

Dissection: The Starfish

Objectives

- To learn some of anatomical structures of the starfish.
- To be able to make contrasts and comparisons of structures between different animal phyla as additional organisms are observed.
- To deduce the adaptive significance of differences in the structures of animal phyla as additional organisms are studied.

Introduction

Starfish belong to the phylum Echinodermata. This phylum consists of over 6,000 species of marine organisms. Members of this phylum are characterized by their pentamerous symmetry in the adults, larval forms are bilateral.

These organisms have an endoskeleton consisting of calcareous plates. In many species, these plates bear spines. The name Echinodermata is derived from Greek meaning spiny skin. A unique characteristic of the Echinodermata is their water vascular system. This is a system of tubes in their body used for locomotion, respiration, food handling and sensory perception.

The phylum is usually divided into five classes. These are the classes Crinoidea (the sea lilies and basket stars), the Echinoidea (the sea urchins and sand dollars), the Ophiuroidea (the brittle stars), the Holothuroidea (the sea cucumbers) and the Asteroidea (the starfish). In this exercise you will be observing a common starfish in the genus *Asterias*. To begin this exercise, go to the Dissections section of the BiologyOne DVD. Select The Starfish from the menu.

In the dissection exercises, you will be asked to examine the organisms and learn something of their individual anatomy. Equally important is a comparison of the anatomical structures of between organisms, noting how they are similar, how they differ, and how their differences may be adaptive to the different life styles of these organisms.

Activity 23g.1 **External Anatomy**

From the introductory screen, click on the forward arrow in the lower right to examine the top or aboral surface of the starfish. Note its five arms giving the starfish its pentamerous symmetry. The central region of the starfish to which the arms attach is called the central disc. Off center on central disc should be able to see a light colored circle.

This is the madreporite. It is a porous structure that allows water to enter the water vascular system.

Located in the center of the central disc is the anus. One can usually not find the anus without magnification.

Turn the starfish over to observe the oral side by clicking on the small starfish located in the lower right. Find the mouth located in the center of the central disc. The mouth is surrounded by a soft membrane called the peristome and specialized oral spines. Radiating away from the mouth are the five ambulacral grooves that extend to the tips of the arms. Within these grooves are numerous tube feet. The starfish is able to extend these out from the ambulacral groove and attach them to the substrate with a sucker-like action. At the tips of each groove there is also a light sensitive pigmented eye spot and a specialized sensory tentacle. These structures are difficult to observe in preserved specimens.

After studying the external features of the starfish, label the illustration located in the Results Section.

Activity 23g.2 **Internal Anatomy**

Turn the starfish so you are viewing its aboral side. To begin the dissection to observe the internal anatomy of the starfish, use your scissors to remove the top of one of the arms. Click on the forward arrow to complete this dissection.

Look at the cut surface of the arm. You should be able to see small white plates just below the body surface. These are the calcareous plates or ossicles of the endoskeleton. You may observe the spike-like projections in some of these.

Extending down the length of each arm is a pair of highly branched pyloric caecae. These are the starfish's digestive glands. Where the pyloric caecae of an arm enter the central disc, the pair joins into a common tube that attaches to the pyloric stomach within the central disc. The pyloric caecae secrete digestive enzymes and also play a major role in absorbing digested food. After observing these structures, cut the pyloric caecae away to expose the structures below. Click on the forward arrow in the lower right to complete this dissection.

Below the pyloric caecae lies a pair of gonads in each arm. When the starfish are in season, the gonads enlarge and fill a large space within the arms. Out of season the gonads are smaller in size, only extending a short distance down each arm. Although the starfish has separate sexes, it is very difficult to distinguish between them without microscopic examination. The gonads lead to a duct that releases the gametes into the seawater. Fertilization occurs in the water column.

In this specimen, the gonads only extend a short distance down the arm. Beyond the end of the gonads, you can observe masses of bumpy structures that extend down the arm on either side of the midline. These bumpy structures are the bulbous tops of the tube feet. These are called ampulla. The ampulla attach by lateral canals to the radial canal that extends down the arm along its midline, along the top of the ambulacral groove.

Having observed the structures of the arms, now observe the internal structures of the central disc by carefully removing the aboral surface with your scissors. Click on the forward arrow in the lower right to complete this dissection. With the top of the central disc removed, you should be able to observe the two chambered stomach of the starfish.

The smaller, thick walled pyloric stomach lies above the larger, thin walled cardiac stomach. The pyloric caecae in the arms connect to the pyloric stomach. From the pyloric stomach, wastes are expelled from the body through a short intestine that leads to an anus on the aboral side of the central disc. The starfish is able to invert its cardiac stomach out through its mouth to envelop its prey and engulf it whole. Indigestible parts are not passed on to the pyloric stomach but instead are regurgitated.

Remove the pyloric stomach to better observe the cardiac stomach. Complete this dissection by clicking on the forward arrow in the lower right. After observing the pyloric and cardiac stomachs, remove the cardiac stomach to observe the structure below. Complete this dissection by clicking on the forward arrow in the lower right.

Below the cardiac stomach you can observe the circular or ring canal of the water vascular system that circles the mouth. The radial canals that extend out each arm connect to this ring canal. Extending up from the ring canal is a tube called the stone canal. This connects to the madreporite. Water can be drawn into the water vascular system through the madreporite, down the stone canal and into the ring canal. Here the fluid is distributed among the radial canals. Ultimately, by controlling the pressures within the water vascular system as well as through muscular control, the starfish is able to manipulate its tube feet.

After studying the internal features of the starfish, label the illustration located in the Results Section.

Results Section

Activity 23g.1 & 2
External and Internal Anatomy

