

PAPER: DIVERSITY OF CHORDATES

TOPIC

Some advanced features of vertebrates over protochordates

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Vertebrates exhibit several advanced features over protochordates (such as urochordates and cephalochordates) that allow them to be more complex and adaptive. These include:

1. Vertebral Column & Endoskeleton

- Vertebrates have a well-developed **vertebral column**, replacing the notochord in adults.
- A **cartilaginous or bony endoskeleton** provides structural support, protection, and efficient movement.

2. Advanced Nervous System & Brain

- Presence of neural crest cells in the development of nervous system in vertebrates whereas Absence of neural crest cells in the development of nervous system.
- Vertebrates have a **well-developed brain** protected by a skull (cranium).
- A **dorsal hollow nerve cord** expands into a **tripartite brain (forebrain, midbrain, hindbrain)**, allowing complex functions.
- They possess **specialized sensory organs** (eyes, ears, olfactory receptors) for better environmental perception.

3. Closed Circulatory System with Heart

- A **chambered heart** (2, 3, or 4 chambers) pumps blood efficiently.
- A **closed circulatory system with red blood cells (RBCs)** improves oxygen transport **whereas in Protochordates Heart chamber less. No blood corpuscles in the blood.**

4. More Efficient Respiratory System

- Protochordates rely on simple diffusion or pharyngeal slits for respiration.
- Vertebrates have **specialized gills or lungs**, increasing oxygen intake for high metabolic demands.

5. Advanced Digestive System

- Vertebrates have a **muscularized and compartmentalized digestive system**, with specialized organs like the liver and pancreas.
- Higher vertebrates have **jaws and teeth** (absent in protochordates), improving feeding efficiency.

6. Paired Appendages for Movement

- Vertebrates have **paired fins (in fish) or limbs (in tetrapods)**, allowing efficient locomotion.
- Protochordates lack true paired appendages.

7. Well-Developed Excretory System

- Vertebrates have **kidneys** for osmoregulation and excretion, whereas protochordates rely on diffusion.

8. Advanced Reproductive System

- Vertebrates show **sexual reproduction** with internal or external fertilization.
- Some groups exhibit **direct development** (without a larval stage), while protochordates mostly have indirect development.

9. Endocrine System for Hormonal Regulation

- Vertebrates possess **specialized endocrine glands** (pituitary, thyroid, adrenal, etc.), regulating body functions.
- Endostyle is totally absent in the adult stages of vertebrates, (only found in the ammocoete larval stage of Petromyzon). **In Protochordates**, Endostyle is present except hemichordates. It is the precursor of thyroid gland of high-er vertebrates

10. High Degree of Cephalization

- Vertebrates show an increased **concentration of sensory organs and nervous structures in the head region** for better coordination and response.