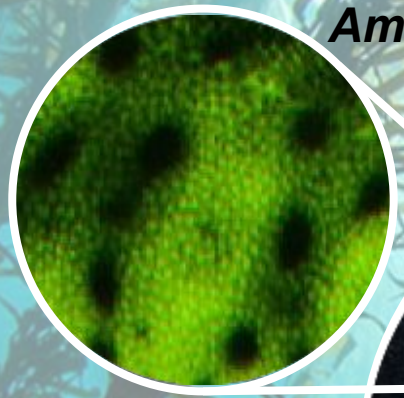
Swell Shark

Ambush predator *Cephaloscyllium ventriosum*

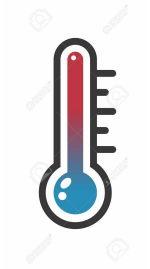
Attaches “mermaid’s purse” egg case to kelp



Emanates green biofluorescence, visible to other Swell Sharks

Swells to double size to deter predators

Excellent underwater vision



Swell Sharks live on the rocky seafloor in kelp forests. When warm water damages kelp, swell sharks have fewer places to hide themselves and their egg cases.

Warming oceans are becoming more acidic. More acidic water dissolves the shells of snails and clams, reducing Swell Sharks' food supply. Having a diverse food source allows Swell Sharks to survive even when one food item is reduced.

Ecosystem in Action

With excellent vision in low light, swell sharks can find food at night on the seafloor.

Swell sharks eat smaller fish (dead or alive), molluscs, and crustaceans. Larger fish, including other sharks, seals, and sea lions eat Swell Sharks.

Science Highlight

Scripps scientists and collaborators study swell sharks' ability to absorb blue light and re-emit bright green light.

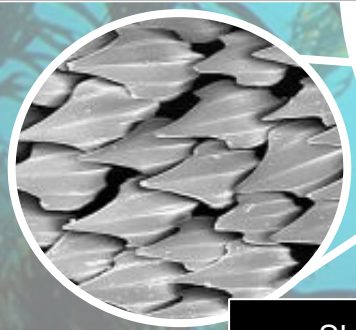
Light colors and patterns guide swell sharks to find each other underwater in a sea of blue.

Horn Shark

Solitary nocturnal predator *Heterodontus francisci*

Horns on fins discourage predators

Corkscrew ‘mermaid’s purse’ secures egg case in hiding places



Skin has dermal denticles—‘skin teeth’

Rows of short teeth and strong bite force for crushing shells

As ocean waters along the coast of California become warmer, Horn Sharks may expand their habitat range further north.

Ghost nets–nets that are lost or forgotten by fishermen–make up almost half the ocean's plastic pollution. Horn Sharks and other animals can get trapped in ghost nets. Fishing-free zones may offer refuge from these dangers.

Ecosystem in Action

Horn Sharks use their pelvic fins like feet to walk along the seafloor.
As Horn Sharks grow older and larger, they move from shallow rocky reefs to deeper sandy flats.
As nocturnal hunters, Horn Sharks hide in the rocks during the day. They come out and search the seafloor for prey at night.

Science Highlight :

As waters warmed over the last twenty years, Horn Shark populations off the coast of Catalina Island increased, while Swell Shark numbers decreased.

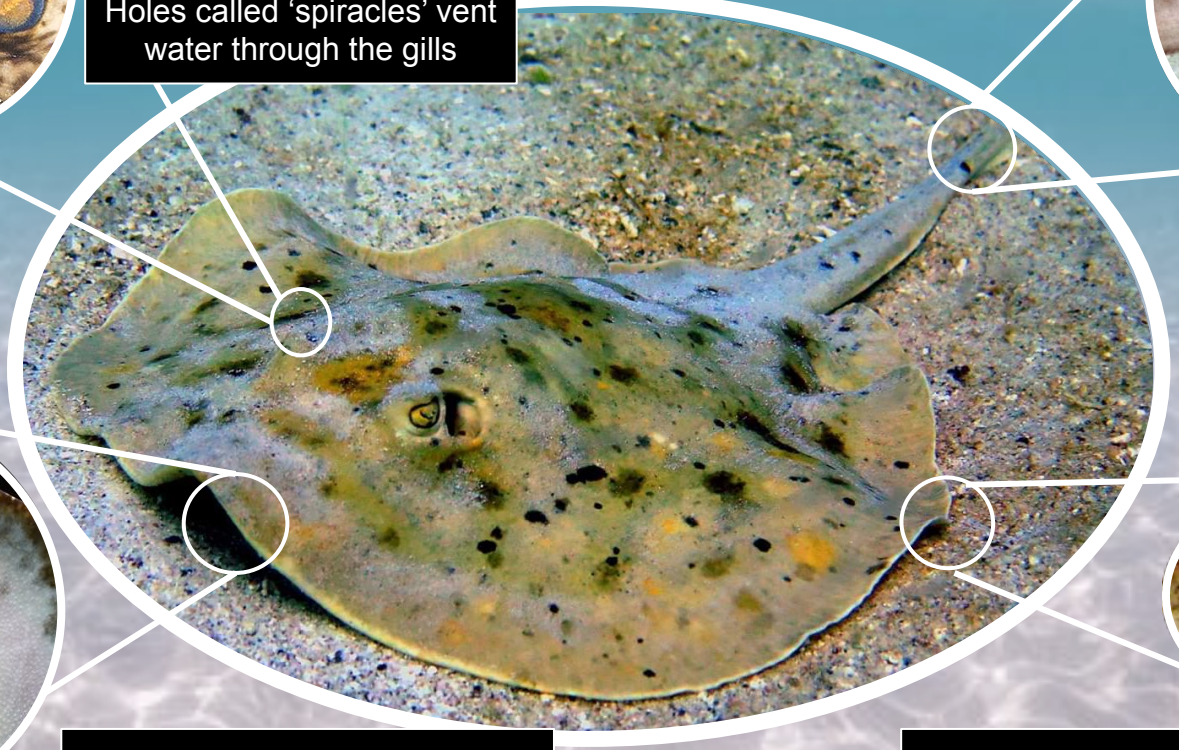
Horn Sharks are still less abundant in the colder waters of the northern Channel Islands.

Round Rays

Low profile bottom dweller *Urolophus halleri*

Holes called ‘spiracles’ vent water through the gills

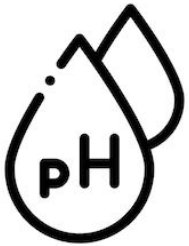
Venomous tail barb defends from predators



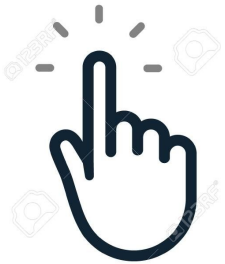
Mouth on the underside for eating seafloor animals

Extended pectoral fins or ‘wings’ used to swim and dig

Round Rays die unnecessarily when fishers catch them by accident (bycatch) in bottom trawlers, gillnets, and when sportfishing.



Ocean acidification affects the availability of small bottom dwellers such as snails and clams that make up a large part of Round Rays' diet.



Round Rays, though not aggressive, will "sting" if stepped on. When walking into the water, remember to do the Stingray Shuffle!

Ecosystem In Action

- Round Rays flap their fins on the sandy seafloor, moving sand to expose hiding prey. This behavior benefits other predators too.
- Camouflaged skin helps to hide from larger predators, such as seals and sea lions.

Science Highlight

Research suggests that temperature is key in the behavioral patterns of Round Rays.

Round Rays mate in early spring and give live birth during warm months. The young rays (pups) stay in shallow warmer waters. In winter, they swim deeper, where water temperatures are more stable.

A changing climate may affect their seasonal movement and reproductive behaviors.

Sea Hare

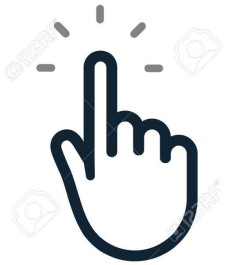
Seaweed grazer *Aplysia californica*

Can eject purple ink as a defense mechanism

Lays millions of eggs tightly packed together

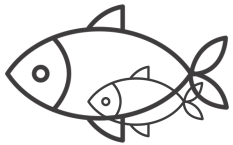
Wing-like flaps used for swimming

A comb like structure (called a radula) used for scraping algae to eat



Sea Hares live in tide pools and move slowly.

They're related to snails, but have no protective outer shell—touching can stress them out!



Sea hares may benefit from ocean warming. In warmer waters, more Sea Hare larvae survive and mature into adults. In colder waters, fewer Sea Hare larvae survive.

Ecosystem in Action :

- During low tide, California Brown Sea Hares can dry out and lose up to 30% of their body weight. Yet, they survive!
- Protected coastal areas in MPAs can have thick vegetation—a feast for Sea Hares.

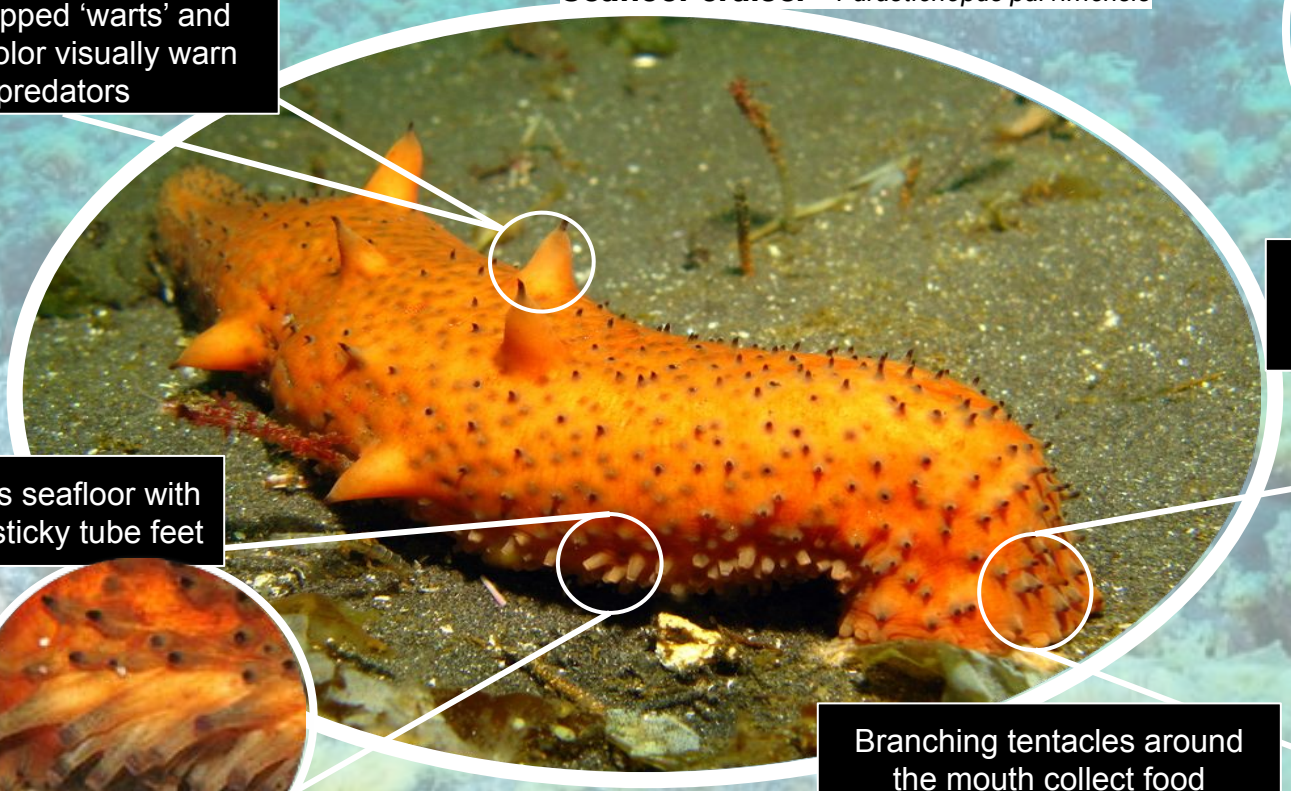
Science Highlight :

Sea hares are considered 'model organisms' in neuroscience because they have large and easily-identifiable neurons. Because of this, Sea Hares contributed to research about cellular biology and memory.

Sea Cucumber

Seafloor cruiser *Parastichopus parvimensis*

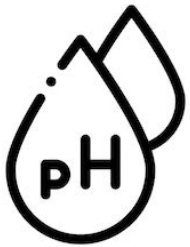
Black-tipped ‘warts’ and bright color visually warn predators



Can eject internal organs as self defense when stressed

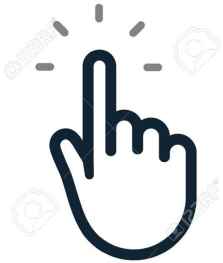
Moves across seafloor with hundreds of sticky tube feet

Branching tentacles around the mouth collect food



Sea Cucumbers' digestive waste increases the pH of the sea water, helping to reduce ocean acidification locally.

Sea Cucumbers are in high demand around the world for food and medicine. They are vulnerable to overfishing because they are slow-growing animals.



Sea Cucumbers contract violently when stressed, expelling their guts, which takes time and energy to regrow. Please touch them gently!

Ecosystem in Action

- Sea Cucumbers recycle nutrients by eating "leftovers" (detritus)—small bits of decomposing food that sink to the seafloor.
- Presence of Sea Cucumbers makes seagrass beds more productive.

Climate Research

Scripps scientists study Sea Cucumbers to learn how seafloor communities react to climate change. During El Niño warm water events, some species of Sea Cucumbers thrive, while others disappear. Warming water affects food availability and nutrient circulation, even on the ocean floor.

Wavy Turban Snail

Algae eater *Megastraea undosa*

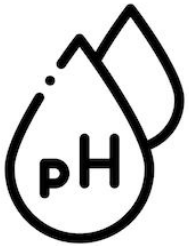
A variety of growth on shells aids camouflage

Internal spiral structure of shell

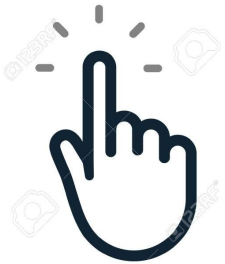
Tiny teeth (radula) scrape algae into the mouth

Operculum traps water inside the shell during low tide events

Popular for their abalone-like meat, Wavy Turban Snails are collected by divers.



Ocean acidification, resulting from more carbon in the atmosphere, can deteriorate the snail's calcium carbonate shell.



Tread lightly around local tide pools to avoid stepping on Wavy Turban Snails, a common inhabitant.

Ecosystem in Action

- Algae and tiny animals grow on large snail shells, helping them camouflage within their rocky habitat.
- Adults are typically found in deeper waters, up to 400m, and migrate along the seafloor to shallower waters at night to feed.

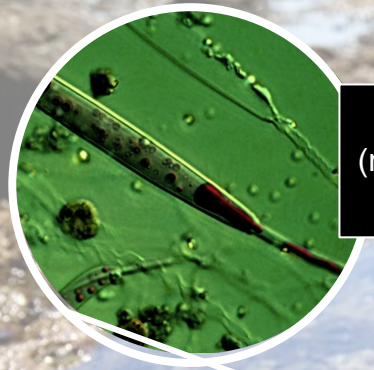
Science Highlights

Archaeological evidence suggests that Native peoples fished Wavy Turban Snails prior to others settling in California.

During El Niño warm water events, more young Wavy Turban Snails survive, while more adults die.

Sea Anemone

Anthopleura xanthogrammica



Tiny stinging cells (nematocysts) in tentacles immobilize prey

An armor of seashell fragments protects the body

A big foot on the flexible holds firmly onto rocks

The soft, toothless gut cavity engulfs stunned prey whole

Unlike most anemones, this California species prefers cold water temperatures. Individuals in warm water are visibly paler from lack of nourishment.

Anemones contract and squirt water when touched forcefully. Too much contact can harm them because they dry out between the tides.

Ecosystem in Action

- Algae (zooxanthellae) live in the lining of the gut, providing sugar and oxygen (created during photosynthesis) to the anemone.
- Giant Green Anemones are solitary and use their tentacles to fight for territory. In contrast, Aggregating Anemones live in large colonies.

Science Highlight

As a close relative to coral polyps, entire colonies of anemones can suffer from bleaching, like coral reefs.

When extreme temperatures or chemical imbalances become stressful to algae in anemones' guts, the algae ejects or dies. This causes loss of color in the anemone, or bleaching. Since the algae provides nutrition to anemones, bleaching threatens anemone survival.

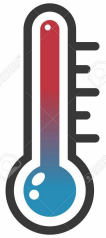
Purple Sea Urchins

Spiny kelp eater *Strongylocentrotus purpuratus*

Flexible tube feet grab onto food

Hard spines protect from predators

Strong teeth scrape urchin-shaped holes in rocks



Sea stars eat sea urchins. Ocean warming intensifies sea star wasting disease, killing many sea stars. As a result, sea urchin populations boom.

Sea urchins are a delicacy in some cuisines and a popular export from California fisheries.

Ecosystem In Action :

- Otters, sea stars, and spiny lobsters eat sea urchins.
- Without predators keeping their populations in check, sea urchins can take over entire kelp forests.
- The result is an *urchin barren*, where sea urchins have chewed through kelp holdfasts, destroying kelp forest habitats.

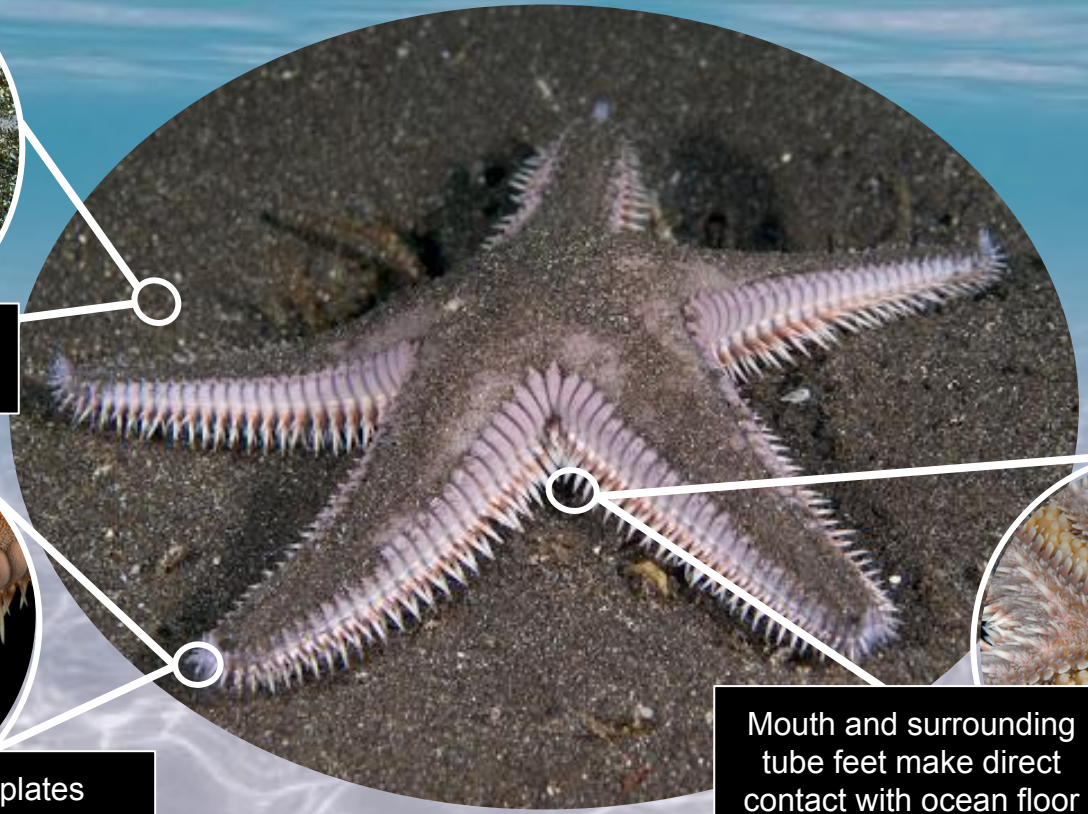
Science Highlight :

Red sea urchins face challenges from warming oceans and overfishing. Scripps scientists are investigating another local sea urchin species, the fragile Pink Sea Urchin, to be a new food source for people.

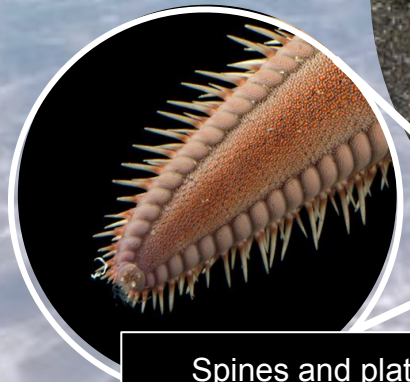
Armored Sea Star

Seafloor predator *Astropecten armatus*

Muted colors blend with sandy surroundings

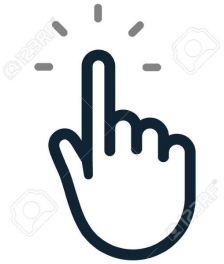


Ochre sea star relatives are brightly colored



Spines and plates protect from predators

Mouth and surrounding tube feet make direct contact with ocean floor



Sea stars have delicate tube feet underneath. So, a gentle one-finger touch on their protective spiny skin won't hurt their tender parts.

Scientists suspect that as oceans warm, more sea stars will get sick with sea star wasting disease.

Ecosystem In Action

- Fish, sea turtles, snails, crabs, shrimp, and sea otters (along the central CA coast) eat sea stars.
- Sea stars extend their stomachs to prey on sea urchins, mussels, and other small invertebrates.

Science Highlight :

Sea stars are threatened by a mysterious wasting disease that disintegrates their flesh. Scientists are searching for what causes this disease—is it a virus, or something else?

From southern California to Washington, community science projects seek answers to these questions: Where do sea stars live? How many are sick? How can we help them?

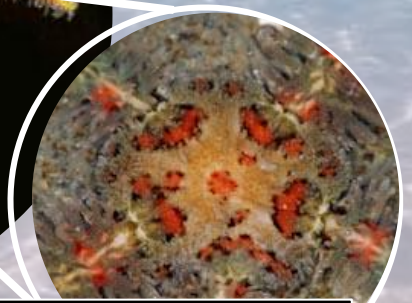
Brittle Stars

Spiny filter feeder *Ophiothrix spiculata*

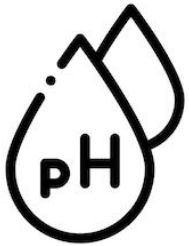
Spines catch floating food particles

Long arms crawl quickly across the ocean floor

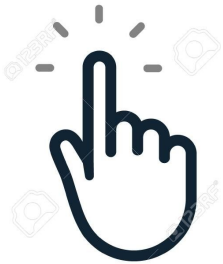
Burrow under sand to hide from fish predators



Central disc secures five long, thin arms



Brittle Stars build and maintain their protective armor and spines. As ocean waters become more acidic, this process becomes more difficult.



A gentle touch prevents brittle stars from losing their arms and wasting energy to regrow them.

Ecosystem In Action :

- Brittle stars squeeze their bodies under rocks, into crevices, and into sand to evade predatory fish.
- If predators are scarce, brittle star populations can grow to carpet the sandy seafloor in huge numbers. In La Jolla, this layer can become an inch thick.

Science Highlight

Over 2,000 species of brittle stars are present in MPAs across the world.
Brittle stars living among coral beds in the Gulf of Mexico may support coral health by fending off oil particles and debris with their long arms.

Hermit Crab

Nocturnal scavenger *Pagurus samuelis*

Crabs choose a home depending on what is available—including trash

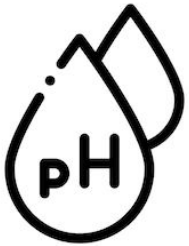
Shell can hold a reserve of cool water, in case it gets too hot or dry

Long feelers sense surroundings; smaller feelers near the mouth sense taste

Soft, curly abdomen fits perfectly into spiral sea-snail shells

Claws can grab food, fight, or guard the entrance of the shell

Hermit Crabs are sensitive to temperature and avoid extreme heat. Warming increases the threat of drying out and overheating in the extremes of their rocky intertidal habitat.



Hermit Crabs occupy old snail shells. Cimate impacts on snails also affect hermit crabs. More CO2 in the atmosphere makes ocean water more acidic. This dissolves shells, so hermit crabs have to compete harder for fewer shells.

Ecosystem In Action

- Hermit Crabs will eat almost anything. They filter edible bits (detritus) out of the water using feathery antennae and pick up food using their claws.
- Living inside a shell, Hermit Crabs hide from predators (like birds and fish) and find shelter from ocean waves and heat.

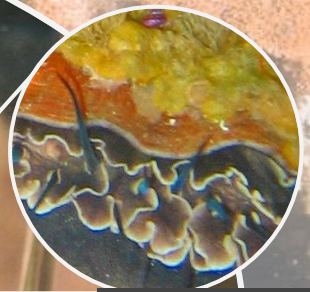
Science Highlight

When they get too hot or dry, Hermit Crabs flip onto their backs and bathe in the small pool of water inside their shell—crucial for their survival.

Red+Pink Abalone

Algae grazers *Haliotis rufescens + Haliotis corrugata*

Thick, strong calcium shell for protection; colorful and smooth on the inside

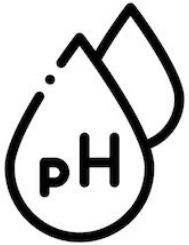


Sensory tentacles search for food and danger, surround the abalone like a skirt

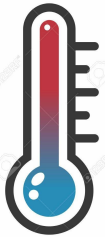
Large muscular foot can hold on tight to rocks

Holes in the shell let water and oxygen flow over the gills

Overfishing has caused abalone populations to decrease. White Abalone were the first marine invertebrate put on the Federal Endangered Species list.



Abalones struggle to make a strong shell in an acidic ocean. A weak shell increases the risk from predators.



Warming oceans make life stressful for abalone and they become more susceptible to disease. In colder, cleaner waters further north, abalone manage to survive.

Ecosystem In Action :

California's largest snails, Red and Pink Abalone can live a long time—30-55 years!

Abalone graze along rocky reefs searching for algae, like feather boa or bull kelp.

By living in the intertidal they were easy prey for people.

Science Highlight :

NOAA Southwest Fisheries Science Center recently released 800 White Abalone here in La Jolla. Hopefully, these abalone will settle and grow new, resilient populations along the California coast.

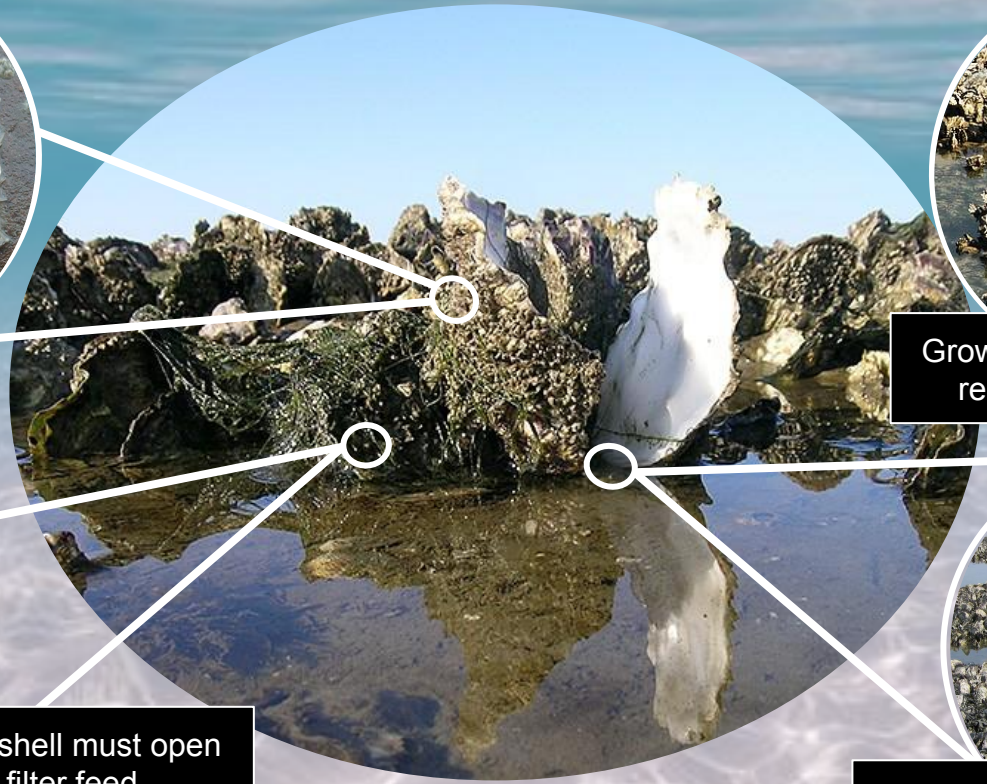
DON’T MAKE OYSTER LABELS NOW

Oysters

Hardy filter feeders

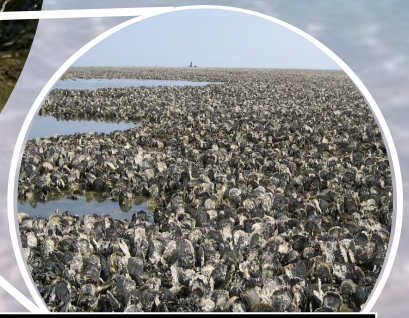
Crassostrea gigas & Ostrea lurida

When closed, their rough shell protects from predators



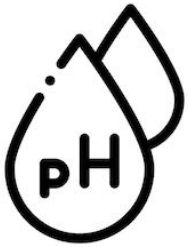
Growing in clusters helps resist wave damage

Hinged shell must open to filter feed



Produce “glue” to stick tightly to rocks and each other

Without heavy fishing, even in a single area, new oysters can grow to replenish depleted reefs.



More CO2 in the atmosphere increases ocean acidity, which makes it harder for oysters to maintain their protective hinged shells.

In warmer ocean waters, more harmful bacteria can grow. Oysters can eat these bacteria and pass them on to human consumers.

Ecosystem In Action :

- Found in coastal wetlands (including the Tijuana estuary), oyster reefs protect coastal communities from intense waves.
- Oyster reefs create a stable settling surface for many organisms (mussels, barnacles, sea anemones, young animals).
- Oysters can filter up to 50 gallons of water per day to clean out excess algae and nutrients

Science Highlight :

Oyster Biosensors

As water oxygen levels decrease, oysters may feed less. Scripps scientist Sarah Giddings equipped wild oysters with technology to detect oysters opening to feed. By understanding relationships between oyster behavior and oxygen levels, scientists can see when oyster habitats need extra human care.