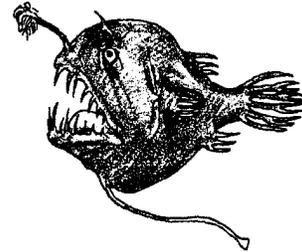


Creatures of the Abyss

Lesson by Karen Mattick, Marine Science Center, Poulsbo, Washington.

Key Concepts

1. Light does not penetrate deep enough to provide energy for photosynthesis in the deep sea.
2. Food webs in much of the deep sea are fueled by detritus (decaying organic material) drifting down from the lighted layers above,
3. Many unique animals do populate these dark waters, feeding on detritus and each other.
4. Deep sea organisms are often small, gelatinous and bioluminescent.



Background

Sunlight is the original source of energy for photosynthesis. Though one might expect the vast, dark regions of the deep sea to be unable to support life without sunlight, they are, in fact, connected to the solar based food webs of the shallows by the fall of detritus, or “marine snow”. The animals that inhabit the dark regions of the ocean survive by feeding on the marine snow or on each other. They live in dark, very cold waters under extreme pressures.

Though the deep sea fish tend to look fierce, most, but not all, are quite small. Their fierce appearance comes from adaptations that allow them to eat anything that comes their way in the sparsely populated waters. Many have sharp fang-like teeth to hold prey. Many have greatly expandable stomachs and jaws that unhinge to allow them to swallow prey larger than themselves. Some have photophores, pockets of bioluminescent bacteria, that they may use as fishing lures to attract prey close to their hungry mouths.

Photophores may also function as identification tags so fish can find others of their species in order to reproduce. Special adaptations for reproduction must be important in an unlighted sea where fellow fish may be few and far between. The male anglerfish, for example, is much smaller than the female, and attaches to the female, literally feeding off her blood. In return, he provides sperm to fertilize her eggs.

These deep sea creatures also tend to have fairly soft bodies. The ferocious looking dragonfish, for example, actually has a small, gelatinous body.

Materials

For each student or team of students:

- 1 copy of student pages, “Creatures of the Abyss”• 1 set Deep Sea Animal picture cards
- 1 set Deep Sea Animal information cards

Teaching Hints

“Creatures of the Abyss” reviews the flow of energy and nutrients in food webs and introduces the animals that inhabit the dark regions of the ocean which students have been mapping in earlier lessons in this unit. Your students are sure to find these animals bizarre and incredible.

Duplicate the “Creatures of the Abyss” reading, the Deep Sea Animal pictures and the Deep Sea Animal information cards. You may wish to cut them apart into separate cards or have your students do the work for you. It is important, however, that students go through the process of trying to match the right information cards to the right animal pictures. You will know that they are actually reading the information cards and studying the pictures when you begin to hear questions about the animals.

You can help satisfy some of your students’ curiosity by supplementing the Deep Sea Animal cards with video of deep sea creatures. Monterey Bay Aquarium and Sea Studios sell two videos, “Monterey Bay Aquarium” and “The Worlds Below”, which include footage of deep sea creatures taken from a submersible in the Monterey Bay canyon. In addition, Monterey Bay Aquarium has a Deep Sea slide set with script available for sale. You can reach the Teacher Programs and Education Departments at the aquarium at 886 Cannery Row, Monterey, CA 93940-1085, 408-648-4850.

Since so many of the animals shown in the Deep Sea Animal cards have photophores and bioluminesce, students may be curious about what causes the light of bioluminescence. You may want to follow up this activity with the lab “Glowing in the Dark: Bioluminescence.” If you do not have time for the whole lab, the activity provides background information you may share with your students.

Key Words

bioluminescence - the production of light by living organisms

cellular respiration - oxidation of organic compounds such as glucose that occurs within cells, producing energy for cellular processes

detritus - in this case, decayed organic material

nutrients - in this case, minerals and other substances needed for phytoplankton growth

photosynthesis - a process which occurs in the presence of sunlight in which six carbon dioxide molecules (CO₂) and six water molecules (H₂O) are combined to yield one molecule of a simple sugar (C₆H₁₂O₆) and six molecules of oxygen (O₂)

phytoplankton - plant plankton; the primary producers of the sea

plankton - the mostly microscopic plants and animals that drift in water; singular = plankter

submersible - device designed for underwater work or exploration

zooplankton - animal plankton

Answer Key

1. Living organisms use energy to move, grow, reproduce and keep other functions of their bodies operating.
- 2 a. The ingredients for photosynthesis are carbon dioxide and water. Solar energy is also an ingredient for photosynthesis.
 - b. Oxygen is a waste product of photosynthesis.
 - c. Glucose is the desired product of photosynthesis. It is valuable because it stores energy from the sun in energy-rich chemical bonds.
- 3 a. The ingredients for cellular respiration are glucose and oxygen.
 - b. The waste products of cellular respiration are water and carbon dioxide.
 - c. Cellular respiration breaks apart glucose, releasing the energy stored in the molecule's chemical bonds so the organism can use the energy.
- 4 a. Living organisms use nutrients as pieces to form their structure and parts. Nutrients are building blocks.
 - b. Animals get nutrients from their food.
 - c. Plants get nutrients from the soil or water around them.
- 5 a. The following deep sea animals are 10 cm or less and would fit in the palm of the hand:
 - anglerfish- 10 cm
 - bristlemouth- 8 cm
 - hatchetfish- 6 cm
 - deep sea shrimp- 4 cm
 - jellyfish- 4 cm
 - larvacean- 0.4 cm
 - tadpole snailfish- 6 cm
 - b. The following deep sea animals are about 1.5 meters or more and are larger than many humans:
 - slender snipe eel- 1.4 m
 - siphonophore- 20 m

6 a. The following deep sea animals bioluminesce:

- black dragon
- hatchetfish
- pacific viperfish
- anglerfish
- bristlemouth
- deep sea shrimp
- jellyfish
- deep sea squid
- amphipod
- shining tubeshoulder
- lanternfish

Students can determine which bioluminesce by reading the information cards and looking for photophores on the animal pictures.

b. Students may suggest a variety of purposes for bioluminescence. The animals may bioluminesce to attract prey or to identify themselves to potential mates.

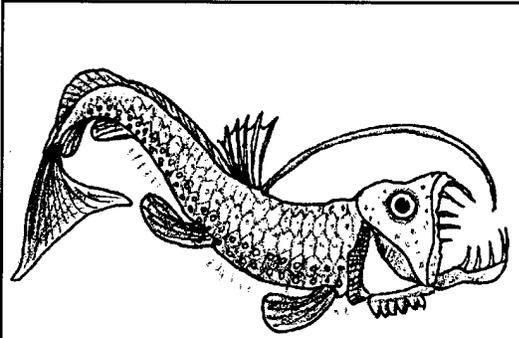
7 a. The following deep sea animal feeds on detritus:

- larvacean

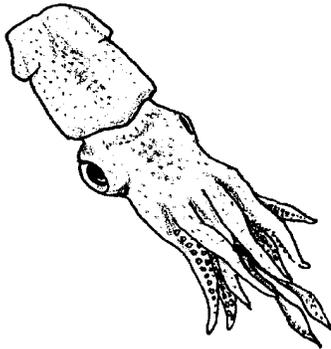
Most of the animals in the Deep Sea Animal card set feed on each other or on small zooplankton that filter detritus from the water.

b. All of the deep sea animals in the card set except the larvacean feed on other animals.

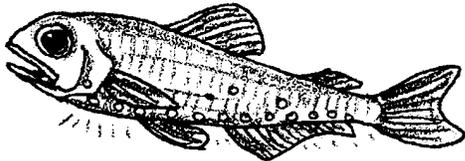
c. These deep sea animals are connected to sunlight-based food webs in that the beginning of these deep sea food webs is decaying materials that sink down from the surface waters. The decaying materials were once part of living organisms that either photosynthesized their food or fed on other organisms that depended on photosynthetic plants.



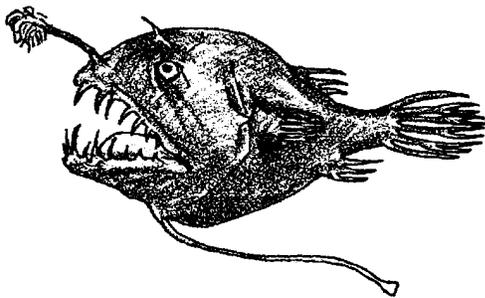
Pacific Viperfish



Deep Sea Squid



Lanternfish



Anglerfish

Pacific Viperfish

The Pacific viperfish feeds on lanternfish and squid. It has a very large mouth and fang-like teeth. Once the viperfish catches something, it won't get away. Its size ranges from 22-30 cm. Notice the two rows of photophores. Look at the long, thin ray on the back (dorsal) fin. How might the ray help attract a tasty meal?

Deep Sea Squid

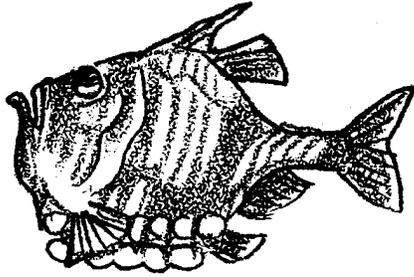
This squid can grow to 30 cm in length. Its photophores adjust to match the ocean twilight. It can move very quickly forward or backward. The two longest tentacles grab and hold its prey. The smaller tentacles move the prey to its mouth. The eyes are of different sizes. Scientists don't know why. Do you have any ideas?

Lanternfish

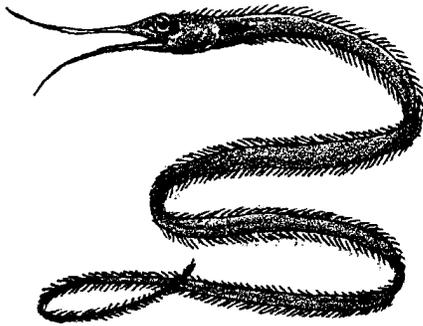
The lanternfish is very common in the deep water. It lives where there is some light. It has very large eyes. The lanternfish swims up and down every day. It stays in the deep water during the day. It moves closer to the surface at night. Scientists think lanternfish may move like this to feed. They are not sure. Its photophores may help it find and communicate with other lanternfish. It grows to about 13cm in length.

Anglerfish

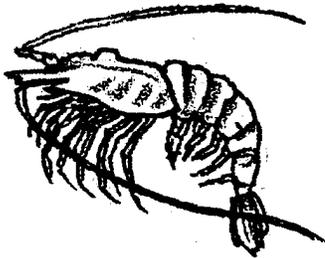
The anglerfish can grow to 10 cm in length. It has an appendage that looks like a fishing pole and lure. The "lure" is a large photophore. It may help attract prey. It is hard to find and keep mates in the deep sea. The anglerfish has a solution. The adult male anglerfish attaches himself to the female by biting on to her. Once attached, his body becomes part of hers. They mate for life.



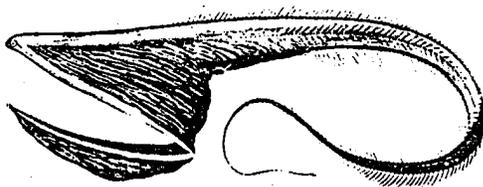
Hatchetfish



Snipe Eel



Deep Sea Shrimp



Gulper Eel

Hatchetfish

The small hatchetfish (to 6 cm) has upward facing eyes. They allow it to see its food in the dimly lit waters above. Once food is spotted, the hatchetfish makes a couple of quick strokes. Then its upward facing mouth can grab its prey. The hatchetfish has photophores on the bottom side. The light helps hide its outline. Other fish swimming below the hatchetfish see the light and not the hatchetfish's silhouette. This kind of coloring is called countershading.

Snipe Eel

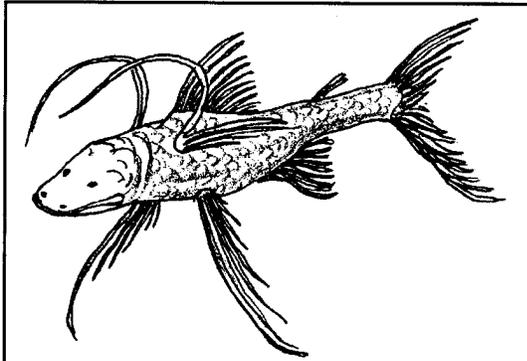
The snipe eel grows to 140 cm in length. It is among the biggest deep sea fish. It has a very long beak-like mouth. The mouth has bristles along the edges. For a long time scientists wondered how the snipe eel used these bristles. Finally, they observed the snipe eel feeding. The snipe eel waves its head back and forth in the water. The bristles act like Velcro to snag deep sea shrimp by the antennae.

Deep Sea Shrimp

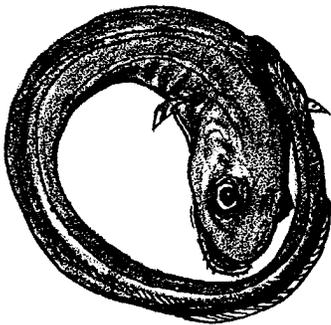
The bright red Deep Sea Shrimp is only 4 cm long. It seems much longer because of its very long antennae. These antennae may sense different chemicals in the water. The chemicals help the shrimp find food and mates. They may also help it avoid predators. The Deep Sea Shrimp has red photophores on its underside. The photophores countershade the shrimp.

Gulper Eel

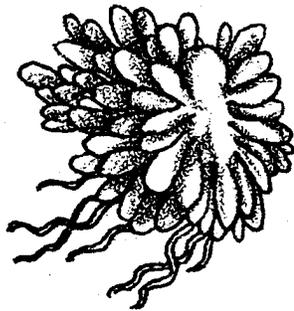
The gulper eel has a very large mouth. It also has a stomach that can stretch. This lets the gulper eel eat prey equal to itself in size. The gulper eel can grow to 76 cm. Most gulper eels are about 40 cm long.



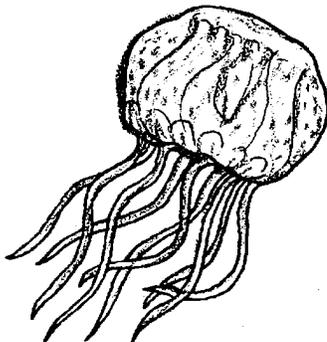
Tripod Fish



Eelpout



Siphonophore



Colobonema jelly

Tripod Fish

The dull brown tripod fish lives on the ocean floor. The pelvic fins are very long, about half the length of these fish which can grow to 29 cm. The pelvic fins and long tail help the tripod fish skim along the ocean floor. Tripod fish eat zooplankton. Threads on the fins sense the zooplankton in the water when they brush into the fins.

Eelpout

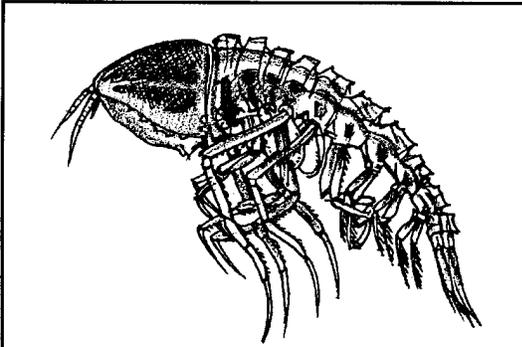
The translucent eelpout is a common deep water fish. It has a very uncommon behavior. When this fish is startled, it rolls up into a donut shape. Scientists wonder how this helps them survive. Some think it makes the eelpout look like a stinging jellyfish. The eelpout grows to 18 cm. It eats any animal it can fit into its mouth.

Siphonophore

Many different kinds of siphonophores live in the deep sea. This one can grow to 20 meters in length. A siphonophore is one animal made of many individual animals. Scientists call it a colony. The tentacles act as fishing lures. The lures attract the prey. The tentacles sting it. Then they pull it into one of the mouths.

Colobonema jelly

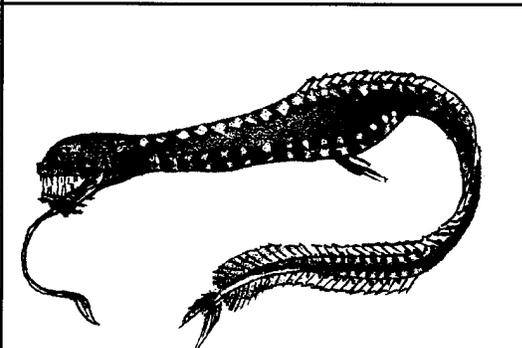
This 4 cm long jelly can glow (bioluminesce). Its tentacles pulse blue and red. They change color as it swims through the water. When a predator appears, the colobonema increases light output. Then, in an instant, it separates its lighted tentacles. The jelly swims off in a different direction. The predator is left with some stringy tentacles. The jelly is free.



Amphipod

Amphipod

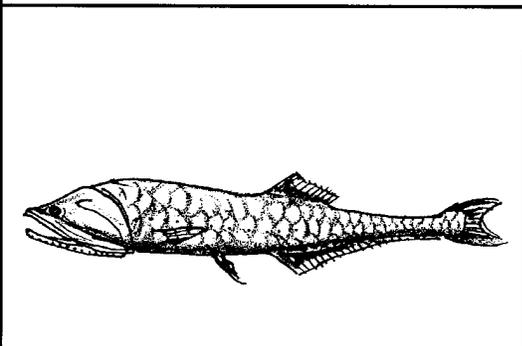
A large (up to 15 cm) relative of the common beach hopper, this amphipod flits around the deep sea. Its giant compound eyes help it search for food. Glowing with a cool, white light, its body is transparent. The light may help it find a mate.



Blackdragon

Blackdragon

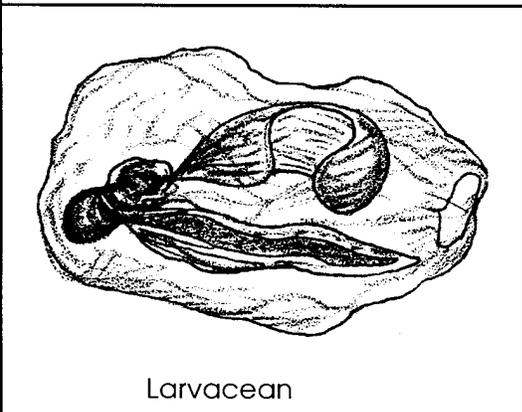
In spite of the long whisker, this is a female blackdragon. She feeds at the sea surface, swimming hundreds of feet up and back each night. Females may grow to 38 cm, males are smaller. Male blackdragons do not feed at all. They don't even have a stomach! They only live long enough to mate.



Bristlemouth

Bristlemouth

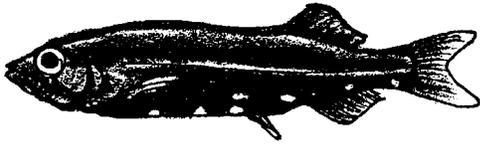
Growing to about 8 cm in length, these are the most abundant fishes in the world. A bristlemouth eats tiny plankton which it catches on the thousands of fine bristles that line its mouth. A row of photophores on its underside help it hide from predators below.



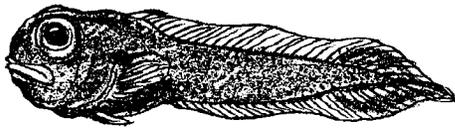
Larvacean

Larvacean

Smaller than a standard pencil width, this animal builds a transparent slime-house. Its wagging tail pumps water through its home. In a clever way to feed, it builds a net to catch detritus or marine snow in the water it pumps. When the net clogs, it flicks it off and builds a new one.



Shining tubeshoulder



Tadpole snailfish

Shining Tubeshoulder

Photophores light the belly of this shiny black fish. Growing to 33 cm in length, this fish has an odd tube on each shoulder. The tubes can release a glowing slime. The slime may confuse its predators. At night, the young of these fish swim upwards to feed on shrimp.

Tadpole snailfish

Looking very much like a frog tadpole, this small fish (up to 6 cm) scoops up shrimp as it swims. Its soft body makes it a favorite meal for other deep sea fish.