Teach Aquaculture Curriculum: Spawning and Rearing Bivalve Molluscs—Larval Culture[1]

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This is Activity 13 in a series of 25 in the Teach Aquaculture Curriculum. The introduction to this series is available at http://edis.ifas.ufl.edu/FA177.

Abstract

In this activity students will use an ocular micrometer to measure the length of bivalve larvae, monitor the density of larvae in their culture system, and understand production protocols used in bivalve hatcheries. This activity will take about 15 minutes per day for approximately two weeks; this is the amount of time it will take for larvae to develop from egg to metamorphosis (setting). One or two students will exchange the water while other students will sample for larval density and place samples under the microscope (with ocular micrometer) to measure growth. This could be done in groups, rotating responsibilities each day, so that all students get to participate in all activities.

Objectives

Students will be able to:

1. Describe the reproductive biology and spawning of bivalve molluscs.
2. Explain how bivalve mollusc larvae develop.
3. Describe the conditions used in hatcheries for commercial production of bivalve molluscs.
4. Apply techniques used for small-scale, experimental mollusc larviculture.

Grade Level

9–12

Subject Area

Biology, Aquaculture

Time

Preparation: 10 minutes

Activity: 10 minutes

Clean-up: 10 minutes

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Student Performance Standards (Sunshine State Standards)

06.03 Illustrate correct terminologies for animal species and conditions (e.g. sex, age, etc.) within those species (LA.910.1.6.1, 2, 3, 4, 5; SC.912.L.14. 19, 31, 33).

11.01 List and explain the meaning of morphology, anatomy, and physiology (LA.910.1.6.1, 2, 3, 4, 5; LA.910.2.2.2; SC.912.L.14.7).

11.02 List and describe the physiology of aquatic animals (LA.910.1.6.1, 2, 3, 4, 5; LA.910.2.2.2; SC.912.L.14.11, 12, 13, 14, 15, 16, 17, 18, 19, 21, 22, 28, 29, 31, 32, 33, 34, 36, 40, 41, 42, 43, 45, 46, 47,48, 51SC.912.L. 18. 7, 8, 9).

11.10 List and describe the major factors in the growth of aquatic fauna and flora (LA.910.1.6.1, 2, 3, 4, 5; LA.910.2.2.2; SC.7.L.17.1, 2, 3).

12.01 Recognize and observe safety practices necessary in carrying out aquaculture activities (LA.910.1.6.1, 2, 3, 4, 5; LA.910.4.2.2, 5).

13.02 Explain how changes in water affect aquatic life (LA.910.1.6.1, 2, 3, 4, 5; LA.910.2.2.2; SC.912.L.17.2, 3, 7, 10).

13.03 Explain, monitor, and maintain freshwater/saltwater quality standards for the production of desirable species (LA.910.1.6.1, 2, 3, 4, 5; LA.910.2.2.2).

14.01 Identify factors to consider in determining whether to grow an aquaculture species (LA.910.1.6.1, 2, 3, 4, 5; LA.910.2.2.2; SC.7.L.17.3).

14.02 Identify/describe facilities used in a grow-out operation (LA.910.1.6.1, 2, 3, 4, 5; LA.910.2.2.2).

14.04 Determine the purpose and functions of a hatchery (LA.910.1.6.1, 2, 3, 4, 5; LA.910.2.2.2).

14.05 Identify and describe the sexual reproductive process and methods of reproducing aquaculture organisms (LA.910.1.6.1, 2, 3, 4, 5; LA.910.2.2.2; SC.7.L.16.3).

14.06 Identify and describe the spawning facilities used in aquaculture (LA.910.1.6.1, 2, 3, 4, 5; LA.910.2.2.2).

15.01 Identify the types of growing systems and important factors in their selection, design, and use (LA.910.1.6.1, 2, 3, 4, 5; LA.910.2.2.2).

Interest Approach

Now that students have successfully spawned bivalves, they should adapt a nurturing approach to see the larvae survive, grow, and develop into juvenile shellfish. This will allow students to use aquaculture techniques including exchange of water, measurement of clam density (survival), and growth rate.

Student Materials

1. *Introduction to the Biology of Molluscs* section

2. *Spawning and Larval Culture of Molluscs* (Lecture) http://www.irrec.ifas.ufl.edu/teachaquaculture/curriculum/4broodstock.php

3. *Videos* http://www.irrec.ifas.ufl.edu/teachaquaculture/curriculum/4broodstock.php. These videos will clearly show the different stages of bivalve molluscs.

Student Instructions

(Continued from lesson plan Activity 12 Spawning and Rearing Bivalve Molluscs: Spawning)

1. If spawning occurs, collect the eggs on a 35-µm sieve by pouring or siphoning water through the sieve, rinse thoroughly with seawater, and place in a bucket with 10 L of seawater.

2. Observe the developing eggs and trochophore stage under a dissecting microscope and use an ocular micrometer to measure the diameter of the eggs and trochophore larvae.

3. The next day, mix the water gently to evenly distribute larvae. Pipette a 1-mL sample of water and larvae and use a dissecting microscope to estimate the number of larvae in the 10 L of water. (example: 50 larvae/mL sample x 1000 mL/L x 10 L = 500,000 larvae). Adjust the larval density to 5 larvae/mL and discard the remaining larvae down a sink drain.

4. Each day, exchange the water in the bucket by collecting the larvae on the 35-µm sieve, gently rinsing with seawater, and placing them into a clean bucket filled with seawater (10 L). Again, gently mix the water to evenly distribute the larvae, take a 1-mL sample, calculate larval density using a dissecting microscope, and measure size (shell length and width) with an ocular micrometer.

5. Continue this routine daily until the clams reach pediveliger stage (8 to 10 days, depending on temperature). At

this point, the larvae will settle to the bottom, reabsorb their velar lobes, and become bottom (benthic) dwellers. This process is called metamorphosis or setting.

Teacher Instructions

Preparations

1. The teacher should have the necessary equipment (e.g., microscope, pipette, sieve, glassware, and replacement water) ready for the students.

Activity

1. The teacher should coordinate with students to exchange water in the culture vessel, take samples to determine larval density (survival), and have a working microscope with ocular micrometer to measure with. This can be a single station at the back of the classroom with individual students quietly going to the station and making their measurements while the teacher is conducting class.

Post Work/Clean-Up

1. Students should clean all glassware used in water exchanges and sampling.

Anticipated Results

1. Students will observe and measure growth of larval bivalves.

Support Materials

1. Activity 12 Spawning and Rearing Bivalve Molluscs: Spawning—Introduction to the Biology of Molluscs http://irrec.ifas.ufl.edu/teachaquaculture/curriculum/4broodstock.php

2. *Spawning and Larval Culture of Molluscs* (*Lecture*) http://www.irrec.ifas.ufl.edu/teachaquaculture/curriculum/4broodstock.php

3. Video: *Hard Clam Spawning* http://irrec.ifas.ufl.edu/teachaquaculture/curriculum/4broodstock.php

4. Video: *Oyster Settlement* http://irrec.ifas.ufl.edu/teachaquaculture/curriculum/4broodstock.php

5. Whetstone, J. M., L. N. Sturmer, and M. J. Oesterling. 2005. Biology and culture of the hard clam (*Mercenaria mercenaria*). SRAC Publication No. 433. http://srac.tamu.edu

Explanation of Concepts

Feeding and swimming mechanisms for trochophore and veliger stages of bivalve molluscs

Growth of bivalve mollusc veligers

Microscope skills and measuring with an ocular micrometer

Volume/density calculations

Table 1. Teacher Materials

Material	Store	Estimated Cost
SPAWNING MATERIALS (per group)		
Assorted containers (buckets, dishes, etc.)	Walmart, hardware store	$3 and up
Means to heat water (microwave, aquarium heater)	NA	NA
Means to cool water (refrigerator, freeze-pacs, frozen water in soda bottles)	NA	NA
Ripe bivalve molluscs	Commercial hatchery	Variable
Paper towels	Grocery store	$3 and up
Hand sanitizer	Grocery store	$3 and up
Dissecting microscope	Carolina Biological Supply http://www.carolina.com	$100 and up
1 mL pipettes	Pentair Aquatic Ecosystems https://pentairaes.com/	$10 and up
Algae starter culture	Pentair Aquatic Ecosystems https://pentairaes.com/	$50 and up
Aerator	Pet store, Walmart	$10 and up
Sieves (made from 35 µm mesh screens)	Pentair Aquatic Ecosystems https://pentairaes.com/	$40 and up