Oyster – Instructor's Guide

Instructor Guide - Middle and High School

Lesson by Kevin Goff

Shape of Life

LESSON The Oyster – A Not-So-Typical Mollusc

Overview: Lab dissection of a representative of Class Bivalvia. Supported by several *Shape of Life* segments, students interpret bivalve adaptations as a radical case of **divergent evolution**: A simple ancestral snail with a mobile lifestyle, single dome-shaped shell, bilateral symmetry, and a head ("cephalization") transformed into a headless, double-shelled, sedentary filter-feeder whose bilateral form is obscure.

Logistics: 75-90 minutes. 2-4 students per team. This lesson can be done as a stand-alone lesson or as part of the Molluscan Macroevolution module. There are separate high school and middle school versions of this lab activity.

Materials:

- ❑ fresh, live, "raw" oysters (*Crassostrea virginica*, readily available in Atlantic and Gulf coastal areas). Other species can probably be substituted, such as the Pacific oyster *Crassostrea gigas*, and Bigger is better …insist on large specimens when ordering from a biological supply company!
- ❑ Dissecting utensils: trays, scissors, scalpels, forceps, probes, latex gloves, etc.
- ❑ Dissecting scopes or magnifying glasses
- ❑ Oyster knife and/or screwdriver, plus heavy gloves (one set for you, not the students; see below)
- ❑ OPTIONAL – If you want students to observe live ciliated gills in action, you'll also need:
    - o Live bivalve(s). Raw oysters are still alive, and live freshwater mussels can be purchased from a biological supply company.
    - o Activated yeast
    - o Depression slide(s)
    - o Medicine dropper
    - o Compound microscope(s)
- ❑ Computer(s) and projector with internet access

Shape of Life

Oyster – Instructor's Guide

Instructor Guide - Middle and High School

Lesson by Kevin Goff

Suggested instructional sequence:

1. You will need to open the oysters yourself well in advance of class. Do NOT let students open oysters. There are different methods for this and it's a good idea to do an internet search for instructional videos. Some folks are "bill" shuckers, but most find it easier to start at the "heel" (umbo): With a ***gloved*** left hand and umbo pointing to the right, pin oyster firmly to tabletop. Insert oyster knife or screwdriver laterally between the two umbos, then twist to pop the hinge ligament. Slip scalpel or knife between mantle and shell, as close to upper valve as possible, and feel for the adductor muscle (refer to lab diagram for its location). Sever the adductor, gently separate soft tissue from the upper valve, and remove the lid …but then lay the valve on top again so that students will see how it fits. Keep oysters cool until class time.
2. Distribute the handout "The Oyster A Not-So-Typical Mollusc." Have students read "Setting the Stage" and watch the following segments on the Shape of Life website (http://www.shapeoflife.org/) either as a whole class or on individual computers:
   - "Sponges: Filter Feeding Made Visible" (2.5 min; on the Behavior page)
   - "Cnidarians: Anemone Catches Goby" (2.5 min; on the Behavior page)
   - "Flatworm Animation: Body Plan" (2.5 min; on the Animation page)
   - "Flatworm: An Invasive Flatworm Hunts Earthworms" (2.5 min; on the Behavior page)
   - "Mollusc Animation: Abalone" (1.5 min; on the Animation page)
   - "Molluscs: Pycnopodia Chases Abalone" (2.5 min; on the Behavior page)

4. Now have students carry out the dissection following the step-by-step instructions and answering interpretive questions en route.
5. Closure: Share and discuss answers via whole-class dialogue.

Answer key / Notes for post-lab discussion:

What two things does this water contain, necessary for survival? *Oxygen and food (especially microscopic algae)*

What events in the intertidal zone might provoke an oyster to slam shut and seal up for a while? Try to think of at least three: *Heavy waves or currents, exposure to air and sun during low tide (vs. dehydration), exposure to air-breathing predators during low tide.*

Why do you suppose the oyster makes its shell so smooth on the inside? The material that the oyster secretes is smooth to prevent debris and parasites from adhering to it.

Describe their texture. How do you think this helps increase the amount of oxygen absorbed?): *The increased surface area is for better absorption of O2 and diffusion of CO2.*

Why do you think oysters can get by with such an inefficient oxygen-delivery system? *Bivalves lead inactive lifestyles and so can get by with a less efficient circulatory system.*

HS ONLY: **What do these circulatory and respiratory adaptations probably tell you about cephalopods' lifestyle? Explain your reasoning.** *They probably lead much more active lifestyles. (This will be the theme of lesson and lab #4, "Life in the Fast Lane.")*

What do you think is the function of these leafy "lips"? (Helpful hint: they aren't for kissing.) *Channel food into the mouth.*

HS ONLY: **Bivalves feed ONLY on microscopic, single-celled organisms. How are their gills and other body parts built for size-selective feeding?** *Size-selective feeding (p. 6): The diameter of food particles is limited by the width of grooves and channels on the gills and palps, the tiny size of waving cilia, and the pinhole size of the mouth.*

- Why was the bivalve body able to evolve into a headless, less symmetrical form?): *A cephalized and bilateral body was an adaptation for directional movement in search of food. Once bivalves took to a sedentary, filter-feeding niche – which the animal simply waits for food to come to it – there was no longer any selective pressure to maintain a distinct head or perfect bilateral symmetry. Ditching the head saved calories, and in the case of oysters, scallops, and other bivalves, there was a benefit to becoming less bilateral in order to lie on one flank.*

HS ONLY What selective pressures allowed the bivalve line to evolve into a headless, less symmetrical form? : (Hint: Recall that bilateral symmetry and cephalization were originally adaptations for… what?) ?): *A cephalized and bilateral body was an adaptation for directional movement in search of food. Once bivalves took to a sedentary, filter-feeding niche – which the animal simply waits for food to come to it – there was no longer any selective pressure to maintain a distinct head or perfect bilateral symmetry. Ditching the head saved calories, and in the case of oysters, scallops, and other bivalves, there was a benefit to becoming less bilateral in order to lie on one flank.*

Shape of Life

Oyster – Instructor's Guide

Instructor Guide - Middle and High School

Lesson by Kevin Goff

NEXT GENERATION SCIENCE STANDARDS

MS-LS1-4 Use argument to support an explanation for how characteristic animal behaviors affect the probability of successful reproduction of animals.

MS-LS2-2 Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.

MS-LS2-4 Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

MS-LS4-1 Analyze and interpret data for patterns in the fossil record that document the existence, diversity, extinction, and change of life forms throughout the history of life on Earth.

MS-LS4-2 Apply scientific ideas to construct an explanation for the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.

MS-LS4-6 Use mathematical representations to support explanations of how natural selection may lead to increases and decreases of specific traits in populations over time.

HS-LS1-2 Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

HS-LS2-2 Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.

HS-LS4-1 Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.

HS-LS4-2 Construct an explanation based on evidence that the process of evolution primarily results from four factors.

HS-LS4-4 Construct an explanation based on evidence for how natural selection leads to adaptation of populations.

HS-LS4-5 Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.

Cross-Cutting Concept #1: Patterns

Cross-Cutting Concept #6: Structure and Function

Scientific and Engineering Practice #4: Analyzing and Interpreting Data

Scientific and Engineering Practice #7: Engaging in Argument from Evidence

Common Core State Standards for Literacy in Science and Technical Subjects supported in this module:

Writing Standard 1.b, 6-8 Write arguments focused on discipline-specific content

Writing Standard 1.b, 9-10 Write arguments focused on discipline-specific content.

Writing Standard 1.b, 11-12 Develop claim(s) and counterclaims fairly and thoroughly, supplying the most relevant data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims.

Writing Standard 2, 9-12 Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical processes.

Writing Standard 4, 9-12 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.