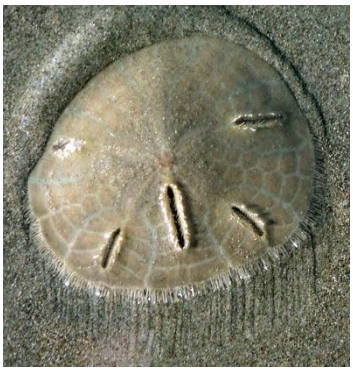
Echinoderms

Introduction: Starfish, sand dollars, and sea urchins all belong to a group (phylum) of invertebrates known as echinoderms. The word "echinoderm" means spiny skin, which describes most of the organisms in this phylum. Echinoderms all live in water and are predators or scavengers, the underside of the animal has a mouth and their arms are used to pry open shelled prey such as mollusks.



One of the more unusual aspects of echinoderms is their ability to regenerate lost arms. A starfish that loses an arm can grow a new one if just a couple of weeks. Echinoderms are radially symmetrical, which is obvious from the way their stars (which can vary in number) radiate from the mouth opening.

Echinoderms are usually found in the shallow water near the shore. They spend much of the time resting in the sand or on rocks. Starfish can move using specialized structures called tube feet. Each arm of the starfish has hundreds of tubes with suckers on them to help them navigate over rocks and sand. The suction of the tube feet is powerful enough to open even the most stubborn clam shell. The movement and circulation of a sea star is accomplished by canals within the animal that fill with water, a system called the water vascular system.

Echinoderms do not have a highly developed nervous system, but they do have a nerve ring that surrounds the mouth and helps to coordinate their movements and responses. Sensory cells on their arms gather information about their surroundings, such as light and temperature to help the organism respond to its environment.

Starfish are an important part of shoreline ecosystems. In one experiment, a starfish (*Pisaster ochraceous*) was removed from an area. This starfish was a predator of many mussel species in that location. With the starfish removed, it was thought that the mussels would achieve greater diversity. On the contrary, with the top predator gone, one species of mussel came to dominate the community and crowded out all the other species. In this sense, the starfish is known as a "keystone" species, which is an animal that is important for maintaining a community's biodiversity. A relative of the starfish, the sea urchin, is an important part of kelp communities where sea otters live.

There are several distinct groups of echinoderms related to sea stars. Sea urchins and sand dollars are grouped together because they have large solid plates that form around their soft bodies. Sea urchins have hundreds of spines sticking off their bodies, which can serve as a defense against predators. Sand dollars tend to be flat and will spend most of their time submerged under the sand in shallow waters.

Brittle stars are a group of echinoderms found mainly on coral reefs. They have very long flexible arms that can break off (and regenerated later). These broken arms will continue to wiggle and move to distract a predator and allow the organism to escape. Sea cucumbers are odd little creatures that resemble a cucumber, hence their name. Sea cucumbers usually feed on dead or decaying organic matter on the ocean floor.

PART ONE: Anatomy of a Starfish (Class Asteroidea)- match the letter to the description

1. The anus is found on the top of a sea star; this is where wastes are removed. _____

2. The mouth is on the opposite side of the anus; food is taken in here: _____

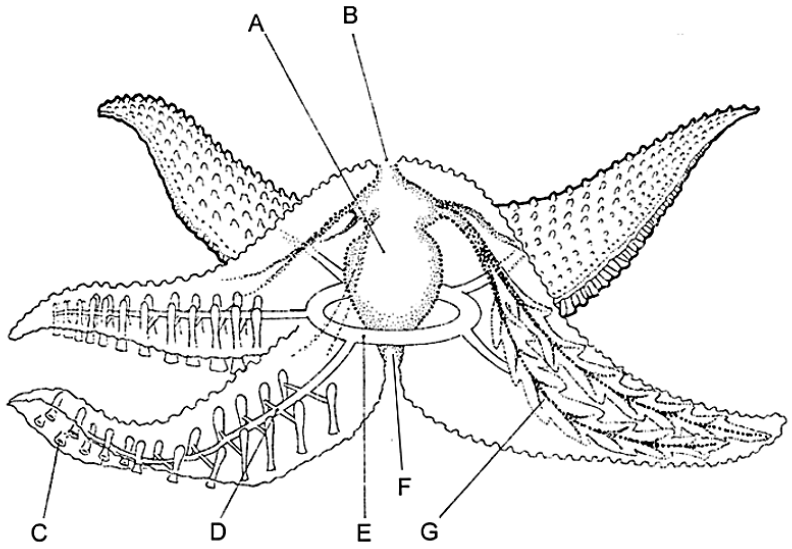
3. Large and centrally located between the mouth and anus is the stomach, where food is digested: _____

4. The ring canal surrounding the stomach, part of the sea star's water vascular system: _____

5. The radial canal extends from the ring canal into the sea star's arms, also part of the vascular system: _____

6. Attached to the radial canal are the tiny tube feet with suckers: _____

7. Digestive glands are located within the arms of the sea star; chemicals help break down food: _____



PART TWO: Questions:

____ 1. What type of echinoderm has flexible arms that are easily broken to escape predators?

a) Brittle Stars b) Sea Stars c) Sea Cucumbers d) Sea Urchins

____ 2. Sea stars belong to what Phylum?

a) Invertebrata b) Arthropoda c) Nematoda d) Echinodermata

____ 3. How do most star fish get their food?

a) Filter feeding b) Scavenging c) Predation of small animals d) Eating plants and algae

____ 4. Which echinoderm is grouped with a sea urchin?

a) sea cucumber b) sand dollar c) sea star d) brittle star

____ 5. An echinoderm that has many spines attached to it is probably a:

a) sand dollar b) brittle star c) sea star d) sea urchin

____ 6. Ring canals and radial canals are both part of the _____ system.

a) circulatory b) water vascular c) muscular d) digestive

____ 7. The process of re-growing body parts is called:

a) regeneration b) homeostasis c) vasculation d) biodiversity

____ 8. What type of symmetry does a brittle star have?

a) bilateral b) open-ended c) radial d) oblong

____ 9. Where is the anus of a starfish located?

a) At the end of an arm b) on its underside c) on its top side d) starfish do not have an anus

____ 10. A "keystone" species is often a(n):

a) top predator b) endangered species c) dominant species d) parasite

____ 11. Sea otters share their habitat with what other important organisms?

a) starfish-brittle stars b) kelp-sea urchins c) sea cucumbers-mussels d) whales-sharks

____ 12. If you remove the starfish from a shoreline area, what happens to the mussel populations:

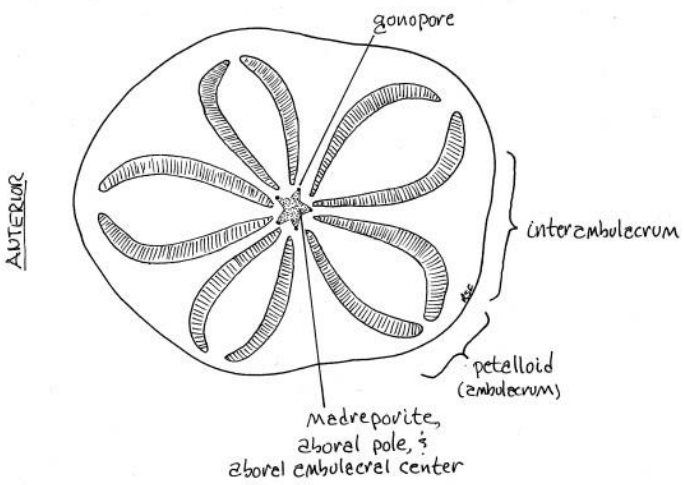
a) they become extinct b) one species crowds out all others c) the area becomes more biodiverse

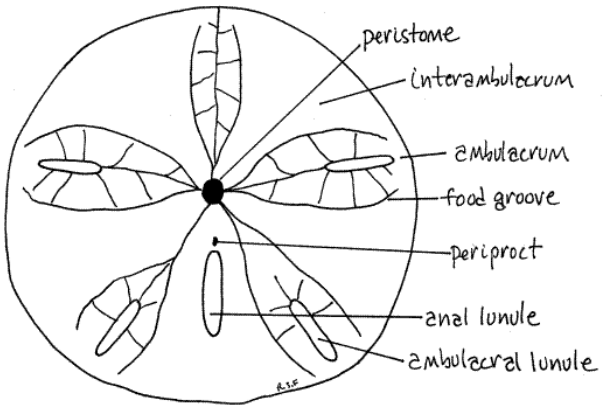
____ 13. The word "echinoderm" means:

a) big foot b) hairy toe c) tube feet d) spiny skin

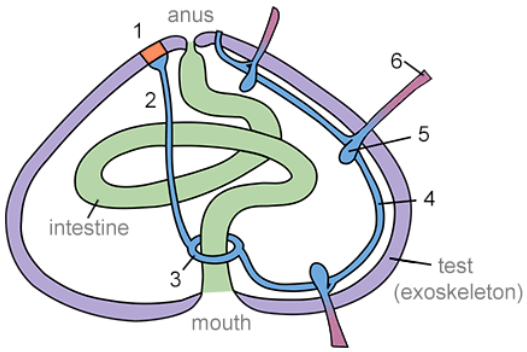
PART THREE: Comparison of the different Echinoderm Classes

Sand dollar



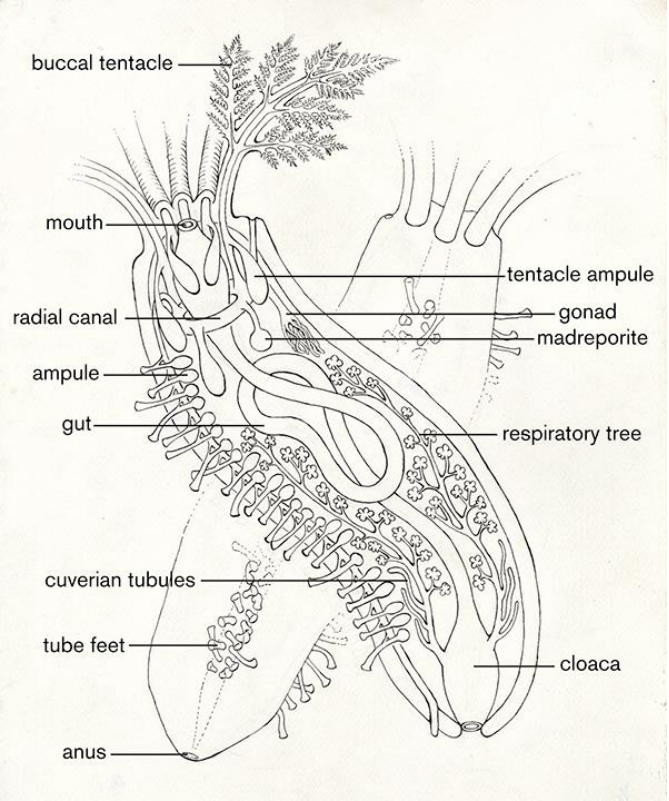


Sea urchin (Class Echinoidea)

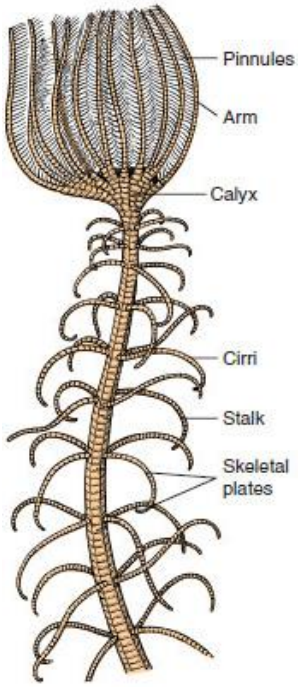


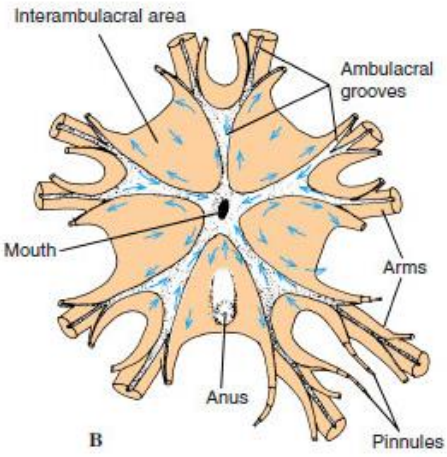
1. Madreporite	A filtered opening that allows water into the water vascular system
2. Aquifer	Water-filled area.
3. Ring canal	The ring canal circles the intestine and has five branches called radial canals.
4. Radial canal	There are five radial canals that supply water to the tube feet.
5. Ampulla	Part of the tube foot that expands when water is forced inside and contracted by using internal muscles.
6. Podia	Suction end found at the end of each tube foot.

Sea cucumber (Class Holothuroidea)

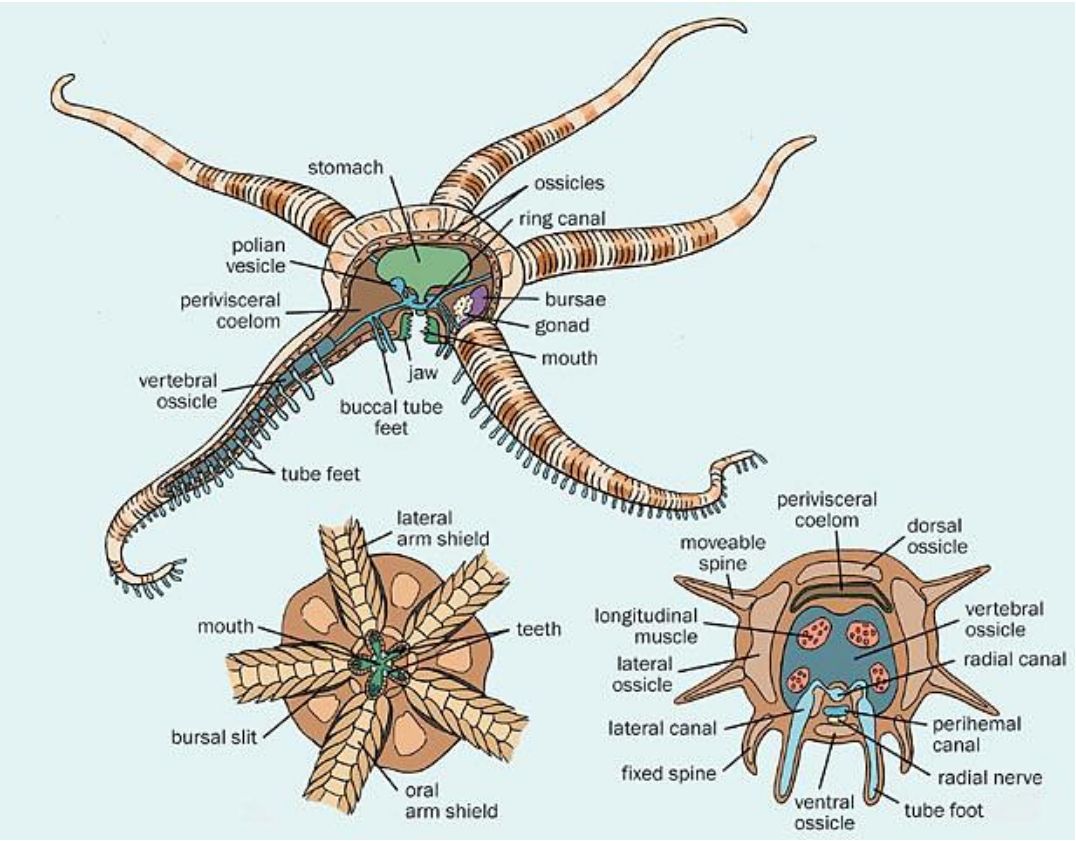


Sea Lily (Class Crinoidea)





Brittle star (Class Ophiuroidea)



PART FOUR: *What did you learn from the three brief articles on the website (Echinoderm brief readings)? Write your major take-aways below. PDF of the articles can be found on the class website.*

Article 1: When the heat is on, starfish lose an arm to survive. New Scientist Journal

Article 2: Starfish eyes show them the way home. By: MacKenzie, Debora, New Scientist Journal

Article 3: Pheromones to protect GBR from crown-of-thorns? Ecos; November 2013, Issue 189, p1-2, 2p

PART FIVE: *How do echinoderms survive without a head, eyes, or a brain?*

Background: Echinoderms have evolved unlike any other animals on Earth. Lacking eyes and a brain, they also have no heart, and pump seawater through their bodies rather than blood. Echinoderms can change their endoskeletons from rock hard to nearly liquid within seconds. Some can purposely break off an arm to distract a predator. Sound unusual? Not for echinoderms.

Question: How do echinoderms survive in the competitive marine environment?

Instructions

1. Choose one species from three of the six major classes of echinoderms. List the species in your data table.

2. Research the species you chose and fill in information in your data table. Observe the echinoderms in their natural habitat by viewing a video online.

Species	Physical Characteristics	Food Sources/Strategies For Obtaining Food	Predators	Defense Strategies	Reproduction and Development	Other Interesting Facts

1. Describe some basic physical characteristics shared by echinoderms.

2. What are the major food sources of the echinoderms you studied?

3. Are echinoderms well-adapted to survive in the marine environment? Justify your answer.