TDC first sem major :paper -1

UNIT 4: CTENOPHORA: GENERAL CHARACTERISTIC AND EVOLUTIONARY SIGNIFICANCE

BY

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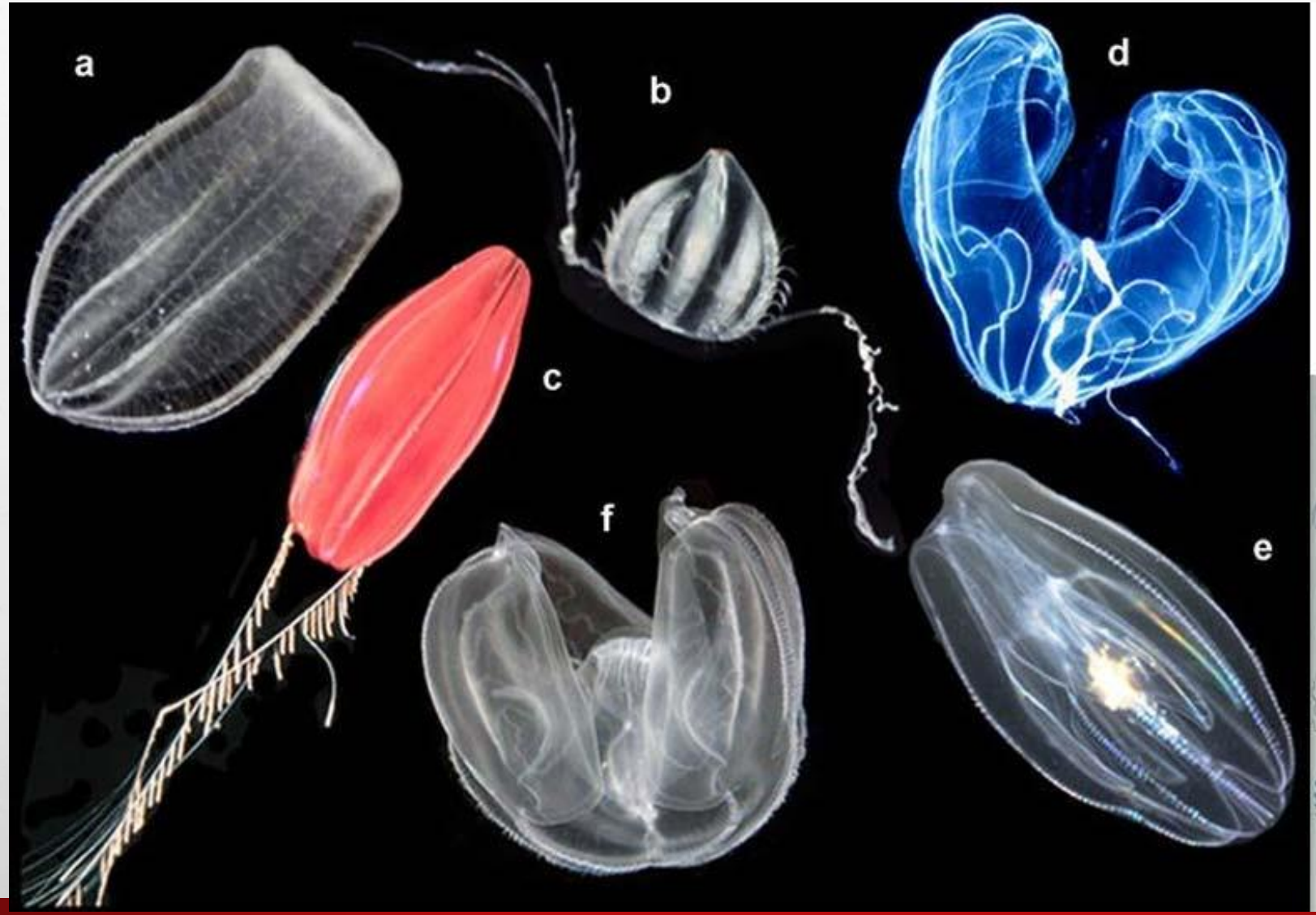


Phylum Ctenophora

Ctenophores are free-swimming, transparent, jelly-like, soft-bodied, marine animals having biradial symmetry, comb-like ciliary plates for locomotion, the lasso cells but nematocytes are wanting. They are also known as sea walnuts or comb jellies

Phylum Ctenophora Characteristics

- They are free-swimming, marine, solitary, pelagic animals. No polymorphism and no attached stages were found.
- The body is transparent, gelatinous, pear-shaped, cylindrical, or flat or ribbon-shaped.
- They have a biradially symmetrical body along an oral-aboral axis.
- They have an external surface with comb-like 8 ciliary plates for locomotion. Hence name as comb jellies

- They have a pair of long, solid, retractile tentacles.
- Their body organization is cell- tissue grade.
- Their body is acoelomate and triploblastic, with the outer epidermis, inner gastrodermis, middle jelly-like mesoglea with scattered cells, and muscle fibers.
- Their digestive system contains the mouth, stomodaeum, complex gastrovascular canals, and 2 aboral anal pores.

- They lack nematocysts.
- They have special adhesive and sensory cell i.e. colloblasts or lasso cells present in tentacles which helps in food captures.
- They lack skeletal, circulatory, respiratory, and excretory organs.
- Their nervous system is diffused types and the aboral end bears a sensory organ, called statocyst.

- They are monoecious (hermaphrodite); gonads are endodermal situated on walls of digestive canals.
- Their development direct with characteristic cydippid larva.
- They lack asexual reproduction and alternation of generation.
- Regeneration and paedogenesis are common in them.

Phylum Ctenophora Classification

Phylum Ctenophora contains about 100 know species and grouped in 2 classes

Class 1. Tentaculata

- **Adults with 2 long aboral tentacles.**
- **In some larva has tentacles, while adults have oral lobes.**
- **Mouth narrow and pharynx small.**

Order 1. Cydippida

- Body simple, round, and oval.
- Digestive canals terminate blindly; no anal pores.
- Tentacles are two long and branched.
- Tentacles are retractile into pouches or sheath.
- Examples: Mertensia , Pleurobrachia , Hormiphora

Order 2. Lobata

- Body oval, laterally compressed.
- Adults with 2 large oral lobes and 4 slender flap-like auricles around the mouth.
- Pouched or sheath tentacles in the larva.
- Tentacles reduced and without sheath in adults.
- Gastrovascular canals are connected by a ring at oral ends.
- Examples: Mnemiopsis, Bolinopsis

Order 3. Cestida

- Body elongated compressed/flat, ribbon-like.
- Two main tentacles in the sheath but reduced.
- Many small lateral tentacles along the oral edge.
- Combs plates in 4 rows but rudimentary.
- Examples: Cestum , covering

Order 4. Platyctenea

- Body greatly compressed/flat in the oral-aboral axis.
- 2 well- developed tentacles with sheath.
- Comb plates reduced in adults.
- Adapted for creeping.
- Examples: Ctenoplana, Coeloplana

Order 5. Thalassocalycida

- They are found surface waters down up to 2,765 Ms in Atlantic oceans and the Mediterranean Sea.
- The body is a bell of Medusa shaped and may be up to 15 cm in diameter.
- Mouth slit holds by a central cone-shaped peduncle.
- A pair of small tentacles hang from the side of the peduncle.
- Com jelly is with its transparent and colorless body. Usually different to see.
- They hold the bell wide opens to captures prey i.e. Zooplankton.
- Presumably hermaphroditic.
- This species has limited swimming ability compared to other comb jellies.
- Examples: Thalassocalyce unstable .

Class 2. Nudu

- Body large, conical, and compressed laterally.
- Without tentacles and oral lobes.
- Wide mouth and large pharynx.
- Voracious feeder.

Order 1. Beroida

- No tentacles and oral lobes.
- Body large, conical, and laterally compressed.
- Mouth large.
- Voluminous Stomach.
- Examples: Beroe

EVOLUTIONARY SIGNIFICANCE OF CTENOPHORA

Despite their fragile, gelatinous bodies, fossils thought to represent ctenophores – apparently with no tentacles but many more comb-rows than modern forms – have been found in Lagerstätten as far back as the early Cambrian, about 515 million years ago. Nevertheless, a recent molecular phylogenetics analysis concludes that the common ancestor originated approximately 350 million years ago ± 88 million years ago, conflicting with previous estimates which suggests it occurred 66 million years ago after the Cretaceous–Paleogene extinction event.

Fossil record

Because of their soft, gelatinous bodies, ctenophores are extremely rare as fossils, and fossils that have been interpreted as ctenophores have been found only in lagerstätten, places where the environment was exceptionally suited to the preservation of soft tissue. Until the mid-1990s only two specimens good enough for analysis were known, both members of the crown group, from the early Devonian (Emsian) period. Three additional putative species were then found in the Burgess Shale and other Canadian rocks of similar age, about 505 million years ago in the mid-Cambrian period

. **All three lacked tentacles but had between 24 and 80 comb rows, far more than the 8 typical of living species. They also appear to have had internal organ-like structures unlike anything found in living ctenophores. One of the fossil species first reported in 1996 had a large mouth, apparently surrounded by a folded edge that may have been muscular. Evidence from China a year later suggests that such ctenophores were widespread in the Cambrian, but perhaps very different from modern species – for example one fossil's comb-rows were mounted on prominent vanes.**

The Ediacaran Eoandromeda could putatively represent a comb jelly. It has eightfold symmetry, with eight spiral arms resembling the comblike rows of a Ctenophore. If it is indeed a Ctenophore, it places the group close to the origin of the Bilateria. The early Cambrian sessile frond-like fossil Stromatoveris, from China's Chengjiang lagerstätte and dated to about 515 million years ago, is very similar to Vendobionta of the preceding Ediacaran period. De-Gan Shu, Simon Conway Morris et al. found on its branches what they considered rows of cilia, used for filter feeding

They suggested that Stromatoveris was an evolutionary "aunt" of ctenophores, and that ctenophores originated from sessile animals whose descendants became swimmers and changed the cilia from a feeding mechanism to a propulsion system.

Other fossils that could support the idea of ctenophores having evolved from sessile forms are Dinomischus and Daihua sanqiong, which also lived on the seafloor, had organic skeletons and cilia-covered tentacles surrounding their mouth, although not all yet agree that these were actually comb jellies

520 million years old Cambrian fossils also from Chengjiang in China show a now wholly extinct class of ctenophore, named "Scleroctenophora", that had a complex internal skeleton with long spines.

The skeleton also supported eight soft-bodied flaps, which could have been used for swimming and possibly feeding. One form, Thaumactena, had a streamlined body resembling that of arrow worms and could have been an agile swimmer

Relationship to other animal groups

The phylogenetic relationship of ctenophores to the rest of Metazoa is very important to our understanding of the early evolution of animals and the origin of multicellularity. It has been the focus of debate for many years.

Ctenophores have been purported to be the sister lineage to the Bilateria,sister to the Cnidaria,sister to Cnidaria, Placozoa, and Bilateria, and sister to all other animals.

A series of studies that looked at the presence and absence of members of gene families and signalling pathways (e.g., homeoboxes, nuclear receptors, the Wnt signaling pathway, and sodium channels) showed evidence congruent with the latter two scenarios, that ctenophores are either sister to Cnidaria, Placozoa, and Bilateria or sister to all other animal phyla

Several more recent studies comparing complete sequenced genomes of ctenophores with other sequenced animal genomes have also supported ctenophores as the sister lineage to all other animals.

This position would suggest that neural and muscle cell types either were lost in major animal lineages (e.g., Porifera and Placozoa) or evolved independently in the ctenophore lineage.

Other researchers have argued that the placement of Ctenophora as sister to all other animals is a statistical anomaly caused by the high rate of evolution in ctenophore genomes, and that Porifera (sponges) is the earliest-diverging animal taxon instead

As such, the Ctenophora appear to be a basal diploblast clade. In agreement with the latter point, the analysis of a very large sequence alignment at the metazoan taxonomic scale (1,719 proteins totalizing ca. 400,000 amino acid positions) showed that ctenophores emerge as the second-earliest branching animal lineage, and sponges are sister-group to all other multicellular animals.

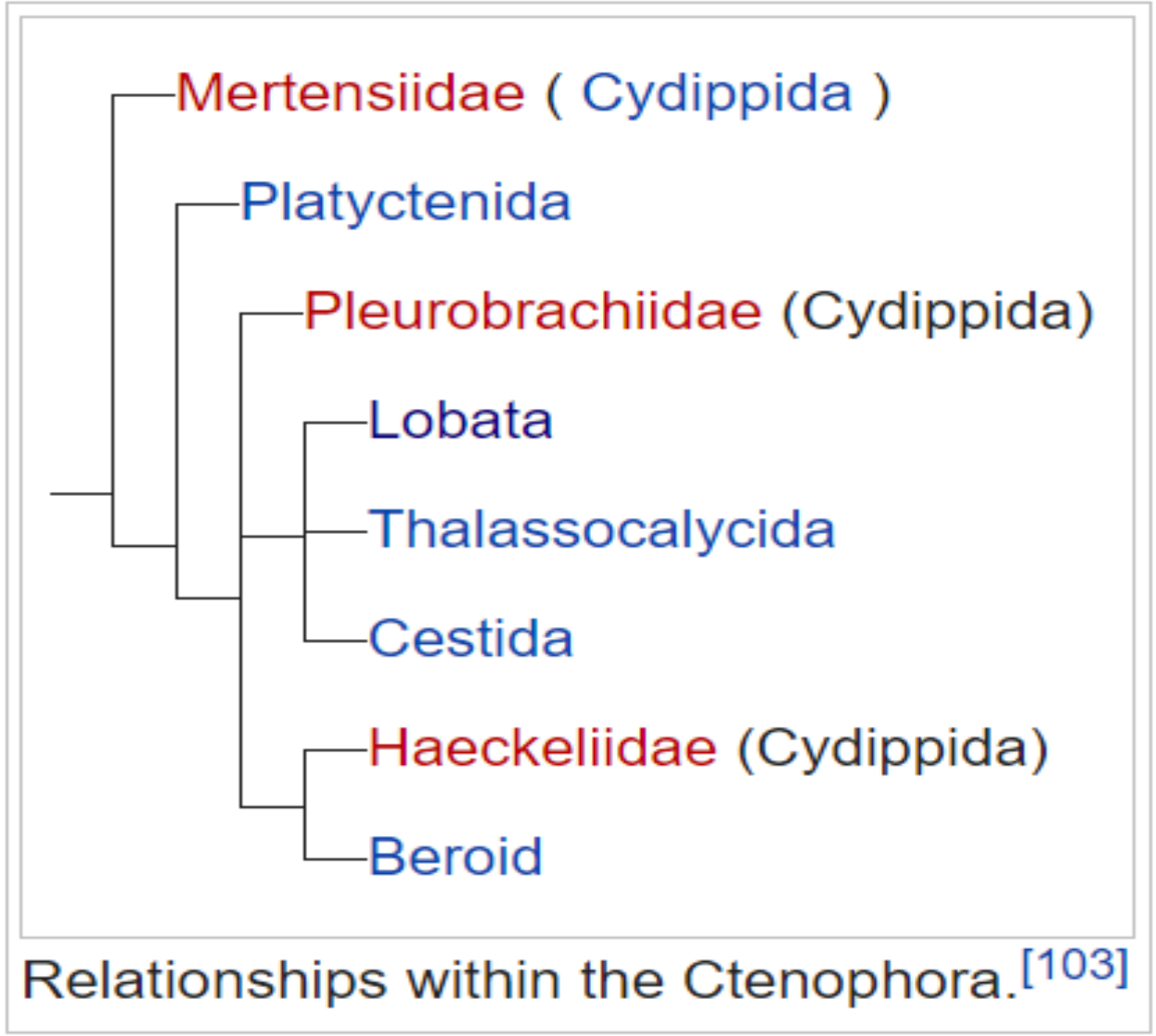
Also, research on mucin genes, which allow an animal to produce mucus, shows that sponges have never had them while all other animals, including comb jellies, appear to share genes with a common origin.

Yet another study strongly rejects the hypothesis that sponges are the sister group to all other extant animals and establishes the placement of Ctenophora as the sister group to all other animals, and disagreement with the last-mentioned paper is explained by methodological problems in analyses in that work.

Neither ctenophores or sponges possess HIF pathways, and are the only known animal phyla that lack any true hox genes (although these are also absent in the larval stage in a few species from other phyla; the nemertean pilidium larva, the larva of the Phoronid species Phoronopsis harmeri and the acorn worm larva Schizocardium californicum, but is activated later in development)

Relationships within Ctenophora

Since all modern ctenophores except the beroids have cydippid-like larvae, it has widely been assumed that their last common ancestor also resembled cydippids, having an egg-shaped body and a pair of retractable tentacles. Richard Harbison's purely morphological analysis in 1985 concluded that the cydippids are not monophyletic, in other words do not contain all and only th



Relationships within the Ctenophora.[103]

descendants of a single common ancestor that was itself a cydippid. Instead he found that various cydippid families were more similar to members of other ctenophore orders than to other cydippids.

He also suggested that the last common ancestor of modern ctenophores was either cydippid-like or beroid-like. A molecular phylogeny analysis in 2001, using 26 species, including 4 recently discovered ones, confirmed that the cydippids are not monophyletic and concluded that the last common ancestor of modern ctenophores was cydippid-like. It also found that the genetic differences between these species were

very small – so small that the relationships between the Lobata, Cestida and Thalassocalycida remained uncertain. This suggests that the last common ancestor of modern ctenophores was relatively recent, and perhaps survived the Cretaceous–Paleogene extinction event 65.5 million years ago while other lineages perished. When the analysis was broadened to include representatives of other phyla,

it concluded that cnidarians are probably more closely related to bilaterians than either group is to ctenophores but that this diagnosis is uncertain. A clade including Mertensia, Charistephane and Euplokamis may be the sister lineage to all other ctenophores.

Divergence times estimated from molecular data indicated approximately how many million years ago (Mya) the major clades diversified: 350 Mya for Cydippida relative to other Ctenophora, and 260 Mya for Platyctenida relative to Beroida and Lobata.

Thank you