

# **Working with Hydra**

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## Introduction

Hydra are freshwater coelenterates found throughout the world. They range in size from less than 1 mm to 5 mm. Their simple structure consists of a polyp — a slender stalk with a row of tentacles surrounding the mouth at the top and a pedal disc at the base, by which the Hydra attach themselves to substrate in streams and ponds. Voracious predators, Hydra's tentacles are armed with stinging cells (nematocysts) that "harpoon" their prey (usually small crustaceans). The tentacle can then rapidly retract to draw the food into the mouth.

Common species include *Hydra vulgaris* (brown Hydra) and *Chlorohydra viridissima* (green Hydra). Green Hydra differ from brown Hydra in that their green color is caused by their symbiont, an alga (*Chlorella*). Green Hydra are also smaller than brown Hydra, ranging from about 0.5 to 2 cm.

## Tissue Function

Hydra's two main cell layers, the epidermis (outermost cell layer) and gastrodermis (inner cell layer) are separated by a thin mesogleal plate, an "acellular" substance. These cell layers are incipient tissues, consisting chiefly of one cell type but containing a number of other cells; they have broad functions rather than the narrow functions typical of true tissues.

The epidermis consists of vacuolated musculo-epithelial cells containing muscle threads (myonemes). These muscle threads attach to the mesogleal plate; when they are contracted, the Hydra's body shortens. Epidermis gland cells on the pedal disc form adhesive secretions. Small interstitial cells are packed in at the base of the musculo-epithelial cells; they are especially prominent in the "growth zone" of the anterior part of the column region and at points where buds or sex organs develop. These cells are unspecialized, and can replace cells of any other type. Many interstitial cells become nematocysts (stinging cells).

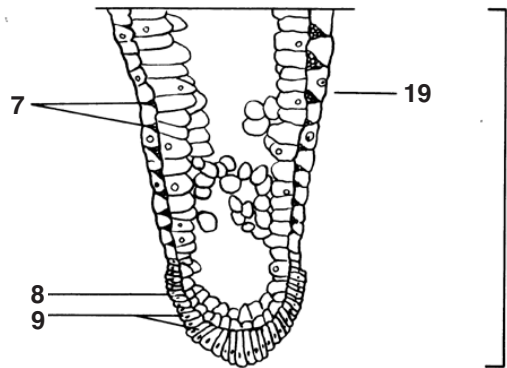
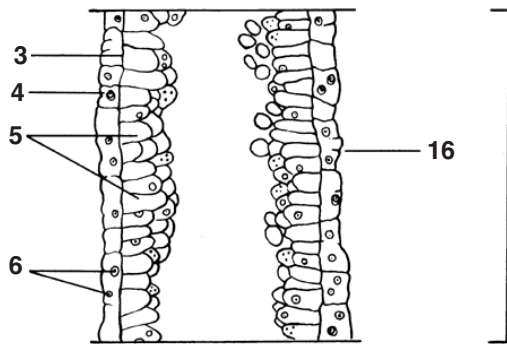
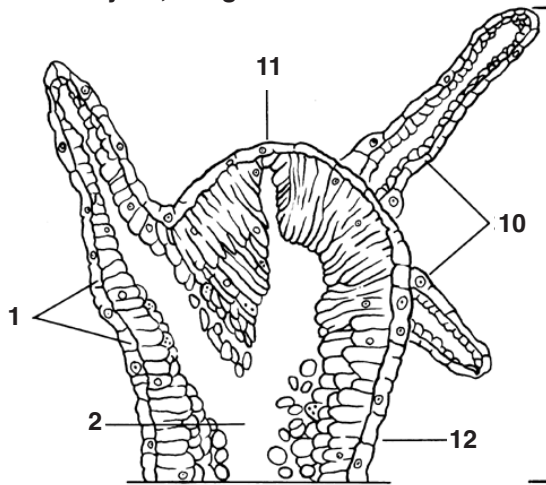
Large nutritive-muscular cells in the gastrodermis feature transverse myonemes that lengthen the body when they contract. The gastrodermis is specialized by region, as shown by the distribution of cells and the changes in nutritive-muscular cell form. Mucous gland cells are abundant near the Hydra's mouth, and enzymatic gland cells secrete enzymes for extracellular food digestion. The column contains gastrodermis where digestion and absorption occurs; the stalk region has a low, inactive gastrodermis.

## Reproduction

Hydra usually reproduce asexually, by budding. This process lasts two to four days, ending with the daughter Hydra detaching from the parent to become a separate organism. Hydra can also reproduce sexually, although this is much less common. Differentiation must be induced by environmental factors such as high carbon dioxide levels or a change in temperature; sexual reproduction usually occurs in the autumn.

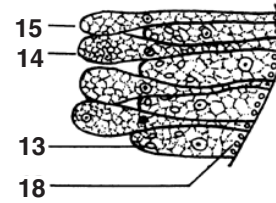
Different species of Hydra are either dioecious or hermaphroditic. Testes form from interstitial cells that produce a swelling in the upper third of the body. Spermatogenesis results in flagellated spermatozoa. In the ovary, a large, yolk-filled oocyte forms in a manner similar to the testes. After the epidermis ruptures over the mature ovum, it is fertilized by spermatozoa released into the surrounding water. The fertilized ovum remains on the parent's body, where it undergoes cleavage and gastrulation to become an embryo. A protective shell, or theca, forms around the embryo, after which it detaches from the parent. The egg may remain dormant for some time before the embryo emerges as a small immature polyp with a mouth, body, and tentacles.

**Hydra, Longitudinal section**



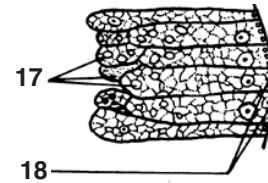
**Gastrodermis of Hypostome Region**

Hypostome Region



**Gastrodermis of Column Region**

Column Region



**Gastrodermis of Stalk Region**

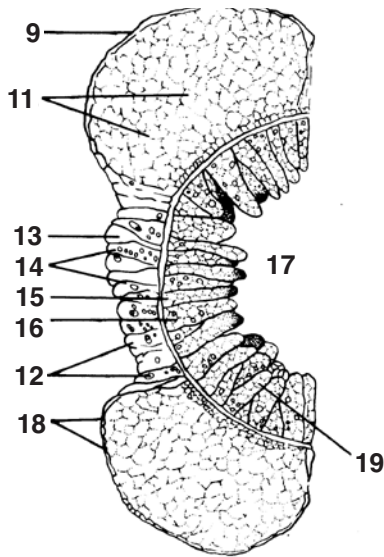
Stalk Region



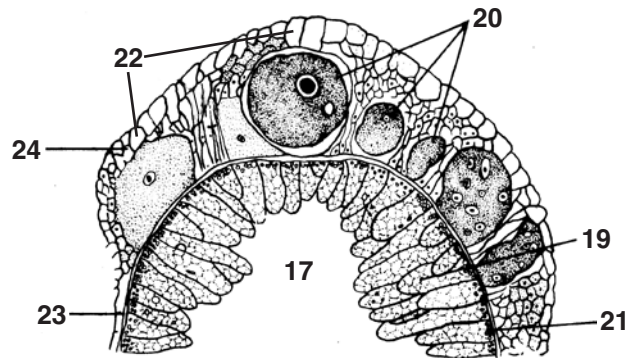
1. Musculo-epithelial cells
2. Enteron (gastrovascular cavity)
3. Mesogleal plate
4. Epidermis
5. Gastrodermis
6. Cnidoblasts (precursors of nematocysts)
7. Interstitial cells
8. Pedal Disc
9. Gland cells
10. Hollow tentacle

11. Position of mouth
12. Hypostome
13. Nutritive-muscular cell
14. Enzyme-secreting cell
15. Mucus-secreting cell
16. Column
17. Food vacuoles
18. Transverse muscle
19. Stalk Cells
20. Cells not engaged in digestion or absorption

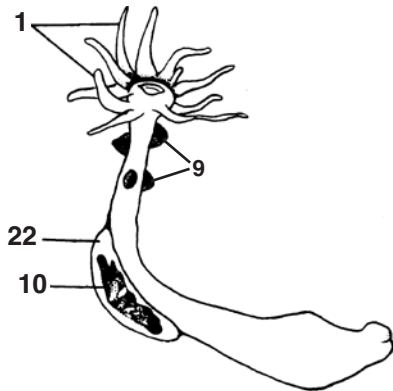
Hydra; cross section through testes



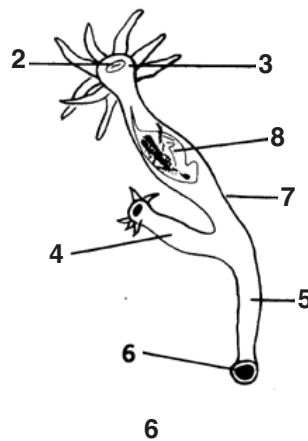
Hydra; cross section through ovary



Hydra with testes and ovary



Hydra with bud



- 1. Tentacles
- 2. Mouth
- 3. Hypostome
- 4. Bud
- 5. Stalk
- 6. Pedal disc
- 7. Column
- 8. Food (daphnia undergoing digestion)
- 9. Testes
- 10. Ovum
- 11. Developing sperm
- 12. Musculo-epithelial cells

- 14. Interstitial cells
- 15. Glandular cell
- 16. Muscular-nutritive cell
- 17. Enteron
- 18. Epidermis
- 19. Gastrodermis
- 20. Lobes of yolk-laden ovum — food provided by disintegrating interstitial cells
- 21. Zoochlorellae (only in green hydra)
- 22. Ovary
- 23. Mesogleal plate
- 24. Epidermis

## Care and Feeding

Hydra are best kept in an aerated aquarium or tub. Keep the temperature relatively low (18–21°C), provide a steady source of food, and ensure the water supply is free of contaminating chemicals. Brown Hydra prefer colder temperatures and tend to be larger and healthier in the winter months.

**Note:** *Hydra cultures, under usual methods of cultivation, undergo a period of depression in which the animals refuse to feed, the tentacles fail to expand, disintegration sets in, and the colony dies out. Therefore, it is recommended that you cultivate more than one culture at a time.*

Use only pond water or a mixture of pond water and deionized water. If tap water is used, remove salts with a water conditioner; the conditioned water can be used immediately. If the water is filtered, it is not necessary to change the water; however, if it is not filtered, the water should be changed daily.

Hydra may be fed the larvae of brine shrimp (larger hydra may also feed on Daphnia). Brine shrimp are easy to raise and maintain in the lab: Fill a brine shrimp hatchery with one liter of salt water and two level teaspoons of brine shrimp eggs. Aerate the hatchery and allow eggs to hatch; this will take approximately two days. Collect the larvae by stopping the aeration and placing a light at one end of the hatchery. The brine shrimp will be attracted to the light, separating from the eggs that failed to hatch. Remove the larvae with a pipet and place them in an aquarium net lined with a piece of cloth. Rinse the brine shrimp under treated tap water to remove the salt, then pour them into a container of treated tap water. Use the brine shrimp immediately, as they will die quickly in tap water.

Feed the Hydra daily by scattering the brine shrimp over the colony with a pipet. Allow approximately half an hour to an hour for feeding, then pour off the water with the remaining brine shrimp. You may also pour the water directly into a bowl and swirl the water to collect the Hydra; the Hydra will be moved toward the center of the bowl. Return the Hydra to their original container or place them in a new container.

Because green Hydra's symbiotic alga is photosynthetic, the green Hydra can be sustained for several weeks without food, provided there is adequate sunlight or wide-spectrum artificial light. Keep the temperature below 25°C (higher temperatures promote rapid growth of algae, which will choke out the Hydra). To keep green Hydra healthy however, they should be fed small crustaceans.

Green and brown Hydra can be kept in a refrigerator in jars for two to three weeks without feeding or water changes. After a few days without feeding, the Hydra will begin to rise to the surface for easy collecting with a pipet.

## Culturing Hydra

In a proper environment, Hydra will bud profusely and at times produce sexual individuals. Cultures that are fed and cleaned daily will produce spontaneous sexual differentiation.

**Note:** *Aeration will inhibit the development of sexual individuals; if you want to induce development of sexual stages, aeration should not be used.*

Temperature reduction will also usually bring about the production of sexual forms. The simplest method is to place the Hydra culture on the bottom shelf of a refrigerator and feed daily.