Archaeology Activity: "Investigate a Shipwreck"

In this activity, students will use their investigative skills to learn about marine archaeology and explore a shipwreck.

What is marine archaeology?

Marine archaeology is the study of human history underwater. Marine archaeologists investigate areas that are partially or fully submerged in water by performing geophysical, geotechnical, or dive surveys. They look for cultural resources underwater that may include shipwrecks, artifacts, paleolandscapes (places where Native Americans may have lived thousands of years ago), or submerged structures. Samples of small cultural resources like glass, pottery, wood, or nails may be removed from a site and taken to a laboratory to help archaeologists learn more about the time period, uses, and people associated with the cultural materials. Samples may then be conserved and stored or displayed at a museum or cultural institution. Larger cultural resources like shipwrecks or submerged structures are generally left where they are found and evaluated for listing on the National Register of Historic Places.

When can an archaeological site be protected?

In the United States, historic sites are evaluated under a law called **the National Historic Preservation Act (NHPA)** of 1966. One important part of this law is called **Section 106**, which requires federal agencies to consider how their projects might affect historic places, including shipwrecks.

Sites are often evaluated for listing on the **National Register of Historic Places (NRHP)**, which is the official list of important historic places in the country.

To be considered for the National Register, a site must meet at least one of the following criteria:

- **Criterion A:** It is connected to important historical events.
  Example: Pearl Harbor National Memorial - associated with the attack on Pearl Harbor during World War II.
- **Criterion B:** It is associated with an important person in history.
  Example: Mount Vernon - home of George Washington
- **Criterion C:** It has a unique design, construction, or represents a specific type of technology.
  Example: Brooklyn Bridge - an important engineering achievement when built and represents a major advancement in bridge design.

- **Criterion D:** It can provide valuable information about the past [National Park Service 1985:5-6].

  Example: Jamestown Archaeological Site - Archaeologists study the site to learn about early English settlement in North America.

Shipwrecks and historic vessels are evaluated slightly differently than other historic places. According to guidance from the National Park Service (National Register Bulletin 20), a vessel's importance is based on:

- how well it represents a type of vessel (such as a steamship),
- how it is connected to important activities in history (such as trade or transportation), and
- how it compares to other similar vessels.

There are five main types of historic vessels that may be eligible for the National Register:

1. **Floating vessels:** ships that are still in the water and operational or preserved.
2. **Dry-berthed vessels:** ships that are out of the water and displayed on land.
3. **Small craft:** smaller boats such as skiffs or workboats
4. **Hulks:** partially intact vessels that are no longer afloat
5. **Shipwrecks:** vessels that are submerged or buried after sinking or running aground

These categories help archaeologists understand how a vessel should be studied and whether it is important enough to be protected. In addition to meeting one of the criteria, a site must also have **integrity**, meaning it still reflects its original characteristics and can accurately represent the past. The **seven aspects of integrity** are:

1. **Location:** the place where the site was originally located
2. **Design:** how the site or structure was arranged or built
3. **Setting:** the surrounding environment or landscape
4. **Materials:** the physical elements used to construct it
5. **Workmanship:** the way it was made or crafted
6. **Feeling:** whether it still gives a sense of the time period
7. **Association:** its connection to historical events or people

In addition, for a vessel, a determination of significance should establish one or more of the following three criteria:

1. whether or not the vessel is either the sole, good, or the best example of a particular vessel type
2. whether the vessel is associated with a significant designer, builder, or shipyard
3. if the vessel engaged in an important trade or activity, or is associated with specific events.

These findings are then submitted to the **State Historic Preservation Office (SHPO)** for evaluation before being sent to the National Park Service for final approval. Each state has its own organization that acts as its SHPO. In Texas, the **Texas Historical Commission (THC)** acts as the SHPO and administers the National Register program. Sites that are evaluated must also be considered during activities such as construction or development. Additionally, when a site is listed on the NRHP, it provides recognition, makes properties eligible for federal grants, and offers protection from certain federal actions.

How do marine archaeologists investigate?

Marine archaeologists use remote sensing tools to study a large area to look for things like shipwrecks, submerged structures, and Native American sites. They use marine geophysics to study the shape, structure, and materials of the seafloor without disturbing the sediment. This allows marine archaeologists to "see" underwater without diving or damaging anything that may be on or near the seafloor. The most common geophysical tools used by marine archaeologists are single or multibeam echosounders (to map the seafloor), magnetometers (to detect ferrous metal materials), side-scan sonars (to create images of the bottom), and subbottom profilers (to reconstruct the structure of the underlying sediment beds).

Bathymetric data can be collected using single-beam or multibeam echo sounder to measure precise depths throughout an area, similar to the way bats and dolphins use echolocation. A single-beam echosounder beams a pulse of sound to the seabed from a single sound cone (transducer). The beam hits the seafloor and the return signal is timed and analyzed to gather depth data. Similarly, a multibeam echo sounder emits a wide, fan-shaped sound wave to cover a larger area of the seafloor. The speed of sound in water can then be calculated to measure the depths and create a topographical map of the seafloor. This helps archaeologists measure how deep the water is and create a map of the seafloor. The data can be displayed using a multicolor scale where warmer colors, like red and orange, represent shallower areas and cooler colors like blue and green, represent deeper areas.

Magnetometers measure the intensity of magnetic forces with a sensor, similar to a giant metal detector. The sensor first measures and records the background (ambient) magnetic strength of an area as a base line in nanoteslas (nT), the standard unit of measurement for magnetic intensity. It then measures any significant differences (anomalies) in the base line magnetic field. Objects with iron (ferrous) create anomalies that can indicate shipwreck or other large metal objects are present. This helps archaeologists find buried metal objects like shipwrecks, anchors, or tools. Vessels made of ferrous metal like iron will have large magnetic signatures while wooden vessels will have very small magnetic signatures.

A side-scan sonar produces an acoustic (sound) image of the seabed, similar to the multibeam echo sounder and animals like bats and dolphins use echolocation. The side-scan sonar sends sounds in fan-shaped pulses. The sound reflects off the bottom and returns back to the side-scan sonar. The depth and shadow data collected can then be used to create a near-photographic representation of the bottom. The sonar beam cannot penetrate any physical barriers. A thin layer of sediment, sea grass, or even marine life could potentially hide artifacts. Although the sonar beams cannot pass through solid objects, they can record their shadows. This provides a three-dimensional quality to a two-dimensional survey. Shadows can represent the vertical relief of an object which can be measured to convey the shape and size of a target in great detail. This creates picture-like images of the seafloor so archaeologists can see objects and debris.

A subbottom profiler generates low-frequency sound pulses that are able to travel through the top layer of sand or sediment on the seabed. The sound pulses can then reflect off deeper sediment or larger objects below the surface. Different kinds of sediments reflect back at different speeds. This information can help archaeologists determine the characteristics of near-surface geologic features, like ancient rivers or paleolandscapes, over the survey area as well as if any large objects, such as shipwrecks are buried near the seabed. The data can be observed as a subsurface profile, where you can see the different layers beneath the water like if you were to cut a slice of seven-layer cake. This information can be used to determine the characteristics of near-surface geologic features over the survey area. This helps archaeologists see what is buried beneath the seafloor, like hidden shipwrecks or layers of sediment.

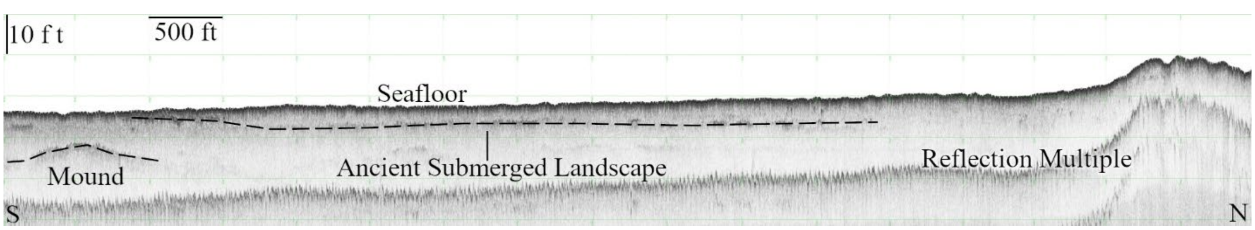


Figure 1. Example of subbottom data courtesy of Chronicle Heritage.

Once an underwater site is located, marine archaeologists need to ground truth. Ground-truthing can be performed using geotechnical techniques or divers. Ground-truthing is the process of physically verifying data collected from remote sensing by examining the ground directly. Marine geotechnical surveys are used to take samples of the seabed using different techniques such as seabed coring, drilling boreholes, and cone penetration testing (CPT) to analyze soil properties and stratigraphy. This can help marine archaeologists identify paleolandscapes or other sites.

Marine archaeologists can conduct dive surveys using Scuba or Surface Supplied Air. Dive surveys allow the archaeologist to see the site up close, take measurements by hand, and collect artifact samples. Scuba stands for self-contained underwater breathing apparatus. Scuba divers use a compressed air tank, regulator, mask, and fins that are attached to and self-managed by the individual diver. When performing dive surveys, divers explore in pairs or groups to provide support in case of emergency. Divers that utilize scuba have a fixed, often short amount of time they can stay under the water; however, they have a greater range of motion and more flexibility when diving.

Surface-Supplied Air (SSA) utilizes a special dive helmet connected to a floating surface-supplied umbilical comprised of an air hose and radio communications cable. On the surface, several individuals and pieces of equipment ensure safe diving operations for the single diver who is in the water. A dive tender is required to aid the diver in putting on and taking off equipment and to tend the diver while they are submerged and moving about the sea floor. The radio communications operator keeps constant contact with the diver, relaying messages between the diver and the surface support team. A standby diver is required on-site in the event of an emergency that would require aid to the primary diver. While using SSA, a diver can stay in the water significantly longer; however, movement is more difficult and the diver’s field of vision is smaller.

These tools help archaeologists locate and understand shipwrecks like the SS Mary before deciding how to study them.

Investigate your Shipwreck

A team of marine archaeologists has just completed a geophysical survey in Aransas Bay. They found three interesting targets that require further investigation.

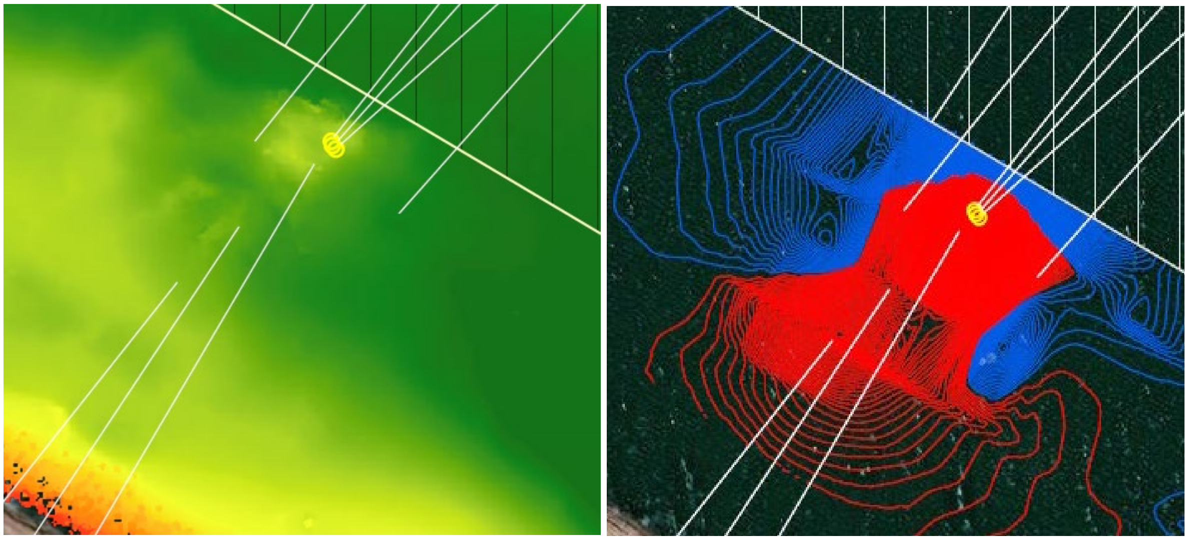


Figure 2. Actual geophysical images of the SS *Mary* captured by Burns et al 2023. Bathymetry image depicting differences in depths using a multicolor scale (left). Magnetometry image depicting a large magnetic signature which indicates a large ferrous metal object (right).

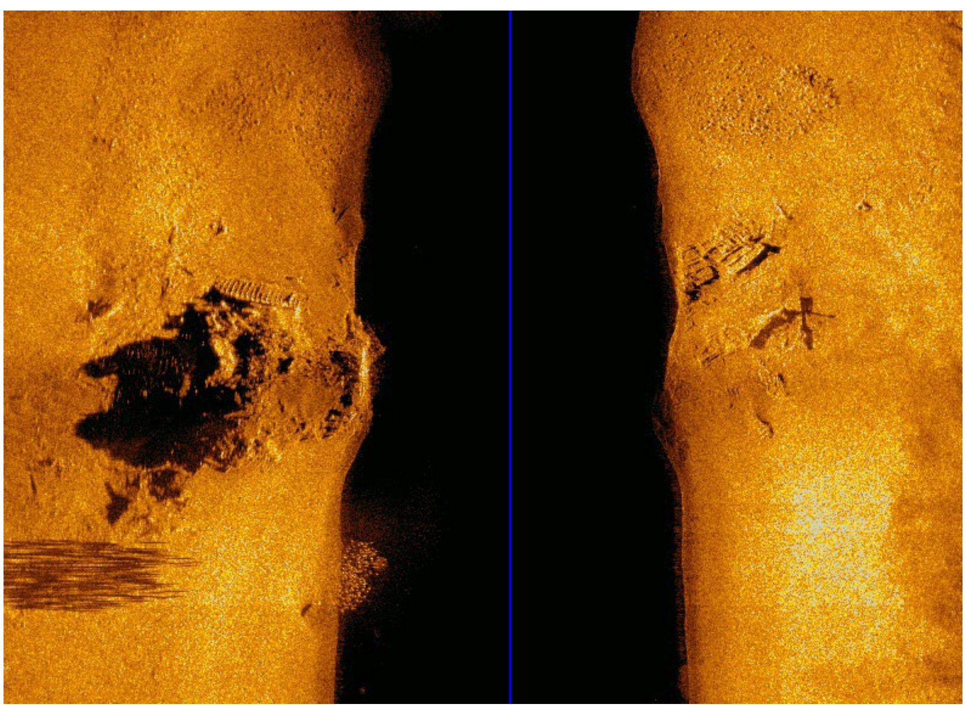


Figure 3. Actual geophysical image of the remains of the SS *Mary* captured by Burns et al 2023. Side Scan Sonar image depicting debris scatter consisting of parts of the SS *Mary*.

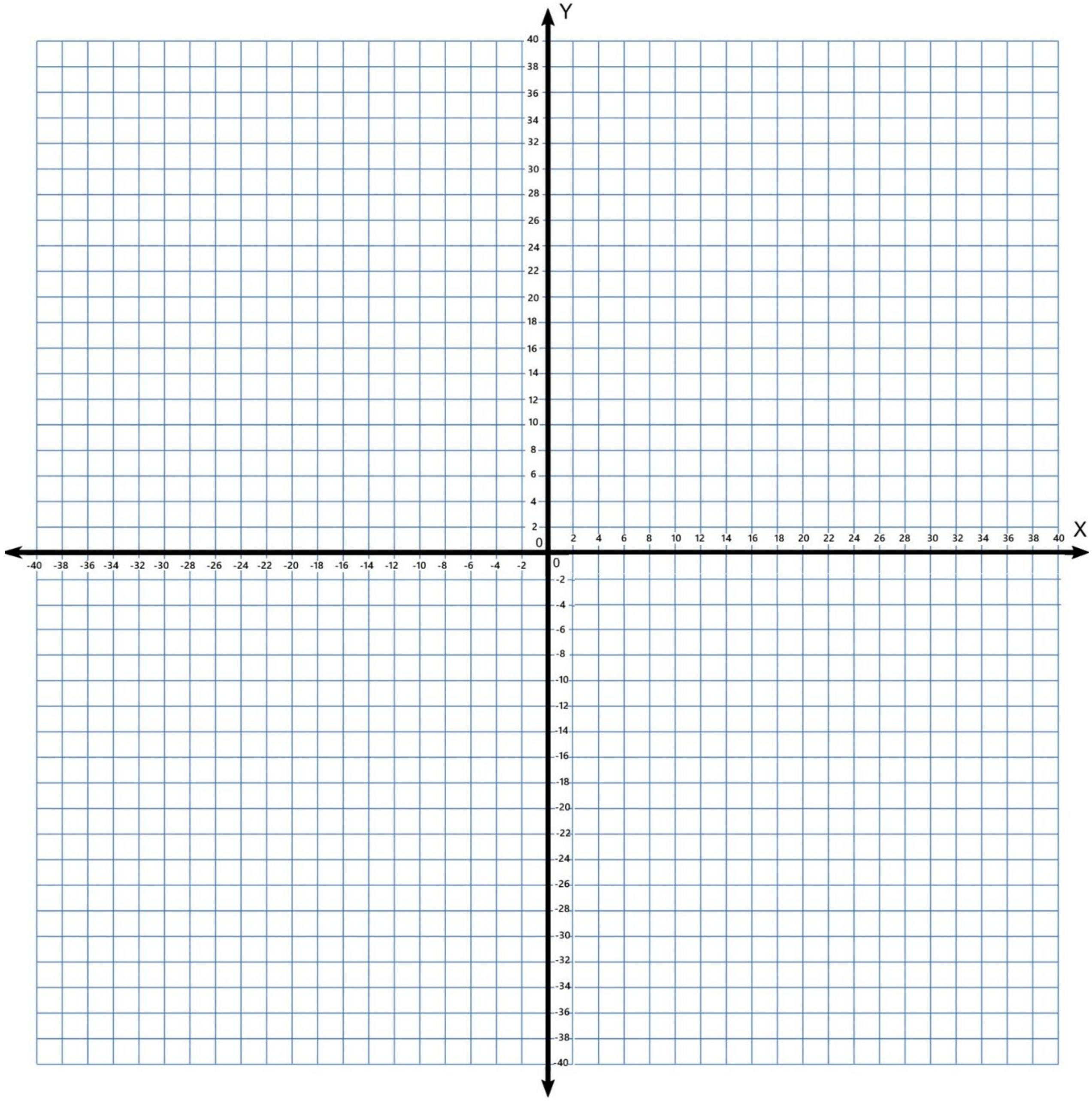
The team identifies three targets and decides to call in their expert diver (you) to investigate. Target 1 is the bow of the vessel. Target 2 appears to be the metal walking beam of a steamship. Target 3 appears to be a large wheel, possibly one of the sidewheels of a steamship. You and your team need to follow the instructions below to map the full extents of the targets.

Your mission: Map each target and determine the shape and features of the shipwreck.

Follow each step carefully. Plot each point on your graph as you go.

1. The survey vessel drops you off in Quadrant III at (-4,-8) where you find the starboard side of Target 1.
2. You follow the starboard side of the bow and swim west 10 feet. Place a point here.
3. Next, you swim west 8 feet and south 2 feet. Place a point here.
4. You swim another 6 feet west and 2 feet south. Here you find some scattered pieces of copper alloy. Take a sample and write down the coordinates.
5. Then you swim 4 feet west and 4 feet south. The end is in sight! Place a point here.
6. After swimming west 6 feet and south 2 feet you finally reach the end of the bow. Place a point here.
7. Now you change directions and start to follow the port side of the bow 6 feet west and 2 feet south. Place a point here.
8. You swim 4 more feet east and 2 more feet south. Here you find some scattered iron nuts, bolts, and nails. Take a sample and write down the coordinates.
9. Next, you swim 6 feet east and 1 foot south. Place a point here.
10. You swim 8 feet east and 1 foot south. You can see the end of the wreck. Place a point here and keep going!
11. After swimming 10 feet east, you reach the end of the wreck. You place a point here and start swimming north.
12. As you swim north, you start to see a weird black substance after 4 feet. This could be gun powder. Take a sample and write down those coordinates.
13. You swim another 6 feet north before something catches your eye. You find bullet fragments, bullets, and bullet casings! Take some samples and write down those coordinates.
14. After swimming north 6 feet, you end up back at (-4,-8), completing your investigation of Target 1. Connect the points to finish your dive drawing of the bow. Swim to (0, 24) to start your investigation on Target 2.

15. You follow the outside of the diamond shaped target 8 feet east and 4 feet north. Place a point here.
16. Next, you swim 8 feet west and 4 feet north. Here you find some iron pipe fragments. Take a sample and write down the coordinates.
17. You swim 4 feet north and 3 feet east before realizing the target is vertically symmetrical and centered on the y-axis. To complete the shape, you will use symmetry. Perform a reflection over the Y-axis to find the remaining two points.
    a. Remember a reflection or flip over y axis is (X, Y) -> (-X, Y)
18. Connect the outer points to create the diamond shape. Then, draw two Xs centered over (-3, 28) on the west side and (3, 28) on the east side to finish your dive drawing of the walking beam. Swim to (16,0) to start your investigation of Target 3.
19. You swim 2 feet east and 6 feet north. Place a point here.
20. You swim 8 feet east and 4 feet north. Here you find iron screws and iron fragments. Take a sample and write down those coordinates.
21. Next, you swim 8 feet east and 4 feet south. Place a point here.
22. Then you swim 2 feet east and 6 feet south. Here you find more screws and bolts. Take one last sample and write down the coordinates.
23. You swim 10 feet west back to the center point and conclude that the radius of each spoke of the paddlewheel is 10 ft. You also notice that the wheel is symmetrical and centered on the x-axis. Perform a reflection over the X-axis to find the remaining three points.
    a. Remember a reflection or flip over x axis is (X, Y) -> (X, -Y)
24. Connect the outer points around the circumference of the circle to create the paddlewheel. Then connect each outer point to the center to create the spokes and complete your investigation of Target 3.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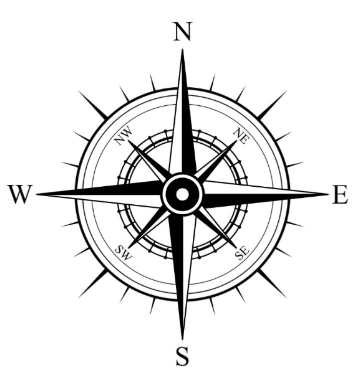
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Evaluate your Findings

Congratulations on your successful dive! Your survey resulted in the collection of 120 artifacts including copper alloy pipe fragments, bullets, gunpowder, iron bars, iron bolts, nails, nuts, pipes, bottles, doorknobs, glass, and screws. The artifacts are brought to the lab to be cleaned and analyzed. The lab team evaluates the materials and designs of the artifacts and estimates that they are from the mid to late 1800s.

The team now has geophysical images, artifacts, and your stellar dive drawing to study and assist in their next step: research. Now, the team must analyze the evidence and determine what shipwreck they have found. The team uses the survey information, old maps, primary sources, and research completed by other scientists and finds the following information. They believe the shipwreck may be the SS *Mary*.

Texas's maritime history is a vital yet often underrecognized part of the state's past. The Steamship *Mary* was a significant vessel in early Texas history, serving as part of the state's first organized steamship line. Through its regular service, the *SS Mary* helped establish dependable coastal transportation, facilitating the movement of people and goods and supporting economic growth along the Texas Gulf Coast.

The Steamship *Mary*, commissioned by Charles Morgan, was built between 1865–1866 at the Harlan and Hollingsworth Company shipyard in Wilmington, Delaware. The SS *Mary* was an iron-hulled sidewheel steamer typical of the coastal passenger and freight vessels that operated along the Gulf Coast in the late 19th century. Measuring just over 234 feet in length, with a beam of about 33 feet, the *Mary* combined an iron hull with largely wooden decks and superstructure, reflecting common shipbuilding practices of the era. After its construction, the SS *Mary* ran on the Morgan Line on coastal routes between New Orleans, Louisiana and Aransas Pass, Texas traveling between 5 and 10 miles per hour for ten years. Designed to carry both passengers and substantial cargo, the SS *Mary* could transport more than 1,000 tons when first launched. The vessel was enrolled at ports including Wilmington, Mobile, Brashear, and New Orleans, mirroring the regional nature of its service.

The SS *Mary* was lost at Aransas Pass on the morning of November 30, 1876, while carrying thirty crew members, eight passengers, two horses, and a valuable cargo of general freight including grain, flour, textiles, cotton, wagon parts, and bottles of medicine. After a difficult night steaming south from Morgan City, Louisiana, the iron-hulled sidewheeler encountered foul weather, a strong north wind, and a powerful outgoing current at dead low tide that created heavy, pounding surf across the sand bar. As conditions worsened, Captain John Benson decided to risk the high surf and treacherous channel rather than maintain his position and be beaten apart and swamped by the waves. During the attempt, the SS *Mary* struck a buoy which caused a tear in the hull. The SS *Mary* then ran aground on the outer bar and within 35 minutes had taken on water up to the upper decks, extinguishing all boiler fires. The vessel and the $75,000 in livestock and cargo were declared a total loss. In the days that followed, wreckage and cargo washed ashore on Mustang Island. Although no lives were lost, the sinking of the SS *Mary* underscored the hazards of 19th-century Gulf Coast navigation and the treacherous nature of Aransas Pass before the construction of jetties.

The sinking of the SS *Mary* in the Aransas Pass led to several marine projects geared towards increased safety in the area that drove industrial and population growth in the Aransas Pass area. In 1878 the government commissioned a Life Saving Station, a precursor of the Coast Guard, for Mustang Island. Additionally, Congress passed a resolution in 1879 authorizing the deepening of Aransas Pass; however, the project was undertaken by Samuel M. Mansfield from May of 1880 until it was deemed unsuccessful and aborted in 1885. The prospect of work and an improved port as well as the newly constructed San Antonio and Aransas Pass Railway in 1886, garnered a lot of attention for the budding port city. This led to the official incorporation of Port Aransas, located on the northern tip of Mustang Island, officially named on April 1, 1911, as well as the city of Aransas Pass, across Redfish Bay from Port Aransas, which was officially founded in 1909.

Use the research and survey results your team has uncovered to answer the following questions.

1. Based on the criteria above, what makes a shipwreck eligible for listing on the National Register of Historic Places?

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2. What other tools could you use to further investigate the shipwreck you found? Explain how they would help.

3. What kind of ship do you think you found? What parts, artifacts, or targets support your findings?

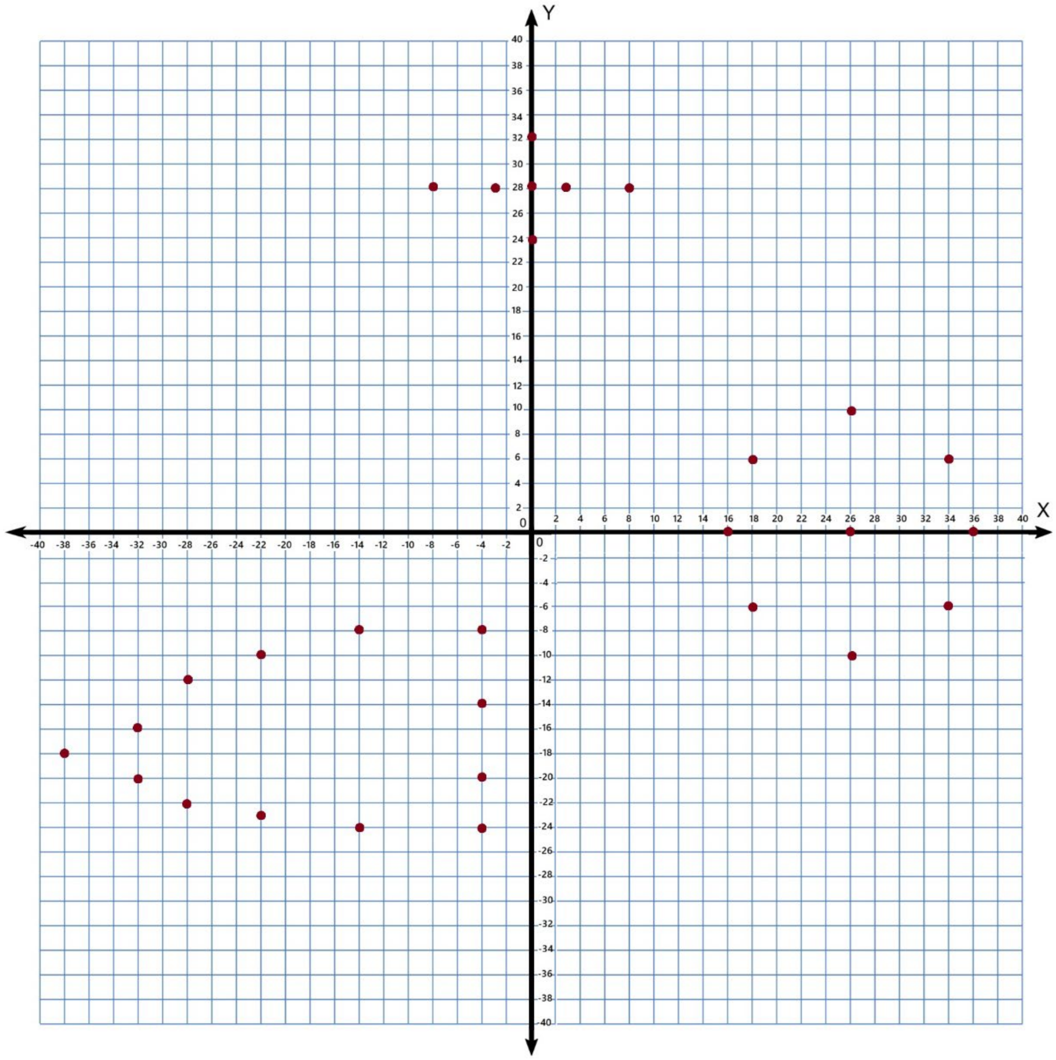
4. What time period do you think it is from? What parts, artifacts, or targets support your findings?

5. What evidence most strongly supports that this shipwreck is the SS *Mary*?

6. Do you think the shipwreck you discovered should be listed on the National Register of Historic Places? Write a persuasive argument saying why or why not.

Coordinate Answer Key

These coordinates were based off historical measurements and the actual dive drawings of the wreck of the SS *Mary*.



Bow

(-4,-8); (-4, -14), (-4,-20); (-4,-24); (-14; -8),(-14,-24); (-22,-10); (-22, -23); (-28, -12); (-28, -22); (-32, -16); (-32, -20); (-38,-18)

Walking Beam

(0,24); (0,28); (0,32); (-8, 28);(-3, 28); (3, 28); (8,28)

Paddlewheel

(26, 0); (26, 10), (34, 6); (36,0); (34, -6); (26, -10); (18, -6); (16,0); (18,6)