Chapter 2

Porifera

2.1 Objectives

- Observe what sponges look like
- Observe water flow in sponges
- Observe different cell types of sponges
- Learn to use a key to identify species

2.2 Description

The phylum Porifera (sponges) is one of the most primitive groups of the metazoa (multicellular animals). They have a cellular level of construction[1], built around a system of water canals. Different cells types provide the functions needed for all basic life processes. For example, special cells called *choanocytes* pump water through canals allowing for the uptake of respiratory gases, acquisition of food, and removal of waste. To understand how sponges work it is necessary to learn the different types of cells, where they are located, and what are their functions.

Sponges are divided into three classes Calcarea, Hexactinellida, and Demospongiae. In addition to being separated into these monophyletic taxonomic groups, sponges are also divided into three structural groups[2], asconoid, syconoid, and leuconoid. These groups differ in the morphology of the water canal systems. The asconoid is the most simple, the syconoid is more complex, and the leuconoid is the most complex.

All sponge cells[3] are totipotent, meaning they have the ability to change from one cell type to another. Unspecialized cells are called archeocytes and may differentiate into other cells types. Several important cell types are choanocytes, pinacocytes, and sclerocytes.

Choanocytes, also known as collar cells, are unique to sponges[4] and are important for water movement through the sponge. Choanocytes are equipped with flagella and are located in the inner lining of the spongocoel, or atrium. Coupled with induced flow, the beating of the flagella of the choanocytes pull water in through pores in the pinacoderm, called ostia or dermal pores, into the flagellated chambers, and

[1] Sponges possess neither tissues nor organs.

[2] These structural groups do *not* represent monophyletic groups, and you should consider them only as functional groups.

[3] Except gametes.

[4] Choanocytes also occur in some protists, which indicates that sponges are also closely related to some protists.

out through the spongocoel and osculum. Give the function of pinacocytes and sclerocytes. Almost all species of sponges have spicules that structurally support and defend the sponge. Spicules are formed by specialized cells called scleroblasts. Scleroblasts precipitate and deposit silicon or calcium within the mesohyl of the sponge. Therefore, sponges have either calcareous ($CaCO^3$) or siliceous (SiO^2) spicules. Spicules take on a wide variety of shapes that are particular to each class of sponges.

Talk about feeding. The water movement created by choanocytes allows for feeding and reproduction. As water passes by the choanocytes, food particles become trapped in the "collar" of the choanocyte or phagocytosed by the choanocytes.

Talk about reproduction. Water movement also enables sperm to enter neighboring sponges where they can fertilize eggs. Although sponges are evolutionarily primitive, their ability to move water through their tissues to feed and reproduce is a truly amazing adaptation to their sessile lifestyle.

2.3 Classification

Phylum **Porifera**
- Class **Calcarea** (calcerous sponges)
- Class **Hexactinellida** (glass sponges)
- Class **Demosponigae**

2.4 Observing live animals

A variety of local sponges are available in the aquaria for the class. Look carefully at and take notes on a variety of these sponges. You are encouraged to remove the sponges from the tank, but always keep sponges submerged in seawater.

- Compare and contrast the different species. Make detailed notes of the external anatomy and color of each species. Also smell the sponges. Remove a small piece, sniff, and enjoy!
- Observe water movement through an individual. Use suspended particles[5] or dye to mark water to observe flow patterns. A useful dye available in lab is fluorescein. Add a tiny drop to the outside of a sponge and see if it pumps it through and out the osculum. Use a pulled pipette to add as little as possible in a specific location. A little fluorescein goes a long way, and a little on your clothes stays there.
- Observe the external structure of a sponge. Place a pieces of a large individual or a small individual in a bowl with seawater and observe it under the dissecting scope. You should look for ostia or dermal pores, the pinacoderm, and the osculums.
- Observe the internal structure of an individual. Use a razor blade and remove a slice of tissue from a one of the live sponges. Place the tissue on a slide and cover with a cover slip. Add water under the cover slip if needed. Observe with the compound microscope. You should be able to clearly see spicules, and water canals. If you are lucky you will see a choanocyte chamber. You should also see that in addition to sponge cells, there are also other unicellular organisms living on and in a sponge.

[5] You can use the muck from the bottom of the aquaria.

- Observe the spicules of several species. Obtain a sample of sponge and place on a microscope slide, or use the sample prepared to observe cell types. Place a drop of bleach (sodium hypochlorite) onto the tissue fragment. The bleach will dissolve much of the organic matter but not the spicules. Place a cover slip over the dissolving tissue and observe with the compound microscope. Make detailed drawing of the different spicules you see. Spicules can be divided into megascleres and microscleres. Use Figure 2.1 to identify and some of the different types of spicules that you find.

  Also determine whether your spicules are calcareous or siliceous. Add a drop of 1 M HCl to a tiny piece of tissue. If calcareous, spicules will dissolve within a couple of minutes. If siliceous, they won't.

- Key out at least one species using E. Kozloff's Keys to the Marine Invertebrates of Puget Sound.

2.5 Observing prepared animals

- Place a preserved Leucosolenia under the dissecting scope and observe the external structure. Leucosolenia is a local marine Calcareous sponge that has an asconoid body type. Notice how it differs from the other sponges you have looked at.

- Observe the skeleton of a glass sponge (Class Hexactinellida) that is at the back of the room. Note the spicules. How many rays do they have? Why don't the spicules just tall apart?

- Observe the whole mount of *Grantia* (Class Calcarea), which is on a slide in the front of the room. *Grantia* is a small, shallow-water syconoid marine sponge. Pay close attention to its body structure, and the arrangement of spicules in the sponge.

- Observe the *Grantia* choanocyte slide. Most of the small cells lining the chambers are choanocytes. Some larger cells, possibly eggs, may also be present. Pale amoebocytes with dark-staining nuclei can be found in the mesohyl. Identify the following: choanocyte, amoebocyte, ostium or dermal pore, spongocoel, and flagellated chambers. How can you tell it is syconoid?

- Observe the commercial sponge fibers slide. Collagen fibers are deposited by a number of different cell types in the sponge. Lophocytes and collenocytes lay down a dispersed, intercellular collagen while spongocytes produce a supportive collagen called spongin. The fibers in this slide are spongin.

- Observe the *Spongilla* gemmules. Gemmules are found as part of the life cycle of both marine and freshwater sponges, but are much more prevalent in the latter where they form an obligatory overwintering stage. Special amoebocytes called archeocytes gather in the mesohyl and are surrounded by other amoebocytes. Spicules form and the outer collagenous covering hardens. In the autumn, the parent sponge degenerates and the gemmules "hatch" in the springtime.

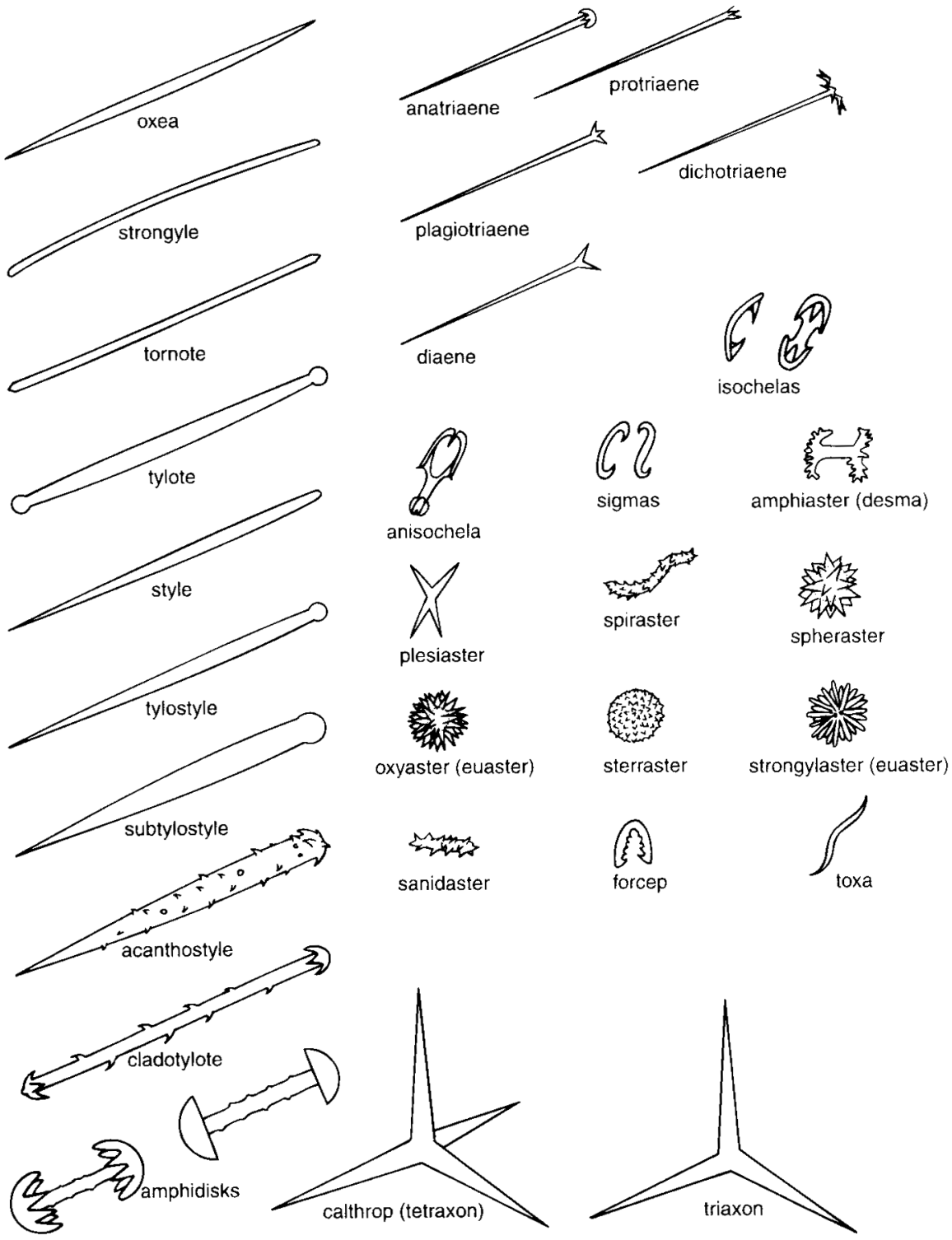

Figure 2.1: Various types of spicules from sponges. Modified from Wallace and Taylor 1997.