Section 2 Cidarians

Objectives

- **Describe** the two cnidarian body forms. 8C TAKS 2
- **Summarize** how cnidocytes function. 10A TAKS 2
- **Summarize** the life cycle of *Obelia*. 8B
- **Compare** three classes of cnidarians. 8C TAKS 2
- **Compare** asexual and sexual reproduction in cnidarians. 10A TAKS 2

Key Terms

medusa
polyp
cnidocyte
nematocyst
basal disk
planula

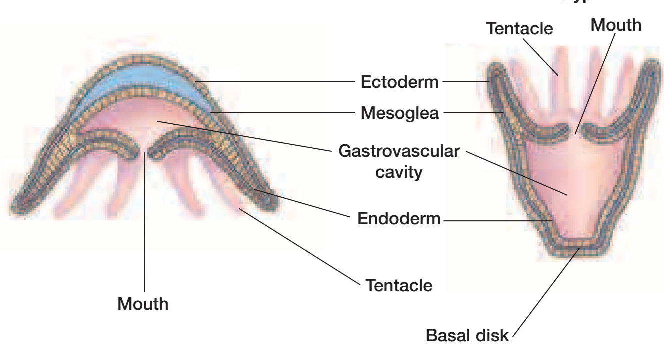
Two Body Forms

As the fragile bell of a jellyfish moves rhythmically through the water or the flowerlike sea anemone sways gently in the ocean currents, it's easy to be caught up in the mystery and beauty of these animals. But don't be deceived by their allure, for jellyfish and sea anemones are carnivores that can inflict a vicious sting. Along with hydras and corals, these animals belong to the phylum Cnidaria *(nih DAIR ee uh)*. Cnidarians have two basic body forms, as shown in **Figure 6,** and both show radial symmetry. **Medusa** *(muh DOO suh)* forms are free-floating, jellylike, and often umbrella-shaped. **Polyp** *(PAHL ihp)* forms are tubelike and are usually attached to a rock or some other object. A fringe of tentacles surrounds the mouth, located at the free end of the body. Many cnidarians exist only as medusas, while others exist only as polyps. Still others alternate between these two phases during the course of their life cycle. 1 2

The cnidarian body has two layers of cells, as illustrated by the hydra in **Figure 7.** The outer layer derives from ectoderm, and the inner layer derives from endoderm. As in the sponge, there is a middle layer of mesoglea. But cnidarians differ from sponges in that cnidarians' cells are arranged into tissues. 1 2

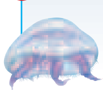
Figure 6 **Cnidarian body forms**

The two body forms of cnidarians—medusa and polyp—consist of the same body parts arranged differently.



Evolutionary Milestone

2 **Tissues**



The cnidarian body plan is more complex than that of a sponge—it contains specialized tissues that carry out particular functions. The tissues, however, are not organized into organs.

Cnidocytes

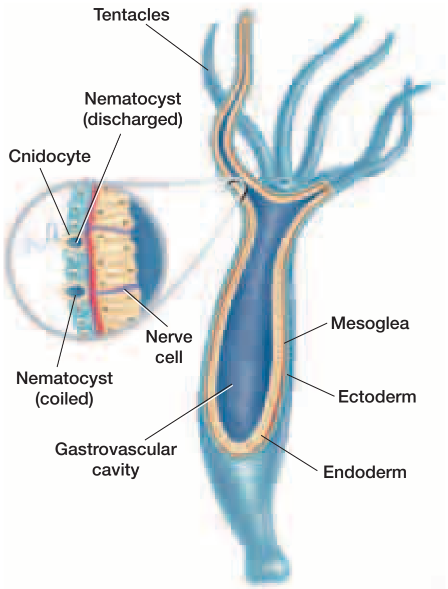
Flexible fingerlike tentacles surround the opening to the gastrovascular cavity of cnidarians. Located on the tentacles are stinging cells called **cnidocytes** *(NIH doh siets),* also shown in Figure 7. Cnidocytes are the distinguishing characteristic of the animals in the phylum Cnidaria. Within each cnidocyte is a small barbed harpoon called a **nematocyst** *(nehm AAH toh sihst).* Nematocysts are used for defense and to spear prey. Some nematocysts contain deadly toxins, while others contain chemicals that stun but do not kill. When triggered, the nematocyst explodes forcefully and sinks into the cnidarian's prey. The captured prey is then pushed into the cnidarian's gastrovascular cavity by the tentacles. 1

Extracellular Digestion

In cnidarians and all subsequent animal phyla, digestion begins extracellularly (outside the cell), in the gastrovascular cavity. Enzymes break food down into small fragments. Then cells lining the cavity engulf the fragments, and digestion is completed intracellularly. This allows cnidarians to feed on organisms larger than their own individual cells. 3

Figure 7 Cnidarian body plan

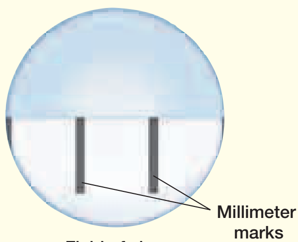
Like all cnidarians, this hydra is composed of tissues derived from endoderm and ectoderm.



MATH LAB

Estimating Size Using a Microscope 2A 2C 6D TAKS 1 TAKS 2

You can use the microscope to estimate the size of cnidarians that are too small to measure directly.



Materials

transparent millimeter ruler, compound microscope with low-power objective or a dissecting microscope, prepared slide of a medusa or polyp

Procedure

1. Identify the millimeter marks along the edge of the ruler.
2. With the microscope on low power (4× or lower), place the ruler on the stage and focus on the millimeter marks.
3. Adjust the ruler so that one edge lies across the diameter of the field, as shown above. Then measure the diameter of the field of view in millimeters.
4. Remove the ruler, and place the prepared slide on the stage. Identify the tentacles, gastrovascular cavity, and mouth.
5. Estimate the length and width of your organism as a ratio of the width of the field of view. For example, the length of your organism may appear to cover about two-thirds of the field of view.

MATH TAKS 8, 8.9B; TAKS 10, 8.14A, C

Analysis

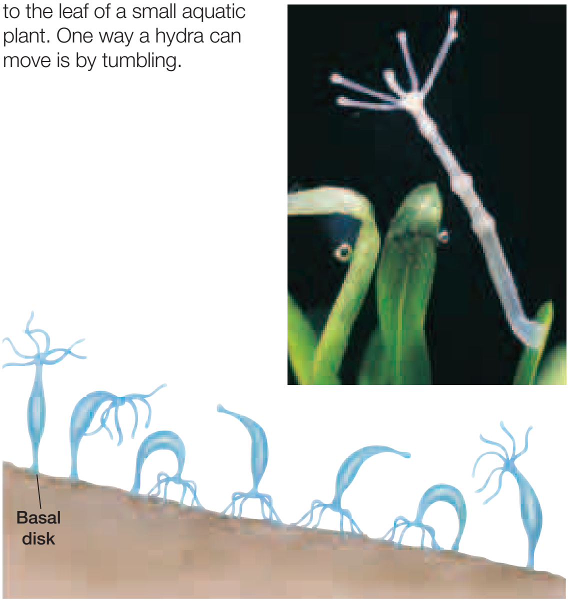
1. **Calculate** the size of your organism in millimeters by multiplying the ratio you found in step 5 by the width of the field of view you found in step 3.
2. **Describe** the body plan of the organism you viewed using terms from step 4.

Hydrozoans

The most primitive cnidarians are members of class Hydrozoa. Most species of hydrozoans are colonial marine organisms whose life cycle includes both polyp and medusa stages. Freshwater hydrozoans are less common, but are familiar to many people because they are often studied in school laboratories. 1

Figure 8 Freshwater hydra

This tiny hydra is attached to the leaf of a small aquatic plant. One way a hydra can move is by tumbling.



Freshwater Hydrozoa

The abundant freshwater genus *Hydra* is unique among hydrozoans because it has no medusa stage and exists only as a solitary polyp. Hydras live in quiet ponds, lakes, and streams. They attach to rocks or water plants by means of a sticky secretion they produce in an area of their body called the **basal disk**. Hydras can glide around by decreasing the stickiness of the material secreted by their basal disk. Sometimes hydras move by tumbling, as shown in **Figure 8.** To tumble, the hydra bends its body over and touches the surface it is attached to with its tentacles. Then it pulls its basal disk free, flipping it over to the other side of its tentacles. The basal disk then reattaches, and the hydra returns to an upright position. Most hydras are brown or white, like the one in Figure 8. Others appear green because of the algae living within their cells. 2 3

Marine Hydrozoa

Marine hydrozoans are typically far more complex than freshwater hydrozoans. Often many individuals live together, forming colonies. The cells of the colony lack the interdependence that characterizes the cells of multicellular organisms. However, they often exhibit considerable specialization. For example, the colonial Portuguese man-of-war (genus *Physalia*) incorporates both medusas and polyps. A gas-filled float (probably a highly modified polyp) allows *Physalia* to float on the surface of the water. Dangling below the float are tentacles that can reach 60 m (about 197 ft). These tentacles are used to stun and entangle prey. Their nematocysts are tipped with powerful neurotoxins (nerve poisons) that are dangerous and may be fatal to humans. *Physalia,* shown in **Figure 9,** has other specialized polyps and medusas, each carrying out a different function, such as feeding or sexual reproduction. 1 2

Reproduction in Hydrozoans

Most hydrozoans are colonial organisms whose polyps reproduce asexually by forming small buds on the body wall. The buds develop into polyps that eventually separate from the colony and begin living independently. Many hydrozoans are also capable of sexual reproduction. Some species of *Hydra* are hermaphrodites, but in most species the sexes are separate. 2

The genus *Obelia* is typical of many marine colonial hydrozoans. *Obelia* lives in colonies that form when one polyp asexually produces buds that do not separate from it. Eventually, there are numerous polyps attached to one stem, forming the colony. The *Obelia* colony shown in **Figure 10** is branched like deer antlers, with various polyps attached to the branched stalks. The reproductive polyps give rise asexually to male and female medusas. These medusas leave the polyps and grow to maturity in the ocean waters. 1 4

During sexual reproduction, the medusas release sperm or eggs into the water. The gametes fuse and produce zygotes that develop into free-swimming, ciliated larvae called **planulae** *(PLAN yoo lee)*. The planulae eventually settle on the ocean bottom and develop into new polyps. Each polyp gives rise to a new colony by asexual budding, and the life cycle is repeated. 1 4

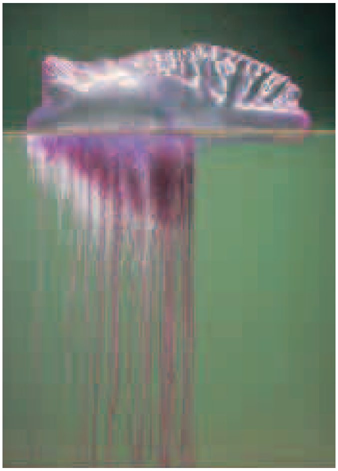


Figure 9 ***Physalia.*** A single Portuguese man-of-war colony can contain 1,000 individual medusas and polyps.

Figure 10 **Reproduction in *Obelia***

In *Obelia*'s life cycle, the medusa stage (sexual) and the polyp stage (asexual) alternate.

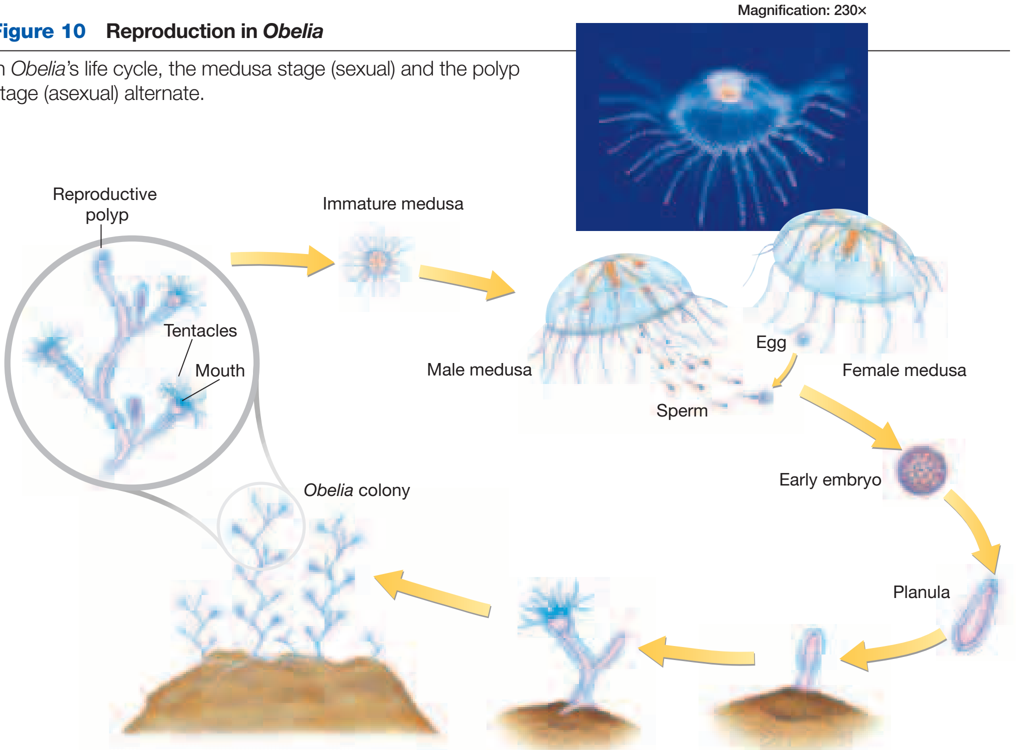
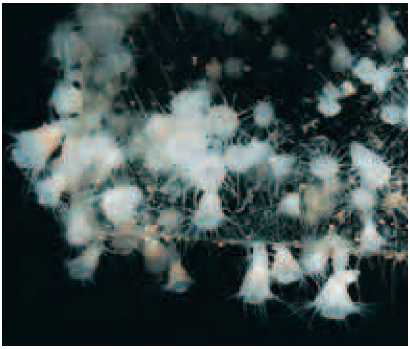


Figure 11 **Marine jellyfish *Aurelia*.** *Aurelia* polyps are about the size of hydras. The free-swimming medusas range from 10 cm (3.9 in.) to 25 cm (9.8 in.) in diameter.



Polyps

Medusa

WORD Origins

The name Scyphozoa is from the Greek *skyphos,* meaning "cup," and *zoia,* meaning "animal." The name refers to the fact that members of this class spend most of their lives as medusas, which have the shape of an inverted cup.

Scyphozoans

Cnidarians belonging to the class Scyphozoa *(sie fuh ZOH uh)* are the organisms usually referred to as true jellyfish. Scyphozoans are active predators that ensnare and sting prey with their tentacles. The toxins contained within the nematocysts of some species are extremely potent. Scyphozoans range in size from as small as a thimble to as large as a queen-size mattress. 1 2

The jellyfish seen in the ocean are medusas, which reproduce sexually. However, most species of jellyfish also go through an inconspicuous polyp stage at some point in their life cycle. The stinging nettle, *Aurelia,* shown in **Figure 11,** is one of the most familiar jellyfishes. *Aurelia*'s tiny polyps hang from rocky surfaces. Periodically the polyps release young medusas into the water. The *Aurelia* life cycle is similar to that of *Obelia,* pictured on the previous page. The major difference is that *Aurelia* spends most of its life as a medusa, while *Obelia* spends most of its life as a polyp. 1 2

Jellyfish Relatives

Related to the jellyfish are the cubozoans, or box jellies. As their name implies, cubozoans have a cube-shaped medusa. Their polyp stage is inconspicuous, and in some species, it has never been observed. Most box jellies are only a few centimeters in height, although some are 25 cm (10 in.) tall. A tentacle or group of tentacles is found at each corner of the "box." Stings of some species, such as the sea wasp, can inflict severe pain and even death among humans. The sea wasp lives in the ocean along the tropical northern coast of Australia. 1 2

Other relatives are members of the phylum Ctenophora *(tehn AW for uh),* which includes the comb jellies. Comb jellies differ from true jellyfish in two major ways—they have only a medusa stage and they have no cnidocytes. Their tentacles are covered with a sticky substance that traps plankton, the comb jelly's main prey. Although a comb jelly is only about 2.5 cm (1 in.) in diameter, its tentacles can be 10 times as long. 1 2

Anthozoans

The largest class of cnidarians is class Anthozoa. Anthozoans exist only as polyps. The most familiar anthozoans are the brightly colored sea anemones and corals. Other members of this class are known by such fanciful names as sea pansies, sea fans, and sea whips. 1

Anthozoans, such as the sea anemone shown in **Figure 12,** typically have a thick, stalklike body topped by a crown of tentacles that usually occur in groups of six. Nearly all of the shallow-water species contain symbiotic algae, such as dinoflagellates. The anthozoans provide a place for the dinoflagellates to live in exchange for some of the food that the dinoflagellates produce. The brilliant color of most anthozoans is actually that of dinoflagellates living within it. Some anthozoans reproduce asexually by forming buds, but they also reproduce sexually by releasing eggs and sperm into the ocean, where fertilization occurs. The fertilized eggs develop into planulae that settle and develop into polyps. 1 2

Figure 12 Sea anemone. When threatened, the sea anemone quickly retracts its tentacles and compresses its body.

Sea Anemones

Sea anemones are a large group of soft-bodied polyps found in coastal areas all over the world. Many species are quite colorful, and most do not grow very large, only from 5 mm (0.2 in.) to 100 mm (4.0 in.) in diameter. Sea anemones feed on fish and other marine life that happen to swim within reach of their tentacles. 2

Sea anemones are highly muscular and relatively complex animals. When touched, most sea anemones retract their tentacles into their body cavity and contract into a tight ball. Sea anemones often reproduce asexually by slowly pulling themselves into two halves. This method of reproduction often results in large populations of genetically identical sea anemones. 1 2

Corals

Most coral polyps live in colonies called reefs, such as the one shown in **Figure 13.** Each polyp secretes a tough, stonelike outer skeleton of calcium carbonate that is cemented to the skeletons of its neighbors. (Some corals called soft corals do not secrete hard exoskeletons.) Only the top layer of a coral reef contains living coral polyps. When coral polyps die, their skeletons remain and provide a

Figure 13 Coral. This coral reef is made up of hundreds of thousands of individual coral polyps. When the polyps feed (inset), they extend their tentacles from the protection of their stony skeleton.

foundation for new coral polyps. Over thousands of years, these formations build up into coral reefs where hundreds of thousands of polyps live together on top of old skeletons. Coral reefs are found primarily in tropical regions of the world, where the ocean water is warm and clear, an environment that is ideal for the corals and the dinoflagellates that live inside them.

TEXAS BIOWatch

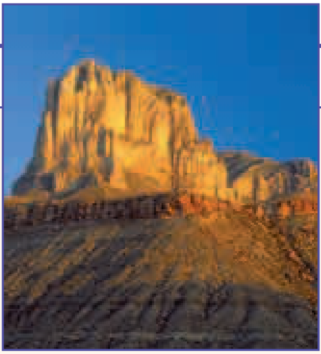
Texas's Inland Reef TAKS 3

One of the finest examples of an ancient fossil reef can be found in the Guadalupe Mountains of western Texas. This mountain range includes El Capitan, a massive limestone cliff, and Guadalupe Peak, the highest point in Texas at 2,667 m (8,749 ft). The Guadalupe Mountains comprise part of the Capitan Reef, which stretches from southeastern New Mexico as far south as Alpine, Texas.

History of the Capitan Reef

The Capitan Reef formed about 250 million years ago. At that time, the area that is now western Texas and southeastern New Mexico was covered by an inland sea, which was connected to the ocean by a narrow inlet. The area was located much closer to the equator than it is today. The warm inland sea hosted a rich diversity of organisms, including horn corals, sea urchins, flowerlike crinoids, clamlike brachiopods, and trilobites. Over several million years, the Capitan Reef formed as invertebrate skeletons accumulated and were cemented in place by encrusting organisms. Unlike modern reefs, which are built mainly by corals, the Capitan Reef was constructed by algae, sponges, and tiny colonial animals called bryozoans.

Eventually, the inland sea became separated from the ocean and began to dry up. Minerals precipitated out of the sea, forming thin bands of sediments that covered the reef over thousands of years. Around the same time, a great mass extinction occurred. Horn corals, trilobites, and many groups of sponges and algae died out, including most of the reef builders.



El Capitan

For 200 million years, the Capitan Reef lay buried under sediments. Then, about 26 million years ago, faulting lifted the reef 3 km above its original position. Wind and rain eroded the overlying sediments, revealing the reef once again.

Section 2 Review

1. **Compare** the two body forms of cnidarians. 8C
2. **Relate** cnidocytes and nematocysts to food gathering. 10A 11B
3. **Draw** and label the life cycle of *Obelia.* 3E 8B 8C
4. **Summarize** the similarities and differences in the three classes of cnidarians described. 8B 8C
5. **Distinguish** between the two types of asexual reproduction found in cnidarians. 10A
6. **Critical Thinking Forming Hypotheses** Some cnidarians are unique in exhibiting polyp and medusa forms. How might their two body forms give them an advantage over species that live in the same environment but have only one body form? 7B 8C
7. **TAKS Test Prep** In cnidarians, digestion takes place 10A
   - **A** only extracellularly.
   - **B** only intracellularly.
   - **C** in a gastrovascular cavity.
   - **D** in a digestive tract.