

Echinoderms Fact Sheet

Spiny Rebels

Echinoderms are like no other animals on Earth. They include sea stars, sea urchins, sea cucumbers, and the striking flower-like sea lilies (crinoids). These animals have a unique body plan and a unique way of moving and feeding.

Most of today's animals have a bilateral body plan—but not these spiny rebels. Evidence suggests that early echinoderms, which evolved over 500 million years ago, also had bilateral symmetry. However, they eventually evolved away from that plan. Instead, every echinoderm is based on a five-part body that interacts with the world equally from all directions. And unlike most animals, they don't have heads with brains to lead the way!

Hunters and Grazers of the Sea

Echinoderms live only in the ocean, where they play critical roles in marine ecosystems. Most are slow-moving or stationary, yet many (like most sea stars) evolved to become successful predators (hunters). Sea urchins became unstoppable grazers. Their phylum name Echinodermata means "spiny skin" in Greek. But their special adaptations are more than skin-deep.

Five Shared Adaptations of Echinoderms

- **Five-part Radial Symmetry**

Their five-part body plan is symmetrical around an axis centered on the mouth. This is easy to see in a five-armed sea star. Rounded sea urchins have a spherical body with the same basic body plan. They are like sea stars with their five arms folded up tip-to-tip. Sea cucumbers have the same five-part body plan stretched into a long tube. Watch "Echinoderm Animation: Five-part symmetry": shapeoflife.org/video/echinoderm-animation-five-part-symmetry

- **An Internal Skeleton**

Their skeletons are made of small plates of calcium carbonate covered by thin skin. Tough connective tissue and small muscles hold the plates together and allow the sea star to be amazingly flexible. Urchins have structures attached to these plates that connect to their moveable spines.

- **A Water-Vascular System**

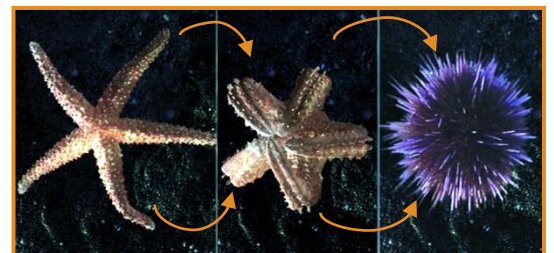
A fluid-filled system in their bodies powers hundreds of tube feet.

- The **radial canal** brings in sea water to power the water vascular system and connects to all the tube feet in the organism.
- **Tube feet** are the working ends of the water-vascular system. They aid in locomotion, grasping, and respiration. The organism extends a foot by increasing the pressure inside a small muscular bulb, which pushes the tube foot out. Tube feet on the bottom of

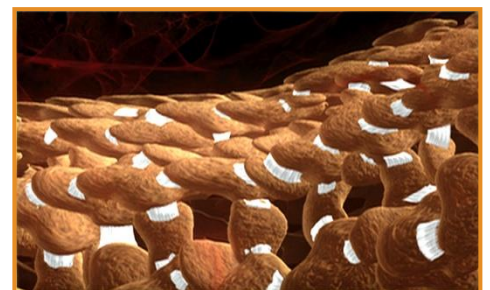


Crinoids (sea lilies) first evolved about 480 million years ago. NOAA

All echinoderms have five-part radial symmetry.



Sea star Legs folded tip-to-tip Sea urchin



The small plates of a sea star's skeleton are held together by connective tissue and small muscles, as shown in this illustration.

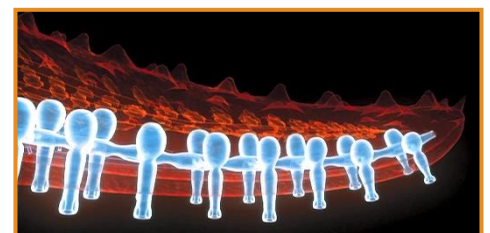


Illustration of the tube feet in a sea star, connected by the radial canal.

the animals usually have suction cups. In some species, select tube feet are specialized to sense light or chemicals in the water.

- **A Nerve Ring**

Instead of a brain, echinoderms have a central **nerve ring** around their mouths. A network of nerves fans out in five directions from the nerve ring. This nervous system relays information sensed from the environment to the rest of the body and it coordinates the tube feet.

- **An Eversible Stomach**

An “eversible” stomach means it can be extended outside of the body for feeding. Sea stars use this feeding strategy to digest food like mussels and other molluscs. A sea star everts part of its stomach through a crack in the mollusc’s shell. It then liquefies the meat and digests its meal right inside the shell!

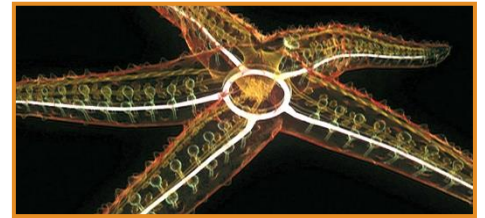


Illustration of the central nerve ring and network of nerves in a sea star



A sea star extends its stomach to feed on deep-sea coral—woah! NOAA

Life Cycle

Almost all echinoderms release eggs and sperm into the water, where fertilization takes place. Fertilized eggs develop into larvae that have bilateral symmetry. Larvae are an important part of ocean plankton, which feed many other marine animals. They may go through several stages before changing into the adult form.

There are Five Unique Classes of Living Echinoderms

- **Crinoids** (sea lilies and feather stars) have feathery structures that gather plankton. Most have a stem structure. Some species must attach to a surface and others are free-swimming.
- **Sea cucumbers** live on the seafloor as adults and are known as the vacuum cleaners of the sea! They have special tube feet at one end of their body that shovel sand into their mouths. Sand is ejected from the other end after nutrients are stripped from it.
- **Sea stars** typically have five arms and are predators. But one species of Antarctic sea star can have more than 50 arms! Most can regenerate lost arms and shed arms as a means of defense.
- **Sea urchins** are rounded with spines. Most feed on algae, such as kelp. Urchins can destroy entire kelp forest ecosystems if their predators, especially sea otters, are absent.
- **Brittle stars** look like sea stars, but have more slender arms. Basket stars are larger with branching arms. Their arms are joined to a central body disk. Most are scavengers or capture small food particles by waving their arms in the water.



A stiff-footed sea cucumber: Sea cucumbers are the largest biomass on the ocean floor. Jerry Kirkhart, Flickr



Purple sea urchins feeding on kelp. They can eventually destroy the kelp forest. Zachary Randell, Flickr

Learn More with Shape of Life Videos

- “Echinoderms: The Ultimate Animal”: shapeoflife.org/video/echinoderms-ultimate-animal
- “Echinoderms: Sea Star Time-lapse: Eating Mussel”: shapeoflife.org/video/echinoderms-sea-star-time-lapse-eating-mussel
- “Echinoderms: Sea Star Time-lapse: Eating Dead Fish”: shapeoflife.org/video/echinoderms-sea-star-time-lapse-eating-dead-fish
- “Echinoderms: Sea Star Time-lapse: Pycnopodia Chases Snail”: shapeoflife.org/video/echinoderms-sea-star-time-lapse-pycnopodia-chases-snail
- “Echinoderms: Urchin Time-lapse Eating Kelp”: shapeoflife.org/video/echinoderms-urchin-time-lapse-eating-kelp
- “Echinoderm Animation: Five-Part Symmetry”: shapeoflife.org/video/echinoderm-animation-five-part-symmetry
- “Echinoderm Animation: Sea Star Body Plan”: shapeoflife.org/video/echinoderm-animation-sea-star-body-plan