# Oysters and Estuaries

Teacher: J.R. Jones, Richard King High School, Corpus Christi, Texas

## Unit Description

This unit includes five 50-minutes classes and a field trip focusing on oysters and estuaries. For background readings and resources, go to the Geography: Teaching with the Stars web site at www.geoteach.org and click on the Teacher Resources page for Tidewaters. This page also includes a profile of J.R. Jones.

The purpose of this unit is to help students understand the role played by oysters in maintaining the health of estuaries. The unit begins with a lab that demonstrates how oysters, as filter feeders, reduce the turbidity of water in estuaries. In the next lesson, an oyster anatomy lab, the students explore how the oysters filter feed. They then participate in lab examining how wetlands filter and purify water that runs off the land and help prevent flooding by functioning as an absorbent area between dry land and a body of water. Next students go a field trip where they get involved in oyster shell recycling. The unit ends with a debriefing focusing on what they have learned in the unit.

## Instructional Objectives

After participating in these lessons, students will be able to:

- observe the filtration capacity of oysters through a change in turbidity in a controlled environment
- describe how oysters filter feed
- explore how wetlands filter and control water that runs off the land.
- explain the role of oysters in estuary ecosystems

## National Geography Standards (2012)

**Geography Standard 7:** The physical processes that shape the patterns of Earth's surface

Physical features interact over time to shape particular places on Earth's surface

**Geography Standard 8:** The characteristics and spatial distribution of ecosystems and biomes on Earth's surface.

Ecosystems are dynamic and respond to changes in environmental conditions

The distribution and characteristics of biomes change over time

**Geography Standard 14:** How humans modify the physical environment

Human modifications of the physical environment can have significant global impacts

The use of technology can have both intended and unintended impacts on the physical environment that may be positive or negative

**Geography Standard 15:** How physical systems affect human systems

Humans perceive and react to environmental hazards in different ways

**Geography Standard 16:** The changes that occur in the meaning, use, distribution, and importance of resources.

The spatial distribution of resources affects patterns of human settlement and trade.

Policies and programs that promote the sustainable use and management of resources impact people and the environment.

## Materials and Advance Preparation

Most materials needed to conduct these lessons are provided in this guide, accessible via links contained in the guide, or available in most classrooms or schools. Others will need to be secured from other sources.

The following is a list of the materials used in the lessons, along with some suggestions for preparing them for use.

**Lesson Two: Turbidity Lab**

Copies of the **Lab Management Duties** chart for each group of four students conducting the lab. Note: This duties chart should be used for Lessons Two-Four, and Six.

Materials:

- 80-90 gallon aquarium
- Bay water **Note:** As a substitute for bay water, you can purchase "Instant Ocean" – it is available online and in aquarium / pet stores nationwide for use in salt water aquaria. Here's an example, although it comes in smaller volumes also:

  www.petco.com/product/5694/Instant-Ocean-Aquarium-Salt.aspx?cm_mmc=CSEMGoogleAdExtProd-_-Fish-_-Instant%20Ocean-_-927988&mr:trackingCode=B06E1416-8381-DE11-B7F3-r0019B9C043EB&mr:referralID=NA&mr:adType=pla&mr:ad=26560831675&mr:keyword=&mr:match=&mr:filter=51515435635
- 10 live oyster (from a local restaurant, seafood shop, a seafood wholesaler, or a grocery store).

  **Note:** You will also need to feed the oysters some sort of phytoplankton mix if you are keeping them for a period of time. Something like DTs (see link, available in aquarium / pet stores) should work.

  www.dtplankton.com/
- hydrometer to measure salinity of water . **Note:** You can purchase an "Instant Ocean" aquarium hydrometer online and in aquarium/pet stores nationwide. Here is one option

  www.walmart.com/ip/20834190?adid=22222222227001502936 5&wmlspartner=wlpa&wl0=&wl1=g&wl2=&wl3=21486607510&wl4=&wl5=pla&veh=sem
- Simple light meter
- Submersible pump
- Background light source

**Note:** If you are not able to conduct the oyster turbidity lab, you can demonstrate oysters filter feeding using the following video. You could also show students the time-lapse sequence in The Texas Gulf Coast at www.geoteach.org/teacher_resources/tidewaters/video/texas_gulf_coast.php.

Time-lapse: Oysters Filtering Water.

www.youtube.com/watch?v=1Zm-yMpHsaQ

**Lesson Three: Oyster Anatomy**

This lesson uses teacher resources developed by the Maryland Sea Grant: Oysters in the Classroom program at the University of Maryland. The teacher resources include a list of materials needed to conduct the lab.

www.mdsg.umd.edu/issues/chesapeake/oysters/education/oysfilt.htm

**Note:** If you are not in a position to obtain the materials needed to complete this lesson (for example, live oysters, an oyster shucking knife) you could make the web page accessible to students and have them work their way through the lesson, using the figures and videos contained in the lesson to explore how the oysters filter feed.

**Lesson Four: Wetlands**

A copy of the **Wetland Construction Guidelines** for each student.

Materials Needed:

- Rectangular containers (roasting pans, cake pans, or paint pans)
- Sponges
- Small paper cups (some with small holes poked into the bottom) or watering can with sprinkler
- A big bag of sand
- Powdered drink mix (Tang works well)

**Lesson Five: Field Trip**

If you plan to have student go on a field trip, related to oyster shell recycling as part of this unit, you will need to make arrangements well in advance.

**Note:** If you are not able to conduct a field trip, you could show students the video of JR's field trip located on the project web site at www.geoteach.org/teacher_resources/tidewaters/video/field_trip.php, the portion of The Texas Gulf Coast video that highlights Dr Pollack's description of oyster recycling, located on the project web site at www.geoteach.org/teacher_resources/tidewaters/video/texas_gulf_coast.php, the video on oyster recycling at http://oysterrecycling.org/videos/, and/or the presentation on oysters and recycling at http://estuaries.noaa.gov/teachers/pdf/oyster-mystery/CBBFcoastalforum.pdf.

## Lesson One
# The Best Laid Plans

This lesson illustrate a basic truth of teaching: No matter how well you plan for a lesson, you must expect the unexpected. In other words, just because you think you've done all you can to assure that an activity will succeed....something can still get messed up. Always have a Plan B.

J.R. Jones came to school expecting to have a great lesson focusing on oysters as filter feeders. But, most of his oysters died over the weekend. He did not panic. Rather, he:

- shared with the students what happened.
- had them speculate about why it happened
- asked the students to decide what to do next.

## Lesson Two

# Turbidity Lab

(two class periods)

### Opening the Lesson

1. Indicate to students that in this lesson they will be observing oysters as filter feeders and measuring their ability to reduce the turbidity of water. Indicate that it is estimated that a three- inch oyster filters 28 gallons of water per day.
2. Fill the aquarium with turbid, brackish water. Suspended sediments should be very fine in nature.
3. Divide students into groups of four. Distribute a copy of the **Lab Management Duties** chart to each group and assign each student in a group to a role. Give students some time to become familiar with their roles.

### Developing the Lesson

4. Test salinity of the water using an aquarium hydrometer. The greater the salinity the higher the hydrometer will float in the water. The salinity level should be about 22 ppt for oysters. Add aquarium salt to increase salinity or fresh water to decrease salinity. (Oysters survive in a wide range of salinity.) This is also a lesson in osmosis. If the water is too fresh the cells of the oysters will absorb water and explode, too salty and they will lose water. Try to get close to 22 ppt for salinity. This will simulate the salinity of a bay. Specific gravity of 1.015 at room temperature of 23 degrees C on a hydrometer is almost 22 ppt salinity.)
5. Set up the back ground light so the light shines through the aquarium length or width-wise.
6. Take the filter out of the aquarium pump because you want to let the oysters filter the water, not the pump Use a submersible pump to create a current. This also will keep fine sediments suspended, and available to the oysters for filtration.
7. Turn off aquarium lights and room lights.
8. Set up the light meter opposite of the light source, to measure the intensity of light going through the aquarium. As the measured intensity increases the water is becoming less turbid due to the oysters removing sediment by filter feeding. The light meter units are in "lux" (Luminous flux). The higher the intensity of the light, the higher the lux reading, and the lower the turbidity of the water.
9. Ask each group to develop and write a hypothesis describing what they think will happen to the turbidity after the oysters have been in the tank for 24 hours.
10. Place the oysters in the tank and begin timing.
11. Have groups create a table to record turbidity every 30 minutes for the school day.
12. Have them collect data from the light meter throughout the day.
13. As they collect data, have them record the data on their tables.

## Closing the Lesson

14. The following day (24 hours later), have each group record the turbidity of the water using the light meter. Ask, did the turbidity increase or decrease? How does this compare to your observations?

15. Ask each group to draw written and graphic conclusions about the role of oysters in filtering water, based on their observations and the data collected.

# Lab Management Duties

### Principal Investigator

Duties:

- Communicate with the lead scientist(s)
- Initial background research
- Meet with other PI's to determine procedures to be followed during class experiment.
- Write hypothesis
- Communicate data to reporter recorder
- Write conclusion with MM

### Materials Manager

Duties:

- Pick up materials from lab assistant
- List materials for formal lab report
- (List materials for respiration lab and turbidity lab-they are related)
- Apply dye to oyster
- Return materials to lab assistant
- Write conclusion with PI

### Reporter Recorder

Duties:

- Set up initial table with appropriate labels of rows and columns to collect raw data
- Write initial observation at the beginning of the turbidity lab
- Collect and record data during experiment in table

### Maintenance Director

Duties:

- Clean working area
- Set up graph with appropriate x and y axis labels
- Write initial observation after dye is applied to the oyster
- Complete graph from data table
- Clean working area

## Lesson Three:
# Oyster Anatomy

This lesson uses teacher resources developed by the Maryland Sea Grant: Oysters in the Classroom program at the University of Maryland. The teacher resources include a step-by-step procedure for conducting the lab at http://www.mdsg.umd.edu/issues/chesapeake/oysters/education/oysfilt.htm

# Lesson Four
# Wetlands

Adapted from Barataria-Terrebonne National Estuary Program

btnep.org

(Two or three 45-minute class periods)

## Opening the Lesson

1. Begin by reviewing what the class has learned about wetlands. What role do they play in the Gulf estuaries? Explain that the students will be constructing a model that will demonstrate some of the important functions of wetlands/marshes.
2. Divide students into small groups of about four individuals.
3. Distribute a copy of **Wetland Construction Guidelines** to each student. Go over the process of building the model with the groups. Allow time for the groups to construct and test their models. You might want to monitor the groups as they work.

## Developing the Lesson

4. Give each group of students a cup (the cup should have holes poked into the bottom of it to simulate a rainstorm). Students should hold their empty cups over the sand-portion of their model. Fill each group's cup with water to simulate a rain- storm. Have the students observe the path and final destination of the rainwater.
5. Ask students:
   a. What happened when it "rained" on the land-portion of the model?
   b. Did any of the rainwater reach the estuary (the empty portion of the pan)?
   c. Why didn't most of the rainwater make it into the estuary?
6. Instruct the students to remove a portion of the marsh/wetland (one sponge) from their models. Have them simulate another rainstorm over the land by filling the cups with water and observing the results.
7. Ask students:
   a. What happened this time when it "rained" over the land-portion of the model?
   b. How do wetlands help prevent flooding?
8. Give each group of students a cup filled with Tang (or other powdered drink mix.) Explain that because so many humans live on the land surrounding estuaries, there are also pollutants on the land (that is what the Tang represents).
9. Ask groups to pour half of their Tang onto the land-portion of the model. Then have them simulate two rainstorms over the land (as described above in the flooding demonstration) and observe the results: the first rainstorm should occur with the marshes intact (all sponges in place), and the second rainstorm with the marshes disrupted (one sponge removed). Students should add additional Tang between rainstorms.

10. Ask students:
    a. What happened when it "rained" over the land portion of the model?
    b. What happened to the Tang?
    c. What happened to the Tang when the marshes were disturbed (one sponge removed?)

## Closing the Lesson

11. Ask students the following questions to review what happened in this activity:
    a. What happened each time when it "rained" on the models?
    b. Do the wetlands affect the speed of water runoff?
    c. How do wetlands help prevent flooding?
    d. How does a wetland help purify water?
    e. What specific kinds of pollutants might, in reality, wash into an estuary during rainstorms?
    f. How does the presence of marshes limit the amount of suspended pollutants in the estuary water?
    g. How might all this affect you?
    h. How can we prevent these undesirable effects?

# Wetland Construction Guidelines

1. Spread a layer of sand in one half of the pan to represent the land. Leave the other half of the pan empty to represent the estuary.

2. Shape the sand so that it gradually slopes down to the water. Smooth the sand along the sides of the pan to seal the edges.

3. Fit the sponges snugly across the pan along the shallow edge of the sand. It is important that the sponges fit snugly inside the pan. It may be necessary to cut some of the sponges to create a solid sponge wall. The sponges represents a wetland or marsh area located between the dry land and open water.

## Lesson Five

# Field Trip

1. Provide students with an overview of the field trip, making connections to what they have already learned about oysters and estuaries, as appropriate.
2. Have students work at all of the stations during the field trip so that they get a complete picture of what is involved in oyster recycling.
3. Provide students with the gear needed to accomplish each task (shovels, mess bags, gloves, rubber boots, wagons, etc.)
4. Get involved in the recycling yourself.
5. Remember to take pictures of the students and other participants in action to use when reflecting on the activity.

## Lesson Six
# Wrap Up

### Opening the Lesson

1. Begin by reviewing the field trip, placing the field trip into the broader context of the unit.
2. Share your observations of the field trip and its significance.
3. Encourage students to share their experiences while on the field trip. What did they enjoy most? What were their expectations?
4. If possible, use pictures of the students from the field trip to engage the students in the discussion.

### Developing/Closing the Lesson

5. Have student groups work on reviewing and completing their assignments for the unit. Monitor their work and ask questions and give advice, as appropriate.
6. Give students an opportunity to reflect on what they learned from and liked about the Oysters and Estuaries unit.