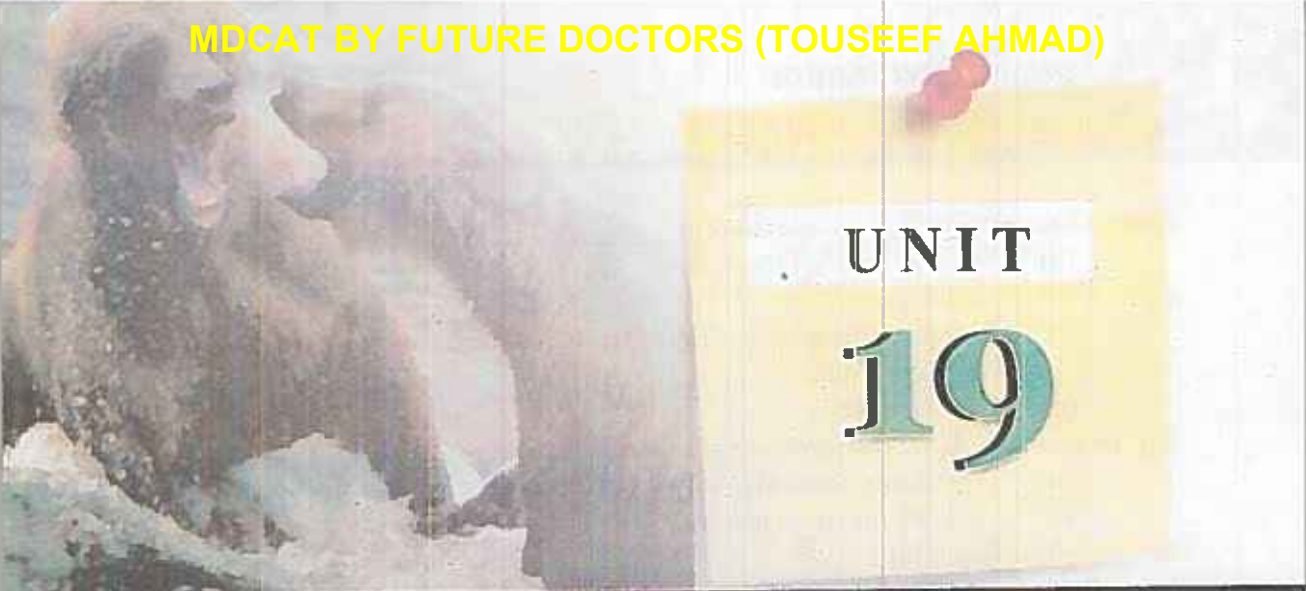




UNIT

19

BEHAVIOUR

KEY CONCEPTS

- 19.1 Nature of behavior
- 19.2 Innate behavior
- 19.3 Learning behavior
- 19.4 Social behaviors

Behaviour is the response of an organism to stimulus or stimuli. The stimuli may originate outside the organism or within the organism (secretions change the chemical state). Behaviour is what animal does and how it does it. For example walking, sitting, sleeping, eating, mating and rearing young ones are all different types of behaviour. The study of animal behaviour is called ethology. Behavior is defined as the aggregate of responses to stimuli for given situation. All living organisms exhibit a variety of forms of behavioural activity determined by the extent to which they are able to respond to stimuli.

19.1 NATURE OF BEHAVIOR

19.1.1 Behavior and stimuli:

The ability of an organism to respond against particular stimuli varies from the relatively simple action of the growth of a plant stem towards a light source, to the complex sexual behavior patterns of territory defense, courtship and mating seen in birds and mammals. In other words, what a person, animal, plant, or any organism does after being stimulated, is part of its behavior. In order to cause that response, the stimulus must be sensed, processed, and interpreted.

19.1.2 Effect of genetics on behavior:

Charles Darwin, who originated the theory that natural selection is the basis of biological evolution, was persuaded by Francis Galton that the principles of natural selection applied to behavior as well as physical characteristics. Members of a species vary in the expression of certain behaviors because of variations in their genes and these behaviors have survival value in some environments. One example of such a behavior is curiosity—some organisms are more curious than others, and in some settings curiosity is advantageous for survival. Heredity has important role in intelligence, moodiness, impulsiveness, shyness, and all other psychological characteristics.

Francis Galton



Fig: 19.1

19.1.3 Biological rhythms:

There are cyclic phenomena in biology, which recurs each year, each lunar month, each day or with the tides. A number of biological characteristics of animals fluctuate in some regular fashion.

Intrinsic “biological clocks” may be involved in regulating such cyclic phenomenon. The organisms living in the temperate zones of the world typically show marked seasonal cycles of activity. Most animals have a breeding season at one time of the year, usually in the spring; some show a decrease in activity and metabolism during the winter - a phenomena termed as hibernation.



Fig: 19.2 Sleepy bear emerges from hibernation after snoozing all through winter.

The adult forms of many plants and animals especially insects, die at the end of each summer season and the species is carried over the winter in the form of seeds, eggs or pupae. In tropics there is usually a period of heavy rain, which alternates with a period of little or no rain. The plants and the animals in such regions have cycles that are geared to these changes in the environment.

Organisms and even several parts of the organisms usually do not function at a constant rate over the entire twenty-four hours of the day. Frequently, there appear to be repeated sequences of events, which occur at about 24 hours intervals. These have been termed as “circadian rhythms” (circa = about; dies = days).

Some animals are diurnal, having their greatest degree of activity during the day. Others are crepuscular and have their greatest activity during the twilight hours. And still others are nocturnal and show their greatest degree of activity during darkness. Certain insects exhibit diurnal variations in pigmentation. There is diurnal deposition and utilization of glycogen in the liver of rabbit and mouse. Man also has circadian rhythms. Many marine organisms living in intertidal zone show marked differences in their activity. Some being active only when the tide is in, others when the tide is out. The vertical distribution of many small marine organisms subject to the diurnal cycle - tend to concentrate near the surface at night and go to the deeper water during the day. Since many fishes feed on them, so the fishes in turn also tend to move nearer the surface at night and to swim farther down in the water during the day.

Many different kinds of animals have evolved “biological clocks” by means of which their activities are adapted to the regularly recurring changes in the external conditions.

These 'clocks' together with other signals received from the external environment; indicate to the organisms the time of the day which is most appropriate for some particular activity.

In a few animals, such as birds and bees, these timing devices have been highly evolved. Bees are not only able to find their way from hive to feeding ground but they can make suitable corrections for the sun's position as the day advances. In an experiment, four feeding tables were setup 50 meters to the north west, north east, south west and south east. The bees were released in the morning. Majority of them flew to the feeding table to the north west.

This shows that bees navigate using the sun as a guide. This also enables the bee to know the best time of the day to visit a plant whose nectar is secreted only during certain hours of the day. Biological rhythms may enable the organism synchronize its activities.

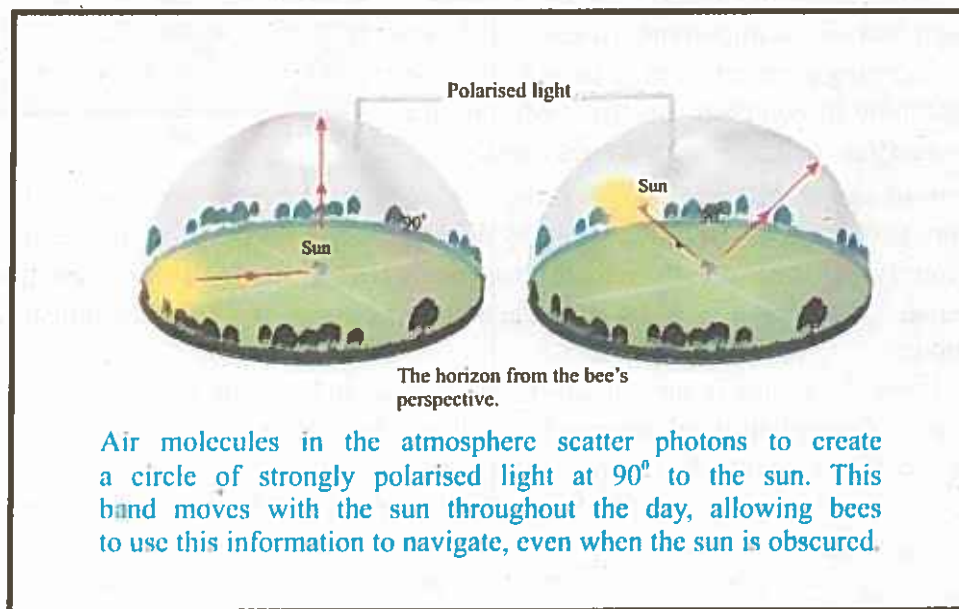


Fig: 19.3 Mechanism followed by bees to navigate using sun.

19.2 INNATE BEHAVIOR

Innate behaviour is inherited or in-born. It does not involve parental sign, training or experience or even of contact with member of the same species. It is sometime called instinctive. There are many characteristics of innate behaviour e.g.

- (i) Innate responses are built in nervous system during development.
- (ii) This behaviour is automatic and machine-like in nature.
- (iii) Innate responses are not forgotten.
- (iv) Innate behaviour has survival value for the species.

The honeybee, for example, inherits the tendency to fly towards flowers to seek nectar. A young duck starts swimming without any experience.

A young spider will spin and weave a web in its first attempt. In a similar way a caterpillar will form a cocoon characteristic of its species. Also a pair of young bird will build a nest without getting any training. A day old chick will peck at objects on the ground. It does not have to learn this behaviour. Although, learning is important in the songs of some birds, other sing even when they have been raised from hatching in complete isolation. Migration of birds is also innate. Innate behaviour is usually in



Fig: 19.4 A young spider weaving its web.

the form of simple reflexes such as removing one's hand from a hot stove and the withdrawal of an acid - stimulated leg by a fresh brainless frog. Not all unlearned behaviours are in the form of simple reflexes many complicated activities in man are also innate. The human suckling reflex is a good example of a complex unlearned behaviour.

Innate behavior is genetically programmed. Individuals inherit a suite of behaviors (often called an **ethogram**) just as they inherit physical traits such as body colour and wing venation. In general, innate behaviors will always be:

1. **Heritable** -- encoded in DNA and passed from generation to generation
2. **Intrinsic** -- present in animals raised in isolation from others
3. **Stereotypic** -- performed in the same way each time by each individual
4. **Inflexible** -- not modified by development or experience
5. **Consummate** -- fully developed or expressed at first performance

Since innate behavior is encoded in DNA, it is subject to genetic change through mutation, recombination, and natural selection. Just like physical traits, innate behaviors are phylogenetic adaptations that have an evolutionary history.

19.2.1 Reflexes:

The most basic unit of innate behavior is a simple reflex. A simple reflex is an involuntary stereotyped response of part of an organism to a given stimulus. It is determined by the presence of an inherited pattern of neurons forming reflex arcs. The reflex arc is a neural pathway that may involve as few as two neurons: a sensory neuron detects a stimulus and is linked with a motor neuron that sets off a response in an effector cell (such as a muscle or a gland cell). More commonly, reflex arcs also include an association neuron spliced between the sensory and motor neurons. A knee jerk, coughing, yawning, blinking of eyes, sneezing, salivation, movement of diaphragm during breathing are all examples of reflex actions.

In Patellar Reflex (knee jerk) when the patellar tendon is tapped just below the knee, the patellar reflex is initiated and the lower leg kicks forward (via contraction of the quadriceps). The tap initiates an action potential in a specialised structure known as a muscle spindle located within the quadriceps. This action potential travels to the spinal cord, via a sensory axon which chemically communicates by releasing glutamate (see synapse) onto a motor nerve. The result of this motor nerve activity is contraction of the quadriceps muscle, leading to extension of the lower leg at the knee.

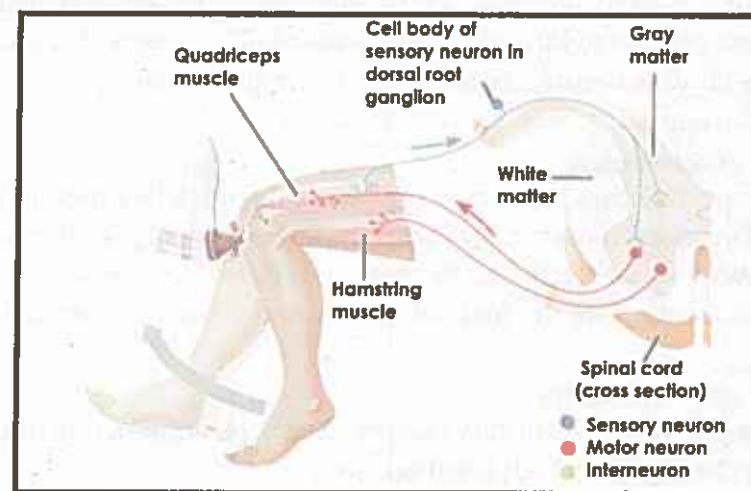


Fig: 19. 5 Patellar Reflex (knee jerk).

Most insects have simple "startle" reflexes triggered by small disturbances as well as more comprehensive "escape" reflexes triggered by larger disturbances.

19.2.2 Orientation Behaviors

Orientation Behaviors are coordinated movements (walking, flying, swimming, etc.) that occur in response to an external stimulus. These behaviors have adaptive value for survival by helping the organism locate (or avoid) the source of a stimulus. There are two types of orientation behaviour:

i. Kinesis:

Kinesis is a change in the speed of movement (orthokinesis) or a change in the rate of turning (klinokinesis) which is directly proportional to the intensity of a stimulus. A kinesis is non-directed orientation, that is, the animal exhibits a random walk. The change in speed or rate of turning increases the probability of locating the stimulus but does not guarantee it.

ii. Taxis:

It is a movement of whole organism directly toward (positive) or away from (negative) a stimulus. Stimulus intensity increases with movement toward the source and decreases with movement away from the source.

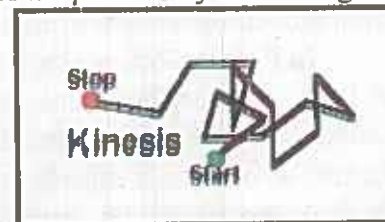


Fig: 19.6 A kinesis is non-directed orientation.

19.2.3 Tropic Movements

These are induced movement of curvature shown by the plant organ (shoot or root), which are capable of turning in any direction. The direction of movements is determined by the direction of stimulus (light, water, gravity etc).

Tropism or tropic movements are classified as under:

(i) Geotropism

Geotropism occurs in radially symmetrical organs like root and stem. The orientation of stem and roots in response to the force of gravity is called geotropism. The roots grow towards the force of gravity and are said to be positively geotropic, the stem grows away from the force of gravity and is therefore called negatively geotropic.

(ii) Phototropism

The tropic movement of curvature induced in plants organs in response to the unilateral effect of light is called phototropism.

Young stems are positive phototropic, turn towards light. The curvature is due to the greater growth on the shaded side than on the side on which the light acts.

Roots are usually indifferent to stimulus of light, their orientation being determined chiefly by the gravity.

19.3 LEARNING BEHAVIOR

Learning can be defined as a persistent change in behavior that occurs as a result of experience. Since a newborn nymph or larva has no prior experience, its first behaviors will be entirely innate. Each individual starts life with a "clean slate": it acquires new skills and knowledge through trial and error, observation of other individuals, or memory of past events. In general, learned behaviors will always be:

1. **Nonheritable** -- acquired only through observation or experience
2. **Extrinsic** -- absent in animals raised in isolation from others
3. **Permutable** -- pattern or sequence may change over time
4. **Adaptable** -- capable of modification to suit changing conditions
5. **Progressive** -- subject to improvement, or refinement through practice

19.3.1 Habituation:

Habituation is learning not to respond to some unimportant stimulus. It is an extremely simple form of learning, in which an animal, after a period of exposure to a stimulus, stops responding. Sensory systems may stop, after a while, sending signals to the brain in response to a continuously present or often-repeated stimulus. Habituation allows animals' nervous system to focus on stimuli that signal the presence of food, a mate, or real danger, rather than waste time or energy on stimuli that are irrelevant to animals' survival and reproduction. Lack of continued response to strong odours is a common example of sensory habituation.

19.3.2 Imprinting:

Imprinting behavior includes both innate and learned components. Imprinting is an amazing example of genetic and environmental influences on animal behavior. It involves a brief sensitive period, also called critical period. Sensitive period is a limited developmental phase when certain behavior can be learned. In 1930s, Konard Lorenz showed that the principal imprinting stimulus in grayleg geese (*Anser anser*) is a nearby object that is moving away from the young.



Fig: 19. 7 Grayleg geese exhibiting imprinting behaviour.

When incubator hatched goslings spent their first few hours with Lorenz rather than with a goose, they imprinted with him and followed him from then on. Furthermore, they showed no recognition of their biological mother or other adults of their own species.

19.3.3 Classical conditioning (Type I learning)

In a series of experiments, Pavlov set out to provoke a conditioned response to a previously neutral stimulus. He opted to use food as the unconditioned stimulus, or the stimulus that evokes a response naturally and automatically. The sound of a metronome was chosen to be the neutral stimulus. The dogs would first be exposed to the sound of the ticking metronome, and then the food was immediately presented.

After several conditioning trials, Pavlov noted that the dogs began to salivate after hearing the metronome. A stimulus which was neutral by itself had been superimposed upon the action of the inborn alimentary reflex. It was observed, after several repetitions of the combined stimulation, the sounds of the metronome had acquired the property of stimulating salivary secretion. In other words, the previously neutral stimulus (the metronome) had become what is known as a that then provoked a conditioned response (salivation)

19.3.4 Instrumental Learning (Operant learning):

It is learning by consequences. Operant behavior can foster adjustment of organism to certain situation. Operant conditioning helps to explain the acquisition and maintenance of more complex voluntary behaviors. Through the process of operant conditioning, organism learns to perform behavior that produces certain rewarding effect on the environment. These behaviors are called operant responses because they operate on the environment to produce rewarding consequences. The organism acquires responses or develops skills that lead to reinforcement. Reinforcement is a change in the environment (stimulus) that increases the frequency of the behavior that precedes it. A reward is defined as a pleasant stimulus that increases the frequency of behavior.

It depends on the animal's ability to remember the outcome of past events and modify future behavior accordingly. Good consequences (positive feedback) reinforce the behavior and increase its likelihood of occurrence in the future. Bad consequences (negative feedback) have the opposite effect. Cockroaches learn to run through a simple maze to find food is a simple example of instrumental learning (also known as operant conditioning).

Behaviour

Chapter 19

While working with his rats in the cumulative recorder box (i.e., Skinner box) he discovered that the rate of responding did not depend on what occurred prior to the behaviour but on what occurred after the behaviour. Skinner's work with rats in his Skinner box led him to discover a process he called *shaping*.

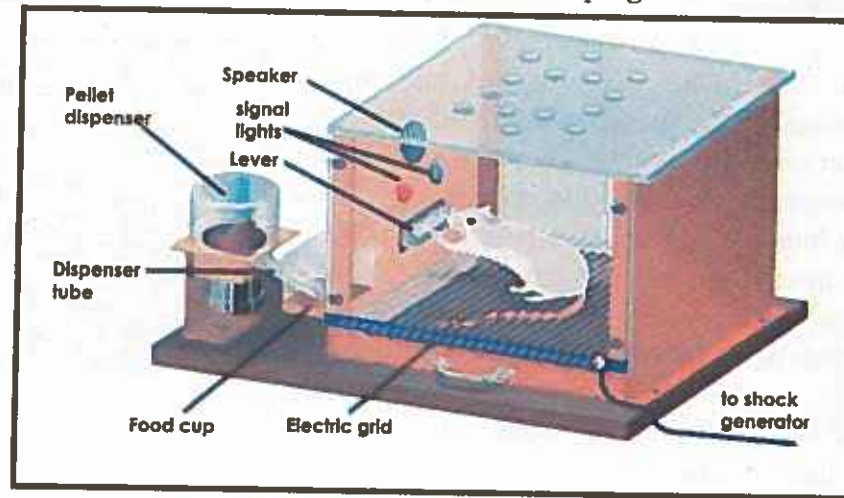


Fig: 19. 8 Rats in the cumulative recorder box.

When the rat is initially put in the Skinner box it does not know that it has to push the lever to get food. Whenever the rat pressed down on this, it received a pellet of dried food. Of course, the rat didn't know this from the outset and only triggered feeding when it happened to touch the lever by accident. But after scoring several such lucky strikes, it appeared to have learned the connection, and consequently the time that elapsed between pushes on the lever became ever shorter.

19.3.5 Insight learning:

A type of learning that uses reason, especially to form conclusions, inferences, or judgments, to solve a problem. Unlike learning by trial-and-error, insight learning is solving problems not based on actual experience (like trial and error steps) but on trials occurring mentally. Often the solution is learned suddenly, such as when a person is in a problem for a period of time and suddenly learns the way to solve it.

This was observed in the Kohler found that chimpanzees could use insight learning instead of trial-and error to solve problems. In one example, a banana was placed high out of reach that the chimpanzees found a way to reach it.

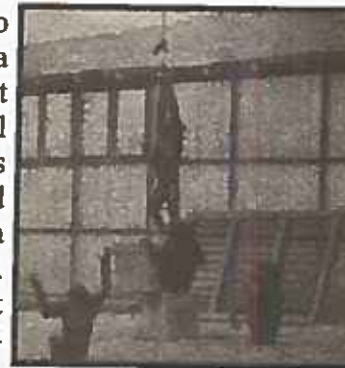


Fig: 19. 9 Experiments of Wolfgang Kohler involving chimpanzees.

The chimpanzees first tried to knock them down by using a stick. Then, the chimpanzees learned to stack boxes on top of one another to climb up to the bananas.

19.4 SOCIAL BEHAVIOURS

Social behavior consists of a set of interactions among individuals of the same species. A wide range of sociality occurs among animals. Some animals rarely if ever interact with one another, even when it comes to issues of parental care. Examples of relatively asocial animals include mosquitoes and polar bears. Highly social organisms live together in large groups, and often cooperate to conduct many tasks. Examples of social groups include packs of wolves and schools of fish. The most highly social animals form tightly knit colonies and include all ants and termites, some bees and wasps, and a few other organisms.



Fig: 19. 10 Honey bees make hives which is a result of social interaction.

19.4.1 Hostile and helpful intraspecific interaction:

Many species of insects and most vertebrates show a variety of (hostile or friendly) group behavioural activities associated with numbers of individuals living together. The cooperation achieved as a result of social behavior which has adaptive significance. It increases the efficiency and effectiveness of the species over that of the other species. In social group a system of communication is essential. The efficiency of the organization is further increased by individuals carrying out particular roles within the society. The roles include members specialized for finding food, reproduction, rearing and defense. Cooperation between members of a society sharing division of labour depends upon stereotyped patterns of behavior and effective means of communication.

Ants, termites and bees are social insects that live in colonies and have an organization based on a cast system. In the honey bee colony there is a single fertile female queen, several thousand sterile female workers and a few hundred fertile male drones. Each type of honey bee has a specific role.

19.4.2 Aggression:

Aggression is a group of behavioural activities including threat posture, rituals and occasionally physical attacks on other organisms. They are usually directed towards members of the same sex and species.

Aggressions have various functions including the displacement of other animals from an area, usually a territory or a source of food, defense of a mate or offspring and establishment of ranking a social hierarchy. **Agonistic behavior** is an



Fig: 19. 11 Agonistic behavior exhibited by two domestic cats threatening each other. Note the more flattened ears of the cat on the right.

aggressive behavior between conspecifics (of the same species) usually involves fighting over a limiting resource such as food, water, space, or mates. Depending on the importance of the resource as well as its scarcity, agonistic behavior can range from all-out fighting to the death to much safer ritualistic behavior. Most species channel their agonistic behavior into ritual contests of strength and threat postures which are universally recognized by the species.

19.4.3 Territorial behavior:

Territory is an area held and defended by an organism or group of organisms against organisms of the same or different species. The exact function of territory formation varies from species to species. However, in all cases it ensures that each mating pair of organisms and their offspring are adequately spaced to receive a share of the available resources, such as food and breeding space.

Prior to breeding, usually males found territory. Defense of the area is greatest at the time of breeding and fiercest between males of the same species. There are a variety of behavioral activities associated with territory formation and they involve threat displays between owners of adjacent territories.

Spider monkeys form loose groups of 15 to 25 animals. They break up into small groups of 2 to 8 animals that travel together and feed throughout the day within a core area of their territory.

When two different troops of spider monkeys come together, the males in each troop display agonistic and territorial behavior such as calling and barking. These interactions happen with much distance between the two groups and do not involve physical contact, indicating that groups respect distinct territorial boundaries.

19.4.4 Dominance hierarchies:

In dominance hierarchies (pecking orders), animals within a group are arranged according to the status. Position in the hierarchy is usually decided by some agonistic form of behavior other than fighting.

The advantage of pecking order is that it decreases the amount of individual aggression associated with feeding, mate selection and breeding site selection. It also avoids injury to the stronger animals which may occur if fighting was necessary to establish the hierarchy. Also it ensures that resources are shared out so that the fittest survive.

19.4.5 Altruistic behavior:

It is the behavior in which certain organisms expend time and energy in caring for other members of the species. It is a form of social behavior whereby one organism puts itself either at risk or personal disadvantage for the good of other members of the species.

In case of activities associated with mating and parental care, altruism is not so difficult to comprehend since the action is clearly in the interests of the parents, offspring and species.

The female baboon protects and cares for its offspring for almost six years and most bird species feed and protect their demanding offsprings until they are capable of feeding for themselves. But why some organisms support to organisms which are not their offspring, for example, birds and monkeys that call out warnings to others in danger and female monkeys who carry and care for the babies of other monkeys.



Fig: 19. 12 Bird species feed and protect their demanding offsprings.

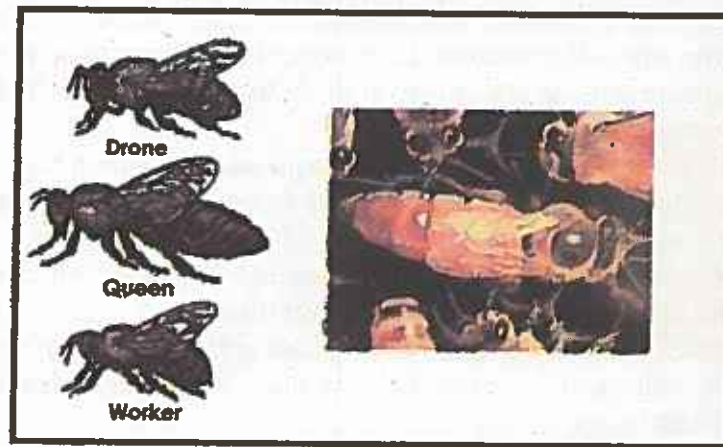


**Fig: 19. 13 Altruistic behaviour in honeybees.
Queen Bee ensures the continuity of the hive.**

Altruistic behavior is seen in the social insects such as honeybees, wasp and ants. In honeybees, female workers are sterile, never produce offspring, yet they spend their lives looking after their brothers and sisters. Especially by helping their sister, queen bee, to reproduce they are aiding in the production of new workers, drones and queen.

KEY POINTS

- Behaviour is the response of an organism to stimulus or stimuli which may originate outside the organism or within the organism. Behaviour is what animal does and how it does it?
- Members of a species vary in the expression of certain behaviors because of variations in their genes, and these behaviors have survival value in some environments.
- Biological rhythms are cyclic phenomena in biology, which recurs each year, each lunar month, each day or with the tides.
- Some animals are diurnal, having their greatest degree of activity during the day. Others are corpuscular and have their greatest activity during the twilight hours.
- Innate behaviour is inherited or in-born and it does not involve parental sign, training or experience or even of contact with member of the same species.
- Innate behavior is genetically programmed. Individuals inherit a suite (**ethogram**) of behaviors.
- Reflex is an involuntary stereotyped response of part of an organism to a given stimulus which is determined by the presence of an inherited pattern of neurons forming reflex arcs.
- Orientation Behaviors are coordinated movements that occur in response to an external stimulus.
- Taxis is a movement of whole organism directly toward (positive) or away from (negative) a stimulus.
- Learning can be defined as a persistent change in behavior that occurs as a result of experience.
- Habituation is learning not to respond to some unimportant stimulus.
- Imprinting behavior includes both innate and learned components. **Genetic and environmental factors influences animal behavior.**
- Insight learning that uses reason, especially to form conclusions, inferences, or judgments, to solve a problem.
- Social behaviour consists of a set of interactions among individuals of the same species.
- In dominance hierarchies (pecking orders), animals within a group are arranged according to the status. Position in the hierarchy is usually decided by some agonistic form of behavior other than fighting.
- Altruistic behavior is the behavior in which certain organisms expend time and energy in caring for other members of the species.

EXERCISE ?

1- Multiple Choice Questions

- (i) *Innate behavior is all but;*
- | | |
|-----------------|---------------|
| (a) Heritable | (b) Intrinsic |
| (c) Stereotypic | (d) Flexible |
- (ii) *Innate behavior is all except:*
- Coded in DNA
 - Modified in individuals' life span
 - Modified with species evolution
 - Programmed responses to external stimuli
- (iii) *Which one is non-directed orientation?*
- | | |
|-------------|----------------|
| (a) Taxis | (b) Kinesis |
| (c) Tropism | (d) Imprinting |
- (iv) *Trial and error learning has no role in*
- | | |
|----------------------|----------------------------|
| (a) Operant learning | (b) Classical conditioning |
| (c) Insight | (d) Imprinting |
- (v) *Advantage of pecking orders is to*
- avoids injury to the stronger animals
 - protect territory
 - find suitable mate
 - Assign specific role to individual subordinates.

2- Short Questions

- How innate behavior ensures the survival of individuals in a population
- What is territorial behavior?
- How insight learning is different from other learnings?
- Write a brief note on altruism in honeybees.
- Give the characteristics of innate behavior

3- Analyzing and Interpreting

- Give examples to interpret that hormones and brain control instincts.
- Relate different examples of learning of human with habituation, conditioning, latent learning and insight learning.

EXERCISE ?

4- Performing and Recording

- Observe spider's web and record the instincts by providing it various stimuli

5- Science, Technology, and Society Connections

- State the role of research in neurobiology in the understanding of behavior.
- Rationalize why the marine snail, Aplysia, has proved very helpful in the studies of neurobiology and the behavior pattern.

6- Online Learning

- www.journals.elsevier.com/animal-behaviour
- www.animalbehavior.org
- www.animalbehaviour.net
- www.guardian.co.uk/science/animalbehaviour