



WATER QUALITY AND FRESHWATER MUSSELS

GRADE: 9-12

PRE-LABORATORY PREPARATION:

If freshwater mussels are purchased from a Biological Supply Company, please follow recommended directions for housing mussels until the water quality activity is performed. Depending on the goals of the laboratory exercise, experimental mussels can be sacrificed to allow students to conduct a dissection and learn about mussel organs. A number of laboratory guides for mussel dissection are available, as well as videos on YouTube to guide you through dissection. It should be noted that mussels purchased from a commercial facility should not be released into local waters. This could harm the local ecosystem.

TIME:

Two 45-minute lessons:

- Day 1: Setup aquaria with everything except yeast suspension, procedure numbers 1-6.
- Day 2: Add the yeast suspension, and start the filtration experiment, procedure number 7.

ACTIVITY OVERVIEW:

This laboratory exercise allows students to measure the effects of filtering by fresh water mussels on water turbidity. Turbidity is a measure of the relative clarity of water: the greater the turbidity, the murkier the water. Turbidity increases as a result of suspended solids in the water that reduce the transmission of light. At higher levels of turbidity, water loses its ability to support a diversity of aquatic organisms.

OBJECTIVES:

This exercise allows students to make hypotheses, gather data, and explain interactions between living organisms and their environment.

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STANDARD CONNECTION

State

9.1.1.1 A Way of Knowing

9.1.1.2 Inquiry

9.1.3.4 Knowledge and understanding (data)

9-12 1. The Nature of Science and Engineering 3. Interactions Among Science, Technology, Engineering, Mathematics, and Society 4. Science, technology, engineering, and mathematics rely on each other to enhance knowledge and understanding. 9.1.3.4.4 Relate the reliability of data to consistency of results, identify sources of error, and suggest ways to improve the data collection and analysis. For example: Use statistical analysis or error analysis to make judgments about the validity of results.

NGSS

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-LS1-3. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.

MATERIALS

Freshwater Mussels (1-2 inches or 5-8 cm, Carolina Biological Supply company, Pack of 12, \$32.75 or Ward's Science, package of six, \$19.59), Housing for the mussels, sand, water from mussels natural environment or non-chlorinated tap water, aquarium pump, and a single air stone for each aquarium, yeast, large glass stir rod, miniature Secchi discs.

PROCEDURE

Day 1:

(1) Discussion with students and setting up the experiment.

Students should be asked what affects water turbidity. Students may talk about nutrient loading, increase in phytoplankton, and water mixing effects on turbidity. Filter feeding should be emphasized and the significant reduction in turbidity that can result.

Show video of mussels filter feeding:

<https://www.sciencelearn.org.nz/videos/732-mussels-filtering-water>



Students should also define the controls that they will need for an experiment. Students should be introduced to the concept of experimental versus control conditions in an experiment and should develop hypotheses to be tested by the experiment.

- (2) Set up four aquaria or plastic containers (9.5 L or 2.5 gallon).
- (3) Label Experimental 1, Experimental 2, Control 1, and Control 2.
- (4) Place approximately 5 cm of sand in each aquarium to serve as substrate for the mussels.
- (5) Add water from the mussels' natural environment or non-chlorinated tap water until the aquaria are approximately two-thirds full.
- (6) Aerate the aquaria with an aquarium pump and a single air stone to ensure that dissolved oxygen is available to the mussels.

Place multiple mussels (3) into each aquarium except for Control 1.

Before continuing with experiment, have students make hypotheses for each of the set-ups. What do they think will happen to the water clarity over time?

Day 2:

- (7) Dissolve one gram of baker's yeast in 250 mL of pond water for each experimental aquarium, and control 1.

Add 250 ml of yeast suspension to control 1, experimental 1, and experimental 2. Stir all aquaria for 30 seconds with a stir rod, being careful not to disturb the substrate or the mussels.

- (8) Measure the turbidity of the water with the mini-Secchi disc (see Diagram and explanation).

Figure 1. Diagram of experimental set up. Ruler is placed near the top of the tank. The Secchi disk is placed on the end of the dowel. One student can look through the narrow end of the tank at the Secchi disk to judge the point at which they can no longer see the Secchi disk, while another student moves the dowel. A third student uses the ruler to mark the point at which the dowel appears to the observer in the tank. This procedure is then repeated as the dowel moves the Secchi disk back into view and the second measurement marked. The students should then average the measurement to figure the Secchi disk transparency measure.

To ensure that the yeast stay suspended in the water column, before taking a turbidity reading all aquaria should be stirred for 30 seconds with a stir rod.



- (9) Take a turbidity measurement every 15 minutes thereafter in each aquarium, control 1, control 2, experimental 1, and experimental 2 for a period of up to 90 minutes. *If class time does not permit 90 minutes, take readings for as long as possible.
- (10) At the conclusion of the experiment, immediately remove the mussels from the aquaria and place into freshwater (not chlorinated). Mussels may die if left in the nutrient rich aquaria with the yeast.

Assessment:

Students are asked to graph their data as Secchi disc transparency measures over time. After the graphs are made, students are asked to make comparisons of data they collected and to draw conclusions about the experiment. Students should be able to accept or reject their hypothesis and to offer possible reasons for why the experimental results occurred.

Extension:

One extension of this laboratory is to determine the filtration rate. The students would have to know the volume of water used in the experiment and the number of yeast cells calculated. Filtration rates can then be determined by the number of cells per unit volume through time.

Lesson Resources

<https://www.sciencelearn.org.nz/videos/732-mussels-filtering-water>

Reference:

HOBACK, W.W., KOUPAL, K.D., SHAFFER, J.J., SMITH, M.J., AND DEPARTMENT of BIOLOGY, UNIVERSITY of NEBRASKA at KEARNEY. Laboratory measures of Filtration by Freshwater Mussels: An Activity to Introduce Biology Students to an Increasingly Threatened Group of Organisms. (Nebraska Game and Parks Commission, Kearney, Nebraska).