

Lesson Plan - Life in the Twilight Zone: Adaptations for living at different depths of the ocean

Summary

This lesson will explore how scientists divide the ocean into zones based on physical characteristics (e.g. light, depth, temperature). Light is extremely important to ocean life for a variety of life functions (photosynthesis, predator/ prey interactions, heat). This lesson will explain how and why certain fish (and other organisms) produce light in the deep ocean. This lesson also explains the importance of light (sun/moon) at the surface to plankton and adaptations based on available light.

Content Area

Marine Biology

Grade Level

1-3

Key Concept(s)

- The ocean is divided into zones based on physical characteristics such as sunlight, temperature, and depth.

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Key Concept(s)

- Ocean organisms have different adaptations to live at every depth of the ocean from the surface of warm tropical waters to the deep, dark, frigid ocean depths.
- Light is very important to most ocean organisms for a variety of life functions.
- Plankton (zooplankton and phytoplankton) have adaptations to maintain or move up and down water column based on light levels.
- Some deep-water fish and other organism can synthesize light to assist in life functions.

Objectives

Students will be able to:

- Explain at least three different vertical zones in the ocean and describe the amount of available light and relative temperature in each.
- Understand that there are a variety of deep-water fish that can produce light to assist in different life functions (i.e. communication, attracting prey, escaping predators, mating).

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Objectives

Students will be able to:

- Explain one reason why phytoplankton need to maintain a position in the sunlit zone.
- Explain why zooplankton move up and down in the water column each day and night.

Resources

Smithsonian National Museum of Natural History Ocean Portal: Bioluminescence

<http://ocean.si.edu/bioluminescence>

Marinebio page: Zooplankton

<http://marinebio.org/oceans/zooplankton/index.aspx>

GCOOS Bathymetry page. Access to topographical maps showing the Gulf of Mexico basin (shape and features). Students can visualize how much area of the Gulf of Mexico is very deep water.

<http://gcoos.org/products/topography/Introduction.html>



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National Science Education Standard or Ocean Literacy Essential Principle	Learning Goals
Unifying Concepts and Processes 1. Systems, order, and organization	Types and levels of organization provide useful ways of thinking about the world. The complexity and number of fundamental units change in extended hierarchies of organization. Within these systems, interactions between components occur.
Unifying Concepts and Processes 5. Form and function	Form and function are complementary aspects of objects, organisms, and systems in the natural and designed world. The form or shape of an object or system is frequently related to use, operation, or function. Function frequently relies on form.
Science as inquiry A.1: Abilities necessary to do scientific inquiry	Ask a question about objects, organisms, and events in the environment. This aspect of the standard emphasizes students asking questions that they can answer with scientific knowledge, combined with their own observations.

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National Science Education Standard or Ocean Literacy Essential Principle	Learning Goals
<p>Life Science C.1. Characteristics of organisms</p>	<p>Organisms have basic needs. Organisms can survive only in environments in which their needs can be met. The world has many different environments, and distinct environments support the life of different types of organisms.</p>
<p>Life Science C.1. Characteristics of organisms</p>	<p>Each plant or animal has different structures that serve different functions in growth, survival, and reproduction. For example, humans have distinct body structures for walking, holding, seeing, and talking.</p>
<p>Life Science C.3. Organisms and their environments</p>	<p>An organism's patterns of behavior are related to the nature of that organism's environment, including the kinds and numbers of other organisms present, the availability of food and resources, and the physical characteristics of the environment.</p>

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National Science Education Standard or Ocean Literacy Essential Principle	Learning Goals
<p>Principle 5 (K-2: A., A.4.) Diversity of Life The ocean supports a great diversity of life and ecosystems.</p>	<p>A. There is a great diversity of organisms in the ocean. A.4. Ocean organisms have a variety of different structures and behaviors that help them survive in the ocean.</p>
<p>Principle 5 (K-2: B., B.1., B.2.) Diversity of ecosystems The ocean supports a great diversity of life and ecosystems.</p>	<p>B. The ocean holds a great diversity of unique environments and habitats where organisms live. B.1. There are distinct and unique ocean habitats throughout the ocean and on the coast, off shore, in the deep ocean and at the surface. B.2. Organisms living in different kinds of places in the ocean have different adaptations in structure and behavior, which help them to survive in their habitat (e.g. find and capture prey).</p>

A large, deep-sea fish, possibly a shark or a similar predator, is shown in profile, swimming towards the right. Its mouth is wide open, revealing a glowing, bioluminescent interior. The fish's dorsal fin is also bioluminescent, creating a bright, glowing trail behind it. The background is a dark, deep blue, suggesting the twilight zone of the ocean.

Life in the Twilight Zone

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All living things are



All living things do not live in the same place.

- Scientists sort the ocean into different parts.
- There are different ways to sort the layers of the ocean.

– Amount of sunlight

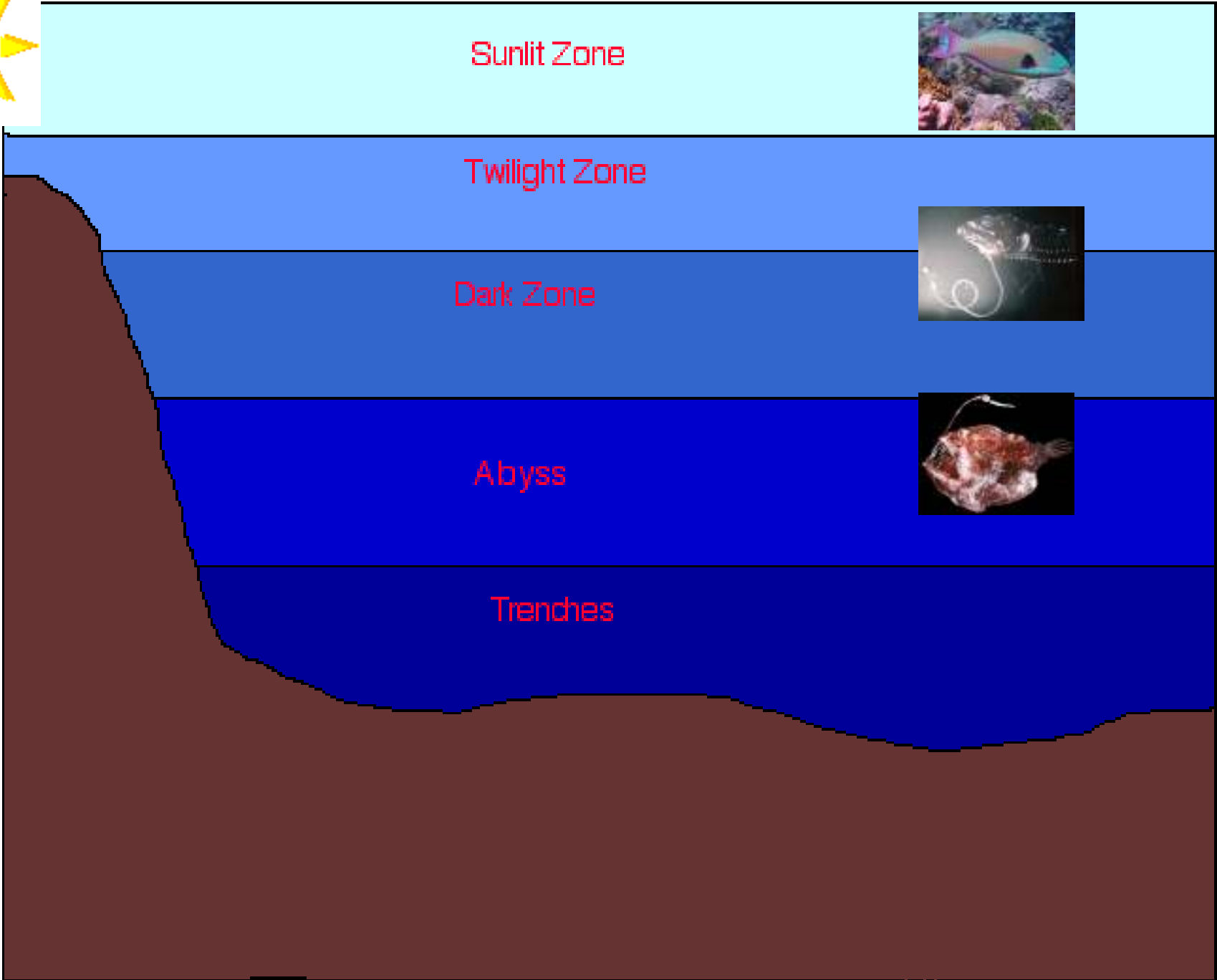


– Water depth



– Water temperature





Sunlit Zone



Twilight Zone



Dark Zone



Abyss

Trenches

80°F

300 FT.



40°F

3000 FT.



35°F

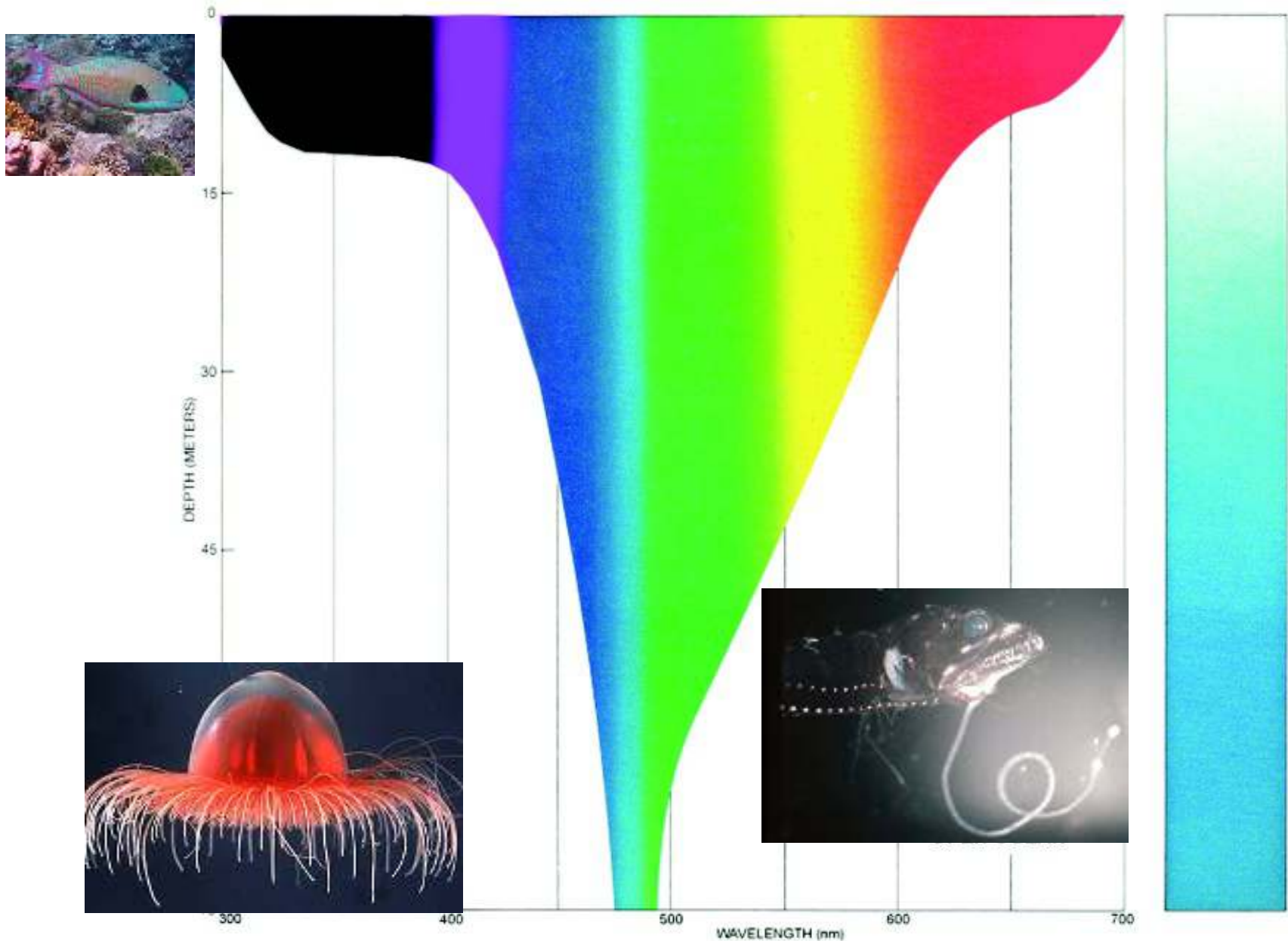
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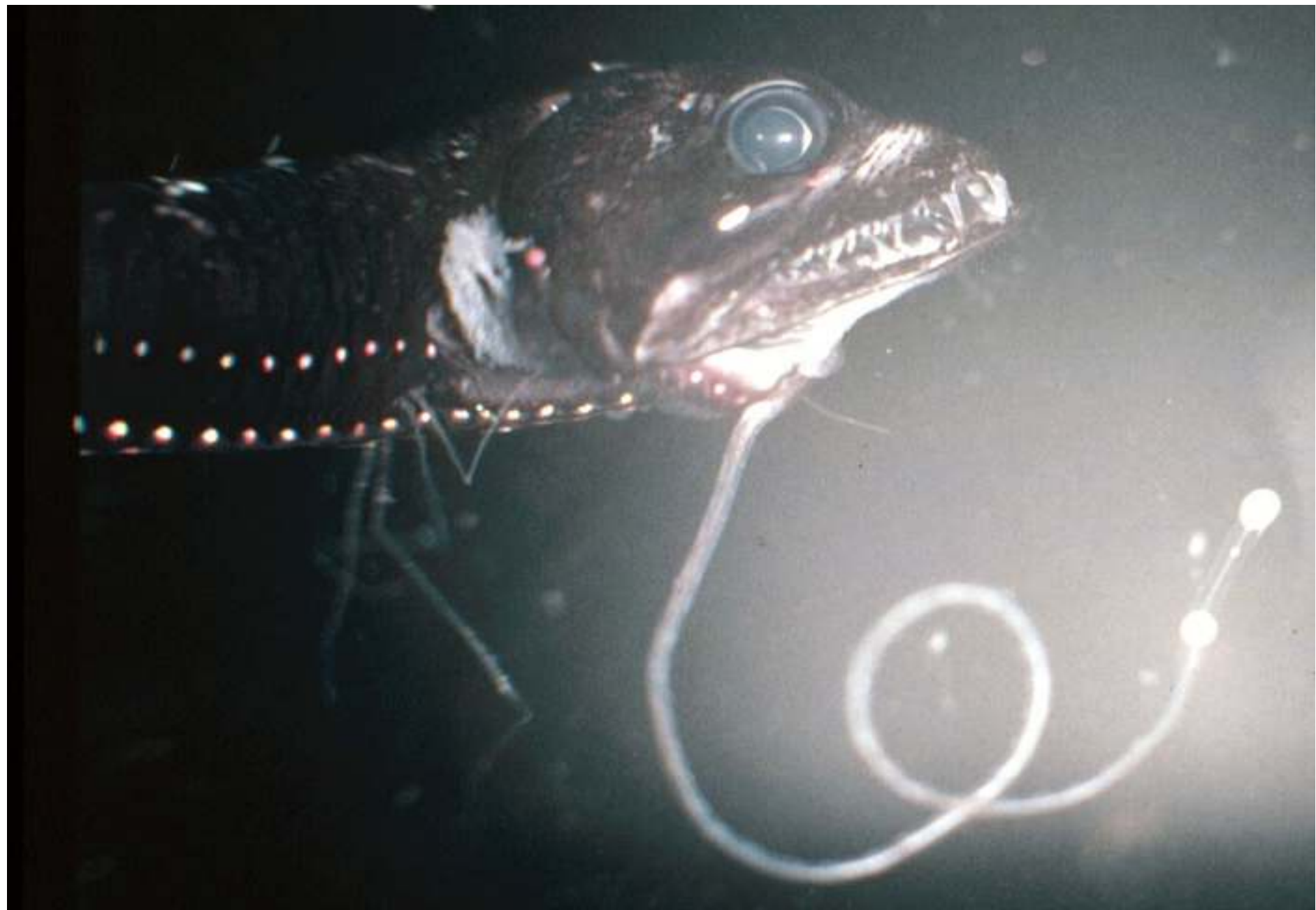
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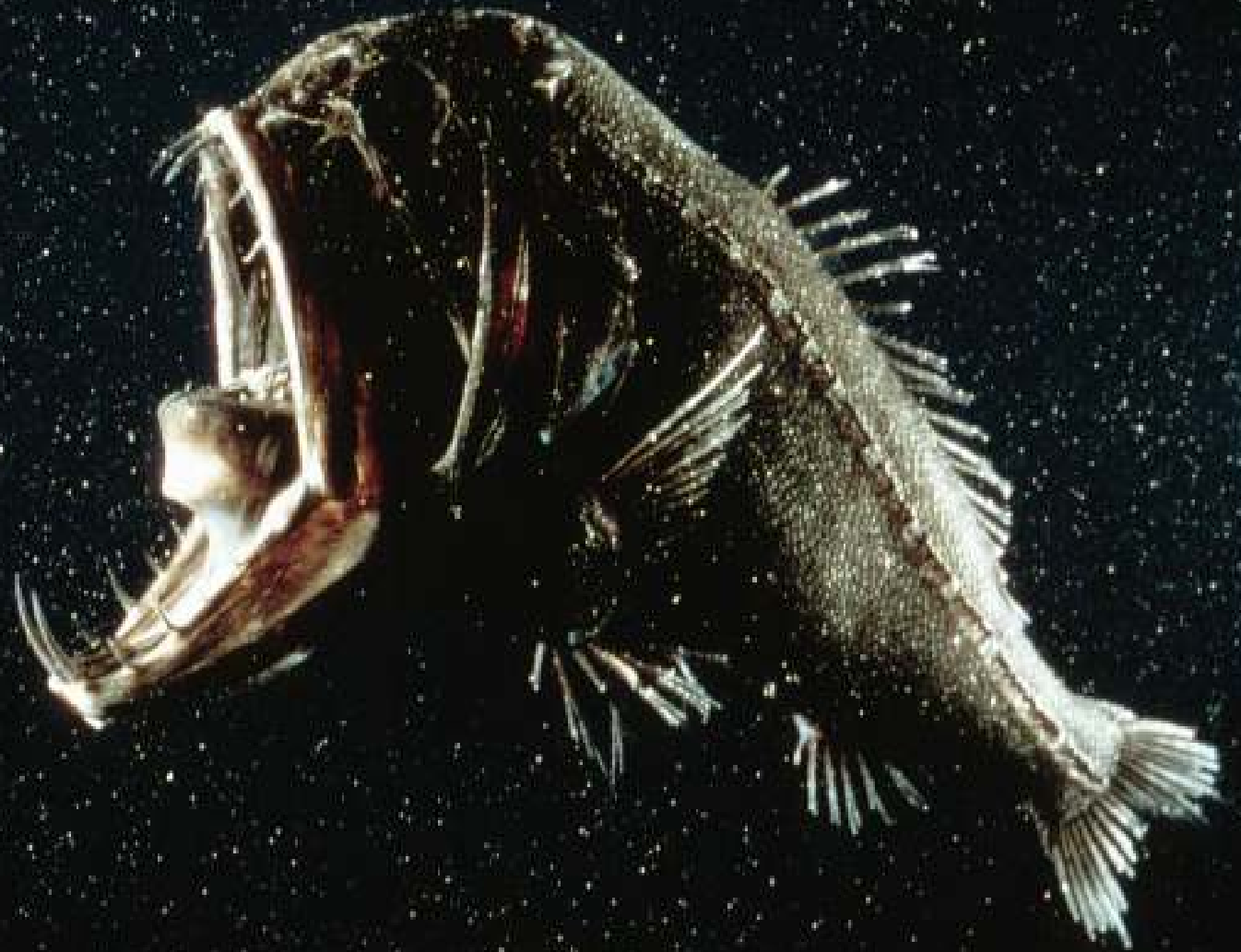
Light and Color in the Ocean

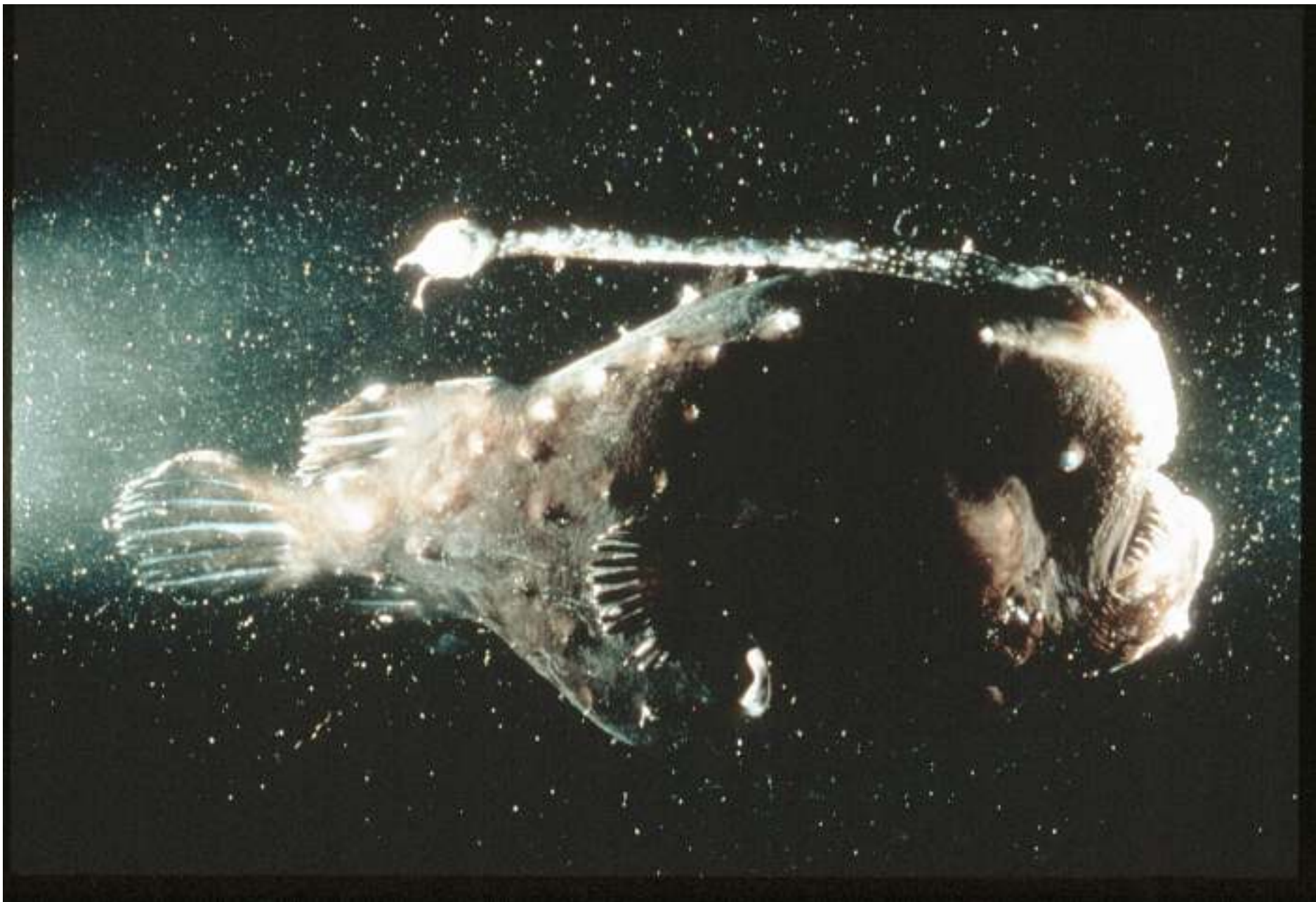


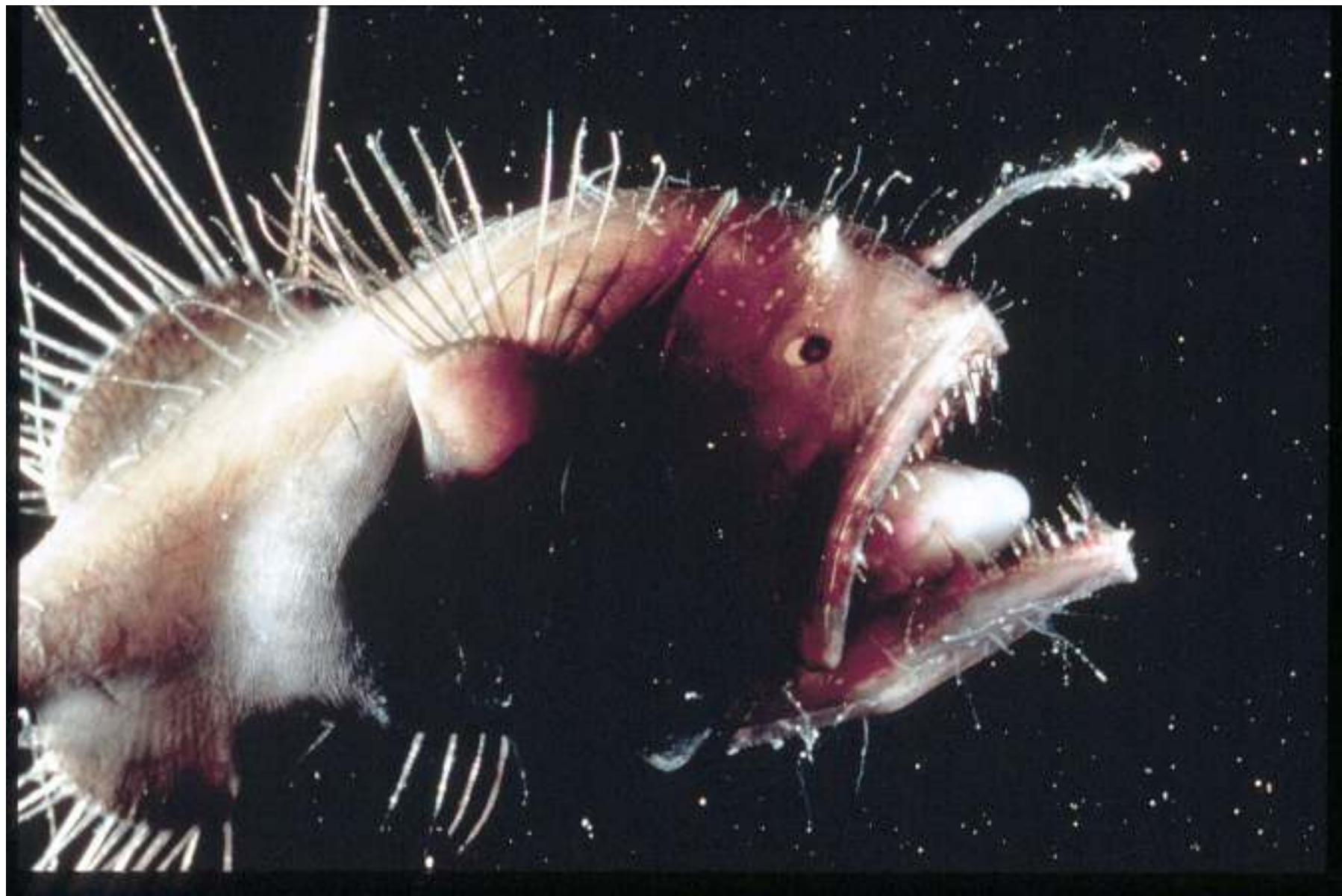






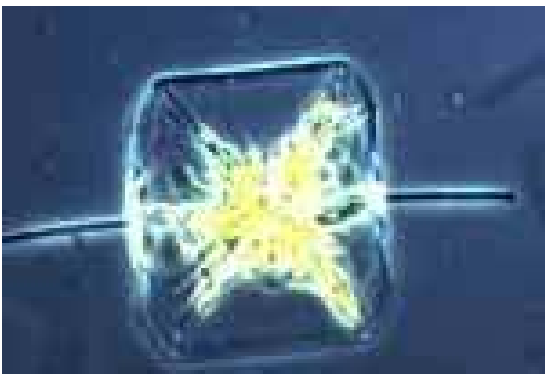




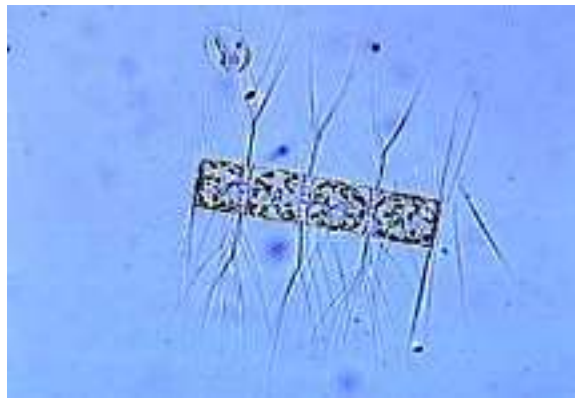




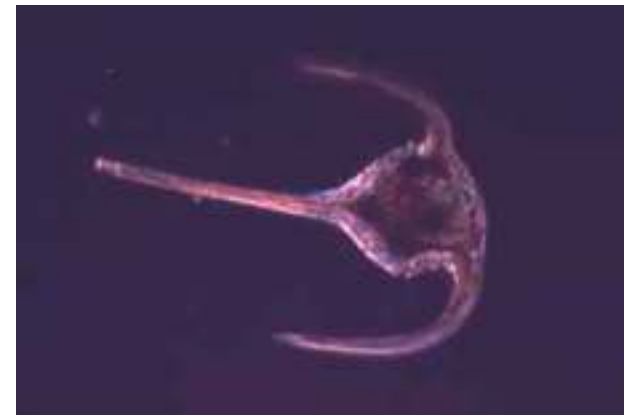




Diatom



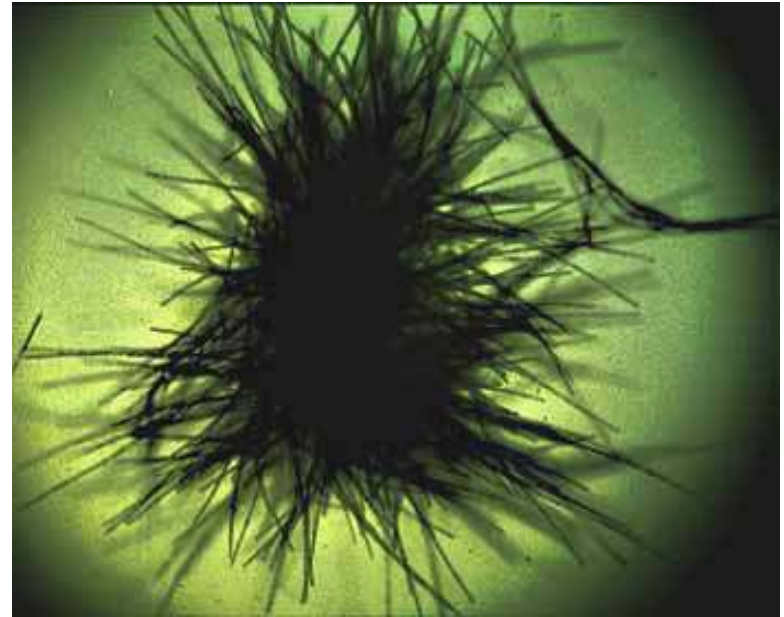
Diatom



Dinoflagellate



Dinoflagellate

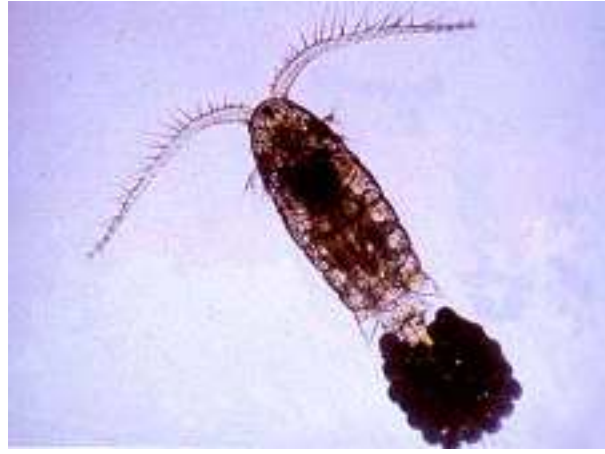


Blue green algae

Phytoplankton: DRIFTING PLANTS



barnacle



Copepod



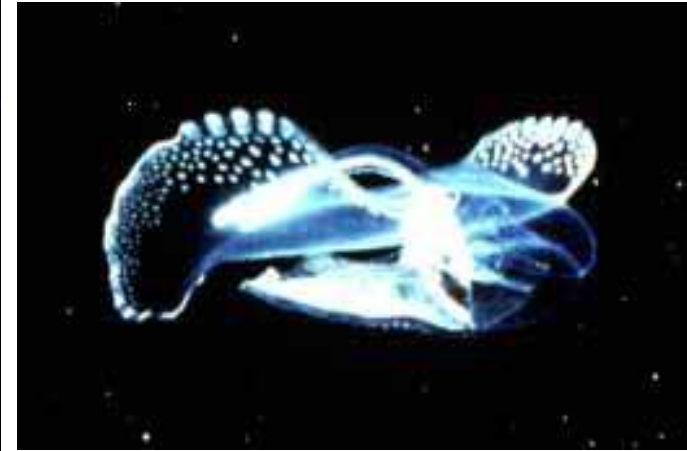
Copepod



Ciliate



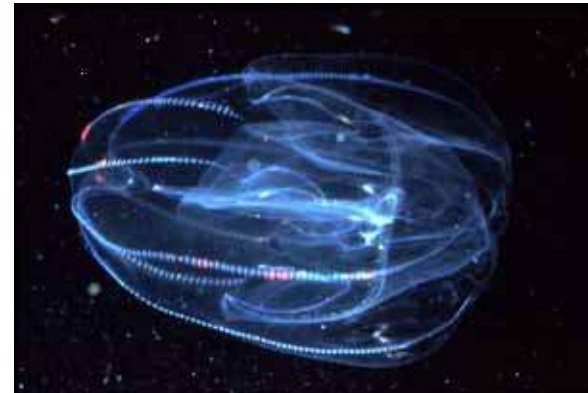
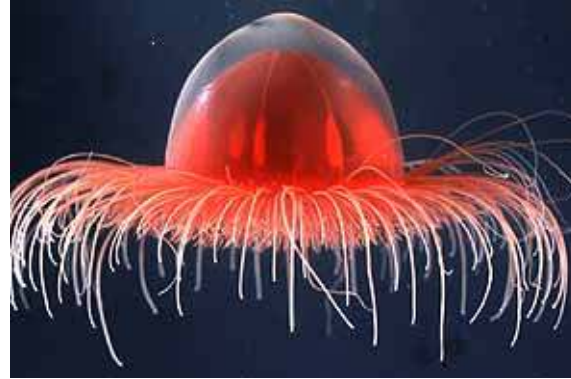
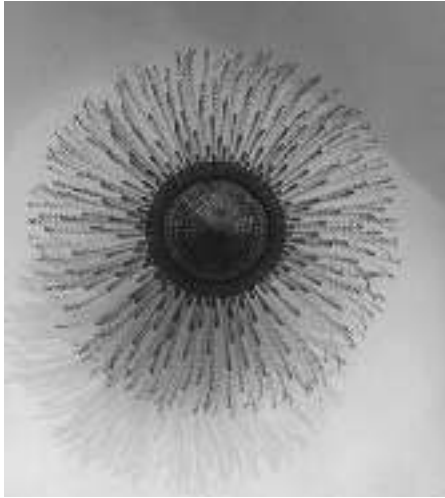
Heteropod



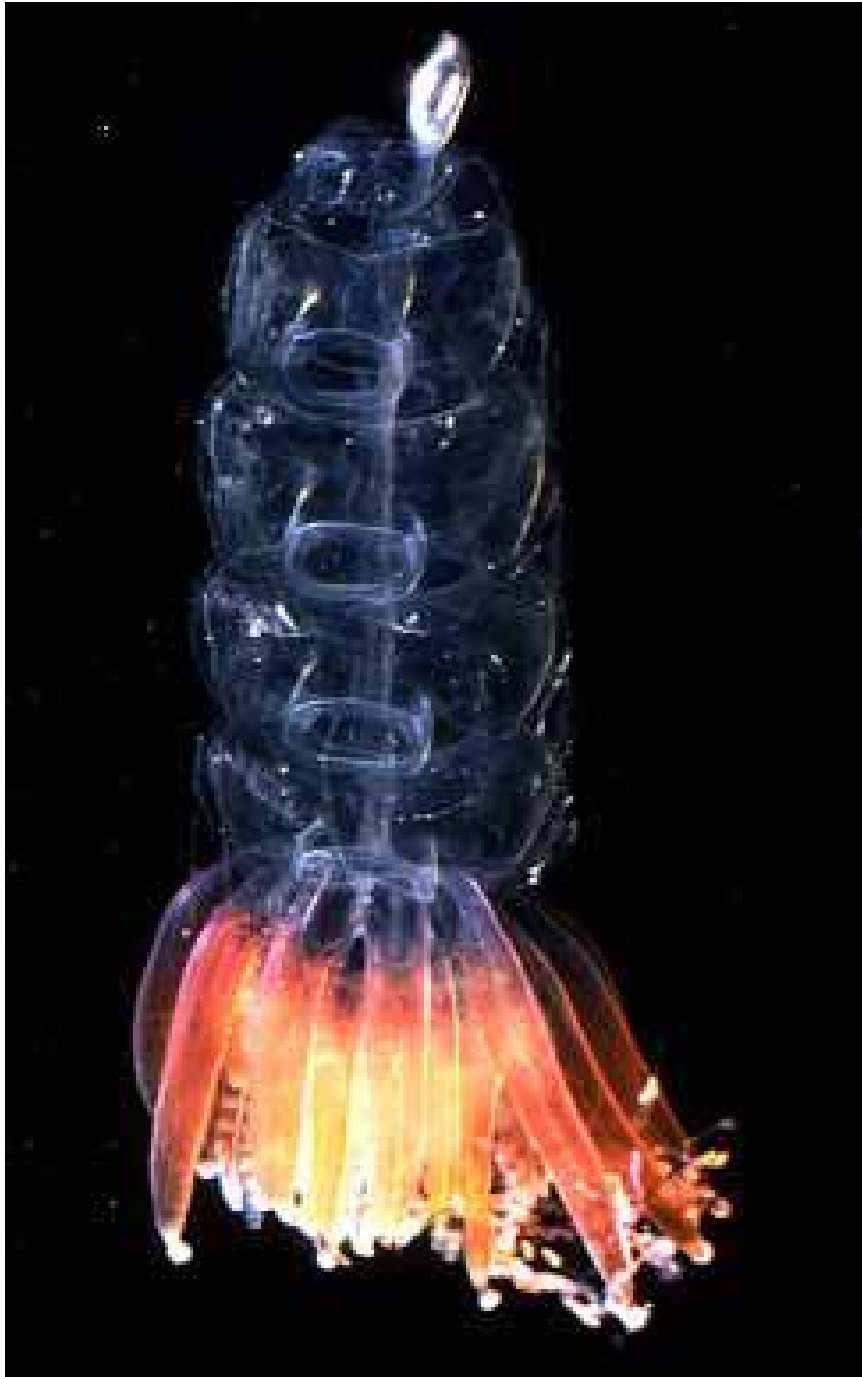
Pteropod

Zooplankton: DRIFTING ANIMALS

Gelatinous Zooplankton...



Have Soft Bodies



DIURNAL VERTICAL MIGRATION



Some fish make their own light!

- A **photophore** is a light-emitting organ.
- It can be simple.
- It can be fancy (shutters, color filters).
- The light can be produced from
 - 1) Digesting certain foods
 - 2) Special cells called photocytes
 - 3) Light-producing bacteria that are grown in the fish (symbiotic)

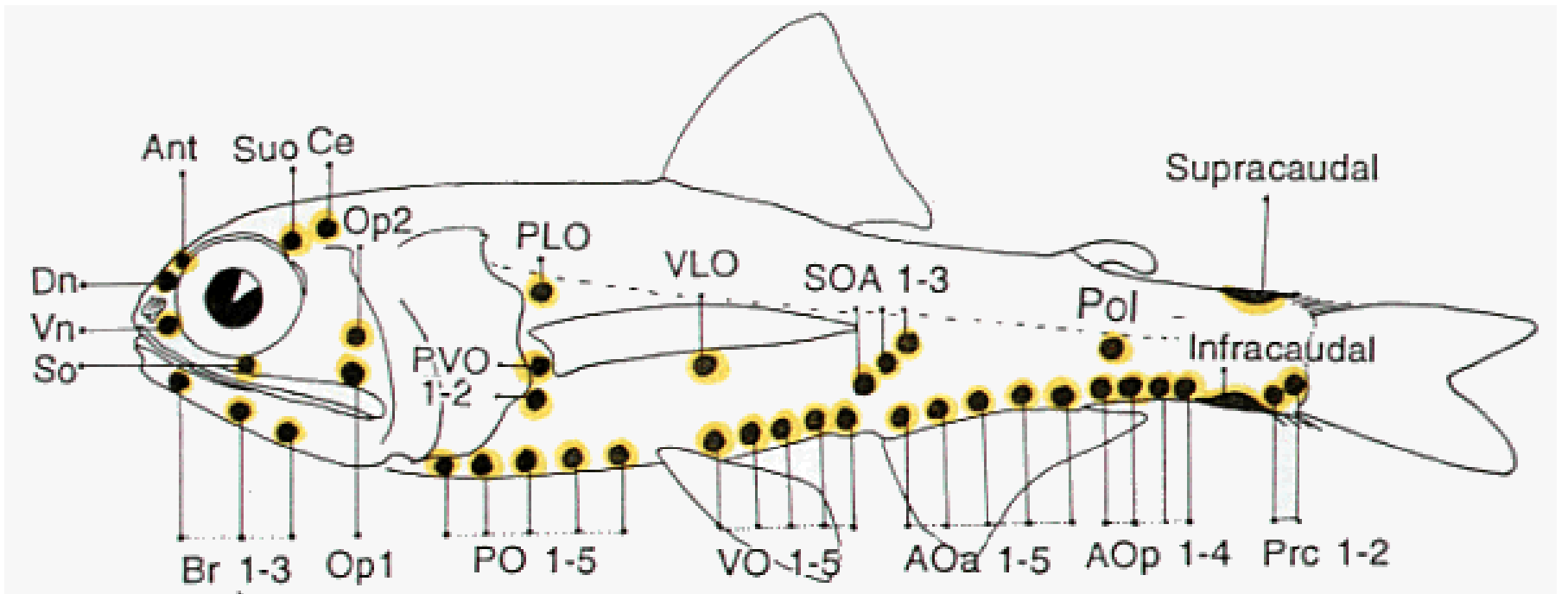


Why bother making light? It takes energy!

- Light producing organs on fish are mainly used to:
 - Attract food
 - Confuse predators

The kind of photophore helps ID fishes.

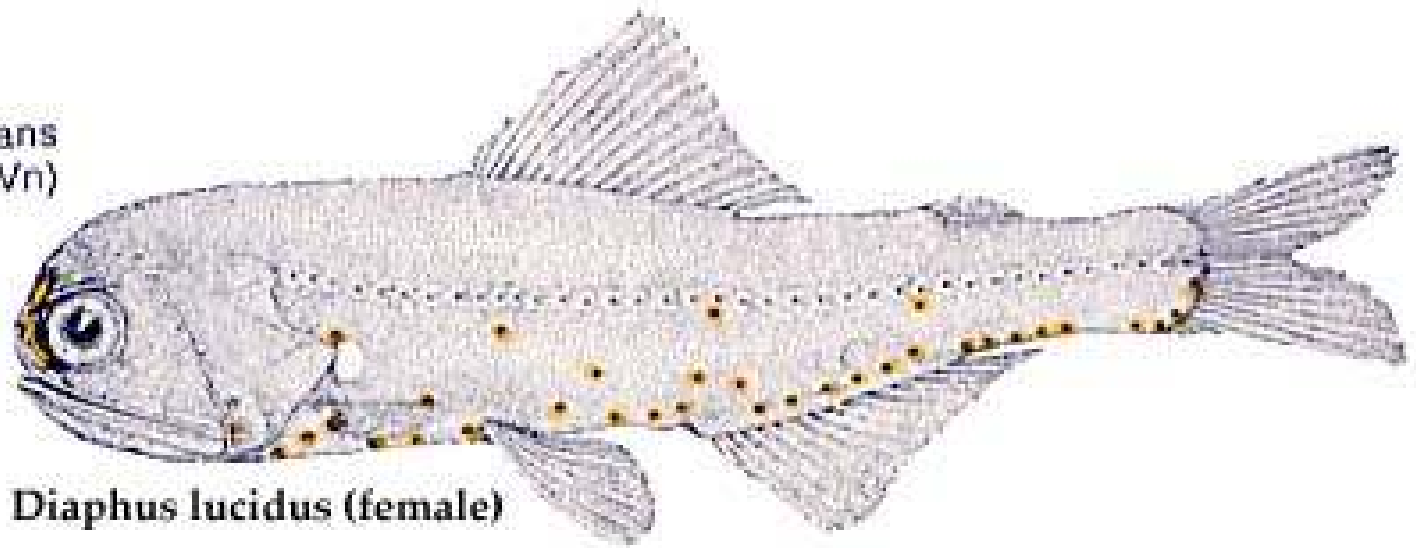




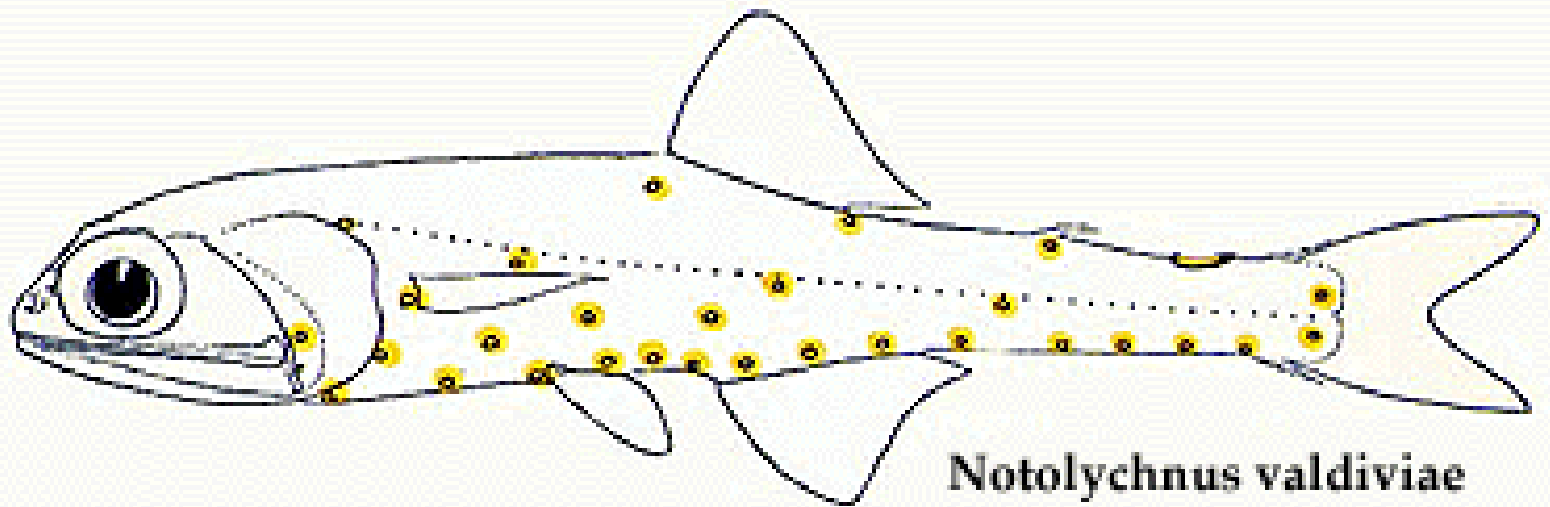
Myctophids (lanternfishes)



headlight organs
(Dn, Vn)

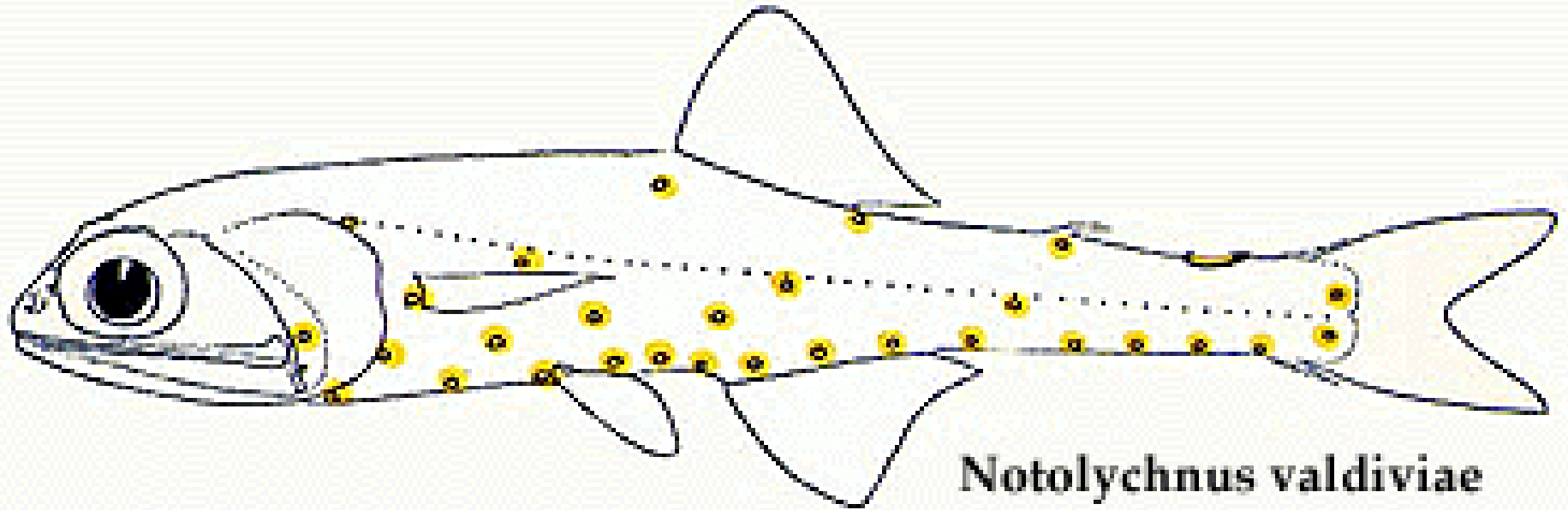


Diaphus lucidus (female)



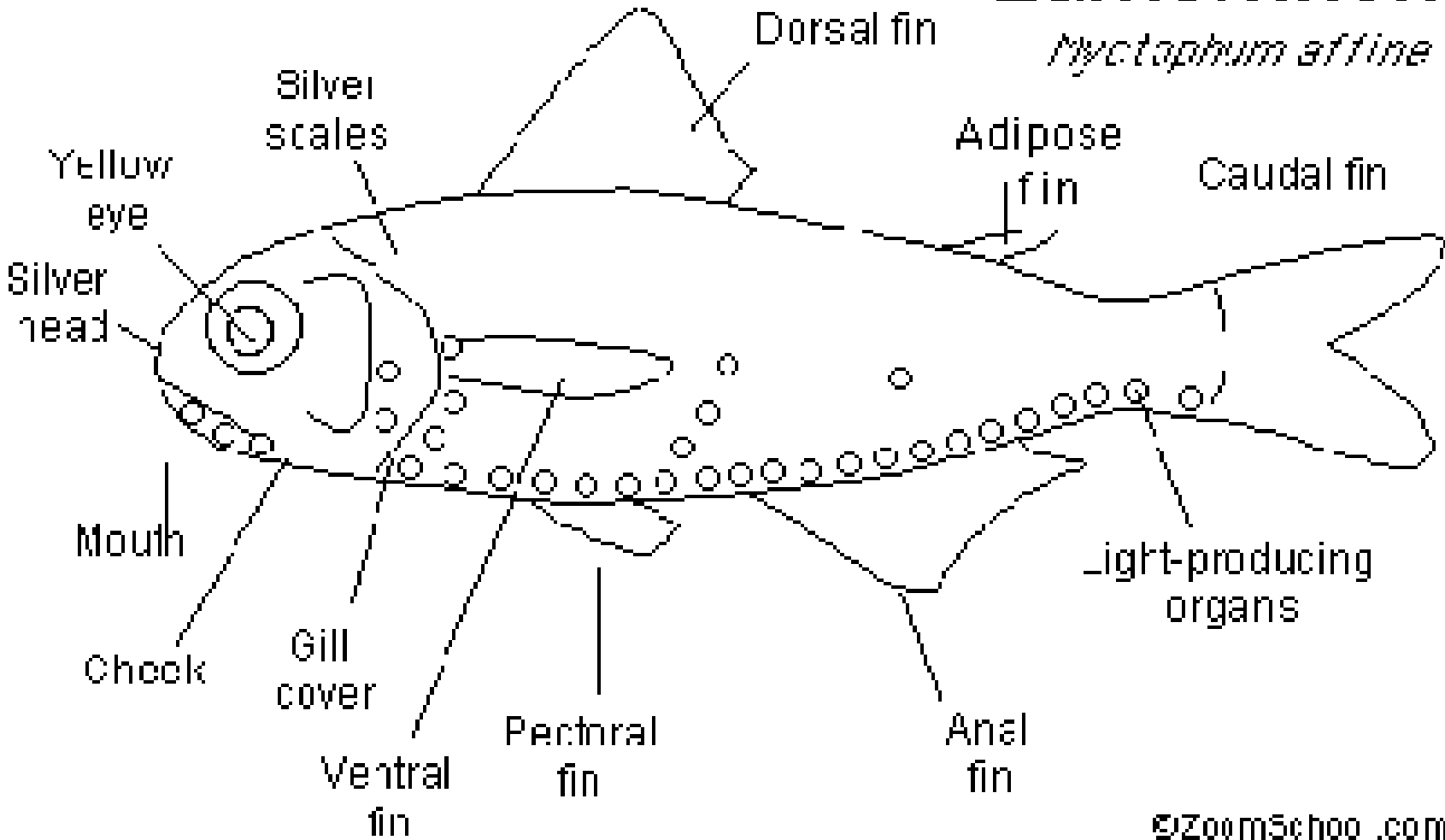
Notolychnus valdiviae

Lanternfish (Myctophid)



Lanternfish

Myctophum affine

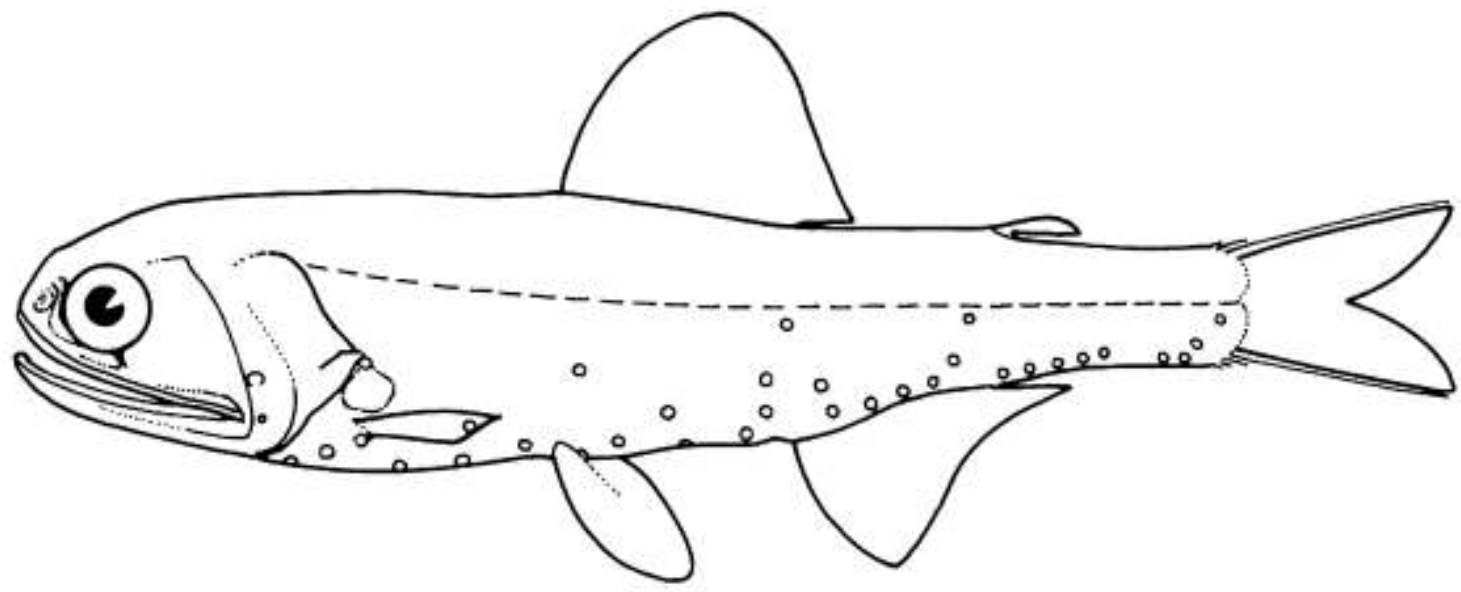




GULF OF MEXICO
COASTAL OCEAN
OBSERVING SYSTEM

Activity

Color and label the different parts of the lanternfish. Feel free to color and label any of the parts of the lanternfish that you learned about in this lesson. Also, you may add photophores or other body structures to this fish and be able to explain how those structures help your fish adapt to life in the deep, dark ocean.





Acknowledgements

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