

## Estuary Live Lesson Plan: Clam Digs Waquoit Bay National Estuarine Research Reserve



Quahog shells by Caroline Goldstein

In this lesson, students study quahogs (a hard-shelled clam) and their estuarine habitats, and investigate water quality in a coastal ecosystem.

Topics: Shellfish; quahogs; Native American culture; estuaries; maps; water quality; dissolved oxygen; actions to improve water quality.

### Introduction

For centuries, people have gone to the shore seeking food. In North America, Native Americans such as the Wampanoag people of southeastern New England found some of the richest supplies of shellfish in estuaries along the coast. Today, delicious and nutritious quahogs, scallops, oysters, mussels, and soft shell clams are still harvested by Native Americans as well as by commercial and recreational fishermen. Shellfish are an important component of a clambake- a seafood feast attended by a large group of relatives and friends.

If you were helping to prepare a Wampanoag clambake at Waquoit Bay, one of your chores might be to dig some quahogs. To do this, you would need to know what quahogs look like, and you would need to know where to find them. In this activity, you will study quahog habitats, use maps to find the best places for quahogs, and find out if the water quality in your chosen clam digging area is adequate to support quahogs.

### Part I: Quahogs

Quahogs are hard-shelled clams that live in the shallow waters of bays and estuaries along the eastern coast of North America. Also known as littlenecks and cherrystones, according to their size, they are a favorite ingredient in New England clam chowder. Use books, pictures, collected shells, the reading titled “The Quahog” (from the Waquoit Bay Research Reserve site profile) included with this lesson, or the internet to answer the questions about quahogs. A list of internet links with information about quahogs is given in the References section of the lesson.

1. What is the Latin or scientific name for quahogs? Give their classification by Kingdom, Phylum, Class, Order, Family, Genus, and Species.
2. How big are quahogs?
3. What color and shape are they?
4. What depths of water can quahogs survive in?
5. What kind of bottom sediment do they prefer?
6. How do they bury themselves?

7. What do quahogs eat? How do they eat?
8. Where do larval (planktonic form of baby) quahogs live? How big are they?
9. How long does it take a larval quahog to reach adult size?
10. How can you tell the age of a quahog by looking at it?
11. What are two different ways quahogs are harvested?
12. What other shellfish are harvested in estuaries?

### Part II: Habitat

After studying quahogs, you will know that they prefer sandy and muddy sediments and that many people harvest them by hand (or by foot!) on shore or in very shallow water. Estuaries, including river mouths and coastal bays where fresh and salt water meet and mix, provide ideal habitats for quahogs, supplying plenty of plankton for food, large areas of their preferred sandy sediments, and waters sheltered from destructive ocean waves. Waquoit Bay is an estuary in Massachusetts with some areas that are just right for quahogs. Use your observation skills to find the best clam “digs” (places to live).

1. Look carefully at the photo in Figure 1, “Waquoit Bay Reference Map”. It is an aerial photo of Waquoit Bay. Write down at least 5 observations and three questions about the photo.
2. Look for light colored areas in the water. These are shallow and/or sandy areas- great places for quahogs! Identify 3 or 4 likely clam habitats that look shallow enough to be uncovered at low tide. Pay attention to landforms and locations so you can identify these spots on another map.
3. Now look at the map of Waquoit Bay depths, called bathymetry, in Figure 2. What colors represent depths of less than 2 feet? Most low tides will uncover depths of two feet or less in Waquoit Bay, and those are the places you will be able to access for clamming. Find the depths of the areas you chose as good quahog habitat. Will you be able to walk out to these places at low tide?

### Part III: Water quality

Quahogs are surrounded by estuarine water- they live in it, they filter it for their food, and their larvae drift and settle in it. Because of this, they depend on good water quality to survive. In order for quahogs to grow and thrive, the water needs to be free of toxic materials, rich in dissolved oxygen, not too silty (full of suspended sediments), and full- but not too full- of plankton. Silt or an overabundance of plankton can clog the delicate filters of shellfish and prevent them from eating properly.

Unfortunately, water quality in many estuaries has been degraded with the byproducts of development: wastewater, emissions from cars and other energy use, runoff from roads and paved areas, and fertilizer use. The most serious effects are, surprisingly, due to enrichment of the water with nutrients from wastewater and compounds formed during fossil fuel combustion. It may seem as though more nutrients would mean more food for quahogs, and at first, with a relatively small input of nutrients, quahogs do grow faster. However, an excess of nutrients contributes to rapid and dense plankton growth, followed by the natural process of decomposition which uses up oxygen. At the bottom of the water column, where quahogs live, the oxygen levels tend to be lowest, and sometimes the process of decomposition in enriched water brings oxygen concentrations down to levels where quahogs can't survive very long.

In the next part of this activity, you will look at the oxygen levels of the water in different parts of Waquoit Bay and find which of the quahog habitats you have identified has the best water quality. Dissolved oxygen (often shortened to D.O.) levels, especially when measured over months, are a good indicator of water quality. Fish and shellfish need relatively little dissolved oxygen to survive- only 5 or more parts per million (ppm). Levels below 5 ppm are stressful for the creatures and levels below 2 ppm can cause fish and shellfish to die.

Look at the graph in Figure 3, titled "Dissolved Oxygen at Depth". The graph shows D.O. levels during March through October of 2003 in different parts of Waquoit Bay. The data was collected by volunteers who sample water quality every month. You can find more of their results on the Waquoit Bay Research reserve web site at <http://www.waquoitbayreserve.org/baywatch.htm>

1. Compare the D.O. levels and describe the general pattern from spring through fall.
2. Look at the line for each site. Are there any D.O. levels below 5 ppm? For each site, record how many measurements were below 5 ppm and the month this occurred.
3. Do any of the levels drop to 0 ppm? Where and when?
4. Now find the location of the D.O. levels on the map. Use the aerial photo in Figure 1, Waquoit Bay Reference Map, to identify where the D.O. sampling was done.
5. Using the aerial photo and the graph of D.O. levels, evaluate the water quality of the locations you chose to dig quahogs. If your chosen spots are not at a sampling location, use the D.O. levels from the nearest sampling location.
6. Based on sandy areas, depth, and dissolved oxygen levels, where will you go to dig clams?

#### Part IV: Quahogs, estuaries, and you

Although we can still harvest quahogs in many estuaries and coastal bays, these and other coastal areas have lost high-quality quahog habitat as development continues to increase. Shellfish may live in coastal areas, but the impacts on estuaries and coastal bays accumulate from development throughout the watershed, the land that drains rain water and groundwater to a common place. Wherever you live, you are in a watershed and your actions affect water quality.

The good news is there are lots of things individuals can do to reduce the negative impacts of development and improve water quality. Some of these actions require you to teach a parent, friend, or community group. Others are actions you can take every day. Choose a few actions from the following list and start improving water quality in your watershed right away- the quahogs on the coast will thank you!

**Problem:** Compounds in the air from fossil fuel use contribute too many nutrients to estuaries and coastal bays

**Solutions:**

- Save energy! Always turn off lights, television, and computers when not in use.
- Walk or bike whenever you can to save a trip in the car. Taking a bus or public transportation is also more energy efficient than using individual cars.
- Help your parents investigate renewable energy. Solar and wind power can be used to make electricity and solar power can be used to heat homes.
- Do a home energy efficiency survey with your parents to find out how you can reduce heating or cooling costs. One form is available at <http://homeenergysaver.lbl.gov/>
- Set up a competition in your class to see who can save the most energy.

**Problem:** Fertilizer use contributes too many nutrients to estuaries and coastal bays

**Solutions:**

- Encourage your parents to reduce or eliminate lawn fertilizer use.
- If your parents feel they need to use fertilizer, help them find organic fertilizer, which is released more slowly into the ground.
- Find out about plants which will grow well in your area with little or no fertilizer and share the information at home or in the community.

**Problem:** Wastewater contributes too many nutrients to estuaries and coastal bays

**Solutions:**

- Help your parents find out about alternative septic systems, especially denitrifying systems. These really help decrease the enrichment of wastewater.
- Encourage your parents to support efforts to improve wastewater treatment in your community, especially by voting to organize and install local wastewater treatment

plants. Neighborhood or area water treatment systems can help take extra nutrients out of the water before it is returned to the ground, and cost less for everyone than installing individual treatment systems.

**Review questions:**

1. What is a quahog?
2. Describe a habitat where you would find quahogs.
3. What is an estuary?
4. Name 3 plants or animals that live in estuaries. (Hint: they might be very small!)
5. What levels of dissolved oxygen are required by quahogs?
6. Name 2 causes of over-enrichment of estuaries and coastal bays.
7. List 3 things you can do to help improve water quality.

**References**

Nice intro for students <http://omp.gso.uri.edu/does/teacher/crft7.htm>

Fact sheet <http://seagrant.gso.uri.edu/factsheets/fsquahog.html>

Quahog anatomy diagram <http://www.assateague.com/nt-bival.html>

Clamming in Maine with Native American connections  
<http://srs.msad71.net/Thompson/Clams.html>

Shellfish harvesting info from Cape Cod  
<http://www.town.barnstable.ma.us/tob02/Depts/CommunityServices/MarineEnvironmental/GuideToShellfishing/quahog.asp>

More maps and images of Waquoit Bay <http://www.waquoitbayreserve.org/maps.htm>

A review of energy conservation teaching materials:  
<http://www.masstech.org/2004dev/cleanenergy/curriculum/about.htm>