

Assessment Schedule – 2025**Biology: Demonstrate understanding of the responses of plants and animals to their external environment (91603)****Assessment Criteria**

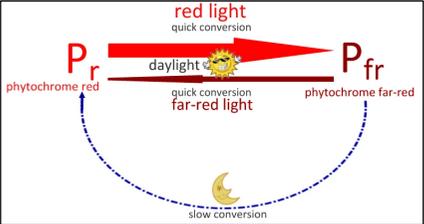
Achievement	Achievement with Merit	Achievement with Excellence
<p><i>Demonstrate understanding</i> involves:</p> <ul style="list-style-type: none"> describing the process(es) within each response and /or the selective advantage provided for the organism in relation to its ecological niche. 	<p><i>Demonstrate in-depth understanding</i> involves:</p> <ul style="list-style-type: none"> using biological ideas to explain how the responses occur explaining why the responses provide a selective advantage for the organism in relation to its ecological niche. 	<p><i>Demonstrate comprehensive understanding</i> involves:</p> <ul style="list-style-type: none"> linking biological ideas to explain why the responses provide a selective advantage for the organism in relation to its ecological niche; linking of ideas may involve justifying, relating, evaluating, comparing, and contrasting, and analysing.

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0–7	8–13	14–18	19–24

Evidence

Question One

Evidence	Achievement	Achievement with Merit	Achievement with Excellence
<ul style="list-style-type: none"> • Photoperiodism is the response (of organisms) to differing ratios of light and dark/ seasonal differences to the length of day or night. • Short-day plants flower when the night is longer than the critical period/ when the night is longer than the day length. • Long-day plants flower when the night is shorter than the critical period/ when the night is shorter than the day length. • The phytochrome system is the system plants use to detect light/ phytochrome is a light-sensitive protein that exists in two forms, phytochrome red (Pr) and phytochrome far-red (Pfr). • Critical day length is the amount of (day) light that determines if plants will flower or not/ critical night length is the length of darkness that determines if plant will flower or not. Acts as a threshold for plants that rely on day/ night length (photoperiod) to regulate flowering. <p>Phytochrome is a light-sensitive protein that exists in two interconvertible forms, Pr (inactive form) and Pfr (active form). During the day, the plant absorbs red light which converts Pr quickly to Pfr. During the night/ in the dark, Pfr slowly reverts to Pr. Plants use the level of Pfr remaining to determine the length of the period of darkness.</p> <p>Short-day plants (bar 2 on graph) require low levels of Pfr to flower. If the night is long enough, most of the Pfr is converted to Pr by morning, signalling to the plant that the night has been long enough to induce flowering. They need a long, uninterrupted night that allows the Pfr level to drop to a certain level/ threshold. High Pfr levels due to a short night/ darkness will prevent flowering (bar 1 on graph).</p> <p>Long-day plants require high levels of Pfr to flower. If the night is short enough, the plant doesn't have enough time to convert Pfr to Pr so, in the</p> 	<p>Describes:</p> <ul style="list-style-type: none"> • short-day plant • long-day plant • photoperiodism • phytochrome system <i>(accept an annotated diagram)</i> • critical day/night length. 	<p>Explains:</p> <ul style="list-style-type: none"> • the difference between a short-day and long-day plant with reference to critical day/night length • how Pr and Pfr work <i>(accept an annotated diagram with sufficient explanation)</i> • critical day/night length – uninterrupted darkness is critical for the active form, Pfr, to revert to the inactive form, Pr • how flowering is caused in a long-day plant • how flowering is caused in a short-day plant. • how plant growers can produce flowers from short-day plants during New Zealand summers <i>(either method)</i>. 	<p>Provides detailed discussion of:</p> <ul style="list-style-type: none"> • the photoperiodic response of flowering in short-day and long-day plants which includes the phytochrome system • how plant growers produce poinsettia flowers/ short-day flowers during New Zealand summers, both methods, with justification.

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morning, the level of Pfr is high/ at a certain threshold and the plant is induced to flower.			
Poinsettias are short-day flowers, so growers can produce flowering poinsettia, during a New Zealand summer /for Christmas (i.e. long days and short nights) if: <ul style="list-style-type: none"> • The plants are kept in more darkness /an artificially extended night length. This means Pfr would have enough time to convert into Pr and be at low levels /reach the critical threshold by morning, inducing flower growth. • The night length is interrupted by red light followed by far-red light (bar 4 on the graph). The far-red light converts the (active) Pfr form back to (the inactive) Pr form, restoring the plant’s ‘time perception’ of a long night. This allows the poinsettia to flower as it perceives the night as uninterrupted /far-red light after red light reverses the effect, allowing the plant to perceive the night as long and subsequently flower. 			

N1	N2	A3	A4	M5	M6	E7	E8
ONE evidence point at Achievement.	TWO evidence points at Achievement.	THREE evidence points at Achievement.	FOUR evidence points at Achievement.	TWO evidence points at Merit.	THREE evidence points at Merit.	ONE evidence point at Excellence.	TWO evidence points at Excellence.

N0 = No response; no relevant evidence.

Question Two

Evidence	Achievement	Achievement with Merit	Achievement with Excellence
<p>Diurnal organism: an organism that is active during daylight hours.</p> <p>Circadian rhythm: an innate rhythm /process /response that repeats every 24 hours. It is controlled by an internal biological clock but can be influenced by cues such as light.</p> <p>Honey bees use landmarks such as trees, buildings, flowers, and other large objects for homing. Honey bees can memorise familiar landmarks near the hive and use these to find their way back home on both sunny and overcast days.</p> <p>Honey bees use the Sun's position in the sky as a compass to determine direction. By using the Sun's location at different times, they can orient themselves relative to the horizon. This environmental cue can be used only on sunny days.</p> <p>Honey bees use polarised light patterns (caused by sunlight scattering in the atmosphere) in the sky to orient themselves to the Sun (compass). This enables them to find their way back home on overcast days.</p> <p>Honey bees can recognise the scent of their own hive and the scent of flowers they have encountered during foraging. They can use these flower scents to orient themselves after foraging, on their way home. This cue can be used on sunny and overcast days.</p> <p>Some studies have shown that honey bees use Earth's magnetic field for orientation /homing. This cue could be used on overcast days.</p> <p>On a day with average sunlight hours, the honey bee's foraging activity steadily increases in the morning but peaks around 1:30 p.m. Towards the end of the afternoon, there is a gradual decrease in foraging. Overall, the foraging activity is consistent throughout the day.</p> <p>On an eclipse day, honey bees show normal foraging activity before the eclipse; however, during the total solar eclipse it decreases to only a few individuals. After the eclipse, their activity slowly recovers but remains lower until after 3 p.m., when it is higher than on a non-eclipse day.</p> <p>The honey bee's circadian rhythm is closely linked to its sun compass, because honey bees rely on the position of the Sun for navigation and homing. The Sun's position changes throughout the day, and honey bees need to constantly adjust their navigation depending on where the Sun is in the sky. Their internal circadian /biological clock helps them accurately interpret the Sun's position throughout the day.</p>	<p>Describes:</p> <ul style="list-style-type: none"> • diurnal organism /behaviour • circadian rhythm (includes internal biological clock) • landmarks used by honey bees for homing • sun / polarised light used for homing • scent /chemicals used for homing • Earth's magnetic field used for homing • foraging activity on a normal day • foraging activity on a solar eclipse day. 	<p>Explains:</p> <ul style="list-style-type: none"> • why a honey bee's circadian rhythm is closely linked to its sun compass • the environmental cues honey bees use for homing on sunny days • the environmental cues honey bees use for homing on overcast days • foraging behaviour on a normal day • foraging behaviour on a solar eclipse day • why honey bees forage during the total solar eclipse darkness. 	<p>Provides detailed discussion of:</p> <ul style="list-style-type: none"> • circadian rhythm and how honey bees use environmental cues on sunny days and overcast days to find their way home (linked to survival / reproductive success) • honey bee foraging on a solar eclipse day compared to a normal day (with reference to figure 4) and why some honey bees still forage.

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<p>Honey bees rely on their circadian rhythm to regulate foraging behaviour. This rhythm is entrained by light but doesn't react instantaneously to short-term, abrupt changes in light levels (e.g. during an eclipse).</p> <p>During a total eclipse, the sudden drop in light is likely to confuse the honey bee's sense of time; however, not all honey bees interpret the temporary darkness as night-time immediately. Some bees may continue foraging, as their internal clocks haven't yet adjusted to the unexpected / sudden lack of light.</p> <p>Individual variation:</p> <ul style="list-style-type: none"> • Some honey bees may be less responsive to the change in light during the eclipse, allowing them to continue foraging for a brief period despite the darkness. Other honey bees may have greater ability to use different cues (e.g. the magnetic fields which are still present during the eclipse). • Some less-responsive bees might interpret the eclipse as passing cloud cover rather than darkness / nightfall, especially if their biological clock is not yet registering the abrupt transition as darkness. 			

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N0 = No response; no relevant evidence.

Question Three

Evidence	Achievement	Achievement with Merit	Achievement with Excellence
<p>Hierarchy: A social order in a group of animals (wolves) that live collectively, where individuals are ranked from highest to lowest or from alpha to omega (i.e. a pecking order). Each animal is dominant over those below it and is submissive to those above it in the hierarchy. The hierarchy is maintained by ritualised (agonistic) behaviours (e.g. displays of dominance /aggression, etc.).</p> <p>Territory: An area that is actively defended /protected /guarded.</p> <p>Kin selection: Behaviours in social animals that benefit others in the group but may be at a cost (survival or reproductive) to the individual (altruistic behaviours, i.e. increase chances of passing on their own genes, not just by reproducing directly but by helping the reproduction and survival of genetically close relatives).</p> <p>Examples of kin selection in a wolf pack:</p> <ul style="list-style-type: none"> • Cooperative hunting: A subordinate wolf helps with hunts but may not gain access to food immediately or receive the same amount of food as higher-ranked individuals; subordinate wolves that are closely related to the alpha pair support the pair to remain healthy, thereby increasing the chances of reproduction in the alpha pair, and so passing on the genes / alleles of the subordinate wolf family. • Offspring-care: Non-breeding subordinate wolves help care for the alpha pair’s pups (i.e. they invest time and effort into increasing the survival chances of pups that share (family) genes but are not directly theirs). • Territorial defence: Non-breeding wolves use energy, risking injury or even death, to defend the pack’s territory (from rival wolves). However, defending the pack’s territory helps the alpha pair maintain /receive resources within the territory, which increases survival and reproductive success. • Altruistic behaviour in risky situations: For example, when protecting litters from other wolves, subordinate wolves risk injury or death. <p>Agonistic displays /ritualised behaviours that maintain pack hierarchy:</p> <ul style="list-style-type: none"> • The use of body language, posture, vocalisation, alpha-pair scent to mark territory, tail /ear position, avoiding eye contact, licking the muzzle of a dominant wolf to communicate dominance. 	<p>Describes:</p> <ul style="list-style-type: none"> • hierarchy • territory • kin selection (must state relatedness) • an example of kin selection • an advantage of living in a pack • a disadvantage of living in a pack. 	<p>Explains:</p> <ul style="list-style-type: none"> • at least TWO examples of how the pack’s hierarchy is maintained • why members of the pack demonstrate kin selection • an example of kin selection and links it to genetic relatedness • an advantage of living in a pack and links it to increased survival rate • a disadvantage of living in a pack and links it to cost-benefit. 	<p>Provides detailed discussion of:</p> <ul style="list-style-type: none"> • how the pack hierarchy is maintained AND why wolves demonstrate kin selection to increase reproductive success • advantages of individuals below the alpha pair living in a pack AND disadvantages of individuals below the alpha pair living in a pack. <i>(Compares to living alone and recognises that advantages outweigh the disadvantages, hence the retention /selection of the behaviour leading to increased reproductive success.)</i>

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<ul style="list-style-type: none"> Ritualised fights / displays of aggression, keep the subordinates in line / reinforce the hierarchy and reduce tension without serious injury to subordinates. <p>Advantages of living in a wolf pack:</p> <ul style="list-style-type: none"> Subordinates have increased protection, with safety in numbers and reduced personal risk. Often, the dominant wolves are at the front of the pack when defending the territory, so protecting the lower-ranking wolves. Even though the subordinate has less access to resources (food), they still benefit as they have a secure food source and access to resources within the territory (e.g. water, shelter). Subordinates have reproductive benefits of passing on a higher percentage of their genes / alleles (by helping the alpha pair breed) than they would if they were solitary. <p>Disadvantages of living in a wolf pack:</p> <ul style="list-style-type: none"> Subordinates have less access to food as higher ranked individuals eat first and more. Lower-ranked wolves may suffer malnutrition, with negative effects on health and survival. Subordinates are very unlikely to reproduce, with only the alpha pair being ‘allowed’ to reproduce. Subordinates receive more aggressive behaviours from higher-ranked individuals. This may cause stress or injury, with negative effects on health and so a decrease in their chances of survival. Subordinates have little to no influence on decision-making. <p>Ultimately, omega wolves or subordinates remain in a pack because the benefits to survival and reproduction outweigh the costs, and the subordinates have a greater chance of passing on their genes / alleles by aiding the successful reproduction of genetically close relatives.</p>			

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