GRADE 9 - UNIT 5

CLASSIFICATION

Principles of Classification

- Scientists classify organisms to make the living world easier to understand.
- A species is a group of living organisms that are able to breed successfully with one another and produce fertile offspring.
- Taxonomy involves dividing living organisms into smaller and smaller groups based on features they have in common.
- The binomial system of nomenclature was developed by **Carl Linnaeus**.
- You can classify living organisms using simple keys.

The Five Kingdoms

- Living things are put into groups called **taxa** based on their similarities and differences.
  - The main taxa are kingdom, phylum (division for plants), class, order, family, genus and species.
  - A kingdom is the largest taxon and consists of all the other taxa.
- In the modern classification, there are five kingdoms namely: Monera (bacteria), Protista (the protoctista), Fungi, Plantae and Animalia.
  - Viruses are not classified in any of the above kingdoms.

Kingdom Monera

- The members of the kingdom Monera are all single-celled prokaryotes. They are all microscopic and reproduce by simply splitting in two. Some of them can make their own food by photosynthesis, but many of them are heterotrophic.
  - Examples include *Mycobacterium tuberculosis*, *Haemophilus ducreyi*, and *Staphylococcus aureus*.

Kingdom Protista

- The protista are all microscopic single-celled eukaryotic organisms.
    - They can be quite complex in their shapes.
    - Protista are the basis of the food supply for all the organisms in the sea.
    - Some protista cause serious disease in human beings.
    - Examples include *Entamoeba histolytica*, Trypanosoma and Dinoflagellates.

Kingdom Fungi

- Members of the kingdom Fungi are eukaryotic and usually multicellular.
- The fungi are a large and very successful group – there are around 80, 000 species.
- They vary in size from single-celled yeasts to enormous puffballs.
- They are heterotrophic. Many fungi are saprotrophs, which means they feed on dead material.
- Fungi play a vital role within ecosystems as decomposers.
- Fungi can be parasites, feeding on living organisms.
- Examples fungi are Rhizopus (bread mould), Mucor and Penicillium (the fungus that produces the antibiotic penicillin).

Kingdom Plantae

- The kingdom Plantae includes a great variety of organisms, which range from tiny mosses to giant trees.
- The main characteristics of all plants include:
    - They have eukaryotic cells.
    - They are multicellular organisms.
    - They contain chlorophyll and carry out photosynthesis.
    - They are predominantly land dwelling.
    - Most have a waxy cuticle that helps to prevent drying out.

- The four most important divisions of the kingdom plantae are:

1. **Bryophyta – the mosses and liverworts**
    - The simplest land plants.
    - They do not have a true root system.
    - They have simple root-like structures called rhizoids.
    - They are non-vascular (do not have xylem and phloem)
2. **Pteridophyta (also known as the Filicinophyta) – the ferns**
    - They have true leaves, stems and roots.
    - Fern stems have rhizomes.
    - Their stems contain vascular tissue.
    - They produce spore-forming bodies.
3. **Gymnospermae (also known as the Coniferophyta) – the conifers**
    - Their seeds are not enclosed in fruits.
    - They have small needle-shaped leaves with a thick waxy cuticle.
    - They are evergreen so they can photosynthesize all year long.
    - The reproductive structures are found in cones.
4. **Angiospermae (Angiospermophyta) – the true flowering plants**
    - They have flowers as reproductive organs.
    - They have their seeds enclosed in a fruit.
    - They have well-developed xylem and phloem tissue.
    - Angiosperms are subdivided into two as monocotyledons and dicotyledons.
    - The main characteristics of the monocotyledons are:
        a. The embryo has a single seed leaf (cotyledon).
        b. The stem contains scattered vascular bundles.
        c. Leaves are generally long and thin with parallel veins.
        d. They are often wind pollinated.
    - The main characteristics of the dicotyledons are:

a. The embryo has two seed leaves (cotyledons).
b. The leaves are often relatively broad and have a network of veins.
c. The stem contains a ring of vascular tissue.
d. They are often insect pollinated.

Kingdom Animalia

- Members of the kingdom Animalia are multicellular and heterotrophic.
  - They exhibit locomotion.
  - Their cells do not have cell walls.
  - They have nervous systems so they are sensitive to their surroundings.
- The main animal phyla are:

1. Porifera – the sponges

- The simplest invertebrates.
- They are hollow filter feeders.
- There is little co-ordination or control.
- They range in size from a few millimetres to two metres.

2. Coelenterata

- Sea anemones, hydra, jelly fish and coral are among the members of this phylum.
- They have soft bodies with a ring of tentacles for capturing prey.
- Coelenterates have two layers of cells in their bodies that surround a central cavity.
- They have only one opening, the mouth, and their bodies have radial symmetry.

3. Platyhelminthes – Flatworms

- The flatworms show a relatively high level of organisation.
- They range from 1 mm to 30 cm in length.
- They have flattened bodies with a mouth but no anus.
- They have no body cavity and rely on diffusion for everything.
- They are hermaphrodites.

- They live in other animals as parasites or are free-living in fresh water.
- Examples of platyhelminthes include Planaria spp, tapeworms and liver flukes like Fasciola hepatica.

4. Phylum Nematoda (nemathelminthes) – roundworms

- The most numerous animals in the world.
- They are found in almost all environments.
- They have narrow, thread-like bodies, which are pointed at both ends and bilaterally symmetrical.
- Their bodies are not segmented and are round in cross-section.
- They don't have a circulatory system but they do have a complete digestive system with both mouth and anus.
- The phylum contains many important parasites, such as Ascaris.

5. Annelida - segmented worms

- They have a body divided into regular segments.
- They have a closed blood circulatory system.
- They are hermaphrodites.
- They have chaetae to help them move.
- They are found in moist soil and water and most are free-living.
    - ➢ They increase the fertility of the soil.
- The common earthworm and the medicinal leech are good examples.

6. Mollusca

- They have a wide range of lifestyles and include the most intelligent of the invertebrate species.
    - ➢ Octopi and squid have well-developed brains.
- They may have shells or be shell-less, live in the sea, or in fresh water or on land.
- The main features of the molluscs include a soft muscular foot with a soft body, which is often protected by the shell.

- Their bodies are divided into head, foot and visceral mass and they are not segmented.
- They breathe through gills.
- Examples include slugs, snails, the marine mussel, octopuses and squids.

7. Echinodermata

- The skin contains many spines.
- They have a mouth, a gut and an anus.
- They are all marine animals, and move around using tube feet.
- The adults have five arms, but the larval stages do not.
- The sea urchins, starfish and brittle stars make up this phylum of invertebrates.

8. Arthropoda

- The arthropods are the most varied animals on the Earth.
- Arthropods are animals with segmented bodies and jointed limbs.
- They have an external exoskeleton made of chitin.
- They have a well-developed nervous system and a complete gut from the mouth to anus.
- They have made use of a wide range of available ecological niches.
- The phylum Arthropoda is divided into class insecta, crustacea, arachnida, diplopoda and chilopoda.

a. Class Insecta

- The insecta live almost everywhere, although most are land-based.
- Insects are the best known of all the arthropods.
- They have head, thorax and abdomen.
- They have three pairs of jointed legs with one or two pairs of wings.
- They have a pair of antennae and one pair of compound eyes.
- Insects include flies, butterflies and moths, beetles, wasps and bees and many other common groups.

b. Class Crustacea

- The crustacea are mainly aquatic.
- They vary in size from very small to quite large.
- The body is made up of two parts – a cephalothorax (head fused with thorax) and abdomen.
- The body is often protected by a tough covering called a carapace.
- They have more than four pairs of jointed legs, two pairs of antennae and simple eyes.
- Crustaceans include Daphnia, crab, prawn, shrimp, barnacle, water flea, lobsters, woodlice and crayfish.

c. Class Chilopoda

- Have long, flattened and brightly coloured bodies
- Have few or less segments and lots of legs
- Have one pair of limbs per segment
- Carnivorous (feed on other animals)
- Have poisonous claws for paralysing their prey
- The centipedes are examples

d. Class Diplopoda

- Cylindrical bodies
- Dull-coloured bodies
- Have more segments than chilopoda
- Have two pairs of limbs per segment
- Herbivorous
- Have claws for biting and chewing plant material
- the millipedes are examples.

e. Class Arachnida

- They are mainly terrestrial although some are aquatic.

- They have two body parts – a cephalothorax (fused head and thorax) and the abdomen – with no antennae.
- They have eight legs in four pairs.
- Arachnids have simple eyes but often up to eight of them.
- Examples of arachnids include spiders, ticks, scorpions and mites.

9. Chordata - fish, amphibian, reptiles, birds and mammals

- Animals in the phylum Chordata have the following three features in common:
  - They have a notochord at some stage of their lifecycle.
  - They have a hollow nerve cord, which is a group of nerves forming a hollow tube. This is located above the notochord.
  - They have gill slits during early stages of development that are later replaced by lungs and gills.
- Vertebrate animals form the largest group of the phylum Chordata.
- Vertebrate animals have a vertebral column/backbone. In addition, they also have the following features:
  - An internal skeleton (endoskeleton) made of bone or cartilage.
  - A closed blood circulatory system consisting of blood vessels.
  - A well-developed nervous system.
  - Two pairs of limbs.
  - Kidneys as excretory organs.

a. Class Pisces

- These are the fishes.
- They are aquatic.
- They have streamlined bodies with scales on their skin.
- They use gills for gaseous exchange and have fins for swimming.
- Fish are ectothermic.
- Fish are important to people the world over as a source of food.

- It is divided into two subclasses: Bony fish (teleosts) and Cartilaginous fish (elasmobranchs).

b. Class Amphibia

- This class includes the frogs, toads, newts and salamanders.
- They spend part of their lives (as larvae or tadpoles) in water and part of it (as adults) on land.
- The first vertebrates to colonise the land.
- They have simple sac-like lungs and smooth, moist skin, which is also used as a respiratory surface.
- Their lifecycle includes metamorphosis.
- Their fertilisation is external and the larval form (tadpole) is aquatic.
- Gills are only present in the larval forms.
- Amphibians are ectothermic.

c. Class Reptilia

- The reptiles are mainly terrestrial animals.
- They have dry skin with scales and their gas exchange takes place exclusively in the lungs.
- They have developed internal fertilisation.
- Reptiles are ectothermic.
- Examples include snakes, crocodiles and lizards.

d. Class Aves - Birds

- Birds have feathers over most of their body, and scales on their legs.
- The forelimbs are adapted as wings.
- Birds have light skeletons, which makes it easier for them to fly.
- The jaws are toothless and are covered by a horny beak.
- Birds reproduce using well-developed eggs with a hard shell.
- They are endothermic.

- Of the main chordate features, only the hollow nerve cord remains in an adult bird.
- Examples include domestic fowl, the wattled ibis (Bostrychia carunculata), white collared pigeon (Columba albitorques) and the Ethiopian eagle owl (Bubo capensis).

e. Class Mammalia

- Mammals produce milk for their young in mammary glands.
- They have a high internal body temperature and regulate their own body temperature.
- Mammals have hair on the skin and external ears.
- Most mammals produce live young.
- The mammals range in size from tiny shrews to elephants and whales.
- They live almost everywhere on the earth.
- Chordate features are only plainly visible in the embryos.

Subdivisions of mammals

- According to the way their young are produced, there are three sub-classes of mammals:
    a. Egg-laying mammals – lay eggs, e.g. duck-billed platypus.
    b. Marsupials – produce immature young e.g. kangaroo, koala bear, opossum.
    c. Higher mammals – produce fully developed young e.g. rats, cows, elephants, cats, monkeys and humans.

Review Questions

Select the correct answer from A to D.

1. Which of these statements is **NOT** a reason why biologists classify the living world?
    A. to simplify their study
    B. to make things sound complicated
    C. to bring order out of chaos or confusion
    D. to try to understand how life originated
2. What is a species defined as?
    A. A group of individuals of the same family living in the same area
    B. One of the highest taxonomic ranks used to classify living organisms
    C. All the populations of different organisms that interact with each other
    D. A group of organisms that can breed successfully and produce fertile offspring
3. Which of the following great biologists developed the system of naming organisms that we use today?
    A. Carl Woese
    B. Carl Linnaeus
    C. Charles Darwin
    D. Ernst Haeckel
4. Which system is used for naming organisms with a two-part name?
    A. Trinomial system
    B. Binomial system
    C. Monomial system
    D. Polynomial system
5. What is the smallest group into which organisms are classified?
    A. Family
    B. Species
    C. Genus
    D. Kingdom
6. *Homo sapiens* is the scientific name of which animal?
    A. honey bee
    B. teff
    C. human being
    D. lion

7. Which of the following is **NOT** one of the five kingdoms used to classify the living world?

   A. Protista
   B. eukaryota
   C. Animalia
   D. Fungi

8. Which kingdom includes bacteria?

   A. Monera
   B. Fungi
   C. Protista
   D. Animalia

9. Which of the following is a characteristic of all members of the kingdom Monera?

   A. has a bony skeleton
   B. does not have an enclosed nucleus
   C. breathes through gills
   D. carries out photosynthesis

10. Which are **NOT** classified in any of the five kingdoms?

   A. Viruses
   B. Humans
   C. Bacteria
   D. Mules

11. Which kingdom serves as the basis for the food supply for many organisms in the sea?

   A. Fungi
   B. Protista
   C. Plantae
   D. Animalia

12. Which kingdom includes organisms that play a vital role as decomposers within ecosystems?

   A. Protista
   B. Plantae
   C. Fungi
   D. Animalia

13. In which of the following plant divisions would you find plants that have no transport tissues and no true roots?

   A. Pteridophyta
   B. Angiospermae
   C. Gymnospermae
   D. Bryophyta

14. To which division of plants do Juniper trees belong?

   A. Bryophyta
   B. Anthophyta
   C. Pteridophyta
   D. Coniferophyta

15. Which of the following statements about Bryophyta is FALSE?

A. They lack a true root system.

B. They are the simplest land plants.

C. They possess rhizoids as root-like structures.

D. They are vascular plants with xylem and phloem.

16. Which of the following statements about ferns is TRUE?

A. Their stems lack vascular tissue.

B. Fern stems do not contain rhizomes.

C. They lack true leaves, stems, and roots.

D. They produce spores for reproduction.

17. Which division of plants has reproductive structures found in cones?

A. Bryophyta

B. Pteridophyta

C. Angiospermae

D. Gymnospermae

18. What type of pollination is common in monocotyledons?

A. Insect pollination

B. Water pollination

C. Wind pollination

D. Bird pollination

19. What is a characteristic of dicotyledons' stem anatomy?

A. Thick waxy cuticle

B. Lack of vascular tissue

C. Ring of vascular tissue

D. Scattered vascular bundles

20. Which division of the kingdom Plantae includes plants with flowers as reproductive organs?

A. Bryophyta

B. Pteridophyta

C. Angiospermae

D. Gymnospermae

21. Which of the following statements about members of the kingdom Animalia is TRUE?

A. They do not exhibit locomotion.

B. They are unicellular and autotrophic.

C. They have nervous systems.

D. Their cells possess cell walls.

22. To which animal phyla do sponges belong?

A. Porifera
C. Coelenterata
B. Nematoda
D. Echinodermata

23. Which phylum includes sea anemones, hydra, jellyfish, and coral?

A. Echinodermata
C. Porifera
B. Coelenterata
D. Mollusca

24. The following statements describe which phylum of animals?

They have narrow, thread-like bodies that are not segmented, pointed at both ends, bilaterally symmetrical and round in cross-section. They have no circulatory system but they do have a complete digestive system with both mouth and anus.

A. Mollusca
C. Annelida
B. Echinodermata
D. Nematoda

25. Which of the following is a common feature shared by tapeworms and liver flukes?

A. Lack distinct body segments
C. Parasitic lifestyle
B. Complete digestive system
D. Have separate sexes

26. Which phylum contains many important parasites, such as Ascaris?

A. Mollusca
C. Annelida
B. Echinodermata
D. Nematoda

27. What phylum includes the most intelligent of the invertebrate species?

A. Mollusca
C. Mammalia
B. Chordata
D. Coelenterata

28. Which of the following classes is **NOT** included in the phylum Arthropoda?

A. Insecta
C. Crustacea
B. Cephalopoda
D. Arachnida

29. How would you classify a recently found creature with scales and gills among vertebrates?

A. Class Pisces
C. Class Amphibia
B. Class Reptilia
D. Class Mammalia

30. Among the animals listed, Which one belongs to a different class of vertebrates?

A. Frog
C. Crocodile
B. Toad
D. Salamander

31. What is a characteristic feature of amphibians' skin?

A. Dry and scaly
C. Moist and smooth
B. Thick and leathery
D. Covered with feathers

32. What type of temperature regulation do reptiles exhibit?

A. Endothermic
C. Ectothermic
B. Mesothermic
D. Homeothermic

33. Which class of the vertebrata has scaly skin on the legs, lays eggs and can regulate its own body temperature?

A. birds
C. fish
B. mammals
D. reptiles

34. Which mammal is an example of an egg-laying mammal?

A. Ostrich
C. Platypus
B. Kangaroo
D. Elephant

35. Which of the following characteristics are typical of the class Mammalia?

A. Lay eggs
C. Have gills for respiration
B. Cold-blooded
D. Possess mammary glands

Glossary

Amphibian: creatures who spend part of their lives in water and part of it on land

Arachnida: spiders

Binomial: having two names

Bryophyte: plant division consisting of mosses and liverworts

Chaetae: bristle-like structures that help segmented worms to move

Chilopoda: centipedes

Chordates: creatures characterised by a notochord, nerve chord and gill slits

Conifers: evergreen plants with needle-shaped leaves whose reproductive structures are found in cones **Angiospermae:** true flowering plants

Crustacean: aquatic creatures with bodies made up of a cephalothorax and abdomen, four pairs of legs, two pairs of antennae and simple eyes

Dichotomous key: a type of key based on making choices between two statements or alternatives

Dicotyledons: flowering plants with two embryonic seed leaves

Dinoflagellates: microscopic single-celled organisms that cause bioluminescence in the sea when they produce a green light

Diplopoda: millipedes

Elasmobranchs: cartilaginous fish

Endothermic: creatures who use heat produced by their own metabolism to regulate their body temperature

Eukaryotic cells: single-celled organisms with a nucleus

Ferns: plants of damp shady places

Gymnospermae: plant division of conifers

Insecta: insects

Liverworts: small, green nonvascular plant growing in wet places

Mammals: creatures who produce milk for their young, have a high internal body temperature and regulate their own body temperature

Marsupials: mammals who produce immature young which are nourished by milk in the mother's pouch

Monocotyledons: any flowering plant having a single cotyledon (leaf) in the seeds

Morphology: appearance of an organism

Mosses: nonvascular plants with a single stem and leaves of only one cell thickness

Mutualists: organisms that live in close association with each other and both benefit from this association

Mycorrhizae: organic association between a fungus and the roots of a plant

Notochord: flexible rod-like structure of cartilage running along the dorsal side of the body

Pentadactyl: having five fingers or toes

Phloem: living transport tissue in plants that transports food around

Prokaryotic cells: single-celled organisms without a separate nucleus

Pteridophyta: plant division consisting of ferns

Reptiles: cold-blooded, usually egg-laying, vertebrates

Rhizoids: simple root-like structure of mosses

Rhizome: root which grows horizontally just below the surface of the soil

Saprotrophs: organisms that feed off dead material

Species: a group of organisms that can breed successfully with one another to produce fertile offspring

Spermatophytes: seed-bearing plants

Taxa: category in classification

Taxonomy: process of classifying living organisms

Teleosts: bony fish

Tube feet: used by echinoderms to move around

Vertebrates: creatures with a vertebral column/ backbone

Wings: forelimbs of birds adapted for flying

Xylem: dead transport tissue in plants, moving water and minerals