

Survival in an Estuary

Estuary Concept

Estuaries are dynamic ecosystems with tremendous variability within and between them in physical, chemical, and biological components.

Learning Objectives

- Describe three types of estuarine environments.
- Describe the environmental conditions necessary for organisms to survive in an estuary.
- List four principal abiotic factors that influence the survival of aquatic life in estuaries.
- Determine the range of pH, temperature, salinity, and dissolved oxygen tolerated by some common estuarine species.

Teacher Background

This activity introduces students to the complex interactions in estuaries, estuarine biological factors, and four important abiotic factors—pH, temperature, dissolved oxygen, and salinity—and how they vary within estuaries. The study centers on Elkhorn Slough National Estuarine Research Reserve (NERR) in California. Elkhorn Slough is one of the relatively few coastal wetlands remaining in California. The main channel of the slough, which winds inland nearly seven miles, is flanked by a broad salt marsh second in size in California only to San Francisco Bay.



Activity Information

Grade Level

6-8, 9-12

Time Required

45 minutes

Topic

Data Activities,
Ecosystem Interactions
and Dependencies,
Water Chemistry

Overview

In this activity, students investigate the range of conditions that selected animal and plant species need to survive in an estuary. They examine data for abiotic factors that affect life in estuaries—salinity, dissolved oxygen, temperature, and pH. Students use archived data (trend analysis graphs) and real-time conditions to predict whether a particular animal or plant species could survive in an estuary.

The reserve lands also include oak woodlands, grasslands and freshwater ponds that provide essential coastal habitats that support a great diversity of native organisms and migratory animals.



Teacher Preparation

1. This activity can be done with water quality data from any Reserve around the country.
2. Students will spend some time learning about four of the several water quality parameters that are measured at each Reserve. Download the [Water Quality Parameters Cheatsheet](#) for student reference. In addition to learning about these parameters and how they are measured students could explore the various tools used in measuring. A Jigsaw is a great strategy for teachers to use to promote student experts.
3. This work should inspire students to ask questions about why these parameters are measured and how changes may impact different species.
4. This activity is a great lesson to move into critical thinking exercises as students begin to develop questions and ideas about the possible causes for water quality differences between Reserve estuaries and even within an estuary.

Procedure or Activity Steps

1. Divide students into teams of two or three. Provide each group with a copy of the [Water Quality Parameters Cheatsheet](#). Have the groups review the information on the cheatsheet around pH, temperature, dissolved oxygen, and salinity parameters.
2. Based on what they read about the four parameters ask students to share how changes in each of these four parameters effect estuary organisms.
3. Familiarize students with the [NERR System Wide Monitoring Program \(SWMP\) graphing tool](#), which collects water quality data. If possible, have student groups go to the graphing tool and walk them through how to locate Elkhorn Slough Reserve, where to find the monitoring sites and parameters. Give students a specific Reserve site, time range, and water quality parameter to graph as practice during the walk through of the tool.
 - a. On the map click on the Elkhorn Slough reserve green circle icon
 - b. Under "Station Name" click "Azevedo Pond" water quality station
 - c. A box pops up on the map. Click the blue banner to select the station
 - d. Hover over the second row of icons and click on the one that says "Graph Data".
 - e. Select a parameter
 - f. Complete the start and end date
 - g. Click the "Graph" button.
4. Pass out the student worksheet: Surviving in an Estuary. The worksheet contains the four sites to investigate along with the list of species and their tolerance thresholds. The goal of this exercise is for students to see what organisms can live in what parts of the estuary based on their tolerances and the effects of water quality parameter changes on these various local species.
5. Ask the students to discuss what their findings suggest and open it up for a broader discussion.
6. Provide students with a copy of the Reserve map found on Page 8 and pictures of the species.
7. What questions do they have or more information do they want?

Materials Needed

- Student Handout: Surviving in an Estuary
- Water Quality Cheatsheet
- Computer to access SWMP Graphing Tool



Surviving in an Estuary

- Visit the [SWMP Graphing Tool](#) and investigate data from the four monitoring sites on the Elkhorn Slough Reserve: Vierra Mouth, South Marsh, North Marsh, and Azevedo Pond. To see where these monitoring sites are within the reserve see the map on the last page of this worksheet.
- Graph one year of data for each parameter and find the Mean, Min, and Max values for each of the four.
- After filling in all four tables review the data to help you determine which species might be found at each site based on their thresholds for survival. Use the “Limits of Tolerance to Environmental Factors for Selected Organisms in Elkhorn Slough” page to assist with making those determinations.

1. Elkhorn Slough: Vierra Mouth

Year_____

Parameter	Mean	Minimum (what month?)	Max (what month?)
DO (mg/l)			
Temp			
Salinity			
pH			

Species expected and why:

2. Elkhorn Slough: South Marsh

Year_____

Parameter	Mean	Minimum (what month?)	Max (what month?)
DO (mg/l)			
Temp			
Salinity			
pH			

Species expected and why:

3. Elkhorn Slough: North Marsh

Year_____

Parameter	Mean	Minimum (what month?)	Max (what month?)
DO (mg/l)			
Temp			
Salinity			
pH			

Species expected and why:

4. Elkhorn Slough: Azevedo Pond

Year_____

Parameter	Mean	Minimum (what month?)	Max (what month?)
DO (mg/l)			
Temp			
Salinity			
pH			

Species expected and why:

Limits of Tolerance to Environmental Factors for Selected Organisms in the Elkhorn Slough

Oysters

- Grow best in water with a salinity of 12 ppt and above, perish if salinity is below 5 ppt or above 25 ppt
- Spawn only when the water temperature hits 18°C for four hours
- Spawn much more prevalent when salinity is over 20 ppt
- Need a DO level of around 4 mg/l
- Best growth when pH is between 7.5 and 8.5

Clams

- Grow best when the water salinity is above 15 ppt
- Spawn only when the water temperature hits 24°C for four hours
- Clam eggs die when the salinity is below 20 ppt
- Need a DO level of around 4 mg/l
- Optimal growth occurs between 10 and 25°C

English Sole

- High year-round salinity, not below 10 ppt
- Diurnal threshold of DO is 4 mg/l (no nocturnal data available)
- Sensitive to nutrients and contaminants during rainy season
- Grow faster in warm water (not below 10°C)

Crabs

- Needs a DO level 3 mg/l or more for survival, optimal at 5 mg/l, 8.6 mg/l for larval forms
- Thrives if pH is between 6.8 and 8.2

Topsmelt

- Primarily marine; in bays, estuaries, and the mouths of coastal streams.
- Salinities ranging from fresh to 35ppt and in temperatures ranging from 5 to 29°C.
- Can survive extreme salinities up to 80 ppt.
- As juvenile fish age they move further into the estuary from fresh to brackish.
- Spawn March through October with salinity around 30 ppt and a temp. range of 13-27°C.
- DO 2-18 mg/l

