VOYAGER FOR KIDS!
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The deep ocean is one of the most extreme environments on Earth. The seafloor in its deepest trenches is under more than six miles of water. It is a dark, cold place, subject to the crushing pressure of the water above it. Yet the deep ocean makes up a whopping three-fourths of the ocean's total volume.

Many people have wondered what types of life might exist down there. Stories of fantastic deep-sea creatures have been told since man first ventured forth on the oceans in small boats. But it is a tough place to study. Just get-

Cynthia Klepadlo, assistant curator of the Scripps Marine Vertebrates Collection, shows off a ribbonfish, a deep-sea dweller that is one of approximately two million specimens in the collection.

Deep-Sea Hatchetfish

The Deep Ocean

Scientists divide the ocean into several environments based on depth. Each is a unique habitat for living things because of differences in temperature, pressure, and the amount of available light and food.

Plants are the basis of the food web in the ocean, just as they are on land. Because phytoplankton and seaweeds need light to live, they are found only to depths of about 500 feet (150 m). These plants support the large numbers of animals in the upper ocean.

The deep ocean extends from about 3,300 feet (1,000 m) below the surface down to the seafloor. Here all sunlight has been absorbed and scattered by the water in the upper ocean. The temperature varies little and hovers near freezing.

The food in the deep ocean must come from above. By the time food sinks to the depths, much of it has been eaten. Thus, the deep-ocean food supply is limited. Because there is less food, the deep ocean contains fewer animals than the upper ocean. And many of them have unique adaptations to their environment.

Adapting to Extremes

Little more than 100 years ago, scientists thought the deep ocean was lifeless. Today, more than 1,150 species of fishes are known to live in its waters. Another 1,500 species of fishes, plus many other creatures, live on or near the seafloor.

Many of these animals have evolved very curious ways to get enough food, conserve energy, identify enemies, and find mates.

EAT ANYTHING

The food supplied to the deep ocean from above is called detritus. This includes dead plants and animals, bits and pieces from the meals of other animals, fecal matter, and decaying materials. Animals at all ocean depths eat detritus, but it is important in the deep ocean because other food sources are scarce.

Occasionally, a large food fall, like a dead whale or large fish, adds to the "rain" of nutrients in the detritus.

Deep-sea creatures also eat each other. Some eat animals that migrate downward from upper ocean habitats. Some eat the young of other deep-ocean species that spend their early lives in upper ocean waters and return to the deep as juveniles.

These photos were taken with the original Monster Camera in the 1970s. At left, tiny amphipods cover the bait. A variety of large fishes attack the bait in the photo at right.

The Monster Camera

Scripps oceanographer John Isaacs had a very big imagination. He wanted to know more about animal life in the deep ocean. Deep-sea creatures were captured in nets and dredges and brought to the surface for study. But Isaacs wanted to find the ones that weren't being caught, and he wanted to see deep-sea animals in their natural habitat.

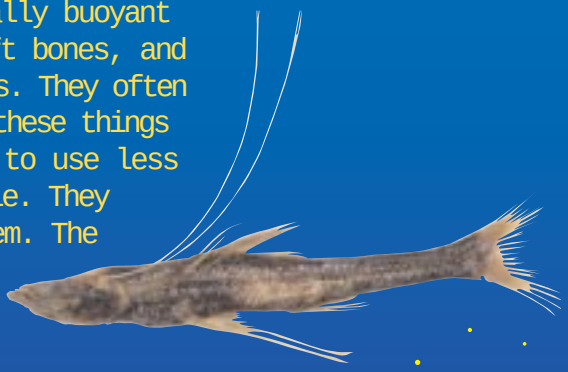
Cameras had been lowered from ships and installed in deep-diving machines, but scientists could not study an area over time. The cameras were not baited, so finding anything to photograph was hit or miss. The creatures photographed were bottom-dwelling animals and small, slow-moving fishes.

Working with Scripps colleagues in the 1970s, Isaacs

comes along. Fishes may have huge mouths, hinged jaws, and expandable stomachs. Many fishes like the swallower (right) have stomachs that can stretch to store prey larger than themselves while the prey is being digested.

CONSERVE ENERGY

One good way to require less food is to use less energy. Fishes that can remain at a desired depth without moving by being neutrally buoyant save energy. Deep-sea fishes may have flabby bodies, soft bones, and watery muscles. Many store reserves of oil in their tissues. They often are much smaller than their upper ocean relatives. All of these things make these deep-sea fishes more buoyant and allow them to use less energy. Many deep-sea creatures move as little as possible. They conserve energy by waiting for their food to come to them. The tripod fish (right) is able to rest on the bottom on special extra-long fins, which position it just above the seafloor in the path of anything that drifts by.



MAKE YOUR OWN LIGHT

Even though there is no sunlight in the deep ocean, "livi
cence is produced by most deep-sea creatures. They can mak
harbor luminescent bac
light for them. Most of
upper parts of the de
feet (1,000 m) and 13
Bioluminescence hel
Sometimes they use a l
that is actually a part
their own body to

could be lowered to depths greater than 16,000 feet (5,000 m) and could remain in place for up to three days. The pictures it brought back changed thinking about the deep sea and its food web.

Not only did it film octopuses, sea star, crabs, amphipods, and hagfish, but large fishes came to the bait, too. One film shows a shark, whose head was estimated to be more than five feet across. Thus, the camera got its name—the Monster Camera.

Fishes bit and twisted the bait, and nudged each other aside for room to eat. Fishes and seafloor animals continued to arrive until the bait was eaten. Then they all disappeared.

Where did all the creatures come from? How did they know to find the bait? What would happen if something really large, like a whale carcass, were used for bait? The scientists suggested that the animals either smelled the bait or were somehow aware of the movement of other animals in the surrounding area.

This fall, Scripps scientists are taking a modernized version of the Monster Camera into the deep sea. They will

Studying the Food Web

Scripps graduate student, Lesley Blankenship, is interested in the food web in the deepest parts of the ocean. By studying who eats whom, she hopes to learn more about the animals that live in the ocean's deepest trenches.

Blankenship studies the diet of small marine creatures called amphipods. These little animals are a type of crustacean, a group that also includes crabs, lobsters, and shrimp. In fact, amphipods look a little shrimplike, with flattened bodies, two sets of antennae, and seven pairs of legs used for swimming, burrowing, and grasping.

Because amphipods exist in most parts of the ocean and have been observed previously at great depths, Blankenship hopes to find lots of them in the Tonga Trench.

Blankenship will examine the gut contents of the animals she traps to find out what they have eaten. She will isolate the DNA code—the basic structure that makes each creature different—from each bit of food. She will compare these DNA samples to those of known deep-sea creatures, and try to identify what the amphipods have eaten. In this way, Blankenship hopes to learn about other animals that live in the deep.

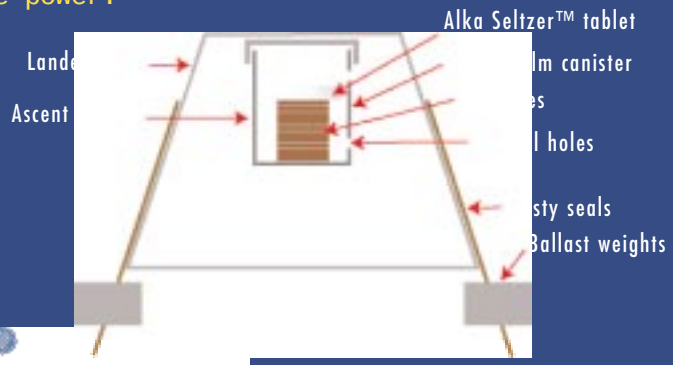
She will also compare the DNA to that of upper ocean animals. She is especially interested in larger fishes and mammals. She hopes to identify what types of dead animals that fall downward from the upper ocean are eaten by creatures deep in the Tonga Trench. This information will help explain how the ocean food web works.

Most amphipods are about one-fourth to one-half inch long (5 to 15 mm). The largest ever seen was photographed by the Monster Camera in 1968 by Scripps scientists John Isaacs and Robert Hessler. This whopper was more than 11 inches long (280 mm) and was photographed at a depth of more than 17,000 feet (5,300 m).

Lesley Blankenship studies the diet of amphipods, some caught more than 26,000 feet (8,000 m) beneath the ocean's surface.

Build a Deep-Sea Lander

You can make a vehicle that will travel to depth and return. Try it first in a deep bucket or fishtank. Then, ask an adult to go with you, and launch your lander in a swimming pool or off a pier. Use more AlkaSeltzer™ if you want your craft to have more power.



MATERIALS NEEDED

1. Clear plastic soda cup
2. 35-mm film canister
3. 5 pennies
4. 2 weights
   (You can use nuts and bolts, tire
   weights, or film canisters filled with
   pennies.)
5. AlkaSeltzer™ tablets (or similar)

ASSEMBLY

1. Use nail to make 2 holes in the side
   wall of the film canister, one close to
   the snap lid at the top, and one close
   to the bottom.
2. Use glue gun to apply a nick-le-sized
   puddle of glue on the top of the film
   canister lid.
3. Glue the film canister inside the cup
   in the center bottom. Remove the
   canister from the lid by pop-ping the
   lower section to the side, leaving the
   lid attached.
4. Make 2 weights by attaching your
   chosen weight material to the twisty
   seals. Leave a twisty seal tail, 1 in.

Emily, daughter of Scripps artist Blaize Mekinna, builds a deep-sea lander.

TO LAUNCH

1. Grasp the lander from the top, tip it
   over underwater, and allow the cup
   to completely flood, then release it.
2. Lander will sink and land on

PRINCIPLES OF OPERATION

1. Pennies and ballast weights cause the soda cup
   lander to sink to the bottom.
2. Water enters film canister under pres-sure, rises
   slowly to contact AlkaSeltzer™. How fast it comes
   in is con-trolled by the size and num-ber of holes.
3. Tablet fizzes
   on contact with water to
   make a gas. Gas exits upper hole of
   canist