Modified copies of text Figs. 3–1, 3–6, and 3–7 are in the student workbook. The labels have been replaced with letters, and spaces have been added for answers. These figures are not referred to in the activity procedures. You can use them at your discretion for drills and tests.

QUESTIONS AND ANSWERS (LO 163)

1. How might having cnidocytes (stinging cells) be advantageous
   a. to a jellyfish?
      Answer: As the jellyfish floats through the water, the stinging cells on the tentacles capture small animals (fish, zooplankton).
   b. to a sea anemone?
      Answer: The anemone is attached to the bottom and cannot move around to get its food. The tentacles extend into the water, and the stinging cells capture small animals passing by in the water currents.

2. How does the body plan of a cnidarian (jellyfish, sea anemone) differ from that of a sponge?
   Answer: Most sponges are asymmetrical. Most cnidarians are radially symmetrical.

3. Sea anemones were named because of their flowerlike appearance. How do sea anemones differ from flowers?
   Answer: Flowers are parts of plants; sea anemones are animals.

4. Using a dictionary, look up the meanings of the word parts for the following words:
   ectoderm, endoderm, mesoglea, gastrovascular cavity, coelenteron, cnidocyte, nematocyst.
   Answer: *ectoderm* (G. *ecto* = outer; G. *derm* = skin), *endoderm* (G. *endo* = inner), *mesoglea* (G. *meso* = middle; G. *glea* = glue), *gastrovascular* cavity (G. *gastro* = stomach; L. *vascul* = a little vessel), *coelenteron* (G. *coel* = hollow; G. *enter* = gut), *cnidocyte* (G. *cnid* = nettle; G. *cyte* = cell), *nematocyst* (G. *nema* = thread; G. *cyst* = bag).

5. What kind of symbiotic relationship is represented by the clownfish and sea anemone, the Portuguese man-of-war and *Glaucus*, turtles and jellyfish? Refer to Topic 2, Sponges, for information on symbiosis.
   Answer: Clownfish and anemone—commensalism; Portuguese man-of-war and *Glaucus*—predator-prey; turtles and jellyfish—predator-prey.

ACTIVITY 1 (LO 164)

View unfired and fired nematocysts under a microscope.

MATERIALS

For each team of students:

____ dissecting scissors
____ sea anemone, live or frozen
____ small culture dish
____ seawater
____ 2 pairs forceps
____ dropper bottle of water
____ 2 microscope slides and coverslips
____ compound microscope (100X, 400X)

____ 2 toothpicks
____ hair

PROCEDURE NOTES

1. Some students may be unwilling to cut a living animal. Point out that cnidarians have both a rudimentary nervous system that probably does not register pain and a remarkable ability to regenerate. Removing a tentacle does no permanent damage.

2. The coverslip may have to be pressed gently to flatten the tentacle.

3. Because nematocysts are tiny and narrow, students must focus the microscope precisely, control the amount of light, and observe the specimen carefully.

4 a. A well-developed arm or leg hair can be used. Make sure the root bulb is attached to the hair.

4 b. If students have difficulty inserting the hair under the coverslip, suggest they try with the coverslip removed.

4 c–d. The nematocysts will be stimulated to fire and embed into the hair root. Since many of the nematocysts have barbs, they will adhere to the hair root.

5. The saliva contains protein molecules (enzymes), which cause the nematocysts to fire.

QUESTIONS AND ANSWERS (LO 164)

6. Why do we use forceps when handling sea anemones in this activity? What does this fact suggest about handling sea anemones or other cnidarians in the ocean or washed up on the beach?
   Answer: We use forceps to reduce the chance of being stung by the nematocysts on the tentacles. Cnidarians should not be handled with bare fingers.

7. In Procedures 4 and 5, which stimulant, hair or saliva, caused the firing of more nematocysts?
   Answer: Answers will vary. Encourage students to answer the question from their observations. If their answers differ, have them discuss possible reasons for the variations. Usually the root hair produces a greater response than the saliva.

8. If a cnidarian has just finished feeding, predict whether it will discharge more nematocysts if the tentacles touch another piece of food. Explain your reasoning.
   Answer: Answers will vary.

9. What might explain why some people get severe reactions to Portuguese man-of-war stings but others do not?
   Answer: Some people are more sensitive to the venom than others. A small person (a child) will often react more violently than an adult. Some people may have thicker skin than others. The location of the sting is a factor because the thickness of the skin varies.

10. Use the following terms to describe a sea anemone, a Portuguese man-of-war, or another cnidarian:

a. ectoderm

Answer: Answers will vary. One possible answer is that a sea anemone is covered by an outer layer of cells called the ectoderm.

b. nematocyst

Answer: The nematocyst is a venomous structure contained within special cells called cnidocytes. Many cnidocytes are located on the tentacles of a sea anemone. When the cell is stimulated, the nematocyst shoots out and injects venom into the prey animal.

c. venom

Answer: Venom is a toxin that is injected into a prey organism through the hollow nematocyst. Some people are more sensitive to the venom of a Portuguese man-of-war than others.

QUESTIONS AND ANSWERS (LO 168)

11. What might explain the large numbers of jellyfish that occasionally wash up on a beach?

Answer: Jellyfish are open-ocean organisms that often float in large clusters. Changing currents and wind can drive jellyfish ashore.

12. Sea anemones are sessile (attached) animals. What do biologists mean when they say that a sea anemone moves?

Answer: A sea anemone can move by contracting the muscle cells in the tentacles and the body wall. A few species can detach themselves from the bottom and move to another location.

13. Jellyfish propel themselves with rhythmic pulsations of their body, yet they are described as plankton (drifting organisms). How might this be explained?

Answer: Although the pulsations allow jellyfish to move slowly through the water, they cannot swim against the ocean current. Hence they drift with the currents.

ACTIVITY 2 (LO 168)

Determine how a sea anemone responds to chemical, mechanical, and light stimuli.

MATERIALS

For each team of students:

____ small culture dish
____ seawater
____ live sea anemone
____ copies of Workbook Tables 3–1 and 3–2
____ forceps
____ 10 disks punched out of filter paper
____ food substances listed in Table 3–2
____ paper towels

PROCEDURE NOTES

1. The water should completely cover the animal.

2. You can have students carefully remove the anemones from the class aquarium, or you can set up the culture dishes with the specimens ahead of time. A student can help you.

3. Typical student responses are shown in Table T3–1.
If the animal is touched too often, it may stay contracted for a long time.

Table T3–1. Sea anemone responses to mechanical stimulation (LO 169)

Stimuli	Type of Response				
	No response	Tentacles move	Sea anemone contracts	Injury	Other observations
Touching forceps to tentacle		away	only when tentacle is touched hard	no	
Touching forceps to body			yes	no	only side touched contracts
Tapping on container	when tapped lightly		when tapped hard	no	sudden jerky contraction
Agitating water		with the water current	no	no	
Exposing to sudden direct light	X		no	no	
Exposing to sudden shade or shadow	X		no	no	

4. The anemones' responses to the foods, especially the animal juices, will be more pronounced if you do not feed the animals for several days before the activity. This procedure is complicated, and results will be poor if the steps are not followed properly. Make sure students keep all tools clean. Even a small amount of soapy film on the forceps may alter the response. Typical student recordings are shown in Table T3–2. After several tests the seawater may become contaminated with the test chemicals. If it does, change the water.

QUESTIONS AND ANSWERS (LO 171)

15. What kinds of mechanical stimuli did the sea anemone respond to? How did it respond?
Answer: Answers will vary. Students should base responses on their observations. Anemones usually respond to touch on the tentacles and body, but not always to vibration or light.

Table T3–2. Sea anemone responses to chemicals in food substances (LO 170)

Examples of food substances	Actual food substances	Type of response (0, +, –)
Proteins		
Fish juice (non-oily)	Fish juice (non-oily)	+
Shrimp juice	Shrimp juice	+
Clam juice	Fish-food solution	+
Fish-food solution		
Oils and fats		
Tuna oil	Tuna oil	+
Corn oil	Corn oil	0
Butter	Butter	+
Starch		
Bread	Bread	+
Cornstarch	Cornstarch	0
Rice (cooked)	Rice (cooked)	0
Sugar		
Refined sugar	Refined sugar	0
Apple juice		
Acid		
Vinegar	Vinegar	–
Lemon juice	Lemon juice	–
Other foods		
Seaweed juice	Seaweed juice	0
Land-plant juice	Land-plant juice	0

16. How did the sea anemone's response to mechanical stimuli compare with its responses to food stimuli?

    Answer: In response to a mechanical stimulus, the anemone makes a simple movement toward or away from the stimulus. In response to food, the tentacles move the food toward the mouth. The anemone appears to fire nematocysts when stimulated by food.

17. What steps did you take to make sure the organism was responding solely to a specific food, not to some other stimulus?

    Answer: The filter paper containing the food juices did not touch the tentacles. The forceps were cleaned after each trial. The anemone was allowed to return to normal after each test. Contaminated water was changed.

18. How might a sea anemone behave if it weren't hungry? How could you know that it wasn't hungry? How might a sea anemone's hunger affect your observations?

    Answer: Answers will vary. If you did not feed the anemones for several days before the activity, inform the students.

19. In this experiment, how might it be possible to get a positive response to a plain disk?
Answer: The disks may have been contaminated with food substances, on the paper may have been treated with chemicals similar to the ones in the food.

20. Which food or food substance did the sea anemone prefer? Which food did it seem to like least? What foods is a sea anemone likely to find in its natural environment?
Answer: In general, anemones (and other cnidarians) prefer food of animal origin. Experiments have shown that certain chemicals present in animals but not in plants trigger a strong positive feeding response. Anemones rarely respond positively to algae or other plant products. The most common food in the environment of cnidarians is zooplankton.

21. In its natural environment, how might pollutants in the water affect a sea anemone's feeding response?
Answer: Chemicals in the water that elicit a strong negative response might prevent a feeding response even when food is available.

22. Fill in the features of cnidarians in Table 1–3, Comparison of animal phyla by features. Use information from Topic 3, your teacher's explanations, and reference books.
Answer: Refer students to their copy of Table 1–3. Answers will vary. Table T1–3 shows possible answers.

ACTIVITY 3 (LO 173)
Observe regeneration in sea anemones.
Determine conditions for regeneration.

MATERIALS
For each team of students:
____ six 250-mL beakers or jars
____ seawater
____ waterproof marker
____ 3 sea anemones
____ net
____ microscope slide
____ scalpel
____ wax paper or aluminum foil
____ copy of Workbook Table 3–3

PROCEDURE NOTES
1. Make sure that students use waterproof markers. After the activity they can remove the labels with alcohol.

2. Students should observe the anemone while it is still in the stock aquarium.

3. Anemones can be gently scraped from the glass surface of the aquarium with a razor blade.

4. The animal will probably react negatively to this treatment by contracting the tentacles and the body. Students should do the best they can in the cutting procedure. Some may be

reluctant to cut a living animal. Tell them that cnidarians have a rudimentary nervous system that probably does not register the sensation of pain.

7. Caution students not to seal the beakers so tightly that the oxygen source will be cut off. Make sure the beakers are not placed in direct sunlight.

9. Alert students to watch for any cloudiness or odor indicating deterioration of the water quality that could alter regeneration of the anemones. Remove dead and decaying pieces of tissue. Student sketches should show the progress of the regeneration growth.

QUESTIONS AND ANSWERS (LO 175)

23. When the original sea anemone in beaker 1 heals, does it have more, fewer, or the same number of tentacles as it had before? What happened to the pieces of tentacles?

    Answer: Answers will vary. Responses should be based on students' observations and data. Typically, the tentacles grow back. Small tentacle pieces do not regenerate an entire new body.

24. Which cut (A, B, or C) would you use to increase the anemone population of your aquarium the fastest?

    Answer: Cuts B and C both regenerate to produce more anemones. In cut B, both pieces regenerate the missing parts. In cut C, the small basal disk regenerates into a tiny new anemone, which then grows into a large specimen.

25. Which cuts, if any, did not regenerate?

    Answer: Typically, severed pieces of tentacles do not regenerate a new body.

26. How is being able to regenerate an advantage to sea anemones? What might happen to a population of sea anemones if
    a. a boat propeller sliced through them?
    b. a fish ate part of an anemone?

    Answer: Many pieces of the bodies of the anemones would probably regenerate.