



## Student Reading—1

### Activity 1: Observing Estuaries

An estuary is a partially enclosed body of water, and its surrounding coastal habitats, where saltwater from the ocean mixes with fresh water from rivers, streams, or groundwater. In fresh water, the concentration of salts, or salinity, is nearly zero. The salinity of water in the ocean averages about 35 parts per thousand (ppt). The mixture of seawater and fresh water in estuaries is called brackish water.

Estuaries are transitional areas that connect the land and the sea, as well as freshwater and saltwater habitats. The daily tides (the regular rise and fall of the sea's surface) are a major influence on many of these dynamic environments. Most areas of the Earth experience two high and two low tides each day. Some areas, like the Gulf of Mexico, have only one high and one low tide each day. The tidal pattern in an estuary depends on its geographic location, the shape of the coastline and ocean floor, the depth of the water, local winds, and any restrictions to water flow. For example, tides at the end of a long, narrow inlet might be heightened because a large volume of water is being forced into a very small space. However, the change in sea level for tides in wetlands composed of broad mud flats might appear to be rather small.

While strongly affected by tides and tidal cycles, many estuaries are protected from the full force of ocean waves, winds, and storms by reefs, barrier islands, or fingers of land, mud, or sand that surround them. The characteristics of each estuary depend upon the local climate, freshwater input, tidal patterns, and currents. Truly, no two estuaries are the same.

Landforms that occur on or near the coast are shaped by wave and wind erosion and glacial transport. Headlands are composed of the very hard rock left behind as

softer rocks are eroded away by relentless wave action occurring over thousands of years. In contrast, sand bars, spits, and even entire beaches can form, or be completely obliterated, in a single severe storm. Estuary features such as salt marshes, bayous, and mangrove forests form in the areas protected by barrier beaches, islands, and strips of coastal land.

Besides the constant erosional forces of water and wind, coastal landforms and features are influenced by other large, long-term geologic events. Glaciers retreating during the last ice age sculpted the northeast coastline of the United States. One look at the peninsulas of Maine clearly shows the direction of retreat of the mile-thick ice sheets. Only the hardest rock was left behind to form the islands and the peninsulas of the coast. During this period, the entire bulk of Long Island was left behind by the forward edge of a massive glacier, deposited like a load of dirt from a huge dump truck. Long Island Sound formed in the gouge behind the rubble.

In this activity, you will explore how landforms and features change as you travel from the interior of our country to the place where rivers empty into the sea—estuaries. Then, you will explore coastal regions from above using Google Earth or other resources to identify landforms and features associated with estuarine and coastal environments.





## Student Reading—2

### Activity 1: Introduction to Weeks Bay NERR

The Weeks Bay National Estuarine Research Reserve (NERR) includes over 6,000 acres of coastal wetlands that provide rich and diverse habitats for a variety of fish, crustaceans and shellfish, as well as many unique and rare plants. Weeks Bay is a small estuary, about 8 km<sup>2</sup>, receiving freshwater from the Magnolia and Fish rivers, and draining a 500 km<sup>2</sup> watershed into the lower portion of Mobile Bay. This sub-estuary of Mobile Bay averages just 1.5 meters in depth and is fringed with salt marshes dominated by black needle rush and cordgrass, as well as extensive swamps with pine, oak, magnolia, maple, cypress, bayberry, and tupelo trees.

The Weeks Bay ecosystem contains many freshwater and marine fish and invertebrate species. Collectively, these species support large commercial and recreational fishing industries. Weeks Bay is especially a critical nursery for shrimp, bay anchovy, blue crab and multitudes of other fish, crustaceans and

shellfish. The Reserve lands also include upland and bottomland hardwood forests, freshwater marsh, submerged aquatic vegetation, and unique bog habitats. Many of these areas are especially important to the large number of trans-Gulf migratory birds as a resting and feeding area.

Additionally, the Weeks Bay NERR is home to many threatened or endangered species, including the West Indian manatee, eastern fox squirrel, red-cockaded woodpecker, wood stork, Alabama red-bellied turtle, gopher tortoise, and Alabama sturgeon.

Although the Reserve is relatively undisturbed, increasing development pressure and population growth within areas of the Weeks Bay watershed has resulted in increasing sources of pollution. These include storm water runoff from parking lots, industrial sites, leaking septic tanks, and landfills, as well as, agricultural runoff. Input of excessive nutrients and sediments from this runoff can have detrimental affects on estuary life including reduction in submerged aquatic vegetation, increase in algal blooms which cause fish kills, and accumulation of toxic substances within shellfish.

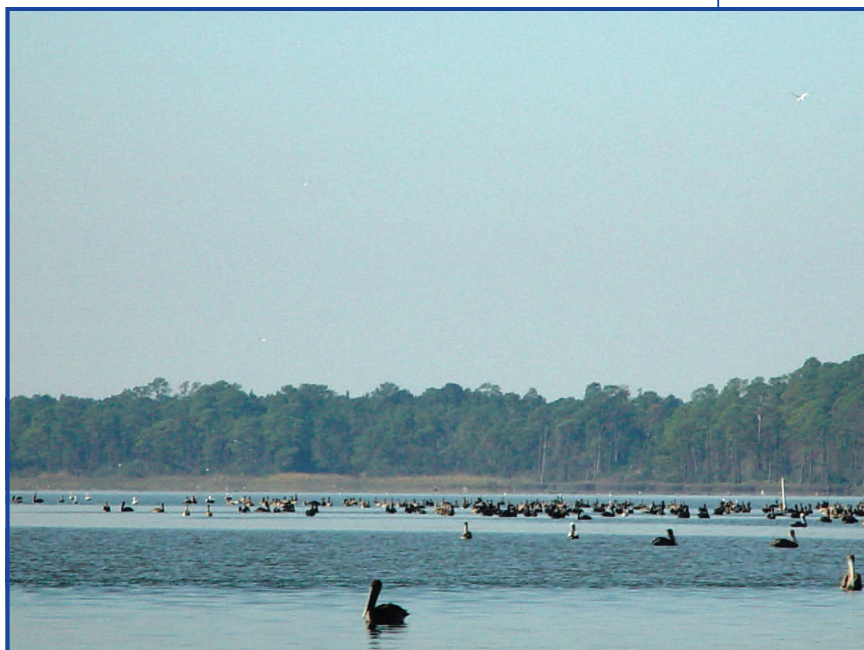


Figure 1. Weeks Bay NERR is home to many species of plants and animals.

## Location of Weeks Bay Reserve



Figure 2.  
Location of Weeks Bay Reserve





## Student Worksheet - 1

### Activity 1: Observing Estuaries

Student Name: \_\_\_\_\_

#### Part 1 — What is an Estuary?

1. Use a blank piece of paper to sketch what you think an estuary looks like.

#### Part 2 — A Trip Down the Alabama River

Take an aerial tour of a section of the Alabama River in Alabama, following the river's course from a point in the south-central portion of the state, through to Mobile Bay where it empties into the Gulf of Mexico. To begin:

1. Open Google Earth
2. Click on the *Fly To* button, and enter these coordinates (31° 08' 53.46 N, 87° 56' 56.46 W).
3. Under the Layers menu, click on Terrain, Geographic Web, Places of Interest, and Roads

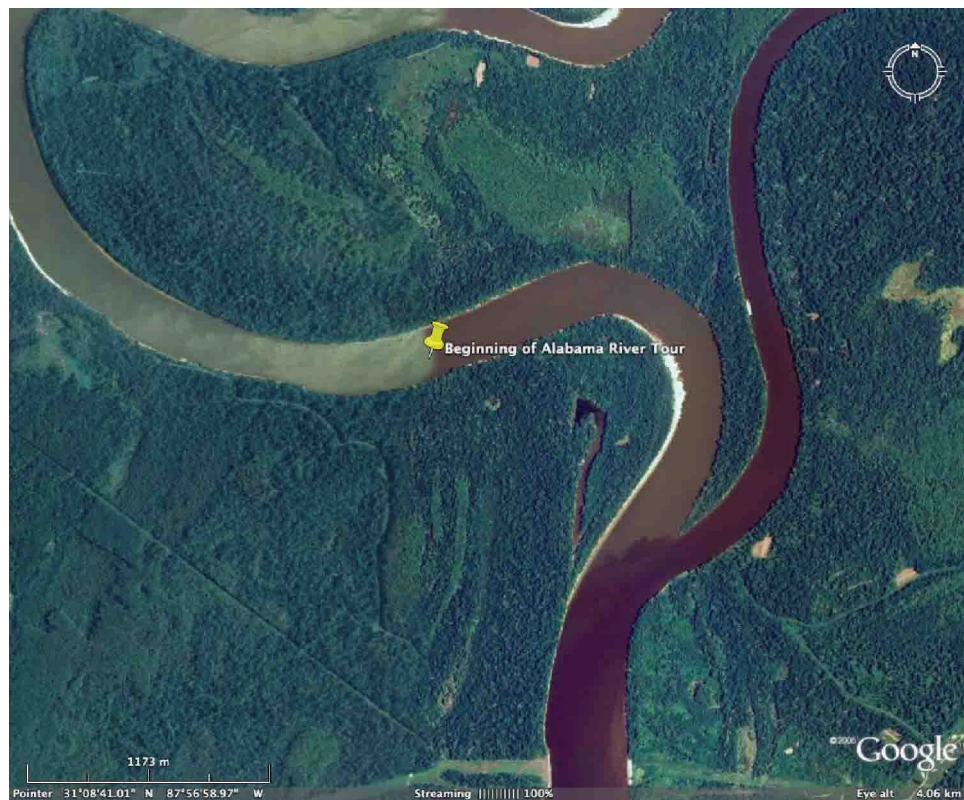


Figure 3.  
The Alabama River in Alabama—the starting point for your tour.

2a. Use the vertical slider in the upper right-hand corner of the screen to zoom towards the river. What kinds of land and terrain border the river? Use the navigation buttons to survey the area. Can you locate farms or other signs of human habitation or industry?

2b. Use the slider in the upper right-hand corner of the image to set your viewing altitude at 4 kilometers (2.4 miles). For the rest of your journey, zoom back to this altitude before moving further downriver. As you travel downriver, what signs of human interaction with the river (industry, towns, ships, etc.) do you see?

2c. When you reach a fork in the river, take the left channel. When you reach Whitehouse Bend ( $31^{\circ} 00' 07.06$ ) on the river, you will see a large brown feature. Zoom in and explore this region. What do you think this feature is?

2d. After you cross highway I-65, you will see two large areas on both sides of the river. Zoom in and zoom out to explore this area. Can you identify what type of terrain these areas are?

2e. Follow the river to Twelve Mile Island. How do you think this island formed? What kind of terrain surrounds the island?

2f. When you reach Bear Creek, a channel of the Alabama River empties into a larger body of water. What is it?



- 2g. When you arrive at Blakely Island Reach in Mobile, Alabama, how has the terrain on both rivers changed?
- 2h. Center the river and fly south until you see Gaillard Island. Find latitude  $30^{\circ} 30' 31''$  (on the right shoreline of the island) and zoom in. Describe what you see.
- 2i. Move back to 4 km of altitude, and fly directly south from Gaillard Island to Mobile Point. Zoom in and describe the terrain you see.
- 2j. Now fly east and explore the region to the north of the beach area beginning with Navy Cove. Describe the types of features and terrain you find there.
- 2k. Now fly directly north across the bay until you reach **Weeks Bay National Estuarine Research Reserve**. Can you identify a sediment plume at the mouth of the bay? Identify other features in the neighborhood of the estuary reserve.





Figure 4. The end point of your Alabama River trip in the Weeks Bay NERR

2l. In your journey, you traveled from an upland region to an estuarine environment (Mobile Bay) to a coastal area. In general, how did the types of terrain change in each region as you made your way downriver?

2m. How does the water change as you move down the river? What evidence can you give for any changes you see?

2n. Describe how different human activities affect the nature of the river and the terrain on both sides of it.

## Part 3 — Estuary Landforms and Features Scavenger Hunt

View the *Estuary Landforms and Features* PowerPoint presentation and take notes about the various structures and features.

Using Google Earth, explore regions of coastline and find as many landforms and features as you can on the *Student Worksheet — Scavenger Hunt*.

Your teacher may start you in a particular coastal region. You may then “fly” to other coastal areas and search for missing landforms and features if time allows.

Exchange your list with another team and check that team’s results by flying to each location they recorded to verify whether the landforms and features have been correctly identified.

3a. Which landforms and features were easiest to find?

3b. Which landforms and features were the most difficult to find?







## Student Worksheet - 2

### Activity 1: Scavenger Hunt

Team Member Names: \_\_\_\_\_

\_\_\_\_\_

When you identify a landform or feature in Google Earth, give the name if provided, and the exact coordinates (latitude and longitude). NOTE: You may not find all landforms and features in a particular stretch of coastline or estuarine region.

Landform	Name/Location (latitude and longitude)
barrier beach	_____
bay	_____
bayou	_____
cove	_____
delta	_____
harbor	_____
headland	_____
lagoon	_____
mangrove forest	_____
peninsula	_____
slough	_____
sound	_____
reef	_____
salt marsh	_____
tidal or mud flats	_____

