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# In Search of the Treasures of South Slough

LEVEL 1 - GRADES 4 and 5

TEACHER'S MANUAL

IN SEARCH OF THE TREASURES OF THE SOUTH SLOUGH

The Estuary Study Program

Level I--Grades 4 and 5

Third Edition, 1982

Revised by Karen Gartland

Address correspondence to

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Coordinator of Outdoor Education  
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**Program Design & Development:**



John and Karen's involvement in all phases of the project has been a key to the success of the Estuary Study Program.

\*\*\*

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OVERVIEW  
OF THE ESTUARY STUDY PROGRAM  
(ESP)



## AN OVERVIEW OF THE ESTUARY STUDY PROGRAM, GRADES 4 THROUGH 8

This manual is about one of three programs designed for the intermediate or junior high school classroom: Level I is designed for the 4th or 5th grade classroom; Level II is designed for the 6th grade; and Level III is for the 7th and 8th grade science or social studies classroom.

### Program Goals

"An estuary is one of the richest places on earth."

This line sums up the "Big Picture" of what we're trying to convey to the learners who are involved in any of the three programs. Students who participate in any one of the programs should leave with:

- 1) an understanding of what an estuary is,
- 2) knowledge of why an estuary is important, and
- 3) knowledge that estuaries change because of natural processes and human use.

### A Short Synopsis of Each Level's Estuary Visit

Level I. In Search of the Treasures of the South Slough (4th and 5th grade).



In Search of the Treasures  
of South Slough  
LEVEL I

Students are sent on a treasure hunt to discover the "treasures of the South Slough." They encounter four different activities, each involving a different "zone" or part of the estuary: the uplands, salt marshes, mudflats, and open water. Each zone's activity helps them get a little closer to figuring out the treasure: that this part of the estuary has been set aside as a SANCTUARY, a protected place for the animals and plants, with very little disturbance by people.

Level II. Secret of the Medallion (6th grade).



The Secret of the Medallion  
LEVEL II

Students are sent on an expedition to figure out the meaning of a special medallion that was uncovered in the South Slough area. To do that, students must "unlock" the "truths" about estuaries through scientific investigations. At seven different "outpost stations" they help figure out the Big Secret of an estuary: "That the sun and the moon combine forces to support one of the richest places on earth."

Level III. Lore of the South Slough (7th and 8th grade).



The Lore of South Slough  
LARRY W.

In the morning, students join five different old-timers of the South Slough to investigate the Slough's rich cultural and natural history. These old-timers share stories of the obvious riches they were so dependent on in the South Slough area: the timber, farmland, minerals, water transport, and native plants and animals.

In addition, surprise visits are made by two characters that stress hidden riches of the natural workings of the estuary: "Dr. Mudflat" and the "Estuary Soup Chef."

After an old-time lunch over an open fire, the science students may conduct scientific investigations in the different zones of the estuary. On the other hand, the social studies students may make mini-investigations of the evidence still remaining of the early activities in the South Slough.

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AN IMPORTANT PROGRAM NOTE: This program is highly dependent on enthusiastic energetic teachers, able to recruit available volunteers. It is imperative that teachers and volunteers attend a five-hour training session held free at the South Slough Sanctuary. Please contact the sanctuary for more details. Address all correspondence to:

Estuary Study Program  
South Slough Estuarine Sanctuary  
P.O. Box 5417  
Charleston, OR 97420  
(503) 888-9015

## INTRODUCTION TO LEVEL I

## INTRODUCTION

Your students are about to embark on an exciting adventure in learning about estuaries. Their entire experience, from the preparation materials and on-site experience, to the follow-up parts of the program, has been carefully planned and prepared to assure a quality experience with plenty of solid, good learning. As important as the knowledge your students will gain is the enthusiasm and excitement which accompanies it. This booklet will briefly explain the program and your suggested roles. Please read it over carefully as soon as possible, for your preparation materials should be arriving approximately two weeks before your class's visit to the slough.

### Assumptions About Age Level

We've based our program upon some assumptions about 4th and 5th graders:

- their need for an organized learning pattern
- their need for very simple terms and concepts
- their need for highly structured learning experiences
- their need for strong leaders and guidance throughout the learning experiences
- their need for concrete and visual representation of abstract ideas
- their need for being captivated by adventure and mystery
- their need for safety-conscious activities and areas

### Key Understanding of Level One On-site Experience

"The South Slough Estuary is a sanctuary for many living things."

### Specific Learning Outcomes of Level One On-site Experience

1. The South Slough Estuary is a shallow, sheltered, and rich body of mixed salt and fresh water which is connected to the ocean.
2. Living things reside in the estuary's four main zones: the uplands, salt marshes, mudflats, and open water.
3. Many different things live here:
  - a. it is a nursery for the young,
  - b. it is a home for year-round residents, and
  - c. it is a resting place for travelers.

### Preparation Materials

These materials are designed to provide the necessary information to prepare your students for the on-site experience.

The preparation materials for Level One are delivered to the classroom in a battered but authentic-looking treasure chest. Upon the lid appears the inscription "The Treasures of South Slough." In the chest is an assortment of objects and preparation materials all designed to provide information and motivation for the on-site visit. The contents include :

- a master packet to be pulled out by the teacher when students are not around. Copies must be made and then placed back into the chest before students' inspection. (With the schools helping with printing costs, this program is allowed to continue. Thank you.)
- a large map showing the ocean, Charleston, and the South Slough. This map is titled "ONE OF THE RICHEST PLACES ON EARTH."
- a stack of small maps, one for each student. Side one is identical to the large one only reduced in size. Side two is an enlarged section showing the area you and your class will visit.
- "Treasure Seeker's Guidebook." This is read to the students and it sets the stage for their visit to the estuary. It also contains preparation activities and introductory information on estuaries.
- a set of nine clues to the "treasure." The clues are fun facts and descriptions of things that live at the South Slough Estuary. Each clue will be a focal point of one of the on-site activities. However, they are not simply stated on a card--they must be decoded. For example, to read one clue, the student must hold it up to a mirror. Another clue must be held up to the light and yet another can be solved using a numbered code. For this preparatory activity, the students work in teams to decode all of the clues (but not figure out the living thing the clue is referring to! Please keep the answers to the clues SECRET). When they come out to the slough, they then know the clues, but their task becomes finding the living thing that fits the clue and "cracking" the clue. The discovery of these living things will lead them closer to the treasure.
- the "Task Cask."
- a North American Flyway Chart.
- a list of key words and definitions (including word game ideas the students can use to help remember the words and their meanings).
- natural objects found around the slough: oyster shells, crab pinchers or molts, dried seaweed, driftwood, etc. These things your students can use to set up a classroom display.
- nametags made out of wood or tagboard

### The Arrival of the Chest

When the chest arrives, (about two weeks prior to your visit), perhaps you could arrange for someone special to deliver it to the classroom, maybe the custodian or principal. In this way, the excitement is stirred from the start. Set the chest in front of the room, closed and intact, for all to inspect from their seats until you are ready to begin the first phase of the preparation. Please DO NOT open it in the presence of the students unless you are ready to set aside some time to probe its contents.

Remember you need to prepare masters before the students inspect the contents of the chest.

On the following pages, this guide will explain how each of the items in the chest works as well as provide a ten-day, hour-or-so-a-day plan for using all of the materials by the day of the visit. The materials can also be completed over longer time blocks in fewer days, although we recommend the particular sequence of activities described here.

## THE TEN-DAY PREPARATION OUTLINE

### Things to Round Up Before the Chest Arrives:

- 1) Some very willing adult volunteers or very capable high school student volunteers. The ratio of students to volunteers should be at most 7 to 1.
- 2) Hard backing for use on the student Treasure Books. Some teachers like hard backing or tagboard for each page; others prefer it for just the back cover. Students will be writing in their books during their visit to the slough.

### The Day the Chest Arrives:

Find a time when students are not around to pull out the MASTER PACKET which includes masters for:

- 1) the Treasure Book,
- 2) key word list,
- 3) key word find, and
- 4) crossword puzzle.

Make copies of each and package them back into the chest. Allow the chest to sit in front of the room as curiosity builds.

### To Begin

When you are ready to devote an hour or so to preparation, have the students look over its contents. They can carefully lift things out to see all that's there, but do not allow them to open any of the packages yet.

### "Treasure Seeker's Guidebook"

After all have had a chance to thoroughly look over the contents, read the "Treasure Seeker's Guidebook" to the class. It presents background information about South Slough as well as provides direction for the preparation materials. (This starts on page 13 in this manual.)

### The Maps

When instructed by the "Treasure Seeker's Guidebook," post and distribute the large and small maps.

### Making the Treasure Books

Masters are included in the "Master Packet" and instructions are found on page 15.

### The "Task Cask"

The "Treasure Seeker's Guidebook" has something to say about this, too. Basically it contains small research tasks that volunteers reach in and select. See page 17.

### The Flyway Chart

Hang and read the information on the flyway chart to the class. Do not refer to birds that are expected to be seen at South Slough during the current season as this will be done on site. The purpose here is merely to introduce the idea of flyways and migration. See page 18.

## First Week Preparation Overview

### Introduced in the Treasure Seeker's Guidebook

- 1) Looking over the treasure chest contents
- 2) Posting large map
- 3) Handing out small maps for inspection
- 4) Making your own Treasure Book
- 5) "Decoding" the CLUES (page 16 in this Manual)
- 6) Introducing the "Task Cask" (page 17 in this manual)

### Another Activity to Include

- 1) Introduce the Flyway Chart, page 18 in this manual.

## Second Week Preparation Overview

- 1) Presenting key words
  - a) playing word games, page 19
  - b) filling out crossword puzzle, pages 21 and 22
  - c) doing word find, pages 23 and 24
- 2) Review the very important South Slough visit CHECKLIST. Review this early because some details require some planning ahead (found on page 25).
- 3) Details the day of your visit
  - a) in class, page 26
  - b) when you depart, page 26
  - c) when you get off the bus, page 26

## PREPARATION MATERIALS



## TREASURE SEEKER'S GUIDEBOOK

(to be read aloud)

Hello, Treasure Seekers:

My name is Clancy and I've been in the business of treasure hunting for a long time. In fact, searching for treasures is my full-time job. Ever since I finished my schooling (where I studied Treasure Hunting), I've been roaming over the state of Oregon looking for treasure. And boy, have I ever found one! You know, though, I'm one of the few who are aware of the great treasures in the South Slough, but you, too, will have a chance to find them! It's not going to be easy--there's lots you must know first. My guidebook will help you prepare for a great day of treasure hunting soon to come. Listen to all the information carefully and do all of the preparations, step by step. Only then will you have the knowledge you must take with you to the South Slough to find the treasures. By the way, when you have finished all your preparations, the fun will have only just begun. Once you're at the South Slough, you will experience many new and great adventures.

### The Treasure Chest

You have probably looked over everything in the chest by now. Please don't take anything from it until your teacher instructs you to. Everything there has a special job in helping you get ready for your treasure hunt. If you don't take care of everything in the chest, you'll never be able to find the treasure.

### The Site of the Treasure Hunt: South Slough

Now you can post the large map on your classroom wall and hand out the smaller treasure maps, one per student. The large map is just like one side of your own smaller treasure map. The treasures are located somewhere on these maps. I won't tell you where they are--you'll have to find that out for yourselves.

South Slough is a very special place. It's part of an estuary. An estuary is a place where a river meets the sea and where the fresh water and salt water mix. Land encloses it from the sea, except where it empties into the ocean. South Slough is a part of Coos Bay which is a rather large estuary for this area. We call it a slough because it is a small part of the main bay. (A river has tributaries and a bay has sloughs.) You can see the entire slough on the map before you.

Part of South Slough has been set aside as a special place where all the animals and plants can live a life with very little disturbance from people. We call this special place a sanctuary.

If you look on your own map, you will see "side one" or "side two" near the NORTH arrow. Turn to side TWO. This is the area you will soon visit. Although the treasures are found throughout the slough, here is where we will be looking. It is an area rich in treasures. In fact, an estuary is ONE OF THE RICHEST PLACES ON EARTH!

## South Slough is the Home for Lots of Special Animals and Plants

Lots of interesting things live here. For some of the living things, the South Slough is a year-round home. For others, though, the slough is a nursery--a place to raise their young ones. Still others use the slough as a stopover on their travels from one part of the world to another. Soon you will meet some of these interesting creatures. Keep your eyes open, too, for signs of the animals you don't actually see or meet in person. Be alert for places they may have eaten a meal or made their home.

## Making Your Own Treasure Book

Like I mentioned before, there will be a lot for you to know before you set out to find the treasure. To help you keep track of it all, you'll need to make your own Treasure Book. Your teacher will help you with the details.

## Decoding the Clues

In your treasure chest you will find nine clues. Each of these clues has to do with something that lives at South Slough. Finding out the identity of these mystery animals and plants will help lead you to the treasure. This you will do when you visit the Slough. But first, you must "decode" the clues. When you have figured out the code, write each clue in your Treasure Book. Wait to "crack" your decoded clue, though! If you are sharp and alert, you will find out the identity of the living thing in the clue when you visit South Slough.

## Task Cask

Any curious volunteers out there that want to put in a little of their own time to get some treasure knowledge or help get ready for the treasure hunt? Then pick a task from the Task Cask. Your teacher will help you.

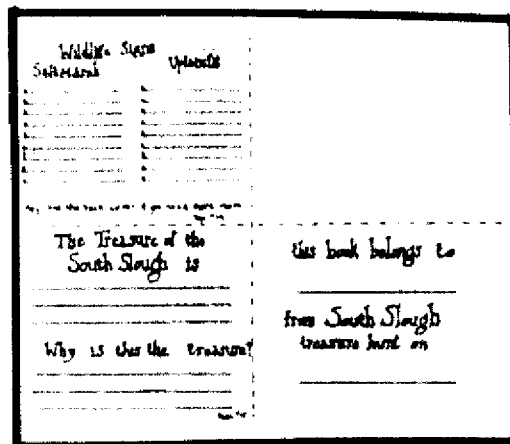
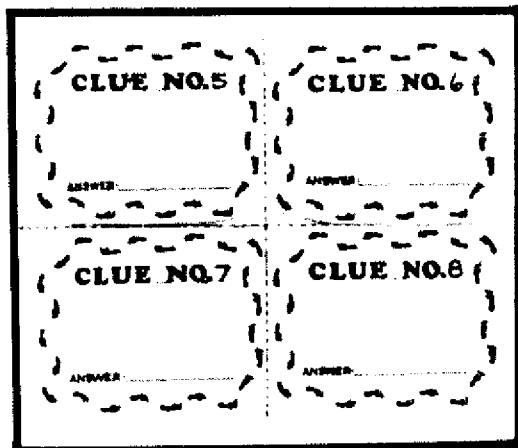
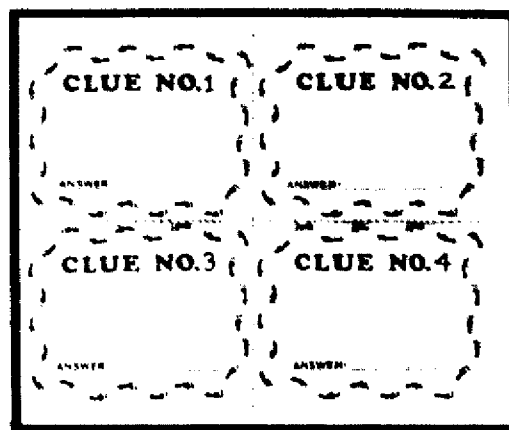
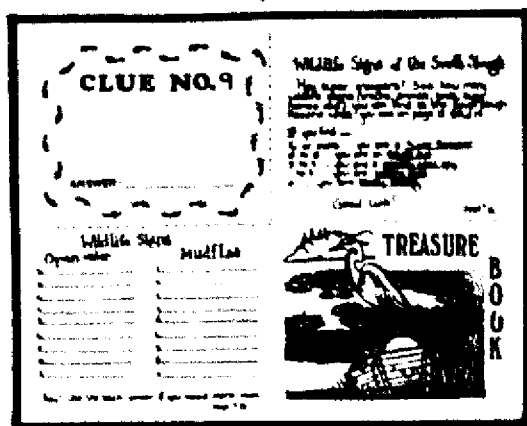
Well, that's about all I have to tell you--for now anyway. Your teacher will help you with some other things you'll need to do to get ready. You'll hear from me again--at the South Slough.

Good luck, Treasure Hunters!

Your friend,

*Clancy*  
Clancy

P.S. Don't forget to bring the Treasure Chest with you when you come to visit the South Slough.

cut

### Step One

Have the students cut the four sheets of paper on the dotted lines.

## Step Two

Students stack the pages in this order (from top to bottom): the cover, clues one through nine, wildlife sign explanation, and the two wildlife sign pages.

### Step Three

Distribute pre-cut cardboard or tagboard back covers that you have "rounded up."

### Step Four

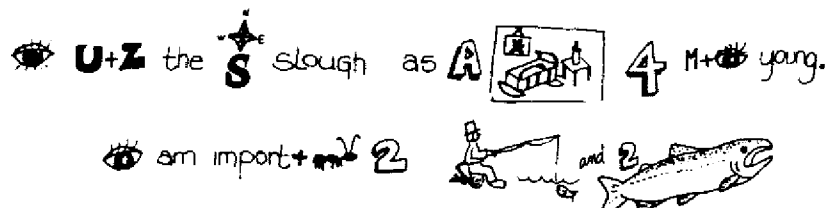
Staple the book with three staples on the left side.

## HOW TO DECODE CLUES

Allow 20-30 minutes a day until all clues are "decoded." This activity can be spaced over several days and can be done in groups of 2-4, depending on class size. Groups decode their clue on scratch paper and each student then writes the decoded clue into his or her own Treasure Book. Next, the groups trade clues with other groups until they have all nine.

### Clues

- "Equipped with a special spear, I stalk my prey on the shores of South Slough." (heron)  
Code: It is written backwards; it must be held up to a mirror to read.
- "My plump, green leaves help me live in salt water. I was a cucumber for the early settlers." (pickleweed)  
Code: It looks almost invisible: it must be pressed with an iron.
- "No head but a foot have I. I must eat 'Estuary Soup' or die. (clam)  
Code: Each number equals a corresponding letter in the alphabet, from A to Z.
- "I am the smallest plant in the 'Estuary Garden' but there is more of me than anything else." (phytoplankton)  
Code: Each number equals a corresponding letter of the alphabet, from Z to A.
- "My recipe calls for a rich mixture of animals, plants, and dead stuff." (estuary soup)  
Code: After the first two words, the word groups in the sentence are scrambled and out of order.
- "The slough is not my home, but it is one of my favorite stopping places on my trip from Peru in South America to the arctic of Alaska and back. At the slough I eat a quick lunch and rest before continuing on my journey." (sandpiper)  
Code: The letters in key words are scrambled.
- "I use my claws to help me eat dead soup eaters and anything else I can find. I retreat to my burrow when the going gets rough." (crab)  
Code: The vowels are omitted from key words.
- "We live in the uplands which offers us protection. We prowl by night, often searching for food at the estuary's shore." (raccoons)  
Code: The sequence of words in the sentence appears in reverse order.
- "I use the South Slough as a nursery for my young. I am important to fishermen and to salmon." (herring)  
Code: The combination of words and pictures illustrates the sounds of words (rebus example below).



## TASK CASK

This opaque cask contains slips of paper describing several small tasks that can be taken on by volunteers. These tasks require simple research, looking in an encyclopedia, or asking parents or others back at home. Some of the tasks help "troubleshoot" your on-site visit.

- Find a tide chart and look up the high and low tides for the day of your visit to the estuary. Announce to your class what the tide height will be when you are at the South Slough. When using the Humboldt Current tide chart, add 30 minutes to the low and high tide readings to get the South Slough tides.
- Find out who uses the waters of the Coos Bay Estuary and report this to your class. Think about recreational and commercial use.
- Call the recorded phone message for Coast Guard weather information.
- Use a Radio Shack Weather Cube to keep track of the weather forecast five days before your field trip.
- Pick up or send away for the South Slough-related pamphlets at the Coos Bay Chamber of Commerce or Oregon Department of Fish and Wildlife.
- Check newspapers for articles on the South Slough or other estuaries.
- Make sure that everyone has a nametag and writes his or her name neatly with a permanent marking pen. If it is a "wooden cookie" name tag, make sure first names are on both sides, nice and BIG and in very readable writing.
- Make sure everyone brings his or her map, treasure book, and a pencil. Double check to see that all your classmates have the correct decoded clue, but not the answers to clues!
- Have the class locate the water ways on their individual maps. With a blue marker or crayon, color in the ocean, Coos Bay estuary, South Slough estuary, and the fresh water creeks. LABEL the South Slough.
- Think up some ideas of your own. The Estuary Study Program coordinator would love to hear your ideas.

## NORTH AMERICAN FLYWAY CHART

### Introduction

This chart has no specific reference to the birds that migrate through the South Slough area, as that will be a focal point of one of the on-site activities. It simply explains why birds migrate, gives some fun facts about how far they go, and tells where the main flyways are located in North America.

### Copy from Chart

Twice every year billions of birds in North America prepare for their journey to some distant land. This great event is called "migration." Because of a lack of food in the winter, birds fly to warmer climates to keep from starving. In the spring they return to their birthplace to raise their young.

Most birds, when migrating, follow well-established routes during their journey. North America has four main flyways. The birds' flyways are highways of the air--without stoplights, intersections, and other obstructions human travelers have to watch out for.

Here are some interesting "Believe It or Not" fun facts about migration.

Experts believe that the majority of birds on migration flights stay at levels between 1000 and 2000 feet. An exception is occasional sightings of geese who have been seen flying in their military V-like formation anywhere from 20,000 to 25,000 feet high!

The champion long distance flyer is the Arctic Tern who makes two transworld journeys flying south to Antarctica in the autumn and returning to the Arctic in the spring. That means the tern flies 27,000 miles every year--only 3000 miles more and it would complete the distance needed to fly around the entire world!

Migration flights are made during both day and nighttime. Many of the songbirds like warblers and sparrows travel at night while the swallows only fly during the day.

Most birds make stops on their migration to rest up and feed, but some birds like the curlew, a shorebird, will make a 2000 mile flight without stopping!

## KEY WORD ACTIVITIES

Key Words should not be presented in such a way that the students feel that they will be tested on them or that they must memorize them. They are simply words with which they should become familiar. The reward will come when they are able to use these words during the on-site activities. Write the words and definitions on the blackboard. Use the key words in sentences that you recite or write on the board. Tell them that knowing the meanings of these words will help them find the treasure.

These are fun ways of practicing and reinforcing the Key Words.

### Crossword Puzzle

- Uses definitions to describe the words that fit across and down (pp. 21 and 22).

### Word Find

- The words appear in a jumble of letters: vertically, horizontally, and diagonally (pp. 23 and 24).

### Password

- This is a game for the class to play as a whole. Two students stand in front of the room, facing the class. A "Key Word" (or other related vocabulary word) is written on the board behind them; they cannot see it but the rest of the students can. One word clues are given to each of the two students in turn, with one guess allowed for each clue. When one of the students guesses the word, two others come to take their place.

### 20 Questions

- A student has one vocabulary word in mind; the others ask "yes or no" questions, trying to establish its identity in twenty questions or less.

### What's the Key Word?

- In small groups, assign key words to be used in a sentence created by the group. Groups write the sentence on the board, leaving the key word blank. Other groups decide on the correct key word to fit the sentence.

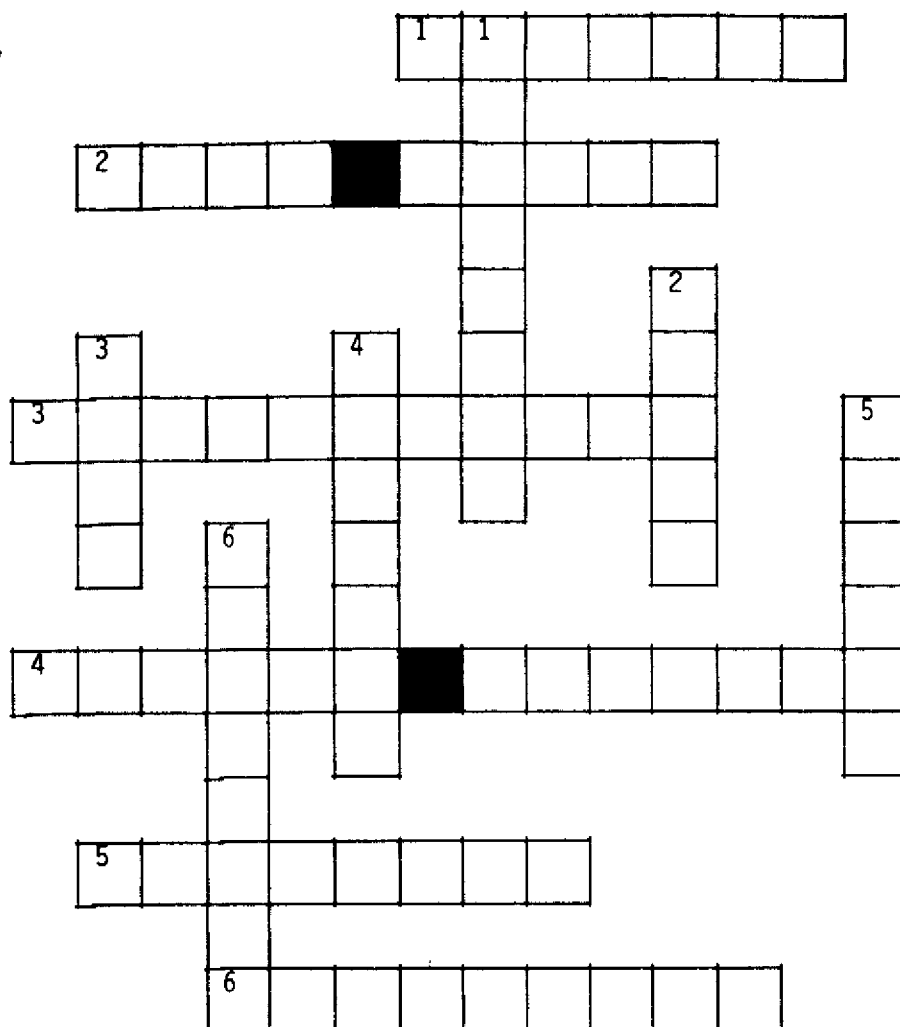
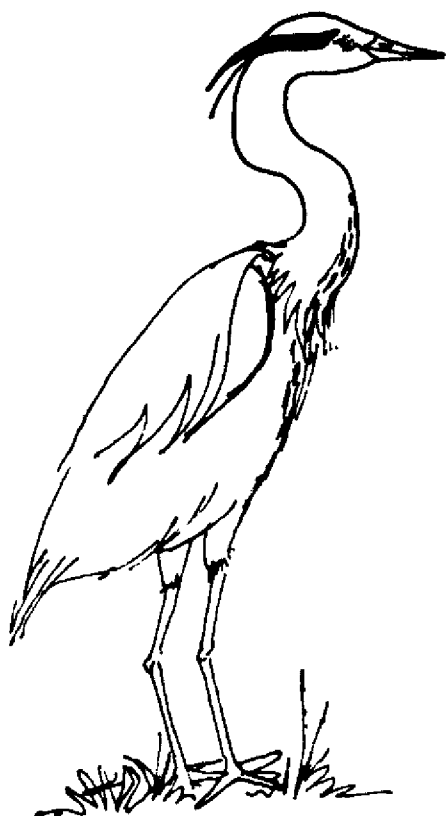
We'd love to hear of other word games that worked for you.

## KEY WORDS

- DECAY - The process by which dead plants or animals are broken down to small pieces by bacteria or fungi.
- DETRITUS - (dee tri' tus) Decaying bits of plants or animals. Detritus floats in the estuary water and is sometimes microscopic.
- ESTUARY - A place where fresh and salt water mix, usually where a river meets the sea. It is enclosed from the sea by land except where it empties into the ocean.
- FILTER-FEEDING - A way that some animals sort out and eat very small plants and animals from the water.
- MICROSCOPIC - Something so small it cannot be seen with the naked eye.
- MIGRATION - To fly to another place in search of a warmer climate, as the birds do in the late fall.
- MUDFLATS - One of the four natural communities of the estuary. It's a muddy place covered and uncovered by the tide water every day. There are very few standing or visible plants. The many holes indicate lots of life below.
- NUTRIENT - A tiny bit of dead plant or animal, or a bit of rock or mineral that provides nourishment or food to living things.
- OPEN WATER - One of the four natural communities of an estuary. It is the water that fills the low places in the mudflats even at low tide and covers the mudflats at high tide.
- PLANKTON - Small plants or animals that are found drifting or floating in the estuary water. Most plankton is hard to see with the naked eye.  
(Phytoplankton is plant plankton. Zooplankton is animal plankton.)
- SALT MARSH - One of the four natural communities of an estuary. It is a grassy place along the edge of the mudflats and next to the trees and bushes of the uplands.
- SANCTUARY - A place that has been set aside to allow the animals and plants to live a life with very little disturbance from people.
- SLOUGH - A small part of a main bay or estuary; a backwater.
- TIDE - The periodic rise and fall of the ocean water level due to the attraction of the sun and the moon. There are usually two high and two low tides every day.
- UPLANDS - One of the four natural communities of the estuary. It is a higher and drier place than the other parts of the estuary and usually has bushes and trees.
- ZONES or NATURAL COMMUNITIES of the estuary - Uplands, salt marsh, mudflat, and open water.



# KEY WORD CROSSWORD PUZZLE



## ACROSS

1. the highest and driest natural community of the estuary
2. a grassy place between the mudflats and the uplands
3. something too small to be seen with the naked eye
4. one way to eat microscopic plants and animals (two words)
5. something which provides nourishment to living things
6. a place where plants and animals can live with little disturbance from people

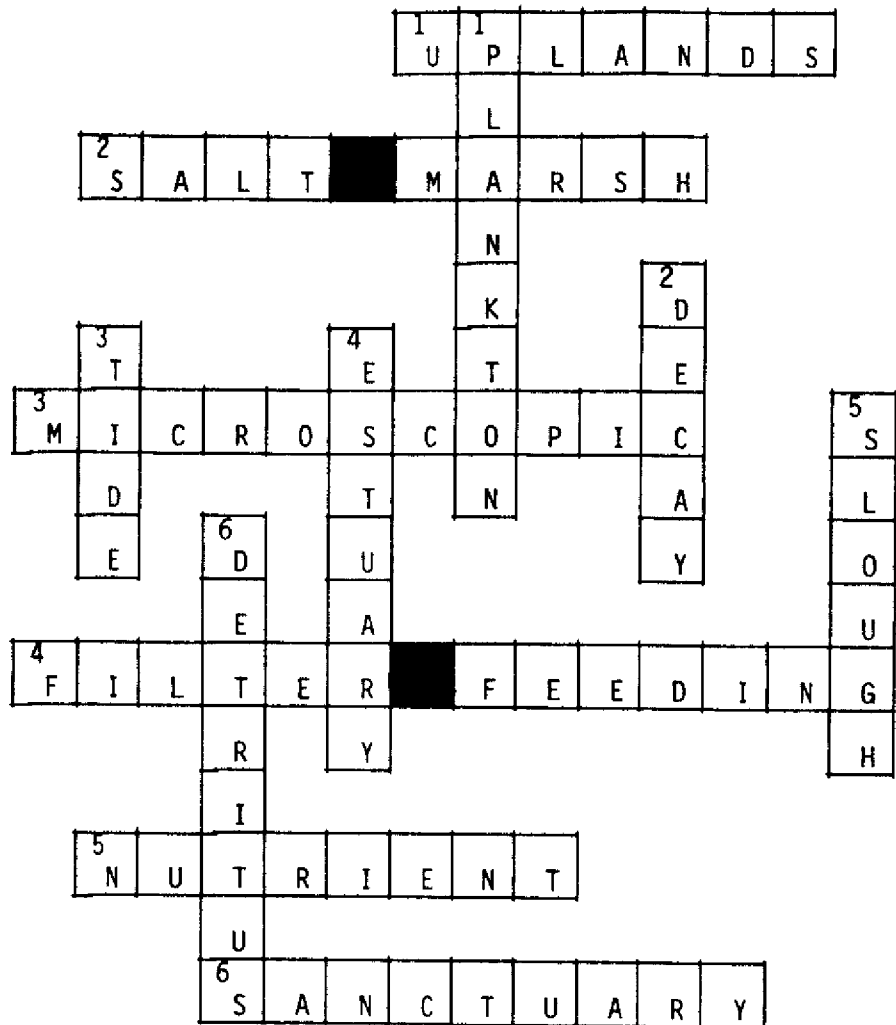
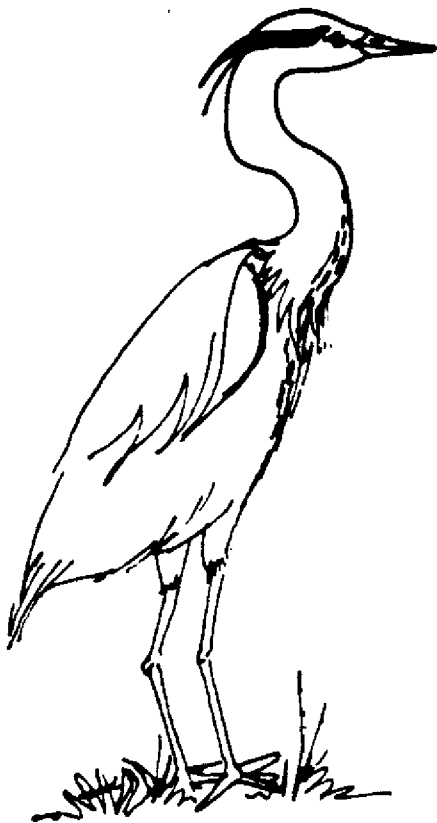
## DOWN

1. small plants or animals which drift in the water (usually microscopic)
2. the breaking down of dead plants and animals
3. the rise and fall of ocean
4. a place where fresh and salt water mix
5. a small part of a main bay
6. the decaying bits of plants in an estuary

## USE THESE WORDS

decay, detritus, estuary, filter feeding, microscopic, nutrient, plankton, salt marsh, sanctuary, slough, tide, uplands

# KEY WORD CROSSWORD PUZZLE (ANSWER KEY)



## ACROSS

1. the highest and driest natural community of the estuary
2. a grassy place between the mudflats and the uplands
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## DOWN

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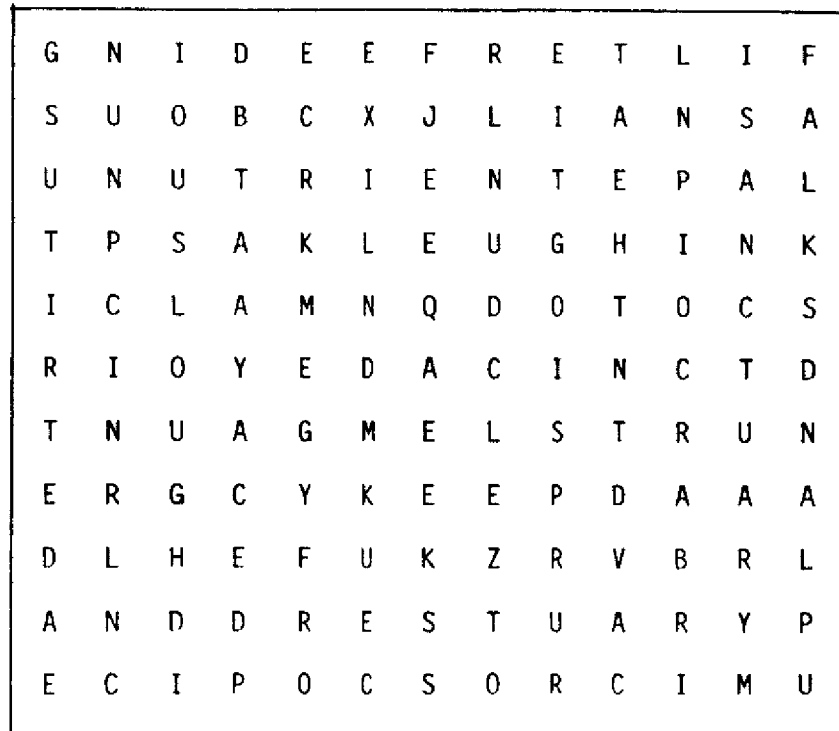
## USE THESE WORDS

decay, detritus, estuary, filter feeding, microscopic, nutrient, plankton, salt marsh, sanctuary, slough, tide, uplands

# KEY WORD WORD FIND

Find these Key Words: decay, detritus, estuary, filter feeding, microscopic, nutrient, plankton, sanctuary, slough, tide, uplands.

Bonus: the names of four other animals you might see on your visit to South Slough are also included.

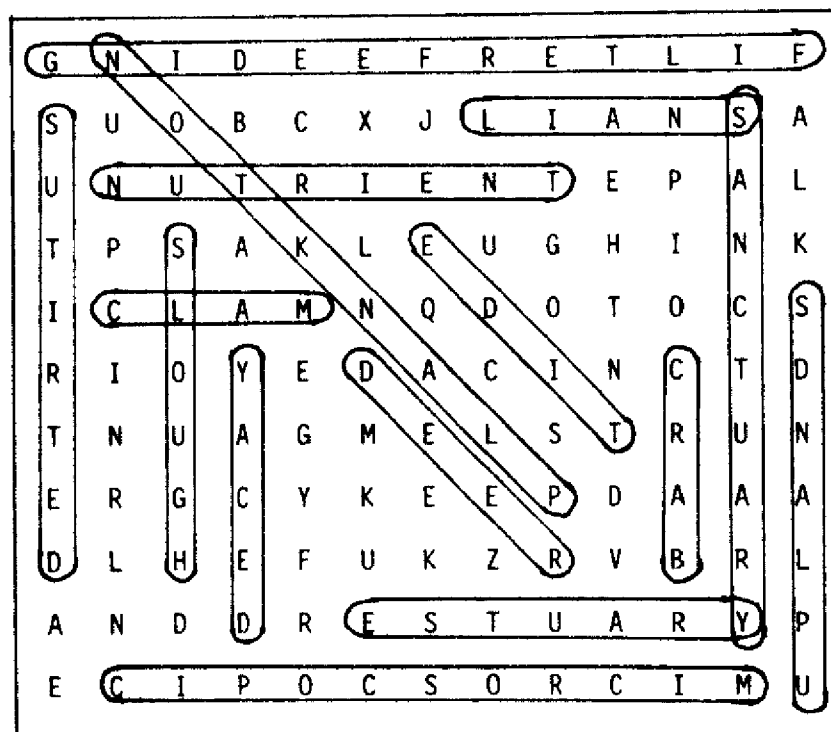


# KEY WORD WORD FIND (ANSWER KEY)

Find these Key Words: decay, detritus, estuary, filter feeding, microscopic, nutrient, plankton, sanctuary, slough, tide, uplands.

Bonus: the names of four other animals you might see on your visit to South Slough are also included.

Answers - snail, clam, deer, crab



THE VERY IMPORTANT SOUTH SLOUGH VISIT CHECKLIST ☐

- ☐ Letter home to parents informing them about the on-site visit and need for a sack lunch - Have you sent it out yet?
- ☐ Lunches and Drinks - Try to get donated apple cider (in the plastic jugs) to heat up at lunch and/or the end of the treasure hunt. Round up day-packs so all the gear (especially lunches) can be carried on student and volunteers' backs. Hand bags or sportsbags are not suitable, for students need hands for recording in their Treasure Book and for following the map on the way to the LOOKOUT.
- ☐ Clothing - Have you made the proper threats, i.e., shown them what they will wear from Lost and Found if they don't borrow warm, layered clothing? Consider having a dress rehearsal one day before. Insist on warm clothing and then another sweater. The wind can really blow down at the slough.
- ☐ Boots - Have you stressed the importance of their trying to borrow some rubber boots or bringing an extra pair of shoes to change into after the visit to the slough?
- ☐ Hat - Have you insisted on hats and explained how over 50% of one's body heat escapes out of the top of one's head? Have you said that hats will be their "ticket" on the bus?
- ☐ Rain gear - Have you emphasized that if they bring rain gear it will probably be good weather, but if they don't it might RAIN? Be ready to cut up plastic garbage bags for rain gear.
- ☐ Safety - Have you gone over some field trip and trail safety tips (especially after your on-site training)?
- ☐ Groups - Are students in compatible, cooperative groups, and have they picked an estuary word for their group name? (Please avoid activity titles or estuary zones for group names. Thank you.)
- ☐ Nametags - Are your nametags ready, with first names filling up the entire nametag? Are first names on both sides? Did you use a permanent marking pen? Are the names very legible?

## THE DAY OF THE VISIT

Page through the Treasure Book, reminding students where decoded clues are located and where the spaces are that need to be filled in during the on-site visit. Point out the Wildlife Sign pages for the four zones and encourage the students to fill them in as much as possible during their on-site visit.

Neatly place all posters, maps, and other items back into the Treasure Chest. Load the chest on the bus.

When you depart for the slough, make sure you have:

- 1) Treasure Chest
- 2) Treasure Books with decoded clues written in them. No clues should be answered yet, though.
- 3) Student maps
- 4) Pencils and extra sharpened pencils
- 5) Hats and raincoats (and plastic garbage bags and scissors to make emergency raincoats)
- 6) Rubber boots
- 7) Lunches, including apple cider by the gallon in plastic jugs
- 8) Nametags with students' names printed neatly on both sides (use permanent marking pen)
- 9) Daypacks
- 10) Students

When you get off the bus at the slough:

- 1) All hats and raingear, boots, and lunches go with students in daypacks.
- 2) All Treasure Books, pencils, and student maps should be in each student's hand. Be ready to do some mapping adventure activities on the way down the trail.
- 3) Students should know their group name as well as their group members.
- 4) All nametags should be worn on the outside and visible the entire day.

ON-SITE  
EXPERIENCE

## ARRIVAL ON-SITE

When the students arrive at the Estuary Education Site, the experience is already in full swing. They know there is going to be a search for treasure and they know that clues have something to do with it. They have the preliminary knowledge they need to fully understand the information that will be conveyed to them throughout the day. The treasure chest and all its contents have done the job of preparing them.

The bus stops partway down the hill, above the bus turnaround. Here the coordinator boards the bus, introduces himself and welcomes the class to the South Slough. Some last minute reminders are given, some introductory remarks are made and with pencils, Treasure Books, and maps in hand and lunches on their back, the class heads out to the viewpoint. There each group acquires a different colored flag that serves as their banner for the hike to the Lookout.

## OVERVIEW OF THE CONCEPTS REVIEWED AT VIEWPOINT

1. An estuary is connected to the ocean.
2. An estuary is where salt and fresh water mix.
3. Estuaries are protected from the large waves of the ocean, and they are rather shallow.
4. Life in the estuary is concentrated in four zones: uplands, salt marshes, mudflats, and open water.

## HIKE TO THE LOOKOUT

After map exercises and a review of main concepts at the view point, the coordinator leads the class to where the narrow trail down the slope begins. He tells the students that the treasure hunt will start at the bottom of the hill and that first they must venture through the uplands area. "Some of these areas are cleared of trees from recent logging," he says, "but as we get closer to the shore we will again see the forest."

"Well," he concludes, "we have a treasure to hunt for. We'd better be on our way."

Staying in their groups, they hit the trail. The pace is brisk so as to keep the travel time to a minimum, but the trail is winding, with bridges and catwalks. All this makes for a fun walk. Small signs along the way call attention to interesting things. The last stretch, "The Tunnel Trail," is several hundred feet of twisting, tight pathway, sometimes completely grown over above their heads. Suddenly the Tunnel Trail opens out to a large overview in a group of trees just above the estuary's shore. It's their first close-up view of the slough and the unexpected scene is striking.



## THE TREASURE TRAILS

Upon arriving at the Lookout, the central staging area for the treasure hunt, students are instructed to find a flaghole for their flag and rally all their group's gear around it. Then they are invited to view the slough through a spotting scope, check their maps, and stop at the bathroom if necessary. After a few minutes of looking over the slough, each leader seats their group together around their flag. When their attention is focused, the leader explains how the treasure hunt will work.

"Each group will set out on one of our two Treasure Trails. Along the Treasure Trail there are lots of big adventures. Each adventure will help you find the identity behind one, two, or even three of the clues. However, you won't be able to figure out the treasure until you know the meaning of all the clues. Here is a letter which will give you a better idea of what to expect."

With this, the coordinator pulls out a bottle with a letter inside. It reads:

Dear Treasure Hunters,

Here are a few tips on how to find the meaning of the clues. As you walk the Treasure Trail, keep your eyes alert for a stake with my mark on it. Somewhere near that stake, packed in a special container, you will find further instructions on how to crack the clues. Your leaders will help you along the way.

Remember, your group must work together as a team to crack the clues. Each time you find the meaning of a clue, your group will receive a shell with a special letter within. Keep these shells in the treasure pouch that you will soon receive. When you have cracked all the clues (but don't crack the shells, please!) and you have all the shells, you will be very close to finding the treasure.

By the way, cracking those clues won't always be easy. I should warn you, the going may get rough.

Good luck!

*Clancy*

Clancy

The Treasure Trails work in the following way. Each trail is circular and contains four learning stations along the way; each learning station occurs in and concerns a particular natural community or zone of the estuary (open water, mudflat, salt marsh, and uplands). During the course of the action at each of the learning stations, the information from one, two, or three of the clues is revealed and associated with its hidden identity. The leader tells the students beforehand that they all must think hard during the activity to crack a clue.

However, if they think they know the meaning of the clue, they must remain silent until the end where each person can tell his or her theory. In this way, the unpredictable, sudden realization of the meaning of the clue won't disrupt the activity, which also passes along other information about estuaries. (It also serves as some fun sharing at the end of the activity to bring the learning to a close.)

The general pattern of all the activities is the same. The groups reach the stake. They search and soon find the container which has further instructions. Inside is a note in a bottle. The note introduces the natural community, tells a bit about it, and sets the stage for the activity. (The container also holds the props for the activity.) The leader reminds the students that if they crack a clue they must keep it to themselves. The leader then facilitates an experience which reveals the identity of clues, and conveys some crucial information about estuaries. Following this is a short period, (usually about five minutes) where they observe or search for residents of that natural community. These findings are listed by the students on the appropriate page in their Treasure Book, and the group heads to the stake where they "circle up" for some sharing. Together they figure out the clue or clues, write the identity in their Treasure Books, repack the instruction container, and continue on their way. The leaders, of course, have participated in each of the activities during the leader training workshop so they are well prepared to handle the simple, step-by-step activities. They also have cue sheets to help them along.

The going is a challenge but fun. It keeps the level of excitement high. Each activity plus the travel to it is designed to last about 25-35 minutes.

The two trails have the same activities which reveal the same clues. On the trails, eight of the nine clues will be cracked. Following the completion of the Treasure Trails, the final clue is cracked by the total group at the Lookout.

Because of the tide and its effects on scheduling, these activities were designed to be successful during either high or low tide. However, it is recommended that the visit occur during low tide as there is more to see and do during this time.

## THE LEADERS

The leaders are usually parent, adult or high school volunteers who have been recruited by the teacher(s) involved. They have all attended a four- to five-hour leader training session at the South Slough to prepare for their facilitating role in the program.

There are two approaches to leader involvement with this program. One is to train leaders to be responsible to one group of students, role-playing each of the four activities as well as traveling with them to each station. This method cuts down on the number of leaders ideally needed to rotate between activity stations with the students. However, it also places a lot of responsibility for facilitating four different activities upon the leader.

The other approach is to train leaders to concentrate on one of the four activities of the treasure trail. This works best when an additional adult is recruited per group to travel with the students the entire day.

The teacher needs to weigh the pros and cons of each approach and when in doubt, recruit and train twice as many volunteers as would probably be needed! Additional volunteers can always be used at the Viewpoint to supervise the student hike to the Lookout. Their presence allows the leaders who are facilitating activities to start down ahead of the class in order to practice and "trouble-shoot" their activity station.

The leaders serve as the facilitators of all the treasure trail activities. In most situations, they role-play a different character, be it a chef mixing up "estuary soup," a gardener in Clancy's Estuary Garden, a tour guide at the Visitor's Center of the World Travelers, or a Mama Raccoon with her night prowler family out for a bit to eat. The leaders involve the students as much as possible, assist when needed, and maintain the timing and flow of each activity.

Incidentally, each activity is designed so that all the students participate. Facilitating total participation is the prime role of the leader. The leaders also make sure the students are involved enough to crack the clue(s) to understand the purpose of the activity. It is also important that the leaders circle up the group after they have completed the activity and searched for residents. In this circle, the group "cracks" the clue(s) and receives the appropriately lettered shell(s) to place into their group's shell pouch.

## PREVIEW OF TREASURE TRAIL ACTIVITIES

The students stop at four learning stations in all, either on Treasure Trail A or Treasure Trail B. It does not matter which station they begin since the stations are arranged on a loop trail. The students will normally visit two stations before lunch and two stations after lunch. The treasure trail activities for each station concentrate on one or more of the estuary's natural communities or zones.

### ACTIVITY: World Travelers

Zone Emphasis: Open Water

Clue #6 - Sandpiper

Clue #9 - Herring

### ACTIVITY: Clancy's Estuary Garden

Zone Emphasis: Salt Marsh--primary  
Open Water, Mudflat  
and Uplands--secondary

Clue #2 - Pickleweed

Clue #4 - Phytoplankton

### ACTIVITY: Estuary Soup

Zone Emphasis: Mudflats--primary  
Open Water--secondary

Clue #3 - Clam

Clue #5 - Estuary Soup

Clue #7 - Mud Crab

### ACTIVITY: Night Prowlers

Zone Emphasis: Uplands--primary  
Mudflats--secondary

Clue #8 - Raccoons

### FINAL CLUE TO BE CRACKED AT THE LOOKOUT

Clue #1 - Heron

Remember: Wait until your class visits the slough to crack the clues.

## TREASURE TRAIL ACTIVITIES

### The World Travelers

The group finally reaches the stake. After a diligent search, a large suitcase is found in the midst of some nearby bushes. Across the side of the suitcase appear the words WORLD TRAVELERS. Upon opening it, the group finds the bottle with the note. It reads:

I'm glad to see you made it to the part of the estuary where you can see the Open Water. Even during the lowest of tides, there will always be some water out there in the deepest channels. The open water of the estuary shrinks and grows with the tides. The estuary water and its shores attract a lot of "world travelers" that come here for a brief stopover, for a long summer vacation, or to raise a family. There is a problem with these world travelers, though. They never seem to want to check in with our Visitor's Center. We need your help to get the job done.

See you later,

*Clancy*

Clancy

P. S. Hint: Take a look at two of your decoded clues, #6 and #9, before you go any farther.

"Let's look at those two clues, group. Hmm....interesting." The leader adds, "Now what did Clancy's letter say about having problems with checking those World Travelers into the Visitor's Center? He probably wants to know who's here and using the area, right? Have you ever signed your name at a Visitor's Center before? You know, they always want to know who you are and where you are from. Since the animals can not read or write, how can they check in? We could help, OK?"

After receiving unanimous agreement to help, the leader takes the suitcase and leads the group to the Visitor's Center.

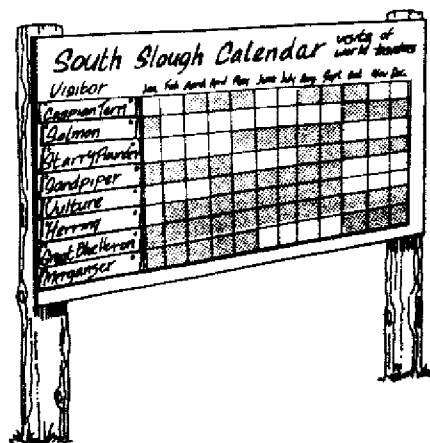
The Visitor's Center is on an open stretch near the water. It consists of two large signboards and a nearby observation area.

"Well, each of you can help us check in one of the World Travelers. These envelopes have a picture and description of a world traveler that each of you will help check in. It tells where the traveler is going, where he is coming from and how long he stays at the South Slough. There are also two tags with your World Traveler's name and picture on each." The leader shows them the contents of one of the envelopes.

"Before I present you your envelope, I want to show you these two boards. One is titled 'The Routes of World Travelers.' You see, we don't know where any of our travelers is going or coming from. This board has a large map on it with lines for the various routes, but we're not sure which route belongs to which world traveler. Your task is to read the information in the envelope and match your tag to the route of your world traveler."



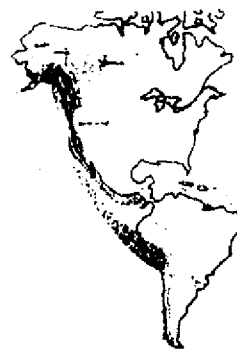
"Next," the leader continues, "this calendar is shaded for each month one of the world travelers is here. Trouble is, we don't know which is which. Again, maybe with the information in your envelope, you could help us figure this out".



Then, the envelopes are distributed, and each student reviews the information on the card inside. Soon the students catch on, and the tags begin appearing on the boards. The students may ask each other for help.

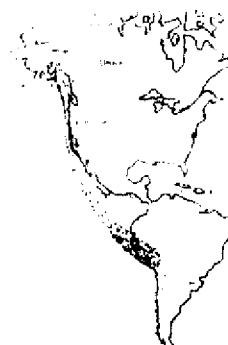
## Contents of Envelopes

Caspian Tern--I am the largest of my kind in North America. I fish by myself and when I find my prey, I plunge headlong into the water after it. I visit the South Slough during the spring months of March, April, and May as I travel north to fish along the Pacific coast. In fall, from late August to October, I stop again at the slough. This time, I'm on my way south to the coasts of Central America.



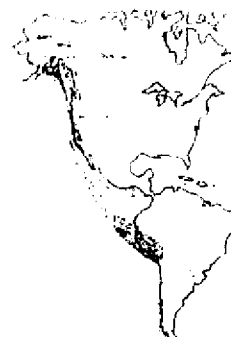
Jan.	Feb.					June	July					Nov.	Dec.
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Salmon--I come from the ocean and swim through the South Slough on my way to my spawning grounds in the freshwater streams. I come through the slough anywhere from October to January. My young swim from the freshwater streams through the slough on their way to the ocean.



	Feb.	March	April	May	June	July	Aug.	Sept.					
--	------	-------	-------	-----	------	------	------	-------	--	--	--	--	--

Heron--I'm a full-year resident of South Slough. I fish its waters all year round and seek the trees of the uplands for shelter. I fold my long neck back to my shoulder when I fly. I wait for or sneak up on my prey. I use my beak as a spear to catch it.



--	--	--	--	--	--	--	--	--	--	--	--	--	--

Starry Flounder--I hatch and grow up in the South Slough. Each year, from May to September, I live in the slough. Then in October, when I'm old enough, I swim out to the ocean to live most of my adult life.



Jan.	Feb.	March	April									Oct.	Nov.	Dec.
------	------	-------	-------	--	--	--	--	--	--	--	--	------	------	------

[illegible]

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
------	------	------	------	-----	------	------	------	-------	------	------	------



After everyone has "registered," they all step over to reveal the boards.

"Wow! There really are world travelers here. Why don't you each tell us a bit about your visitor?"

Briefly, the information is shared. Then the leader has all the students come up onto the observation area where they look through binoculars to try to get a glimpse of a world traveler. Encouragement is given to record all wildlife signs in the place at the back of their treasure book. There is also a place on the board to write in names of other travelers they see or hear.

Finally, when all the props are put away, the binoculars are safe and secure, and the tags and cards are replaced in the envelopes, they enter the answers to their clues in their Treasure Books, receive their shells and continue on their way.

Travelers represented in envelopes: Sandpiper, Caspian Tern, Salmon, Herring, Starry Flounder, Heron, Merganser, Vulture

#### Answers and Clues

#6 - Sandpiper: The slough is not my home, but it is one of my favorite stopping places on my trip from Peru in South America to the arctic of Alaska and back. At the slough I eat a quick lunch and rest before continuing on my journey.

#9 - Herring: I use the South Slough as a nursery for my young. I am important to fishermen and to salmon.

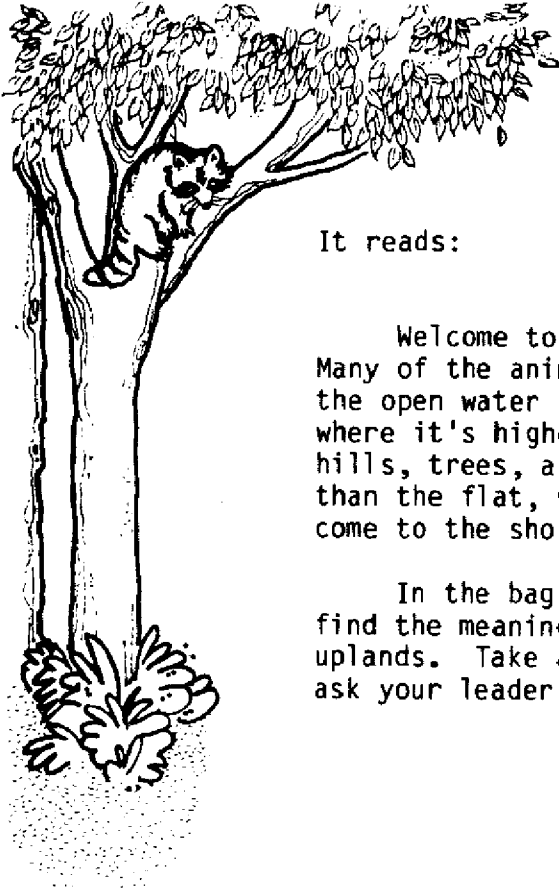
#### Props:

Bottle with note from Clancy  
Suitcase  
8 envelopes  
8 cards with traveler information  
16 tags with names of travelers  
8 pair of binoculars  
Visitor's Center "official" hat and pin

#### Site Set-Up:

- Stake
- Routes of World Travelers Board
- South Slough Visitor's Calendar with place to write in names of other travelers
- Observation area

## The Night Prowlers



The students walk along the Treasure Trail, searching for the special stake. Soon after they find it they spot the container. Dangling from a branch above them is a bag tethered to a rope. They lower the bag and open it. Inside they find another old bottle with a note inside--obviously a message.

It reads:

Welcome to the part of the estuary we call the Uplands. Many of the animals and plants of the estuary don't live in the open water or mudflats. Instead, they live along the edge where it's higher and drier--what we call the uplands. The hills, trees, and shrubs of the uplands offer more protection than the flat, wet areas. Many of the animals of the uplands come to the shores to feed on the estuary's rich food sources.

In the bag you will find some things that will help you find the meaning of clue #8 and learn a little about the uplands. Take a look at your clue in your treasure book and ask your leader about the magic crab claw.

Good luck,

*Clancy*  
Clancy

After reviewing clue #8, the leader reminds the group: "Remember, if you think you know the identity of the clue, keep it to yourself until we're back at the stake."

The leader takes the group to a nearby planked walkway which extends from the edge of the uplands twenty feet out into the nearby salt marsh.

"Now, you're probably wondering about that magic crab claw; well, here it is."

With this, the leader pulls out a claw from the bag.

"With this magic crab claw, I'm going to turn you into raccoons. Yes, raccoons."

The leader instructs the new raccoons to get on all fours at the touch of the claw. When everyone is on all fours, she hands out the masks. Each student gets a black, Lone Ranger-type mask to wear. The leader then pulls out the raccoon puppet.

"O.K., I am the mama raccoon. You are all part of my family and we have come down from the upland forest to search for our dinner along the estuary shore. We are covered with a thick coat of greyish fur and walk on four legs, and our masks make us resemble a night prowler. We just woke up after a long day's sleep and we're venturing from our den, which is located in the uplands. Now it's time for our meal. Let's search for one of our favorite foods--clams.

However, there's a special way we raccoons search for our food. Instead of using our eyes, we pat with our hands!"

The leader leads the group and spreads them out a bit. She instructs them to face outward and look up. Then, with open hands, they are told to pat the surface and feel for their food.

"Don't look down! Use only your hands to find your food. When you feel a clamshell or other food, bring it up on the shore." (The shells have been scattered previously on each side of the planking.)

"Keep searching for all you can find--but quickly! Soon we must return to the uplands. By the way, if you ever hear me growl loudly, that means danger. Let's group together now and follow me."

Mama raccoon tells them they should quickly pile up all the food they found in a big heap.

"Well, not a bad catch. I'll bet we do lots better than other raccoons who don't live as close to an estuary as we do. We are fortunate to have a place that is so rich in food. Food not just for us, but for other animals as well--like the osprey and herons who hunt fish, deer who graze on the grass, and mink who eat baby birds and...baby raccoons! Speaking of mink, I think I smell one. GROWL!!"

The warning signal thus sounded, the group jumps to their feet and scrambles with the mama raccoon off the planks and along a small trail to the foot of a large tree.

"Let's get to the uplands where we'll be protected!" the mama raccoon shouts.

"Oh no," the leader says, "I can feel the magic wearing off. It's time to become humans again, or we'll be raccoons the rest of our lives! Quick! Take your masks off and put them in this bag!"

This task completed in a flash, they are back to being humans. As they return to the stake, the leader suggests they explore the uplands of the estuary

for evidence of other animals that might live there. Their brief exploration might turn up such things as nests, burrows, dens, woodpecker holes, antler rubbings, animal trails, deer bones, tracks, animal sounds, gnawed trees or shrubs, shredded fir cone piles, owl pellets, animal droppings, shredded bark on trees, and short lengths of grass in piles. The location of some of this evidence may be marked.

Upon arriving at the stake, the leader neatly places the props back in the bag and assembles the group in a sharing circle.

"Well, you all did a fine job of keeping the clue a secret! Did anybody figure it out?"

As one might guess, the answer is now obvious. After talking a bit about how they know it, they write "raccoons" on page eight in their Treasure Books.

After placing the bag up in the tree, they venture onward.

#### Answer and Clue

#8 - Raccoons: We live in the uplands, which offer us protection. We prowl by night, often searching for food at the estuary shore.

#### Props:

- Large burlap sack
- Cloth bag for masks
- 8 Lone Ranger-type masks
- Raccoon hand puppet
- Crab Claw
- Bottle with note from Clancy
- Kneepads for leader
- Gloves for leader
- Clamshells

#### Site Set-up:

- Stake
- Plankway to clam shells

## Estuary Soup

Walking along the trail, the group spots the next stake. Near it they find a bottle with a note:

Great! You are quite close to the Mudflats! The mudflats are the dining room for many animals who eat there every day. Although the tide washes over and floods the mudflats twice daily, the area is rich with life and food for many estuary residents. You'll have a chance to meet some of the animals that live here, but first head on up the trail to the kitchen and our local chef will show you how to prepare a famous meal--Estuary Soup!

Your friend,

*Clancy*

Clancy

P.S. But first look at the three clues to be cracked: Clues #3,5, and 7. Remember, mum's the word till the very end.

After reviewing their three clues, the group walks ahead to a sign that says "Estuary Kitchen and Restaurant--Please wait to be seated." (At this point the leader suggest that the group focus on the mudflat, while he sneaks away to become the chef.) Soon they hear "the chef" inviting them to come into his kitchen. (Sit-upons are distributed if necessary.)

"Welcome to my kitchen! Today we're going to make Estuary Soup. This is a very popular meal for many estuary animals. But I need lots of help making this important meal. Johnny, can you see if you can find the recipe card in my cabinet?" (A large recipe card is pulled out which clearly describes in large letters how to make the soup.) Then the chef sets a hefty soup kettle on the top of his cabinet.

"OK, let's read this recipe card. Susie, what is the first step?" Susie steps forward to read Step One: "Add fresh water to soup kettle." "Oh, yes, now I remember," mumbles the chef. "Fresh water is very important in this soup. It comes to the estuary from the rivers, streams and rains." "Hilda, can you find the pitcher of fresh water in my estuary soup cabinet?" "Oh, thank you, let's give Hilda a hand for that fine performance."

"What's next? Step Two. What ever could that be? Tom, help me out, please. Step Two, Step Two." Tom smiles and comes forward and reads aloud "Step Two: Add salt water to soup kettle," and then quickly sits down again. The chef retorts, "Not so fast, my son; please take the pleasure of finding the salt water in my cabinet." As Tom scrambles around, the chef adds, "And of course the salt water is delivered here from the ocean by the tide. In this particular estuary, at least half of our soup is made of the ocean water."

"Anyway, we must move on. We've got salt and fresh water in our soup now. Step Three please, Lisa. It says "Add billions of tiny plants (phytoplankton)." The chef invites her to find the tiny plant container with the ever-so-important phytoplankton, and as she shakes the container over the kettle, the chef adds his two-cents worth. "Tiny plants, so tiny that it looks as though Lisa is not pouring anything out!" (The chef beats on the container a bit.) Speaking to the rest of the group he adds, "You may be puzzled as to why it appears that nothing is coming out of the can. Unlike land plants such as daisies, blackberries, and trees, some plants which exist in the water of the estuary are tiny and microscopic. We call these billions of plants phytoplankton. It is not so important to remember the name as it is to know that there are billions of these microscopic plants in Estuary Soup."

The next step is "Step Four: Add millions of tiny animals (zooplankton)." Another helper reaches into the cabinet to find the container labelled "Tiny Animals--Zooplankton."

"Just as there are billions of tiny plants in the water, there are millions of tiny animals. Actually, they feed on the plants! We call these animals zooplankton. I remember this strange word because zoo is at the beginning of the word, and at the zoo you see animals. So you have the word zooplankton meaning animal plankton."

After the tiny animals are added comes Step Five: "Add billions of tiny bits of dead animals and dead plants: detritus. When plants die, they begin to decay and rot and are broken down into tiny particles by bacteria and insects. The movement of water also helps to break them down into smaller bits." Often times special floating plants attach to these pieces, just like they were a raft. Lots and lots of these rafts have tiny plants all over them that some animals lick off! This might seem strange but it happens so much that it is very important!

A volunteer adds this ingredient to the kettle, and after a quick review of what's in the kettle so far, the group is ready for Step Six. "Mix with three special mixing spoons." This time the chef picks on three students to come forward to find a spoon. They find the big wooden spoons, each having a different label on the wide end: "Tide," "Stream Flow," and "Soup Eaters."

Someone stirs with the "Tide" spoon while the chef asks him to imagine the constant rise and fall of the tide. Next, the "Stream Flow" spoon is used as the group considers the water pouring in from the hills. Finally the third spoon is used as the chef mentions how the "Soup Eaters" themselves stir the soup up as they go about their business of eating the estuary soup.

"Step Seven: Karen, please assist me here." She looks down the card and reads "Invite the 'Soup Eaters' to your lunch by 'setting the table.' Look for placemats in the cupboard. Pass one to each group member." Before the chef has time to say anything, she has passed out the placemats to her fellow group members.

"Thank you very much," the chef beams. "Now if you will all hold your placemats up and read the words on the back side, we can go on to Step Eight, which reads: 'Introduce the soup eaters by reading your placemat to your group members.' Let's start here with Tom."

Students examine the picture of their soup eater and read the fun fact about it.

Placemats read:

Barnacle: I stand on my head and kick food into my mouth with thread-like fibers that strain the food from water currents.

Mud Shrimp: I stand at the entrance of my burrow and filter food out of the water by making a basket with two of my long-haired legs.

Duck: I use my webbed feet to paddle around and with my bill I strain the Estuary Soup for goodies to eat.

Clam: I suck up Estuary Soup into my gills. Then, tiny hairs sort out the food particles from the water and pass them on to my stomach.

Lugworm: With special mucus glands, I pick up decaying bits of plants and animals, digest them and put the leftovers back into the mud to make it richer.

Oyster: I live on "estuary soup" and am grown by oyster farmers. In South Slough I am grown on big shells attached to stakes.

Mud Crab: I live in a burrow in the mudflats and eat dead soup eaters and anything else I can find.

"Now let's see what those soup eaters are eating. Step Nine says to collect a bucket of estuary soup from the estuary." (If the tide is low, "estuary soup" will be available in a "sunken bucket." Otherwise, a bucket with a rope on it will be on hand to bring up the estuary water.)

"OK, Step Ten says to 'dish up the soup.' Let's get some of this fresh soup here, and along with it I'll send a special tool, called a pocket scope." With all eyes on him, the chef dishes up the soup and demonstrates the use of the pocket scope.

Once students have thoroughly checked over their dish of soup and used the pocket scope, they are invited to search for soup eaters and other estuary animals that might be using this area. Some animals they find may even be eating soup eaters. The chef reminds them that Step Twelve advises them to record signs of wildlife in their Treasure Book under the correct zone or natural community. The students find themselves where three zones interface: the salt marsh, the mudflats and the open water.

After several minutes of searching for and seeing crabs, bird prints, raccoon prints, etc., the leader produces a bucket containing a live clam. The students all look at it closely. The leader explains how it reaches up with a long tube to siphon soup from way down below the mud. He also mentions how it uses one large foot to move around.

Hopefully by looking under driftwood the students will be able to locate and capture a mud crab. They place it in a glass bowl full of "soup" and mud and watch it while the leader tells a bit about the importance of the crab's tunnels.

"If it gets very hot on the surface of the mudflat during low tide, the crabs are able to escape to their burrows. They can survive there even with very little water."

Finally, all the props are put away and they circle around to see if they cracked any clues. Sure enough, all three have been cracked and the answers are revealed: #3=clam, #5=estuary soup, #7= mud crab. They enter all three answers into their Treasure Books on the correct page and collect their well-deserved shells.

#### Answers and Clues

#3 - Clam: "No head but a foot have I. I must eat 'Estuary Soup' or die."

#5 - Estuary Soup: "My recipe calls for a rich mixture of animals, plants, dead stuff, and water."

#7 - Mud Crab: "I use my claws to help me eat dead soup eaters and anything else I can find. I retreat to my burrow when the going gets rough."

#### Props:

- Bottle with note from Clancy
- Chef's apron and hat
- Kitchen cabinet
- 8 soup bowls
- 3 large wooden spoons
- 8 placemats
- 2 pitchers
- 1 old soup kettle
- 3 large spice cans
- Something to hold animals: crab and clam
- 8-10 sit-upons (glorified plastic bags or a facsimile)
- 8-10 pocket scopes

#### Site Set-Up:

- Stake
- Stump or platform on which to set kitchen cabinet

Useful but not absolutely necessary: planks near the mudflats to view signs of life.



## Clancy's Estuary Garden

Upon finding the stake, the students soon realize that finding their instructions will prove a bit harder than usual. After a quick search proves fruitless, the group is met by a gardener.

"Did Clancy get hold of you guys to let you know what is happening?" the gardener asks. Looking at the confused group, the gardener continues, "Well, he said he left you a note somewhere around here. I think he said it would be near the stake." Suddenly someone notices that a note is scrawled on the back of the stake itself. It reads:

Welcome to the part of the estuary we call the Salt Marsh. Take a good look around at the grassy plants because what you are looking at is one of the three important sections of the estuary garden. I like to call it a garden that "takes care of itself." I like it that way because it means less work for me and more time for me to treasure hunt.

Today, you will become "Garden Inspectors" and help my assistant gardener check the garden. Unlike the gardens that you might know, this garden planted itself, weeds itself, fertilizes itself, and waters itself, yet it is full of food that feeds many animals. We can hardly believe all this is happening so we like to inspect it quite often; this is where your help is needed.

But before you go any farther, review your clues #2 and #4. These might be two of the "vegetables" in the estuary garden to be on the lookout for!

Good luck, Inspectors!

*Clancy*  
Clancy

Quickly the group shares clues #2 and #4. Then the gardener chimes in, "It's just like Clancy, deserting me when there is so much to do and so little time to do it. Well, at least he left us a note. We just can't believe this huge garden can take care of itself, so we keep inspecting it, trying to figure out how it all works so well. Maybe you guys can give us a few ideas."

"Here," the gardener says, hanging a hand lens around their necks. "You might be able to use these. Let's have a practice inspection first so you know how to operate these. I like to call them 'bigger-makers'." The gardener makes sure all eyes are watching as he demonstrates and then double-checks as they all focus on their finger. "You either go down to the object you are looking at or bring it up into focus near your eye." He has students practice focussing on their own finger, making sure the hand lens is right up to their noses.

"Clancy said you would want to check out the garden pretty closely, so he wrote an inspection sheet. Here it is, all set-up on a clipboard. I'll hold on to it for a while. But as you can see, we've got a lot to check off and only a few minutes to do it. We'd better get hopping!

"Let me explain, inspectors. Our garden is split into three main sections. You are standing in one of them now--the salt marsh section. This is where the

grassy-looking plants grow. Then we have a section where several special estuary plants grow in the mud. We call that the mudflat section of our estuary garden. And finally, we have an open water section where the tiniest of plants grow." Then he whispers to the group, "And that isn't all. A little later I might tell you about some 'bonus' areas that add food and fertilizer to our garden!"

"Well, our inspection sheet advises us to start with the tiniest plant because sometimes it's the forgotten vegetable of our garden. But I don't think you will forget this one. It's pretty amazing. It may be the tiniest, but this is the plant we have the most of in our estuary garden." The group walks over to a little shelter with a sign outside that says: "INSIDE: VEGETABLES FROM THE OPEN WATER SECTION OF OUR ESTUARY GARDEN."

"To speed up our inspection, Clancy has set out some of this mysterious vegetable, that is supposed to be so tiny. It is a very small group of plants called phytoplankton. While everyone takes a turn looking at it through a microscope, others of you can take a look at the thousands of phytoplankton here in this jar. And, here are some color photographs of these floating plants, over 1000 times their size."

Quickly the students look at the phytoplankton under the microscope with the help of the gardener. Questions are answered and blanks are filled in on the inspection sheet. Keeping up the fast pace, the gardener quickly hands out the different-colored cards with strings attached to them.

"Everyone go ahead and put the cards around your neck, with the picture facing out. You'll still be able to read the back," the gardener explains. "Will everyone who is a phytoplankton raise their hand? Anyone see what's happening here? How about color groups getting together." Pretty soon the students catch onto the concept of the food web interactions and line up accordingly; each color is a different set of interactions.

"So this famous garden vegetable is food for different animals around here. Let me record on our inspection sheet the information you came up with here." The interactions are recorded and repeated or acted out to the group.

Examples of interactions: 1) Plant plankton, which is eaten by a tiny animal plankton, which is eaten by a herring, which is eaten by a chinook salmon, which is eaten by a person. 2) Phytoplankton, which is eaten by an oyster, which is eaten by a person.

Before the group leaves the open water section of the garden, they pass the **BONUS EXHIBIT**. It displays other plants that the water brings into the other sections of the garden at high tide. "As if millions and millions of phytoplankton weren't enough, the open water also transports these 'rafts' of seaweeds into our garden. As they decay, these rafts of plant material provide homes and food for animals. They also 'fertilize' the garden as they decay, free of charge."

The group proceeds to the mudflat section of the estuary garden. It is situated at the edge of the salt marsh. Several different types of plants are displayed here, including an aquarium of eelgrass. The gardener says, "This estuary plant doesn't actually grow here, so Clancy brought it in to show us. It naturally grows out there on the bottoms and sides of the mudflat near the deeper channels of the open water." He points to their location. "Eelgrass is a very important plant because it is a great hiding place for all sorts of

living creatures. It is also a terrific home for other tiny plants, called diatoms. Instead of only floating around like most phytoplankton, these diatoms attach to places like this eelgrass blade. They literally 'coat' it. The eelgrass is also useful when it rots and decays; then it becomes fertilizer for other plants."

Along with looking into the aquarium and examining the eelgrass blades and roots, students are also invited to shake up a jar of decaying eelgrass. Information is recorded on the inspection sheet, and students move on to another BONUS EXHIBIT where two displays are set up.

One display shows tiny diatoms which grow on the mudflat. The other shows the two important seaweeds which grow on the mud: sea lettuce and enteromorpha. The gardener points out the importance of these plants in the estuary garden.

Quickly the food web interaction cards are distributed and reviewed. Examples may include the following:

- 1) Eel grass is coated with diatoms; the diatoms are eaten by pipefish; and pipefish is eaten by a heron.
- 2) Enteromorpha provides a hiding place for many tiny animals.
- 3) Sea lettuce is eaten by ducks, which are hunted and eaten by humans.
- 4) Mudflat diatoms are eaten by the bent-nose clam, which are eaten by the raccoon.

The inspection team keeps a fast pace and moves onto the last of the estuary garden sections. "We've been walking along this section all along. This is the salt marsh section of our garden. I see some of the garden markers are still standing. Let's see, what does Clancy's inspection sheet say to look for here? Hmm...."

"Here's an interesting vegetable in the salt marsh. It says to carefully look for (and feel) my edges. Is that on our checklist? OK, everybody feel for the edge of a sedge. Start at the bottom of the stem and carefully work your way up until you feel the edges. How many edges to the sedge? Sometimes this plant is known as 'cutgrass,' and if you feel the tops of their blades, you might find out why. Careful! Remember, sedges have edges."

The group covers the inspection sheet, finding both fresh and decaying samples of the sedge, rush, clumpgrass (tufted hairgrass), arrow grass, salt grass and finally pickleweed. The gardener makes sure the students inspect the salt grass leaf with their hand lens to see the little salt crystals. He also makes sure they have a chance to taste the pickleweed. Before the interactions cards are shared, the students are also invited to try and find evidence that the upland plants have added nutrients and fertilizers to the salt marsh. Then the gardener assists them in locating evidence of decaying leaves or needles from the uplands.

A sample interaction card is

- 1) Decaying salt grass is broken down into pieces which are coated by bacteria. The pieces are eaten by a clam which digests the bacteria and excretes the salt grass pieces. The clam is dug up by the human (who cooks it and adds it to chowder), and the salt grass piece is coated by bacteria again!

"Boy, oh boy, this place is sure amazing. What a garden; each section is full of life. Even the decaying and rotting 'vegetables' are used here."

Everything is being used, nothing is being wasted. Did we inspect everything Clancy set out for us to do? This certainly is a rich place!"

"Well, we better see if anyone cracked our two clues. Of course the students remember the infamous pickleweed (#2) and the tiny floating plant, the phytoplankton (#4). Everyone writes the correct answers in his Treasure Book and adds his favorite wildlife signs to the appropriate pages. The gardener thanks the students for all their help, assures them that Clancy will want to see their results (so he'll keep the inspection sheet), and sends them on their way.

"Clancy will send the inspection sheet back to your teacher when he's finished. Thanks again for all your help. I hope you'll be back again someday soon."

The group moves on.

### Answers and Clues

#2 - Pickleweed: My plump, green leaves help me live in the salt water. I was a cucumber for the early settlers.

#4 - Phytoplankton: I am the smallest plant in the estuary garden, but there is more of me than anything else.

### Props:

Gardeners outfit  
8-10 hand lenses  
Clipboard with inspection sheet and pencil  
(The inspection sheet lists things to observe and do at the salt marsh, mudflat, and open water section of the garden. It will be distributed during the activity.)  
Microscope or dissecting scope with petri dishes  
Prepared slides of phytoplankton  
Food web interaction cards (open water, mudflat and salt marsh sections)  
Jar of phytoplankton  
Bonus exhibit materials  
Aquarium of eelgrass  
Garden stakes for salt marsh plants  
Plankton net, if time allows  
Signs for the different estuary garden sections

### Site Set-up:

- Stake with Clancy's note scrawled on the back
- Shelter for the scope
- Signs for different sections of the estuary garden

Useful but not absolutely necessary: possible boardwalk through salt marsh.

## THE END OF THE TREASURE HUNT

Over about a ten-minute period, the groups straggle back to the Lookout. (The coordinator and assistants have made periodic checks on the Treasure Trails to make sure the timing is right.) As they return, they are told not to talk with the other groups yet about the clues.

When all the groups return, they are asked to assemble behind their flag and the coordinator begins again. "Well done, everybody. You are now very close to finding the treasure. But each group has only found the meaning of eight clues. You must have the meanings of all nine to find the treasure. Nine shells are needed and you have only eight. I'm going to read you a message that's in this envelope. After I finish reading it everyone in your group should secretly discuss what you think is the correct answer and await further instructions.

The message reads:

You have already been introduced to me at the World Travelers station. I'm a full-year resident at the South Slough. I fish its waters all year round and seek the trees of the uplands for my shelter. I fold my long neck back to my shoulder when I fly. After I sneak up or wait motionless for my prey, I use my beak as a spear to catch it.

Excited and eager to find the treasure, the students quickly and secretly share their ideas with their group members. Seconds later the coordinator adds, "Oh, here's another note: You have almost figured out the treasure. Just one more step to go.

"I hope that as you earn your last shell  
You experience much pleasure;  
The letters found within them all spell  
Where to find the treasure."

"Hmm, if your group thinks they know the answer to that last clue, send a representative forward to whisper it into my ear. They will return with some information and possibly your LAST SHELL. If your group is correct, I'll give you the shell for that clue and you should write the answer for Clue #1 in your Treasure Book. When everybody knows all the clues, we'll read the final note."

In a short time, the letters are lined up and the real treasure is spelled out: S-A-N-C-T-U-A-R-Y. After the students repeat together the treasure, the coordinator reads the parting remarks:

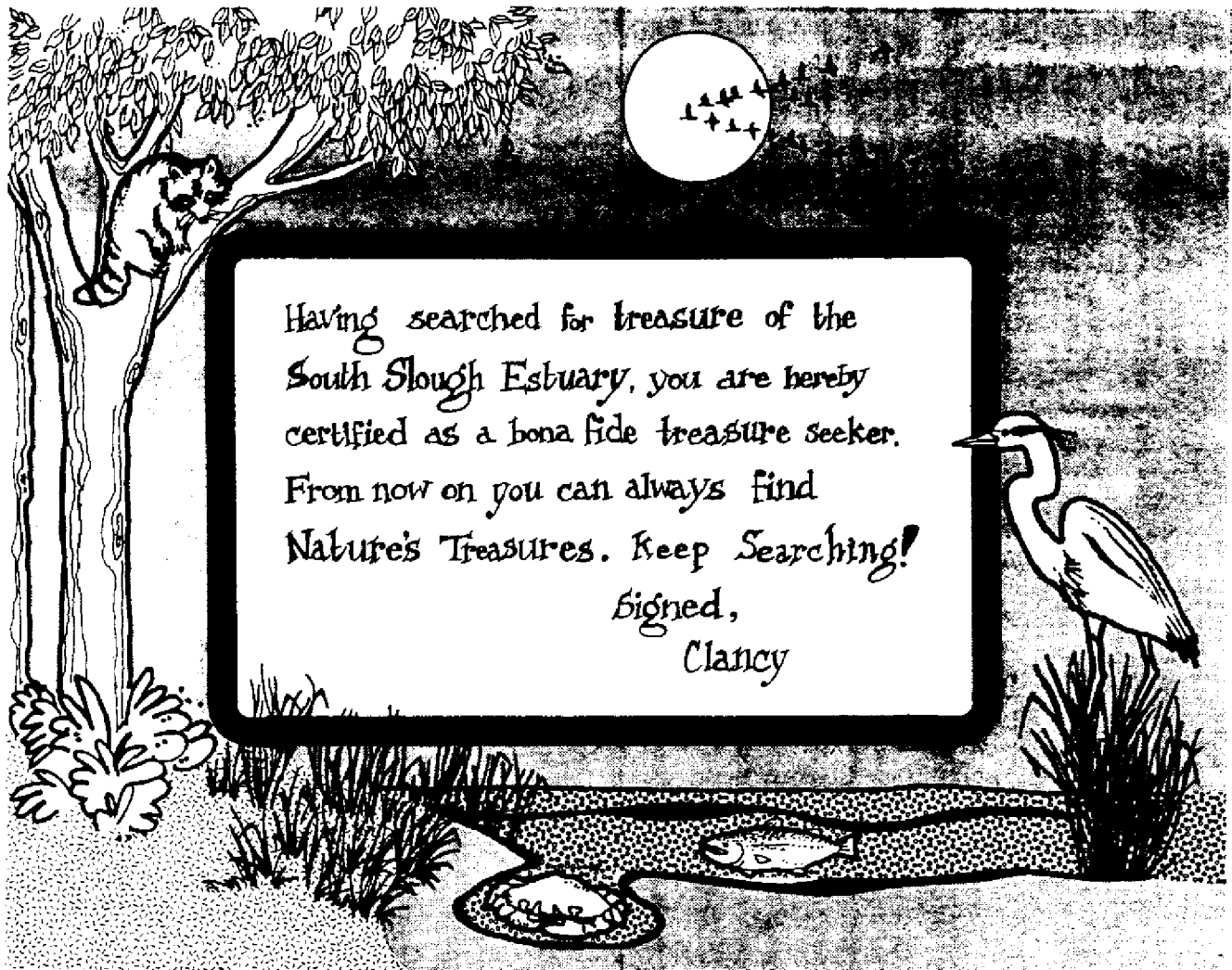
Congratulations! You have found the treasures. It has been around you the entire time. This sanctuary is a treasure to all the things that live and pass through it. The sanctuary and all its life are a treasure to people like you and me.

Always remember that and treasure and care for these kinds of places. To help you remember, I want you to have a certificate that congratulates you on your fine efforts in searching for the treasure.

Thank you for coming and bring a friend back and share the treasure with them soon.

Your friend,

Clancy  
Clancy



The coordinator reads their certificate to them out loud and if there is time, a quick review is given.

## A Quick Review

The coordinator quickly reviews the main features of the estuary. The four natural communities are again pointed out, but this time the activities the students engaged in at each of the zones are reviewed to reinforce their learning.

Then the closing remarks: "The plants and animals that live here are all very fortunate that this is a sanctuary. If it weren't, the upland forests might all be cut, and our friends the raccoons would have no place to live.

"All the salt marshes could be diked and filled in to make fields, as they once were, and there would be no salt marsh plants. Now you know that the estuary produces much more food than you ever thought.

"The water could become polluted and add poisons to our Estuary Soup, killing all the things in the mudflats that depend upon it.

"The open waters could all be dredged and too many log rafts, large boats, and barges could be allowed to come here. This could disturb the fish and waterfowl, and discourage our World Travelers from visiting us.

"The death of the estuary would mean no clams, no salmon, no oysters, no herring, and the loss of many other things that we eat all the time.

"The South Slough Estuarine Sanctuary really is a treasure to all of us. We are all very fortunate to have a sanctuary like this so close to home."

As the students walk down the steps of the Lookout, they are again congratulated by the programs staff for their fine work. Thank yous and goodbyes are exchanged. At first glance they saw muck and swamp. Now they know it is all really a treasure. As they head up the Timber Trail to the bus, several surprise banners from Clancy greet them to remind them of the "Treasures of the South Slough." It had been a good day.

THE  
FOLLOW-UP



These activities follow in a logical sequence from the events of the preparation and on-site components. You are, of course, invited to create your own activities; these are merely a starter. By the way, if you know of other activities that are helpful, please let the program coordinators know in writing so they may pass them on to other teachers.

### Classroom Sharing

When you return to the classroom, this sharing circle may be the most appropriate way to end the day. The students assemble in a circle and each recite and complete this line: "South Slough Estuary is a treasure to me because..." In this low-energy way, the students can share and reinforce what they have experienced.

Also on the day of the visit you may want to provide an opportunity for the students to share, in their own words, some of the things they've learned.

### More Clues

Here is a list of other plants and animals that live in and around South Slough. Have each student secretly choose one of them and find some information about that animal or plant. Then they may write a clue about their animal or plant. They may even put the clue in a code. The kids then trade clues, trying to decode the clue and identify the mystery plant or animal. Next, the decoded clues are read before the class. The class tries to figure out the identity of the subject in the clue. When the guesses are unsuccessful, the student that wrote the clue tells the answer and tells a bit about that plant or animal. (The students can choose a subject one day and have the clues created and coded a day or so later.)

### Possible Choices for Clues:

#### PLANTS

seaside arrowgrass	marsh clover	sedge
Sitka spruce	red alder	silverweed
mudflat diatoms	eelgrass	salt grass
seaweed like sea lettuce	clumpgrass or rushes	marsh dodder

#### ANIMALS

river otter	shrimp	deer
black bear	bay mussel	English sole
staghorn sculpin	coho salmon	cutthroat trout
limpet	snail	elk
coyote	black brant	harbor seal
muskrat	owl	mink
vole	coot	plover
killdeer	whimbrel	pintail
widgeon	zooplankton	ghost shrimp
starry flounder	mallard	kingfisher
pipefish	sand shrimp	

## South Slough Mural

Make a mural of the South Slough and post a small picture of the subject of each clue at the places where each lives. Shade the zones in different colors representing open water, mudflats, salt marsh, and uplands. Students may also choose plants or animals from the above list and share with the class several facts about each before attaching their pictures to the mural.

## Migrator Investigators

Here is a partial list of some of the animals which migrate through the South Slough at various times of the year. Have the students make a large chart illustrating the Pacific Ocean and West Coast of North America. Each student chooses one fish or bird and draws the routes the migrator takes over the course of a year. Add different colored lines to the chart to trace the routes of animals which use the South Slough as a nursery. Keep track of all these "world travelers."

### Partial List of Migratory Birds and Fish

common loon	whimbrel	yellowthroat
arctic loon	willet	Wilson's warbler
horned grebe	dunlin	Swainson's thrush
western grebe	short-billed dowitcher	water pipit
pied-billed grebe	long-billed dowitcher	western tanager
green heron	western sandpiper	golden-crowned sparrow
black brant	sanderling	*****
American widgeon	red phalarope	
canvasback	northern phalarope	<u>NURSERY FISH</u>
greater scaup	parasitic jaeger	steelhead
common goldeneye	Bonaparte's gull	cutthroat
harlequin duck	caspian tern	coho
red-breasted merganser	common nighthawk	chinook salmon
turkey vulture	rufous hummingbird	striped bass
rough-legged hawk	western wood pewee	Pacific herring
osprey	olive-sided flycatcher	three spine stickleback
semipalmated plover	violet-green swallow	starry flounder
killdeer	tree swallow	English sole
black-bellied plover	barn swallow	Dungeness crab
surfbird	warbling vireo	

## Real Pickles

Here is a recipe for making real pickles from pickleweed, similar to how the settlers once did. You or some of the parents can prepare them and bring them to class one day for a sample.

This recipe can be found in Euell Gibbons' Stalking the Blue-Eyed Scallop.

Wash pickleweed and pack into pint jars with stems straight and vertical.  
Make a pickling solution of:

1 qt. vinegar	1 sliced onion
1/2 cup sugar	6 dried bayberry leaves
3 T. mixed pickling spices	

Boil together 10 minutes then pour boiling hot over pickleweed until the jars are level full. Seal and store for 3 weeks before opening.

### Group Report Topics

Your class can break into groups to research and present simple topics of concern about the estuary. You will probably have to help locate resource materials.

Suggested topics:

- How to Farm Oysters
- How to Collect Shrimp
- How to Dig Clams
- How to Catch Crabs
- Where Other Oregon Estuaries are Located
- Where Other National Estuaries are Located  
(South Slough was the first!)

### The Estuary and People

- 1) List on a blackboard or chart all the ways that estuaries are important to people.
- 2) Try to find things you eat in your daily life that are somehow connected to an estuary.
- 3) Agar, alginate, and carageenan are seaweed-derived ingredients found in some of our common processed foods. Research the fine print on food packages in your home to see if you can discover foods containing these ingredients.

### Estuary Investigation

Trace your local watershed to the ocean. What estuary would it include?  
Investigate your closest estuary.

### Individual Writing Assignments

How is the estuary like (or different from):

- a forest
- a lake
- an ocean
- a desert
- an old growth stand

## Creative Writing

Use these titles and story starter ideas, or others, to spark story or poetry writing.

"A Day in the Life of..." (Harold Heron, Russell Mussel, or another creature you encountered during your visit)

"Sounds and Smells of the South Slough"

"The Mystery of the South Slough" (The mystery might be solved by cracking a code or following a treasure map.)

Three South Slough animal residents take a field trip to visit your class at your school. Describe their day.

## Films

You may wish to look for these and other estuary films at your County Education Service District or local School District Film Library. Be sure to check for appropriate audience designation and to preview your films. If a film is too technical, you may want to show only part of it.

Bay of Fundy

Estuary: Columbia's Link with the Sea

Ecology of a Tidal Slough

## Other Places to Look for Appropriate Films:

Film Title:

Mailing Address:

Estuary

Modern Talking Pictures  
5000 Park Street North  
St. Petersburg, FL 33709  
(813) 541-5763

Estuary: Columbia's Link  
with the Sea

Your coastal county marine extension  
agent's office (if in Oregon), or the  
Portland State Film Library  
P.O. Box 1383  
Portland, OR 97207  
(503) 229-4890  
rental fee--\$5

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### Additional Resources

At the present time, there are very few west coast oriented estuary audiovisuals, especially at an elementary level. Three persons who could keep you posted on the latest material would be:

<u>Title</u>	<u>Address</u>
Education Specialist	Oregon State University Marine Science Center Newport, OR 97365
Information and Education Specialist	National Oceanic and Atmospheric Administration 11400 Rockville Pike Rockville, MD 20852
Education Specialist	South Slough Estuarine Sanctuary P.O. Box 5417 Charleston, OR 97420 (503) 888-9015