NO PREP

# Echinoderms

## Sea Stars and Sea Urchins

**Includes:** Student reading, case study, differentiated questions, teacher key

Name: Period: Date:

# Echinoderms: Sea Stars and Sea Urchins

**Wonders of the Echinoderms**

The ocean floor is alive with creatures that don't look like anything else on Earth. Among the most fascinating are echinoderms, a group that includes sea stars, sea urchins, sand dollars, and sea cucumbers. Unlike the symmetrical bodies of most animals, echinoderms exhibit radial symmetry, meaning their body parts are arranged around a central axis. They also possess an internal skeleton made of calcium carbonate, giving them a rigid yet lightweight structure. These features set them apart as one of the most unique and ecologically significant phyla in the marine environment. What makes echinoderms especially compelling is their ability to thrive without a brain. Instead, they rely on a nerve ring and radial nerve cords that coordinate movement and responses to the environment. This decentralized system works in harmony with another distinctive feature: the water vascular system. This hydraulic network allows echinoderms to move, capture food, and exchange gases, proving that intelligence is not the only way to be successful in nature.

**Name:** **Period:** **Date:**

# Echinoderms: Sea Stars and Sea Urchins

## Wonders of the Echinoderms

The ocean floor is alive with creatures that don't look like anything else on Earth. Among the most fascinating are echinoderms, a group that includes sea stars, sea urchins, sand dollars, and sea cucumbers. Unlike the symmetrical bodies of most animals, echinoderms exhibit radial symmetry, meaning their body parts are arranged around a central axis. They also possess an internal skeleton made of calcium carbonate, giving them a rigid yet lightweight structure. These features set them apart as one of the most unique and ecologically significant phyla in the marine environment. What makes echinoderms especially compelling is their ability to thrive without a brain. Instead, they rely on a nerve ring and radial nerve cords that coordinate movement and responses to the environment. This decentralized system works in harmony with another distinctive feature: the water vascular system. This hydraulic network allows echinoderms to move, capture food, and exchange gases, proving that intelligence is not the only way to be successful in nature.

## The Water Vascular System

At the heart of echinoderm biology is the water vascular system, a network of canals powered by seawater. Water enters through a sieve-like structure called the madreporite, travels through canals, and extends into tube feet. These tube feet act like suction cups, enabling echinoderms to cling to rocks, open shells, and slowly crawl across the sea floor. The water vascular system is a perfect example of evolutionary innovation. It allows echinoderms to survive in environments ranging from sandy shallows to deep-sea habitats. For sea stars, the ability to exert steady pressure with tube feet gives them the power to pry open tightly shut clams and mussels. For sea urchins, the system helps coordinate movement of their spines and feeding structures, called Aristotle's lantern, which scrape algae from rocks. This

unique way of moving and feeding is unlike anything found in vertebrates. It highlights how adaptation can take many forms, especially in the demanding environment of the ocean.

**Regeneration and Survival**

One of the most well-known abilities of echinoderms is regeneration. If a sea star loses an arm, it can regrow it over time. In some cases, a single lost arm can even grow into a whole new individual, provided part of the central disk is attached. This ability provides a powerful survival advantage, allowing echinoderms to escape predators and recover from injury. Sea cucumbers take regeneration to the extreme. When threatened, some species expel their internal organs to distract predators, later regenerating the lost parts. This process, though shocking, is an effective way to survive in a hostile environment. Regeneration also makes echinoderms valuable for scientific study. Researchers investigate these mechanisms to better understand tissue repair, with potential implications for medical science and regenerative therapies. What may look like a simple starfish arm on the beach is, in fact, a gateway to new insights into biology and medicine.

**Echinoderms as Keystone Species**

In many ecosystems, echinoderms play the role of keystone predators. For example, the ochre sea star helps control mussel populations along rocky shores. Without sea stars, mussels would dominate these areas, reducing biodiversity. By keeping mussel numbers in check, sea stars create space for other species like barnacles, algae, and small invertebrates to thrive. Sea urchins also play a significant ecological role. By grazing on algae, they prevent reefs and kelp forests from becoming overgrown. However, if their populations become too large, urchins can overgraze and devastate kelp forests. In these cases, predators like sea otters help maintain balance by feeding on urchins. This interconnected web demonstrates the importance of echinoderms as both consumers and prey in marine ecosystems. Echinoderms remind us that even animals without brains or blood can shape entire ecosystems. Their ecological influence far outweighs their simplicity, making them critical engineers of marine life.

**Case Study: The Sea Star Wasting Disease**

**In the early 2010s, researchers along the Pacific Coast of North America began noticing something alarming: massive die-offs of sea stars. A mysterious condition, later named Sea Star Wasting Disease (SSWD), caused lesions, tissue decay, and eventually the disintegration of entire bodies. Populations of ochre sea stars, once abundant along rocky shores, were nearly wiped out in some areas. Scientists linked the outbreaks to viral infections, though environmental stressors like warming ocean temperatures may have made sea stars more vulnerable. The ecological consequences were immediate. Without sea stars to control them, mussel populations surged, monopolizing space on rocky shores. Biodiversity plummeted as other species were crowded out. These changes illustrated the crucial role of sea stars as keystone predators. Recovery has been slow, and scientists continue to study both the disease and its long-term effects on ecosystems. The case of SSWD underscores the fragility of marine systems and the outsized influence of echinoderms in maintaining ecological balance.**

1. Why did the decline of sea stars lead to a drop in biodiversity on rocky shores?

2. What environmental factors may have contributed to the spread of Sea Star Wasting Disease?

**Multiple Choice**

1. What is the function of the water vascular system in echinoderms?

    a) Protect against predators by releasing toxins from the skin

    b) Store oxygen for respiration

    c) Pump blood through arteries

    d) Power movement and feeding through hydraulic pressure

2. Which structure helps sea urchins scrape algae from rocks?

    a) Tube feet and suction cups

    b) Nerve ring

    c) Aristotle's lantern

    d) Madreporite

3. Why are sea stars considered keystone predators?

    a) They produce powerful toxins to deter aggressive predators

    b) They prevent mussels from monopolizing rocky shores

    c) They regenerate lost arms

    d) They use spines for defense

**Matching**

Write the letter of the correct definition on the line next to each term.

| Term | Definition |
|---|---|
| 1. ___ Water vascular system | A) Ability to regrow lost arms or body parts |
| 2. ___ Tube feet | B) Role played by some starfish in controlling mussel populations |
| 3. ___ Regeneration | C) Specialized structures used for movement and gas exchange |
| 4. ___ Sea urchin spines | D) Fluid-filled network that powers movement and feeding |
| 5. ___ Keystone predator | E) Protective adaptations used for defense and burrowing |

**Fill-in-the-Blank**

1. The sieve-like structure where water enters the vascular system is called the _____.

2. The rigid skeleton of echinoderms is made primarily of _____.

3. Sea cucumbers can expel their _____ as a defense mechanism.

**Short Answer**

Answer each question in 2-4 complete sentences.

1. Explain how tube feet help sea stars open clams and mussels.

_____

_____

_____

2. How does the overpopulation of sea urchins affect kelp forests?

3. Why might scientists study regeneration in echinoderms for medical purposes?