

Figure 5. Behavioural display.

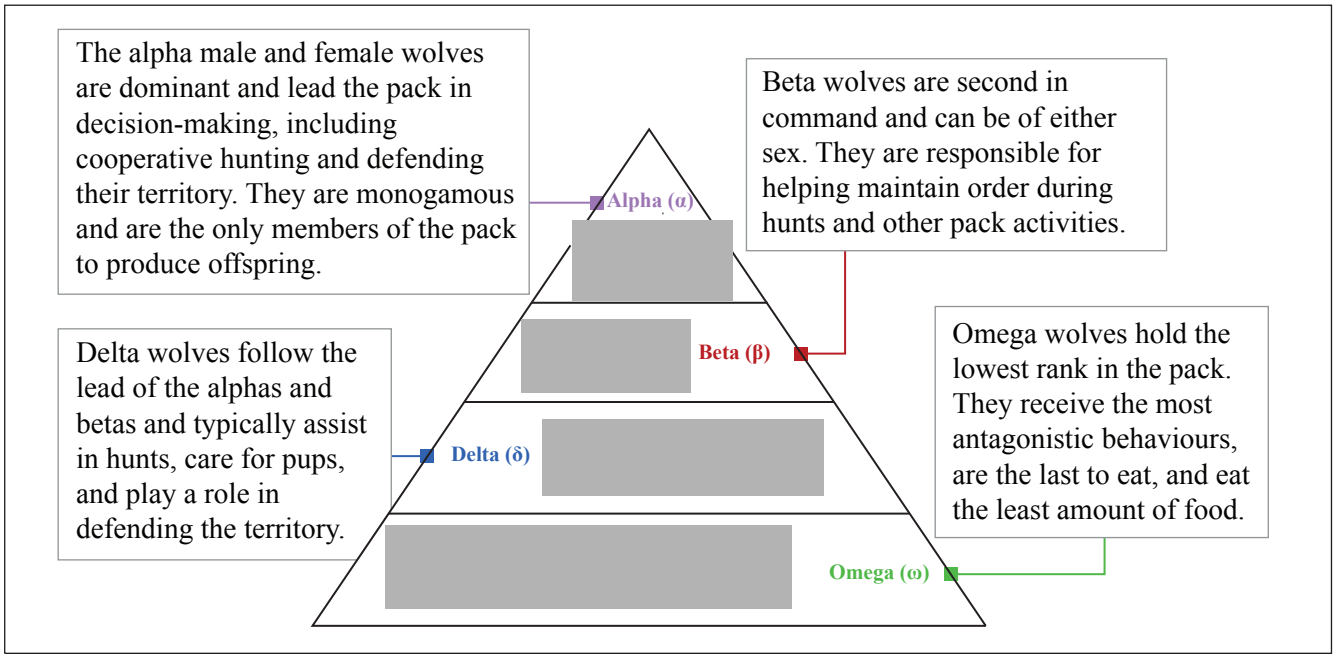

Figure 6: Social dominance hierachy of a grey wolf pack.

Discuss advantages and disadvantages of hierarchical behaviour in a wolf pack.

In your answer, include discussion of:

- the terms hierarchy and territory, including definitions
- how the hierarchy of the pack is maintained
- how and why members of the pack demonstrate kin selection
- an advantage and disadvantage of individuals below the alpha pair living in a hierarchy, compared to living on their own.

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QUESTION NUMBER

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QUESTION NUMBER

Acknowledgements
Material from the following sources has been adapted for use in this assessment:

Figure 1: http://extension.msstate.edu/publications/selecting-and-maintaining-poinsettias
Figure 2: https://www.pathwayz.org/Tree/Plain/PHOTOPERIODISM
https://stock.adobe.com/1448334301
Figure 3: https://stock.adobe.com/768631526
Figure 4: https://www.researchgate.net/publication/330250857_Foraging_and_homing_behavior_of_honey_bees_Apis_mellifera_during_a_total_solar_eclipse. DOI: https://doi.org/10.1007/s00114-018-1597-2.
Figure 5: https://stock.adobe.com/825111153
Figure 6: https://www.researchgate.net/publication/322488015_Grey_Wolf_Algorithm_for_Requirements_Prioritization