# Ctenophora (Comb Jellies)

**Introduction**

Ctenophora (ktenos, “comb”; phoros, “bearing”) is a phylum of marine invertebrates commonly known as **comb jellies**. With approximately 200 described species, these gelatinous animals inhabit oceans worldwide, ranging from shallow coastal waters to the deep sea. Known for their striking iridescence and, in many cases, bioluminescence, ctenophores are among the most visually remarkable marine organisms. What truly sets them apart are two unique features: **ctenes**, or comb rows, used for locomotion, and **colloblasts**, specialized adhesive cells for prey capture. These defining traits distinguish Ctenophora from all other animal phyla.

**Discovery and History**

Comb jellies have been recognized since the 18th century, initially grouped with cnidarians due to their gelatinous bodies. However, it became clear in the 19th century that ctenophores lacked the stinging cells (nematocysts) characteristic of cnidarians and instead possessed unique features, such as comb rows and colloblasts. This distinction led to their classification as a separate phylum. In recent years, molecular studies have sparked renewed interest in ctenophore evolution, with some researchers proposing that they represent the earliest-diverging animal lineage. This controversial hypothesis challenges traditional views on the evolution of multicellularity and nervous systems, making ctenophores a subject of ongoing scientific debate.

**Evolutionary Relationships**

The evolutionary position of Ctenophora within the animal kingdom remains unresolved and is a central topic in phylogenetics. Molecular evidence suggests two competing hypotheses: one posits that ctenophores are the earliest-diverging lineage of animals, predating even sponges, while the other places them closer to cnidarians and other early-diverging metazoans. If the first hypothesis is correct, ctenophores would provide evidence of an independent evolution of nervous and muscular systems, as their decentralized nerve net and contractile muscle fibers are unique among basal animals. Regardless of their precise evolutionary placement, ctenophores are crucial for understanding how animal complexity emerged.

**Morphology and Body Plan**

Ctenophores have a gelatinous body with biradial symmetry and three main tissue layers: the outer epidermis, the inner gastrodermis, and the mesoglea, which provides structural support and buoyancy. While their body plan appears simple, their distinguishing characteristics—**ctenes** and **colloblasts**—highlight the phylum's unique adaptations.

**Ctenes (Comb Rows)**

The comb rows, or **ctenes**, are the defining locomotory structures of ctenophores. These consist of eight longitudinal rows of large, fused cilia that beat in coordinated waves. The beating of the ctenes propels the animal through the water with remarkable efficiency, giving comb jellies their characteristic smooth and gliding motion. Ctenes are also responsible for the shimmering, iridescent appearance of comb jellies, as light refracts off the moving cilia. This iridescence, combined with their bioluminescent capabilities in some species, makes ctenophores among the most visually stunning marine animals. The ctenes are the largest cilia found in the animal kingdom, emphasizing the phylum's evolutionary specialization for locomotion.

**Colloblasts**

Ctenophores use **colloblasts**, unique adhesive cells, to capture prey. These cells are found on the tentacles of most species and function by secreting a sticky substance that traps zooplankton, fish larvae, and other small prey items. Unlike cnidarians, which immobilize their prey with stinging nematocysts, comb jellies rely entirely on the non-toxic adhesive properties of colloblasts. Once prey is ensnared, the tentacles retract, and the food is guided toward the mouth for digestion. In species without tentacles, such as those in the nuda group, the body surface is used to engulf prey directly. Colloblasts are unique to ctenophores and a key innovation that underscores their distinctive approach to feeding.

**Habitat**

Ctenophores are found in marine environments across the globe, ranging from warm tropical waters to the icy polar seas and from shallow coastal zones to the deep ocean. Their adaptability to diverse habitats highlights their ecological versatility. Tentaculate species are common in surface waters, where they prey on abundant plankton, while species lacking tentacles, such as Beroe ovata, often inhabit deeper waters. Invasive species like Mnemiopsis leidyi have demonstrated the phylum’s ecological impact, particularly in regions such as the Black Sea, where their rapid reproduction and voracious feeding have destabilized native ecosystems by outcompeting local predators. Despite their delicate appearance, comb jellies are highly resilient and capable of thriving in a wide range of marine conditions.

**Diversity**

Despite their gelatinous simplicity, they exhibit remarkable diversity in form, behavior, and feeding strategies, broadly classified into two main groups: **Tentaculata** and **Nuda**.

**Tentaculata**, the larger and more diverse group, includes species equipped with long, retractable tentacles lined with colloblasts. These tentacles are used to capture prey, such as zooplankton, by secreting a sticky adhesive that immobilizes the prey. Once ensnared, the tentacles retract, and the captured prey is guided toward the mouth for ingestion. Species in this group, such as Pleurobrachia pileus (commonly called sea gooseberries), are often found in surface waters, where plankton is abundant. Their tentacles can be extended several times their body length, making them highly efficient predators in plankton-rich environments.

**Nuda**, on the other hand, lack tentacles entirely. Instead, they rely on their large, muscular oral lobes to engulf prey directly. This group includes species like Beroe ovata, which are specialized predators that feed primarily on other ctenophores. The absence of tentacles in Nuda has led to adaptations in their body structure, such as a highly expandable mouth capable of swallowing prey whole. These species are often found in deeper or nutrient-sparse waters, where they occupy a unique ecological niche as gelatinous predators.

Ctenophores’ ability to thrive in a wide range of habitats reflects their ecological flexibility. Tentaculate species are most common in shallow, plankton-rich waters, while nuda species dominate in regions where gelatinous prey like other comb jellies are abundant. Together, these two groups highlight the incredible adaptability of ctenophores, allowing them to play diverse roles in marine ecosystems.

**Ecology and Interactions**

Ctenophores are key predators in marine ecosystems, playing a crucial role in regulating plankton populations. They primarily feed on zooplankton, small crustaceans, and fish larvae, exerting top-down control on lower trophic levels. This predatory behavior can have significant cascading effects on marine food webs, particularly in regions where invasive ctenophores become dominant. Comb jellies themselves are preyed upon by larger gelatinous predators and certain fish species, integrating them into complex trophic interactions. In some cases, ctenophores form symbiotic relationships with algae or bacteria, further influencing nutrient cycling within their environments.

**Life Cycle and Reproduction**

Ctenophores reproduce prolifically, enabling them to rapidly colonize new environments. Most species are hermaphroditic, producing both eggs and sperm. Fertilization occurs externally, with gametes released into the water column. Their development is direct, bypassing a larval stage, with juveniles emerging as small cydippids that closely resemble adults. This efficient reproductive strategy, combined with their rapid growth and high feeding rates, allows ctenophores to dominate marine ecosystems under favorable conditions.

**Conservation and Future Directions**

Although ctenophores thrive in diverse marine habitats, their ecosystems face threats from climate change, pollution, and habitat disruption. Ocean warming and acidification could impact plankton populations, indirectly affecting ctenophore abundance and distribution. Invasive species like Mnemiopsis leidyi demonstrate how ctenophores can disrupt ecosystems, causing declines in native species and affecting fisheries. Despite these challenges, ctenophores remain an important focus for research. Their comb rows and colloblasts represent extraordinary adaptations, with potential applications in understanding biomechanics, adhesive technologies, and bioluminescence.

**Closing Remarks**

Ctenophora is a phylum defined by its elegance and distinctiveness. With their shimmering comb rows and innovative colloblasts, comb jellies exemplify the beauty and adaptability of marine life. Studying their unique traits not only reveals the intricacies of ocean ecosystems but also provides critical insights into the evolutionary pathways that shaped the diversity of animals.

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