PATTERNS OF BEHAVIOUR

Behaviour: an internally directed system of adaptive activities that facilitate survival and reproduction.

Ethology: is the scientific study of animal behavior, particularly when that behaviour occurs in the context of an animal's natural environment.

TYPES OF STIMULI

(a) Internal Stimuli

***Examples*:**

(i) Hunger signals a need for more energy and causes an animal to search for food

(ii) Thirst signals a loss of internal fluid and causes an animal to look for water

(iii) Pain warns an animal that some part of its body may be subject to injury causing it to take some action to avoid injury

(b) External Stimuli

***Examples*:**

(i) The sound of a predator can cause an animal to hide or run away to avoid being caught

(ii) The sight of potential mate can trigger courtship behaviors

(iii) Changes in day length can trigger reproductive behaviors or migration

TYPES OF BEHAVIOR

1. Innate / instinctive behaviour: natural, inborn patterns of behaviour e.g. suckling in newborns.

2. Learned behaviour: behaviour acquired through experience / practice.

3. Complex behaviour: blend of innate and learned components.

INNATE BEHAVIOR

Natural, inborn behaviour that is genetically programmed hence inherited.

Note:

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

Advantages of innate behaviour

(i) Innate responses are generally rapid – organisms can react quickly to their environments (predators etc.) e.g. the earth worm quickly / rapidly withdraws into its burrow, away from the danger.

(ii) Innate behaviour suits species that have short lifespans – they don't have time to learn behaviours

(iii) Suits species with no parental care/solitary lifestyles as they can't learn behaviours from other members of the species

CATEGORIES OF INNATE BEHAVIOUR

1. Reflex: a simple, automatic response of a body to a stimulus that involves no conscious control e.g. Pull hand away from hot surface, baby feeding, horse tail swatting at flies. Reflexes enable bodies to respond quickly to a stimulus protecting them from harm

Escape reflex: involuntary responses which follow a specific pattern in response to a given stimulus.

Example: Earthworms withdraw underground in response to vibrations on the ground

2. 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 insect locate (or avoid) the source of a stimulus.

3. Kinesis: non-directional orientation behaviour where the rate of movement is directly proportional to the intensity of a stimulus.

Example: Woodlice move around rapidly and randomly when exposed to light until they find better conditions then they stop moving or move slowly.

4. Taxis: A directional locomotory response to a given stimulus.

***Example*:**

Fly maggots move away from light sources (negative **phototaxis**)

5. Fixed Action Pattern : Inborn behavioural response triggered by a very specific stimulus, which once initiated, continues until completed.

- Each fixed action pattern is triggered by a unique stimulus known as a **sign stimulus** / **key stimulus**, or, if it is a signal from one individual to another, it is called a **releaser**.

Examples of Fixed action patterns:

(i) Toad capturing a grasshopper / prey (**releaser** is any movement by a small [prey-sized] nearby object).

Note: *A toad can **starve** even though it is surrounded by dead insects because it cannot recognise non-moving animals as prey!*

(ii) If, while the female graylag goose is rolling the egg back to the nest, the egg slides off to the side, she continues repeated movement to roll any objects like cans which are outside the nest, using her beak and neck, until they reach the nest. (**Sign stimulus** is the egg outside the nest).

(iii) Yawning in humans

- Unlike simple reflexes, FAPs may involve a whole-body response and often require a threshold level of internal readiness (drive).

RELEASERS OF INSTINCTIVE BEHAVIOR

Releasers / sign stimuli / key stimuli: Signals that trigger instinctive acts.

Once the body is prepared for certain types of instinctive behavior, an external stimulus may be needed to initiate the response. However, the stimulus need not necessarily be appropriate to be effective.

Examples:
(i) Exposing the red breast of a male robin releases territorial behaviour in another male robin, but even a simple clump of red feathers instead of a stuffed robin will elicit similar response.
(ii) During the breeding season, the female three-spined stickleback normally guided by the red-bellied male to the nest that he has prepared, after which he prods the base of her tail to cause her release the eggs. But even in the absence of the male, the female will follow any small red object to the nest, and any object that touches near the base of her tail causes her to release eggs.

LEARNED BEHAVIOR
Learning: adaptive change in behaviour that occurs as a result of experience / practice.
Learnt behaviour: behaviour acquired through previous experience / practice.

COMPARISON OF INNATE BEHAVIOUR AND LEARNED BEHAVIOUR

INNATE BEHAVIOUR	**LEARNED BEHAVIOUR**
1. Heritable - encoded in DNA and passed from generation to generation ***2. Intrinsic*** - present in animals raised in isolation from others ***3. Stereotyped*** - 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 ***6. Unintelligent*** and automatic	***1. Non-heritable*** - 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 ***6. Intelligent*** and intellectual

Advantages of learned behaviour
(i) Flexible
(ii) Benefits animals with longer life spans and so there is time to learn
(iii) Benefits animals with an element of parental care of the young; which involves learning from the parent
(iv) Benefits animals that live with other members of the species for at least a time e.g. in herds & packs

Note: The responses of learnt behaviour are adapted to the environment.

TYPES OF LEARNED BEHAVIOUR

1. Habituation: is learning to "ignore" stimuli that are not important, irrelevant, or repetitive
e.g. after sometime, birds learn to ignore a scare crow that is positioned in one position of the garden.

2. Associative learning: any learning process in which a new response becomes associated with a particular stimulus.

Two types of associative learning

(a) Classical Conditioning: A process in which an animal learns to associate a previously neutral stimulus with a behavior once triggered by a different stimulus

(i) Honey bees learn to associate floral colors and fragrances with the presence of nectar.
(ii) Pavlov's Dogs salivated on hearing the sound of a bell in expectation of food, yet initially it was the food smell that stimulated salivation.

Pavlov on the control of salivation in dogs

- He noted that when presented with the sight and smell of food, the dogs began to salivate in preparation of eating.
- Pavlov began to ring a bell each time the dog was shown their food.
- After a while he found dogs salivated when the bell was rung, regardless of whether food was present.

(b) Operant conditioning (Instrumental learning / 'Trial-and-Error' learning):

A form of adaptive learning in which an animal learns to carry out a particular action in order to receive a reward or avoid an unpleasant experience.
(i) In Skinners box, rats learnt to press a lever in order to obtain food.
(ii) Cockroaches learning to run through a simple maze to find food.

Skinner's work on pigeons / rats

- Trained rats and pigeons to press a leaver in order to obtain food.
- Certain motor-output responses generated e.g. running around, resting, pressing leaver.
- After training the subject will show the conditioned response (e.g. pressing the leaver) if the response-unconditioned stimulus (a food reward) association has been memorized.

3. Latent Learning (Exploratory learning): Animals explore new surrounding and learn information that has no apparent value at the time, but may be remembered and used later when necessity arises.
(i) Rabbits / rats / mice explore their burrows, which may save them in case of an emergency.
(ii) A sand wasp remembers the pattern of surrounding landmarks to help her find the nest when she returns.
(iii) Worker ants can remember a series of landmarks along a trail and follow them (in reverse order) back home to the nest site.
(iv) A hen uses previous experience to regroup eggs in the nest using wings.

4. Insight learning: The highest form of learning in which an animal applies thinking and reasoning in order to solve problems or deal with complex situations with repeated trial and error.

(i) A chimpanzee piles boxes to increase height for reaching hanging sweet bananas which are out of its reach.
(ii) A child uses stones to hit at mango fruits which are high on the tree.

5. Imprinting: Within a specific period of time after birth an animal learns to recognize and bond to its parent. Imprinting occurs in the sensitive period called "**critical period"**- which is around 36 hours after hatching in goslings and helps survival during infancy
Example:
Goslings, ducklings and chicks become attached to the organism they interact with during the sensitive period.

COMPLEX BEHAVIOR
Most overt behavior is neither 100% innate nor 100% learned. Sometimes innate behaviors may be modified (or modulated) through practice and experience.
Example: In locusts the ability to fly is innate, but an older, experienced individual consumes less energy (per unit time) than a novice flier. This suggests that the older insect has "learned" to fly more efficiently.

TIMING OF BEHAVIOUR
Circaannual - occurs on a seasonal / annual basis
Examples: hibernation in bears, frogs, toads, salamanders bury themselves in mud during the winter.
Circadian - This is a 24-hour, light-regulated, sleep/wake cycle of behaviour.
Circadian rhythms are controlled by genes, yet are also influenced by factors such as jet lag and shift work.

TERRITORIAL BEHAVIOUR / TERRITORRIALITY
A **territory:** a physical space an animal defends against other members of its species.

The main reasons for territoriality
1. Control food supply **2.** Retreat; shelter; nest , **3.** Access to females; space for sexual display; courtship

Animals that have territories mark and defend their space by **singing** e.g. birds, **urinating** e.g. mammals, **constantly standing guard** e.g. carpenter bees, **releasing pheromones** e.g. some insects

Advantages of territoriality	**Disadvantages of territoriality**
1. Males able to hold on to resources show their evolutionary fitness and are attractive to females. 2. Exclusive access to food, particularly at times of shortage. 3. Exclusive area for breeding and raising young.	1. Cost of defending territory including risk of physical contact, and displays of strength. 2. Need to be vigilant for intruders. 3. Defending territory is time that could be feeding or mating. 4. Vocal or visual communication of territory ownership makes the individual vulnerable to predation. 5. Difficult for smaller animals to hold territory; i.e. more

4. Space for sexual display and courtship. 5. Spacing of animals avoids competition. 6. Reduces aggression / conflicts. 7. Improves local knowledge of predators and resources. 8. Exclusive place to retreat and shelter. 9. Dispersion of nests reduces predation. 10. Higher survival rates.	likely to be attacked than larger animals 6. Difficult to move if resources exhausted. 7. Importance of territory size. If too large, then hard to maintain control. If too small, not enough resources for effort of defending. 8. Higher risk of predation if territory within predator's territory. 9. Easy for predators to find. 10. Ever present threat of take-over as surplus of animals without territory. 11. Extra vigilance required at certain times of the year (e.g. breeding season).

MIGRATION

Migration: Inborn, seasonal, long-distance travel of animals to specific locations, usually with a return.

Orientation: organism is capable of detecting compass direction (N, S, E, W) using cues from the environment

Navigation**:** organism is capable of detecting its position as well as orientation, (N, S, E, W of something – river, ocean, mountain range, etc)

Examples of migration:

(i) Some species of Gallinaceous and raptorial birds migrate from valley to mountain peaks.
(ii) Salmon return to native streams to breed after several years at sea.
(iii) Deer and Caribou, African ungulates - mammals engaged in overland migrations.
(iv) Some sharks, whales (northern oceans for calving, southern areas for breeding) and other marine mammals - engaged in long distance oceanic migrations

Migration is triggered by seasonal changes in weather, air temperature or day length, or changing food supply.

Examples**:** wildebeest move towards rain in the dry season, some animals move from one food source to another, while others migrate to particular breeding areas.

CUES THAT ANIMALS USE TO NAVIGATE

(i) ***Endogenous*** - hormonal
(ii) ***Exogenous*** - external cues from the environment

Examples:

1. Sun compass - movement of sun; angle of sun; polarised light (pattern of light based on sun's position and reflection on water)
2. Geomagnetic compass - sensitivity to magnetic North and the earth's magnetic field
3. Star compass or position of moon
4. Other visual cues - patterns of waves; cloud patterns; landmarks
5. Smell

6. Sound
7. Electric
8. Young animals may learn when and where to migrate by following their parents

Advantages of migration	Disadvantages of migration
1. Return to specialist site for breeding that does not need all year round food supply, and often no (or few) predators. 2. Move to where food/prey available when not breeding, particularly with young (i.e. maximise feeding opportunity). 3. Stationary can mean increased predator risk. 4. Constant temperature conditions: escape bad weather and lower temperatures (and greater risk of death), especially to give birth. 5. Able to have specialist breeding site (e.g. no predators) and another site for feeding. 6. Flexible strategy - some members of the species can migrate and others not depending on where live. 7. Stationary animals risk exhausting food supply using it all year round, particularly if competition from other species. 8. Opportunity for different members of the species to meet, and greater breeding variety 9. Ideal when specialist food required because the earth's resources are not evenly distributed. 10. Birds migrating at night usually safe from predators as few day-time birds of prey adapt to night-time hunting.	1. Large amount of energy required to travel long distances. 2. Problems and risks of navigation. 3. Risk of forgetting sites or not being able to find again. 4. Leave home territory empty allowing for invaders, and then fights on returning. 5. Risk at temporary stopovers from lack of local knowledge about predators. 6. Vulnerable to weather changes or poor conditions in one year. 7. Many decisions required including optimal fuel load and optimal time of departure. 8. Other risks like the change from salt to freshwater or vice versa for some fish. 9. Evolutionary maladaptive behaviour in some cases; e.g. green turtles feed on eastern coast of South America but breed on Ascension Island (south Atlantic). 10. Risks of night-time migration if animals normally active in day-time (e.g. bat predation of birds).

AGGRESSION/ AGONISTIC BEHAVIOURS

Ritualised behaviours that substitute for physical contact and fighting e.g. yawn of baboons, dogs and baring their teeth, cats and raising their fur, birds raising their feathers, fighting and physical contact in wolves, coyotes, seals, etc.

- Aggressive behaviour is used to intimidate another animal of the same species.
- Animals fight or threaten one another in order to defend their young, their territory, or a resource such as food.
- Animals of the same species rarely fight to the death; fights are symbolic / highly ritualised.
- The fight is over when the defeated individual shows submission to the victor.
- In animals, usually the oldest or strongest wins the argument.

DOMINANCE HIERACHY

A ***dominance hierarchy:*** a form of social ranking within a group in which some individuals are more subordinate than others.

The ability to form a dominance hierarchy is innate, but the position each animal assumes may be learned.

The term ***pecking order*** comes from a dominance hierarchy that is formed by chickens. The top-ranking chicken can peck any other chicken. The chicken lowest in the hierarchy is pecked at by all the other chickens in the group.

Importance of dominance hierarchy

(i) Reduces aggression, established order and stability
(ii) Influences resources among population (food, water, etc.)
(iii) First choice of mating
(iv) Subordinate remains to obtain food, avoid predators, chance to mate

HIBERNATION

Hibernation: a state in which the body temperature drops substantially, oxygen consumption decreases, and breathing rates decline to a few breaths per minute to avoid cold temperatures. Its conserves energy

AESTIVATION

Estivation: is a state of reduced metabolism that occurs in animals living in conditions of intense heat. Could be due also to lack of food or periods of drought.

REPRODUCTIVE BEHAVIOUR

Courtship Behaviour: is a set of display behaviours in which an animal attempts to attract a mate and exhibit their desire to copulate.

Examples:

(i) Singing in male birds
(ii) Peacocks display flamboyant plumage colors and prominent tail feathers
(iii) Preening.
(iv) Dancing in birds
(v) Building nests in birds

I**mportance of courtship behaviour**

(i) It involves formation of a pair bond – relationship between male and female of same species which means they recognise each other as individuals and avoid aggression.
(ii) It advertises sexually receptive individuals
(iii) Brings both mating partners to reproductive readiness simultaneously

(iv) It ensures that members of the same species find each other and mate e.g. at dusk, different species of fireflies flash distinct light patterns. However, female fireflies of one species respond only to those males exhibiting the species-correct flashing pattern.
(v) Maintain distinct species

GUIDING QUESTION
Describe releasers as they relate to animal behavior
Answer plan
RELEASERS = sign stimuli > behavioral response {innate/stereotyped}
(environmental) (fixed action pattern)
RELATIONSHIP TO ANIMAL BEHAVIOR (OTHERS MAY BE GIVEN):
(i) 3-spined stickle-back red belly > aggressive behavior
(ii) pheromones (chemical) > mate attraction
(iii) male Aedes - tuning fork > attract female
(iv) urine in dogs > avoidance of territory
(v) female digger wasp behavior must run course once triggered
(vi) European red robin breast > aggressive behavior
(vii) black gulls > white egg shell pieces . egg shell removal
(viii) bowerbirds - red pebbles, berries > attract female to nest
(ix) Herring gull - red spot on beak > infant feeding response
(x) ants > chemicals > trails

ANTI-PREDATORY BEHAVIOUR
(a) Mimicry
Superficial resemblance of two or more organisms that are not closely related taxonomically. e.g. the non-poisonous viceroy butterfly mimics the poisonous monarch butterfly.
For example.
the palatable species mimics other distasteful species e.g. viceroy butterfly mimics the poisonous monarch butterfly, the harmless hoverfly mimics the painful stinging wasp
Qn. Differentiate between Batesian and Mullerian mimicry.

GUIDING QUESTION
Viceroy butterflies avoid predators by mimicking monarch butterflies' coloration, but viceroys are not poisonous and monarchs are. When might this mimicry stop deterring predators?
This type of mimicry depends on predators learning to avoid the butterflies. To do that, they have to taste a few to learn that they taste bad. If there are a lot more viceroys than monarchs, the predators will usually have a satisfying meal without getting sick, and will not associate getting sick (when they eat an occasional monarch) with eating the butterflies. The whole mimicry depends on predators making the association between color and poison.

(b) Camouflage
The use of any combination of materials, coloration, or illumination for concealment, either by making animals difficult to see, or by disguising them as something else.

Advantage of camouflage	Disadvantages of overcamouflage
Reduces predation chances, enabling the organism to reproduce and pass on advantages genes to offspring.	(i) Increases risks of being trampled upon while in the habitat. (ii) Makes it difficult to be noticed by potential reproductive mates.

(c) Warning colouration

Conspicuous colouring that warns a predator that an animal is unpalatable or poisonous e.g. the poisonous frogs, some snakes, monarch butterflies and some grasshoppers.

CHEMICAL SIGNALS (e.g. PHEROMONES)

These serve as releasers in many animals.

Examples:

(i) Social insects (ants, bees, and termites) release pheromones that elicit alarming, mating, and foraging in other members of their species.

(ii) The pheromone from the mammary glands of domestic rabbit releases immediate nursing behavior by their babies (pups).

ALTRUISM

Altruistic behavior is one in which an individual (the donor) performs an action that helps another animal (the recipient) with no apparent advantage to itself.

Examples: alarm calling in squirrels, helpers at the nest in scrub jays, sterile worker castes in honey bees etc.)

KIN SELECTION

Is the evolutionary mechanism that selects for those behaviours that increase the inclusive fitness of the donor.

GUIDING QUESTIONS

1. *Alarm calls put the caller at increased risk of predation by drawing attention to its location. Why might this behavior be favoured by evolution?*

Animals that use alarm calls put themselves at risk but increase the chances of their relatives' survival. Animals that live in colonies with alarm calls usually live in large family groups, so their genes benefit by allowing others in the group to survive. Alarm calls may be favored by kin selection.

2. *What are some benefits to living in a group? What are some negative consequences of group living?*

- Group members can cooperate in finding food.
- Group hunters can catch larger prey than individual animals can, and animals foraging might find spots where food is plentiful and all members of the group benefit rather than wasting time fighting over it.
- Groups can defend territories more efficiently than individuals can, and living in a group also provides better access to mates.

- There are also drawbacks to living in a group.
- Groups may attract predators or attacks by other animals because of scents or noises.
- Animals living in groups also spread disease more easily than animals living on their own.

DISPLACEMENT ACTIVITY

- An irrelevant activity produced by an excess of one or more conflicting drives in an organism.

Displacement activities occur when an animal experiences high motivation for two or more conflicting behaviours, the resulting displacement activity is usually unrelated to the competing motivations.

Examples

(i) Birds may peck at grass when uncertain whether to attack or flee from an opponent.
(ii) A human may scratch his or her head when they do not know which of two options to choose.
(iii) A bird may pick up nesting material from the ground and throw it away on being disturbed from the nest.
(iv) Sticklebacks suddenly dig in the vertical position during a boundary clash.

VACUUM ACTIVITY

Animal behaviour pattern performed without apparent need or stimuli.

Examples

(i) Even if there are no insects, a bird snaps at imaginary insects in the air, no reason to do so but just exercising instinctive action pattern.
(ii) Domestic squirrel raised in a metal cage will go through the entire sequence of nut-burying activities as if it were in the bush.

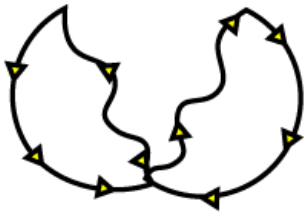
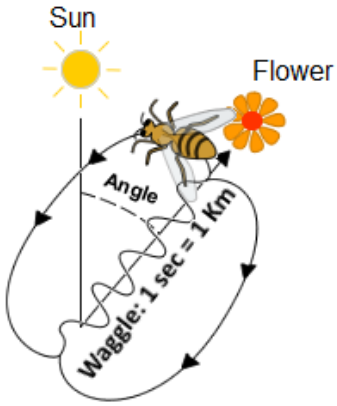
REDIRECTED ACTIVITY

Behavior that is redirected from a threatening or inaccessible target to another target that is more convenient or less threatening **e.g.** middle level managers when disciplined by their superiors may fail to respond in kind, so they take it out on their subordinates.

HONEYBEE DANCE LANGUAGE

- Honey bee dancing is performed by a worker bee that has returned to the honey comb with pollen or nectar, informing other workers about both the distance and direction where the food is.

1. Round dance: Communicates only distance from the food source (less than 50 meters from the hive). It involves running around in narrow circles, suddenly reversing direction to her original course.
2. Sickle dance: Communicates only distance from the food source (between 50 and 150 meters from the hive). This dance is crescent-shaped and represents a transitional dance between the round dance and a waggle dance.
3. Waggle dance (wag-tail dance): Communicates both distance and direction. Is performed by bees foraging at food sources that are more than 150 meters from the hive.

Round dance	Sickle dance	Waggle dance
		

How waggle dance is performed

- A bee that performs a waggle dance runs straight ahead for a short distance, returns in a semicircle to the starting point, runs again through the straight course, then makes a semicircle in the opposite direction to complete a full figure-eight circuit.
- While running the straight-line course of the dance, the bee's body, especially the abdomen, wags vigorously from side to side.
- The duration of the waggle phase is proportional to the distance from the food source (1 second = 1 Km).
- The orientation of the dancing bee during the straight portion of her waggle dance indicates the location of the food source relative to the sun.
- The angle that the bee adopts, relative to vertical, represents the angle to the flowers relative to the direction of the sun outside the hive.