Radially Symmetrical Animals With Tissues: Phyla Cnidaria and Ctenophora

Note: These links do not work. Use the links within the outline to access the images in the popup windows. This text is the same as the scrolling text in the popup windows.

. How do animals with tissues differ from the sponges? (Page 1)

Cnidarian Phylogeny:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/cnidarian_phylogeny.html

As the first multicellular animals evolved, two lines diverged. In one line (the Parazoa) the simple, cellular level of organization was retained giving rise to the diversity of sponges that we recently viewed. In the other line (the Eumetazoa) cells became tightly bound into true tissues. This week, we will study the simplest animals in the Eumetazoan line: the radially symmetrical Cnidarians and comb jellies. Note that all other animals are bilaterally symmetrical and have a more complex body structure.

Cnidarian Tissue Layers:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/gastrodermis.html

This microscopic image is a cross section through the body wall of a Cnidarian. Note how tightly the cells are held together in both the epidermis and gastrodermis. This feature allows the epidermis to form a body covering that seals the inner tissues from the outside environment. Likewise, the gastrodermis lines the digestive cavity and prevents digestive juices from leaking into the body wall.

Symmetry: http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/symmetry.html

As we saw in our study of sponges, animals in the Parazoan line have no definitive symmetry. They can grow more or less randomly and often branch to form a variety of sizes and shapes. All of the Eumetazoa are symmetrical. Radially symmetrical animals have nearly identical body parts arranged around the main, central axis. They usually have no definite head and are often sessile. Bilaterally symmetrical animals are symmetrical along a plane dividing the body into right and left halves. This type of symmetry facilitates the development of a head and encourages mobility.

I. What is a Cnidarian? (Page 2)

Living Hydra:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/living_hydra.html

The hydra is a tiny animal commonly found in streams and ponds. It is one of the few Cnidarians that has adapted to a fresh water environment. The hydra possesses several features common to all Cnidarians, such as the circle of tentacles surrounding the mouth.

Hydra Diagram:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/hydra_diagram.html

All Cnidarians have a fluid-filled body cavity that serves both as a digestive space and a circulatory system. Some of the cells lining the cavity bear flagella to assist in circulation of the fluid. This distributes digested food and oxygen rich water throughout the body. Note that the cavity even extends into the tentacles. Unlike most animals, the internal cavity has only one opening to the exterior. While usually referred to as the nouth, this opening also serves as the anus to eject undigested food and wastes.

Hydra Mouth:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/hydra_mouth.html

he mouth can be seen in this stained hydra specimen. The mouth can open quite wide to allow the hydra to wallow large prey or to eject prey that cannot be subdued or is inedible.

Iydra Tissues:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/hydra_tissues.html

n this section of the hydra body wall, the two tissue layers, epidermis and gastrodermis are illustrated. The pidermis covers the body as contains several specialized cell types that will be described later. The astrodermis contains flagellated cells as well as cells that secrete digestive enzymes. The space between hese tissue layers is filled with a jelly-like substance called mesoglea. It is a thin layer in the hydra, but can e much thicker in some Cnidarians, especially the jellyfish.

Iydra Tentacles:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/hydra_tentacles.html

he tentacles of Cnidarians are equipped with specialized stinging cells that house capsules called ematocysts. Stinging cells are found throughout the epidermis in many Cnidarians, but are most abundant n the tentacles. They aid in feeding by paralyzing prey as well as in defense and sometimes in locomotion y anchoring the tentacles to a substrate. Some Cnidarians also have nematocysts within the gastrodermis to ubdue struggling prey that has been swallowed alive.

Iemotocysts:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/nematocysts.html

his image contains the diagram of a nematocyst on the left and a nematocyst within a living hydra on the ight. The stinging cell that houses the nematocyst bears a trigger that will discharge the nematocyst when timulated by touch or by certain chemicals. The nematocyst capsule is filled with fluid and contains a long, oiled filament bearing large barbs.

Iemotocyst Discharging:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/nematocyst_discharging.html

tudy the black and white diagram to watch a nematocyst discharge. When triggered, the capsule constricts nd fluid pressure causes the filament to evert and shoot outward, often with considerable force. The ilaments of some nematocysts contain small spines along the filament as well as larger barbs which may enetrate the body of a small prey animal. Toxins from within the filament are injected into the prey, aralyzing or killing it. The photograph of a discharged nematocyst from a hydra is shown in the inset. here are several different types of nematocyst. In addition to the type shown here, there are nematocysts acking barbs and poison, but with long sticky filaments that attach to prey or to any solid object they contact.

3ody Forms:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/body_forms.html

ll Cnidarians have either the polyp or the medusa shape. Actually, these two forms have more similarities han differences. Both have tentacles encircling the mouth, a central body cavity and two tissue layers with nesoglea between them. The medusa form is somewhat flattened with the mouth located ventrally. It also as a thicker layer of mesoglea which is firm and often functions as a support for the body.

'oly and Medusa:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/polyp_and_medusa.html

n these living Cnidarians, the polyp and medusa forms are easily distinguished. Note the thick, transparent nesoglea of the medusa. The medusa forms are typically called jellyfish and the mesoglea is the "jelly". ɔolyps typically spend most of their time attached at the base to a solid substrate and many are sessile. ⁄ledusae are much more mobile, they either float or travel through the water by contractions of the body.

II. What are the different kinds of Cnidarians? (Page 3-5)

Iythical Hydra:
ıttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/mythical_hydra.html

The name Hydra originally referred to an aquatic beast with nine heads. When Hercules cut off a head, ınother grew in its place making the monster difficult to kill. The real hydra has no head at all, but the entacles that surround the mouth will grow back if removed. Perhaps this accounts for the mythological ıame given to this Cnidarian.

Capturing Prey:
ıttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/capturing_prey.html

The hydra can capture a wide range of aquatic animals using its tentacles and stinging cells. After capture the ɔrey is brought to the mouth. The hydra is often ambitious, or at least not very discriminating, in the size of ɔrey that it attempts to capture!

Hydra Feeding:
ıttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/hydra_feeding.html

Prey often looks too big for the hydra to swallow, but somehow it manages to expand its mouth and stuff the ınimal down.

Hydra Digestion:
ıttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/hydra_digestion.html

Digestion in Cnidarians is a 2-part process. First, food is partially digested within the body cavity by ınzymatic secretions of the gastroderm. This is called extracellular digestion. Then, the partially digested ood is engulfed by cells of the gastroderm and digestion is completed within the resulting food vacuoles. This second step is intracellular digestion and closely resembles that found in many protozoans and in ponges.

Hydra Attached:
ıttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/hydra_attached.html

Hydra attach to underwater objects, such as these plant leaves, and extend their tentacles while waiting for ɔrey.

Hydra Contraction:
ıttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/hydra_contraction.html

Cnidarians do not have muscle tissue, but both the epidermal and gastrodermal cells of hydra have contractile ibers at their base. When the epidermal fibers contract, the body or tentacles shorten. The fibers in the gastroderm are oriented in a circular pattern. Their contraction causes the body or tentacles to extend. If the pidermal fibers contract on only one side of the body, the body bends in that direction. Thus, contracting ibers can produce the variety of body and tentacle motions seen in the hydra.

ydra Tentacles Contracting:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/tentacles.html

'his hydra has extended two of its tentacles. Notice how quickly the tentacles can contract.

reen Hydra:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/green_hydra.html

Many hydra are bright green in color. Symbiotic green algae live within this hydra's body. The hydra uses ome of the sugars and oxygen produced by algal photosynthesis, whereas the algae have a safe home and an utilize the carbon dioxide produced by the hydra. These green hydra can survive for longer periods vithout food than most Cnidarians due to the symbiotic relationship.

ymbiotic Algae:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/symbiotic_algae.html

'his micrograph is a close up of a green hydra body. The spherical algae symbionts are clearly visible. The ive within the gastrodermal layer.

Rocky Coast:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/rocky_coast.html

Hydroid colonies may be found on coastal rocks exposed at low tide. Here a light brown hydroid is growing mong other marine animals and seaweed.

ydroid on Shell:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/hydroid_on_shell.html

Hydroids can attach to most underwater objects. Here an orange hydroid is growing on the shells of living nussels.

ydroid Colonies:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/hydroid_colonies.html

'he individual polyps within a hydroid colony are tiny, usually smaller than the Hydra, but the colony as a vhole can grow much larger. These two colonies are several cm long. Like most hydroids, these colonies re sessile. One colony is growing on kelp and the other on an underwater rock.

ydroid Sheath:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/hydroid_sheath.html

All hydroid colonies are surrounded by a protective sheath which can be thin and almost transparent as seen n this stained specimen or thick and rigid. The sheath surrounds each polyp and provides a haven into vhich the polyp can retract if threatened. Note that the sheath also covers the connecting branches between olyps.

iving Obelia:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/living_obelia.html

Obelia forms colonies 1 to 2 cm high. The small polyps with extended tentacles are actively feeding. They rovide the nourishment for other parts of the colony that do not feed.

'olyp Specialization:
ıttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/polyp_specialization.html

n this stained specimen, two common types of polyp can be distinguished. The feeding polyps are esponsible for capturing and digesting food, whereas the reproductive polyps reproduce asexually to create ree swimming offspring.

'eeding Polyp:
ıttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/feeding_polyp.html

n this living hydroid, the details of a feeding polyp are visible. Note the bumps on the tentacles. They :ontain nematocysts that allow the polyp to capture prey in a manner similar to the Hydra. Digestion occurs vithin each feeding polyp. Since the central cavities of all polyps are connected, nutrients can circulate hroughout the colony.

Reproductive Polyp:
ıttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/reproductive_polyp.html

'his reproductive polyp has no tentacles or mouth. It's sole purpose is to reproduce. Each of the spherical tructures within this polyp will develop into a medusa as the next stage in the hydroid life cycle. We will eturn to the topic of reproduction shortly.

Iydroid Diversity:
ıttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/hyroids_movie.html

Iere are more examples of hydroids. Note the unique shapes of each colony. In some hydroids the polyps ıre too small to be seen. The Fan hydroid is especially interesting. It resembles coral, but is actually a olonial hydroid.

'ire Coral:
ıttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/hydroid_coral.html

'his type of hydroid has tiny polyps and a massive sheath of calcium carbonate. Since any polyp supported y a calcaneous skeleton is called a coral, this species, which also has potent stinging cells, is known as fire :oral. However, it differs from most corals in several respects, such as the inability of the polyps to withdraw :ompletely into the sheath. The vast majority of corals are more closely related to sea anemones as we shall ee shortly.

iolitary Hydroid:
ıttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/solitary_hydroid.html

Aost marine hydroids are colonial, but a few live as solitary polyps. They often grow in small clusters like hose shown here.

iiphonophore:
ıttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/siphonophore.html

Ay candidate for the most spectacular type of Cnidarian is the siphonophore. These colonial hydroids start ife as a single polyp that develops a gas-filled float at its base, turns upside down, then buds to form several ypes of polyps and medusae. The siphonophore shown here has polyps with long tentacles to capture food, ınd medusae (called swimming bells) that contract to propel the colony through the water. Other polyps,

Two Siphonophores:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/two_siphonophores.html

Siphonophores can take an amazing variety of forms, but most have both polyps and medusae within the colony. The swimming bells of these two siphonophores are modified medusae, whereas the tentacle bearing members of the colony are polyps.

Portuguese Man-of-War:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/portuguese_man-of-war.html

The Portuguese man-of-war is a large siphonophore with nematocysts that can inject a potent toxin. It readily kills small fish when they swim into the long, trailing tentacles. Captured food items are passed to a non-stinging form of polyp for digestion. Note also the large gas-filled float. the Portuguese man-of-war has no swimming bells, but the sail-like extension on the float propels the colony along the water surface by wind power.

Beached Man-of-War:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/beached_man-of-war.html

This Portuguese man-of-war has washed up on the beach as often happens after storms. The colony has no control over its direction and will drift with the prevailing wind or ocean currents. The float in this specimen is still filled with gas.

Jellyfish Abundance:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/jellyfish_abundance.html

Jellyfish are almost entirely marine and very common throughout the world. At certain times of the year, jellyfish become so numerous that the water in some locations is thick with them. The medusa shape is evident in this congregation of jellyfish.

Jellyfish Mesoglea:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/jellyfish_mesoglea.html

Like all Cnidarians, jellyfish have a layer of mesoglea between the epidermal and gastrodermal tissues. Jellyfish mesoglea much thicker than that of hydroids and contains fibers for further stiffening. The raised dome of this dead jellyfish is thick and firm due to the jelly-like mesoglea within.

Jellyfish Body:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/jellyfish_body.html

The body of the jellyfish is dome-shaped and called the umbrella. Tentacles are attached to the umbrella periphery and the mouth is centrally located on the underside. This typical medusa form resembles a polyp turned upside down and flattened.

Jellyfish Arms:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/jellyfish_arms.html

We are viewing this jellyfish from the underside, and the umbrella shape of the body can be clearly seen. Several long extensions of tissue called oral arms surround the mouth. These structures assist in feeding by guiding food into the mouth and sometimes bear nematocysts.

'ellyfish Canals:
ıttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/jellyfish_canals.html

Due to its body shape, the body cavity of the jellyfish is more complex than that of a polyp. It consists of a nouth, main body cavity (sometimes called a stomach), and a series of canals that travel through the nesoglea. Radial canals connect the main cavity to a ring canal that runs around the edge of the umbrella ınd connects to the cavities within the tentacles. Thus, circulating water and digested food are delivered to ıll living tissues within the jellyfish. In some species, outpocketings of the main cavity are present to assist in he digestion of large prey.

Canals in Umbrella:
ıttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/canals_in_umbrella.html

n this jellyfish, a network of small canals can be seen running through the umbrella from the central body avity to the periphery.

Swimming Movements:
ıttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/swimming.html

This small jellyfish is stuck in a dish. It is trying to escape by vigorously contracting the umbrella. This ısually generates a type of "jet propulsion" by ejecting water from beneath the umbrella cavity. In this case hough, water surrounding the jellyfish is too shallow and the animal cannot swim. Note also that the ellyfish is upside down in this view.

'ellyfish Prey:
ıttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/jellyfish_prey.html

The Lion's Mane jellyfish shown here is a voracious predator. It swims slowly with tentacles trailing until a ish or other small animal is snared. Nematocysts on the tentacles function as in the hyroids to paralyze prey, ınd numerous oral arms carry it to the mouth. In the lower picture, the Lion's Mane has captured a fish. In he upper, it is beginning to swallow a small jellyfish.

Plankton Feeding:
ıttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/plankton_feeding.html

The moon jellyfish, shown here, has very small tentacles. Instead of snaring and paralyzing prey, it feeds oı plankton. It swims to the surface of the water, then slowly descends. Tiny food organisms become trappe on the sticky underside of the umbrella and are carried to the umbrella's edge by beating cilia. They are theı scraped off by the oral arms and eaten. This jellyfish is very common in coastal waters throughout the world.

Small Jellyfish:
ıttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/small_jellyfish.html

Some jellyfish are only a few centimeters in diameter. This one captures prey by spreading its long tentacles ınd descending through the water. Small animals, such as crustaceans, are trapped in the tentacle "net".

Large Jellyfish:
ıttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/large_jellyfish.html

These two species of jellyfish grow to a meter or more in diameter. They are among the largest animals without a backbone. The stiff layer of jelly that supports the body, allows jellyfish to attain such a large size.

Thick Arms:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/thick_arms.html

Some species of jellyfish, like those seen here, have especially thick and intricately structured oral arms.

Colorful Jellyfish:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/colorful_jellyfish.html

Although many jellyfish are transparent or lightly tinted, some have colorful patterns on the umbrella. The jellyfish on the left is called the Compass jellyfish because of its markings. It is one of the most common jellyfish, especially along the Atlantic coast of Europe.

Stalked Jellyfish:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/stalked_jellyfish.html

There are even some stalked species. This strange looking Trumpet jellyfish attaches to a solid object by an adhesive pad at the base of the stalk and hangs in the water awaiting prey. Its tentacles are in clusters at the points of the star-shaped umbrella.

Live Stalked Jellyfish:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/live_jellyfish.html

Observe the movements and clusters of fine tentacles in this cute stalked jellyfish filmed by a student.

Bioluminescence:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/bioluminescence.html

Animals that live in the deeper parts of the ocean are often bioluminescent, that is they give off flashes of light much like that of a firefly. Presumably the light serves as a signaling device in an otherwise dark world. Two bioluminescent jellyfish are seen here. The animal at the bottom is not a jellyfish, but we have seen it before. It is a siphonophore that is also lives in the deep ocean and is bioluminescent.

Freshwater Jellyfish:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/freshwater_jellyfish.html

You probably have never seen a freshwater jellyfish, but they live in ponds and lakes throughout America. These small jellyfish feed on tiny planktonic animals and often increase to large numbers in late summer, when plankton is most abundant. The jellyfish seen here is capturing plankton by descending through the water.

Box Jelly: http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/box_jelly.html

The Box Jellies are usually pale blue and almost transparent. The body is shaped like a bell or a box and has four distinct sides. Box jellies can reach a size of 20 cm in diameter with tentacles up to 3 meters long. In some species, the tentacles are branched.

Sea Wasp: http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/sea_wasp.html

Box Jellies of the tropical Pacific ocean are known as sea wasps. The venom of these jellies can kill a human within 10minutes.

\nemone Pharynx:
ıttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/anemone_pharynx.html

:he polyp body form of sea anemones and corals is similar to that of the Hydra. There are two major lifferences however: the mouth extends inward to form a tube called the pharynx and the body cavity is livided into compartments by partitions that extend from the inner body wall to the pharynx.

'artitions: http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/partitions.html

:he body of this anemone has been cut across the middle to reveal the pharynx and body cavity in cross ection. Numerous partitions can be seen extending inward like the spokes of a wheel. Although the ›artitioning forms compartments within the body cavity, fluids can freely circulate through openings at the ›ase of each partition. Corals have a similar body plan.

Vater Circulation:
ıttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/water_circulation.html

:his image is a close-up view of the mouth in a living anemone. Water is pulled into the mouth through one ›r more grooves that are lined with long cilia. The grooves continue down the pharynx and the beating cilia ›ull a water current into the body cavity. Shorter cilia located around the remainder of the mouth and ›harynx beat in the opposite direction and expel water though the center of the mouth. This creates a ·ontinuous water flow through the body of the animal.

›hape Changes:
ıttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/shape_changes.html

3oth anemones and corals can extend and contract the body. Dramatic changes in size can occur when a arge amount of fluid is either taken into the body or expelled. These animals can also retract their tentacles ınd deflate the body to a small lump.

›ea Anemone:
ıttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/sea_anemone.html

›ea anemone means "flower of the sea" and this anemone with its tentacles spread certainly does resemble a lower.

\nemone Body:
ıttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/anemone_body.html

Jnlike a flower, the sea anemone has a broad body column which rests on a large, flat structure called the ›asal disk. The anemone may remain in one spot for lengthy periods, but can easily glide along a surface by novements of this disk.

\nemones Attached:
ıttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/anemones_attached.html

:hese anemones are using their basal disks to attach to an underwater rope. Attachment can be quite strong, ınd trying to remove them often pulls the anemone apart before the basal disk lets go.

\nemone Moving:
ıttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/anemone_moving.html

his anemone has extended its basal disk as it begins to move to a new location.

nemone Tentacles:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/anemone_tentacles.html

ooking down at the mouth of this anemone, we can see the tentacles spread to capture prey. The anemone vaits until an animal comes within reach and then springs into action. The tentacles whip out and ematocyts discharge to snare and paralyze the prey.

nemone Feeding:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/anemone_feeding.html

he anemone on the left is swallowing a crab. The other anemone has captured a fish. Although the tinging nematocysts of sea anemones can paralyze a small animal, they are too weak to penetrate human kin.

nemone Feeding:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/tiny_prey.html

his anemone in the Monterey Bay aquarium is feeding on minute animals swimming in the water. Note how t uses tentacles to transfer captured food to its mouth. Fifteen minutes of feeding have been compressed to 0 seconds in this video.

hort Tentacles:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/short_tentacles.html

his anemone has short, fine tentacles and feeds on plankton.

lankton Feeder:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/plankton_feeder.html

he short tentacles of a this plankton feeding anemone are clustered around grooves. Tiny food organisms tick to the tentacles and are carried into the mouth.

igestion: http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/digestion.html

his preserved anemone has been split lengthwise to show the pharynx entering the body cavity. The botton f the cavity is filled with coiled threadlike structures that secrete potent enzymes. The partitions within the avity create a large surface area for absorption of the partially digested food and digestion is then completed ntracellularly as in hydroids. The concentrated enzymes and increased surface area allow anemones to ligest large prey. Indigestible parts, such as shells of snails and the carapace of crabs are ejected from the nouth following a meal.

reen Anemone:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/green_anemone.html

t is common for anemone living in shallow water to harbor photosynthetic organisms around the mouth and vithin the tentacles. This anemone houses green algae and utilizes their photosynthetic products much like he green hydra we saw earlier.

nemone and Shrimp:

his tiny cleaner shrimp is living on the tentacles of an anemone. It keeps the tentacles and mouth area free f debris which benefits the anemone. The shrimp is protected from predators by its carnivorous host.

lown Fish:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/clown_fish.html

he clown fish is frequently found in association with anemones. Its body is covered with a special type of nucus that prevents the anemone from stinging or eating it.

lown Fish and Anemone:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/clown_fish_movie.html

he clown fish benefits by living among the anemone's tentacles where it is safe from predators. It assists ir eeping the area around the anemone's mouth free of debris by stirring the water with its swimming motions he clown fish and anemone may also share some food.

ntertidal Zone:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/intertidal_zone.html

he intertidal zone is the region of coastline that is exposed when the tide is out and completely covered by igh tide. In this photograph, the tide is out and marine plants and animals can be seen covering the exposed ocks. A closer view would show anemone here, clinging to the rocks amid the plant life.

idepool: http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/tidepool.html

idepools are hollows along the rocky coastline that remain filled with water at low tide. Here we see two reen anemone feeding in a tidepool.

urrowing Anemone:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/burrowing_anemone.html

hese tube anemone live in deeper parts of the sea. They lack a basal disk, but use a rounded basal end to lig a burrow. Strong muscle fibers in the body column enables them to pull down and disappear into their urrow in the blink of an eye. Often only tentacles are visible above the sea bed.

losed Anemone:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/closed_anemone.html

Vhen an anemone is threatened or when it is exposed at low tide as shown here, it deflates, retracts its entacles and seals the mouth opening. This protects the fragile parts of the animal from predators or, in the nemone shown here, from drying out.

arpet Anemone:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/carpet_anemone.html

his anemone lives in deeper parts of the ocean. Broad folds around the mouth bear short, densely packed entacles. When many of these animals are living side by side they resemble a carpet on the sea bed.

olorful Anemones:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/colorful_anemones.html

Here are some examples of the many brilliant colors found in sea anemones. My favorite is the one at the lower right.

Coral Colony: http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/coral_colony.html

In this colony of cup corals, some of the polyps are extended with their tentacles spread, whereas others have closed and retracted into their piece of the skeleton. As in almost corals, the members of the colony are in contact with one another through the fused branches of the skeleton.

Coral Closed: http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/coral_closed.html

Corals that live in shallow water usually close during the day, when their food supply is less abundant. In this brain coral, the polyps have retracted into the grooves of the skeleton.

Coral Feeding: http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/coral_feeding.html

At night, the brain coral polyps spread their tentacles to feed. Plankton rise to the surface at night and are trapped on the tentacles by sticky threads discharged from nematocysts.

Coral Reef: http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/coral_reef.html

Many of the corals that live in warm, shallow water are reef builders. This photograph is part of a Hawaiian reef exposed at low tide. A variety of coral species are living in close proximity as in common in the tropical climates. Reefs provide important habitats for a variety of animal life, and play an important role in the ecosystem. You will learn about coral reef communities from Dr. Heatwole later in the course.

Coral Diagram: http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/coral_diagram.html

The corals that build reefs belong to a group that are closely related to sea anemones. Note the resemblance of the polyp body to that of an anemone. The common name "stony coral" reflects the rock-like nature of the skeleton. It is composed of calcium carbonate secreted from the base of each polyp. Polyp bodies sink into depressions within the skeleton and skeletal plates protrude upward, making indentations between the partitions of the body cavity. As polyps increase their number by asexual reproduction, more skeleton is secreted and the reef grows. All members of a colony are joined by connections at the lower body cavity.

Stony Corals: http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/stony_corals.html

The rock like consistency of stony corals is evident in these examples. On the left we see living corals and on the right, the skeleton of a dead brain coral. Polyps are only present on the coral surface, so this ball of brain coral grew for many years with the inner polyps dying as new layers were added at the periphery. Coral beds increase their height in a similar manner.

Coral Symbionts: http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/coral_symbionts.html

All of the reef building corals harbor photosynthetic symbionts. Without the extra nutrients provided by olyps on the left have a normal association with green symbionts, but on the right, the symbionts are gone nd polyps are dying.

leached Coral:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/bleached_coral.html

Vhen environmental conditions become unfavorable, symbionts are ejected from the polyps which ubsequently die. This is called coral bleaching, since the remaining skeleton has a white, chalky ppearance. Bleaching can be caused by water pollution or changes in water temperature. Warming of the vater by only one or two degrees can cause bleaching, with eventual death in large areas of reef.

orthern Coral:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/northern_coral.html

he reef building corals can only live in warm climates and at water depths of less than 100 feet. However, nany other species of stony coral inhabit colder deeper waters. These corals usually lack photosynthetic ymbionts and are slow growing forms. The living coral in the left was found in the waters of North Carolina, but similar corals are common all along the northern coast of America and occur as far north as Norway. In the dead coral on the right, skeletal plates can be seen within the depressions vacated by polyps.

tony Coral Skeleton:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/stony_coral_skeleton.html

Here is another species of stony coral. Small bits of coral skeleton are commonly found on beaches hroughout the world.

Iushroom Coral:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/mushroom_coral.html

he mushroom coral is highly unusual. It is a single polyp encased in a calcareous skeleton, and is huge for a oral; the single polyp may grow to a diameter of 50 cm. Unlike other coral, the mushroom can actually nove from place to place. The specimen on the left is living on Australia's Great Barrier Reef. Small entacles are visible emerging from its surface. On the right, we see the cleaned skeleton of this coral which as characteristic grooves radiating from the mouth.

oral Polyps:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/coral_polyps.html

his second type of coral has a somewhat different polyp and produces a skeleton that is soft or horny rather han rock-like. The polyps of all such corals are remarkable similar, having exactly 8 tentacles which are lightly branched or fringed.

keleton Diagram:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/skeleton_diagram.html

he skeletal material is secreted into the mesoglea of the body and connecting branches of the colony and hus surrounds the entire polyp body. Some species also have a compacted cylinder of skeleton within the onnecting tubes as shown here. This harder material is the source of most coral jewelry.

oft Corals: http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/soft_corals.html oft corals have only calcium carbonate spicules for support and are usually quite flexible. The soft coral on he right is shown close-up which allows the tiny polyps to be seen.

Gorgonian Coral:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/gorgonian_coral.html

Gorgonian corals are widespread, but especially common in the tropics where a large number of species may e found. A horny skeleton stiffens the branches of the colony, but most gorgonians retain some flexibility. In his colony, tentacles of the tiny polyps are extended and visible if you look closely.

Gorgonian Diversity:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/gorgonian_movie.html

Here we see some common types of gorgonian coral: the sea plumes, sea fans and sea whips. All of these orals have very small polyps. In the close-up view of a sea whip skeleton, openings that contained the olyps are indicated by arrows.

V. Do Cnidarians have a nervous system? (Page 6)

Nerve Net: http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/nerve_net.html

The nerve cells of Cnidarians are linked to form a net that extends through the body column and into the entacles. Nerve impulses can be conducted in both directions along the nerve fibers and spread outward from he site of a stimulus. The nerve net has the basic elements found in nervous systems of more advanced nimal groups, but unlike most animals there is no brain or concentrations of nerve cell bodies.

Cnidarian Coordination:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/cnidarian_coordination.html

n this cross section of a polyp body, location of the nerve cells may be seen. Note that nerve fibers run hrough the base of both the epidermal and gastrodermal layers. Specialized sensory cells that can detect hemical or mechanical stimuli are also found in both layers. Thus a touch to the epidermis is detected by ensory cells, and nerves signal muscle fibers to contract allowing the animal to respond by appropriate body novements. Nematocyst discharge may also be initiated by nerves. Sensory cells within the gastrodermis an sense the presence of food and stimulate the gland cells to secrete enzymes. Or they can detect the resence of foreign matter and stimulate its ejection by muscle fiber contraction within the body wall.

Medusa Senses:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/medusa_senses.html

Most medusae have special sensory structures at the base of each tentacle. These structures sense light and gravity allowing the medusa to move toward or away from light and to properly orient the umbrella during eeding and swimming.

Sensory Structures:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/sensory_structure.html

This diagram shows the sensory structure at the base of a jellyfish tentacle. The so called "eye spot" is a group of cells sensitive to light. The statocyst contains granules that move freely within the hollow center of he structure. As the umbrella tilts, the movement of granules due to gravity is detected by sensory cells the ine the cavity. This allows the jellyfish to change the orientation of its body as appropriate.

/. How do Cnidarians reproduce? (Page 7)

Iydra Budding:
ιttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/hydra_budding.html

'he Hydra can easily replace missing tentacles. If a hydra is cut into several pieces, a new polyp will often orm from each piece. Animals with such potent powers of regeneration can usually reproduce asexually. 'he Hydra does so by forming buds along the body column. After attaining sufficient size, each bud letaches and becomes a new hydra.

\nemone Budding:
ιttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/anemone_budding.html

\ bud complete with tentacles has grown from the body column of this anemone.

\nemone Splitting:
ιttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/anemone_splitting.html

\nemones commonly reproduce by a rather bizarre type of splitting. The uppermost anemone in this ›hotograph is pulling itself apart and will soon break into two separate individuals.

/ledusa Gonads:
ιttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/medusa_gonads.html

n this small medusa, the gonads are orange. Sexes are separate in most medusae, so the gonads will produce ither eggs or sperm. Location of the gonads on the underside of the umbrella is typical and also seen in arge jellyfish.

Iydroid Life Cycle:
ιttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/hydroid_life_cycle.html

/Vhen a Cnidarian has both body types in its life cycle, the polyp always reproduces asexually. The eproductive polyps of the colony bud to form small medusae. The medusae reproduce sexually and the ertilized egg develops into a larval form called a planula. The planula is a small, flattened ball which uses ilia to swim to a suitable attachment site. The attached larva grows into a young polyp which branches and ›uds to form a new colony.

)belia Medusa:
ιttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/obelia_medusa.html

'his living medusa is viewed from the ventral side. It is the sexual stage of Obelia, the colonial hydroid lescribed earlier. Like most hydroid medusae, it is small and short lived, but can swim to a location far ·nough from its sessile parent to avoid competition between parent and new daughter colonies.

'ellyfish Life Cycle:
ιttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/jellyfish_life_cycle.html

/lost jellyfish also alternate between polyp and medusa forms, but the medusa is clearly prominent. The ιdult jellyfish produces eggs or sperm. The sperm are released into the water, but many species retain their ·ggs within the body. Sperm from a male jellyfish enter the body of the female with incoming water. The ertilized eggs are ejected through the mouth and develop into planula larvae which attach and grow into sexually by splitting horizontally to form young jellyfish.

Iydra Reproduction:
ıttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/hydra_reproduction.html

\t certain times of the year, usually fall or winter, hydra reproduce sexually. Some species are ıermaphroditic, producing both eggs and sperm, while others (as shown in the diagram) have separate sexes. 'he gametes develop from unspecialized cells in the epidermis, giving rise to clusters that protrude from the ›ody. These bulges are called testes and ovaries although they are not true organs. Sperm are released into he water and fertilize a ripe egg that is extruded from an ovary. Fertilized eggs are released into the water ınd develop into new hydra polyps. Typically the new hydra begins to reproduce asexually as soon as it natures.

'oral Spawning:
ıttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/coral_spawning.html

ea anemones and coral also reproduce sexually, giving rise to planula larvae that attach and grow into new ›olyps. The two species of coral shown here are spawning by releasing eggs and sperm into the sea. /lembers of the same species usually spawn together to assure that fertilization occurs.

/I. Are Cnidarians important to humans? (Page 8)

'ire Corals: http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/fire_corals.html

'ire corals are common in warm, tropical waters. The are tan or yellow in color and can have either a ›ranched orplate-like shape. Their long, thin polyps can deliver an irritating sting.

'ire Coral Encounter:
ıttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/fire_coral_encounter.html

\lthough the fire corals pose little threat to human health, they can inflict a painful rash.

'ellyfish Encounter:
ıttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/jellyfish_encounter.html

'hese jellyfish can reach a size of 2.5 meters across with tentacles 40 meters long! They can deliver serious tings.

/Ian-of-War Encounter:
ıttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/man-of-war_encounter.html

f you see the blue float of this siphonophore, swim the other way! The tentacles may be hard to see beneath he water and can reach a length of 20 meters. They are equipped with especially large and powerful ıematocysts that can produce painful weals on the human body.

'ommon Box Jelly:
ıttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/common_box_jelly.html

'his common box jelly is only 2-3 cm in diameter. Its painful sting is rarely fatal, but at least one death has ›een documented.

ustralian Sea Wasp:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/australian_sea_wasp.html

he sea wasps are deadly. Fortunately, they are only present in coastal waters at certain times of the year. Varning signs on Australian beaches indicate the presence of this deadly box jelly.

ea Wasp Stings:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/sea_wasp_stings.html

he venom injected from sea wasp tentacles results in death unless treated immediately. Although Australian re well aware of the danger and take care not to encounter sea wasps, there are still two or more fatalities pe ear.

recious Coral:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/precious_coral.html

he so called "precious" corals provide material for jewelry. The orange color is most familiar, but blue orals are also used.

eef Community:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/reef_community.html

oral reefs provide habitats for an entire community of animals, including, crustaceans, worms, other nidarians and many species of fish. Dr. Heatwole will discuss the biodiversity of reefs later in the course.

nderwater Scene:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/underwater_scene.html

he major contribution of cnidarians to human life may be the sheer beauty that they provide as all snorkelers nd scuba divers can attest.

'II. How do the comb jellies (Phylum Ctenophora) differ from the Cnidarians? (Page 9)

omb Jelly Diagram:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/comb_jelly_diagram.html

his common marine dweller, called the gooseberry, is typical of the comb jellies. Rows of comb plates adiate over the body. Each plate consists of many combs formed by horizontal rows of cilia. These cilia use to one another forming the "teeth" of the combs. Beating of the cilia provides a slow, but graceful wimming motion. The tentacles of comb jellies bear adhesive filaments rather than nematocysts. As the nimal swims, the tentacles trail through the water snaring small crustaceans and fish. The tentacles can be etracted into sheaths when not in use. Although the body of these animals is radially symmetrical, the resence of a tentacle on each side adds a bilateral aspect, and comb jellies are technically biradial in form.

lternate Forms:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/alternate_forms.html

ome comb jellies have short, fine tentacles and feed on plankton. Others, like the one shown here on the eft, lack tentacles and capture soft bodied animals by engulfing them into the mouth. Still other forms, like he one on the right, are flattened, with comb plates along the edges of the body.

Comb Jellies:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/comb_jellies.html

The relationship between comb jellies and jellyfish is apparent when one sees a living animal. The transparent bodies of comb jellies are filled with the same jelly-like mesoglea that supports the jellyfish body. Can you find the comb plates on these two specimens?

Nocturnal Scene:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/nocturnal_scene.html

Bioluminescence gives comb jellies a striking appearance at night as their comb plates and tentacles light up.

Anemone Pharynx:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/anemone_pharynx.html

The polyp body form of sea anemones and corals is similar to that of the Hydra. There are two major differences however: the mouth extends inward to form a tube called the pharynx and the body cavity is divided into compartments by partitions that extend from the inner body wall to the pharynx.

Partitions: http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/partitions.html

The body of this anemone has been cut across the middle to reveal the pharynx and body cavity in cross section. Numerous partitions can be seen extending inward like the spokes of a wheel. Although the partitioning forms compartments within the body cavity, fluids can freely circulate through openings at the base of each partition. Corals have a similar body plan.

Water Circulation:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/water_circulation.html

This image is a close-up view of the mouth in a living anemone. Water is pulled into the mouth through one or more grooves that are lined with long cilia. The grooves continue down the pharynx and the beating cilia pull a water current into the body cavity. Shorter cilia located around the remainder of the mouth and pharynx beat in the opposite direction and expel water though the center of the mouth. This creates a continuous water flow through the body of the animal.

Shape Changes:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/shape_changes.html

Both anemones and corals can extend and contract the body. Dramatic changes in size can occur when a large amount of fluid is either taken into the body or expelled. These animals can also retract their tentacles and deflate the body to a small lump.

Sea Anemone:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/sea_anemone.html

Sea anemone means "flower of the sea" and this anemone with its tentacles spread certainly does resemble a flower.

Anemone Body:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/anemone_body.html

Jnlike a flower, the sea anemone has a broad body column which rests on a large, flat structure called the basal disk. The anemone may remain in one spot for lengthy periods, but can easily glide along a surface by novements of this disk.

Anemones Attached:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/anemones_attached.html

These anemones are using their basal disks to attach to an underwater rope. Attachment can be quite strong, and trying to remove them often pulls the anemone apart before the basal disk lets go.

Anemone Moving:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/anemone_moving.html

This anemone has extended its basal disk as it begins to move to a new location.

Anemone Tentacles:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/anemone_tentacles.html

Looking down at the mouth of this anemone, we can see the tentacles spread to capture prey. The anemone waits until an animal comes within reach and then springs into action. The tentacles whip out and nematocyts discharge to snare and paralyze the prey.

Anemone Feeding:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/anemone_feeding.html

The anemone on the left is swallowing a crab. The other anemone has captured a fish. Although the stinging nematocysts of sea anemones can paralyze a small animal, they are too weak to penetrate human skin.

Anemone Feeding:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/tiny_prey.html

This anemone in the Monterey Bay aquarium is feeding on minute animals swimming in the water. Note how it uses tentacles to transfer captured food to its mouth. Fifteen minutes of feeding have been compressed to 0 seconds in this video.

Short Tentacles:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/short_tentacles.html

This anemone has short, fine tentacles and feeds on plankton.

Plankton Feeder:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/plankton_feeder.html

The short tentacles of a this plankton feeding anemone are clustered around grooves. Tiny food organisms stick to the tentacles and are carried into the mouth.

Digestion: http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/digestion.html

This preserved anemone has been split lengthwise to show the pharynx entering the body cavity. The bottom of the cavity is filled with coiled threadlike structures that secrete potent enzymes. The partitions within the ntracellularly as in hydroids. The concentrated enzymes and increased surface area allow anemones to ligest large prey. Indigestible parts, such as shells of snails and the carapace of crabs are ejected from the nouth following a meal.

Green Anemone:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/green_anemone.html

t is common for anemone living in shallow water to harbor photosynthetic organisms around the mouth and vithin the tentacles. This anemone houses green algae and utilizes their photosynthetic products much like he green hydra we saw earlier.

Anemone and Shrimp:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/anemone_and_shrimp.html

This tiny cleaner shrimp is living on the tentacles of an anemone. It keeps the tentacles and mouth area free of debris which benefits the anemone. The shrimp is protected from predators by its carnivorous host.

Clown Fish:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/clown_fish.html

The clown fish is frequently found in association with anemones. Its body is covered with a special type of nucus that prevents the anemone from stinging or eating it.

Clown Fish and Anemone:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/clown_fish_movie.html

The clown fish benefits by living among the anemone's tentacles where it is safe from predators. It assists in keeping the area around the anemone's mouth free of debris by stirring the water with its swimming motions The clown fish and anemone may also share some food.

Intertidal Zone:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/intertidal_zone.html

The intertidal zone is the region of coastline that is exposed when the tide is out and completely covered by iigh tide. In this photograph, the tide is out and marine plants and animals can be seen covering the exposed ocks. A closer view would show anemone here, clinging to the rocks amid the plant life.

Tidepool: http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/tidepool.html

Tidepools are hollows along the rocky coastline that remain filled with water at low tide. Here we see two green anemone feeding in a tidepool.

Burrowing Anemone:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/burrowing_anemone.html

These tube anemone live in deeper parts of the sea. They lack a basal disk, but use a rounded basal end to lig a burrow. Strong muscle fibers in the body column enables them to pull down and disappear into their burrow in the blink of an eye. Often only tentacles are visible above the sea bed.

Closed Anemone:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/closed_anemone.html

Vhen an anemone is threatened or when it is exposed at low tide as shown here, it deflates, retracts its entacles and seals the mouth opening. This protects the fragile parts of the animal from predators or, in the anemone shown here, from drying out.

Carpet Anemone:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/carpet_anemone.html

This anemone lives in deeper parts of the ocean. Broad folds around the mouth bear short, densely packed entacles. When many of these animals are living side by side they resemble a carpet on the sea bed.

Colorful Anemones:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/colorful_anemones.html

Here are some examples of the many brilliant colors found in sea anemones. My favorite is the one at the ower right.

Coral Colony:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/coral_colony.html

n this colony of cup corals, some of the polyps are extended with their tentacles spread, whereas others have closed and retracted into their piece of the skeleton. As in almost corals, the members of the colony are in contact with one another through the fused branches of the skeleton.

Coral Closed:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/coral_closed.html

Corals that live in shallow water usually close during the day, when their food supply is less abundant. In his brain coral, the polyps have retracted into the grooves of the skeleton.

Coral Feeding:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/coral_feeding.html

At night, the brain coral polyps spread their tentacles to feed. Plankton rise to the surface at night and are rapped on the tentacles by sticky threads discharged from nematocysts.

Coral Reef: http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/coral_reef.html

Many of the corals that live in warm, shallow water are reef builders. This photograph is part of a Hawaiian eef exposed at low tide. A variety of coral species are living in close proximity as in common in the tropical climates. Reefs provide important habitats for a variety of animal life, and play an important role in the ecosystem. You will learn about coral reef communities from Dr. Heatwole later in the course.

Coral Diagram:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/coral_diagram.html

The corals that build reefs belong to a group that are closely related to sea anemones. Note the resemblance of the polyp body to that of an anemone. The common name “stony coral” reflects the rock-like nature of the keleton. It is composed of calcium carbonate secreted from the base of each polyp. Polyp bodies sink into depressions within the skeleton and skeletal plates protrude upward, making indentations between the partitions of the body cavity. As polyps increase their number by asexual reproduction, more skeleton is ecreted and the reef grows. All members of a colony are joined by connections at the lower body cavity.

tony Corals:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/stony_corals.html

he rock like consistency of stony corals is evident in these examples. On the left we see living corals and n the right, the skeleton of a dead brain coral. Polyps are only present on the coral surface, so this ball of rain coral grew for many years with the inner polyps dying as new layers were added at the periphery. oral beds increase their height in a similar manner.

oral Symbionts:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/coral_symbionts.html

ll of the reef building corals harbor photosynthetic symbionts. Without the extra nutrients provided by hotosynthesis, polyps would lack the energy to secrete their stony skeletons. In the coral shown here, olyps on the left have a normal association with green symbionts, but on the right, the symbionts are gone nd polyps are dying.

leached Coral:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/bleached_coral.html

Vhen environmental conditions become unfavorable, symbionts are ejected from the polyps which ubsequently die. This is called coral bleaching, since the remaining skeleton has a white, chalky ppearance. Bleaching can be caused by water pollution or changes in water temperature. Warming of the vater by only one or two degrees can cause bleaching, with eventual death in large areas of reef.

Northern Coral:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/northern_coral.html

he reef building corals can only live in warm climates and at water depths of less than 100 feet. However, nany other species of stony coral inhabit colder deeper waters. These corals usually lack photosynthetic ymbionts and are slow growing forms. The living coral in the left was found in the waters of North arolina, but similar corals are common all along the northern coast of America and occur as far north as Norway. In the dead coral on the right, skeletal plates can be seen within the depressions vacated by polyps.

tony Coral Skeleton:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/stony_coral_skeleton.html

Iere is another species of stony coral. Small bits of coral skeleton are commonly found on beaches hroughout the world.

Mushroom Coral:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/mushroom_coral.html

he mushroom coral is highly unusual. It is a single polyp encased in a calcareous skeleton, and is huge for a oral; the single polyp may grow to a diameter of 50 cm. Unlike other coral, the mushroom can actually nove from place to place. The specimen on the left is living on Australia's Great Barrier Reef. Small entacles are visible emerging from its surface. On the right, we see the cleaned skeleton of this coral which as characteristic grooves radiating from the mouth.

oral Polyps:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/coral_polyps.html

his second type of coral has a somewhat different polyp and produces a skeleton that is soft or horny rather han rock-like. The polyps of all such corals are remarkable similar, having exactly 8 tentacles which are lightly branched or fringed.

keleton Diagram:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/skeleton_diagram.html

he skeletal material is secreted into the mesoglea of the body and connecting branches of the colony and hus surrounds the entire polyp body. Some species also have a compacted cylinder of skeleton within the onnecting tubes as shown here. This harder material is the source of most coral jewelry.

oft Corals: http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/soft_corals.html

oft corals have only calcium carbonate spicules for support and are usually quite flexible. The soft coral on he right is shown close-up which allows the tiny polyps to be seen.

orgonian Coral:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/gorgonian_coral.html

orgonian corals are widespread, but especially common in the tropics where a large number of species may e found. A horny skeleton stiffens the branches of the colony, but most gorgonians retain some flexibility. In his colony, tentacles of the tiny polyps are extended and visible if you look closely.

orgonian Diversity:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/gorgonian_movie.html

ere we see some common types of gorgonian coral: the sea plumes, sea fans and sea whips. All of these orals have very small polyps. In the close-up view of a sea whip skeleton, openings that contained the olyps are indicated by arrows.

V. Do Cnidarians have a nervous system? (Page 6)

erve Net: http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/nerve_net.html

he nerve cells of Cnidarians are linked to form a net that extends through the body column and into the entacles. Nerve impulses can be conducted in both directions along the nerve fibers and spread outward from he site of a stimulus. The nerve net has the basic elements found in nervous systems of more advanced nimal groups, but unlike most animals there is no brain or concentrations of nerve cell bodies.

nidarian Coordination:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/cnidarian_coordination.html

n this cross section of a polyp body, location of the nerve cells may be seen. Note that nerve fibers run hrough the base of both the epidermal and gastrodermal layers. Specialized sensory cells that can detect hemical or mechanical stimuli are also found in both layers. Thus a touch to the epidermis is detected by ensory cells, and nerves signal muscle fibers to contract allowing the animal to respond by appropriate body novements. Nematocyst discharge may also be initiated by nerves. Sensory cells within the gastrodermis an sense the presence of food and stimulate the gland cells to secrete enzymes. Or they can detect the resence of foreign matter and stimulate its ejection by muscle fiber contraction within the body wall.

Medusa Senses:

Most medusae have special sensory structures at the base of each tentacle. These structures sense light and gravity allowing the medusa to move toward or away from light and to properly orient the umbrella during feeding and swimming.

Sensory Structures:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/sensory_structure.html

This diagram shows the sensory structure at the base of a jellyfish tentacle. The so called "eye spot" is a group of cells sensitive to light. The statocyst contains granules that move freely within the hollow center of the structure. As the umbrella tilts, the movement of granules due to gravity is detected by sensory cells the line the cavity. This allows the jellyfish to change the orientation of its body as appropriate.

V. How do Cnidarians reproduce? (Page 7)

Hydra Budding:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/hydra_budding.html

The Hydra can easily replace missing tentacles. If a hydra is cut into several pieces, a new polyp will often form from each piece. Animals with such potent powers of regeneration can usually reproduce asexually. The Hydra does so by forming buds along the body column. After attaining sufficient size, each bud detaches and becomes a new hydra.

Anemone Budding:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/anemone_budding.html

A bud complete with tentacles has grown from the body column of this anemone.

Anemone Splitting:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/anemone_splitting.html

Anemones commonly reproduce by a rather bizarre type of splitting. The uppermost anemone in this photograph is pulling itself apart and will soon break into two separate individuals.

Medusa Gonads:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/medusa_gonads.html

In this small medusa, the gonads are orange. Sexes are separate in most medusae, so the gonads will produce either eggs or sperm. Location of the gonads on the underside of the umbrella is typical and also seen in large jellyfish.

Hydroid Life Cycle:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/hydroid_life_cycle.html

When a Cnidarian has both body types in its life cycle, the polyp always reproduces asexually. The reproductive polyps of the colony bud to form small medusae. The medusae reproduce sexually and the fertilized egg develops into a larval form called a planula. The planula is a small, flattened ball which uses cilia to swim to a suitable attachment site. The attached larva grows into a young polyp which branches and buds to form a new colony.

Obelia Medusa:

'his living medusa is viewed from the ventral side. It is the sexual stage of Obelia, the colonial hydroid lescribed earlier. Like most hydroid medusae, it is small and short lived, but can swim to a location far nough from its sessile parent to avoid competition between parent and new daughter colonies.

'ellyfish Life Cycle:
ittp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/jellyfish_life_cycle.html

Aost jellyfish also alternate between polyp and medusa forms, but the medusa is clearly prominent. The idult jellyfish produces eggs or sperm. The sperm are released into the water, but many species retain their ggs within the body. Sperm from a male jellyfish enter the body of the female with incoming water. The ertilized eggs are ejected through the mouth and develop into planula larvae which attach and grow into olyps. The polyp stage of most jellyfish is small and inconspicuous. It lives just long enough to reproduce sexually by splitting horizontally to form young jellyfish.

Iydra Reproduction:
ittp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/hydra_reproduction.html

At certain times of the year, usually fall or winter, hydra reproduce sexually. Some species are iermaphroditic, producing both eggs and sperm, while others (as shown in the diagram) have separate sexes. 'he gametes develop from unspecialized cells in the epidermis, giving rise to clusters that protrude from the ody. These bulges are called testes and ovaries although they are not true organs. Sperm are released into he water and fertilize a ripe egg that is extruded from an ovary. Fertilized eggs are released into the water ind develop into new hydra polyps. Typically the new hydra begins to reproduce asexually as soon as it natures.

'oral Spawning:
ittp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/coral_spawning.html

iea anemones and coral also reproduce sexually, giving rise to planula larvae that attach and grow into new olyps. The two species of coral shown here are spawning by releasing eggs and sperm into the sea. Aembers of the same species usually spawn together to assure that fertilization occurs.

'I. Are Cnidarians important to humans? (Page 8)

'ire Corals: http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/fire_corals.html

'ire corals are common in warm, tropical waters. The are tan or yellow in color and can have either a ranched orplate-like shape. Their long, thin polyps can deliver an irritating sting.

'ire Coral Encounter:
ittp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/fire_coral_encounter.html

Although the fire corals pose little threat to human health, they can inflict a painful rash.

'ellyfish Encounter:
ittp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/jellyfish_encounter.html

'hese jellyfish can reach a size of 2.5 meters across with tentacles 40 meters long! They can deliver serious tings.

Man-of-War Encounter:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/man-of-war_encounter.html

If you see the blue float of this siphonophore, swim the other way! The tentacles may be hard to see beneath the water and can reach a length of 20 meters. They are equipped with especially large and powerful nematocysts that can produce painful weals on the human body.

Common Box Jelly:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/common_box_jelly.html

This common box jelly is only 2-3 cm in diameter. Its painful sting is rarely fatal, but at least one death has been documented.

Australian Sea Wasp:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/australian_sea_wasp.html

The sea wasps are deadly. Fortunately, they are only present in coastal waters at certain times of the year. Warning signs on Australian beaches indicate the presence of this deadly box jelly.

Sea Wasp Stings:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/sea_wasp_stings.html

The venom injected from sea wasp tentacles results in death unless treated immediately. Although Australians are well aware of the danger and take care not to encounter sea wasps, there are still two or more fatalities per year.

Precious Coral:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/precious_coral.html

The so called “precious” corals provide material for jewelry. The orange color is most familiar, but blue corals are also used.

Reef Community:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/reef_community.html

Coral reefs provide habitats for an entire community of animals, including, crustaceans, worms, other cnidarians and many species of fish. Dr. Heatwole will discuss the biodiversity of reefs later in the course.

Underwater Scene:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/underwater_scene.html

The major contribution of cnidarians to human life may be the sheer beauty that they provide as all snorkelers and scuba divers can attest.

VII. How do the comb jellies (Phylum Ctenophora) differ from the Cnidarians? (Page 9)

Comb Jelly Diagram:
http://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/comb_jelly_diagram.html

This common marine dweller, called the gooseberry, is typical of the comb jellies. Rows of comb plates radiate over the body. Each plate consists of many combs formed by horizontal rows of cilia. These cilia wimming motion. The tentacles of comb jellies bear adhesive filaments rather than nematocysts. As the nimal swims, the tentacles trail through the water snaring small crustaceans and fish. The tentacles can be etracted into sheaths when not in use. Although the body of these animals is radially symmetrical, the resence of a tentacle on each side adds a bilateral aspect, and comb jellies are technically biradial in form.

lternate Forms:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/alternate_forms.html

ome comb jellies have short, fine tentacles and feed on plankton. Others, like the one shown here on the eft, lack tentacles and capture soft bodied animals by engulfing them into the mouth. Still other forms, like he one on the right, are flattened, with comb plates along the edges of the body.

omb Jellies:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/comb_jellies.html

he relationship between comb jellies and jellyfish is apparent when one sees a living animal. The ransparent bodies of comb jellies are filled with the same jelly-like mesoglea that supports the jellyfish body. an you find the comb plates on these two specimens?

octurnal Scene:
ttp://courses.ncsu.edu/zo495x/common/zo155_site/wrap/cnidaria/cnid_popups/nocturnal_scene.html

ioluminescence gives comb jellies a striking appearance at night as their comb plates and tentacles light up.