Station 1
The Cnidarians – Phylum Cnidaria

Some of the most colorful marine organisms are the radially symmetrical cnidarians; they are sometimes known as the “flowers of the sea”. Only a few forms, such as Hydra, occur in aquatic habitats. While some forms are extremely dangerous (box jellies), most are important, harmless members of the marine ecosystems.

Members of the Phylum Cnidaria are diploblastic. Their bodies consist of the outer epidermis (derived from ectoderm) and the gastrodermis (derived from endoderm) which are held together by a non-cellular mesoglea. Cnidarians have an incomplete digestive system. With this type of digestive system there is a single opening, the mouth, in which food will enter and digestive waste will be eliminated. The gastrovascular cavity not only serves as the site of digestion but also is important in support (as it is filled with water), gas exchange, and the excretion of metabolic wastes.

The epidermis of a cnidarian contains contractile cells that will allow for movement. A simple nervous system, called a nerve net, coordinates these movements. These adaptations allow for a more active lifestyle than the sponges previously examined; cnidarians are predators!

To aid in their capture of prey (or in some cases self-defense from larger predators), cnidarians have cnidocytes located on their tentacles. Cnidocytes are stinging cells which contain a coiled thread called a nematocyst, which when discharged, deliver a venomous sting.

Cnidarian life cycles may include two growth forms: a polyp and/or medusa. Polyps consist of a body stalk, which terminates in a ring of tentacles surrounding the mouth. The polyp form is usually sessile and is not as well equipped for locomotion as the medusa. Medusae are free-swimming and are best described as being shaped like an umbrella or bell.

Reproduction in cnidarians can include sexual and asexual stages. Gonads develop in the epidermal tissue and release gametes into the water directly for external fertilization. A form of asexual reproduction called budding is common and consists of the production of buds which form as outgrowths of the polyp.
Examples of Cnidarians

*Hydra* – a solitary aquatic polyp

*Hydra* are small aquatic predators that feed on small zooplankton. They use their tentacles and cnidocytes to capture prey. *Hydra* lack a medusa stage in their life cycle and only exist as polyps reproducing sexually with gametes or asexually by budding. *Hydra* are fairly sessile attaching to an aquatic substrate and waving their tentacles waiting for prey. They are however, capable of locomotion using a somersault or inchworm approach to moving.

Observe the *Hydra* models and slide and use the laminated sheets to label your figures.

Label the epidermis, gastrodermis, gastrovascular cavity, mesoglea, tentacles, bud, mouth, gonads, nematocyst, cnidocyte

Label the cnidocyte and the nematocyst
**Obelia - a polymorphic life cycle**

*Obelia* are **polymorphic. Obelia** polyps form a sessile colony. There are two types of polyps in the colony; a **feeding polyp** equipped with tentacles surrounding the mouth and a **reproductive polyp** which produces asexual medusae by budding. These medusae are free-swimming and represent the sexual stage of the life cycle. At maturity, gonads on each meduase release gametes (sperm or egg) into the water. After fertilization, the larva locates a suitable location and attaches to the substrate and develops into a new polyp colony.

Observe the slides of the *Obelia* life cycle and note the dramatic differences in the two growth forms.

**Sea Anemones – large polyps with no medusa stage**

Sea Anemones are often the most brightly colored inhabitants of coral reefs, jetties or tide pools. Only a polyp form is present in the life cycle and both sexual and asexual reproduction are common. Sea anemones feed on a variety of plankton or small marine life using their tentacles to capture and subdue their prey.
Coral – colonial polyps that secrete a calcareous cup

**Hard and soft corals** are important components of marine ecosystems. Corals exist as large colonies of polyps each of which is surrounded by a protective calcareous cup (**corallite**). When disturbed, the corallite allows the polyps to retract and seek refuge. These colonies are often quite large and when massed together can form reefs. Coral reef ecosystems rival the tropical rainforests with striking biodiversity.

Observe the coral specimens and examine the hard corals under the dissection microscope to see the corallite openings where the living polyps once resided.

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**Portuguese Man-O-War – a colonial polyp**

Portuguese man-o-war drift on the ocean currents using their gas-filled float as a sail. These floats are modified polyps. Man-o-war have feeding polyps with long tentacles which dangle into the water column and capture fish and other prey using powerful nematocysts. The colorful man-o-war are common on Texas beaches and often deliver uncomfortable stings to unwary fisherman or
**Jellies – free-swimming medusa stage dominates life cycle**

Marine jellies (or jellyfish) are often encountered along beaches or bay systems. The large, free-swimming medusa move by pulsing actions of their bell. Many species have powerful nematocysts used to capture prey and can deliver an uncomfortable sting to potential predators as well. For example, the box jellies of the Pacific are known as some of the most dangerous, venomous animals on the planet. The tentacles are positioned along the margin of the bell-shaped medusa. Oral arms surround the mouth and hang under the bell. Four circular gonads can be seen in mature specimens during the breeding season.

The *benthic* (bottom-dwelling) polyp stage of the life cycle is tiny compared to the medusa.

**Review Questions**

1. Describe the difference between a polyp and medusa.

2. What are gonads?

3. Describe budding by *Hydra*.

4. Where is the mesoglea?

5. Which portion of the *Obelia* life cycle is capable of sexual reproduction?


7. Describe the tissue layers of *Hydra*. 
Station 2
The Flatworms – Phylum Platyhelminthes

The flatworms, Phylum Platyhelminthes, are found in many different habitats. Some are marine or aquatic while others are terrestrial or may inhabit the bodies of a host (parasites). Flatworms (so named from the dorso-ventral compression of their body’s appearance) are triploblastic organisms. They are acoelomate and bilaterally symmetrical. Muscle tissue (derived from mesoderm) is arranged into longitudinal and transverse muscle groups. This allows for improved coordination of movements as compared to cnidarians. Flatworms also possess a more advanced system of organs to carry out specific functions and many of these sensory organs are located at the anterior of the animal (cephalization). Flatworms have an incomplete digestive system with a single opening and a large gastrovascular cavity for digestion. The nervous system is more advanced than the nerve net of cnidarians and consists of a small brain and a pair of longitudinal nerves. These longitudinal nerves branch into smaller transverse nerves to reach the body organs.

Most flatworms are monoecious. However, many parasitic forms have complex life cycles that include asexual reproduction and the use of final and intermediate hosts.

Examples of Flatworms

Planaria – a free-living aquatic flatworm

Planarians are found in many aquatic habitats, but are especially fond of streams with an abundance of gravel or rocks. Planaria (Dugesia) feed on aquatic detritus or small plankton. They use their auricles (ear-like flaps) to locate prey by chemoreception and touch. The mouth is located on a prehensile pharynx located on the midventral body surface. Food enters the mouth, passes through the pharynx and enters the gastrovascular cavity. The gastrovascular cavity is “V” shaped and consists of many folds of tissue increasing the surface area available for digestion. Digestive waste is eliminated through the mouth.

Planarians use their eyespots to detect light intensity and are negatively phototactic (prefer dark places). They move by using the muscle in their flattened bodies or by gliding along on mucus secreted by ciliated epidermal cells on the ventral side of the body.

Planaria are monoecious but do cross-fertilize and probably locate suitable mates using chemoreceptors found in the auricles. Planaria are well known for their regeneration of lost body parts. They may also reproduce asexually by budding.

A pair of longitudinal nerves runs laterally along the body converging anteriorly to form the simple brain under the eyespots. With increasing complexity of body systems comes increased metabolism and increased production of metabolic wastes like water, carbon dioxide and nitrogenous wastes (such as ammonia). To rid the body of these metabolic
wastes, planaria use **protonemphridia (flame cells)**. These protonemphridia are scattered widely throughout the body so that wastes may be removed efficiently from the tissues.

Observe the planaria slide and use the models and laminated sheets to label the figures.

*Dugesia slide*- label the eyespots, auricles, mouth, pharynx, gastrovascular cavity

*Dugesia model*- label the eyespots, auricles, mouth, pharynx, gastrovascular cavity, brain, longitudinal nerves, transverse nerve, longitudinal muscle, transverse muscle, protonemphridia
Tapeworms – parasitic flatworms

The tapeworms (or cestodes) are uniquely adapted as endoparasites (live inside a host). The adult tapeworms live in the small intestines of the final host (the host which harbors the adult stage) and do not have a digestive system. The tapeworm’s scolex (head-region) has an assortment of hooks or suckers for attachment to the final host’s small intestine. The remaining body is divided into segments known as proglottids. Each proglottid is a monoecious reproductive machine capable of producing an enormous number of fertilized eggs. Tapeworms can reach impressive sizes (some over 25m) due to the thousands of proglottids that form their body. The mature proglottids near the posterior are much larger as they are filled with fertilized eggs and may by passed from the host’s body in the feces.

The beef tapeworm (Taenia) is a common endoparasite of humans. To complete the life cycle, a ripe proglottid breaks free from the adult tapeworm and is passed with the host’s feces. If these feces are deposited in a grassy area, the tapeworm larvae attach to the blades of grass. The intermediate host (the host which harbors the larval stage) for the beef tapeworm is a bovine, which may ingest the larvae by consuming the grass. Once in the intermediate host’s body, a cyst surrounding the scolex develops in the muscle tissue. Humans can become infected by ingesting poorly cooked (temperature less than 60°C / 140°F) “measly” beef containing these cysts. The larval scolex is liberated from the cyst and attaches to the small intestine where it remains for its adult life.

Examine the tapeworm specimen, slide and use the laminated sheet to label the life cycle.
Review questions

1. Name the structures used by a planaria to excrete metabolic waste.

2. Which structures in a planaria are used for “smell”? For detecting light?

3. List the three germ layers in a planaria and describe an organ derived from each (think about this one!)
4. Describe the sexual reproduction seen in planarians.

5. What is negative phototaxis?

6. Describe the function of the scolex of a tapeworm.

7. Which organisms have proglottids? What is their function?

8. Why does a tapeworm lack a digestive system?

9. How can a person ensure that if they consume beef, that they will not become infected by a tapeworm?

10. Google the words “hydatid cyst” and use the space below to describe the medical significance.
Station 3
Observation of Live Planaria and Hydra

Observation of Hydra

Use a pipette to carefully transfer a Hydra from the culture to a depression slide and view under scanning power; you do not need to add a cover slip. Observe the way the Hydra moves and look for the cnidocytes on the tentacles (they look like little ‘bumps’).

Now carefully take a dissection probe and touch the Hydra. Describe how it responded in the space below.

Now take a few of the brine shrimp larva from the seawater (about 4% NaCl) culture and transfer to a Petri dish with fresh spring water. This will take a steady hand because you do not want to transfer too much seawater. Allow the brine shrimp to swim for a moment to remove the seawater. Collect in the pipette once again and transfer to the depression slide. Observe the Hydra to see if it can capture a brine shrimp larva and consume it. Use the space below to record your observations.

Why did you rinse the brine shrimp?

Now take the 5% vinegar solution and carefully place one drop in the depression slide. As you do this, watch the Hydra’s reaction through the microscope and record your observations below.
Observation of Planaria

Using a pipette carefully transfer a live planaria from the culture to a Petri dish filled with spring water. Observe the way the planaria moves along the Petri dish. Is it moving using muscle or ciliated epidermal cells and mucus? How can you tell?

Now carefully cover one-half of the Petri dish with a cover and allow the planaria to move on its own for a few minutes.

Where does it seem to want to go?

Why?

How does it know where it is going?