Arthropods

- Two out of every three known species of animals are arthropods. Members of the phylum Arthropoda are found in nearly all habitats of the biosphere. More than 1 million arthropod species have been described, most of which are insects.
- Arthropods date back to to the Cambrian explosion (535–525 million years ago).

- A variety of organs specialized for gas exchange have evolved in arthropods.
- Most aquatic species have gills with thin, feathery extensions that place an extensive surface area in contact with the surrounding water.
- Terrestrial arthropods generally have internal surfaces specialized for gas exchange. For example; most insects, have tracheal systems; branched air ducts leading into the interior of the body from pores in the cuticle.

Arachnida

- They have 2 main body parts: a cephalothorax and an abdomen. The cephalothorax has 4 pairs of jointed legs; no antennae.
- Gas exchange in spiders occurs in respiratory organs called **book lungs.**
- A **book lung** is a type of respiration organ used for atmospheric gas exchange that is found in many arachnids. These organs are found inside an open abdominal, air-filled cavity and connected with the surroundings through a small opening for the purpose of respiration.

Myriapoda: Centipedes and Millipedes

- Subphylum Myriapoda includes millipedes and centipedes. Myriapods are terrestrial, and have jaw-like **mandibles.**

- **Millipedes** (class Diplopoda), have many segments and **each segment has two pairs of legs**. They feed on plants. Millipedes roll up their bodies when they sense danger approaching predators.

- **Centipedes** (class Chilopoda), **have one pair of legs per trunk segment**. They are carnivores. Centipedes use their legs to run from enemies.

Hexapoda : Insects

- Subphylum Hexapoda, (insects and relatives), has more species than all other forms of the life combined. They live in almost every terrestrial habitat and in fresh water. Insects are very rare in marine habitats.

- An insects body has 3 parts: the head, thorax, and abdomen. The head has one pair of antennae and two compound eyes ~ well- developed sense organs.

- Thorax has **3 pairs of jointed legs** and usually one or two pairs of wings.

Crustacea

Although a few crustaceans are terrestrial, most of them are aquatic (generally marine) and have gills.

Most aquatic crustaceans go through one or more swimming larval stages.

Crustaceans, typically have branched appendages that are special organs used for feeding and locomotion.

Sexes are separate in most crustaceans.

- The anterior-most appendages are antennae; crustaceans are the only arthropods with **2 pairs of antennae**.
- Three or more pairs of appendages are modified as mouthparts, including the hard mandibles.
- Walking legs are present on the thorax, and, unlike, the insects, crustaceans also have appendages on their abdomen.

- Lobsters, crayfishes, crabs, and shrimps are all relatively large crustaceans called decapods. The cuticle of decapods is hardened by calcium carbonate; the portion that covers the dorsal side of the cephalothorax forms a shield called the carapace.
- Most of the decapod species are marine.

Deuterostomia

- Sea stars and other echinoderms, may seem to have little in common with phylum Chordata (which includes the vertebrates). Nevertheless, DNA evidence indicates that echinoderms and chordates are closely related.
- They also share features, characteristic of a deuterostome mode of development
  - Radial cleavage
  - Formation of the mouth at the end of the embryo opposite the blastopore. (anus develops from blastopore)

Echinodermata

- Sea stars and most other **echinoderms** are slow-moving or sessile marine animals.
- Echinoderm skeletons are made up of interlocking calcium carbonate plates and spines. This skeleton is enclosed by the epidermis and is thus an **endoskeleton**.
- In some species, such as sea urchins, the plates fit together tightly. In others, such as starfish, the plates are more loosely bound. Sea cucumbers have a reduced endoskeleton below their skin composed of plates.

Vertebrates

Chordates

- **Chordates** are bilaterian animals that belong to the clade of animals known as Deuterostomia.
- Vertebrates are a subphylum within the phylum Chordata. There are about 52,000 species of vertebrates.
- Two groups of invertebrate deuterostomes, the urochordates and cephalochordates, are more closely related to vertebrates than to other invertebrates.

Derived Characters of Chordates

- Some species have some of these traits only during embryonic development.
- ***Key characters of chordates:***
  - ***Notochord***
  - ***Dorsal, hollow nerve cord***
  - ***Pharyngeal slits or clefts***
  - ***Muscular, post-anal tail***

Notochord

The **notochord** is a longitudinal, flexible rod between the digestive tube and nerve cord.

It provides skeletal support throughout the length of a chordate.

In most vertebrates, a more complex, jointed skeleton develops, and the adult retains only remnants of the embryonic notochord.

Dorsal, Hollow Nerve Cord

- The nerve cord of a chordate embryo, develops from a plate of ectoderm that rolls into a tube dorsal to the notochord.
- The nerve cord develops into the central nervous system: the brain and the spinal cord.

Pharyngeal Slits or Clefts

- In most chordates, grooves in the pharynx called **pharyngeal clefts** develop into slits that open to the outside of the body.
- Functions of **pharyngeal slits**:
  - Suspension-feeding structures in many invertebrate chordates
  - Gas exchange in vertebrates (except the tetrapods)
  - Develop into parts of the ear, head, and neck in tetrapods.

Muscular, Post-Anal Tail

- Chordates have a tail posterior to the anus.
- In many species, the tail is greatly reduced during embryonic development. The tail contains skeletal elements and muscles. It provides propelling force in many aquatic species.

Craniates are chordates that have a head

- The origin of a head, enabled chordates to coordinate more complex movement and feeding behaviors.
- **Craniates** share some characteristics:

- a skull,
- brain,
- eyes, and other sensory organs

Derived Characters of Craniates

- One feature **unique** to craniates is the **neural crest**, a collection of cells near the dorsal margins of the closing neural tube in an embryo.

- **Neural crest cells** give rise to a variety of structures, including some of the bones and cartilage of the skull.

- In aquatic craniates, the pharyngeal clefts evolved into **gill slits**.

- Craniates have a higher metabolism and are more muscular than tunicates and lancelets.

- Craniates have a heart with at least 2 chambers, red blood cells with hemoglobin, and kidneys