7- Phylum Arthropoda

Phylum Arthropoda is one of the largest and most diverse phyla in the animal kingdom, comprising over 80% of all known species. The name "Arthropoda" comes from the Greek words *arthron* (joint) and *podion* (foot), referring to the jointed appendages that are characteristic of this group. Arthropods are found in nearly every habitat on Earth, from the deepest oceans to the highest mountains.

Key Characteristics:

1. **Segmented Bodies**: Arthropods typically have segmented bodies, where each segment may have specialized functions. The body is often divided into three main regions:
    - **Head**: Contains the sensory organs (eyes, antennae) and mouthparts.
    - **Thorax**: Often the region where legs and wings (if present) are attached.
    - **Abdomen**: Usually the region where the digestive and reproductive organs are located.
2. **Exoskeleton**: Arthropods have an external skeleton made of chitin, which provides protection, support, and prevents water loss. This exoskeleton is rigid and must be molted (shed) periodically in a process called **ecdysis** (molting) to allow for growth.
3. **Jointed Appendages**: One of the defining features of arthropods is their jointed appendages, such as legs, antennae, and mouthparts, which allow for complex movements and specialized functions.
4. **Bilateral Symmetry**: Most arthropods exhibit bilateral symmetry, meaning their body can be divided into two mirror-image halves.
5. **Open Circulatory System**: Arthropods have a heart and a hemocoel (body cavity), but blood (hemolymph) is not contained in blood vessels. Instead, it bathes the internal organs directly.
6. **Highly Developed Nervous System**: Arthropods have a well-developed brain and ventral nerve cord, with sensory organs like compound eyes (in many species) and antennae for detecting chemicals, touch, and vibrations.
7. **Respiratory Systems**: Arthropods have various methods of breathing depending on their environment:
    - **Tracheal system** (insects): A network of tubes that transport oxygen directly to tissues.
    - **Gills** (in aquatic arthropods like crustaceans).
    - **Book lungs** (in arachnids like spiders).
8. **Sexual Reproduction**: Most arthropods reproduce sexually, with distinct male and female individuals. Some species, however, can reproduce asexually via parthenogenesis.

Major Subphyla of Arthropoda:

1. **Chelicerata**: Includes spiders, scorpions, ticks, and mites. These arthropods typically have six pairs of appendages: four pairs of walking legs, one pair of chelicerae

(pincer-like mouthparts), and one pair of pedipalps (used for sensory functions or manipulating food).
    - **Examples**: Spiders, scorpions, horseshoe crabs.
2. **Myriapoda**: Includes millipedes and centipedes. These arthropods have many body segments, each with one or two pairs of legs.
    - **Centipedes**: Have one pair of legs per segment and are carnivorous.
    - **Millipedes**: Have two pairs of legs per segment and are herbivorous.
3. **Crustacea**: Includes crabs, lobsters, shrimp, and barnacles. Crustaceans are primarily aquatic and have two pairs of antennae and a hard exoskeleton (often calcareous).
    - **Examples**: Crabs, shrimps, crayfish, barnacles.
4. **Hexapoda**: This is the largest group, comprising insects and their relatives. **Insects** have three body regions (head, thorax, abdomen), three pairs of legs, and often two pairs of wings.
    - **Examples**: Bees, butterflies, beetles, ants, flies, mosquitoes.

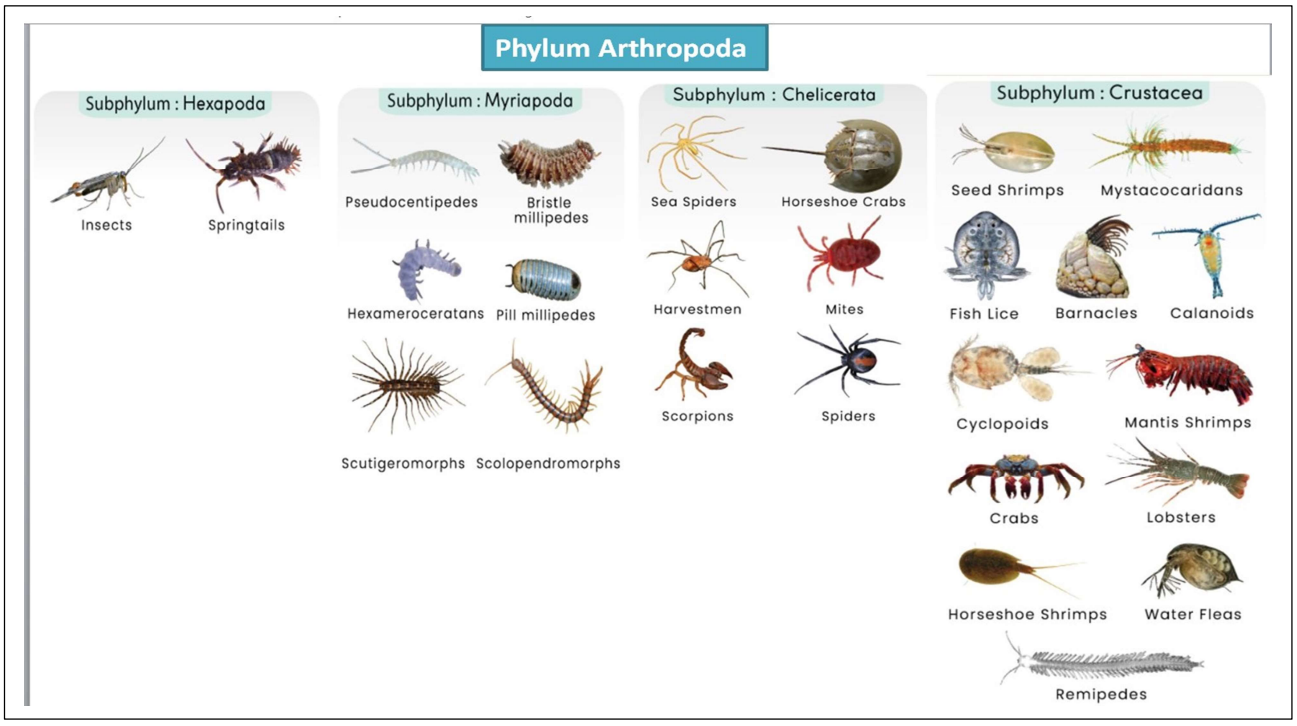

Figure 01: Major Subphyla of Arthropoda

<u>Ecological and Economic Importance:</u>

- **Ecological Roles**: Arthropods play essential roles in ecosystems, such as pollinators (e.g., bees), decomposers (e.g., millipedes), predators (e.g., spiders), and prey (e.g., insects for birds and amphibians).
- **Economic Impact**: Many arthropods have significant economic importance:
    - **Insects** like bees and butterflies are vital for pollination, supporting agriculture and biodiversity.
    - **Crustaceans** such as shrimp, crabs, and lobsters are important in global fisheries.

- **Insects** like silkworms are sources of materials such as silk, and certain species are harvested for food (e.g., locusts in some cultures).

- **Pests and Disease Vectors**: Some arthropods are harmful to humans and animals, acting as vectors for diseases (e.g., mosquitoes transmit malaria, ticks transmit Lyme disease), and agricultural pests (e.g., aphids, locusts, and the Colorado potato beetle).

Adaptations:

- **Flight**: Insects are the only arthropods capable of powered flight, which has enabled them to colonize a wide range of ecological niches.
- **Social Behavior**: Many arthropods (especially insects like ants, bees, and termites) have evolved complex social structures, including division of labor, communication, and cooperative behaviors

8- Phylum Mollusca

Phylum Mollusca is a diverse group of invertebrates that includes more than 85,000 species, ranging from microscopic organisms to large marine giants like the *giant squid*. Mollusks are found in marine, freshwater, and terrestrial habitats, making them one of the most successful and ecologically significant phyla. The name "Mollusca" comes from the Latin word *mollis*, meaning "soft," which refers to their typically soft, unsegmented bodies.

Key Characteristics of Mollusks:

1. **Soft Body**: Most mollusks have a soft, unsegmented body that is often protected by a hard external shell made of calcium carbonate (though some species, like octopuses and slugs, lack a shell).

2. **Mantle**: The mantle is a key feature of mollusks. It's a layer of tissue that covers the internal organs and secretes the shell (if present). In some mollusks, like squid and octopuses, the mantle is involved in locomotion.

3. **Shell**: Most mollusks have a protective external shell, which can be single (as in snails) or multi-chambered (as in nautilus). Some mollusks (like octopuses and slugs) have either reduced or no shell at all.

4. **Muscular Foot**: Mollusks possess a muscular foot, which is typically used for locomotion. In aquatic mollusks, it may be adapted for crawling, swimming, or burrowing, while in some species, the foot is modified for other purposes (e.g., siphon for jet propulsion in squid).

5. **Radula**: Most mollusks (except bivalves) have a radula, a tongue-like organ covered with tiny, chitinous teeth used to scrape food particles off surfaces or to tear food apart. It is especially prominent in snails, slugs, and other gastropods.

6. **Respiratory System**: Mollusks generally have gills (in aquatic species) or lungs (in terrestrial species). The gills are usually located in the mantle cavity and are used to extract oxygen from water.

7. **Open Circulatory System**: Most mollusks have an open circulatory system where the blood (hemolymph) is not enclosed in blood vessels but flows freely in body cavities. However, cephalopods (like squids and octopuses) have a closed circulatory system, which is more efficient for their active lifestyle.

8. **Sexual Reproduction**: Mollusks typically reproduce sexually, with distinct male and female individuals. Many species release their eggs and sperm into the water (external fertilization), while some (like snails) have internal fertilization. Many mollusks have separate sexes, though some, like many gastropods, can be hermaphroditic.

Major Classes of Mollusca:

Mollusca are divided into several classes, each with unique characteristics:

1. **Class Gastropoda**: This is the largest and most diverse class, containing over 60,000 species. Gastropods are primarily characterized by a single, coiled shell (in most species) and a muscular foot. They include snails, slugs, limpets, and whelks.

    - **Examples**: Garden snails, conchs, abalones, sea slugs (nudibranchs), and slugs.

2. **Class Bivalvia**: Bivalves have two hinged shells and a relatively simple body. They are filter feeders, feeding by filtering plankton and other small particles from the water. Bivalves are primarily aquatic, living in both marine and freshwater environments.

    - **Examples**: Clams, oysters, mussels, and scallops.

3. **Class Cephalopoda**: Cephalopods are highly intelligent, fast-moving mollusks with complex eyes, advanced nervous systems, and a well-developed brain. They include the squid, octopus, cuttlefish, and nautilus. Cephalopods have a reduced or absent external shell, and their foot is modified into tentacles or arms used for grasping, movement, and feeding.

    - **Examples**: Octopus, squid, cuttlefish, nautilus.

4. **Class Polyplacophora (Chitons)**: Chitons have a unique shell made up of eight overlapping plates, giving them a segmented appearance. These mollusks are typically found in intertidal zones, where they cling to rocks.

    - **Examples**: Chitons.

5. **Class Scaphopoda (Tusk Shells)**: These are small, marine mollusks with a tubular, tusk-shaped shell. They live buried in sand and use their tentacles to capture small organisms from the surrounding water.

    - **Examples**: Tusk shells (or scaphopods).

6. **Class Monoplacophora**: These are deep-sea mollusks that have a single, cap-like shell. They are considered primitive and were once thought to be extinct until they were rediscovered in the 1950s.

    - **Examples**: Neopilina.

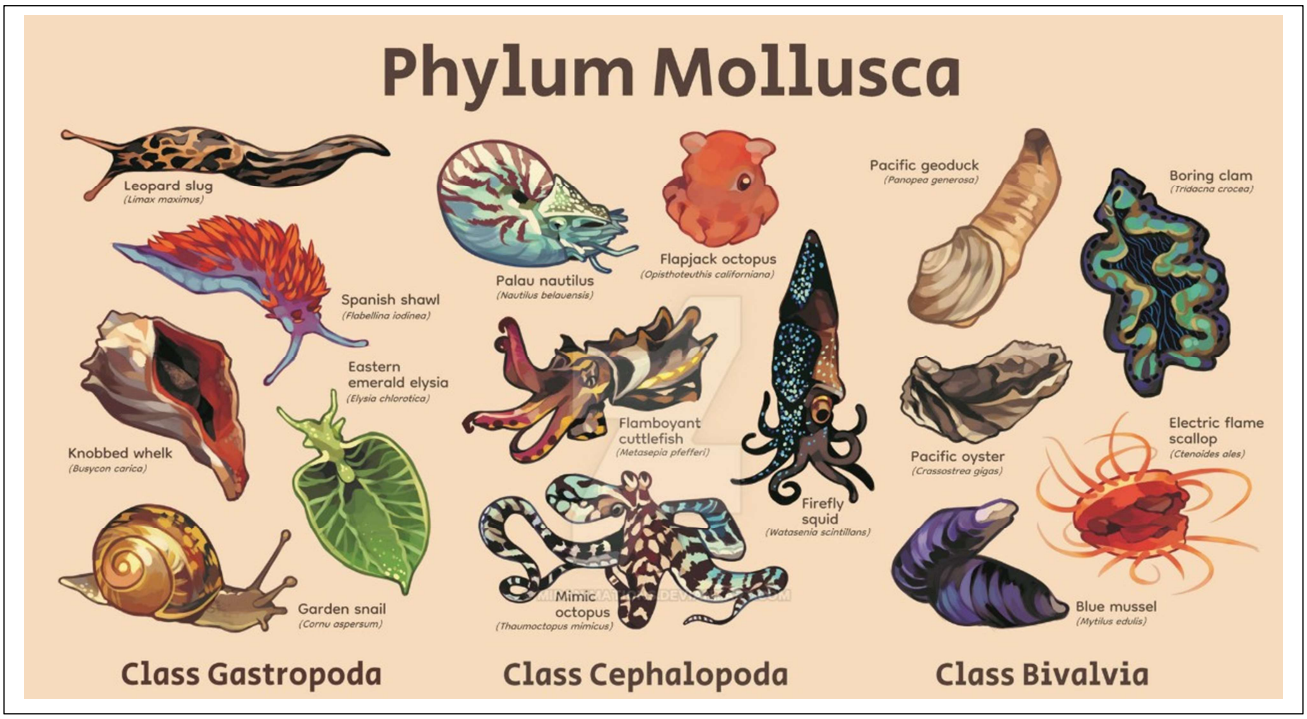

Figure 02: Some species of Mollusca

9- Phylum Echinodermata

Phylum Echinodermata is a group of marine animals that includes species such as starfish (sea stars), sea urchins, sand dollars, sea cucumbers, and brittle stars. They are known for their unique characteristics, such as radial symmetry (in adults), a calcareous exoskeleton, and a water vascular system that aids in movement and feeding. Echinoderms are exclusively marines and can be found in oceans at varying depths, from shallow coastal waters to the deep sea.

Key Characteristics of Echinoderms:

1. **Radial Symmetry**: Echinoderms have a distinctive form of symmetry. While the larvae are bilaterally symmetrical, adult echinoderms exhibit **pentaradial symmetry**, meaning their bodies are arranged in five parts (or multiples of five) around a central axis. This symmetry is most easily seen in starfish, sea urchins, and brittle stars.

2. **Calcareous Endoskeleton**: Echinoderms have an internal skeleton made of calcium carbonate plates, often called **ossicles**, that give them a rigid structure. In some

species, these plates are covered by a layer of soft tissue, while in others; they may form spines or other projections.

3. **Water Vascular System**: One of the defining features of echinoderms is their **water vascular system**, a network of fluid-filled canals and tube feet that helps with locomotion, feeding, and respiration. The tube feet, which are located on the underside of the body, can extend and retract to allow movement or help in gripping surfaces.

4. **Tube Feet**: These are small, flexible, and often sucker-like structures that extend from the water vascular system. Tube feet are used for a variety of functions, such as movement, respiration, and capturing prey (in some species).

5. **No Head**: Echinoderms lack a distinct head, and they do not have a centralized brain. Instead, they have a nerve ring around the mouth and a radial nerve extending into each arm (in starfish), or along the body in sea urchins and other species.

6. **Regeneration**: Many echinoderms can regenerate lost body parts. For example, if a starfish loses an arm, it can regenerate the missing limb. In some species, an entire new individual can grow from a single part of the body.

7. **Complete Digestive System**: Echinoderms have a complete digestive tract, typically with a mouth on the underside and an anus on the top side of the body.

8. **Exclusively Marine**: Echinoderms are entirely marine organisms and are found in all ocean habitats, from shallow intertidal zones to deep ocean floors.

9. **Sexual Reproduction**: Most echinoderms reproduce sexually with separate sexes. They typically release their eggs and sperm into the water for external fertilization, though some species have internal fertilization. In addition to sexual reproduction, many echinoderms can also reproduce asexually by regeneration.

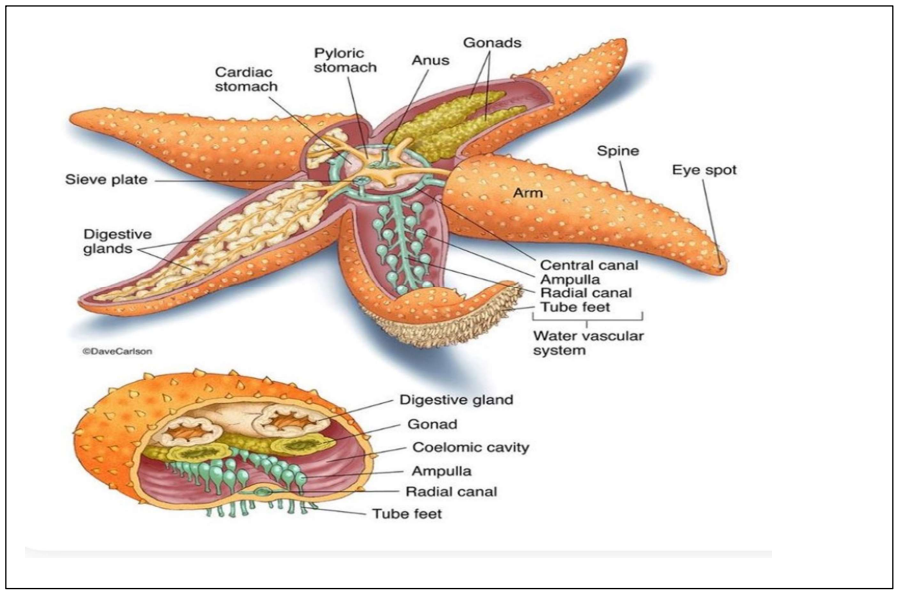

Figure 03: Anatomical structure of a sea star

Major Classes of Echinodermata:

Echinoderms are divided into several classes, each with distinct features:

1. **Class Asteroidea**: This class includes the familiar **starfish** (or sea stars). Starfish typically have a central disc and five (or more) radiating arms. They are often carnivorous and prey on mollusks, such as clams and oysters. They use their tube feet to pry open the shells of their prey and then extend their stomachs out of their bodies to digest the prey externally.
    - **Examples**: Common starfish (*Asterias*), crown-of-thorns starfish (*Acanthaster planci*).
2. **Class Echinoidea**: This class includes **sea urchins**, **sand dollars**, and **sea biscuits**. Members of this class typically have a round or oval body covered by a hard, spiny test (shell). Sea urchins have long, sharp spines that help with defense, and they use tube feet for movement. Many are herbivorous, grazing on algae.
    - **Examples**: Regular sea urchins (*Strongylocentrotus*), sand dollars (*Dendraster*).
3. **Class Holothuroidea**: This class includes the **sea cucumbers**, which have soft, cylindrical bodies that resemble cucumbers. Unlike most echinoderms, sea cucumbers are not radially symmetrical in the traditional sense; they have a bilateral body plan. They are detritivores, feeding on organic material found in the ocean floor sediments. Some species can eject their internal organs as a defense mechanism, a process known as **evisceration**.
    - **Examples**: Sea cucumbers (*Holothuria*), which can be found in shallow waters and deep-sea environments.
4. **Class Ophiuroidea**: This class consists of **brittle stars** and **basket stars**. These echinoderms have long, flexible arms that are distinct from the central disc. Unlike starfish, brittle stars do not have tube feet on their arms for movement. Instead, they use their arms for rapid, snake-like movement. They are typically scavengers or filter feeders.
    - **Examples**: Brittle stars (*Ophiura*), basket stars (*Gorgonocephalus*).
5. **Class Crinoidea**: Crinoids are often called **sea lilies** or **feather stars**. They have a stalk-like base (in some species) and feathery arms used for filter feeding. Crinoids are mostly sessile (fixed in place) but can also be free-moving (in the case of feather stars). They are mostly found in deeper waters but can also be found in shallow waters.

- **Examples**: Sea lilies (*Antedon*), feather stars (*Crinoidea*).

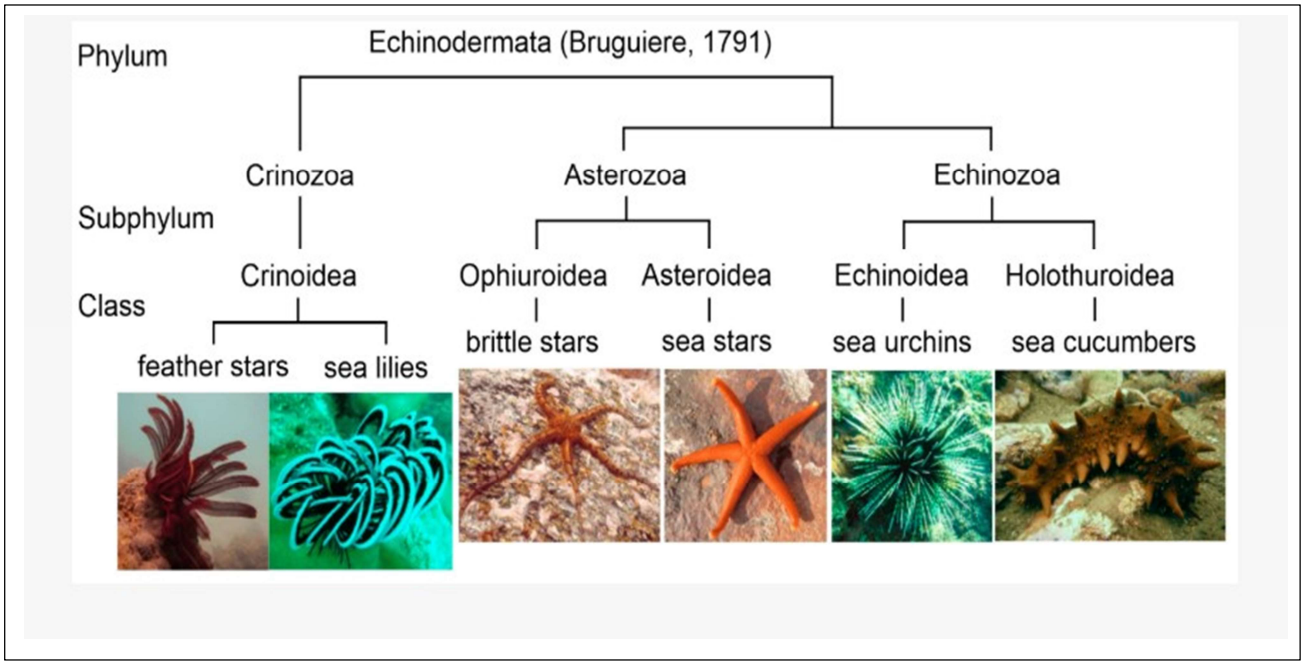

Figure 04: Major Classes of Echinodermata