Shape of Life

Molluscs: Gastropod

Instructor Guide

Lesson by Kevin Goff

LESSON Snips and Snails and Gastropod Tails

Overview: A brief hands-on investigation of Class Gastropoda (snails and slugs), followed by a critical thinking exercise centered on segments of the Shape of Life. Students first examine the bodies and behavior of live slugs or snails, then use water balloons to model their unique style of locomotion, and finally tackle a series of analytical questions designed to cultivate a grasp of divergent evolution: the branching of a single ancestral form into multiple new forms for diverse new functions, niches, and habitats.

Logistics: 45-60 minutes. 2-4 students per team. This lesson can be done as a stand-alone lesson or as a preview to the next three lessons/labs (Molluscan Macroevolution module). In the latter case there will be some overlap; modify as needed. There are both high school and middle school versions of the lab activity.

Materials:

- ❑ Live snails or slugs. You can collect the animals locally or purchase them from a pet store or biological supply company. Pulmonate slugs – readily found in moist environments under logs and such – are especially good, as they tend to be active, don't require an underwater environment, and can't hide inside a shell. (By the way, students may notice a hole in a slug's flank; this is the opening to the mantle cavity, which is highly vascularized and acts as a simple lung.)
- ❑ Dissecting scopes or magnifying glasses
- ❑ Petri or specimen dishes
- ❑ Balloons. Straight/cylindrical balloons work better than round ones, but can be harder to find. (Have a mop handy!)
- ❑ Coloring pencils
- ❑ Computer(s) and projector with internet access

Suggested instructional sequence:

1. Distribute the handout "Snips and Snails and Gastropod Tails." Have students read the first page and make observations and sketches of live slugs or snails in specimen dishes. You can have them return their gastropods to you before moving on to page 2 and the water balloon models.
2. Let students make their slug models with water balloon. They may need help getting their models to "walk" via retrograde wave, and this is something you may wish to demonstrate yourself at a central station. Have students clean up their lab areas before proceeding to page 3.

3. Either as a whole class or on individual computers, have students watch the following segments on the Shape of Life website (http://www.shapeoflife.org/) and answer the questions on page 3:
    - "Mollusc Animation: Shell Repair" (1.5 min; on the Animation page)
    - "Molluscs: The Survival Game" (only the first 8 minutes; stop at nautilus; on the Phyla page)
4. Now have students carry out the coloring and critical thinking exercises on pages 4-5.
5. Closure: Share and discuss answers via whole-class dialogue.

Answer key / Notes for post-lab discussion:

Why do you think gastropod shells gradually "diverged" from a simple dome into so many complex shapes? *Gastropod shells took on diverse new forms as defenses against different shell-breaking predators. (This will be the topic of the next lesson and lab, "Shell Shocked.")*

But in modern moon snails – as seen on the Shape of Life – the foot and radula "diverged" for NEW functions and a NEW lifestyle. Explain: *While most gastropods are grazers or scavengers, moon snails evolved into predators. Their foot became adapted for burrowing and wrapping around prey, while their radula became adapted for drilling through their prey's shells.*

What might be the benefit of these changes? (Hint: how did your live snail react when you handled it?) *This change provided a space into which the animal can retreat for safety.*

What ancestral body features have clams lost? Why? *Clam (and other bivalve) body feature losses (p. 6): They have lost a distinct head region with sense organs, since they no longer forage for food, and they have lost the radula, since it's useless for filter-feeding. (These and other changes for a sedentary, filter-feeding niche will be explored in lesson and lab #3, "Eastern Oyster / Blue Mussel: A Not-So-Typical Mollusc.")*

What does this tell you about the squid's new lifestyle, versus its sluggish ancestors? *This change goes hand-in-hand with a life of fast swimming.*

Besides the shell, what other features of the ancestral mollusc have changed for this new niche? Why?: *Streamlined shape, grasping tentacles, jaws, well-developed eyes, excurrent siphon ("funnel") built for jet propulsion. (These and other changes for a predatory, open water niche will be the focus of lesson and lab #4, "Life in the Fast Lane.")*

Pressure for so many different mollusc body plans to evolve (p7). The arms race between predator and prey.

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NEXT GENERATION SCIENCE STANDARDS

MS-LS1-4 Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.

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 under the assumption that natural laws operate today as in the past.

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.

MS-ESS1-4 Construct a scientific explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year-old history.

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: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.

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: Support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources.

Writing Standard 1.b, 9-10 Write arguments focused on discipline-specific content: Develop claim(s) and counterclaims fairly, supplying data and evidence for each while pointing out the strengths and limitations of both claim(s) and counterclaims in a discipline-appropriate form and in a manner that anticipates the audience's knowledge level and concerns.

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 in a discipline-appropriate form that anticipates the audience's knowledge level, concerns, values, and possible biases.

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.