1. Why Organisms Need to Respond (page 3)

1. (a) A behaviour is the response of an organism to a particular situation or stimulus.
   (b) Behaviour is adaptive because it increases fitness (increases survival and reproductive success). A behaviour that is not adaptive would not persist (there would be selection against it).
2. An orientation behaviour describes how an organism positions itself in response to an environmental stimulus, whereas a timing behaviour is a predictable response to an environmental rhythm.
3. A behaviour might become innate (genetically programmed) through natural selection. There would be selection against behaviours that were not adaptive and these would disappear. Eventually, the genes associated with adaptive behaviour will become fixed in the organism's genome and every individual will behave similarly.

2. Types of Stimuli (page 4)

1. (a) Gravi- (d) Photo-
   (b) Chemo- (e) Thermo-
   (c) Thigmo- (f) Hydro-
2. Negative phototaxis (note: previous activity defines animal orientation behaviours)

3. Kineses (page 5)

1. (a) i. 0-10%
   ii. 0-10%
   iii. 90-100%
   (b) High numbers of turns and fast movements return the woodlice to an area of high humidity.
   (c) 80-100%
2. (a) **Experiment 1:**
   Light: 125.25 squares Dark: 49.75 squares
   Experiment 2:
   Light: 111.25 turns Dark: 51.75 turns
   (b) Dark
   (c) Rate of movement and rate of turning were both much lower in the dark than in the light, indicating the woodlice were not seeking a different type of environment.
   (d) If a woodlouse is in an unfavourable environment, moving more quickly and turning more make it more likely that a more favourable environment will be encountered more quickly. This will minimise the time it spends in an environment that is not favourable to its survival.
3. (a) 30°C.
   (b) Klinokinesis
   (c) The louse make many random turns when outside its preferred temperature environment, but relatively few turns when at a favourable temperature.

4. Taxes (page 7)

1. A kinesis is a non-directional response to a stimulus in which the rate or movement or turning is related to the stimulus intensity. A taxis is an orientation and movement in response to a directional stimulus or a gradient in stimulus intensity.
2. Simple orientation behaviours operate to position the animal in an environment that is favourable to its survival.
3. (a) Snails: negative gravitaxis.
   (b) Moth: positive chemotaxis.
   (c) Lobster: positive thigmotaxis.
   (d) Mosquitoes: positive thermotaxis.
   (e) Maggots: negative phototaxis.
4. (a) Nematodes move towards the NH_4Cl in plate A but make random movements in plate B.
   (b) Positive chemotaxis
   (c) This behaviour increases the chances that the nematodes will find suitable food and avoid toxins.
5. Although there might be some brief movements towards the light (especially for maggot 1) in every trial, there was a **net** movement of the maggot away from the light. The maggots are negatively phototactic (move away from the light).

5. Pheromones (page 9)

1. (a) Pheromones are chemicals produced by an animal and released into the environment where they influence the behaviour or physiology of others of the same species.
   (b) Pheromones are species specific so that the message is received by the right organism, e.g. to attract a mate and trigger courtship behaviours.
2. The response of the male moth is adaptive because it enables the male to locate a mate. The threshold for detection is very low, so he can detect females even when they are far away.
3. Social insects use pheromones to communicate and to maintain social order. Pheromone trails laid by an ant that has located food enables others in the colony to locate the food source. Alarm pheromones from one ant alert others so that a mass attack against the threat can be initiated by the entire colony. In honeybees, pheromones maintain social order ensuring the different castes carry out their assigned roles.

6. Migration (page 10)

1. Migration is the long distance movement of individuals from one place to another, often on a seasonal basis.
2. (a) Costs include the energy spent in migrating and the risk involved because migration involves long distance travel across unfamiliar landscapes.
   (b) The longer the migration, the greater the energetic cost. Note: Energetic costs per km are highest for animals that walk or run, so their migrations are shorter.
   (c) Animals migrate because the benefits gained at the destination (in terms of food and suitable environment) outweigh the risks/costs.
3. (a) Navigational efficiency is increased by aligning to both the movement of others and individual guidance mechanisms, thus reducing the errors of either method.
   (b) Survival is enhanced by the reduced error in navigation, which increases the chance of arriving at the correct destination and reduces energy expenditure because fewer navigational errors are made.

7. Migration Patterns (page 11)

1. Nomadic migration might be necessary to escape deteriorating habitats and colonise new ones that have more favourable conditions. An example is humans following seasonal food sources.
2. One-way migration (dispersal) and nomadic migrations. These forms of migration would allow the original population to spread into new areas and establish new populations.
3. Any of a number of examples: Change in day length, or temperature, or food supply (reduced).
4. Migration is adaptive in that it allows individuals to relocate to an area more suited to their survival at a certain life stage (i.e. more favourable with better food resources and/or breeding sites and/or climate).

8. Examples of Migration (page 12)

1. (a) Migratory locust: 7 (f) Monarch butterfly: 2
   (b) Caribou: 3 (g) European swift: 6
   (c) Shearwater: 9 (h) Humpback whale: 1
   (d) Polar bear: 8 (i) European eels: 4
   (e) Green turtle: 5 (j) Spiny lobster: 10
2. (a) Monarch butterfly: To avoid climatic extremes; moving away from harsh northern winter temperatures, followed by movement away from Mexico's summer heat.
   (b) Humpback whale: Exploiting the plankton-rich summer feeding grounds in the polar regions; enhancing survival of newborn in winter breeding grounds in the tropics (possibly because it is desirable for young to be born in shallow and sheltered waters).
   (c) Spiny lobster: Compensation for gradual loss of population "downstream" of the longshore current.
3. (a) Migratory birds are now not travelling as far south during the winter and they are making their migrations north earlier than usual.

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