FOR SEA Photo CD
Script 1

Adaptations:
Behaviors & structures of rocky shore animals
for feeding, moving and protection.

8-82Rocky beaches and the crashing waves that create them present both dangers and opportunities to marine organisms.

8-47The waves sweep away all traces of sediment and expose and carve the rocky shore boulders and tidepools. Any creature that lives here must have some way to withstand the scouring surf lest it, too, be swept away or crushed.

7-66These same waves, however, also create an abundance of nooks, crannies and surfaces to serve as living space. They provide a rich supply of oxygen.

7-31The constant movement of water also brings in fresh supplies of nutrients and plankton and washes away waste products.

7-68The organisms of the rocky shore are adapted to get what they need from the environment while protecting themselves from dangers.

8-76This means that they have special behaviors and body parts that allow them to get the food they need, to either move around the tidepools or attach themselves firmly to rock surfaces, and to protect themselves from harsh environmental conditions and from predators.

8-20For many organisms at the rocky shore, hunting for food is as simple as waiting for the waves to bring food nearby. These animals sit in one spot and extend tentacles or feathery appendages into the water to capture a drifting dinner.

8-18The barnacle, for example, opens the shell plates that seal its shell home and extends feathery legs into the water. These fan back and forth, functioning much like a fisherman's net, trapping tiny animal plankton floating in the water. When its net is full, the barnace pulls its legs in and passes the captured food to the mouth hidden inside the shell.

8-44Tube worms, like barnacles, use feathery appendages to capture plankton. The worm lives safely nestled in its sturdy tube house.

7-49When it is hungry, it extends a feathery plume covered with tiny hairs.

7-48When plankton drift into the plume, the hairs grab on and pass the plankton from one hair to another until the plankton reaches the worm's mouth inside the tube.

7-50Burrowing sea cucumbers extend their tentacles from their hiding place under rocks and in crevices. These bright orange tentacles wait for plankton to come near.

7-51When the sea cucumber catches some food, it pulls one tentacle into its mouth at a time, licking off any food sticking to the tentacles.

7-11Sea anemones also create a net to capture plankton, but, instead of feathery legs, they use stinging tentacles.

8-54The tentacles are packed with very tiny cells each containing a coiled thread. Each coiled thread is tipped with poison or a dart or a tiny lasso. When plankton, shrimp, fish or other unwary animals bump into the anemone, the coiled threads erupt out of the cells. They either fire poison into the prey, or prick the animal's skin, or wrap around the prey, holding it tight.

8-55 Once the stinging tentacles catch food, they pass the meal to the mouth in the center. The anemone swallows its food whole, digests all the meat and spits back out any left over bones or shells.

7-13If an anemone doesn't capture food for some time, it simply shrinks. When food resources are plentiful again it eats well and grows. That's why it's impossible to tell an anemone's age by its size.

7-9Giant green sea anemones have an additional source of nutrition. They carry in their tissues a microscopic algae called *Zooxanthellae* (zo-zan-thell-e).

7-14 The algae give the anemones their green color.

7-12In fact, if a giant green sea anemone lives in a cave where there is no sunlight, its algae will die and the anemone will be white.

7-7The algae capture sunlight energy and use it to photosynthesize their own food. They combine water and carbon dioxide to make sugar. This sugar feeds both the algae and provides some nourishment for the sea anemone. The algae gets a place to live, protected by the anemone's stinging cells, and can use the carbon dioxide the sea anemone produces as a waste product to make new sugar.

Some rocky shore animals actually bring the sea water, rich with food, into their bodies.

8-3Mussels and scallops, for example, open their shells and begin siphoning in water.

8-8The water passes across their gills. The gills are covered by tiny hairs which absorb oxygen and sort out plankton and send it to the animal's stomach. Any particles the mussel or scallop doesn't want and any waste products are squirted back out of the shell in the outgoing flow of water.

8-89Barnacles, tube worms, sea cucumbers, sea anemones, scallops and mussels wait for their food to come to them.

8-63Snails, nudibranches (sea slugs), chitons, limpets, sea urchins and sea stars, on the other hand, travel up and down the rocks hunting for their meals.

8-14Snails, nudibranches, chitons and limpets each crawl on a strong muscular foot, extending a pair of sensory tentacles that can detect their favorite foods.

8-7Chitons, limpets and some snails prefer algae.

8-75 They use a special tongue, called a radula, to scrape algae off the rocks. This radula is covered with tiny teeth made of calcium-carbonate (shell material) or minerals such as opal.

8-46The giant gumboot chiton has a radula with iron teeth.

8-45Nudibranchs and some snails use their radulas to eat meat. Some species of nudibranches devour sea anemones, sponges, and even other nudibranches.

8-13Many types of snails use their radula to drill a hole through the shell of another marine animal and then scrape out the meat inside.

8-77Sea urchins move across the rocks on hundreds of suction cup tube feet in search of seaweeds.

7-27 They prefer brown algae, or kelp, and can eat enormous quantities. They crawl on top the seaweed and chew it into tiny pieces using the complicated mouth parts on its underside.

7-90 Its mouth structure, known as Aristotle's Lantern, consists of many tiny teeth arranged into a beak shape.

8-43 These teeth make quick work of seaweeds and can scavenge meat as well.

8-42Sea stars may have the most dramatic eating style of all the invertebrates at the rocky shore. When they find suitable prey, say a clam, for example, they crawl on top of the animal and begin pulling on the shelll with their suction cup tube feet. The sea star operates the tube feet by pumping water in and out of them so it doesn't tire very easily. The clam, on the other hand, holds its shells closed with muscles. These muscles do tire.

7-56 Eventually, the clam cannot hold its shells closed any longer. The sea star then everts its stomach into the clam shell and digest the meat. Its stomach looks very much like a plastic bag sticking out of the sea star's mouth and into the clam shell.

7-72Some sea stars prefer other prey. The blood star, for example, everts its stomach to eat sponge and

7-53the leather star digests sea anemones or sea pens.

8-100It is clear, then, that some animals find food and make a home at the rocky shore by attaching in one place. They attach so tightly that they can avoid being torn free and washed away by the scouring waves.

7-73Other animals, however, are more mobile. They can move in search of food and optimum conditions. When the need arises they can hide in a crevice or clamp onto the rocks for a time.

Sessile organisms, those that remain attached to the rocks, typically do so by glueing themselves to the rocks.

8-62A barnacle, for example, secretes an adhesive from a gland in its head through one of its antennaes. The barnacle begins its life as a planktonic animal, drifting in the water currents. This larval barnacle is covered by an exoskeleton, but does not yet have the hard calcium carbonate shell that it will have as an adult.

8-17Once it is close to being fully mature, the barnacle begins to hunt for a hard surface to which it can attach. It needs a surface near other barnacles and yet not too crowded. Once it finds an appropriate space, it stands on its head, secretes its glue and effectively cements it head to the rock. It will live in this spot the rest of its life.

8-1The mussel also creates a glue to attach itself to rocks, but it secretes its cement down a groove in its foot. The mussel extends its foot out of its shell probing the nearby area for a place to attach. Then it sends the glue down the thin groove along its foot. As this glue is exposed to the seawater, it hardens into a tough thread. The mussel then moves its foot and sends out more glue.

8-2Soon it is firmly attached to the rocks by a clump of threads called byssal threads. The threads are strong enough to bend and stretch some in the waves without breaking.

8-11Snails, limpets, and chitons can stick tightly to rocks, but they do so with a large, muscular foot.

8-12When the animal is moving, waves of contractions move along the foot, pushing against the rock and propelling the animal forward.

8-10A special slime coats the foot and allows the animal to glide as it moves. When the animal needs to clamp down, however, the foot creates suction against the rock and the slime becomes sticky under the pressure of the foot.

8-5It is extremely difficult for waves, predators or beach combers to pry loose one of these animals.

8-39Sea stars and sea urchins also can stick tightly to rocks, but they also can crawl quickly.

7-92Both animals are covered with tiny suction cup tube feet.

7-57Each foot is a hollow tube connected by canals to all the other tube feet.

7-59 The sea star or sea urchin sucks in seawater through a pore on its back and pumps the water in and out of its feet. When a tube foot is full of water, it lets go of the rocks and the animal can move. When the sea star or urchin sucks water back out of the foot, it creates suction that allows the foot to stick.

7-58By coordinating hundreds of these tiny feet, sea stars and urchins can move as fast as a meter or more a minute or they can stick so tightly to rocks that any attempt to dislodge them will risk tearing their feet.

8-34In addition to finding food and attaching to rocks, rocky shore tidepool animals must be able to protect themselves from temperature and salinity changes and from drying out at

8-33low tide. They must have adaptations that help them escape predators.

Some of the intertidal animals make hard shells to protect their fleshy insides.

8-19Once barnacles have attached to the rocks, they secrete calcium carbonate. The calcium carbonate hardens into shell plates. The barnacle encircles its body with shell plates and then creates plates that function as doors at the top of its new shell house.

8-61When a predator threatens or the tide is low, the barnacle pulls in some saltwater, shuts its shell plate doors and waits for the predator to leave or for good conditions to return.

8-22A few predators can crack the barnacle's defenses. The snail, with its radula, can drill through a barnacle shell if it is small enough. Sea stars can pull the doors open. Many barnacles avoid these predators simply by living very high on the rocks. Most snails and sea stars cannot survive this high on the rocks where the tide can be out for hours.

8-72The snail grows a spiral shell to protect its body. When threatened, the snail can pull its muscular foot inside the shell and

8-71close a trap door on the opening to its shell. This trap door, also known as an operculum, is made of chitin, a substance very much like our fingernails.

8-6Chitons grow eight shell plates on their backs. When firmly attached to rocks, a predator will encounter the shell plates instead of the fleshy foot underneath.

8-67 When the chiton is attacked when it is not stuck to a rock, it curls up in a ball, like a pill bug, protecting its foot.

8-15Nudibranches are similar to snails but they carry neither a spiral shell nor eight shell plates. Some rely on camouflage for protection. Most, however, escape being eaten by tasting bad. In fact, scientists believe that any nudibranches are brightly colored to warn would-be predators that they taste bad. A few species of nudibranches actually receive a special line of defense from their food. Some nudibranches feed on sea anemones. Instead of being harmed by the anemone's stinging tentacles, the nudibranch swallows the stingers and then the stingers move into feathery looking projections on the nudibranch's back. If another animal tries to eat the nudibranch, it will swallow a mouthful of stingers.

7-75Sea stars and sea urchins do not have stingers, but they do have a large arsenal of other defenses.

7-62The sea star's body is covered with tiny shell plates all hooked together to look something like mesh. Skin grows over these plates, so we don't usually see the, but they are there making the sea star's body more rigid and less appetizing.

7-73The sea urchin grows a special shell called a test. This test helps its soft insides from drying out and being attacked by predators.

7-61Both sea stars and sea urchins grow spines and special pinchers, called pedicellaria. The sea star's spines cover its top side and are quite small while

7-89the urchin's spines are long and make it look like a pin cushion.

7-60The pedicellaria cover the bodies of both animals but are hard to see because they are small. Each pincher has five teeth that when closed look something like tulip buds. When a predator comes near, the teeth open and close, clamping shut on the predator's soft skin.

7-77In addition, sea stars can protect themselves by shedding a ray. If a predator threatens, the sea star actually can make one of its limb detatch. Scientists believe that the predator will try to eat the shed ray while the sea star can crawl away and, over time, grow back the missing limb.

As amazing as it may sound, sea stars are not the only tidepool inhabitants that can regenerate a missing appendage.

7-42Crabs often shed a leg or even a pincher when they are threatened. The crab gradually grows a new leg, but the process is a little more complicated than it is for a sea star.

7-44Crabs grow a protective exoskeleton around their bodies. This hard outer skeleton is jointed to allow the crab to walk and to pick up and tear meat. From time to time the crab becomes too big for its exoskeleton and must molt. It opens the back of its covering and pulls its entire body, including its legs, pinchers, antennae, gills and eyes, out of the exoskeleton. The crab had been growing a new, larger, but still soft exoskeleton under its old covering. Now that new exoskeleton absorb seawater, swells to its larger size and then hardens.

7-43When a crab sheds a leg, the replacement limb will not have its own exoskeleton until the next time the crab molts.

7-41Hermit crabs, like other crabs, grow an exoskeleton to protect their bodies. A hermit crabs, however, has a tail that is soft and not covered by hard exoskeleton material. To protect its tail, it must find an empty snail shell and crawl in tail first. Tiny hook-like legs along its tail hold on tightly to the shell.

7-45Whenever a predator approaches, the hermit crab pulls inside its borrowed shell home.

8-88The hermit crab and all the other animals of the rocky shore have an astounding variety of body parts and behaviors that enable them to survive at the rocky shore.

8-97They may filter their food, sting it, or hunt it down.

7-47Some may attach themselves to the rocks while others move in search of food and safety.

8-95Some are soft and fleshy, protected by camouflage or stingers, while others carry armor of shelll or spine.

8-87They endure pounding waves, hours exposed at low tides and the threat of predators.

8-82But these hardy creatures also enjoy the cool, oxygen rich waters, numerous hiding places, and abundant food of the rocky shores. They make rocky beaches s ome of the richest places in the sea.