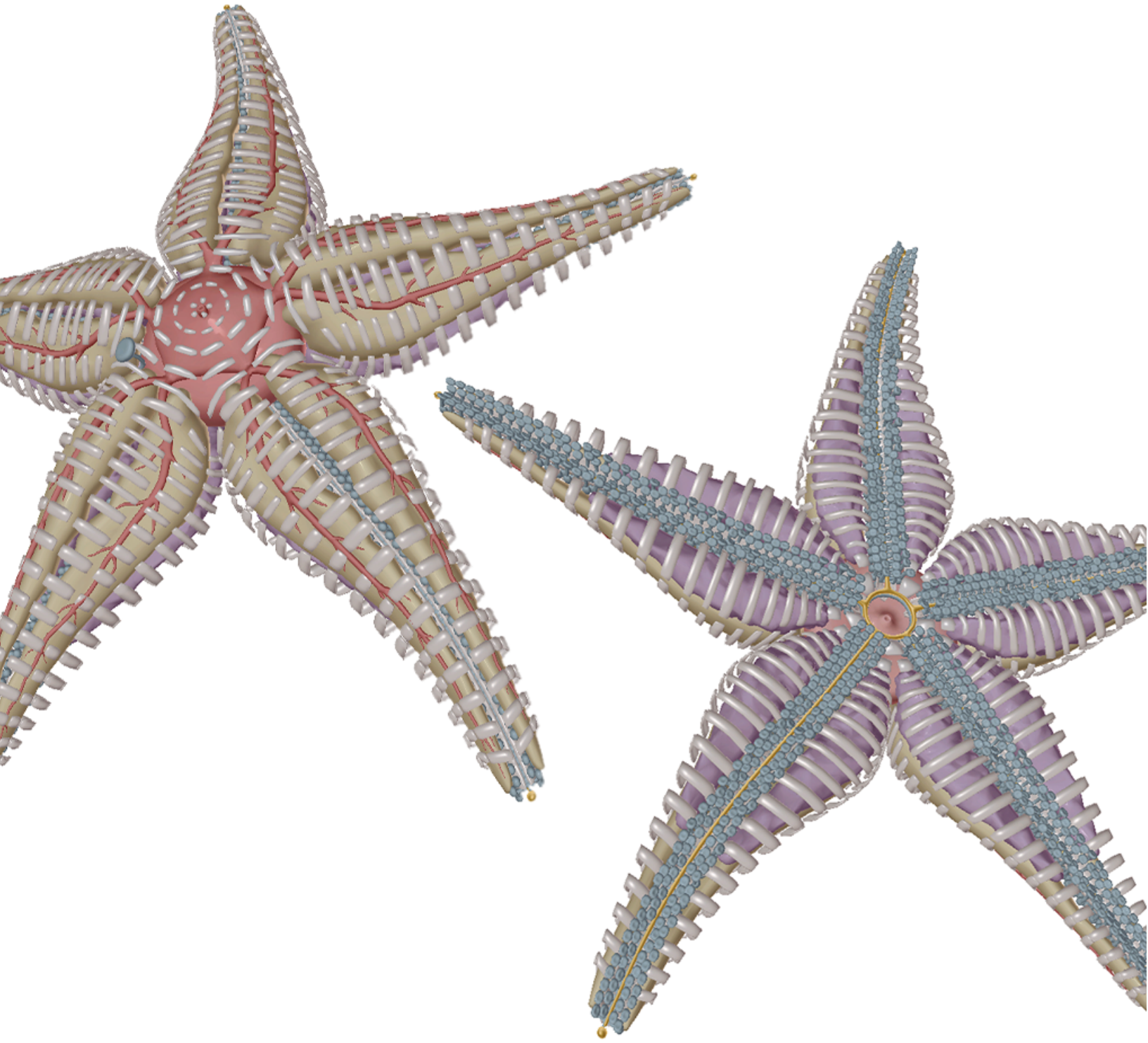
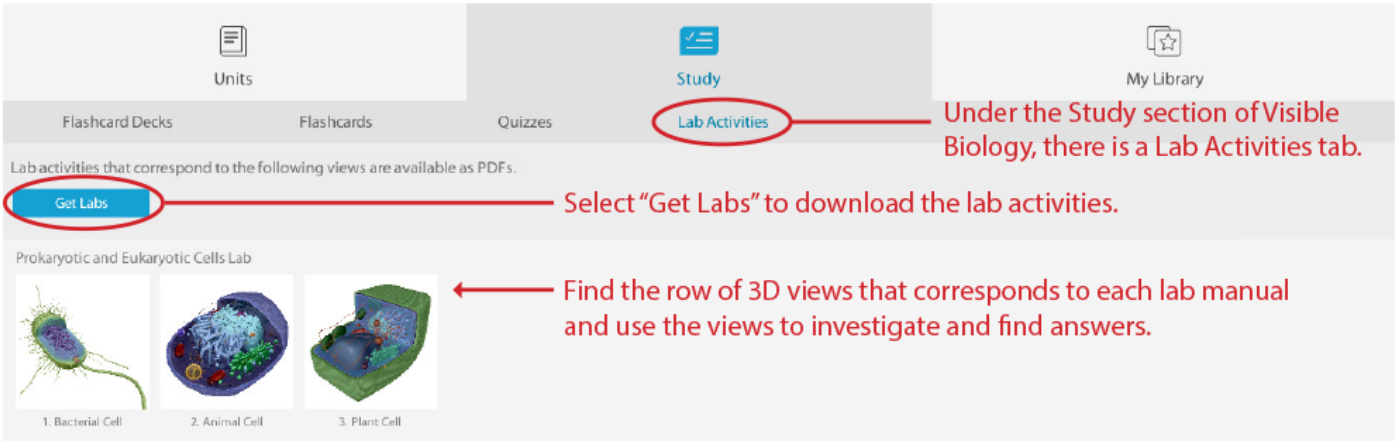


Biology Lab Activities: Sea Star

How to use this manual

This lab manual is intended for use with the Visible Biology product.

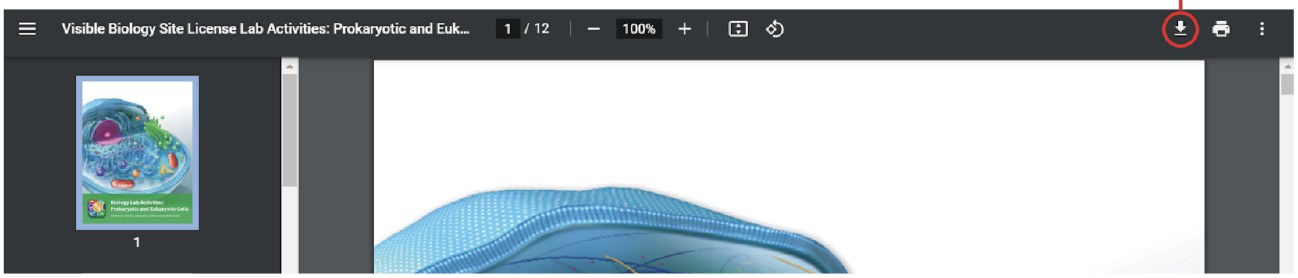
Where to find 3D models



How to save answers

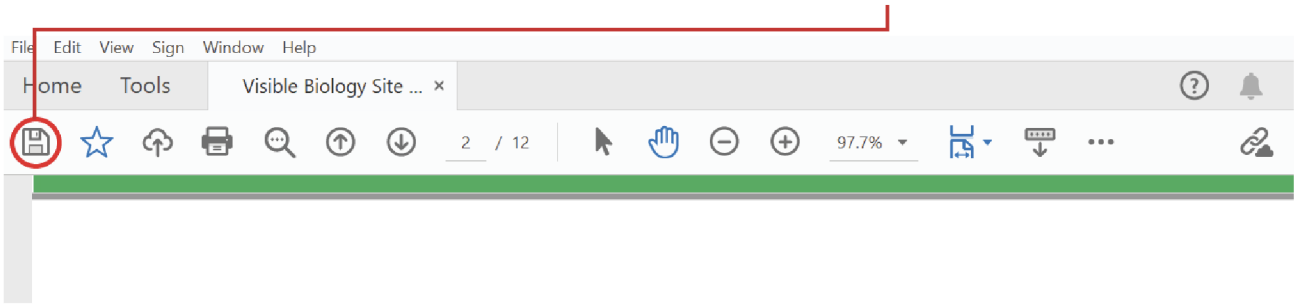
1. Have Adobe Reader installed on your computer.
   Windows: https://get.adobe.com/reader/
   Mac: https://helpx.adobe.com/acrobat/kb/install-reader-dc-mac-os.html

2. Download each lab file to your computer.



3. Open the downloaded file in Adobe Reader.
   Right-click on the file. In the menu that appears, go to "Open with..." and select Adobe Reader from the submenu.

4. Type your answers into the boxes to complete the lab and select the "Save" icon to save the lab.



5. Submit your saved version of the lab to your instructor via email, dropbox, Google Drive, or however your instructor has requested.

Any questions? visiblebiology.com

Name: Date:

Biology Lab Activities: Sea Star

Background Questions

Based on what you've learned in class, in your textbook, and from using Visible Biology, answer the following questions about the sea star.

1. What type of body symmetry is present in sea stars?

2. The sea star ingests small food particles through its _____ and larger prey via the _____ stomach, which the sea star pushes outside of its body through its mouth. This adaptation allows the sea star to begin _____ its food externally.

3. If the sea star loses one of its limbs, it can regenerate it through_____ reproduction.

4. The sea star uses a _____ vascular system to help it move through its environment. This system of canals is similar to the structure of the circulatory system in other animals. However, the sea star lacks a heart and _____.

5. Sea stars are part of the phylum Echinodermata. In 1–2 sentences, explain the characteristics the sea star shares with other animals in this phylum.

Name: Date:

Lab 1: Sea Star Structure and Function

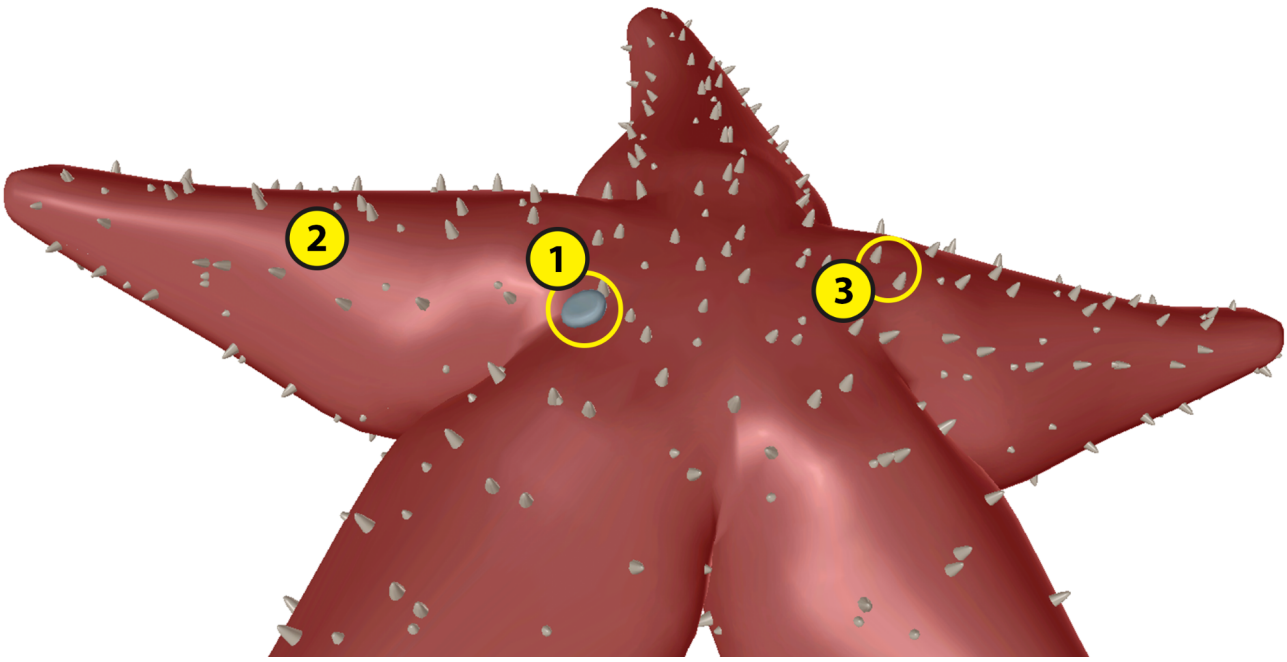
Activity 1: Label the sea star

1. Launch the view
    - Launch Visible Biology.
    - Navigate to Study/Lab Activities, and find the Animal Structure and Function Lab section.
    - Select view 1. Sea Star.
2. Label the image below
    - Explore the 3D model of the sea star to find the structures you need to label.
    - Fill in the blanks to label the structures from the list below.

Part A: Label the external structures on the sea star's aboral surface.

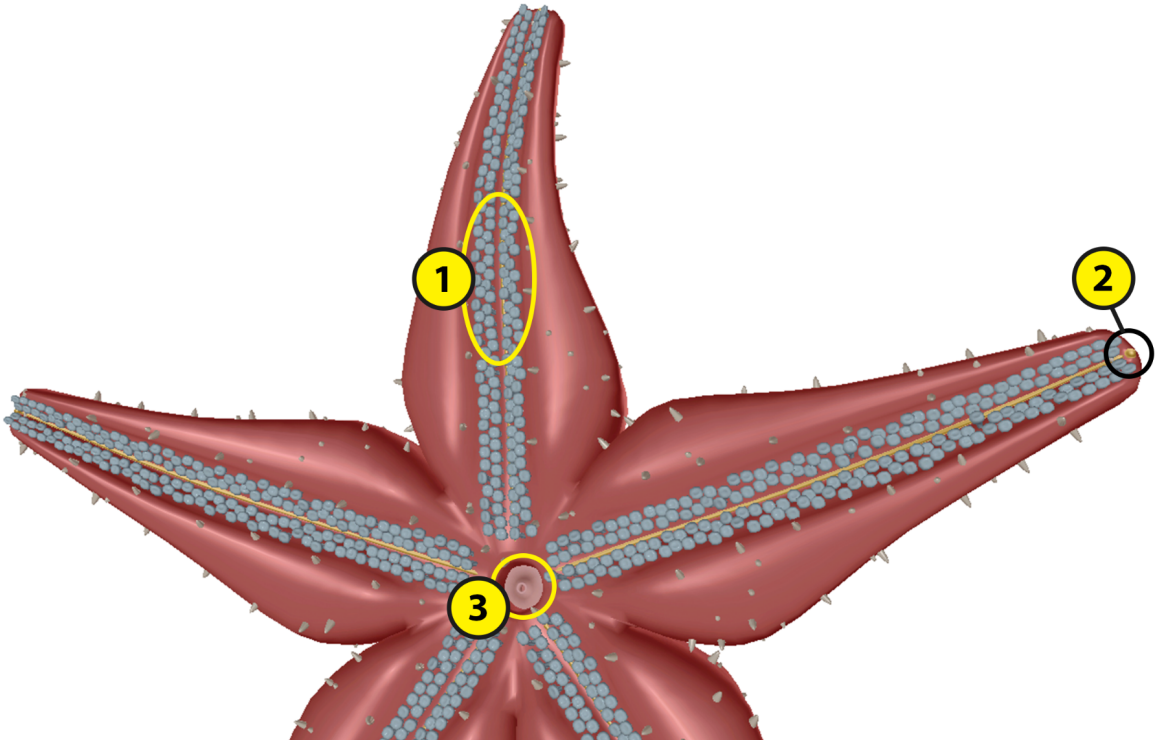
Word List:
Epidermis
Madreporite (sieve plate)
Spines

___
___
___



Part B: Label the external structures on the sea star's oral surface.

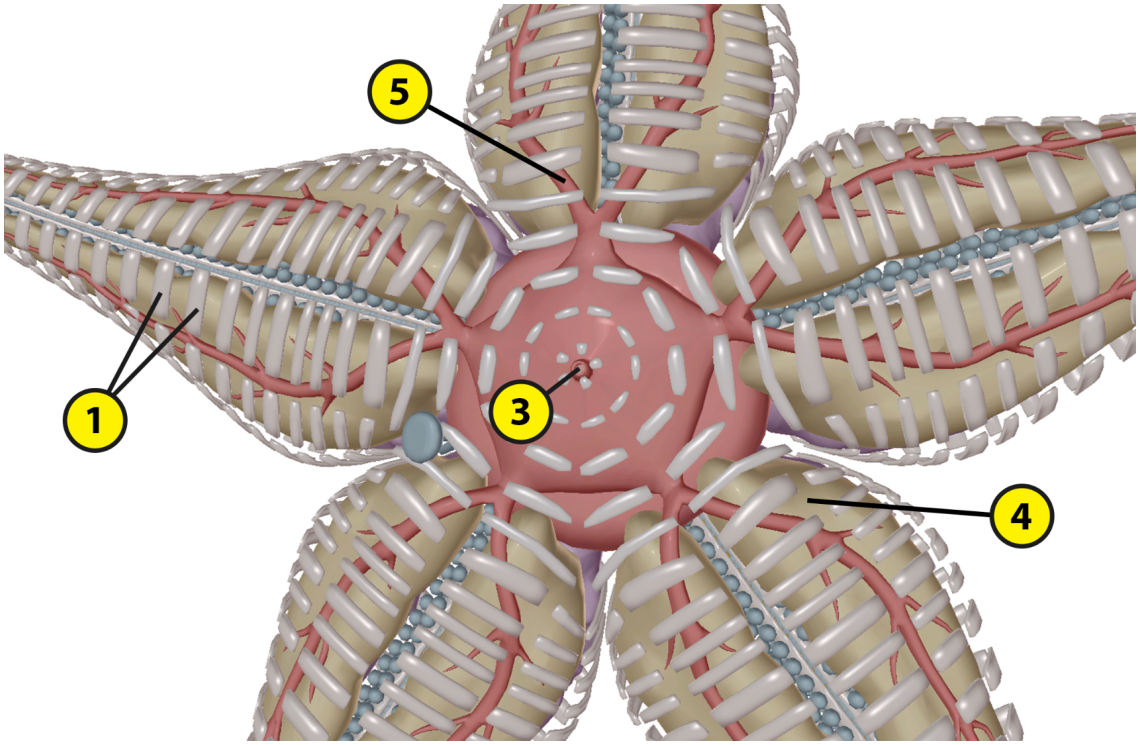
<u>Word List:</u>
Eyespot
Mouth
Podia of tube feet



Part C: Label the internal structures on the sea star's aboral side.

Word List:

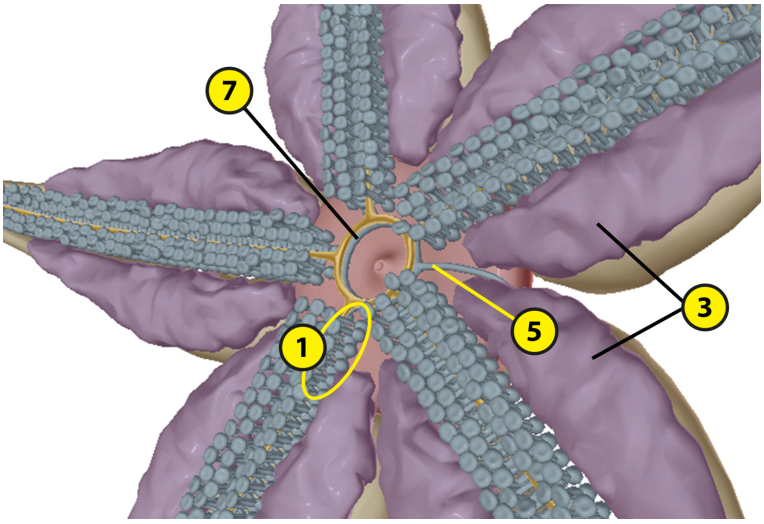
Anus ___
Endoskeleton ___
Pyloric caeca (glands) ___
Pyloric ducts ___
Pyloric stomach ___

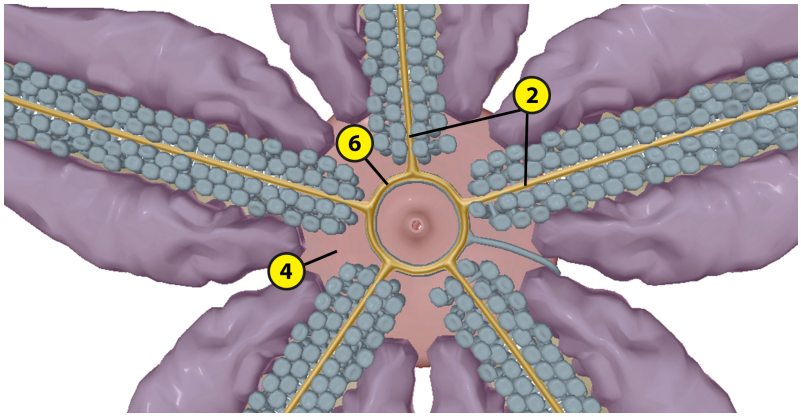


Part D: Label the internal structures on the sea star's oral side.

Word List:

Ampullae of tube feet
Cardiac stomach
Gonads
Nerve ring
Radial nerves
Ring canal
Stone canal





Name: Date:

Lab 1: Sea Star

Activity 2: Explore the structures of the sea star and their functions

Refer to your labeled sea star images from Activity 1 and the content in Visible Biology. Based on what you've learned, match each of the following structures with the brief description of its function.

Structures:

a. Ampullae
b. Anus
c. Cardiac stomach
d. Endoskeleton
e. Epidermis
f. Eyespots
g. Gonads
h. Madreporite (sieve plate)
i. Mouth
j. Nerve ring
k. Podia of tube feet
l. Pyloric caeca (glands)
m. Pyloric ducts
n. Pyloric stomach
o. Radial nerves
p. Ring canal
q. Skin gills
r. Spines
s. Stone canal

Descriptions:

___ These structures lie beneath the pyloric caeca and produce the sea star's gametes.
___ This structure contains sensory receptors for touch and smell.
___ This structure allows water to enter the sea star's water vascular system.
___ These structures detect light intensity within the sea star's environment.
___ This structure gives the sea star structural support.
___ This structure excretes the sea star's food waste.
___ These structures excrete enzymes to be used during digestion.
___ This structure is connected to the madreporite and runs into the ring canal.
___ These structures protect the sea star's aboral surface from predators.
___ These structures carry enzymes to the pyloric stomach.

___ This structure can be pushed through the sea star's mouth to start digesting food outside the body.
___ These are water-filled sacs connected to podia and the lateral canals.
___ Food travels from the cardiac stomach to this structure, where enzymes break down food into nutrients.
___ These muscles project out of the sea star's body on the oral surface to help it move.
___ These structures exchange oxygen and carbon dioxide with the water surrounding the sea star.
___ This structure, located on the oral surface of the sea star, can ingest small food particles.
___ This structure runs around the central disk and connects to the radial nerves of each arm.
___ These nervous system structures run along each of the sea star's arms.
___ This structure circles the sea star's central disk and is connected to the stone canal.

Name: Date:

Lab 2: Sea Star Dissection

Introduction

Sea stars (starfish) are aquatic invertebrates with radial symmetry. They are part of the phylum Echinodermata, which is characterized by protective spiny skin. Sea stars' skin also serves as a respiratory structure, as they diffuse oxygen into their bodies through their skin. Several adaptations help sea stars survive in their environment, including tube feet that anchor them in place, a water vascular system that moves them through the water, and the ability to regenerate lost limbs. A unique feature of the sea star is that it can push its cardiac stomach out of its mouth, allowing it to break the shell of its prey and start digesting its food outside its body. Sea stars can reproduce asexually or sexually via external fertilization. Their embryos develop similarly to chordates (which include mammals) because they are both deuterostomes, meaning the anus forms before the mouth. Sea stars differ from many other animals because they lack a brain, a heart, and blood.

In this activity, you will examine a sea star and learn about its external and internal structures.

Materials

- Sea star (virtual or preserved)
- Dissecting scissors or scalpels
- Dissecting pins and probes
- Dissecting tray
- Hand lens
- Lab gloves

Dissection

Observe the external structures of the sea star

Looking at the sea star, you will see that it's made up of the central disk and five arms. The two surfaces of the sea star are called the aboral and oral surfaces. The aboral surface is farthest from the mouth and the oral surface contains the mouth.

1. On the aboral surface of the sea star, observe the following structures:
    a. Epidermis
    b. Spines
    c. Skin gills
    d. Madreporite (sieve plate)
    e. Anus (if visible)

2. On the oral surface of the sea star, observe the following structures:
    a. Mouth
    b. Tube feet
    c. Eyespots

If using the Visible Biology virtual sea star, follow these steps

Note: In addition to using the Hide button to hide individual body systems, as outlined in the following steps, you can use the Systems tray to toggle individual body systems on or off in the view. Within the view, you can zoom in/out or rotate the model as needed to observe the sea star's structures.

1. First, select the epidermis and use the book icon to learn more about it. Then, use the Systems tray to remove the entire integumentary system from the view.
2. Select any part of the endoskeleton and use the book icon to learn more about it. Then, use the Hide button to remove the entire support system from the view.
3. Observe the following digestive system structures. Select each structure and use the book icon to learn more about each. Once you have examined each digestive structure, select any of them and use the Hide button to remove the entire digestive system from the view.
    a. Mouth
    b. Cardiac stomach
    c. Pyloric stomach
    d. Pyloric caeca (glands)
    e. Pyloric ducts
    f. Anus
4. Next, observe the reproductive structures, or gonads. Select them and use the book icon to learn more. Once you have examined them, use the Hide button to remove the entire reproductive system from the view.
5. Then, observe the following circulatory system structures. Select each structure and use the book icon to learn more about each. Once you have examined each circulatory structure, select any of them and use the Hide button to remove the entire circulatory system.
    a. Madreporite (sieve plate)
    b. Stone canal
    c. Ring canal
    d. Radial canals
    e. Lateral canals
    f. Tube feet (ampullae and podia)
6. Finally, observe the following nervous system structures. Select each structure and use the book icon to learn more about each. Once you have examined each nervous system structure, select any of them and use the Hide button to remove the entire nervous system.
    a. Nerve ring
    b. Radial nerves
    c. Eyespots

If using a preserved specimen, cut your sea star to observe its internal structures

1. Use your dissection scissors to remove the tip of the arm opposite the madreporite (sieve plate).
2. Cut along each side of that arm and across the top or dorsal side, where the arm meets the central disk. Remove that section of the epidermis and observe the endoskeleton on its underside.
3. Continue cutting the epidermis away from each arm, leaving the madreporite in place.
4. Observe the following internal structures:
    a. Digestive System: Mouth, cardiac stomach, pyloric stomach, pyloric caeca (glands), pyloric ducts, and anus

b. Circulatory System (water vascular system): Madreporite (sieve plate), stone canal, ring canal, radial canals, lateral canals, and tube feet
c. Nervous System: Nerve ring, radial nerves, and eyespots
d. Reproductive System: Gonads

Questions

Based on your observations during this lab activity and what you've learned about the sea star's structures and their functions, answer the following questions.

1. What is unique about the way the sea star eats and digests food? Why is it important that it can push its cardiac stomach outside of its body?

2. How do you think the sea star protects itself from predators without eyes or a brain?

3. How does the water vascular system of the sea star also help it move in its environment?

4. Describe what you would have to dissect to find the sea star's gonads. Once visible, is it possible to determine the sex of the sea star by simply viewing its gonads?