# PHYLUM ECHINODERMATA

# SEA STAR

Sea star/Starfish are representative animals of Phylum Echinodermata. "Echin" means "spiny" and "derma" means "skin. Other members of this phylum include Sea Urchins, Sea Cucumbers, Sand Dollars and Brittle Stars.

Characteristics of the phylum are

- spiny skin
- pentaradial symmetry
- calcareous endoskeleton
- water vascular system
- tube feet
- marine environment

On the starfish, the dorsal surface is known as the **"aboral"** surface, and the ventral surface is the **"oral"** surface. This is because the mouth of the starfish is located on the ventral side.

**External Surface: Aboral and Oral**

✎ Identify the external structures on your starfish. Place the labels on the appropriate diagram:

- rays: arms
- central disc: part to which arms are attached
- madreporite: small yellow or red structure which allows water to entre the water vascular system
- anus: opening in central disc, hard to see
- mouth
- ambulacral groove: long groove running along the center of each ray
- tube feet: soft projections lining the ambulacral groove, used for movement

**Internal Anatomy**
**Digestive and Reproductive Systems:**

✎ Label

- cardiac stomach
- pyloric stomach
- pyloric cecum / digestive glands
- pyloric duct

**Feeding**

Starfish have 2 stomachs, a cardiac stomach and a pyloric stomach. Sea stars can evert their cardiac stomach when they feed, extending their stomach out through their mouth to the outside of their body. They can digest their food outside their body, making it possible for them to eat prey that is larger than their mouths. Partially digested food is passed from the cardiac stomach to the pyloric stomach, to continue digestion. The digestive glands (pyloric cecum) secrete enzymes into the pyloric stomach for digestion.

The large gland filling each ray is the pyloric cecum (digestive gland). These digestive glands secrete enzymes into the pyloric stomach for digestion.

**Reproduction**

Gonads are located under the pyloric cecum in each ray. They are pale, lumpy organs extending from the central disc, down the arm. During breeding season gonads are large, at other times they maybe be small. Starfish have separate sexes, testes are grey in colour and ovaries are orange. Preserving starfish specimens may cause them to lose their true colours.

✎ Label:

- gonads

**Water Vascular System**

The water vascular system consists of hollow tubes to circulate sea water around the sea star. Sea water enters through the madreoporite and moves by way of canals to all body parts.

Find the zipper-like ridge that runs down the center of each arm. This is a radial canal to which tube feet are attached. In the central disc, the five radial canals connect to a circular canal called the ring canal. A short canal called the stone canal leads from the ring canal to the madreporite where water enters.

The bulb-like, "top" of a tube foot called the ampulla. This sac works like the top of an eyedropper to create suction. The bottom of the tube foot is a sucker. Each ampulla is connected to a tube foot which extends through the skeletal plates onto the underside of the sea star. Pressure changes due to the movement of fluids into and out of the ampulla enable the starfish to contract and relax the tube feet. The tube feet act as tiny suctions cups that grip objects. With the tube feet, a starfish can move and hold prey.

✎ Label:

- ampulla
- tube feet
- radial canal
- ring canal
- stone canal
- madreporite

# ECHINODERMATA QUESTIONS

1. Describe how the term “penta-radial symmetry” applies to the starfish.

2. How does the surface of a starfish, or sea urchin relate to the phylum name?

3. On which surface of the starfish is the mouth located? Where is the mouth in relation to the stomach?

4. On which surface is the anus located? Where in the anus in relation to the stomach?

5. Compare your answers to questions 3 & 4, to the location of the stomach in humans.

6. Compare and contrast with the “stomachs” of the sea star with the …
    a. the crayfish

    b. the earthworm

7. What is the function of the pyloric caeca?

8. What is the function of the gonads?

9. What system does the water vascular system represent in a sea star?

10. How many radial canals does the sea star have? How many ring canals?

11. What is circulated in the water vascular system?

12. What system is the equivalent of the water vascular system in humans?

13. What is circulated in the human vascular system?

14. What advances do Echinoderms have over Arthropods that lead biologists to classify them as closer relatives of the Chordates? (Chordates are the next phylum along the evolutionary scale, after the Echinoderms.)