

ARMORED MILLIPEDE

CARD 16

GROUP 6: PRIMITIVE ANIMALS



PHYLUM
Arthropoda

CLASS
Diplopoda

FAMILY
Various



Armored millipedes vary in size, with some species reaching almost a foot in length. Despite their shell-like armor, many rely on poison glands to deter enemies from attacking.

KEY FACTS



SIZES

Length: The largest millipedes can reach 1 foot in length. Other species frequently grow to 8 in.



BREEDING

Mating: Male and female may embrace for several hours. Fertilization takes place within the female's body.

Eggs: Depending on species, may lay up to 300 eggs.



LIFESTYLE

Habit: Nocturnal.

Diet: Leaves and other decaying vegetable matter on forest floor. Some species forage in trees.



RELATED SPECIES

There are 8,000 species of millipede worldwide.



Range of armored millipedes.

DISTRIBUTION

Found in the United States and in tropical forests around the world.

CONSERVATION

Armored millipedes are not directly threatened. But, like other inhabitants of tropical forests, they are at risk from the continued destruction of their habitat.

SPECIAL ADAPTATIONS OF ARMORED MILLIPEDES



Defense: The millipede curls into a spiral, exposing only its hard armor plating to an enemy.

Color: Species may be brightly colored or striped to deter predators and indicate that the millipede is inedible.

Segments: Each snugly overlaps the next and houses two pairs of powerful, jointed legs.



Motion: Legs move in a ripple down the length of the millipede.



Armored millipedes rest during the day.

At night they forage for rotting vegetation among the dead leaves on the tropical forest floor.

The wavelike pulse of their short legs gives them considerable power when burrowing.

HABITAT

Armored millipedes push their way through soil and decaying vegetation with ease. Under piles of leaf mold or in damp crevices, millipedes can be

found resting by day or feeding at night. There are also some species that climb trees to feed on vegetable matter caught in the branches.



Above: A cluster of eyes at the base of each antenna can be seen on this giant millipede.

FOOD & FEEDING

Unlike centipedes, with which they are often confused, armored millipedes do not hunt living creatures. Instead, they eat the leaves and other matter that fall from trees and decay on the ground in their tropical forest habitat.

Millipedes may also attack crops planted by humans. But they are unlikely to be a principal source of damage. Their jaws are simply not strong enough to pierce anything that is not already damaged or decaying.

Left: Decaying vegetation on the forest floor provides food and lodging for millipedes.

Right: The millipede's rippling motion can be viewed under a microscope. This way of moving developed many millions of years ago.

DEFENSES

Because armored millipedes move slowly, they are vulnerable to attack. As a result, they have developed several means of defense.

One defense is the armor itself. Many species, such as the pill millipedes, curl up into a ball when attacked. Some species become as large as a golf ball. Another defense is poison glands. In most cases the poison is constantly secreted to give the millipede a toxic coating. Some larger species can spray their poison as far as three feet.

Other defenses include bright markings to warn off predators. A millipede that lives in the sequoia forests of California is even luminous.



BREEDING

Armored millipedes may mate for several hours. The male winds around the female and holds her with his front legs. Fertilization occurs within the female's body. Depending on the species, she may lay up to 300 eggs.

Unlike earthworms and most insects, many female centipedes and millipedes tend their eggs. Some disguise the eggs by coating them with excrement. Others build an intricate nest and coil them-

selves around the eggs. Various kinds of nests are built. The usual materials are soil and excrement, although some millipedes spin a nest of a silklike substance.

When it hatches, the armored millipede may have only a fraction of the adult number of legs. It gains more legs every time it molts, or sheds, its hard outer shell.

Below: After elaborate leg-waving courtship rituals, millipedes may mate for many hours.



DID YOU KNOW?

- Millipedes first appeared about 400 million years ago.
- The name *millipede* means "1,000 legs." But millipedes rarely have more than 200 or 300 legs.
- One species of millipede was once ground up and used to poison arrowtips.
- Some millipedes spit a fluid that can cause blindness in humans.

NORTHERN RED ANEMONE

CARD 15

GROUP 6: PRIMITIVE ANIMALS

ORDER
Actiniaria

FAMILY
Actinidae

GENUS & SPECIES
Tealia felina



The northern red anemone is a beautiful marine animal that spends most of its life below the tidemark around temperate shores. It is one of the largest anemones in the North Atlantic.

KEY FACTS



SIZE
Body: Diameter, up to 5 in.



BREEDING
Asexual reproduction: Divides in two, or small individuals bud off.
Sexual reproduction: Eggs and sperm are released into the water to produce tiny free-swimming larvae.



LIFESTYLE
Habit: Solitary, but may occur in groups from the tidemark down to about 325 ft. Prefers to attach itself to a rocky, shady spot.
Diet: Small crustaceans and small fish.



RELATED SPECIES
There are over 6,000 species of anemone and coral. The genus *Tealia* contains several species, including several varieties of the northern red anemone, *T. felina*.



Range of the northern red anemone.

DISTRIBUTION

The northern red anemone is a temperate marine species that occurs in the coastal waters of the North Atlantic and Baltic Sea.

CONSERVATION

Although not specifically threatened, the northern red anemone is affected by pollution and habitat destruction, as are many inshore marine animals.

FEATURES OF THE NORTHERN RED ANEMONE

The northern red anemone exists in a number of different varieties, which may be red, gray-blue, or green. Identification is also complicated by the existence of similar, closely related species.

Tentacles: Tapered and flexible. Over 100 arranged in rings around the central opening. *Translucent* (light can shine through them), and often red. Armed with poison cells that spring out in attack.

Retracted form: Rubbery, jellylike appearance. The anemone generally reverts to this position at low tide to avoid drying out. It also retracts as a defense mechanism.

Protrusions: Sticky warts on the surface of the body attract grains of sand and gravel for camouflage.



Base: A strong foot (hidden) attaches the anemone to a rocky spot from the mid-tidemark down to about 325 feet.



The northern red anemone appears fairly static, sitting on the seabed with only its brightly colored tentacles waving gently in the current. But when a shrimp or small fish brushes past, its lightning-fast stinging cells paralyze the animal. The anemone can then use its tentacles to draw the victim slowly into its mouth.

FOOD & FEEDING

The northern red anemone feeds on small invertebrates and fish. Attracted to the anemone by its colorful tentacles, the prey sees it as potential food or a place to take shelter.

As soon as the prey comes into contact with the anemone, groups of stinging cells resembling tiny barbed harpoons are fired from the tentacles into the victim. These cells are called

nematocysts, and the tip of each is filled with a poison that paralyzes the prey.

Chemicals released by the victim cause the anemone to contract its tentacles and open its mouth, drawing the prey into the central body cavity. Nutrients are absorbed, then waste material is passed out through the central opening, which serves as both mouth and anus.

Left: *The northern red anemone lives in fertile waters to depths of about 325 feet.*

Right: *The brightly colored tentacles vary greatly in different anemones.*



DID YOU KNOW?

- The sting from a northern red anemone's tentacles can cause a rash on sensitive parts of the human body.
- Some anemones use their poisonous tentacles to stop other anemones and corals from settling close to them.
- A few anemone species give

birth to live young that form within the parent's body.

- Specimens of the species *Tealia columbiana* may grow up to three feet across.
- The internal organs of the northern red anemone are arranged in a circle around a central axis.



Left: *The anemone is a simple animal known as a coelenterate. It has a saclike body with a central opening that is used as both a mouth and an anus.*

HABITS

The northern red anemone occurs on the seabed, from the mid-tidemark down to about 325 feet. To avoid bright light, it attaches itself to a rocky surface in a crevice or seaweed.

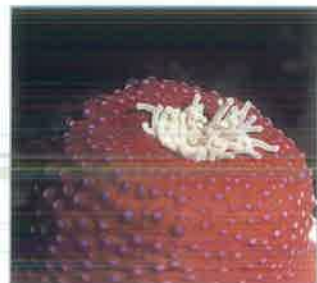
The column of the northern red anemone is covered with sticky gray warts. Sand and gravel stick to the warts and camouflage the anemone.

When approached by a predator like a large fish, the anemone pulls in its tentacles so that only the squat, rubbery column shows. If attacked, it squirts out

Right: *When exposed at low tide, the anemone retracts its tentacles to avoid drying out.*

a jet of water and contracts its tentacles even more.

To avoid drying out at low tide when it may be exposed to air for several hours, the anemone retracts its tentacles and shrinks to a jellylike blob. It expands again when the tide covers it.



BREEDING

The northern red anemone can reproduce sexually or asexually. It can release both eggs and sperm into the water where the egg is fertilized by the sperm, producing a *larva* (an imma-

Left: *Underwater, its tentacles make the anemone look like a flower in bloom.*

ture form between egg and adult). The larva settles on a rocky site, where it then develops into a tiny anemone.

It can also produce tiny replica anemones by *budding* (producing offspring "buds"), or by dividing down the middle to form two individuals.



Left: *A strong foot attaches the northern red anemone to a rocky surface. It changes its position with a deliberate creeping motion.*

SPONGE

CARD 13

GROUP 6: PRIMITIVE ANIMALS

PHYLUM
Porifera

CLASS
Demospongiae



Sponges look like plants, grow like plants, and even reproduce themselves like plants, but they are not plants. They are one of the most unusual animals on earth.

KEY FACTS



SIZES
Length: Up to 6 ft.



BREEDING
Sexual reproduction: All sponges generate both eggs and sperm. Sperm is released into the water in summer to fertilize eggs, which become mobile larvae.
Asexual reproduction: Seedlike particles called *gemmules* are released in fall, lie dormant through winter, and develop into sponges in spring. Fragments of adults may also grow into new sponges.



LIFESTYLE
Habit: Sedentary. Filter-feeders.
Diet: Suspended and dissolved organic debris, bacteria.



RELATED SPECIES
There are some 5,000 species of sponges worldwide that form the subkingdom Parazoa.



Range of the sponge.

DISTRIBUTION

Found worldwide in all seas, from the lower shores to the ocean depths. Some freshwater species are also found in rivers, lakes, and ponds.

CONSERVATION

The bath sponges *Spongia officinalis* and *Hippospongia equina* are overcollected in places, but most species are in no danger of extinction.

HOW THE SPONGE FEEDS

WATER IN

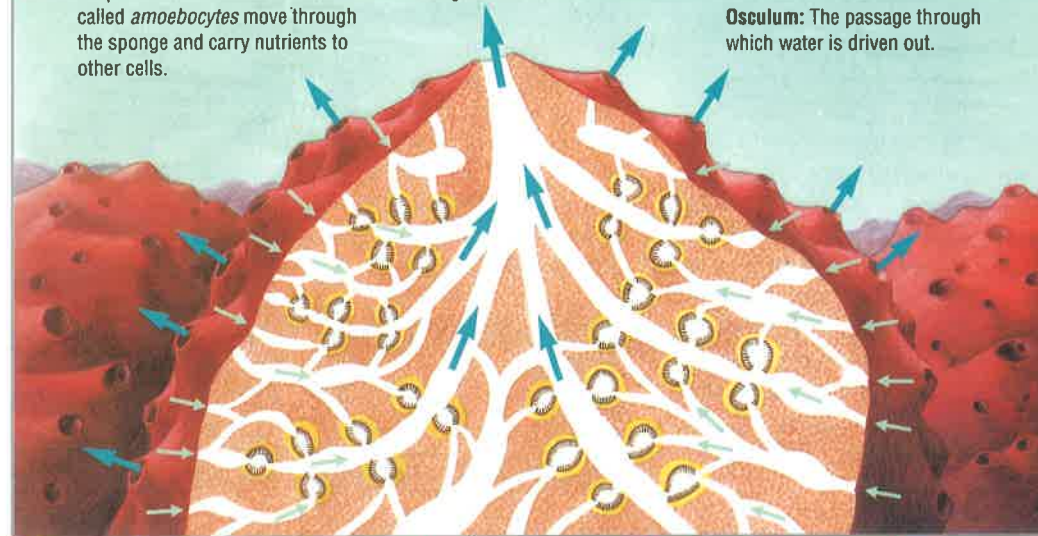
The sponge draws water into central cavities through small pores and chambers. These cavities are lined with cells that digest food particles suspended in the water. Mobile cells called *amoebocytes* move through the sponge and carry nutrients to other cells.

Flagellae: Whiplike tails lining the cell walls.

WATER OUT

Water is driven out of the cells by the whiplike tails of the flagellae.

Osculum: The passage through which water is driven out.





Sponges are found all over the world in lakes, rivers, and seas. They live in rock pools along the shoreline as well as in deep ocean trenches. Some sponges stand alone, forming shapes that resemble fingers or flasks. Others may fuse together into shapeless masses that cover submerged rocks.

BREEDING

Each sponge has both female and male organs. In summer a sponge releases clouds of sperm. The sperm cells are drawn in by nearby sponges to fertilize their eggs. The tiny larvae settle on the seabed and grow into new sponges.

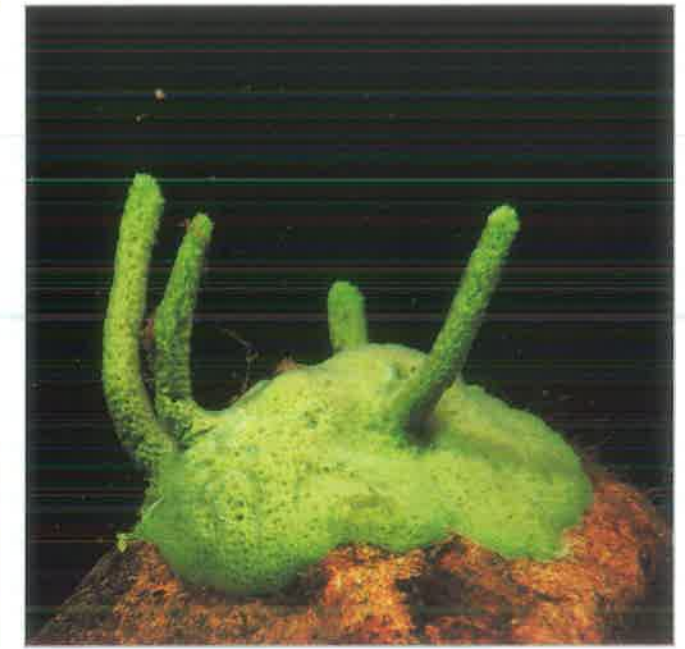
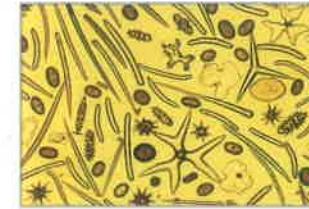
Sponges also reproduce asexually. If a sponge is split into two or more parts, it may regrow into separate sponges.

Left: *The tubular form of some sponges provides an ideal hide-out for small invertebrates.*

Right: *Under a microscope, it is possible to see living cells grouping together to form new sponges.*

It may also grow a lobe of tissue that forms a new individual (called *budding*). In fall many sponges produce seedlike particles called *gemmules*. The parent sponge disintegrates, but the gemmules sprout into new sponges in spring.

Right: *The silicon spikes of some freshwater sponges can cause allergic skin reactions.*



DID YOU KNOW?

- Many sponges produce toxins that can poison sharks. Scientists are now studying ways to use these toxins as shark repellents.
- Like geraniums, sponges can be cultivated by taking cuttings. This method is used

- to produce bath sponges.
- Sponges contain compounds of medical interest, including some that have been used to treat arthritis.
- Some sponges secrete acids that enable them to bore into coral reefs.

DEFENSES

Most sponges have developed effective defense systems to deal with predators. Some species, such as the river sponge, contain thousands of tiny silica needles that make them hard to eat. Many tropical marine sponges contain chemicals

that are toxic to fish as well as other predators. Because they are loose communities of cells, most sponges can survive being broken up into smaller fragments. Each piece simply reorganizes itself and grows into a tiny sponge.

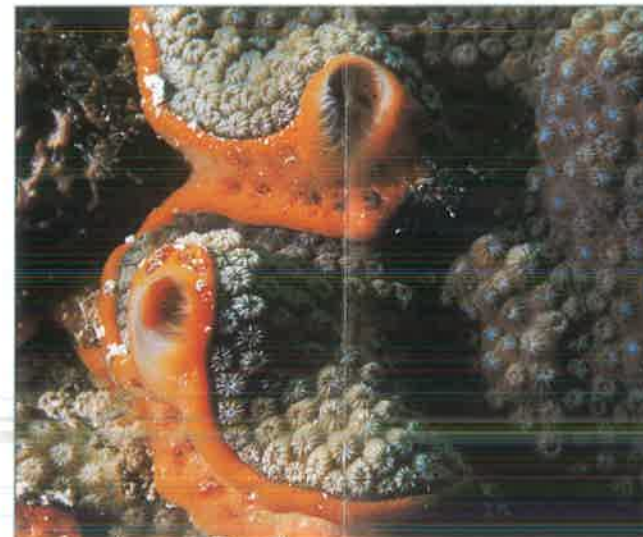
CHARACTERISTICS

Sponges have many cells, but these cells can survive independently of one another, unlike the cells of higher animals. For this reason, sponges are sometimes regarded as colonies of single-celled animals that cooperate to obtain food.

A sponge is basically a mass of these cells arranged in a series of tubular or spherical groups, each with a central opening. The entire cell struc-

Right: *The skeletons of sponges are 15 times more absorbent than cloth.*

ture is reinforced by an internal "skeleton" that is either pinned together with tiny barbs of silica or lime, or held together by a mesh of resilient protein fibers. The fibrous skeleton of the warm-water marine sponge is what is used as a natural bath sponge.



FEEDING

Sponges feed by drawing water in and then filtering out any suspended food particles. The group of cells works together to draw the water through minute pores in the structure into chambers that are lined with cells that can "swallow" the food particles. These cells have whiplike tails called *flagellae*, which drive the water through the system and out through a large cen-

tral opening. Once taken in, the food is passed to cells called *amoebocytes*. These cells move through the body of the sponge, carrying nutrients to other cells and releasing materials used to build the skeleton.

Some sponges have *algae* living in their bodies. These single-celled plants manufacture food by *photosynthesis*—using sunlight to convert chemicals into carbohydrates. The algae may pass some of these nutrients to the sponge.

LOLIGO SQUID

CARD 11

GROUP 6: PRIMITIVE ANIMALS

PHYLUM
Mollusca

ORDER
Decabrachia

FAMILY
Loliginidae

GENUS & SPECIES
Loligo opalescens



Attracted by the light of the moon shining on the sea, loligo squid gather by the thousands every March to mate and spawn in the shallow waters off Southern California.

KEY FACTS



SIZES

Length: Head and body, 8 in.
Tentacles: Eight arms, 2 in. Two long tentacles extend to 8 in. for catching prey.



BREEDING

Sexual maturity: 3 years.
Mating season: March.
No. of eggs: Laid in sacs of 200-300. Each female lays about 20 sacs at a time.
Hatching: 3-4 weeks.



LIFESTYLE

Habit: Usually solitary, although huge schools gather during mating season.
Diet: Mainly fish.
Lifespan: 3 years.



RELATED SPECIES

Closely related to the common squid, *Loligo vulgaris*. Giant squid of up to 60 ft. (including tentacles) are found in the northern Atlantic Ocean.



Range of the loligo squid.

DISTRIBUTION

The loligo squid is found throughout the warmer waters off the west coast of North America, extending south from San Francisco to Mexico.

CONSERVATION

Although the loligo squid is fished extensively each year, the fishing is controlled, and this species is not yet in danger of extinction.

FEATURES OF THE LOLIGO SQUID

The **arms** and **tentacles** of all squid are covered with suckers to provide a powerful grip that is used when hunting. At the center of the tentacles is the squid's **mouth** that has a horny **beak** with which it tears up prey before swallowing it. It has two well-developed **eyes**. In some species, notably those that live at great depths, eyes are also light-producing organs.

Two long **tentacles** used for catching food.

Eight **arms**, sometimes called short tentacles.

Eyes

Suckers

There are more than 300 species of squid, ranging in size from less than half an inch to over 60 feet in length. The loligo squid grows to approximately eight inches and, like all its close relatives, has eight short arms and two long tentacles that it uses to catch prey.

FOOD & HUNTING

Squid eat fish and crustaceans primarily. The loligo catches a fish by grasping it in its long tentacles. It paralyzes its prey with venom produced by its salivary glands and bites off the prey's head.

The squid's torpedo-shaped body enables it to move rap-

idly over short distances. It changes color to blend in with its surroundings and so becomes invisible to both its prey and predators.

The squid's only defense is to escape behind the dark clouds of "ink" that it squirts into the water.

DID YOU KNOW?

- The giant squid, *Architeuthis*, is the world's largest living invertebrate.
- The giant squid's only predator is the male sperm whale. A live squid measuring 40 feet long has been found inside a male sperm whale. Female sperm whales eat much smaller squid.
- Squid possess the largest nerve fibers of any animal.
- The most dangerous squid are found off the coast of Peru. They live in schools and hunt in the same manner as the piranha, tearing their victims to shreds in seconds.
- In 1961 a gold medallion was found inside a loligo squid caught off San Sebastian, Spain. It had been lost by a swimmer in Barcelona two years earlier and 900 miles away.

BREEDING

On moonlit nights in March, loligo squid gather near the water's surface. The group consists of males and females that are ready to mate.

The males find mating partners as quick as possible since the presence of so many other males creates competition for available females. As a male becomes excited, his head and tentacles become

flushed. He then seizes a female and retrieves a sac of sperm from his own body that he inserts into her body with one of his tentacles. The eggs are thus fertilized in the female's body and she then lays them in jelly-filled sacs, each containing 200 to 300 eggs.

Each female produces approximately 20 sacs that are joined together in flower-

shaped configurations and are as large as 10 feet across. The sacs are attached to each other with a sticky secretion that prevents them from being washed away.

Tiny squid hatch from the egg sacs three to four weeks later. They are moved and spread by coastal currents.

In three years they are fully grown and ready to mate.



SQUID & MAN

The breeding habits of the loligo squid make it particularly easy to catch.

Fishermen in California catch the majority of squid in March, when the squid gather to mate. The squid are attracted to light, so the fishermen hang lamps on their boats to encourage them to rise to the surface. Several thousand tons of squid are caught each year.

Still, because they produce so many eggs, the loligo squid are in no danger of becoming overfished. But fishing is controlled because, if the squid were hunted on a larger scale, it would endanger the other marine life that preys on the squid for food.



Above: *Loligo* squid lay their eggs in large clumps.

Right: The eggs hatch several weeks later and the tiny squid break free from their jelly sacs.



Left: Squid mate in groups.



OYSTER

CARD 10

GROUP 6: PRIMITIVE ANIMALS

CLASS
Bivalvia

ORDER
Eulamellibranchia

FAMILY
Ostreidae



The oyster is a remarkable animal. It changes its sex each year, can spawn in its male or female form, and is able to release up to one million eggs at a time.

KEY FACTS



SIZES

Length: European flat oyster, up to 3 in. after 5 years. Other species differ in size.



BREEDING

Sexual maturity: Matures first as a male, then becomes a female and continues to change sex throughout its lifetime.

Spawn: Year-round, depending on temperature and salt content of the water.

No. of eggs: From 1 to several million, according to species.



LIFESTYLE

Habit: Adult oysters live in clusters attached to rocks or any clean, solid object.

Diet: Small, edible particles filtered from sea water.



RELATED SPECIES

Other bivalves, including tropical pearl, thorny, and exotic oysters.



Range of the oyster.

DISTRIBUTION

Found along the coastlines of the United States, Europe, Mexico, Canada, Hawaii, and Australia. Pearls are most common in those from Japan, Australia, and Venezuela.

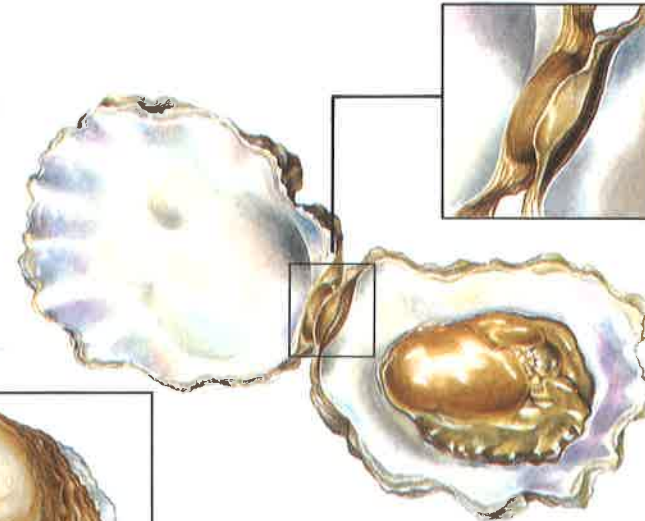
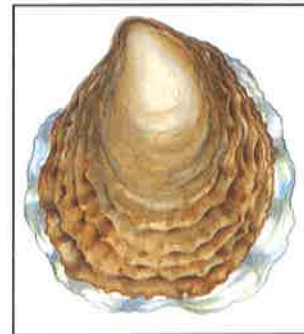
CONSERVATION

Overfishing and marine pollution have led to destruction of many natural oyster beds. Today, oysters are a luxury food raised mainly on commercial farms worldwide.

INSIDE THE OYSTER

The oyster is a mollusk with two hard shells, or valves, attached by a hinge and held together with a strong, triangular muscle. The flattened right and rounded left shells act as armor for the oyster's soft body flesh. They vary slightly in shape according to species.

The oyster adds fresh layers to its shell each year—just like the rings of a tree—providing an easy way of estimating its age.



Once the two halves of its shell are pried apart more than half an inch, the muscle that holds them together opens, and the anatomy of the oyster can be studied in detail. Pearls are produced by the oyster, which coats any foreign object that gets inside its shell, such as pieces of grit, with secretions called **nacre**. This covering builds up over the years to produce a highly valued jewel.



Left: Resting on the bed in the Indian Ocean, a thorny oyster of the *Spondylus* genus opens to reveal its insides.

FOOD & FEEDING

The oyster feeds by filtering tiny food particles from the water. By beating the tiny hairs, or *cilia*, of its gills, it forces water through its partly opened shell at the rate of 2 to 4 gallons an hour. Any food particles sucked in stick to

mucous strings that are attached to the cilia. The food is then forced into its mouth. Inside its stomach, the oyster has a rod-shaped mass of digestive enzymes, rotated by the current of water, which pulls in the food.

THE OYSTER FAMILY

The name oyster has been given to a variety of bivalve mollusks, not all of which are considered true oysters. The true oyster is the European flat oyster, *Ostrea edulis*, which is made up of two different-sized, irregularly shaped shells.

In the same family are *Crassostrea virginica*, found on the east coast of the United States, the Portuguese oyster, *Crassostrea angulata*, and the Japanese oyster, *Crassostrea gigas*. All of these species of oyster are edible.

Oyster larvae will settle on any solid object beneath the water's surface and cement themselves in place. They then start growing, adding layer upon layer to their shells to accommodate the expanding body inside.

OYSTERS & MAN

Oysters have been farmed for thousands of years—mounds of discarded oyster, scallop, and mussel shells have been found during archaeological digs of ancient Rome. The

Romans imported North Sea oysters and were the first to create artificial oyster beds to satisfy the demand.

Below: Thriving oyster beds at low tide.



BREEDING

The oyster has both male and female reproductive organs and undergoes a constant cycle of sex changes. It may spawn (breed) as either a male or a female, depending upon the salt content and the temperature of the water.

The eggs, which look like a milky white cloud, are normally released on an ebbing tide. An oyster sheds an average of 1 million eggs, on which small fish feed. The fertilized eggs float for seven to 18 days before settling, if they can avoid being eaten.

In spite of its minute size, each larva has a tiny shell complete with muscles and a foot. Once its swimming stage is over, the larva extends its foot, settles on any solid object it can find, and cements itself in place. At this stage, it is known as an oyster spat.



Left: Once they are anchored in place, oyster spat begin to grow their shells, which are protection for their soft, vulnerable bodies.

DID YOU KNOW?

- During the 18th and 19th centuries, oysters were so plentiful and inexpensive that they were considered poor man's food.
- It takes from five months to seven years for an oyster to produce a cultured pearl.
- The Chinese are credited with starting the cultured pearl trade in the 14th century. They introduced tiny metal buddhas (see below) into oysters, around which the pearls developed.

