UNIT TWO

Animals

Characteristics of animals

Animals are

- Eukaryotic - moves
- protect themselves - respire
- Multicellular - excrete
- Heterotrophic - grow
- Sensitive to stimuli -have different body symmetries.
- They reproduce,

- Animals can be categorized into two major groups
- Based on the presence or absence of a backbone: vertebrates and invertebrates.
- Vertebrates are further classified into
  - homoeothermic (warm-blooded) animals that include mammals and birds,
  - Poikilothermic (coldblooded) animals that include fish, reptiles, and amphibians.
- Invertebrates are also classified into
  - porifera,
  - Platyhelminthes
  - cnidaria,
  - arthropoda
  - Annelida
  - echinidermata, and
  - mollusca.
- Arthropods are again classified into crustacea, spiders, insects, and many-legs

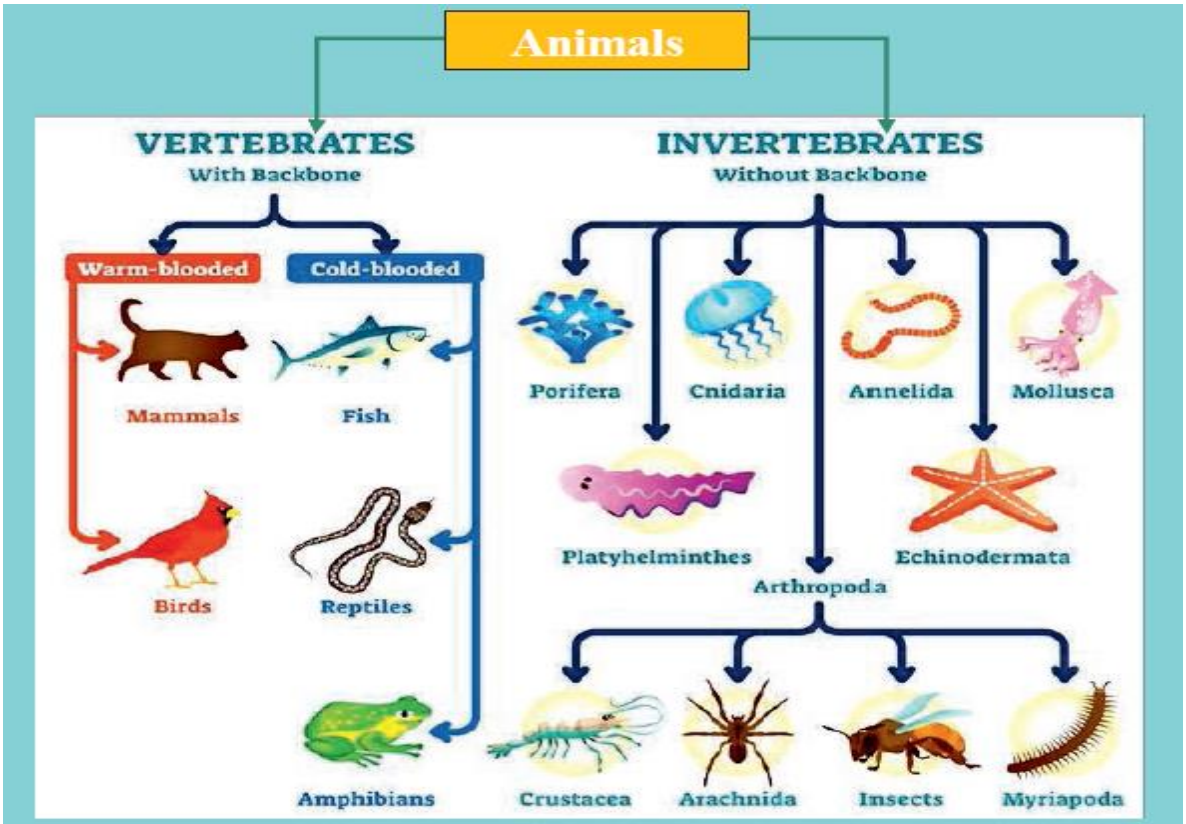


Figure 2.1 Classifications of animals

2.2.1 Invertebrate Animals

- Invertebrates are animals that do not have a backbone or vertebral column.
- This group of animals is the most diverse group of animals in the world.
- They are found almost everywhere,
    - From the hottest deserts
    - the deepest sea beds
    - the darkest caves
    - The highest mountains.
- They lack a rigid internal skeletal system.
- Many invertebrates are soft-bodied.
- some of them have an external skeleton called an exoskeleton,
- Usually made of chitin, which protects their soft inner bodies.
- Invertebrates are cold-blooded
- Do not regulate their body temperature.

- This group includes
  - Earthworms, insects, spiders,
  - snails, sponges, jellyfish, lobsters,
  - Crabs, sea stars, and squid.

Vertebrate animals

- Vertebrates are the most advanced groups in the animal kingdom.
- They are a highly advanced group of animals
  - (for their advanced problem- solving skills,
  - Communication and social behaviors).
- These groups of animals possess a well-defined internal skeleton system with cartilage
- A backbone or vertebral column separated into
  - An axial skeleton (skull, vertebrae, ribs and sternum) and
  - Appendicular skeleton (girdles and appendages).
- Vertebrates have more complex and specialized organ systems such as
  - The circulatory systems,
  - respiratory systems,
  - nervous systems, and
  - Excretory systems.
- The circulatory system is a closed circulatory system with a ventral heart having 2-4 chambers and a median dorsal artery.
- The respiratory system consists of either gills or lungs.
- They have a centralized nervous system with a brain and sensory organs (eyes, ears, nostrils).
- The excretory system of vertebrates consist of paired kidneys

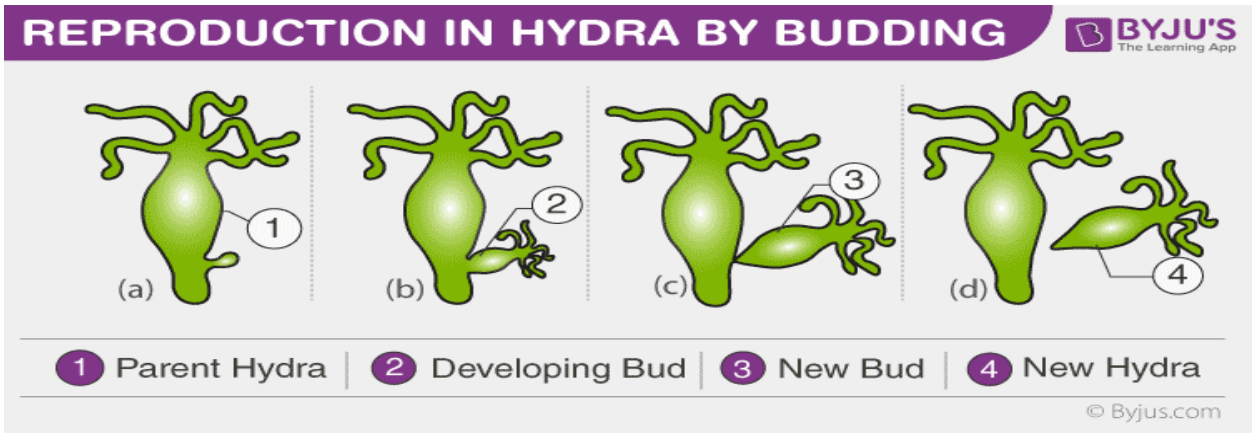
Reproduction in Animals

- Reproduction is one of the common characteristics of animals
- That enable them to ensure the continuity of their species.
- Reproduction is the process by which living organisms duplicate themselves.
- There are two types of reproduction in animals.
- These are **asexual reproduction** and **sexual reproduction.**

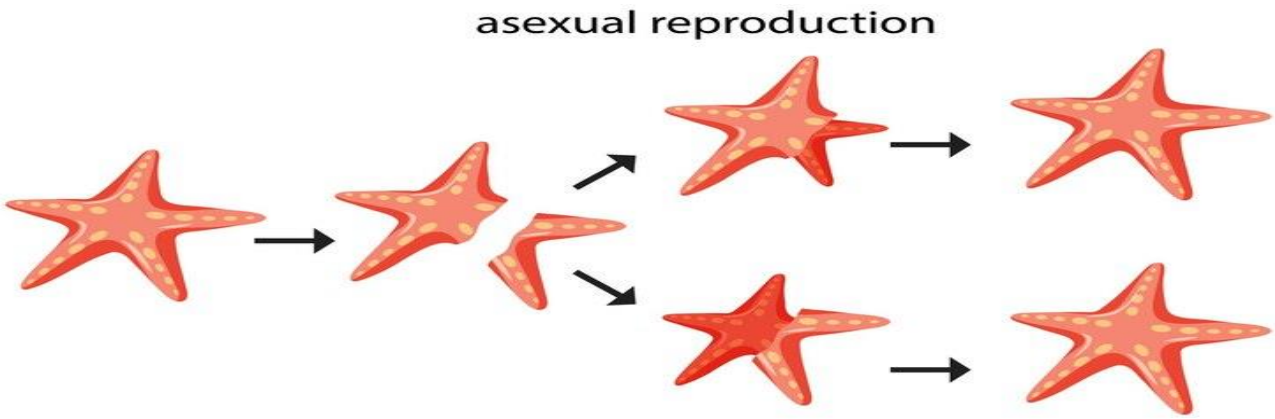
2.3.1. Asexual reproduction in animals

- Asexual reproduction is a type of reproduction
  - ✓ that involves a single individual and
  - ✓ Does not require the fusion of gametes from two parents.
- Asexual reproduction in animals is more common among invertebrates than in vertebrates.
- The two most common forms of asexual reproduction are
  - Budding
  - Fragmentation

  especially in aquatic animals.
- Budding refers to a form of asexual reproduction in which
  - ✓ a new organisms develops from an outgrowth or bud on the parent organism
- The new organism remains attached to the parent organism as it grows,
- Separated from it only when it is mature, leaving behind scar tissue.
- This types of reproduction is common in hydra and other invertebrate animals



- Fragmentation, refers to a process in which organism breaks into two or more parts,
- And each of those parts regenerates into a new complete individual.
- Example:- planarian, and sea stars



- parthenogenesis is a form of asexual reproduction in which
  - ✓ an egg develops into an embryo without being fertilized by a sperm
- Offspring are produced from unfertilized eggs
- They inherit their genetic material from a single parent.
- Examples include invertebrates such as ants, wasps, aphids, bees, etc
- Involves development of a female (rarely a male) gamete without fertilization.

2.3.2 Sexual reproduction in animals

- Sexual reproduction is a type of reproduction
  - ✓ that involves two individual parents and
  - ✓ Requires the fusion of gametes from two parents (male and female).
- It produces offspring that have genetic material from both parents.
- The parents are diploid organisms with a complete set of chromosomes (2n).
- In sexual reproduction, males produce sperm and haploid cells (n) in the testes
- Where sperm cells are stored in the epididymis until ejaculation.
- Females produce an ovum or egg haploid cell (n) that matures in the ovary
- the fusion of sperm cells with female gametes produces a fertilized egg called a zygote(2n),
- Which develops into an embryo and then into an individual organism.
- There are two types of fertilization:
  - external fertilization
  - internal fertilization
- Internal fertilization are the eggs released from the ovary into the uterine tubes for fertilization,
- External fertilization eggs are released into the aqueous environment
- After fertilization, a series of developmental stages occur in embryonic development
- The first stage is cleavage,
  - ✓ Which involves a series of mitotic cell divisions of the fertilized egg (zygote).
- This cell division results in an eight-celled structure.
- The second stage is rearrangement of cells into hollow structures called blastulae.
- The blastula undergoes further cell division and rearrangement with the process called gastrulation.
- The gastrula that has different cell layers called “germ layers”.
- These layers are ectoderm, endoderm and mesoderm

- These germ layers later develop into different tissue types, organs, and organ systems.
- Organogenesis is the formation of organs during embryonic development.

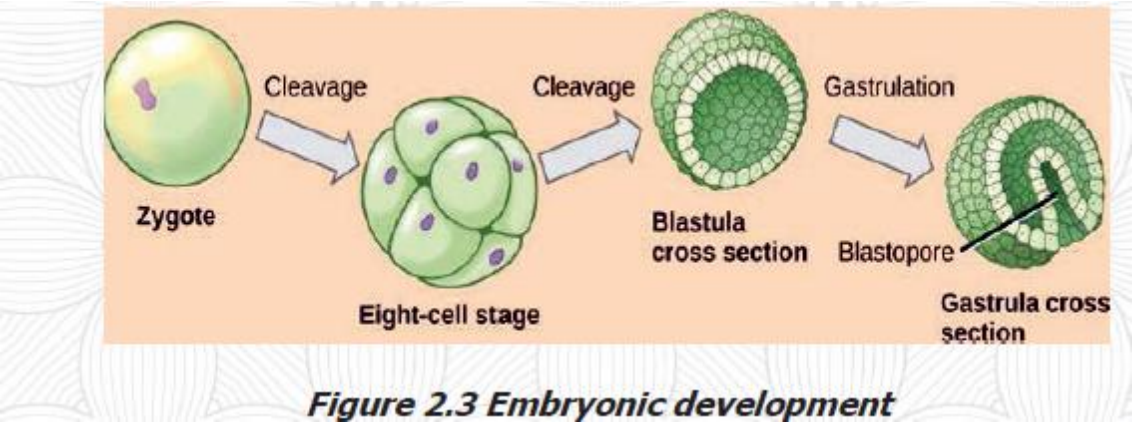


Figure 2.3 Embryonic development

2.3.3 Reproduction in insects (complete and incomplete metamorphosis)

- Insects constitute the most diverse groups of animals
- Are the largest class of the phylum Arthropoda (the animal phylum).
- They have segmented bodies, jointed legs, and external skeletons (exoskeletons).
- Insects include flies, grasshoppers, lice, butterflies, bees, and beetles
- All honeybees exhibit both sexual and asexual reproduction and have their own life cycle.
- During sexual reproduction, eggs are usually fertilized internally.
- Some insects undergo parthenogenesis, a process in which an individual develops from unfertilized eggs.
- In sexual reproduction, the male produces sperm and fertilizes the egg produced by the female during mating.
- After fertilization, the female insect lays eggs and hatches
- After hatching, insects undergo a series of major changes in body structure as they develop.
- This series of changes is called metamorphosis.
    - The process of structural and physiological change an organisms under
- Chemical substances in the insects control the process of metamorphosis.
- There are two types of metamorphosis. These are:
    1. complete metamorphosis
    2. incomplete metamorphosis
- Complete metamorphosis has four stages.
    - ✓ Egg, larva, pupa and adult, e.g. honey bees
- In complete metamorphosis has three stages. Eg. **Egg, nymph,** and **adult. E.g. grasshoppers**

2.3.4 Reproduction in Frog

- Frogs undergo sexual reproduction and have male and female reproductive structures.
- Unlike birds, frogs do not produce amniotic eggs.
- they are usually covered in a jelly-like substance
- They must lay their eggs in water to protect them from drying out.
- Frogs have external fertilization.
- Internal fertilization also occurs in a few species of frogs.
- In external fertilization, the female releases eggs from her body into the water and the male releases his sperm to fertilize the eggs.
- In a process called metamorphosis,
    - after the fertilization of an egg by sperm,
    - Frogs go through a larval stage that is very different from the adult form.
    - The fertilized eggs develop into a larval stage called a tadpole that is different from the adult frog

2.3.5 Reproduction in Crocodiles

- Crocodilians are large semi-aquatic reptiles that live in different parts of the world.
- Crocodiles reproduce sexually involving both male and female parents.
- The mating season for crocodiles usually begins in July or August and mating takes place under water.
- During mating, the sperm fertilizes the egg and develops in the female.
- They have internal fertilization.
- They lay their eggs and bury them in sand or deposit them in mound vegetation.
- The number of eggs a crocodile deposits varies from 10 to 100
- Unlike frogs, crocodiles have hard, leathery eggs that enable them to protect their young.

2.3.6. Reproduction in Birds

- Birds reproduce sexually and have internal fertilization.
- Most bird species are monogamous but there are also polygamous species.
- Monogamous is usually a mating system between a single adult male and a single adult female
- Polygamous is a mating system with several partners during a single breeding season.
- Male birds do not have external genital organs whereas females have a single ovary.
- Reproduction in birds starts by the joining of an egg or ovum with a sperm cell in the oviduct.

- The ovum which is produced in the ovary and travels down through the oviduct for fertilization to occur.
- The oviduct consists of the infundibulum, magnum, isthmus, uterus, and vagina

Table 2.1 Parts of oviduct and functions

Parts of the oviduct	**Nature and Functions**
Infundibulum	• A funnel-shaped upper portion of the oviduct • Its purpose is to search out and engulf the yolk, causing it to enter the oviduct.
Magnum	• It is the longest part of the oviduct. • Secretion of albumen: nearly all the egg white is deposited in the magnum.
Isthmus	• It is the relatively short portion of the oviduct • Formation of shell membrane-inner and outer shell membranes • The glands of the isthmus produce sulfur containing amino acids that are important for shell membrane formation.
Uterus	• Developing an egg takes a longer period of time. • Formation of eggshell-shell is formed over shell membranes.
Vagina	• The final section of the oviduct is the vagina, which is separated by a sphincter presents in between the uterus and the vagina • During oviposition, relaxation of the muscles allows the egg to leave the uterus, and it is almost immediately laid through the cloaca.

- Both male and female birds have a structure called the cloaca.
- During mating, the male brings its sperm to the female cloaca, and the sperm from the male cloaca fertilizes the egg.
- The fertilized egg travels down to the uterus, forming a layer of albumen around it,

- which is followed by the shell membranes in the uterus
- Birds lay eggs after the egg completes its development.
- The number of eggs a bird lays varies from a few to more than 10, depending on its species.
- For example, penguins and albatrosses lay few eggs,
- Chickens and ducks can lay more than 10 eggs.
- The major parts of the egg of a bird are
    - the yolk,
    - the chalaza,
    - the albumen,
    - the membranes,
    - air sac and the shell

Incubation, Hatching and Parental Care in Birds

Incubation or brooding

- is the process of keeping eggs warm with body heat while the embryos inside continue to develop after birds lay their eggs
- In most cases, the female parent incubates the eggs
- Although males sometimes participate.
- When a breeding season approaches, the female will develop a brood patch to help transfer heat effectively
- This brood patch has an area of skin with densely packed blood vessels
- That produces more heat and facilitates heat transmission to the egg.
- Birds rotate their eggs periodically to ensure an even distribution of warmth.
- This helps the embryo to finish its development inside the egg

Hatching

- After incubation, the embryo completes its development and hatching occurs.
- During hatching, the chick develops a tooth-like structure at the beak's tip to break the eggshell.
- The chick also communicates with its parents a day or two before hatching, with parents with some vocal sounds.
- The chick then starts to use the hard tip of its bill,
- a tooth-like structure called an egg tooth,

- Finally the chick breaks out of the egg, and the young lose the egg tooth after hatching

Parental Care in Birds:

- One of the methods bird use to protect their young is by building nests.
- Birds make nests in areas that are hidden in order to avoid predators.
- Some birds do not use nests.
- They simply lay their eggs on bare cliffs.
- the length and type of parental care varies widely amongst different species of birds
- In some species, parental care ends at hatching.
- Other species care for their young for an extended time.

2.3.7. Reproduction in rat

- Rat (genus Rattus) is the name generally applied to numerous members of several rodent families.
- The black rat (Rattus rattus) and the brown rat (Rattus norvegicus) are among the most common types of rats species.
- They live virtually everywhere that human populations have settled
- The black rats is predominantly live in warmer climates
- The brown rats are dominantly found in the temperate regions.
- Giant Mole rat (Tachyoryctes macrocephalus), also known as the giant root rat
- It is endemic to Ethiopia where it is confined to high altitude shrub and grasslands
- Commonly found in the Afro-alpine habitat such as the Bale Mountains.
- Reproduction in rats is representative of mammalian sexual reproduction.
- The male reproductive structure of a rat consists of
    - testes (singular testis),
    - scrotum
    - seminiferous tubules,
    - epididymis,
    - vasdeferens and
    - penis with bacula
- the female reproductive structure of a rat consists of
    - two ovaries, oviducts,
    - uterine horns and vagina with vulva

- Like in other mammals, fertilization of the egg occurs inside the female
- The fertilized zygotes develop in the mother during a gestation period known as pregnancy.

Pregnancy and Development in Rats :

- The average pregnancy time or gestation period of a rat varies depending on the species.
- The gestation period for a brown rat is 22 to 24 days
- the gestation period for black rats is usually 22 days
- The gestation period for giant mole rats is 37- 49 days.
- Each zygote divides and forms a hollow ball of cells that further develops into a blastocyst called a blastula.
- The umbilical cord, a complex system of connecting blood vessels nourishes the embryo from the mother.
- The placenta transports oxygen from the mother to the embryo and removes waste from the embryo's environment
- The amniotic sac protects the embryo during pregnancy.
- Gradually, the embryo forms a neural plate,
- later develops into brain and spinal cord, the arm and leg buds become visible,
- The rat gives birth to hairless, deaf with sealed eyelids offspring.
- Rats normally give birth from 7 to 12 offspring per litter
- But the number is fewer than this for giant mole rats.
- The mother feeds milk and, after 45 days, the young rats are fully weaned
- Then they are actively foraging and feeding.
- The age of sexual maturity also vary depending on species.
- In brown-black rats, the age of sexual maturity is 3–4 months old.
- Giant mole rats become reproductively mature when they are 4-6 months old.

Parental care in rats:

- Is often critical for the survival and development of the offspring.
- Rats build nests to rear their young, called pups or kittens.
- The pups stay in the nest built by their mother until they are weaned.
- The female rats care pups regardless of which their true mothers are.
- If a mother dies, the other females will take over nursing her pups.
- Male rats do not participate in the parental care.

2.4 The economic importance of animals (insects)

- Insects have plenty of economic importance in the world.
- Insects are the most diverse animals in the world.
- They have both positive and negative impacts on our economy, our lives, and the ecosystem.

2.4.1 Beneficial aspects of insects

A. Agriculture

- One of the major activities of agriculture is crop production.
- Insects provide services to agriculture through pollination and regulation of pests.

Pollinators:

- Insect pollinators are flower-visiting insects that forage on flowering plants to obtain plant-provided food (nectar, pollen).
- They have the potential to transfer male gametes (pollen) to the female gametes
- It is an essential activity for the reproduction of the majority of the world's flowering plants
- Many plants depend on pollination for seed and fruit production.
- An estimated 35% of crop production yielded in the world is a result of insect pollination.
- This has huge economic value in the world as well as in the country.

Pest regulation:

- Insect predators and parasitoids that attack and feed on other insects,
- Particularly on insect pests of plants are used in pest control.
- Also is known as a natural biological control,
- which destroys harmful insects that infect both animals and plants
- Important insects in pest regulation include mantis, lady beetles, ground beetles, rove beetles, flower bugs, lacewings and hover flies.
- For example, Stagmomantis insects, species of mantis feed on grasshoppers and caterpillars that damage crops.
- Chilomenes, a ladybird beetle, feed on aphids that damage cotton plants and destroys scale worms that are pests of orange and lemon trees respectively.
- Epicauta, a blister beetle, eat up masses of the eggs of locusts

- Insects also play a great role
    - in feeding on unwanted weeds,
    - creating channels for smaller organism's
    - Water, air, and roots to travel through to improve soil aeration.
    - enhance the nutrient cycle and physical properties of the soil, such as soil structure

B. Food

- Many species of insects are being used as a food for people in many countries.
- Evidence suggests that edible insects have potential to become a valuable protein source for addressing the global food demand.
- They are widely recognized as a sustainable source of animal protein.
- There are over 1,462 recorded species of edible insects in the world.
- Most insects are consumed in Asia and Central America.
- Usually crickets, grasshoppers, beetle and moth larvae and termites are eaten there.
- Insects are important sources of food for many vertebrates, including birds, amphibians, reptiles, fish and mammals.
- One of the many ways to address food and feed security for the over increasingly growing world population is through insect farming.
- They reproduce quickly, high growth, and conversion rates and low environmental footprint
- They are nutritious, with high protein, fat and mineral contents and can be reared easily

C. Industry

- One of the benefits of insect related to industries is their role in commercial products.
- Insects are being used to produce different materials at home and in industries.
- The following are some of the examples.
- **Production of Honey and Bee Wax:**
- Honey and wax production are considered some of the commercial benefits of insects.
- For example, the honeybees (Apis meliffera L.) produce millions of tons of honey and wax every year around the world.

- **Production of Silk:**
- The other commercially beneficial insects are silk worms (Bombyx mori and other silk worms).
- Silkworms produce silk fibers, which are woven into the delicate, smooth material used for luxurious textiles and for different purposes in the textile industry

Production of shellac:

- Shellac is a resin secreted by Lac insects. Among the many species of lac insects, Laccifer lacca, is the commercially cultured lac insect.
- Shellac is still in use as dyes, inks, polishes, sealing waxes, and as stiffening agents in the fabrication of felt hats.
- It is an animal originated commercial resin.

Production of Cochineal:

- Cochineal pigment is extracted from scale insects such as Dacylopius coccus.
- The cochineal pigment was important for the intensity and permanency of colors in painting.
- The cochineal pigment is still giving the colors in foods, beverages, cosmetics (lipsticks) and art product.

Production of Tannic Acid:

- Tannic acid is a chemical compound used in dyeing goods made of leather in leather industries, for tanning and in manufacturing some inks.
- Tiny wasps in the family Cynipidae secrete some chemical and in response to this, the tree produces gall tissues that contain tannic acid.

D. Health and medicine

- Some insects have medicinal value in treating different human and animal diseases.
- Since ancient times, insects and insect-derived products have been used as medicinal agents in many parts of the world.
- For instance, honey is applied to treat burns, chronic and post- surgical wounds.
- Bee and ant venom are used to treat joints pain.
- Recent research confirms that bee products promote healthy immune systems, improve circulation and decrease inflammation

2.4.2 Harmful aspects of insects

- Some insects are pests of plants, fruits, and grains in a store.
- They feed on several parts of green plants and crops, such as leaves, stems, buds, flowers, fruits, and seeds on fields and in stores at home thereby damaging crops and reducing production.
- These insects include locusts, caterpillars, bugs, hoppers, aphids etc.
- Locusts are among the most destructive of all insect pests.
- Countries have faced threats of swarms of desert locusts.
- Consequently, regional and international organizations have started to monitor desert locust populations and launch control measures when necessary.
- Locusts are particularly destructive in hot and dry regions when there is a sudden increase in their numbers.
- The prevalence of food shortage has further forced them to migrate.
- They migrate in huge swarms, for several kilometers away devouring virtually every green plant in their path.
- Some insects are also regarded as serious pests for stored cereal grains.
- The most common insect pests of stored cereal grains are:
    - Rice Weevil (Sitophilus oryzae);
    - Lesser Grain Borer (Rhyzopertha dominica);
    - Rust Red Flour Beetle: (Tribolium spp.);
    - Sawtooth Grain Beetle: (Oryzaephilus surinamensis);
    - Flat Grain Beetle: (Cryptolestes spp.)
- Several insects serve as vectors for transmitting diseases from one organism to another or serve as intermediate hosts for several pathogens
- Anopheles mosquitoes transfer malarial parasites, “Plasmodium,” from one person to another.
- Culex mosquitos spread filariasis and transmit filarial worms from infected to healthy people.
- The tsetse fly, Trypanosoma gambiense, also spreads the African sleeping sickness to the human population.

- The housefly (Musca domestica) spreads food and water-borne diseases to human populations.

2.5 Animal Behavior

- Animal behavior means all the ways in which animals interact with other organisms and the physical environment.
- It includes the movements of animals, interaction of animals within and with the environment and learning about their environment**.**
- Animals have different behaviors and behavioral patterns for survival and reproduction

2.5.1 Types of Animal Behavior

- Animal behavior can be categorized into two main types:
    1. innate or inherent behavior
    2. Learned or acquired behavior.

Innate or inherent behavior

- Innate or inherent behavior is an inborn behavior that is determined by genes and independent of experience and specific to a species.
- There are three types of innate or inherent behavior. These are
    - Instinctive, reflexive, and Orientative

1.1 instinctive behaviours in animals.

- Examples are
    - Web making in spiders
    - Nest-building in birds
    - Swimming with dolphins and other aquatic species.
    - Opening of mouth in chicks of many bird species when their mother returns to the nest.
    - Honeybees dance when they return to the hive after finding a source of food

1.2. Reflex behaviours in animals.

- Examples are
- **A simple reflex** action is a sudden, involuntary response to stimuli.
- For example, when you touch a sharp or hot object, you pull your hand away rapidly without even thinking about the action.

- You blink when something gets too close to your eye
- During a reflex action, messages about pain do not travel all the way to and from the brain.
- Instead, they travel only as far as the spinal cord, and the spinal cord responds to the messages by giving orders to the muscles.
- This allows you to respond to pain more quickly.

1.3. Orientation behaviours in animals.

- **Examples are**
- **Taxis** is directed in relation to a given stimulus. It is the orientation of an animal (directed either towards or away) in response to the source of stimulus.
- If the orientation is towards the stimulus, it is called as a **positive taxis**
- If it is away from the stimulus, it is known as a **negative taxis**.
- Example: The movement of cockroaches away from the source of light.
- **Kinesis** is undirected, random movement.
- Kinesis is a type of locomotory behavior in relation to the source of stimulus.
- The animal responds to the variation in the intensity of the stimulus and not the source or direction of the stimulus.
- Example: The movement of woodlice in relation to the temperature around them.

Learned or acquired behavior

- Learned or acquired behavior is not inherited and not determined by genes.
- It is the type of animal behavior acquired during the lifetime of an individual.
- Learned behavior allows an individual organism to adapt to changes in the environment that are modified by previous experiences.
- Examples of simple learned behaviors include
    - habituation,
    - classical conditioning,
    - operant conditioning,
    - sensitization,
    - latent and insight learning

Habituation

- Is a simple form of learning in which an animal stops responding to a stimulus, or cue, after a period of repeated exposure.
- This is a form of non-associative learning, in which the stimulus is not linked with any punishment or reward.
- For example, you were reading a book when someone turned on the television in the same room.
- At first, the sound of the television might have been annoying.
- After a while, you may no longer have it noticed.
- Accordingly, it mean that you have become accustomed to the sound.

Classical conditioning

- is a result of associative learning in which a response already associated with one stimulus is associated with a second stimulus to which it had no previous connection.
- Classical conditioning was discovered by Ivan P. Pavlov, a Russian physiologist.
- There are three stages of classical conditioning.
- Stage 1: Before conditioning.
- This stage states that an unconditioned stimulus (UCS) produces an unconditioned response (UCR) in an individual,
- which means that a stimulus in the environment has produced a behavior or response which is unlearned (i.e., unconditioned), and
- Therefore it is a natural response which has not been taught.
- In this case, no new behavior has been learned yet.
- Stage 2: During conditioning.
- During this stage, a stimulus that produces no response is associated with the unconditioned stimulus, due to what it is known as a conditioned stimulus (CS).
- For learning to take place, the UCS must be associated with CS on a number of occasions, or trials at this stage.
- Stage 3: After conditioning.
- This conditioning happens once the conditioned stimulus (CS) has been associated with the unconditioned stimulus (UCS) to create a new conditioned response.

Operant conditioning

- is a method of learning that uses rewards and punishment to modify behavior
- Instead, whenever an organism performs a behavior or an intermediate step on the way to the complete behavior, the organism is given a reward or a punishment.
- It was discovered by B.F. Skinner.
- An experiment known as the Skinner box, Skinner placed a rat in a box
- When rats press a lever when a green light is on, they receive a food as a reward.
- When they press the lever when a red light is on, they receive a mild electric shock.
- As a result, they learn to press the lever when the green light is on and avoid the red light.
- Based on the theory of operant conditioning, behavior will likely be repeated when the organism is reinforced (rewarded), and behavior will occur less frequently when it is punished.
- Skinner identified three types of responses or operant behavior.
- **Neutral operants** are responses from the environment that neither increase nor decrease the probability of a behavior being repeated
- **Reinforcers** are responses from the environment that increase the probability of a behavior being repeated are called reinforcers.
- Reinforcers can be either positive or negative.
- **Punishers** are responses from the environment that decrease the likelihood of a behavior being repeated are called punishers.
- Punishment weakens behavior

Insight learning

- is the sudden realization of a problem's solution
- Humans have used insight learning to solve problems ranging from starting a fire to traveling to the moon

Sensitization

- Also referred to as reverse tolerance, is a non-associative learning process in which repeated administration of a stimulus results in the progressive amplification of a response.
- It occurs when a stimulus is presented above the tolerance threshold.
- For example, repetition of a painful stimulus may make one more sensitive to a loud noise.

2.5.2 Patterns of Behavior

- There are different behavioral patterns in animals.
- behavioral patterns are different due to the diversity of species
- Examples of behavioral patterns in animals include
    - behavioral cycles,
    - reproductive behavior,
    - social behavior,
    - competition,
    - Territory and
    - Communication.

Behavioral cycles

- Are behavioral pattern in which animals respond to periodic changes in the environment.
- It can be daily or seasonal cycles.
- Example 1. Seasonal migration (movement)
- Seasonal migration refers to the movement of various species of birds, insects, and mammals from one habitat to another during different times of the year
- Because of seasonal fluctuations in factors such as the availability of food, sunlight, temperature, and breeding difficulty.
- Example: migration of various whale and bird species from their summer habitats in the Arctic or Antarctic to the tropical waters near the equator
- Eg. 2. Circadian rhythms (sleep and wake)
- Circadian rhythms/ biological clocks, is the 24-hour internal clock in our brain that regulates cycles of alertness and sleepiness by responding to light changes in our environment.
- Light and dark have the biggest influence on circadian rhythms
- One of the most important and well-known circadian rhythms is the sleep-wake cycle.

Reproductive behavior:

- It is a behavioral pattern of animals to meet the needs of reproduction.
- It the coordination of the timing and patterning of reproductive activity.
- Reproductive behavior is vital for locating and selecting suitable mates, producing offspring, and rearing them successfully to independence.

- Eg. Courtship that involves sounds visual displays or chemicals and paradise dance.

Social behaviour:

- It is the behavioral pattern of animals commonly observed in that live in groups.
- Insects such as ants, termites, bees, exhibit some of the most well developed social behavior and wasps are social behaviors.
- One benefit of social behavior for these insects is that different individuals perform better in certain activities or division of labor as workers and soldiers.
- Other examples of social behaviour are observed in elephants, penguins, human beings and other primates.

Competition:

- It is a behavioral pattern of animals observed during competition such as for resources.
- Example: competition includes the competition between animals for space, territory, water, mates and food.
- Competition occurs naturally between living organisms that coexist in the same environment.
- There are two basic types of competition:
    1. intraspecific competition: occurs between individuals of the same species
    2. interspecific competition: occurs between individuals of different species

Territoriality:

- It is a behavioral pattern that involves protecting spaces by an animal from others.
- The territories of animals contain all of the resources and conditions they need to survive.
- Many animals defend their area by using display behavior instead of fighting.
- The behavior gives signals for other animals to stay away.
- Displaying behavior is generally safer and uses less energy than fighting.
- Example,
    - ✓ Male dogs and lions use pheromones in their urine to mark their territory.
    - ✓ Male gorillas use display behavior to defend their territory by pounding on their chests and thumping the ground with their hands,
    - ✓ robin by displays his red breast to warn other robins to stay away.

Communication behaviour:

- It is a behavioral patter vital for the interaction of animals.
- Animals can communicate with the aid of sight, sound, tactile (with body touch),and
- Chemical cues (they produce special chemicals called pheromones**)**.
- Example:-birds sing and frogs croak to communicate with each other.
- Ants communicate with chemicals called **pheromones**
    - to mark trails to food sources so other ants can find them.
    - To identify nest mates
    - To alert the colony when members are injured

2.6 .Homeostasis in animals

- Animals are directly affected by the environmental situations.
- A change in these situations may negatively affect the physiological functions of their bodies.
- They need to have a controlling mechanism for these factors in order to maintain stability in their body.
- Despite environmental changes, most animals maintain almost constant internal body conditions through homeostasis.
- Homeostasis is the self-regulatory process by which animals maintain stable internal conditions in their bodies regardless of external condition.
- A change in the internal or external environment (stimulus) is detected by receptors in the animals' bodies, which sends information to a control center (the brain).
- As a result, the body system responds to the stimulus and by returning the value back or toward the set point.
- Homeostasis involves four component: stimulus, receptor, control center, and effector.

Stimulus:

- Is a change in the environment that forces the organism to response.
- It can be a change in body condition, such as an increase or decrease in body temperature, glucose, or water.

Receptor:

- It detect the change in the environment or body condition and send signal to control center to counteract it, returning the internal condition to the normal.
- For example, thermo receptors (the end of sensory neurons)

Control center:

- This receives messages from receptors and sends commands to the effector to counteract the change.
- The hypothalamus, a region of the brain, is a control center for homeostasis.

Effector:

- It acts on the stimulus based on the command control center, counteracting the change and returning the internal body condition to normal.
- Organs or tissues such as the kidney, liver, or heart are effectors.

2.6.1 Thermoregulation

- Is the process of maintaining the internal body temperature constant.
- Many organisms use behaviour, physiology, and morphology to regulate body temperatures
- Based on temperature regulation, animals can be divided into two groups:
    1. **Poikilothermic animals**
    2. **Homeothermic animals**

1. Poikilothermic animals: adapting to environmental temperature

- Poikilothermic/ ectothermic/ lack internal control over their body temperature
- Body temperature varies with environment
- The body temperature of these organisms is generally similar to the temperature of the environment
- Some rest in the sunlight on a cold day to keep their bodies temperature slightly below or above the environmental temperature.
- Some animals swim in water to cool their body.
- Some also use burrows to keep their bodies warm and still others such as bees use group activity or stay in a hive to survive in cold seasons.

2. Homoeothermic Animals

- Homoeothermic animals can generate internal heat to maintain a constant internal body temperature.
- Also known as endothermic
- They use Morphological , physiological and behavioral methods of temperature regulation
    - Morphological- fur, fat and feathers, the surface- area-to-volume
    - physiological – vasoconstriction, Shivering, Vasoconstriction, sweating
    - behavioral – seeking sun or shade or huddling together for warmth
- Homoeothermic animals also use vasoconstriction in response to the coldest environment.
- Vasoconstriction is the narrowing of blood vessels to the skin by the contraction of their smooth muscles to reduce blood flow in the peripheral blood vessels and retain heat.
- Shivering is another way of maintaining body temperature in cold.
- Shivering is caused by involuntary contractions of your muscles.
- Muscle contractions require energy from respiration that releases heat to warm the body.
- Homoeothermic animals can loss heat in a variety of ways when the environment is hot.
- Include vasodilation which is the widening of blood vessels at the skin surface to increase heat loss through the surface of the skin thereby cool their body through emission and evaporation.
- Sweating is another way of maintaining body temperature during a hot season.
- Sweat, which is produced by the sweat glands travels up the sweat duct and out of the sweat pore onto the skin surface.
- The processes of coordination occur in the part of the brain called hypothalamus.
- When the temperature of the environment changes (decreases or increases), signals are sent to the brain to alert the hypothalamus.
- The hypothalamus then responds by activating the process of vasodilation, vasoconstriction, shivering and sweating to maintain the body temperature constant
- The body structure of animals also helps to maintain their body temperature.
- For instance, large ears in hot areas help to lose heat and cool their body,
- Whereas small ears and fur in cold areas help to minimize heat loss and keep their body warm.
- The size of the animals also affects regulation of body temperature.

- As animals grow in size, their inside volume increases and the outside surface area decreases.
- This affects the surface-area-to-volume ratio or the surface-to-volume ratio of animals, which consequently affects heat loss.
- The larger the animal, the smaller the surface area-to- volume ratio it will have, so it will have lower heat loss
- Example- elephant
- Animals also maintain their body temperature by searching out cold or hot habitats that allow them to alter its rate of heat loss or gain,
    - making nests or digging burrows
    - huddling with conspecifics(two or more animals in body contact, increasing body temperature)
    - in human like wearing clothes or turning on an air conditioner

2.6.2 Osmoregulation

- Is a process that regulates the osmotic pressure of fluids and electrolytic balance in organisms to maintain homeostasis.
- About 60% of the human body is composed of fluids.
- Approximately 2/3 of our body's water content is in our intracellular fluids and the remaining 1/3 forms our extracellular fluid.
- Extracellular fluid consists of the fluid between cells (interstitial fluid) and the blood plasma.
- A disruption in the osmotic pressure can result in an imbalance in the movement of water between them and hence alter the concentration of their electrolytes.
- Osmoregulation is important to balance osmotic pressure of fluids and electrolytes.
- In humans and other animals, this process is brought about by osmoreceptors, which can detect changes in osmotic pressure.
- Humans and most other warm-blooded organisms have osmoreceptors in the hypothalamus, part of the brain and in the kidneys.

- There are two major types of osmoregulation:

1. Osmoconformers:

- Organisms that try to match the osmolarity of their body with their surroundings
- These organisms maintain the same osmotic pressure inside the body as outside water.
- Examples - invertebrates like starfish, jellyfish and lobsters.

2. Osmoregulators:

- Organisms that actively regulate their osmotic pressure, independent of the surrounding environment
- Examples -many vertebrates, including humans.
- The kidney is the main organ responsible for osmoregulation in humans.
- When the water level in the body is high, the kidney releases a large amount of hypotonic urine.
- When the water level is low, it retains water and produces a low amount of hypertonic urine.
- The kidneys maintain the electrolytic balance of the body.
- The hypothalamus of the brain and Antidiuretic hormone (ADH)secreted from pituitary gland controls osmoregulation

2.6.3 Blood Sugar Regulation

- Glucose is the main source of energy for the normal functioning of our body systems including the brain.
- Two hormones produced from pancreas are responsible for controlling the concentration of glucose in the blood.
- These are **insulin** and **glucagon**.
- Insulin promotes the conversion of glucose into glycogen so that the excess glucose can be stored for a later use in the liver.
- Glucagon promotes the conversion of glycogen into glucose so that the lack of glucose can be compensated for by the new supply of glucose.
- Glycogen is stored in the liver and converted in to glucose when the glucose level decreases.

Negative and positive feedback mechanisms

- Negative feedback mechanism is a homeostatic process that reverses the direction of the stimulus or any deviation from the normal.
- This means that if the level is too high from the normal, the body brings it down, and if the level is too low from the normal, the body lifts it up.
- Positive feedback occurs when a change in a variable triggers a response that causes more change in the same direction.
- Positive feedback mechanism accelerates a change in the body's physiological condition rather than reversing it.
- A negative feedback system has three basic components.
- These are sensor (receptor), control center and effector**.**
- The sensor (receptor) receives stimulus and reports to the control center if there is any deviation.
- The control center compares the value of the deviation from the normal and activates the effector
- An effector causes a change to reverse the situation and returns the value to the normal set point
- Examples:- negative feedback mechanisms
- In humans is the feedback mechanism in temperature regulation.
- This mechanism works by promoting either heat loss or heat gain.
- When the sensor (receptor) receives a stimulus that indicates an increased body temperature from the normal range, it sends its message to the brain's temperature regulation center, where the control center stimulates a cluster of brain cells.
- the control center causes vasodilatation so that the more blood flows to the surface of the skin allowing the heat to radiate into the environment, activate sweat glands to increase their output through diaphoresis (excessive sweating) to remove heat through evaporation across the skin surface
- The reverse occurs when the body temperature drops from the normal range.
- It means that vasoconstriction and deactivation of sweat glands occurs.
- If heat loss is severe, the brain (control center) causes skeletal muscles to contract and produce shivering to release heat while using up ATP for muscles contraction.