Estuaries in the Balance:

The Copano/Aransas Estuary Curriculum Guide

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PRIMER

1

DISCOVERING THE COPANO/ARANSAS BAY SYSTEM

The Copano/Aransas Estuary is the region where waters from the Mission and Aransas Rivers flow into the Copano Bay, and from there, to the Aransas Bay and then the Gulf of Mexico. Estuaries are dynamic systems where tidal and river currents mix fresh river water with salty ocean water. As a result the salt content, or salinity, of estuarine waters varies from fresh to brackish to salt water. Copano Bay, fed by the Mission and Aransas Rivers and Copano Creek, covers about 65 square miles. The Copano Bay watershed drains an area of 1,388,781 square miles. It connects to Aransas Bay, which has an area of 70 square miles and is in turn bordered on the east by San Jose Island, a 21-mile long barrier island.

Estuaries serve as vital habitats and critical nursery grounds for many species of plants and animals. The Copano/Aransas estuary is home to many species of finfish, shrimp, crabs, clams, and oysters. Nearby Aransas National Wildlife Refuge lists 392 bird species (resident and migratory) and 39 mammal species as having occurred on the refuge. Sixty species of fish are listed on the refuge checklist as common, and the checklist for amphibians and reptiles lists 63 species. The refuge currently lists about 850 plant species, and it is continually being adjusted and expanded. The Texas coast is well known for the large populations of migratory shorebirds and songbirds that utilize its shores as a stopover before crossing the Gulf of Mexico in the fall, and after the crossing in the spring. Thousands of people come to Texas to view migrating warblers and other birds every spring.

Estuaries are also important to humans as we rely on them for food, drinking water, industry, and recreation. Nearby Corpus Christi is the site of the fifth largest port in the nation and industrial activities including major petrochemical refineries. The estuary is also important for its commercial fishery production of oysters, crabs, shrimp, and finfish. In addition to these species, important recreational fisheries include redfish (red drum), spotted sea trout, southern flounder, black drum, and others.

RELATED VOCABULARY

Estuary—an area partially surrounded by land where fresh water and salt water meet.

Watershed—an area of land drained by a river or other body of water.

Salinity—the salt content of water. Estuarine waters vary from fresh (no salt) to marine (salty ocean water).

Density—the mass (amount of material) in a certain volume of matter.

Euryhaline—describing species which can tolerate a wide range of salinities.

Gradient—the rate at which a physical characteristic such as salinity increases or decreases over a distance.

Habitat—the place where a plant or animal grows or lives in nature.

Nursery ground—habitats of young fish and shellfish. Such areas provide food and protection for the young animals.

Fishery—the business of catching fish and shellfish, or the population of fish or shellfish that are being targeted for catching.

ACTIVITY
1.1

AN ESTUARY NEARBY: A SCAVENGER HUNT MAPPING EXERCISE

Grade Level
3–5
Subject Areas
Science, Social Studies, Mathematics
Duration
1 class period
Setting
Classroom, computer laboratory
Skills
Mapping, interpreting, computing
Vocabulary
Estuary, Salinity, Watershed, Runoff
Correlation with Texas Essential Knowledge and Skills (TEKS)
Soc. St. 3.4A,D, 3.5A-D, 3.17 A,B,D,E, 4.6A,B, 4.8C, 4.9A-C, 4.21C, 5.6A,B, 5.9A,B

CHARTING THE COURSE

In this exercise students will learn about estuaries and watersheds and become familiar with the geography of the Copano/Aransas Bay region. They will gain their sense of place within the area by locating and mapping the Fulton school in relation to the geography of the Bay region. This lesson has two parts. In Part 1 the activity takes shape as a mapping scavenger hunt. In Part 2 students employ computer skills to conduct a mapping exercise using the Internet.

OBJECTIVES

Students will be able to:

1. Describe what an estuary is.
2. Locate the Copano/Aransas Estuary on a map.
3. Recognize that many tributaries and streams flow into the estuary.
4. Locate their "space" (school) and other major geographical features in relation to the estuary.

MATERIALS

- Copies of Copano/Aransas Estuary watershed map, Texas, and county road maps
- Transparency films
- Marking pens
- Computers with internet-access
- Stick on stars or other symbols

PROCEDURE

Warm Up

Open a class discussion about what estuaries and watersheds are. Ask them what the nearest bodies of water are to their school, and if they lead to a creek, estuary, or bay. Tell them they will take a Virtual Field Trip from the Fulton Learning Center in Fulton, Texas, which is near the Aransas Bay. Review the basic features of a map.

THE ACTIVITY

Part I

1. Divide class into groups of 3 to 4 students.
2. Hand out transparency films and original or copies of road maps of the Rockport/Fulton area (map should include Copano/Aransas Bays).
3. Ask students to locate the school on the map (or have a star on map designating the location of the Fulton school).
4. If not marked, have students place a stick-on star on location.
5. Now students should trace on the transparency the outline of the land/bay margin and state and mark the location of the school.
6. Using the Scavenger-Map Activity hand out, students should find, trace on the transparency and label the following items as noted in the student worksheet.

Part II

1. Have students log on to http://maps.google.com/. (For more advanced classes, have students work with Google Earth, which can be downloaded for free)
2. Search the map for their school (or use Fulton Learning Center, Fulton, TX)
3. Change the format to hybrid (this will combine satellite image with overlaid road drawings).
4. Have students point out rivers, creeks, and streams on the map.
5. Follow the most prominent waterway as far as it will go. (Students will likely see creeks, moving toward rivers, ponds, and lakes; if using maps of Rockport/Fulton, many will ultimately lead to the Copano/Aransas Estuary).
6. Based on the previous exercise, have them identify the water body.

WRAP UP

Have students discuss what they learned through this exercise. Ask: How is it possible for actions at their school to impact the estuary?

EXTENSION

If the students live outside of the Copano/Aransas Bay area, find maps for the students' home area, and complete the scavenger hunt with questions related to their area.

Name: Date:

ACTIVITY 1.1

AN ESTUARY NEARBY: A SCAVENGER HUNT MAPPING EXERCISE

1. Locate your school on the map provided.
2. Mark the location with a sticker.
3. Trace on the transparency the outline of the land/bay margin and state and mark the location of the school.
4. Trace on the transparency and label the following items:
   a. The Gulf of Mexico
   b. North, south, east and west
   c. The ajor body of water located east of your school
   d. Two rivers on the map
   e. The river closest to your school that flows into the Copano Bay
   f. A city located near the Aransas Bay.
   g. The source of salt water that enters the Aransas Bay
   h. The major source of fresh water that enters the Copano Bay (the largest river)
   i. A place where you'd like to visit and explore.
5. How far is your school from the Bay?
6. Challenge question. What path of creeks and rivers would rain falling on your school take follow to get to the Copano or Aransas Bay?

ACTIVITY
1.2

GOING WITH THE FLOW: CONSTRUCTING A WATERSHED MODEL

Adapted from "Watershed S.O.S. (Saving Our Sources)": http://learningtogive.org/lessons/unit374/

Grade Level
3–5
Subject Areas
Science, Social Studies
Duration
1–2 class periods
Setting
Classroom
Skills
Modeling, constructing, describing
Vocabulary
Watershed, Runoff
Correlation with Texas Essential Knowledge and Skills
Science 3.3C, 3.7C, 3.9A,C, 4.3C, 4.7C, 4.8B, 5.3C, 5.7B; Soc .St. 3.4A

Adapted from "Watershed S.O.S. (Saving Our Sources)": http://learningtogive.org/lessons/unit374/

CHARTING THE COURSE

In this exercise students will construct a model of a watershed, and demonstrate how water flows in the watershed.

BACKGROUND

The Copano Bay receives water draining directly from surrounding land through groundwater and surface runoff, as well as from the Mission and Aransas Rivers and Copano Creek. The entire area of land that drains into a particular water body is called a **watershed**. Watersheds are separated from one another by elevations in the area such as slopes and hills. The Copano watershed encompasses about 1,388,731 acres.

OBJECTIVES

Students will be able to:

1. Describe what a watershed is.
2. Describe the many ways that water enters the bay.
3. Construct a model watershed.

MATERIALS

- Scrap paper
- Water-based markers (blue, black, brown, red)
- Optional: materials for landscape features (i.e. coffee or sand for dirt, small pieces of felt or scrubbing pads for marshes)
- Plastic tray
- Spray water bottle

PROCEDURE

Warm Up

Open a class discussion about what estuaries and watersheds by asking how does water enter the bay? Define what a watershed is and talk about how human activities can affect the quality of the water in the bay.

THE ACTIVITY

1. Have students work individually or in teams of two to four students.
2. Distribute materials.
3. Instruct students to construct their own model of a watershed with the main criteria being that water must flow from higher lands to lower lands and flow into a bay.
4. First, crumple the paper into a loose ball. Then partially open the paper and place it on a table. The paper should still be crumpled enough to have portions that resemble hills and valleys. Be sure there is a tray under the paper.
5. Using a blue marker, have students mark streams or rivers on their papers, and also have them mark where they think the water will collect as it runs downhill (lake or bay).
6. Using a black marker, have students outline ridges that separate one stream or river from another.
7. Using the brown marker, students should draw exposed soil that could erode or wash away into the lake or bay as the water flows through the watershed.
8. Using the red marker, have students draw in some pollutants that may be found in their watershed, such as soap from washing cars, fertilizers or pesticides from lawns, or animal wastes from a farm.
9. Have students spray (or you can go around to each model and spray) a very light mist of water over each model.
10. Observe where the water runs down and collects. Record what happens to each of the colors.

WRAP UP

Have students present their models to the class and discuss the impact of the associated land use. Discuss these questions:

- What does the spray represent?
- Why does water flow down into the creases?
- What is water called when it runs down the creases? (runoff)
- What water bodies would the watershed represent in your community?
- What happened to the ink? How could this be a problem to plants and animals in the water?
- What can we do to protect the estuaries and bays?

ACTIVITY
1.3

LIFE IN THE ESTUARY

Grade Level
3–5
Subject Areas
Science
Duration
1–2 class periods plus independent work time
Setting
Classroom
Skills

Vocabulary
Habitat, Ecosystem
Correlation with Texas Essential Knowledge and Skills
Science 3.9A, 3.10A,B, 4.9A, 4.10A,C, 5.9A,5.10A

CHARTING THE COURSE

In this exercise students will become acquainted with the many plants and animals of the Estuary as they search for information about the physical appearance, adaptations, and life history of a particular species. Students will prepare reports and share information with their classmates orally and via a field guide, which the class constructs.

BACKGROUND

The Copano/Aransas Estuary provides important habitat to a variety of plants animals. Hundreds of species of fish, crustaceans, and other invertebrates live in the Estuary, and the sea grass beds serve as refuge and nursery grounds for many larval forms of aquatic life. The Texas Coastal Bend is noted for being a vital habitat for migratory shorebirds and songbirds, and is adjacent to the Aransas National Wildlife Refuge, winter home of the endangered Whooping Crane.

OBJECTIVES

Students will be able to:
1. Name important animals and plants of the Copano/Aransas Estuary.
2. Relate key life history characteristics of prominent estuarine species.

MATERIALS

- Copano/Aransas Estuary selected plants and animals list
- Student worksheet
- Reference materials (books, internet, others information sources)
- Binders and materials for compilation of reports/Field Guide construction

PROCEDURE

1. Have students select a plant or animal from the species list.
2. Have students conduct research/report on their species finding information indicated on the student report worksheet.
3. Have students orally present their research.
4. Construct class “Field Guide of Copano/Aransas Estuary Plants and Animals” by compiling student reports.

WRAP UP

Shared knowledge through oral presentations. Conduct a class discussion about which animals/plants students found most interesting. A class book may be made with written reports.

LISTS

List of animals and plants in the Copano/Aransas Bay estuary:

Finfish

Redfish • Black drum • Spotted sea trout • Southern flounder • Hard-head catfish • Gafftop catfish • Pinfish • Mullet • Pig perch

Birds

Whooping Crane • American Oystercatcher • Great Blue Heron • Great Egret • Black Skimmer • Laughing Gull • Royal Tern • Reddish Egret

Plants

Shoal grass • Manatee grass • Widgeon grass • Turtle grass • Cord grass • Black mangrove • Glasswort • Wolfberry

Invertebrates

Brown Shrimp • Grass shrimp • Blue crab • Spider crab • Eastern oyster • Lightning whelk • Marsh clam • Bay scallop

Name: Date:

ACTIVITY 1.3

LIFE IN THE ESTUARY

Common Name of **ANIMAL** or **PLANT**: _____

Scientific name of **ANIMAL** or **PLANT**: _____

Write in complete sentences.

DESCRIPTION AND ADAPTATIONS: _____
_____
_____
_____
_____
_____
_____
_____
__

LIFE HISTORY

1. Habitat: _____
_____
_____
_____
_____

2. Life cycle: _____
_____
_____
_____
_____
_____

3. Food: _____
_____
_____
_____
_____

Illustration: Draw and color your organism in its habitat on the back of this page, or on another sheet of plain paper.

ACTIVITY
1.4

TAKING IT WITH A GRAIN OF SALT

Grade Level
4–8
Subject Areas
Science, Social Studies, Mathematics
Duration
1–2 class periods
Setting

Skills

Vocabulary
Salinity, Density, Gradient, Estuary, Euryhaline, parts-per-thousand (ppt)
Correlation with Texas Essential Knowledge and Skills
4.1A, 4.2D, 4.4A 4.5A,C, 5.1A, 5.2C,D, 5.4A, 5.5A,D, 5.9A,6.1A, 6.4A, 6.12E, 7.1A, 7.2C, 7.4A, 7.8A,C, 7.10A, 8.1A, 8.2C, 8.4A, 8.11C,D

CHARTING THE COURSE

In this exercise students will explore the concept of salinity, and how and why it varies from rivers to estuaries to the Gulf of Mexico. Students will compare and contrast properties of fresh and salt water, learn how salinity is measured, and use a hydrometer to measure the salinity of various water samples.

BACKGROUND

Perhaps the most distinguishing feature of an estuary is its ever-changing salinity. Salinity, the dissolved salt content in the water is the single most important factor effecting the distribution of organisms in the estuary. Unlike the ocean where salt content varies little over large areas the salt content of the estuary varies greatly, changing from nearly full strength salt water at the mouth of the bay to fresh water at its uppermost point.

The salts present in seawater include sodium chloride, magnesium chloride, potassium chloride, calcium chloride, and a number of minor constituents. One-quart of seawater contains about 1 ounce of salts. The salts in seawater originate from land and are the result of the weathering and erosion of landforms by surface waters.

Salinity is typically expressed in units of parts per thousand (ppt), the salt content in 1000 parts of water. In the Copano/Aransas Estuary salinity may approach 0 ppt near the mouth of the Aransas and Mission Rivers into Copano Bay during wet periods, but it may approach 30 ppt or higher during times of drought. Salinity gradually increases downstream to about 35 ppt at the entrance to the Gulf of Mexico. The entire salinity gradient in the bay will shift under high flow conditions and salinities will decrease bay wide. Likewise under conditions of low flow or drought, bay wide salinities will increase.

Estuaries with their widely variable salinities host both freshwater species in the upper reaches and saltwater species in the lower reaches. Only those species able to tolerate a wide range of salinities, **euryhaline** species, are able to successfully inhabit the portions of the estuary with widely fluctuating salinities.

OBJECTIVES

Students will be able to:

1. Define salinity.
2. Describe how salinity varies spatially and temporally in the estuary.
3. Define parts per thousand.
4. Measure salinity of seawater with a hydrometer.

MATERIALS

For each group of 4 to 5 students:
Water, two 250-mL beakers, plastic tray, spoon, golf ball, hydrometer, aerial map of the Texas coast (obtain from Coastal Bend Bays and Estuaries), blue, green, and yellow centimeter cubes (or other tiles), 1 set of cards with salinity values written on them.

For class: Salt (Kosher salt will dissolve best), food coloring (blue and red), two 1-liter beakers, small Petri dish, triple beam balance (or electronic balance), clear plastic box or aquarium, aluminum foil, duct tape, water

PROCEDURE: What is salinity?

1. Demonstrate one property of salinity (density) by showing students two 1-liter beakers of water, one with blue food coloring and one with red coloring. Have the red sample saturated with salt. Ask students to identify which is salt water and which is fresh without tasting the water. After taking several suggestions, pour water into smaller beakers and hand out 1 beaker of red and 1 of blue water to each group. Use a small plastic tray to contain spills. Let groups vote on which beaker they think is salt water. Lead discussion into concept of density, the amount of matter in a certain volume of liquid. Which water has higher density? (salt water) What happens to an object when it is put into water that has a higher or lower density than the object? (The object will sink if it is denser than the water; it will float if it is less dense than the water.) Let groups test if the golf ball will sink or float in each type of water. They should carefully lower the ball into the fresh water; it will sink. Using the spoon to take out the ball, they can then put it in the salt water. It should float in the salt water. (Be sure to test this ahead of time! The water must be very salty for the ball to float.) Since the salt water has more matter in it, it is denser than the golf ball, and therefore the ball floats in the salt water. However, the ball is denser than fresh water, so it sinks.

2. Introduce the term parts per thousand. Compare it to percent, which is parts per hundred. Show the class a one-liter beaker, which is usually marked "1000 mL". Review the prefix "milli," meaning one thousandth, and the fact that there are 1000 mL in a liter. Explain that if you have 35 parts per thousand (ppt) of salt, there would be 35 milliliters of salt in 1000 milliliters of water. 35 mL is about the same as 35 grams, so you are going to measure 35 grams of salt and put it in 1000 mL (actually, it should be 965 mL) of water, to make 35 ppt, the average salinity of sea water. Lead the students in measuring 35 grams of salt on the balance (remembering to measure the mass of the empty Petri dish first). Add the salt to the liter of water and stir.

3. Show the class a hydrometer and how to read it. Hand out one to each group, and have them practice with fresh water (the reading will be 0). Then give them a sample of the 35 ppt water, and test that. The readings will probably not be 35, but should be close. You may want to discuss why the reading is not 35—inaccuracies in the balance, the amount of water, or the temperature of the water (since density changes with temperature).

4. ***Optional:*** If you have access to coastal water, collect samples and have students measure the salinity of each. Have students guess (hypothesize) which water sample came from which area (river, bay, marsh, beach, etc.).

5. Collect materials and place a large map of the Texas coast on each table. Have students find their town and identify various bodies of water. Hand out yellow centimeter cubes (3 to a group) and ask students to place them in areas they think would be salty. They should choose the Gulf of Mexico, and there will be discussion about where to put the other 2 cubes. Next, give each group 3 blue cubes, and have them place them where they think the water is fresh. Most will find Lake Corpus Christi, but they may have difficulty finding other areas. Many will pick bays. They should find a river, and perhaps a pond. Finally, ask what color is made by mixing blue and yellow, and give them 3 green cubes. Ask them to place them on areas (such as an estuary) where fresh and salt water mix. Discuss each group's choices, but do not tell them if they are right or wrong at this time.

Open a class discussion about the definition of an **estuary**. Discuss the meaning of the word **gradient**, and the idea that salinity of water will increase as water from rivers mixes with salt water, and there is a gradient

of salinity from a river to an estuary to bays and the Gulf of Mexico (at another time, you may introduce the concept of hypersalinity, but it might be confusing at this point). Explain that salinity in the bay can change depending on how much river flow enters. In dry years, flow is low and salinity increases, while in wet years, flow is high and salinity decreases. Within the year, salinity tends to be lowest in the spring as a result of rain. During the summer, rains decrease and evaporation increases, leading to higher salinity.

Explain the importance of the salinity gradient in the distribution of organisms living in the bay. Estuaries with their variable salinities host both freshwater species in the upper reaches and saltwater species in the lower reaches. Only those species able to tolerate a wide range of salinities, **euryhaline** species, are able to successfully inhabit all portions of the estuary.

Hand out cards with salinities printed on them. Have students order them from low to high salinity, and match the cards with potential locations on the map. If you have measured the salinity of local water samples, tell the students the locations you sampled, and challenge them to identify which water sample came from which area.

Optional: In a small aquarium or clear plastic box, make a divider of aluminum foil in the center. Be sure the foil is securely taped so that no water can leak under it. Pour salt water on one side and fresh water on the other. Using a pin or paper clip, make several holes in the foil, allowing the water to pass through. Fresh water will enter the salty side and float, while salt water will enter the fresh side and sink. You might be able to put the golf ball in the water, and see if it will float at the interface of salt and fresh water.

WRAP UP

Students should discuss how salinity changes from location to location in the bay and how the distribution of animals changes as a result. What other things might affect the distribution of animals in an area? How might changes in weather affect the salinity and animal distribution in the bay.

ACTIVITY 1.4

Salinity Cards (make one copy for each group)

35 PPT	**14 PPT**	**0 PPT**
6 PPT	**24 PPT**	**30 PPT**

Name: Date:

ACTIVITY 1.4

TAKING IT WITH A GRAIN OF SALT

1. Draw a picture of your two beakers with a golf ball in each one. Tell what happened to the golf ball, and why it floated or sank.

2. In your own words, what is **salinity**?

3. What is **density**?

4. If water has a salinity of **35 parts per thousand**, what does this mean?

5. What is an **estuary**?

6. Describe the salinity **gradient** from a river to an estuary and then to the gulf or ocean.

7. What types of environmental factors affect the water salinity in our bays and estuaries?

8. How can animals in the estuary be affected by changes in salinity?

ACTIVITY
1.5

SEASONS OF CHANGE

Grade Level
6–8
Subject Areas
Science, Social Studies, Mathematics
Duration
1–2 class periods
Setting
Classroom
Skills

Vocabulary
Salinity, Gradient, Euryhaline, parts-per-thousand (ppt)
Correlation with Texas Essential Knowledge and Skills
Science 6.2C,D,E, 6.12E; 7.2C,D,E, 7.8C, 7.10A, 7.13A; 8.2C,D,E, 8.11B.C.D

CHARTING THE COURSE

In this exercise students will construct and interpret graphs comparing monthly salinity measurements for a 1-year period for three oyster bars located along a salinity gradient, demonstrating how one environmental variable changes seasonally. This activity follows the same concepts as Activity 1.4 and can be conducted as an extension, or instead of Activity 1.4.

BACKGROUND

Activity 1.4 (Taking it with a Grain of Salt) presents relevant background information about salinity and its importance in defining the estuary and the distribution or organisms in the Bay. Salinity, the dissolved salt content in the water is the single most important factor effecting the distribution of organisms in the estuary. Unlike the ocean, where salt content varies little over large areas the salt content of the estuary varies greatly, changing from nearly full strength salt water at the mouth of the bay to fresh water at its uppermost point. This activity expands on the concept and focuses on spatial and temporal changes in salinity throughout the estuary.

The salinity at a particular place in the estuary can fluctuate greatly with in a year through the seasons as well as from year to year. Typically the spring yields high fresh water inputs as melting snow and springtime rainfall increase fresh water flow into major rivers. This results in decreases in salinity in upper estuary locations. The salinity gradually increases through the summer and fall, as rainfalls typically are lower than in spring. On an annual basis a dry or drought year will result in relatively high salinities through out the bay where as wet years will cause a reduction in bay-wide salinities. For oysters this can greatly impact survival, as disease and predation tend to be higher at higher salinities.

OBJECTIVES

Students will be able to:
1. Define salinity.
2. Describe how salinity varies through space and time in the estuary.
3. Show how salinity affects the distribution of animals in the estuary.

MATERIALS

- Map of the Copano/Aransas Estuary with sample sites marked
- Monthly salinity data set
- Graph paper, or computer software for creating graphs

PROCEDURE

Warm Up

Open a class discussion about the definition of an estuary and the importance of the salinity gradient in the distribution of organisms living in the Bay. Or follow up with the Taking it with a Grain of Salt Activity. Explain that salinity in the bay can change depending on how much river flow enters. In dry years flow is low and salinity increases; in wet years flow is high and salinity decreases. Within the year salinity tends to be lowest in the spring as a result of rain.

THE ACTIVITY

1. Distribute salinity data set and materials for constructing graphs.Instruct students to plot the salinity data presented. The x-axis should be time (month) and the y-axis should be salinity in parts-per-thousand (ppt). Students should draw three lines, one for each site.

2. Have students interpret the graph, answering the following questions.
   Does the salinity at each site remain constant or change through time?
   Does the salinity differ between sites?
   Overall which site has the higher salinity?
   What is the highest and lowest salinity for each site?
   What is the range of salinity for each site?
   When did the highest and lowest salinity occur for each site?
   How would salinity change if a drought occurred and river flow was below average for the next 12 months?

WRAP UP

Students should discuss their interpretations of the salinity graph. Be sure to emphasize that there is great variability in the environment. Factors such as salinity in the estuarine environment are constantly changing. What trends do they observe? What other factors might similarly change? Also, have students speculate on how this information would be used in real life.

Name: Date:

ACTIVITY 1.5

SEASONS OF CHANGE

A. Using the data in Table 1, draw a graph to compare the salinity at the oyster reefs known as Shellbank, Lap, and Long Reefs in Copano and Aransas Bays. Be sure to put a title and labels on your graph.

B. After completing your graph answer the following questions.

1. Does the salinity at each site remain constant, or does it change through time?

2. Does the salinity differ between sites?

3. Overall, which site has the highest salinity?

4. Overall, which site has the lowest salinity?

5. What is the highest and lowest salinity for each site? **When** did each occur?

High: Shellbank-_____ Lap- _____ Long- _____
Date: _____ _____ _____

Low: Shellbank-_____ Lap- _____ Long- _____
Date: _____ _____ _____

6. What is the **range** of salinity for each site? (Subtract lowest from highest)

Shellbank-_____ Lap- _____ Long- _____

7. How would you expect the graph to look the next year if there is above average rainfall all year long?

8. How would this information be used in real life?

TABLE 1

Monthly salinity data at three sample locations: Shellbank Reef, Lap Reef (both in Copano Bay), and Long Reef (Aransas Bay). The data is for the years 2011–2012. real life.

SALINITY PARTS PER THOUSAND (PPT)

	Shellbank Reef	Lap Reef	Long Reef
2011:			
Apr	16	18.5	26
June	25	26	30
Sept	34	37	40
Nov	37	38	37
2012:			
May	25	27	28
Aug	32	33.5	40
Nov	35	34	31

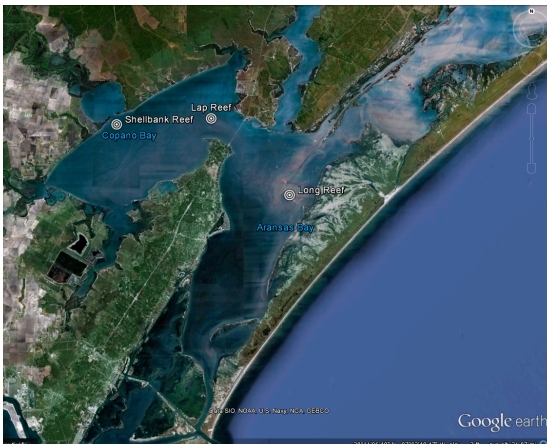

Figure 1. Map of Copano Bay and Aransas Bay, TX, showing the locations of Shellbank Reef, Lap Reef, and Long Reef.

EXTENSIONS

Introduce the concept of non-point source pollution.

Storm drain mapping activities are available through the state and other organizations (Texas Natural Resources Conservation Commission: http://files.dep.state.pa.us/water/Watershed%20Management/WatershedPortalFiles/StormwaterManagement/MS4_Information_Resource_CD_Files/storm_drain_stenciling_manual.pdf)

Invite Aquatic Resource Specialist Beth Almaraz from the Nueces River Authority to speak on watershed issues and demonstrate a watershed model (balmaraz@nueces-ra.org; http://www.nueces-ra.org/NRA/)

Visit NOAA's Estuaries 101 for more activities on estuaries and salinity (http://estuaries.noaa.gov/teachers/MiddleSchool.aspx)

Estuaries in the Balance is a web-based curriculum centered on the Texas coast; it offers short videos followed by games and lessons on estuaries and on four keystone species: blue crab, oyster, redfish, and whooping crane (http://cgee.hamline.edu/CoastalBendEstuaries/)

Give students a list of bay animals and have them research the animal's salinity requirements.

Take a Bay field trip on the R/V Wetland Explorer with Capt. Jay Tarkington (TAMUCC Center for Coastal Studies Aquatic Education Program at http://ccs.tamucc.edu/programs-2/aep/).

Analyze and interpret a pie graph containing percentages of all dissolved minerals in seawater (Texas State Aquarium lesson: "Salt of the Sea").

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