Year 13 Science: Orientation in space: tropisms, taxes, kineses and migration

Name: _____ Date: _____

Try these without your notes first, then check the answer key.

Practice

1. A flatworm moves away from a bright light by steering its head from side to side. Name the response.

2. A woodlouse covers 42 cm in 60 s on dry paper. What is its speed in cm s^{-1}?

3. Why does a root bend down while a shoot bends up, if both have more auxin on the lower side?

4. Clover leaflets fold at night and open in the morning, whichever side the light comes from. Name the response.

5. What does a bird need, as well as seeing the Sun, to use a sun compass?

Exam-style question: kuaka migration

Kuaka (bar-tailed godwits) feed on worms and shellfish on New Zealand mudflats from September to March, then fly north to breed in Alaska, where the short summer brings a huge burst of insects. Young birds make their first southward flight without adults.

6. Describe the difference between migration and homing, using kuaka as an example.

7. Explain two cues kuaka could use to navigate across open ocean.

8. Discuss why migration gives kuaka a selective advantage, despite the cost of the journey.

Fix the mistake

9. Correct this statement: "Light destroys auxin on the lit side, so the shaded side grows more."

10. Correct this statement: "Woodlice move towards the damp, so it is a taxis."

11. Correct this statement: "Mimosa folding its leaves is a tropism because it responds to touch."

12. Correct this statement: "Godwits migrate so they can survive, which helps the species."

Answer key (for parents and tutors)

1. A flatworm moves away from a bright light by steering its head from side to side. Name the response.
   Negative phototaxis, because it steers in relation to the direction of the light.
2. A woodlouse covers 42 cm in 60 s on dry paper. What is its speed in cm s^{-1}?
   42 ÷ 60 = 0.70 cm s^{-1}.
3. Why does a root bend down while a shoot bends up, if both have more auxin on the lower side?
   Root cells are much more sensitive to auxin, so the high concentration on the lower side inhibits their elongation; in shoots the same concentration speeds elongation, so the lower side grows more and the shoot bends up.
4. Clover leaflets fold at night and open in the morning, whichever side the light comes from. Name the response.
   A nastic response (nyctinasty), because the direction of movement does not depend on the direction of the stimulus.
5. What does a bird need, as well as seeing the Sun, to use a sun compass?
   An internal clock, so it can correct for the Sun moving across the sky through the day.
6. Describe the difference between migration and homing, using kuaka as an example.
   Migration is a regular seasonal journey between two areas, here between Alaska and New Zealand each year; homing is returning to a particular site, such as the same estuary or breeding ground (Achieved).
7. Explain two cues kuaka could use to navigate across open ocean.
   A time-compensated sun compass, using the internal clock to allow for the Sun's movement, and a magnetic compass reading the direction and angle of the Earth's field; the magnetic sense works under cloud, and young birds flying alone show the route depends on these inherited cues, not on following adults (Merit).
8. Discuss why migration gives kuaka a selective advantage, despite the cost of the journey.
   In Alaska long days and an insect boom give enough protein to raise chicks quickly; leaving before winter avoids freezing mudflats with no food, while New Zealand estuaries offer plentiful food in the southern summer. The journey costs a lot of fat and some birds die, but birds that migrate raise more surviving young than any that stayed in either place, so the behaviour and its inherited cues are selected for (Excellence links the cues, the timing and the food supply to breeding success).
9. Correct this statement: "Light destroys auxin on the lit side, so the shaded side grows more."
   Auxin is moved sideways to the shaded side by carrier proteins; it is redistributed, not mostly destroyed.
10. Correct this statement: "Woodlice move towards the damp, so it is a taxis."
    Woodlice do not steer towards damp air; they slow down and turn more in it, which is a kinesis.
11. Correct this statement: "Mimosa folding its leaves is a tropism because it responds to touch."
    It is a nastic response: fast, reversible, caused by turgor change, and its direction does not depend on where it was touched.
12. Correct this statement: "Godwits migrate so they can survive, which helps the species."
    Selection acts on individuals: birds that migrate leave more surviving offspring, so the migratory behaviour spreads.