Section B: Introduction to the Vertebrates

1. Neural crest, pronounced cephalization, a vertebral column, and a closed circulatory system characterize the subphylum Vertebrata
2. An overview of vertebrate diversity
1. Neural crest, pronounced cephalization, a vertebral column, and a closed circulatory system characterize the subphylum Vertebrata

- The dorsal, hollow nerve cord develops when the edges of an ectodermal plate on the embryo’s surface roll together to form the neural tube.

- In vertebrates, a group of embryonic cells, called the **neural crest**, forms near the dorsal margins of the closing neural tube.
• Neural crest contributes to the formation of certain skeletal elements, such as some of the bones and cartilages of the cranium, and other structures.

• The vertebrate cranium and brain (the enlarged anterior end of the dorsal, hollow nerve cord) and the anterior sensory organs are evidence for a high degree of cephalization, concentration of sensory and neural equipment in the head.
• Organisms that have the neural crest and a cranium are part of the clade **Craniata** which includes the vertebrates and the hagfishes.
  • Hagfishes lack vertebrae but do have a cranium.
• The cranium and vertebral column are parts of the vertebrate axial skeleton.
  • This provides the main support structure for the central trunk of the body and makes large body size and fast movements possible.
  • Also included in the axial skeleton are ribs, which anchor muscles and protect internal organs.
• Most vertebrates also have an appendicular skeleton, supporting two pairs of appendages (fins, legs, or arms).
• The vertebrate endoskeleton is made of bone, cartilage, or some combination of the two materials.
  • Although the skeleton is a nonliving extracellular matrix, living cells within the skeleton secrete and maintain the matrix.
  • The vertebrate endoskeleton can grow continuously, unlike the exoskeleton of arthropods.
• Active movement by vertebrates is supported by ATP generated through aerobic respiration.

• These movements may be to acquire prey or to escape predators.

• Adaptations to the respiratory and circulatory systems support mitochondria in muscle cells and other active tissues.

• These include a closed circulatory system, with a ventral, chambered heart that pumps blood through arteries and capillaries to provide nutrients and oxygen to every tissue in the body.

• The blood is oxygenated as it passes through capillaries in gills or lungs.
• An active lifestyle requires a large supply of organic fuel.

  • Vertebrate adaptations for feeding, digestion, and nutrient absorption help support active behavior.

• These multiple adaptations in form and function to a variety of systems have supported the transition from a relatively sedentary lifestyle in pre-vertebrates to a more active one pursued by most vertebrates.
2. An overview of vertebrate diversity

- Our current understanding of vertebrate phylogeny is based on anatomical, molecular, and fossil evidence.
  - At the base are hagfishes and lampreys which lack hinged jaws.
  - All other vertebrates, the gnathostomes, have true jaws and also two sets of paired appendages.
    - In “fishes,” including the cartilaginous fishes and three classes of bony fish, these paired appendages function in swimming.
    - In tetrapods, the appendages are modified as legs to support movements on land.
• Among tetrapods, most amphibians lay eggs in water or an otherwise moist environment.

• The other terrestrial tetrapods are amniotes, producing shelled, water-retaining eggs which allow these organisms to complete their life cycles entirely on land.

  • While most modern mammals do not lay eggs, they retain many of other key features of the amniotic mode of reproduction.

• The traditional vertebrate group known as “reptiles” (turtles, snakes, lizards, crocodiles, and alligators) does not form a monophyletic group unless birds are included.
Fig. 34.7

Copyright © 2002 Pearson Education, Inc., publishing as Benjamin Cummings