Bio Factsheet

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Innate Behaviour

This Factsheet describes:

- **differences between innate and learned behaviour;**
- **taxes and kineses as examples of innate behaviour;**
- **reflex actions such as reflex escape responses and the linking of different reflex actions to produce more complex patterns of behaviour.**

The study of behaviour is called **ethology**.

Introduction: innate and learned behaviour

Characteristics of innate behaviour:

- Innate behaviour responses are not learned but are inherited. They are determined by inherited nervous pathways.
- They involve **reflex actions** or **taxic** or **kinetic** responses.
- As a result of the 'built-in' nervous pathways a given stimulus will always produce the same response.
- Innate behaviour patterns have been selected over many generations of evolution and their main importance is their survival value to the species.

Characteristics of learned behaviour: (to be covered in a later Factsheet):

- Learned behaviour depends on the evolution of **memory**. Without memory learning cannot occur.
- Both **short-term memory** and **long-term memory** are involved in learning behaviour.
- Learned behaviour requires **habituation**. This is where exposure to continuous repetition of a stimulus (not associated with reward or punishment) will suppress any normal innate response to the stimulus. For example: the initial innate response of birds to a scarecrow is to avoid it. In time this behaviour will be suppressed as the birds learn to ignore the scarecrow.
- Learned behaviour may also involve **imprinting**, **classical conditioning** (development of conditioned reflexes), **operant conditioning** (trial and error learning) and **insight learning**.

***Remember:**– as animals increase in complexity, specific behaviour patterns may involve integration of innate behavioural patterns and several of the types of learned behavioural patterns referred to above. Thus, in some cases, the distinctions between innate behaviour and learned behaviour may not be clear-cut.*

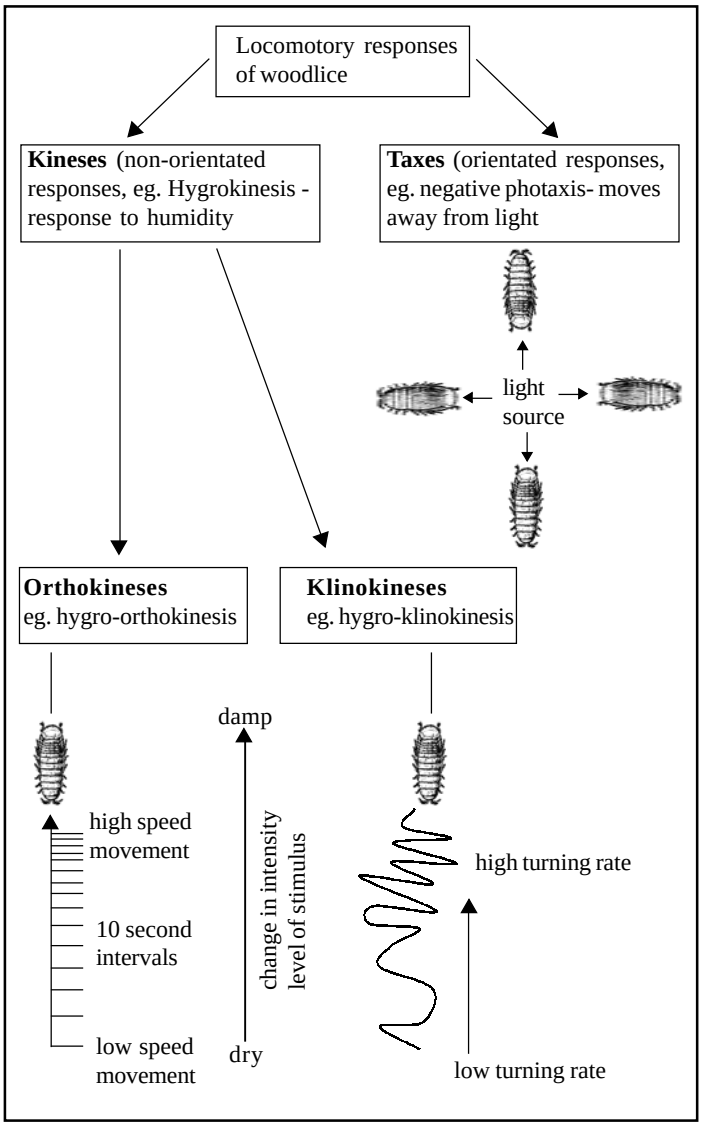
Taxes and kineses

These are forms of innate behaviour which involve locomotion of organisms in response to a specific external stimulus. They help to keep an animal in a favourable environment.

A **taxis** is a movement in response to the direction of a stimulus. Movements towards the stimulus are positive, movements away from a stimulus are negative. For example, earthworms show **negative phototaxis**, moving away from light into the soil.

A **kinesis** is a random movement in which the rate of the movement is related to the intensity of the stimulus but not to its direction. An **orthokinesis** involves changes in the speed of movement. A **klinokinesis** involves changes in the rate of turning. Woodlice show these types of behaviour (Fig 1).

Fig.1. Orientation behaviour of woodlice



***Exam Hint:** – remember that the slower the rate of turning, the quicker an animal will leave an unfavourable area. Thus a woodlouse in a choice chamber containing damp and dry areas will move faster and turn less in the dry area. Thus it will orientate towards the damp area. When it reaches the damp area it will move slower but turn more frequently. This will tend to keep it in the damp area. A common error is to state the rates of turning and moving the wrong way round.*

Reflex actions

Reflex actions are simple types of innate behaviour that involve simple circuits of neurones (called **reflex arcs**) in the nervous system. Many reflexes are protective and aid the survival of animals. A sudden stimulus, such as a change in light intensity, a change in a muscle tension, a touch on part of a body or a sudden loud noise, will cause an automatic, involuntary and stereotyped response. (**Stereotyped** refers to the fact that the responses to a specific stimulus are always similar).

The simple reflex arc:

- carries the nerve impulses generated when the stimulus is received by the receptor, via the sensory neurone, the relay neurone and the motor neurone, to the effector which produces the response (Fig 2).
- Spinal reflexes pass impulses through the spinal cord, for example, the knee jerk reflex.
- Cranial reflexes pass impulses through the brain stem, for example, the coughing reflex.
- Reflex arcs do not involve the higher centres of the brain, although the conscious centres may make the animal aware that the reflex action has occurred. Reflex arcs are said to be 'economical in their use of nervous system components'. This frees up the bulk of the nervous system to perform more complicated physiological and behavioural functions.
- Examples of protective reflexes include coughing, sneezing and muscle flexion reflexes. These enable limbs to be quickly drawn away from painful, dangerous stimuli, such as a hot plate or sharp object.
- Muscle flexion responses are important in the **reflex escape response**. For example when a predator is suddenly seen or heard or smelt by its prey, the initial response is the reflex flexion of limb muscles starting an evading action.

The relay neurones of reflex arcs also synapse with with connector neurones that pass up or down the spinal cord and brain. This enables:

- higher association areas in the brain to be 'aware' that the reflex actions have occurred.
- reflex actions to be linked so that several different reflex actions may be activated simultaneously. For example, a sudden visual stimulus of a predator received by the cone or rod receptors in the retina of the prey, may simultaneously trigger the accommodation (focussing) reflex, the iris reflex and the muscle flexion reflexes thus making the escape response more efficient. (The initial receptors and sensory neurones are common for all these reflexes, but impulses will then pass via different connector neurones to the relay neurones of the different reflexes).
- brain centres can sometimes modify reflex actions, although reflexes cannot be stopped completely because the reflex impulses pass so quickly. Such modifications may result in changes in behaviour. For example, a new-born baby will empty its bladder automatically by a reflex action. By learning, during development, the baby develops the ability to consciously delay the bladder emptying reflex until a convenient time for urination.

Specimen Questions

1. Read through the following passage and then complete it by writing suitable words or phrases in the spaces.

Inherited behaviour responses which are not learned are called …….. responses. They involve …….. , or …… , or ……. responses. A certain stimulus will invariably produce the ……. response.

A ……. is a movement in response to the direction of a stimulus, for example, woodlice show …….. by moving away from bright light.

A …….. is a movement where the rate of movement depends on the intensity of the stimulus. An …… involves changing the speed of movement and a …….. involves changing the rate of turning. For example, woodlice show ……. movement and turn …….. when in damp areas than when in dry areas which tends to make them …… in the damp area.

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Mark scheme

1. innate;
   reflex; taxic; kinetic; (any order)
   same; taxis; negative phototaxis; kinesis; orthokinesis; klinokinesis;
   faster; more; stay;

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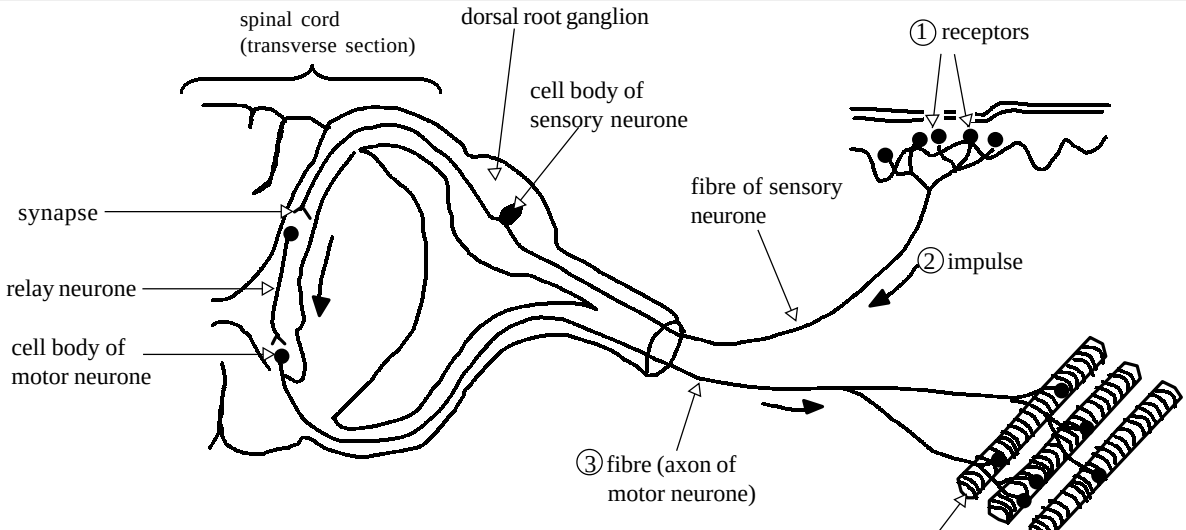
Fig 2. A simple reflex arc



This Factsheet is concerned with the roles of reflex actions in behaviour. Fuller details of the anatomy and physiology of reflex arcs, including their roles in controlling internal body functions, can be found in Factsheet 58, January 2000.