The Land the Mississippi River Built

Research Questions

1. **What is a river system?**
2. **How did the Mississippi River create Louisiana's coastal wetlands?**
3. **How do rivers interact with Earth's systems?**
4. **Why are Louisiana's coastal wetlands disappearing?**

What comes to mind when you think of Louisiana? Perhaps it's New Orleans or jazz. Maybe it's hurricanes or Cajun cooking, or even alligators! One of Louisiana's unique features is its location right on the Gulf of Mexico, at the mouth of the Mississippi River. This makes Louisiana a very important place.

Southern Louisiana contains about 40 percent of the total coastal marshland in the **contiguous** United States (not including Alaska and Hawaii)! These wetlands provide critical wildlife habitat, food, recreation, and fuel to the whole country.

What Is Found in Coastal Louisiana?

Resource	Percentage of U.S. Total
Fish Catch	28
Shrimp and Oysters	35 to 40
Oil	20
Natural Gas	25
Wintering Ducks and Geese	20

A shrimp boat trawls Louisiana's coastal waters.

Today, Louisiana is losing its wetlands at an alarming rate. About every 30 minutes, a piece of land the size of a football field is lost to the sea! Is there anything we can do? JASON host researchers Rachel Sweeney and Denise Reed think there is. Rachel Sweeney uses aerial images and other tools to track disappearing wetlands. Denise Reed works in the field, sometimes knee-deep in mud, to identify the factors that lead to wetland loss.

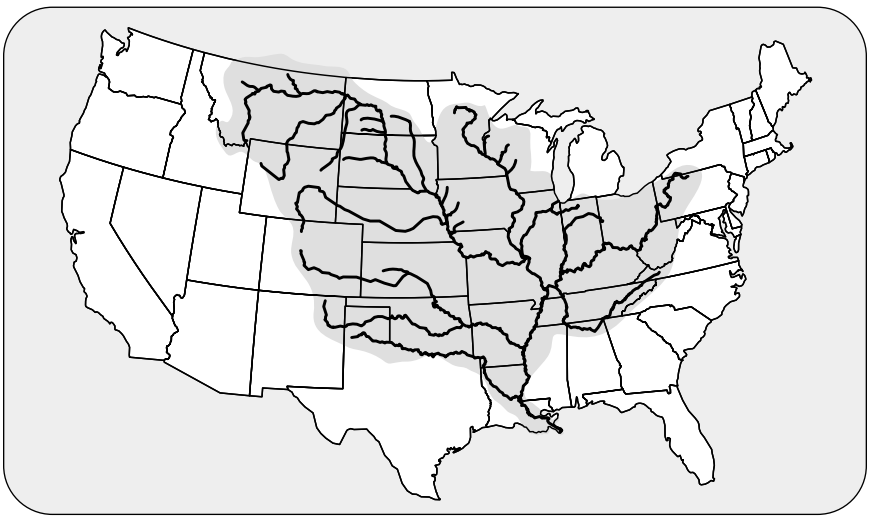
How were Louisiana's coastal wetlands formed and why are they disappearing? It all begins with the mighty Mississippi River.

1 What is a river system?

The Mississippi River is a part of one of the largest **river systems** in the world. A river system includes all the waters feeding into the main river, or the river **stem**, and all the waters branching out from it. **Tributaries** (TRIB you TAIR eez) flow into the river stem, and **distributaries** (DIS trib you TAIR eez) flow away from it. In the Mississippi River system, the Ohio River is a tributary and the Atchafalaya (Atch a fa LAY a) River is a distributary. The map on page 10 shows the Mississippi River system in Louisiana.

The Mississippi River is the fifth longest river in the world. Only the Missouri, Nile, Amazon, and Yangtze rivers are longer. The Mississippi River's waters begin their journey 450 m (1,475 ft) above **sea level** in Lake Itasca in northern Minnesota. From these headwaters, or **source**, the river winds its way through 10 states. The waters end their journey 4,107 km (2,552 mi) later, flowing through Louisiana to the river's **mouth**, or end, in the Gulf of Mexico.

The land area that a river system drains is called a **drainage basin**, or **watershed**. The watershed of the Mississippi River system drains over 1.6 million km^2 (1 million mi^2). It includes 31 states and 2 Canadian provinces. That's a lot of water entering the river! On average, over the course of a year, more than 152,400 m^3 (5,000,000 ft^3) of water pours from the Mississippi's mouth into the Gulf of Mexico every second!



The Mississippi River watershed drains about 40 percent of the continental United States.

FACT OR Fallacy?

It would take many years for a raindrop falling into the source of the Mississippi River to reach the Gulf of Mexico.

Fallacy: A raindrop falling into Lake Itasca would arrive at the Gulf of Mexico in about 90 days.

LINK TO...

You can learn more about watersheds by visiting the **Field Research Digital Lab** on Team JASON Online at *www.jason.org* and reading the article, "Waters Around the World: Oceans, Watersheds, and Your Local Aquatic Site." Not sure if you are registered on Team JASON Online? Check with your teacher.

STOP & EXPLORE

Get ready for the Expedition! Take the first step toward understanding wetland formation by exploring how water and soil interact. Turn to the Hypothesis-based Learning Activity, Let's Settle This! on page 28 to begin.

ADD TO YOUR Journal

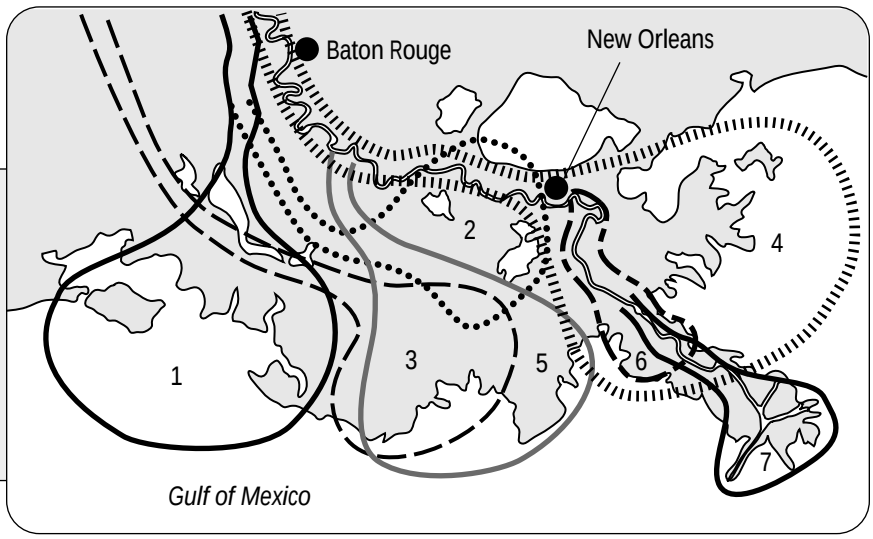
Think about a river system in your area. Using maps, personal observation, and memory, draw a diagram in your JASON Journal. Show the parts of the river. Write what you know about the river's source, mouth, and history.

2 How did the Mississippi River create Louisiana's coastal wetlands?

Water is not the only thing the Mississippi River delivers to the Gulf of Mexico. Natural river systems collect everything that runs off the surrounding land, including rocks, soils, plants, and even pesticides and other pollutants. The force of the river carries these materials away and sweeps the **sediment** (SED i ment), which is composed mostly of clay, silt, and fine sand, along in the river's path.

In natural river systems, most of the sediment is carried to the river's mouth. There, it settles to the bottom in a process called **deposition** (DEP o ZI shin). During **floods**, when a river overflows its banks, some sediment is deposited over the adjacent land, or **floodplain.**

Newly deposited sediment contains a lot of water. Over time, this excess water is squeezed out by the pressure of more sediment being deposited on top. The sediments compact and sink. This is called **subsidence** (sub SI dinse). If new sediment is deposited at a faster rate than old sediment subsides, the thickness of sediment increases overall and new land appears. Plants take root as soon as the sediment builds up to the water level, establishing a coastal marsh. New land that is built at the river's mouth is called a **delta** (DEL ta).



7,000 Years of Deltas

1. Sale/Cypremort
2. Cocodrie
3. Teche
4. Bernard
5. Lafourche
6. Plaquemine
7. Balize/Birdsfoot

Over 7,000 years, a series of deltas formed coastal Louisiana.

The river continues to build this new land. Over time, the river also grows in length. Eventually, the river finds a more efficient route to the ocean and begins building a new delta. Then, the process of deposition, subsidence, and delta formation begins again. When a river starts to build a new delta, the old delta slowly sinks and erodes away.

This is the process by which the Mississippi River formed southern Louisiana. Over the last 7,000 years, the Mississippi River has formed seven distinct deltas. These deltas are what is now coastal Louisiana. The modern mouth of the Mississippi River is called the Balize or Birdsfoot delta. Louisiana's coastal wetlands spread over a huge expanse—almost 1.5 million hectares (3.7 million acres) along the Gulf of Mexico and inland.

Today, deposition by the Mississippi River is no longer building Louisiana's land at the rate it once did. Instead, for the last 100 years, Louisiana's coastal land area has been shrinking! How do we know? For people living and working along the coast, the changes are obvious. Areas that once were wetlands are becoming open water. For managers such as Rachel Sweeney, aerial photographs and satellite images provide a big picture of land loss and a way to monitor changes over time.

This is a clear sign of Louisiana's land loss!

STOP & EXPLORE **Now it's time to investigate wetland loss more closely. Join Rachel Sweeney as she monitors land change in coastal Louisiana. Turn to Activity 1.1, A Bird's-Eye View of Land Change, on page 31.**

LINK TO... Pictures taken by **NASA's** Mars Global Surveyor show what looks like a fan of sediment deposits on the red planet. Scientists believe this could indicate where an ancient river once flowed. To see these images and more, go to *www.jason.org*, log onto Team JASON Online, and click on **Resources.**

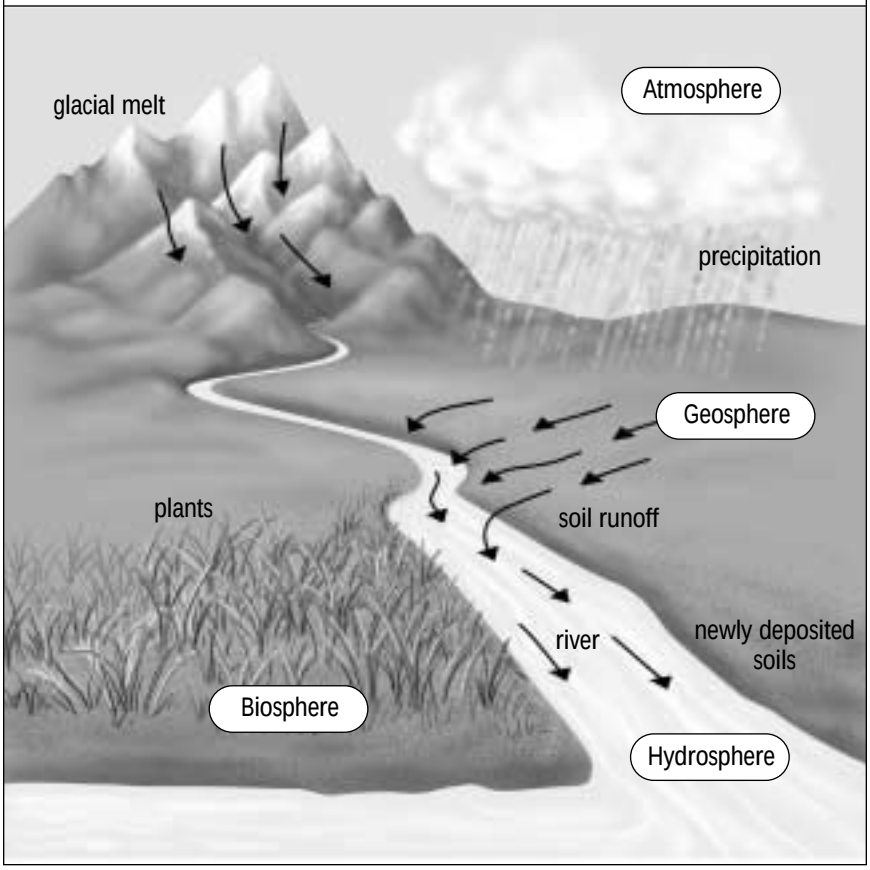
3 How do rivers interact with Earth's systems?

Think about the rivers you've seen and what you've just learned about how rivers build land. Rivers are great connectors of Earth's systems. They transport water from Earth's **hydrosphere** (HI dro SFEER), which contains all its liquid and frozen water, and sediment from Earth's **geosphere** (GEE o SFEER), or land area. Rivers are also closely connected with the **atmosphere** (AT mo SFEER), the envelope of gases surrounding Earth, and the **biosphere** (BI o SFEER), the part of Earth in which life exists.

FACT OR Fallacy? **One of the best protections against a hurricane is a healthy marsh.**

Fact: Scientists have found that healthy marshes usually recover relatively quickly from hurricane damage. Coastal marshes also help absorb the impacts of water from high waves and heavy rains. This "buffering" helps protect inland areas.

How Rivers Interact with Earth's Systems



"One of the main problems our marshes are having is 'keeping their heads above water.' In some areas the land is sinking very rapidly due to subsidence, and in other places the water flow through the marsh has been changed."

—Denise Reed

STOP & EXPLORE **To learn more about Earth's dynamic systems, try the Earth Systems Digital Lab. Click on the Digital Labs area of Team JASON Online.**

4 Why are Louisiana's coastal wetlands disappearing?

Now that you know how Louisiana's wetlands were created, it's time to look at some of the reasons why they're disappearing. Louisiana's wetlands have always been in a state of change, continuously losing and gaining land. Subsidence, wave action, and severe storms all affect wetland areas. Together, sea-level rise and subsidence can cause coastal areas to become submerged. Subsidence can also allow salt water to flow into freshwater areas—as the land sinks, salt water from the Gulf of Mexico moves in. Louisiana's wetlands range from freshwater, to **brackish**, a mix of fresh and salt water, to salt water. Changes in **salinity** (say LIN ih tee), or the amount of salt dissolved in water, can then kill freshwater

plants. If the vegetation in a marsh dies, the land is easily washed away.

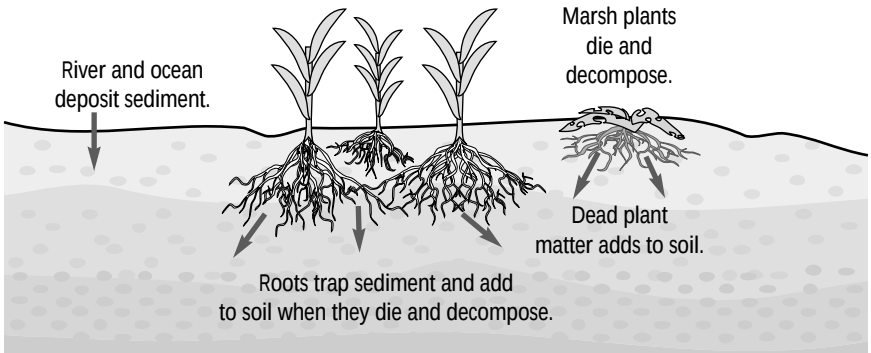
Severe storms can affect Louisiana's wetlands in several ways. They can tear up plants, wash away beaches, and flood freshwater marshes with salt water. Hurricanes can wear away barrier islands, which protect the coastal areas from pounding waves. Storms, however, can also bring in new sediment, which will build up soil and help keep wetland plants above rising sea levels.

As barrier islands become smaller, they provide less protection to the mainland coast.

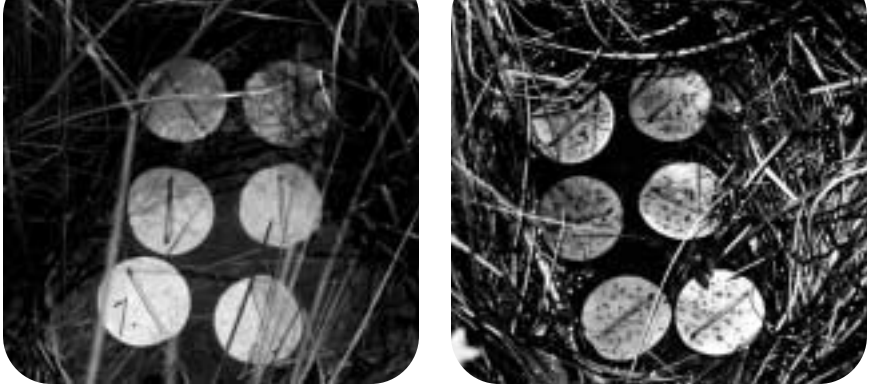
What is the role of marshes in land building?

In healthy wetlands, natural factors balance one another. Subsidence, sea-level rise, and even the action of severe storms are balanced by sediment deposition and the land-building processes of marshes. A healthy marsh contributes to land building in two ways. First, the stems, leaves, and stalks of wetland plants slow water down and trap sediment. This action gradually builds up the soil surface. Second, plant roots hold soil in place and slow **erosion** (ee RO zhin), the carrying away of weathered sediments and rocks by wind and water. Plant roots, stems, and leaves also add to soil material when they die and decompose. Even in winter, when many plants die back and dead leaves float away, strong root systems continue to hold land in place.

LINK TO... You can learn more about coastal wetlands by viewing **NOAA** maps of Louisiana's coastal watersheds and reading about wetlands across the United States. Go to *www.jason.org*, log onto Team JASON Online, and click on **Resources.**



How plants help build marshes.



Denise Reed uses sediment traps to measure sediment accumulation. The trap on the left has just been set. The trap on the right shows sediment that has accumulated over time.

"The control of the Mississippi River is forcing sediments into the deep waters off the Gulf of Mexico rather than allowing the sediment-laden water to circulate through Louisiana's wetlands and rebuild the barrier shorelines."

—Rachel Sweeney

In most of Louisiana's wetlands, however, the rate of land building is not keeping pace with the rate of subsidence and the effects of other natural and human factors. Why is this balance changing, and what is happening to the marshes as a result?

What effects have people had on the river system?

What has changed over the last 100 years is the human factor. When Europeans first settled along the Mississippi River, they tried to keep the river from flooding their farms and towns. At the same time, they wanted access to the river for transportation and fresh water. They built **levees** (LEH vees), raised banks along the river, to keep it from overflowing. Over time, continued human efforts to control the river dramatically changed its natural flow and flooding patterns.

Today, the Mississippi River's flow is still controlled. About two-thirds of the river is contained by levees. Because of these levees, the modern Mississippi can no longer overflow its banks naturally to deposit sediment and to build new land. Instead, the river funnels more than 2 billion kg (about 4 billion lbs) of sediment to the Gulf of Mexico every year.

Along the river's length, people have also built **dams,** barriers to prevent the downhill flow of water, and **locks**, gated enclosures used to raise or lower boats from level to level. As valuable as these structures are, they alter the river's flow and trap valuable sediment. Less sediment then flows down to the coast. Paving areas along the river has also decreased the amount of sediment entering it.

In addition, over the last 100 years, people have been pumping the oil and natural gas lying beneath Louisiana's wetlands. This has increased subsidence. To help remove and transport the oil and natural gas, people have built **canals** throughout the wetlands. Still other canals have been cut through the marshes for commercial and recreational boats.

LINK TO... Pull together all you've learned by manipulating natural and human forces. Go to *www.jason.org* and log onto Team JASON Online. Then click on **Digital Labs** and try the "Wetlands Perpetual Motion Machine." Can you find a balance?

These changes in wetland **hydrology** (hi DROL i gee), or the patterns of water flow in a system, had other effects as well. Canals have provided new pathways for salt water to invade freshwater marshes. As the salinity of the marshes has changed, many freshwater plants and animals have died because they cannot adapt to a saltwater environment. Without plants to hold the land in place, much of the land has washed away. These changes have also affected the ability of wetlands to protect inland areas from storms, floods, and especially hurricanes.

Is there hope for Louisiana's wetlands?

Can we turn back the tide of wetland loss? Rachel Sweeney and Denise Reed believe we can. Rachel Sweeney manages a variety of projects that support natural land-building forces. These projects depend on the work of researchers such as Denise Reed. Their data is used to design the projects and to measure their success. Some projects are short term and affect a relatively small area. Structures such as fences or rock walls are built to slow wave erosion and trap sediment. Sediment from the ocean floor is used to build up eroded beaches. Grasses are planted to hold soil in place.

Larger, long-term projects focus on restoring part of an area's original hydrology, so that river water can build land again. Agencies across the state are working together on projects to fill in canals and open levees. The goal of these projects is to allow sediment deposition to occur through a controlled process of natural flooding. With hard-working, dedicated people like Rachel Sweeney and Denise Reed on the job, coastal Louisiana may have a whole lot to gain!

Monitor your own patch of wetlands using the tools and data-gathering methods of Denise Reed. Turn to Activity 1.2, Monitoring the Marsh: A "Core" Issue, on page 37.

Fieldwork in Your Neighborhood

How does what you have learned about Louisiana's wetlands relate to water in your local area? Learn about the properties of water at a local site by doing the Fieldwork Activity, Testing for Density and Salinity, on page 41.

Continue exploring your local aquatic site by visiting the **Field Research Digital Lab** on Team JASON Online.

Did You Know...

Built in 1841, Fort Livingston on West Grand Terre Island was occupied by 300 men at the beginning of the Civil War. Since that time, erosion of West Grand Terre Island has brought the shoreline up to the fort's walls. Protecting this landmark is one of the goals of the East / West Grand Terre Islands Restoration Project.

ADD TO YOUR Journal

How are wetlands important to people in your area? In your JASON Journal, describe the important features of your local wetlands and compare them to the important features of Louisiana's wetlands. Create a public service announcement or poster explaining why people should take care of local wetlands.