

Marine Biodiversity as a Source of Natural Products

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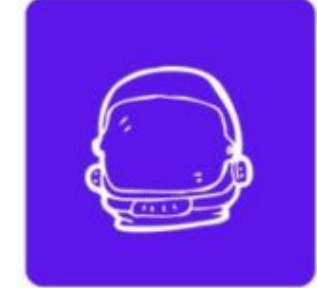
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Introduction



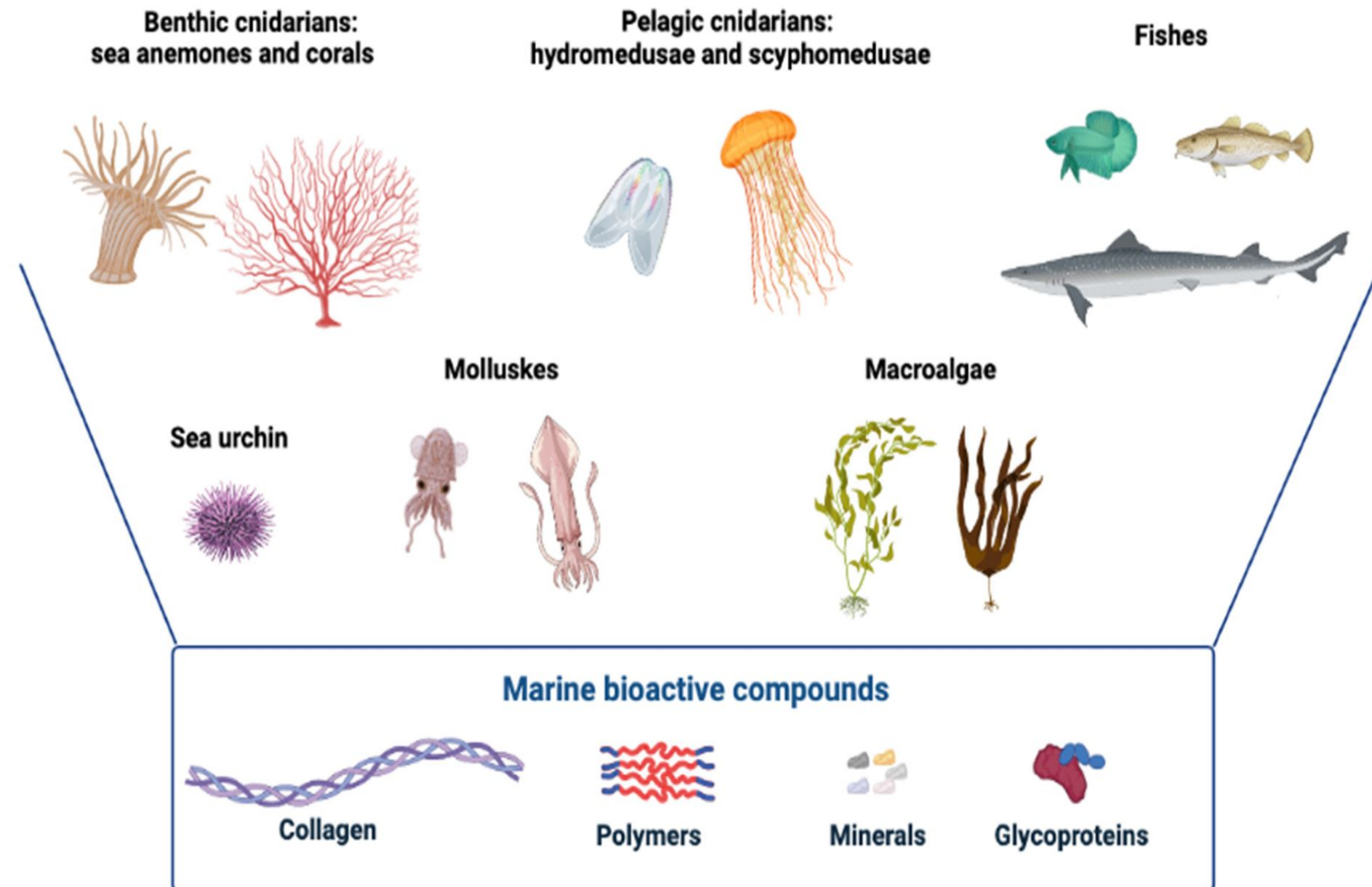
(Source: iodiversity 8th Grade Quiz | Wayground (formerly Quizizz))

Marine biodiversity refers to the variety of life forms found in ocean ecosystems. These organisms are a rich source of bioactive natural products with applications in pharmaceuticals, nutraceuticals, and biotechnology.

(Duarte, 2006)



Why Marine Organisms?



- ❑ Unique chemical structures due to extreme environments
- ❑ Compounds with antimicrobial, anticancer, and anti-inflammatory properties
- ❑ Untapped potential: less than 1% of marine species studied chemically

The Richness of Marine Biodiversity

Key Stats:

- ~240,000 known marine species (millions undiscovered).
- High diversity in coral reefs, deep-sea vents, mangroves.

Why marine organisms?

- Chemical defenses (anti-predator toxins, antimicrobials).
- Adaptations to salinity, pressure, and temperature extremes.

(Duarte, 2006)

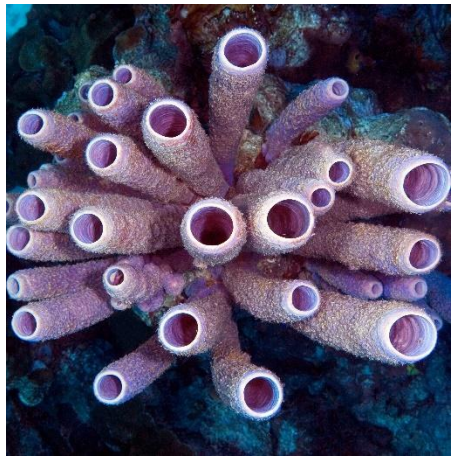


(Source: <https://www.asiaone.com/world/map-worlds-uncharted-ocean-beds-takes-shape-despite-crisis>)



Marine Organisms of Interest

☐ Sponges



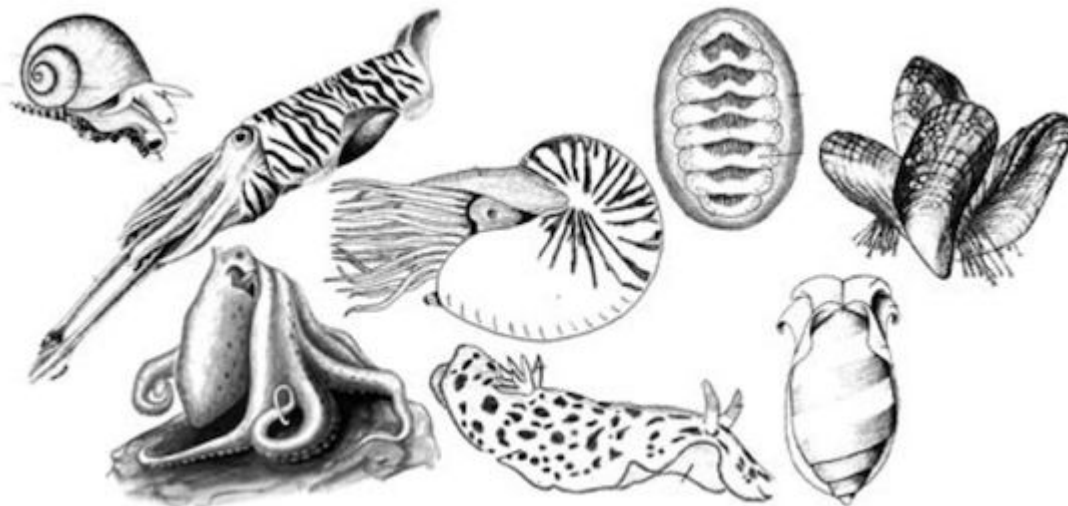
☐ Cyanobacteria



☐ Algae



☐ Tunicates, Mollusks



☐ Marine fungi & actinomycetes



Applications Marine of Natural Products

❑ **Pharmaceuticals:**

Cancer drugs (e.g., Cytarabine, Trabectedin)



❑ **Nutraceuticals:**

Omega-3 fatty acids, antioxidants



❑ **Cosmetics:**

Anti-aging and UV-protective compounds



❑ **Industrial:**

Enzymes for biocatalysis



(Martins *et al.*, 2014; Suleria *et al.*, 2015)

Challenges and Opportunities

- ☐ Sustainable harvesting and biodiversity conservation
- ☐ Need for advanced technologies (metagenomics, synthetic biology)
- ☐ Legal and ethical issues (bioprospecting, benefit-sharing)

(Source: Ethical Bioprospecting Frameworks Future → Scenario)



Biotechnology & Synthetic Biology Solutions

- ❑ **Culturing Marine Microbes** (avoid overharvesting).



- ❑ **Genetic Engineering:** Expressing marine genes in lab strains.



- ❑ **AI & Bioinformatics:** Screening genomes for biosynthetic pathways.



Case Study: Marine Drug Development

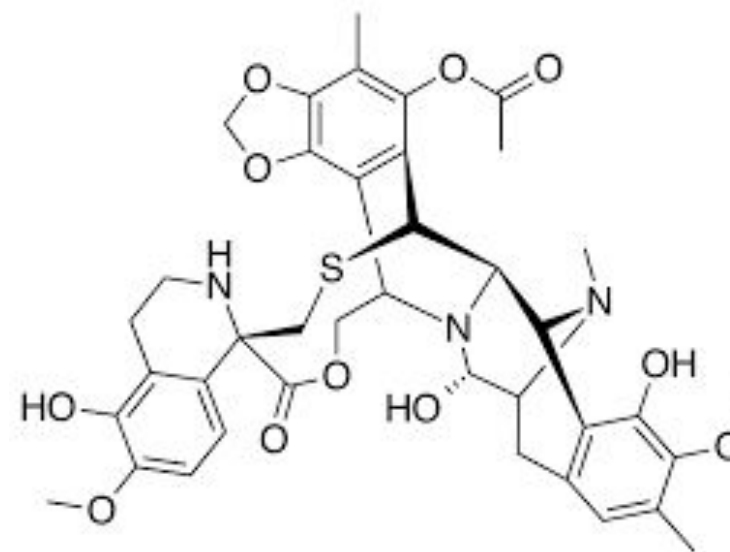
❑ **Trabectedin (Yondelis):**

Derived from sea squirt (*Ecteinascidia turbinata*), approved for soft tissue sarcoma and ovarian cancer.

- ❑ Demonstrates the therapeutic value of marine-derived compounds and the need for marine conservation.



Ecteinascidia turbinata



(Montaser & Luesch, 2011)

Future Directions

- ❑ **Deep-Ocean Exploration:** Hydrothermal vents, uncharted species.
- ❑ **Climate Change Impact:** Loss of biodiversity = lost potential.
- ❑ **Interdisciplinary Collaboration:** Chemists, biologists, policymakers.

(Rogers *et al.*, 2012)



Conclusion

- ❑ Marine ecosystems are a treasure trove of novel natural products.
- ❑ Research and conservation are vital to unlock their full potential for human health and industrial innovation.



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