Organisms respond to changes in their internal and external environments

Responding to Change Aids Survival

- Organisms must respond to changes in their environment in order to survive
- They can only survive if they are successful at:
  - Finding favourable conditions for living
  - Finding food
  - Avoiding being eaten
- If these vital requirements are not met then a species will die out or go extinct
  - For example, a red robin must find worms and insects to feed on and at the same time, they must also be watching out for predators such as crows

Detecting and responding to change

- Responses to change can vary in complexity depending on the type of organism involved and the specific circumstances they are responding to
- Responding to change requires detection
  - Detection involves a stimulus being detected by a receptor cell
- There are different types of receptors
  - Some receptor cells produce **electrical activity** in nerve cells in response to stimuli
  - Other receptor cells **secrete substances** in response to stimuli
- The nerve impulses sent by receptor cells travel to a **coordinator**
  - This is either the brain or the spinal cord
- From the coordinators, the impulse is conducted to the specific **effector** that will produce the appropriate **response**
- Using the earlier example of the red robin staying alert to predators:
  - A sudden movement by a crow (the stimulus) is detected by the receptors in the robin's eye
  - The receptor cells send an impulse along the nerves and to the brain (coordinator)
  - The brain sends an impulse to the wing muscles (effectors) of the red robin so it can fly away (response)

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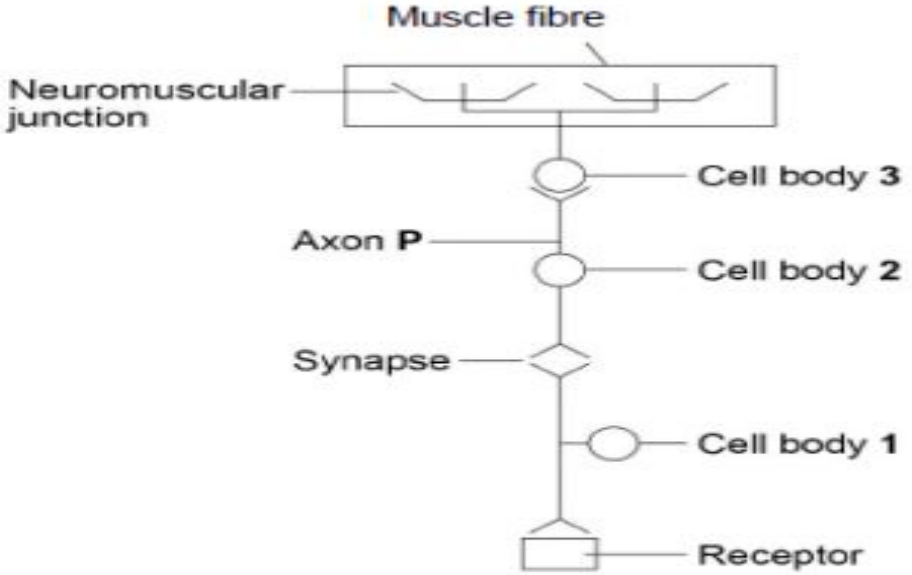
The sequence of detection, coordination and action results in a response that saves the robin's life

- This kind of **fast** response is necessary for organisms to survive
  - An initial three-stage **reflex action** as demonstrated in the example allows for the initial response to be rapid

- The response, however, must not be completely fixed, it needs to be **flexible**
  - After the initial reflex action, the organism can take control of the response and display much more complex behaviour

- In the case of the red robin, its reflex reaction to seeing a crow is to begin to fly, it is then able to **control its direction of flight** so that it flies away from the crow

The diagram below shows a nerve pathway in an animal.



(a) The nerve pathway shown in the diagram may be regarded as a simple reflex arc.

Use the diagram to explain why.

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(1)

(b) Suggest **two** advantages of simple reflexes.

1. _____

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2. _____

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(2)

Growth Factors in Flowering Plant

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Growth responses in plants

- Just like animals, the survival of plants is dependent on their ability to respond to changes in their environment
  - Some plants produce poisonous substances to defend against herbivore damage
  - Trees in forests grow very tall so they can reach a light source
  - Some flowers can close up at night to reduce water loss in a dry environment
- Unlike many animals, plants do not possess a nervous system and so they respond to stimuli in a different way
- Responses that involve plants growing against gravity or towards light occur due to uneven growth
  - A seedling will bend and grow towards the light, this occurs because there is more growth on the shaded side than on the illuminated side
- This type of growth response towards a stimulus is referred to as a tropism
  - Phototropism is a growth response to light
  - Gravitropism is a growth response to gravity
- Tropisms can be positive or negative, causing the plant to grow towards or away from the stimulus

Growth factors

- The growth response of plants relies on chemical substances that are released in response to a stimulus
- These specific growth factors act in a similar way to the hormones that are found in animals
- The effect of specific growth factors is not as quick as that of an electrical nervous system but it still occurs at a substantial speed
    - Phototropic responses have been detected in plant shoots within minutes of being exposed to light
- In flowering plants, specific growth factors move from the growing regions to other tissues, where they regulate the growth in response to a directional stimulus

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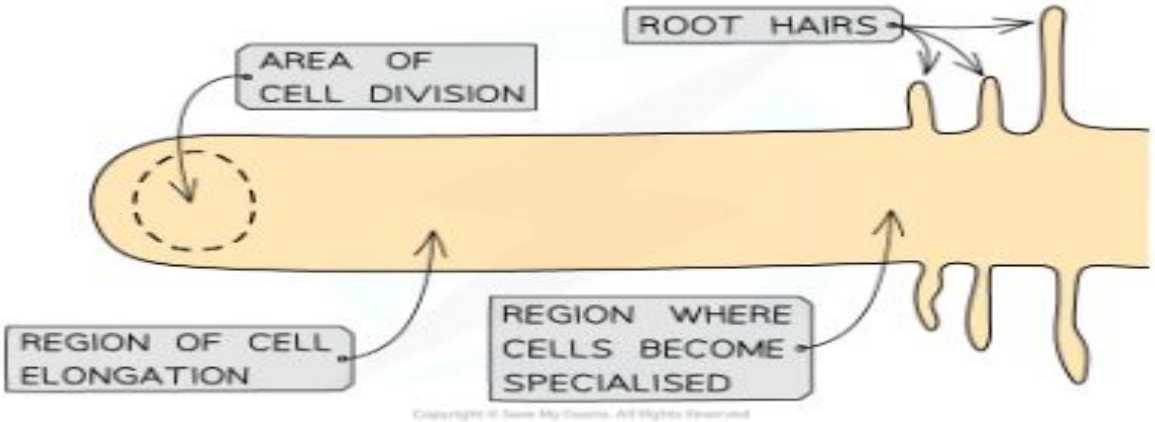

The different growing regions of a root

Indoleacetic acid

The first specific growth factor to be discovered in plants was indoleacetic acid (IAA)

- Other specific growth factors have been discovered since however their mechanism of action is still disputed
- IAA is synthesised at the tips of roots and shoots and it mainly affects the elongating region of a plant
    - The elongating region is found just prior to the tip/area of cell division
- When IAA moves into the elongating region it binds to the protein receptors on the cell membranes
- Scientists are unsure of its exact mechanism but it is known that it lowers the pH by releasing hydrogen bonds
- The lowered pH breaks some of the bonds found between the microfibrils in cellulose cell walls
- This causes the cell wall to loosen and allows the cells to be more easily stretched when the turgor of the cells increases (by an increase of water being stored in the vacuole)
- By affecting the cell elongation of a root or shoot IAA influences the growth of the plant towards the stimulus
    - For example, if the shaded side of a plant experiences greater cell elongation then that side of the plant will grow faster, causing it to bend towards the light

Q1.

Figure 1 shows an investigation into growth factors in plants.

Figure 1

Tip removed from shoot of plant

Then, tip replaced on one side of cut shoot

Then, growth curvature occurred **without** a directional light source

(a) Use your knowledge of indoleacetic acid (IAA) to explain the growth curvature shown in **Figure 1**.

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The parsley plant is growing towards the light source as a result of phototropism