Plant and Animal Responses to their Environment
ANSWERS

Orientation in Time

Biological Rhythms: Circadian Rhythms
STOP AND CHECK (PAGE 5)

- 24 hours.
- Linked to sleeping and feeding patterns of animals, including human beings. There are also clear patterns of core body temperature, brain wave activity, hormone production, cell regeneration, and other biological activities. It allows organisms to anticipate and prepare for precise and regular environmental changes. Triggered by: light availability.
- Examples: Sleep-wake cycle and body temperature cycle.

Biological Rhythms: Circannual Rhythms
STOP AND CHECK (PAGE 6)

- 1 year.
- Linked to seasonal change, some plants have a very strict time frame in regards to blooming and preparing for spring. If they begin their preparations too early or too late this might affect their survival rate. Having a circannual cycle may keep them from making this mistake if a particular geographic region experiences a false spring, where the weather becomes exceptionally warm early for a short period of time before returning to winter temperatures. Triggered by: changes in day length.
- Examples: hibernation of animals and leaves falling off plants.

Biological Rhythms: Circatidal Rhythms

STOP AND CHECK (PAGE 7)

- 12 hours.
- Linked to tidal changes as the organism usually (not always) becomes active at high tide and not so during low tide. Triggered by the gravitational pull of the moon.
- Fiddler crabs are active during low tide to feed and go into their burrows during high tide.

Biological Rhythms: Circalunar Rhythms

STOP AND CHECK (PAGE 8)

- 29.5 days.
- Linked to nocturnal light.

Photoperiodism

STOP AND CHECK (PAGE 10)

- A long day is in summer, a short day is in winter, and a day-neutral is any time in the year.
- Pigment levels tell the plant when to flower.

Exogenous Rhythms

STOP AND CHECK (PAGE 11)

- Exogenous and endogenous.
- Controlled by something outside the body, they are externally driven.
- Light availability in a day-night cycle, tide length in a circatidal rhythm, or the changing day length in circannual rhythms.

Endogenous Rhythms

STOP AND CHECK (PAGE 11)

- Endogenous rhythms are controlled by an internal biological clock and are not affected by changes in the environment. They can continue when the environmental conditions remain constant.
- The biological rhythm is running during constant environmental conditions.
- The internal biological clock.

Zeitgebers and Entrainment

STOP AND CHECK (PAGE 13)

- Because the internal clock cycle is 25 hours while the day-night cycle is 24 hours, resets are needed to keep things in sync.
- They are environmental cues that reset an internal clock.
- Any environmental factor: light, temperature, humidity.
- This act of resetting the internal, biological clock to match the environment.
- A phase shift occurs when the time of activity or inactivity is pushed forwards or backwards.

Actograms

STOP AND CHECK (PAGE 15)

- To figure out whether a rhythm is endogenous or exogenous, the length of the biological rhythm (period), and any entrainment and phase-shifting that occurs.
- Graph showing when an organism is active and inactive over the course of each day, as well as any changes in the environment.
- Draw a line from the first to the last day of the period when the animal is kept in constant conditions, the phase shift is how much the activity period is changing each day, calculated by hours divided by days.

Orientation in Time

QUICK QUESTIONS (PAGE 16)

- It is active at night but inactive during the day, therefore it is exhibiting a nocturnal circadian rhythm.
- Free-running is when the biological rhythm is running during constant environmental conditions, it is shown in the later 2 weeks of the actogram, where the period of activeness at night is shifted earlier and earlier because the endogenous cycle is not 24 hours.
- Entrainment is the act of resetting the internal, biological clock to match the environment. This can be seen in the first 2 weeks, having the light as an environmental cue to reset the clock so that you have constant non-shifting periods of activeness at night. This goes out of sync when the animal is exposed to darkness all the time, mainly because our internal biological clocks have a cycle period closer to 25 hours, so the period of activeness shifts as more days go by. This process is known as free running.

Orientation in Space

Orientation Responses Shown by Plants

STOP AND CHECK (PAGE 19)

- Nastic responses are non-directional responses to the intensity of the stimulus while tropisms are directional responses to a directional external stimulus.
- Positive is towards stimuli while negative is away.
- Light: phototropism
- Chemical: chemotropism
- Gravity: gravitropism or geotropism
- Water: hydrotropism.
- Temperature: thermotropism
- Physical contact: thigmotropism

Auxin

STOP AND CHECK (PAGE 20)

- Molecules that are often produced in one location and do stuff in another.
- Auxin causes cells to grow longer than normal, this can bend plants towards or away from light sources.
- Auxin moves to the lowest side of the roots due to gravity, and the loss of auxin on the higher side causes cells to elongate while the cells on the lower side stay the same. The result is that the root starts to bend and grow downwards.

Orientation Responses Shown by Animals

STOP AND CHECK (PAGE 11)

- Tropism in plants is a growth response while animals have taxis, which is a movement-based response.
- A taxis response is a directional response involving the movement of the animal either towards or away from the directional external stimulus
- Orthokinesis is a change in the speed of an animal's movement, where the movement is faster in unfavourable conditions but slower in favourable conditions while klinokinesis involves a change in the rate of turning of an organism. The rate of turning is faster in unfavourable conditions but slower in favourable conditions.

Homing and Navigation

STOP AND CHECK (PAGE 23)

- Homing involves an animal finding its way to its home site over unfamiliar areas, often after migrating to different locations.
- They use a navigation method that involves using landmarks to guide their way back.

Migration

STOP AND CHECK (PAGE 25)

- Migration is the routine mass movement of a species to the same place, migratory behaviours often follow a seasonal trend.
- Organisms move to new feeding grounds because the current one has run out, or for breeding purposes, where the new location is more beneficial to the survival of their offspring.

Orientation in Space

QUICK QUESTIONS (PAGE 25)

- Migration is the routine mass movement of a species to another location, often for feeding or breeding purposes. In this example, the routine movement is the travel between the Arctic and Antarctic.
- The purpose can be thought of as having the best environment to live in. Moving to the Antarctic for its non-breeding purposes can be useful in the summer for a new feeding ground. The new location is more beneficial to the survival of their offspring.
- It can be a variety of factors, most likely will be dependent on the day-light cycle as summer moves into autumn/winter. Other factors can include wind patterns and temperature.
- It probably does this by looking at the temperature of wind currents. The Arctic terns can determine the direction of cold/hot winds blowing to determine which direction the Antarctic is in.
- Tropism is the response we are looking for, i.e., a directional response to a directional source of stimuli.
- This might be due to the hormone auxin. The hormone can be released/isn't broken down in the dark sides of the shoot, this will bend the shoot towards the light source.
- This might be useful for plants as it can enable them to grow towards the strongest source of light to give them the best chance of survival. This is particularly true in situations where the plant is located in forests where sunlight might be limited.
- Woodlice exhibit orthokinesis (change in movement intensity) while the flatworm is klinokinesis (change in the rate of turning).

- Taxis response is a directional response. They are different from the two mentioned above because it is directional, i.e., they can move towards or away from the source of the stimuli.
- It can be beneficial for the woodlice to remain stationary during humid conditions so that they will stay in these conditions for longer periods of time and it can help them not lose water from their bodies. For the flatworms, they increase the amount of turning they do in increasing light to ensure that they spend more in dark areas, as it's beneficial to their survival to not get cooked by intense sunlight or eaten by predators because they found them in the light.

Interspecific and Intraspecific Relationships

Territory

STOP AND CHECK (PAGE 27)

- A territory is an area where an animal lives and the area that it defends from other animals. Home range is the area where an animal will search for food and water that it can't find in its territory, and doesn't usually involve defending. A lek is where males (usually) come together and perform mating displays, often competitively, to attract female mates for the purpose of breeding.

Ecological Niche

STOP AND CHECK (PAGE 28)

- An ecological niche describes the physical and biological conditions or factors a population or species faces in its habitat.
- They would start competing for the same resources and ultimately one species will dominate the other, forcing the other to change ecological niche or face extinction.

Intraspecific Relationships

STOP AND CHECK (PAGE 30)

- Intraspecific relationships are interactions with other animals from the same species.
- Space, food, mates.
- The advantage is that there is safety in numbers, being able to warn or fight off predators, and help each other to find food. The disadvantages include disease being more common in close groups, more competition for things like food and space, and there can even be an increased vulnerability to predators as large groups are more noticeable.

Hierarchies

STOP AND CHECK (PAGE 31)

- Linear is the simple progression from most dominant to most submissive. Complex involves structures involving different groups such as subordinate groups, family groups, bonding pairs, and labour groups, often all controlled by a dominant, alpha member.
- By establishing rank, each member knows its place in the hierarchy which reduces fighting and competition for food and other resources.

Reproductive Strategies

STOP AND CHECK (PAGE 32)

- Monogamy is finding one mate and sticking with it, whereas polygamy describes organisms having many mates.
- Monogamy is better when you require full commitment to your children to raise them in harsh environments, while polygamy is better if all you have to do is deposit your egg/sperm.

R and K-Strategy

STOP AND CHECK (PAGE 34)

- **R-strategy:** pro is you put in very little effort per child and your own survival isn't jeopardised by having to care for your children. While many of your children die or are eaten by predators, low survival rates can be detrimental.
- **K-strategy:** Children have a much higher survival rate, but you spend a lot more energy per child to care for and protect them.

Courtship

STOP AND CHECK (PAGE 35)

- Some birds have songs they sing to attract mates, while others use colourful feathers in their tails e.g. peacocks and birds of paradise.

Interspecific Relationships

STOP AND CHECK (PAGE 36)

- Exploitation.
- Commensalism and mutualism.
- Interspecific relationships are often more harmful to one organism, as there is no kinship to deter a member of one species to not kill or fatally harm the other. Intraspecific relationships are unlikely to end in serious harm, as kinship deters them inflicting fatal harm.

Exploitation

STOP AND CHECK (PAGE 38)

- Predation is where one animal hunts and feeds on another. Herbivory is a type of predation where one animal feeds on one plant species.
- Parasites benefit by having a secure home for reproduction or by taking some of the host's resources, like food, water and heat.
- Head lice and tapeworms.

Mutualism and Commensalism

STOP AND CHECK (PAGE 38)

- Mutualism is where both parties benefit, while commensalism is where one benefits while the other is unaffected.
- A species might benefit from a mutualistic relationship if the absence of this means both species are disadvantaged. In humans, we have gut bacteria that help us digest food. We provide them with a place to live and let them snack off the food that passes through the intestines, and they pay us in the form of good digestion and the development of a gut immune system. Without the relationship, both species suffer.

Mimicry

STOP AND CHECK (PAGE 40)

- To avoid predators.
- Batesian mimicry is where a harmless species mimics a dangerous or poisonous species.
- Müllerian mimicry is when two unpalatable species (animals that aren't tasty) mimic each other's warning signals. This teaches the predator to avoid the 2nd species once it tries to eat the first species.

Interspecific and Intraspecific Relationships

QUICK QUESTIONS (PAGE 40)

- Humans with bacteria have mutualism. Commensalism is the relationship between mites and us humans. Plasmodium and humans have parasitism as the relationship between them.
- In mutualism, both the humans and bacteria benefit from the relationship, as humans get the vitamin that is otherwise unattainable while the bacteria get to flourish and reproduce in our gut. Commensalism is different as one party gets benefits while the other is unaffected. The mites feed off our dead skin cells while we feel nothing from them, no effect whatsoever. Finally, for parasitism, the Plasmodium flourish in our bodies and reproduce using

humans as a conduit. In return, we get malaria, not a fair trade to say the least. Clearly, the protozoa are benefitting at our expense.

- Coevolution is likely to happen when different species have close ecological interactions with one another. These ecological relationships include:
    - Predator
    - Prey and parasite/host
    - Competition
    - Mutualism

Plants and insects represent a classic case of coevolution, one that is often, but not always, mutualistic. Many plants and their pollinators are so reliant on one another and their relationships are so exclusive that biologists have good reason to think that the match between the two is the result of a co-evolutionary process.

But we can see exclusive matches between plants and insects even when pollination is not involved. Some Central American Acacia species have hollow thorns and pores at the bases of their leaves that secrete nectar. These hollow thorns are the exclusive nest site of some species of ant that drink the nectar. But the ants are not just taking advantage of the plant, they also defend their acacia plant against herbivores.

This system is probably the product of coevolution, where the plants would not have evolved hollow thorns or nectar pores unless their evolution had been affected by the ants, and the ants would not have evolved herbivore defence behaviours unless their evolution had been affected by the plants.

