

Plankton It's a Way of Life—Lesson Plan Student Guide With Links

Look at video called “Plankton: It’s a Way of Life Zooplankton Microscope Video.”
[Here is the link to the video.](#)

Teacher will hand out the [Observation Worksheet](#) for Zooplankton Videos. Use this to make your observations, identifications and drawings when you watch the video. The video has five sequences of different larvae. Try to identify three of the five and make drawings of what you observe. Use the [Zooplankton Information Guide](#) which is attached at the end this document. Think about adaptations zooplankton might have for life in the open ocean.

Look at Video of Plankton Feeding

Here are the links to the videos:

[Veliger larva](#)

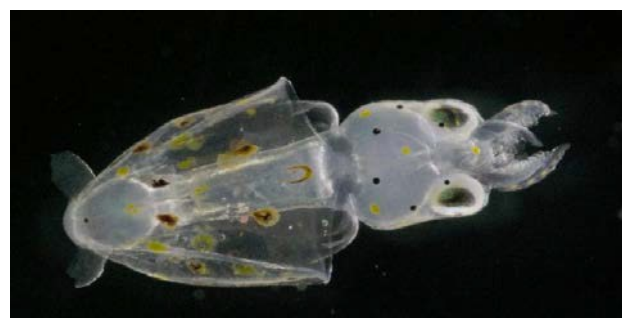
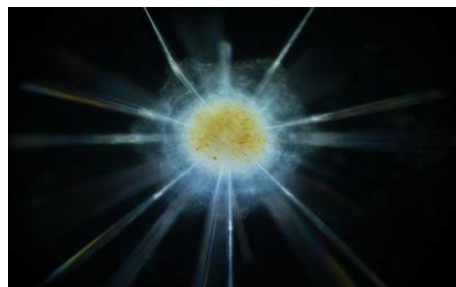
[Sea star bipinnaria feeding](#)

[Crab larva](#)

Teacher will handout the ‘**Guide For Watching Videos of Zooplankton Feeding.**’ Your teacher will tell you if you should watch only one video or all three. This guide will tell you what to look for as you watch. Take note as you observe.

Shape Of Life Lesson Plan

Zooplankton Information Guide



ACORN BARNACLE



Adult stage



Nauplius stage

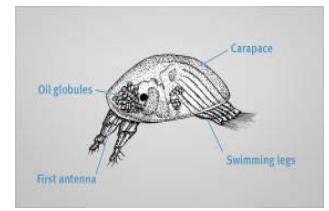
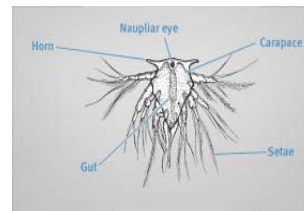


Illustration of nauplius and cyprid stages

Name of organism: Acorn barnacle, nauplius and cyprid larval stages

Scientific name: *Balanus* sp.

Related to: Shrimp, crabs and all barnacles. Arthropoda (phylum), Crustacea (subphylum), Cirripedia (infraclass).

Time spent as plankton: In the plankton as larvae for 2 to 4 weeks

Size of larva: A stage-one nauplius is 157 x 266 microns (size of one to two human hairs).

Role in the environment: As nauplii, barnacles can be very numerous and an important food source for zooplankton. Adult barnacles settle on boat hulls, which causes drag and reduces the efficiency of the vessels.

Fun facts to share:

- Barnacles spend their entire adult lives with their “heads” cemented to a hard substrate and their long hairy legs sifting tiny plankton from the water to feed.
- Adult *Balanus* barnacles are both male and female (simultaneous hermaphrodites). When acting as females, they brood the fertilized eggs within their shells before releasing the first stage nauplius larvae.
- It is easy to recognize the early larval stage of a barnacle (nauplius), due to its shield-shaped carapace (thin shell-like protection). The nauplius is the feeding stage, its “job” is to eat and grow. This stage will molt and grow five times and then transform into a cyprid stage—whose sole job is to find the best place to call home and settle down.
- A larval barnacle finds its home by sensing a chemical produced by adult barnacles of its own species. From the base of the first antennae of the cyprid, the larval barnacle secretes a type of glue that cements the animal permanently in the place where it will develop into an adult barnacle.



Barnacle (*Balanus* sp.) Life Cycle

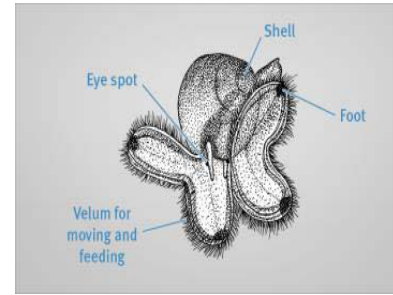
TURBAN SNAIL



Adult turban snail



Veliger larva



Labeled illustration

Name of organism: Turban snail, veliger larva

Scientific name: *Tegula* spp.

Related to: Snails, abalone, nudibranchs and all gastropods. Mollusca (phylum), Gastropoda (class), Tegulidae (family).

Time spent as plankton: Several days to 1.5 weeks, depending on food availability and water temperature.

Size of larva: Day-three veligers are between 165 and 210 microns (one to two hair widths in size).

Role in the environment: Larvae are food for other plankton and filter-feeders; adults are important primary consumers and prey for invertebrates, birds, fish and marine mammals.

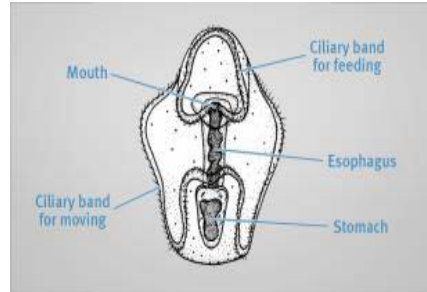
Fun facts to share:

- Check out the beautiful, butterfly-like wings (velum) that are moving the larval snail around the dish and creating a current to bring in the tiny plant plankton that make up its diet.
- This larva will develop a foot and even a trap door (to protect the animal from predators) as it gets ready to settle down and find a home on the rocky shore or kelp forest.
- Have you ever seen a snail in the tide pools? Well, this is what they look like as babies—they look a lot different from the adults!
- These planktonic larvae go through an amazing transformation from this stage (veliger) into the juvenile snail—they lose the velum and the snail

BAT STAR



Adult Bat Star



Bipinnaria larval stage



Brachiolaria stage

Name of organism: Bat Star, bipinnaria and brachiolaria larvae

Scientific name: *Patiria miniata*

Related to: Other sea stars, sea urchins, sand dollars and sea cucumbers. Echinodermata (phylum), Asteroidea (class), Asterinidae (family).

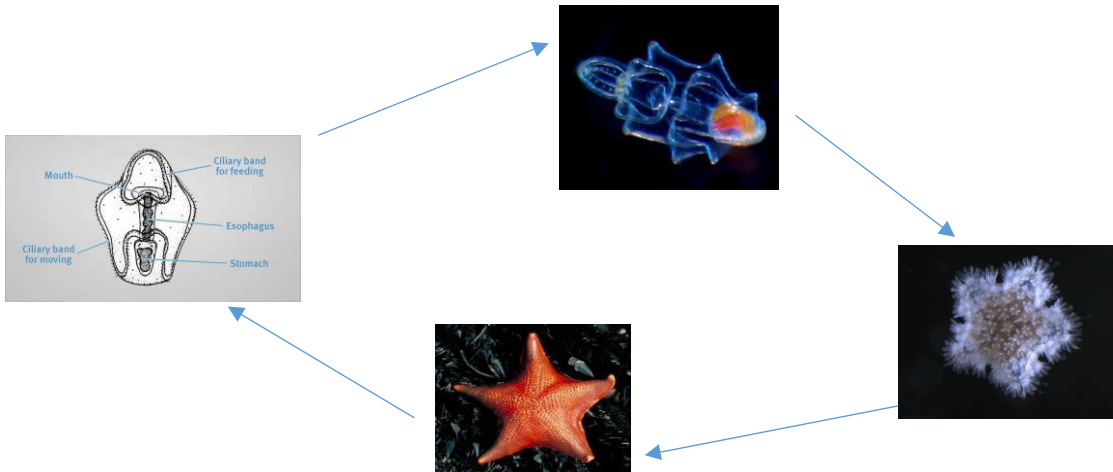
Time spent as plankton: 6 to 8 weeks

Size of larva: Bipinnaria is 1.8 x 1.0 mm; brachiolaria is 2.8 x 1.0 mm

Role in the environment: Sea stars, such as the bat star, are important members of the lower rocky intertidal and subtidal communities (to 290 m) as well as sandy seafloor environments. Bat stars are like janitors, playing a key role in cleaning up decaying algae and animals on the seafloor. Their larvae are in the water column throughout the year and feed for nearly two months on small phytoplankton—and therefore are both prey and predator in the planktonic community.

Fun facts to share:

- Bat stars have separate males and females and are a very common sea star found along the Pacific coast. They come in a variety of colors ranging from bright orange to purple, and they're sometimes mottled.
- The bipinnaria larva swims and feeds by means of a band of cilia (hair-like structures) curving around the sides of the body. The beating cilia create mini vortices to draw microscopic phytoplankton into the larval mouth. These same ciliary bands are used to move the larvae throughout the water column. [Watch this video to the beautiful vortex pattern.](#)
- The bipinnaria feeds for about a month and then transforms into the next stage called a brachiolaria. When conditions are right the brachiolaria metamorphoses into an adult sea star. During metamorphosis, the bilateral symmetry of the larva makes a place for radial symmetry and most larval structures are lost. The juvenile then becomes a benthic adult with radial symmetry. This new tiny bat star is about 1 mm or 0.04 inches in diameter.



Bat Star Life Cycle (*mix of illustrations and photos*)

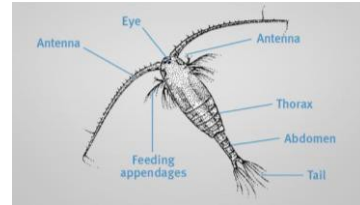
CALANOID COPEPOD



Nauplius larva



Adult copepod



Labeled illustration

Name of organism: Calanoid copepod

Scientific name: *Calanus pacificus*

Related to: Shrimp, crabs and all crustaceans. Arthropoda (phylum), Crustacea (subphylum), Copepoda (subclass), Calanoida (order), Calanidae (family)

Time spent as plankton: Entire life (holoplankton)

Size of larva: Nauplius as small as 0.05 mm in length

Role in the environment: Calanoid copepods are one of the most numerous multicellular animals in the sea. The copepods are a critical link between phytoplankton and other planktonic species, fish, sea birds, and even some great whales.

Fun facts to share:

- *Copepod* means “oar footed,” because they have oar-like appendages to move through the water.
- There are over 10,000 species of copepods that have been described. At least 1/3 of all copepods are parasitic on fishes and invertebrates.
- Copepods are often referred to as the insects of the sea due to their sheer numbers and their relation to insects. Like insects, copepods grow by going through a series of molts—up to as many as twelve.
- A copepod starts out as a nauplius larva (looks like a pear-shaped bean with hairs on the sides) and then becomes the copepod we know.
- Calanoid copepods have separate males and females. It’s hard to tell them apart, but if you look closely the males have modified swimming legs or antennae for grasping the female for transferring packets of sperm.
- Some copepods release sperm and eggs into the water; others brood their fertilized eggs.

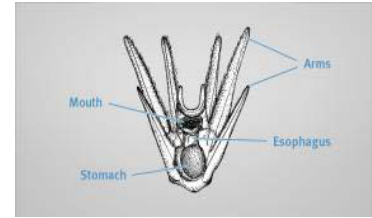
PURPLE SEA URCHIN



Adult Purple Urchin



Echinopluteus larva



Labeled illustration

Name of organism: Purple sea urchin

Scientific name: *Strongylocentrotus purpuratus*

Related to: Sea urchins, sea stars and sea cucumbers. Echinodermata (phylum)

Time spent as plankton: Six weeks as larva before settling

Size of larva: At the eight-armed larval stage, size ranges between 0.75 and 0.80 mm (width of 7 to 8 human hairs).

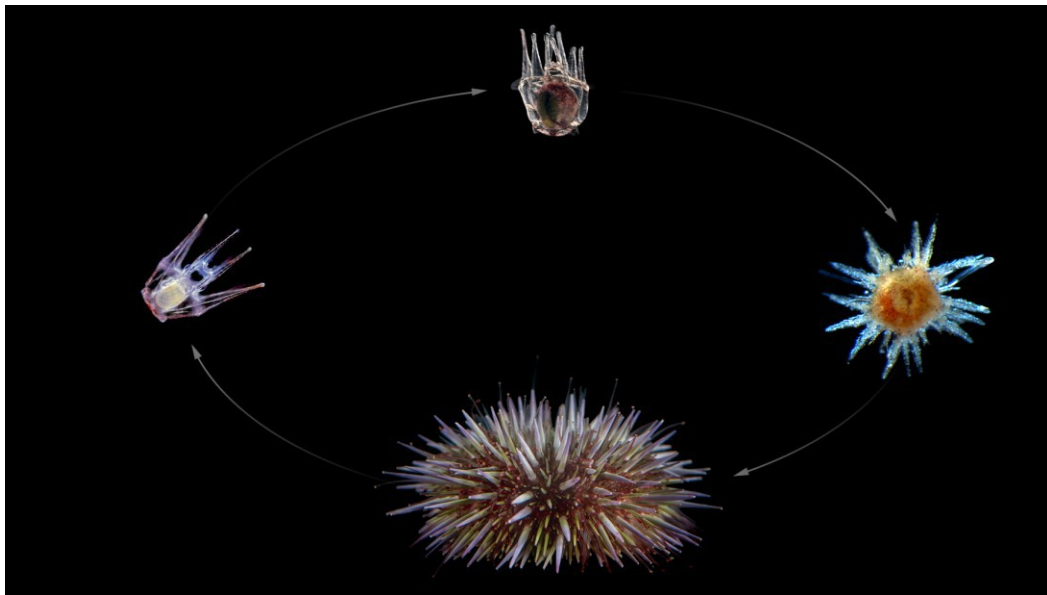
Role in the environment: Predators include sea otters, sunflower sea stars, ochre sea stars, leather sea stars, some crabs, wolf-eels and other fishes. Their preferred food is kelp, and they also eat red algae.

Fun facts to share:

- A larval sea urchin looks like a spaceship traveling through a very dense solar system? You can see the food being drawn into the mouth here (pointing to the mouth) as the thousands of hairs (cilia) beat rhythmically to create a vortex to bring in the food. Can you imagine if we could do that to bring bagels or hamburgers in for our meals?
- The purple sea urchin is one of the most studied marine invertebrates. This is due to their easy access and the fact that sea urchin embryos are transparent and fairly easy to rear. The purple sea urchin has been studied for more than 100 years!
- Purple sea urchins reach sexual maturity around two years of age and are dioecious—they have separate sexes. When conditions are right, the males will shed gametes into the water and this stimulates the females to send out millions of eggs into the water to unite and form the developing embryo. A free-swimming blastula forms within 18 hours of fertilization.
- Sea urchin larvae are one of the most fascinating plankton to watch feeding and moving through the fields of green phytoplankton. Their

job from the time they are two days old until six weeks later is to survive, swim, feed and find a place to settle down to become a juvenile sea urchin. We know they feed on diatoms, dinoflagellates, coccolithophores, flagellates, tintinnids and other small, suspended particles.

- In the early echinopluteus larval stage there are only four arms with cilia along the inside edge providing both movement and creating a current to bring in surrounding phytoplankton.
- As the larva develops, it will add arms, changing from the four-armed animal to a six and then eight-armed individual. The body form changes dramatically with metamorphosis as the ends of the arms and larval gut and mouth are reabsorbed and tube feet begin to appear.
- Metamorphosing juveniles sink rapidly to the seafloor where five primary tube feet extend out and attach to the benthos.

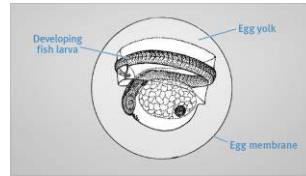


Sea urchin life cycle

PACIFIC SARDINE



Adult Sardine



Labeled Illustration

Name of organism: Pacific sardine

Scientific name: *Sardinops sagax*

Related to: Herrings, sardines, sprats, pilchards and shads. Chordata (phylum), Actinopterygii (class), Clupeidae (family).

Size larva: The newly hatched larva is about 3.5 mm in length.

Role in the environment: Fish eggs and larvae are a critical food source for countless marine organisms from invertebrates to fishes. As Pacific sardines grow, they become a critical low-level trophic predator that is important to the entire ocean food web and countless people who depend on them.

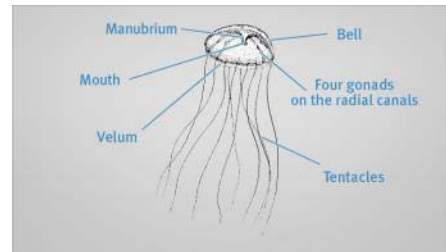
Fun facts to share:

- You can see through the transparent body wall of the egg and see the eyes, notochord, bones, etc. of the larva.
- Many fishes coordinate the spawning of their gametes to increase the likelihood of fertilization occurring in the water column. These developing eggs have an egg yolk that nourishes the developing embryo for the duration of its time in the egg.
- The yolk sac is clearly visible for the first four to seven days. Once they hatch from the egg, they'll live off a bit of the yolk for a few days and then begin their life feeding on tiny plankton.
- As the larval fish continues to grow, it develops pigment spots, and the dorsal fin develops and shifts forward. At the juvenile fish stage (about 35.0 mm in total body length) it can start to swim against currents and is no longer planktonic.

Gregarious Jelly



Adult gregarious jelly



Labeled illustration

Name of organism: Hydromedusa, gregarious jelly

Scientific name: *Clytia gregaria*, formerly known as *Phialidium gregarium*

Related to: Hydrozoans (in the same class)—group of smaller jellies that typically have two life stages: colony and medusa. Cnidaria (phylum), Hydrozoa (class), Leptothecata (order), Campanulariidae (family). Of the jellies on exhibit, the gregarious jelly is closely related to the crystal jelly and the umbrella jelly.

Time spent as plankton: Hydromedusa spend its entire life as a medusa in the plankton. It lives about three months as plankton

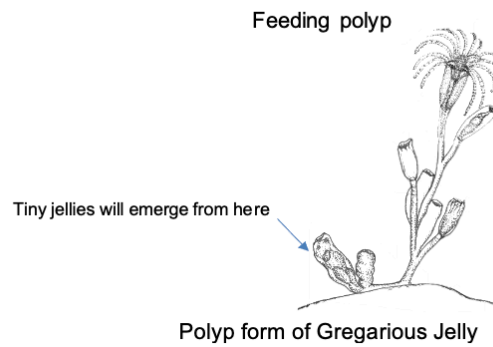
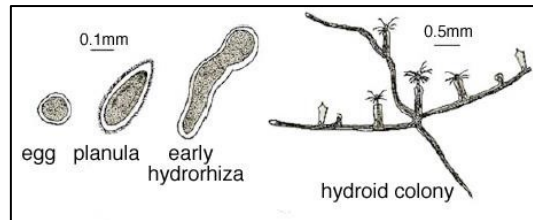
Size of medusa: About the size of a human thumbnail (1.5 cm)

Role in the environment: As a member of the planktonic community, the hydromedusa is both predator on microplankton and prey for larger planktonic predators. In its longer-lived polyp form, the hydroid colonies are home for lots of tiny invertebrates and food for nudibranchs and many other animals.

Fun facts to share:

- These jellies are carnivorous; they eat mostly softer prey such as invertebrate eggs and soft-bodied plankton in the wild. The gregarious jelly hunts and consumes other jellies that would otherwise be competing for the same foods.
- When mature, this jelly has over 60 highly extendable tentacles around the edge of its bell. This jelly is known to “fish” for food. It sinks upside down, trailing its tentacles behind. Then it rights itself, swims upward and sinks down again, repeating the process until its belly is full.
- The four thick white lines positioned near the edge of the bell are the gonads, or reproductive organs.
- The adult jellies release eggs and sperm into the water where they unite to form embryos. The embryos become planula larvae.
- This non-feeding planula larva settles on a hard surface within two or three days after fertilization and turns into a sessile branched hydroid.

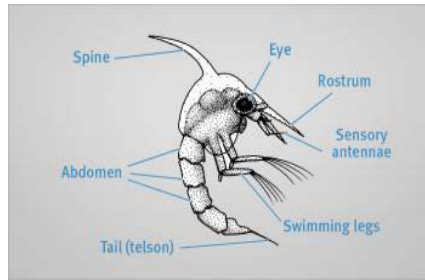
- When conditions are right, the hydroid releases tiny jellies called ephyrae which grow into medusae.
- Within three weeks these medusae are mature, and they live for about three months as jellies, maxing out in size to about 1.5 cm. With a lifespan that rarely exceeds three months, this jelly species is relatively short-lived.



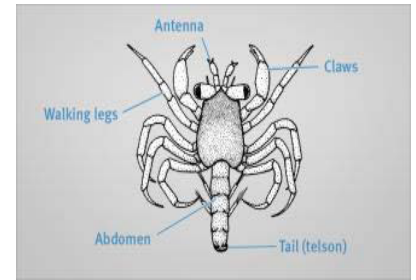
STRIPED SHORE CRAB



Adult striped shore crab



zoea



megalops

Name of organism: Striped shore crab, zoea and megalops larvae

Scientific name: *Pachygrapsus crassipes*

Related to: Other crabs, shrimp and lobsters. Arthropoda (phylum), Crustacea (subphylum), Malacostraca (class), Decapoda (order).

Time spent as plankton: Around 8 to 16 weeks, depending on temperature and food supply.

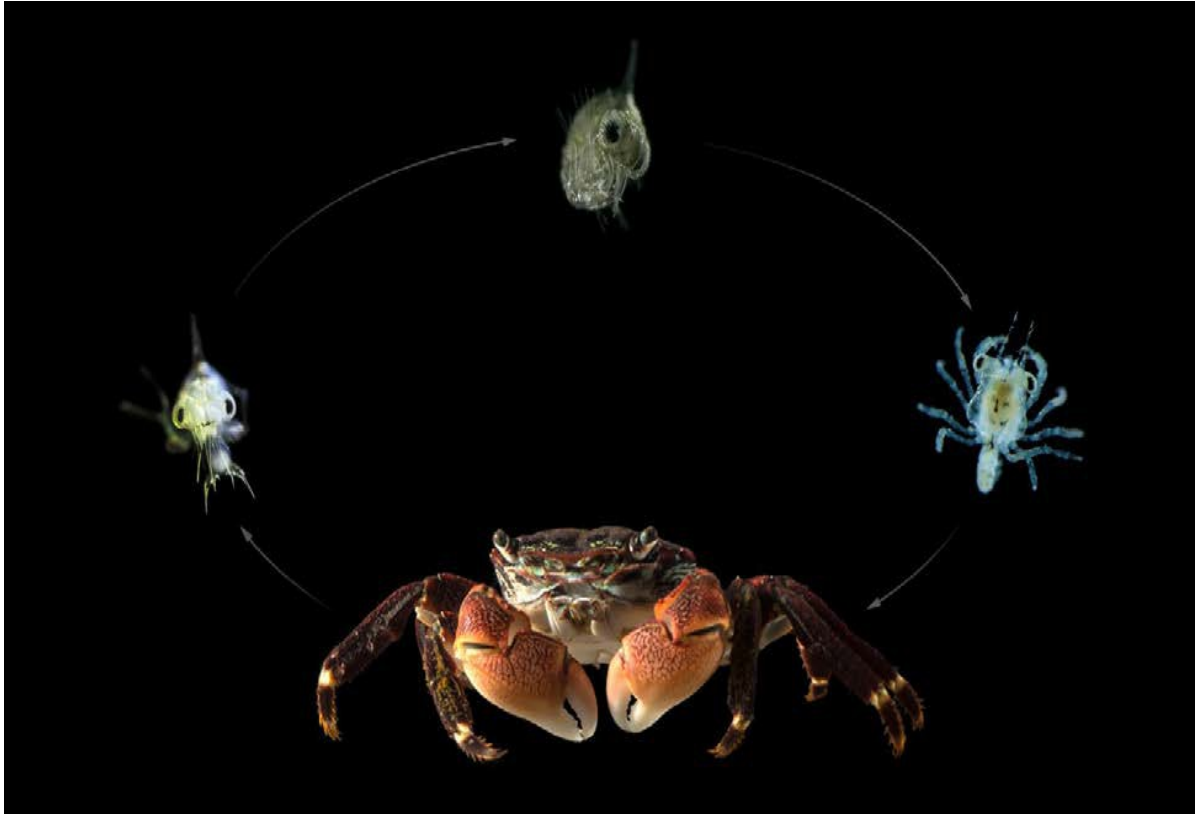
Size of larva: Their size ranges from 1.0 mm (first zoea stage) to 5.6 mm (megalops stage).

Role in the environment: In coastal and estuarine environments these crabs are fairly common and are a source of food for many animals and in turn their larvae feed on phytoplankton and some zooplankton while drifting.

Fun facts to share:

- Mating happens between April and September when the females are molting and have a soft shell. The eggs are brooded by the female. Between 16 and 25 days zoea larvae hatch.
- Striped shore crab zoea have a distinctive, laterally flattened carapace with two spines, one dorsal, and the other like a long, sharp, spiny “nose.” They have a pair of large compound eyes, antennae, and 3 pairs of feeding appendages for filtering phytoplankton
- The last stage, called the megalops, provides the first glimpse of a “crab” form. A juvenile stage follows that includes several molts before settling out of the plankton to begin adult life in the rocky intertidal and hard mud shores.
- Adults of this species spend half of their lives out of water and can withstand a wide range of salinity.

- Adults are opportunistic omnivores, feeding on films of algae and diatoms on rocks, green algae, dead animals, small intertidal invertebrates, limpets and even other crabs, including younger versions of their own species.
- All crabs molt as they grow. After molting individuals have soft shells until a thin membranous layer is deposited and the cuticle gradually hardens.



Striped Shore Crab Life Cycle

POLYCHAETE WORM



Adult worm



Trochophore

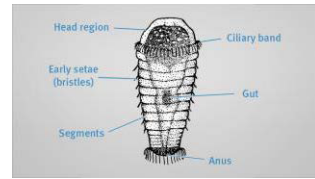


Illustration of larva

Name of organism: Polychaete worm, trochophore larva

Scientific name: phylum: Annelida, class: Polychaeta.

Related to: Related to all marine polychaetes and terrestrial earthworms.

Time spent as plankton: Several weeks before settling

Size as larva: 100 to 270 microns (0.004 to 0.01 inches) long

Role in the environment: The larvae feed by whirling cilia to create a vortex to bring in phytoplankton and organic particles. When abundant, the larvae are prey for other zooplankton; the adults are eaten by many invertebrates, fish and birds. Worms play a critical role in bioturbation or moving around the sediment to oxygenate.

Fun facts to share:

- Polychaetes are amazing in their diversity of size, color, form and where they live. You can find them in the intertidal, on pilings, on sandy and muddy sea floors, in the mid water zones, and the deepest oceans. As adults, they range in size from a few millimeters to 3 meters in length!
- In some polychaetes, the worms produce gametes in their segments in little pouches, and when they are ripe, they literally explode, sending the male and female gametes into the water to unite to form planktonic larvae.
- All polychaetes start out as a trochophore larva; first as a pear-shaped larva with a ring of cilia (called prototroch). This ring of cilia allows the larva to move and to feed by drawing in tiny particles in the water to the primitive mouth. The early larva has a sensory area in the head region, a single eye and a tuft of cilia on the top.
- As the larva grows it may develop two tentacles in the head region (depending on the species).