# Hemichordata

**Introduction**

Hemichordates (hemi, “half”; chordata, “cord”) are marine invertebrates that occupy a critical evolutionary position within the deuterostome lineage, bridging the gap between echinoderms and chordates. With approximately 130 described species, these animals display a distinctive **trimeric body plan**, divided into the proboscis, collar, and trunk. Hemichordates are split into two main groups: **Enteropneusta (acorn worms)**, which are solitary burrowers, and **Pterobranchia**, which are colonial and live in protective tubes. Their unique anatomical features, such as the **stomochord** and **glomerulus**, make hemichordates essential for understanding the evolution of chordate traits, including gill slits and the dorsal nerve cord.

**Discovery and History**

The discovery of hemichordates dates back to the 19th century when species like Balanoglossus (an acorn worm) were initially classified as chordates due to their notochord-like stomochord. However, further studies revealed that the stomochord is a unique structure unrelated to the chordate notochord, prompting their classification as a separate phylum. Pterobranchs were first described from deep-sea specimens, with their colonial nature sparking comparisons to bryozoans. Research on hemichordates has since shed light on their evolutionary links to echinoderms and chordates, emphasizing their significance in understanding deuterostome evolution.

**Evolutionary Relationships**

Hemichordates belong to the deuterostome superphylum, sharing common ancestry with echinoderms and chordates. Their evolutionary importance lies in their possession of structures like **pharyngeal slits** and a dorsal nerve cord, features also found in chordates. Molecular evidence suggests that hemichordates and echinoderms diverged from a common ancestor, with hemichordates retaining several primitive traits. This phylogenetic position highlights their role as a transitional group, providing insights into the origin of complex animal body plans.

**Morphology and Body Plan**

Hemichordates exhibit a **trimeric body plan**, a hallmark of the phylum, with three distinct regions specialized for different functions:

1. **Proboscis**: A muscular, anterior region used for burrowing, feeding, and sensory functions.
2. **Collar**: Houses the mouth and often contains the beginnings of the nervous system.
3. **Trunk**: Contains the digestive, reproductive, and respiratory systems, with pharyngeal slits for filter feeding and gas exchange.

**Distinguishing Features**

Hemichordates possess several unique anatomical structures that set them apart from other deuterostomes:

**Stomochord**
 The stomochord, a rod-like structure located in the proboscis, was historically thought to be homologous to the notochord of chordates. However, it is now recognized as a hemichordate-specific feature. The stomochord provides structural support to the proboscis and serves as an anchor point for muscles involved in burrowing and feeding.

**Glomerulus**
 The glomerulus is a specialized excretory organ located within the proboscis, adjacent to the stomochord. It consists of a network of blood vessels surrounded by specialized cells that filter waste from the blood. These wastes are excreted through the proboscis pore, making the glomerulus a crucial component of hemichordate osmoregulation and excretion. This organ is unique to hemichordates and reflects their evolutionary innovations in dealing with waste removal in marine environments. The glomerulus’s function and structure are distinct from those of excretory systems found in chordates or echinoderms, underscoring its significance as a defining characteristic of the phylum.

**Pharyngeal Slits**
 Pharyngeal slits, openings in the wall of the pharynx, serve dual functions in hemichordates: filter feeding and gas exchange. These slits are considered evolutionary precursors to the gill structures found in chordates, highlighting hemichordates’ transitional role in deuterostome evolution.

**Diversity and Habitat**

Hemichordates are exclusively marine, found in a wide range of habitats, from shallow intertidal zones to deep-sea environments. Their two main groups exhibit distinct forms and ecological roles:

**Enteropneusta (Acorn Worms)**
 These solitary, burrowing animals are most commonly found in intertidal mudflats and sandy sediments. Acorn worms use their muscular proboscis to ingest organic material and sediments, functioning as deposit feeders. Species like Saccoglossus kowalevskii are particularly well-studied due to their simple anatomy and accessibility.

**Pterobranchia**
 Pterobranchs are colonial animals that live in protective tubes secreted by the organism. They use tentacle-like structures, called lophophores, for filter feeding, capturing plankton and organic particles from the water. Found in deeper waters, pterobranchs form interconnected colonies that highlight the phylum’s ecological diversity.

**Ecology and Interactions**

Hemichordates play important roles in benthic ecosystems. Enteropneusts, through their burrowing and feeding activities, enhance sediment turnover and nutrient cycling, improving habitat quality for other organisms. Pterobranchs contribute to planktonic food webs by filtering organic material from the water column. Hemichordates themselves serve as prey for a variety of marine predators, including fish and crustaceans, and form a vital component of the benthic food web.

**Life Cycle and Reproduction**

Hemichordates exhibit a range of reproductive strategies, including both sexual and asexual reproduction. In most species, sexes are separate, and fertilization occurs externally in the water column. The larvae of enteropneusts, called **tornaria larvae**, are free-swimming and bear a striking resemblance to the bipinnaria larvae of echinoderms, reflecting their evolutionary connection. Pterobranchs, in contrast, reproduce asexually through budding, allowing colonies to expand and thrive in stable environments.

**Conservation and Future Directions**

Although hemichordates face few direct threats, their habitats are vulnerable to sediment pollution, ocean warming, and other anthropogenic disturbances. As key contributors to marine nutrient cycling and sediment health, hemichordates play a crucial role in maintaining benthic ecosystem stability. Their unique anatomy and evolutionary significance also make them invaluable for studying the origins of chordates and the development of complex animal body plans. Future research into their genetics, development, and ecological roles will continue to shed light on this fascinating phylum and its place in the tree of life.

**Closing Remarks**

Hemichordates are a remarkable group of marine invertebrates whose unique trimeric body plan, stomochord, and glomerulus underscore their evolutionary and anatomical distinctiveness. As a key link between echinoderms and chordates, they provide critical insights into deuterostome evolution and the origins of complex animal life. Studying hemichordates enriches our understanding of marine biodiversity and the intricate ecological roles these animals play in ocean ecosystems.

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