Diving into Wisconsin Shipwreck Education: Archaeological Outreach 2022-2023

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And finally, thank you to our institutional and organizational partners that provided a testing ground for these activities.

Cover photo: Students enjoy educational activities at the 2023 University of Wisconsin Science Café.

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PART I:
INTRODUCTION

A grant proposal submitted in 2019 entitled "Boatloads of Lumber: Expanding the Reach of Wisconsin's Maritime Resource Education" included the goal of developing a series of educational activities in a package that could be applied in an informal environment that would teach children of different age groups about Wisconsin shipwrecks and the science of maritime archaeology. Due to the COVID-19 pandemic and social restrictions that came with it, the first version of this educational package was shifted and developed for online use. The method of engagement with the package of educational programs developed in this way involved students logging in to a specially made website with the instructor guiding them via Zoom or a hybrid program. Given the circumstances, this method worked.

For the 2022-2024 grant cycle, these programs were adapted for in person educational programming within various partner institutions. This iteration of the maritime educational programming included field deployment and implementation of portions of the educational package. Existing activities were translated and modified from online to physical activities. The structure and organization of the activities was created. Educational tools and the infrastructure for transporting the educational materials from place to place was also required. The utility and value of the teaching materials was evaluated and weighed against the desire to reach to as wide of an audience as possible. This ranged from intimate one-on-one programs or with a small group of participants, to table activities at large events or festivals that engaged interested passersby. Some activities worked for one occasion or the other, and sometimes would work both. When discussing each of the activities, the best circumstance for their use will be noted.

This program went beyond the grant scoping in several ways, which resulted in positive outcomes and set precedents. Working with partner organizations and Wisconsin Sea Grant Institute as opportunities arose, programming was carried out with the expressed goal of expanding the reach of the education package, the Maritime Archaeology program, and Wisconsin Historical Society, respectively. Additionally, this laid the foundation for building an educational community with our partner organizations. The details of these opportunities will be discussed later in this report.

Partner Organizations

Each partner organization was selected because of their ties to maritime history and culture, and educational pursuits for their respective communities. The educational package was deployed and used amongst the same partner organizations and institutions that had paired with the program during its initial phase. Opportunities with other organizations and

institutions outside of our partner organizations were also pursued to maximize the reach. An example of this: by returning to the University of Wisconsin Science Expeditions in 2023, we were invited to provide programming for the 4-H Summer Academy in Madison, Wisconsin, and another at the Monticello Public Library.

An opportunity arose when the education department of a partner institution was unable attend a prominent community event due to scheduling issues and we were invited to offer our educational programs instead. This was the case with the Door County Maritime Museum, which held a special Christmas event in November 2022 and 2023 when Santa Claus visited their museum. They wanted to offer an educational program at an otherwise fun event to take advantage of the number of children that came to visit. Their education coordinator had a scheduling conflict and was unable to be at the event, so she invited us to come instead to offer an educational experience in both 2022 and 2023. There are many partner organizations with the strong desire to have educational programming but because of limited staffing, financial issues, or the type of institution, are unable to provide a children's educational experience. They invited us to give a program and they learned from the event so they could provide educational programs in the future. This was the case with several institutions such as the Superior Public Museums, caretakers of the SS *Meteor*. They operate a popular museum ship but have not had many opportunities to engage with children. We also worked with the Bayfield Maritime Museum. As a seasonal, volunteer staffed entity, they typically do not engage young visitors. They incorporated our programming into a larger county-wide educational event. The National Museum of the Great Lakes tends to draw an older crowd, but strongly wished to provide programming to draw in children and families. We were able to assist in that role at their 2023 Great Lakes Festival.

Some partner organizations worked with the first version of our program but chose not to participate with the second. We reached out to these organizations, but they did not respond or were not interested in hosting an educational event. Rogers Street Fishing Village indicated that they did not feel like enough interest was garnered to offer a program for children to have us present as an option during regular museum hours. We suggested participation at their large community event, Rogers Street Days, but that was declined though they advertise the event as "Fun for the whole family." Neville Public Museum had previously participated during the first iteration of programming also declined continued participation. They expressed concern and confusion over the maritime educational program branding. We also reached out to the Great Lakes Shipwreck Museum. They worked extensively with the program during its first iteration, but they did not respond to emails. Changes in staffing at local museum partners changed our relationship with them. The Kenosha Public Museum had previously worked extensively with

our program and scheduled for many 2023 events. When their educational coordinator left, the maritime programming was dropped.

Lastly, this project was hindered by the lingering effects of the COVID-19 pandemic. It was presumed there would be very high demand for in person educational programing after two years of staying home. This was not the case. Many of the previously large outreach events yielded lower 2022 and 2023 attendance than pre-pandemic. This was a constant theme from organizations and institutions. Covid disrupted meetings and staff absences due to Covid infections were a factor and slowed progress.

Partner organizations included:
Door County Maritime Museum, Sturgeon Bay, Wisconsin
Kenosha Public Museum, Kenosha, Wisconsin
National Museum of the Great Lakes, Toledo, Ohio
Port Washington Historical Society, Port Washington, Wisconsin
Superior Public Museums, Superior, Wisconsin
Wisconsin Maritime Museum, Manitowoc, Wisconsin

In addition to these partner organizations, this project built bridges within Wisconsin Historical Society with the organization's Education Department. This cooperation was important to promote unity within the Historical Society and it was logical for our programs to work together. They assisted in promoting and advertising our programs on their webpage, as well as in the newsletter sent out to schools, teachers, and libraries. They also noted that our programs were free and funded by Wisconsin Sea Grant Institute. Unfortunately, none of this cooperative promotion and advertising resulted in returns for the project. Our program assisted them by collaborating with and advising about archaeological activities that the WHS Education Department was developing. They invited the program to the 2022 Wisconsin Idea Summer Camp and again for the 2023 Wisconsin Historical Society Archaeology Summer Camp. They also gave us programming space to present at the Wisconsin Historical Society Museum during the 2022 Science on the Square Exhibition. The WHS Education Department also reached out for the program to collaborate with the 2023 NOAA "Get into Your Sanctuary" event. Lastly, the WHS Education Department invited this program to be a co-presenter at the 2023 Wisconsin State Reading Association Conference in Milwaukee, Wisconsin. We co-presented about using objects to teach history. Again, this was done to promote the maritime educational package to any perspective teachers, but unfortunately our lecture was only attended by two participants and did not result in any returns.

Figure 1. Students measure the windlass of the *Lottie Cooper.* (Jordan Ciesielczyk, WHS)

Another first, the maritime educational program was presented at state historic sites run by Wisconsin Historical Society, largely thanks to a 2023 All Staff Meeting in Madison. Northern Great Lakes Visitors Center in Ashland, Wisconsin and Black Point Estate in Lake Geneva, Wisconsin requested maritime programming at their facilities. Black Point Estate restarted their summer camp in 2023 and held three summer camp sessions. We held an hour-long maritime program for each of the sessions. At the Northern Great Lakes Visitors Center, we participated in a day-long summer camp at their facility where maritime programming was incorporated into the summer camp. Later in summer 2023, the Northern Great Lakes Visitors Center asked us to assist in the development of a day-long summer camp excursion that would take kids on a tour of the local maritime heritage of the Bayfield Peninsula. We held an hour-long program and then assisted as educator for the remainder of the day, giving the kids a special tour of the Bayfield Maritime Museum and discussing the shipwrecks of the region and artifacts that are on display at the museum.

Field Methodology

The maritime educational package was modified from its initial online form for use in this hands-on iteration of the program. Activities were modified during their use and practice in the field from the originally derivation. These activities may be modified further based on the educational needs or interests of a particular group, or at the discretion of the educator giving the programs. This speaks to the utility of these exercises because they are adaptable to the situation or the educator using them. Although the existing activities were divided by difficulty (basic or intermediate) to accommodate different age groups, in some cases it was found that

the younger age group could engage with the intermediate or more challenging versions of activities. These activities were used in this way to enhance the educational experience.

The online program was moved from the private, developmental online hub to a public space which can easily be accessed by everyone. The new portal is https://education.wisconsinshipwrecks.org. This move allowed for branding and coloration that is consistent with other Sea Grant housed materials. Each activity was modified prior to the move to incorporate improvements made during their use in the field. During in-person educational events, the new publicly accessible activities were heavily advertised. Further improvements in the visibility of the educational activities portal on the website is needed, along with physical materials such as bookmarks or postcards to advertise the site and the online computer game *Legend of the Lost Emerald.*

PART II:
EDUCATIONAL ACTIVITIES

Figure 2. A student explores a shipwreck with the Oculus headset (Jordan Ciesielczyk, WHS)

I. Oculus Headset

A new program was developed during this iteration of maritime educational program development that incorporated the use of an Oculus headset. Initially, an Oculus headset from the Wisconsin Sea Grant Institute was secured for testing and evaluation with existing programming. At first, it was challenging to incorporate the headset into educational programming because of the extensive time required for individuals, without neglecting the needs of other activities in the program. Another problem with the first headset was that earlier iterations of the Oculus had limited battery life, and the battery would drain while the Oculus was powered down and not in active use. This headset was temperamental and had to be in a perfect internet environment to function properly.

After proving this device's utility as an educational tool, Wisconsin Historical Society's Office of the State Archaeologist purchased an updated Oculus headset of their own for use in outreach opportunities. This new Oculus has a secondary battery for extended use and the batteries also do not drain while the headset is powered down and not in use. The updated headset operates in a wide variety of internet environments. This improvement in capability increased its utility as an educational tool. Even though the participants could not be brought to the physical shipwreck, the shipwreck could be brought to them to explore.

Methods

The Oculus headset can be used for both kinds of events – small group and a table. The only shortcoming is that when used in a small group, the educator guiding the group must remain vigilant on the time the headset is used per student especially when integrating it with the other activities. A timer app on the educator's cellphone was used to keep track of the amount of time a student could interact with the headset. Depending on the size of the group, the amount of time per student could be changed. At large table events, the amount of time a participant would receive on the headset would be at the discretion of the educator, but typically interested kids could be given more time. Additionally, this tool for outreach can be used with adults, camp counselors, teachers, and chaperones – expanding outreach numbers and allowing more people the opportunity to visit a shipwreck using the device.

The headset was used to access existing assets on Sketchfab.com. Parties currently creating and displaying 3D photogrammetry shipwreck models, including those sunk in Wisconsin waters are regularly uploaded to Sketchfab.com. Sketchfab is the premiere website for shipwreck photogrammetry. These 3D models can be viewed through the headset directly from Sketchfab or preloaded for use when an internet signal is not available. This educational outreach program was designed to bring children to shipwrecks and the headset was the best way to achieve that goal.

A special WHS Maritime Program profile was created for the Oculus headset on Sketchfab.com. Wisconsin shipwrecks were added to the profile for ease in access during educational programs. Where possible, the images and wrecks were downloaded into the headset for offline use. The headset model had the capacity for it. Not all shipwrecks on Sketchfab are available for download by the owner, so an internet connection is needed for accessing those models. As new shipwrecks are discovered and visited by archaeologists, models are often created. These can be downloaded and immediately incorporated into the next outreach event keeping the material fresh and timely. However, there was never a need to use the headset completely offline, but the capability to do so was maintained as a precaution.

The typical wreck used for this was the *Rouse Simmons,* the famous Christmas tree ship, which was imaged and processed by Maritime Preservation Program volunteer, Zach Whitrock. During a few programs when there was extra time, we also showed children the imagery of the Lake Mendota canoes. We attempted to use images of shipwrecks to give a more regional flair. For example, when conducting programming in Ashland on Lake Superior, Wisconsin shipwrecks sunk in Lake Superior were selected.

In August 2023, we began using the 3D photogrammetry model of the recently discovered *Trinidad* wreck*,* discovered by avocational archaeologist partners in July 2023. This proved to be another boon because it sped up the process from discovery of a cultural resource to its incorporation into outreach. We were able to share a brand-new shipwreck discovery, within weeks of its discovery! *Trinidad* is a well-preserved shipwreck. The model was by also made by WHS volunteer, Zach Whitrock. During the of one the programs where the *Trinidad* was used in this way, we incorporated it with the photomosaics of the *Silver Lake* and the *Rouse Simmons.* The kids were able to see and identify three distinct schooner hull shapes used on the Great Lakes. In this case the children were able to identify the differences and it inspired them to make observations and think about these resources.

Figure 3. Students Using the Clawsome! cartesian diver (Jordan Ciesielczyk, WHS)

II. Buoyancy with the Clawsome! Cartesian Diver

A new activity was developed teaching buoyancy using the Clawsome! Cartesian Diver. Maritime archaeology incorporates science to make observations. We purchased the Clawsome! Cartesian Diver because it incorporated a game with underwater artifacts for recovery, adding to its utility and fun. A game was developed that works best for small group engagements. At large table events the game was discarded as it took longer, but the Clawsome! as a stand-alone worked well.

The Clawsome! Cartesian Diver teaches the following concepts: buoyancy, Archimedes principle, Boyle's law, density, displacement, and when used as a game, conservation, and archaeological ethics. This game teaches buoyancy, which is a scientific principle that guides how archaeologists work underwater. This tool is unique, eye catching, and popular. The activity brought folks to the table at large events. At the Door County Wooden Boat Show 2023 we had a group of young boys who returned to the table to play with the Cartesian diver multiple times.

Methods

This game can be used for small groups or large table events, though it works better for large table events. The game for small groups was born out of a joke. After explaining positive, neutral, and negative buoyancy, we had the kids fill out an "archaeological collection permit" so

they could legally recover the artifacts. This added value to exercise because it was also used to teach about archaeology laws. The Clawsome! Cartesian Diver has a series of small plastic artifacts which are sunk on the bottom or partially buried by the fishbowl gravel. When a student squeezes the bottle, the claws on the bottom of the cartesian diver open and they try to pick up the artifacts: a ship's wheel, an amphora, a cannon, and a sword. This made the fun game fun, competitive, and provided the opportunity to educate children about archaeology and conservation. This game qualifies as STEM education for teaching the scientific principles behind scuba diving and shipwreck archaeology.

The activity itself begins with a simple overview of buoyancy, density, displacement, Boyle's law, Archimede's principle, and displacement. The educator then illustrates positive, negative, and neutral buoyancy using the diver. The educator explains how the diver works. There is a small bubble inside of the diver, that when the bottle is squeezed, the added pressure makes the bubble smaller thus making the diver denser than the water it's in and it becomes negatively buoyant. When released, the bubble increases in size, making the diver float to the surface as the diver became positively buoyant. These are demonstrated and then handed to the students for them to try it themselves. They are asked to try to grab an artifact using the diver. It helps to remind students that they can remove the Cartesian diver out of its base. Remember to always have the hook (a tool that is provided with the diver) for fixing the diver when the bubble inside pops.

At large table events the Cartesian diver bottle is set up strategically on the table. It brings people to the table out of their own curiosity. Curiosity like this opens the door to education. At both small group events and at large table events, it was typically used at the beginning of the programming. The typical strategy was to explain the process of diving and exploring underwater and then "dive" Wisconsin shipwrecks. Explaining buoyancy with the Cartesian diver was typically used before Artifacts Tell a Story exercises with the shipwreck mosaics. One of the challenges encountered with this activity was the timing. When using this activity with small groups, to keep the game going, allow participants to pick up one artifact and then pass it along to the next child. Sometimes in practice this would prove more challenging. In these cases, it would be moved along to the next child in line, but the child would be given another opportunity to try again. For future use, it might be beneficial to order multiple Clawsome! Cartesian Divers.

Figure 4. An educator demonstrates buoyancy with the baking powder submarines (Rose Haveri NGLVC)

III. Buoyancy with the Baking Powder Submarine Diver

Another program developed during this iteration was a buoyancy program using baking powder submarines. Sometimes it was used by itself and other times, it was used in conjunction with the Cartesian diver to reinforce the concepts of buoyancy. It is a different tool to teach the same concept. Additionally, these submarines are eye catching and work as an attractor to a table at large event. The baking powder submarines have the added benefit of acting as a larger visual aid.

The baking powder submarine teaches the following concepts: Archimedes' principle, Boyle's law, buoyancy, density, but also about acids, bases, homogenous mixtures, solution, solvents, and solutes. This activity teaches buoyancy through a chemical reaction and illustrates the principles in an exciting, interesting way. This activity is set up like a scientific experiment and depending on the group and situation, the educator has the kids scoop the baking powder into the submarines. They are asked about what they think will happen when the submarine is placed in the water. This makes them observe the chemical reaction. They are surprised when

the submarine became positively buoyant. The primary issue with this activity is that it is very messy and uses open water baths which may not be permitted in some museum settings.

Methods

It is prudent to ask if there is a water source available ahead of time. The plastic tub is filled up to the line and an aquarium decoration of a shipwreck is placed in the water. This is done to simulate the baking powder submarines exploring a shipwreck with its masts sticking out of the water. It also provides the opportunity to teach students something about refraction, another scientific principle that governs the study of shipwrecks, adding to the utility of this activity.

The next step at large table event is to fill the submarines with baking powder. When asked about the submarines, that starts a conversation, and the educator explains buoyancy and the chemical reaction that makes these submarines work. Even adults enjoyed learning about the chemical reaction. If using this activity with a small group, one participant can be asked to volunteer to help fill up the submarines with baking powder. If kids are at a large table event, the educator can ask for a volunteer to assist in filling the submarines, since there are four submarines, four children would be asked to assist in filling the submarine with baking powder.

If the participant is mature enough, the educator may then ask them to place the submarine in the water and give it a few shakes. For many groups of students who can't handle those directions, the educator takes the submarine, gives it a few shakes and places it in the water. One of the challenges with this activity is that time varies for the chemical reaction. Sometimes the submarines start working instantly or it could take a minute. This builds up anticipation. It's possible the delayed reaction has something to do with water quality and water temperature. It's an imperfect chemical reaction in that when it comes time to refill the submarine, left over baking powder could be left inside.

When the submarines begin the reaction, the baking powder reacts with water creating carbon dioxide bubbles. Those bubbles then increase, making the submarine positively buoyant. It then rises to the surface where it tips. The bubble is released at the surface. The submarine sinks again, becoming negatively buoyant. An issue may occur when conducting this program outdoor. If the water is warm or heated, the density of the water decreases, and the submarines become less buoyant. They will not surface. They move halfway up in the water column where they tip. This issue created another scientific observation for the participants. "The submarines are positively buoyant, but don't break the surface, what could that tell us about the water density?" This is where having the Cartesian diver available would also help to answer this question. These two activities complement each other.

This activity is very messy, and an educator must be prepared. Typically, a roll of paper towels should be on standby. When the submarines are removed from the water, they are placed on a double layer of paper towels because they are wet and dripping with baking powder. The submarines need to be cleaned with dishwashing detergent after each use and before return to the storage containers. Additionally, after multiple uses, the water inside of the tub becomes cloudy with unused baking powder, which hinders the visibility of the activity. Therefore, periodically when time permits, the educator should replace the water. The plastic tub also must be cleaned with dishwashing detergent after use, or the dissolved baking powder will cake inside. This activity works very well as a visual aid for buoyancy and for the moments when people mistake baking powder for baking soda. It also gives an opportunity for explaining how baking soda will not work for this demonstration, baking soda is a base - when added to water there is no reaction. A future strategy might be to fill the submarines with baking soda instead and asking the student why this didn't work?

Figure 5. An educator demonstrates a dry suit for Dress the Diver (Rose Haveri, NGLVC)

IV. Dress the Diver

The Dress the Diver activity took a different form for in person programming. For small group events, it is usually an activity used at the beginning of each educational program. Introduce maritime archaeology, describe the suit (Dress the Diver), explain how it works (buoyancy), and then dive a shipwreck (Artifacts Tell a Story and Parts of a Ship), and then resources (Find a Route). The educator brings their own personal scuba diving equipment, a dry suit, undergarment, gloves, mask, snorkel, fins. This educator does not have a full kit, but it was sufficient to draw interest without having to carry bulky and expensive equipment. Options were explored early on in utilizing unused equipment, but unused equipment is currently on a mannequin scuba diver at the Wisconsin Maritime Museum.

There were several instances when working with partner institutions the co-educator not only had open circuit scuba equipment, but also a rebreather unit. This was an educational boon, and the two different types of diving gear were compared with each other. These were used during the programs at the Door County Boys and Girls Club in Sturgeon Bay, Wisconsin. The education coordinator at the Door County Maritime Museum combined the equipment into an overview of diving gear. This would quickly become a Q & A session about diving equipment, how it works, and any stories we have from diving. The students then lined up and were allowed to wear scuba gear, press buttons, fill the buoyancy control vest, deflate the vest, and

listen to the air coming out. It gave a visceral experience of equipment that is not commonly seen nor shared with children.

Methods

When it came to large table events, the available equipment is spread out across the table as another display piece and allows passerby to see and touch the gear. When children stop by, the equipment is used in the same way as with a small group as an introduction. As time went on and more educational activities were brought online, these would be used less and less at large table events. Showing equipment has educational utility because this is what is used by maritime archaeologists to do their science. Unless they choose to get an open water basic scuba certification much of the lay public does not get the opportunity to interact with diving equipment, so it does serve the purpose of attracting people (children and adults alike) to come and learn more.

When used with small groups, the equipment was incorporated into the introduction to maritime archaeology. It was used to explain that we must use to explore underwater shipwrecks. The children then can touch and look at the equipment. Often when it came to masks, snorkels, and fins, they are asked if they recognized what these objects were or if they had these objects at home. If there was a group that was young enough and willing, we would pretend to put on our scuba equipment piece by piece to transition into the next activity of Artifacts Tell a Story or Parts of a Ship. For the future this should be kept in the rotation but know that having full kit has its challenges and takes lot of time between other activities in the program.

Figure 6. Artifacts Tell a Story programming (Andrea Stromeyer DCMM)

V. Artifacts Tell a Story

This activity has the most utility. It is simple and extremely versatile, can be used for both educating small groups and for large table events. It can be adapted to fit different educational scenarios. This activity was also the most modified from the original program as better visual aids were desired. In its initial form, the wrecks of the *Atlanta, Home,* and *Milwaukee* were used, and large print outs of the wreck sites were made. There isn't a wreck map of the *Milwaukee* as the wreck is too large. A large, laminated image of the shipwreck of the *Milwaukee* was used instead.

For the first half of the program these pictures worked well, and the smaller size allowed for more wrecks to be used and for comparisons to be made. Eventually, large, mosaic images of the *Rouse Simmons* and the *Silver Lake* were made and because these images were larger, nicer and more impressive, this activity changed to use these wrecks instead. Therefore, it was Artifacts Tell a Story between two wooden schooners. Use of the *Milwaukee* continued so that the activity could maintain its steamship component and students could compare the different

artifacts between steamships and sailing ships. Having the large mosaics of the *Silver Lake* and *Rouse Simmons* helped because each schooner has a different hull shape and the story between both wrecks is different. Because each of these wrecks have similar artifact assemblages, often the mosaic images were used interchangeably between *Rouse Simmons* and *Silver Lake* and would be still contrasted with the smaller image of the *Milwaukee*. Additionally, if the educator was conducting a program for a specifically winter holiday event like "Santa Coming to DCMM" or "Christmas Tree Ship at WMM," the *Rouse Simmons* was used because it is known as the "Christmas Tree Ship."

Methods

For small group events, in the middle of the program, the students would transition to Artifacts Tell a Story. Depending on the shipwreck used, the story of the wreck was shared with students and certain details and context clues were emphasized to assist the students in understanding the artifacts they were looking at, such as the year the ship was built, the year that the ship sank, what its hull was made from. At this point, the small, laminated cards that represented artifacts are placed across the mosaic image of the shipwreck imitating how artifacts are spread across the wreck. Participants are then free to pick up each card and then guess if that artifact goes with the shipwreck or not.

When they guess the incorrect artifact, they are usually prompted with a detail from the story in the following ways: "The *Rouse Simmons* was a three masted sailing ship. Do you think it had a steam engine?" or "Look at the mosaic image, do you see anything that might be a steam engine?" Sometimes the child would pick a part of the ship on the mosaic that they thought might be a steam engine and the educator said: "That's a really good guess that could look like an engine, but that object is not a steam engine it's a __ "and then describe what the object is. The educator then states: "keep that in mind for the next activity – you're already a step ahead" as the next activity was Parts of a Ship. If there was a card that the participant was unsure of, it would be set aside into the "maybe" pile that would be revisited at the end. Cards that did go with the schooner shipwreck were placed in the "yes" pile and cards that didn't were placed in the "no" pile. Then they would transition to the steamship shipwreck.

On the occasions where there were larger groups of students, the game would be modified to accommodate more students. Sometimes the students would be paired off and each pair would pick up a singular artifact card and the students would vote together if they all thought the artifact went with the shipwreck or not. This would spark discussions between students about the artifacts and critical thinking about the shipwreck stories.

When children come up to a table, they are brought into the activity; they see the large, impressive picture and want to learn more. It is carried out in the same way as with small groups and then this activity can be used as a gateway to the other activities that were available at the table. Prior to obtaining the large mosaics, the smaller laminated posters were used instead in the same way with a picture of the wreck map and a historic image of the ship to give kids an idea of what the ship looked like during its career.

This activity can be used in multiple ways which again speaks to its versatility. After having completed one event in 2022 with the Door County Boys and Girls Club, they had specifically asked for our education program to return along with our colleagues at the Door County Maritime Museum. Since the very same students would be revisited, this necessitated some out-of-the-box thinking. A different but similar activity was devised using the same program infrastructure. This variant had the kids run through the program learn about Wisconsin shipwrecks and typical artifacts found on shipwrecks and their stories. The kids had access to materials provided by the Door County Maritime Museum to make their own shipwreck and then they created their own story behind the shipwreck. They were to use interpretations of the artifacts on their shipwrecks to help tell the story of their wrecks. Some children drew pictures of their shipwreck, and one participant even made a little book that told the story of her shipwreck. What the kids did was archaeology! They made a shipwreck, filled it with materials and then used that material to tell a narrative about the past. They created their own archaeological interpretation.

Figure 7. Students matching parts of a ship (Jordan Ciesielczyk, WHS)

VI. Parts of a Ship

This activity and its place within the program were used interchangeably with the previous activity - Artifacts Tell a Story. Logically, it would make sense to metaphorically build the ship first and then fill it with artifacts. However, because Artifacts Tell Story had a lot more appeal and could reach a wider audience, often that activity was favored over this one. Although nautical terminology has been incorporated into the American English lexicon, it remains a challenge for many adults much less children. Although some initial trial activities were aconducted using the initial infrastructure of the same laminated printouts of shipwrecks used for Artifacts Tell a Story, this activity did not stand out until the acquisition of the large prints of the mosaics. What added to its utility is the radical difference in shape and design of the shipwrecks used in the large mosaic images between the *Rouse Simmons* and the *Silver Lake.*

Methods

The methodology used for this activity is very similar to the previous Artifacts Tell a Story. This activity works well for both small group programs and for large table events. This activity was also found to work well with older students. Since it typically followed Artifacts Tell a Story, the

mosaic images would then be reused for this activity. Although for using this activity with a small group, the students would start with the mosaic of the *Rouse Simmons* and then transition to the *Silver Lake*.

The cards with the terms are mixed up over the mosaic images and to introduce students to the activity. It often starts as "We just learned about the artifacts that the ship had aboard. Now we're going to learn about parts of the ship itself. You might remember some of these terms from the other activities." If the child needed a little help to begin the activity, the educator guides them through one or two matches between what they see on the mosaic and the term on the card. Once the kid has the idea, they continue themselves. It worked the same way as Artifacts Tell a Story: the child lifts the card, reads the back, and then attempt to match it to what they saw on the shipwreck. To add to this activity, where there are multiples of the same structural feature, for instance such as a hatch on the deck, multiple "hatch" cards would be used to mark each hatch. This was thought to enhance the understanding of shipwrecks.

This activity was a little more advanced, so whenever the kids made a mistake, it was not approached until the end where the matches were reviewed. The participants were asked leading questions "what about this part made you think that it was this?" and so on. It would start a conversation where the child could rethink the proper match. When describing port and starboard as that was always a little challenging to the kids, the educator would stand with each arm outstretched in the shape of a "T" paralleling the direction of the ship on the mosaic and the educator would prompt "if port is always left on a ship, then which side is port?" or the educator would offer the well-used example of "port and left have the same number of letters, so that's a way to remember which side is which on a ship." Sometimes an educator must do extra to convey the concept. However, kids did not have to work hard to remember which way is the bow or stern.

After the participants match all the cards to each corresponding part on the shipwreck of the *Rouse Simmons* then the mosaic of the *Silver Lake* was unrolled next to it. This is an educational boon because *Silver Lake,* a scow schooner, has all the same structural features as the *Rouse Simmons* but arranged in a way that is almost unrecognizable. It made for an exciting challenge for the kids. Some groups took time with it and some groups, once they found the bow, filled it in immediately. Then, the educator gave a brief story of the *Silver Lake* to give the group context as to what they were looking at before they started matching the parts of the ship.

At large table events, this was another activity in the educator's tool kit that could be used at their disposal. When it comes to large table events, often the kids only stop at the table for a limited amount of time, or they had a limited ability to focus on a given activity. If the educator

had a group of kids who after one or two activities were still interested and still had time before they moved on, they could add Parts of a Ship. If a kids had a specific question about a part of a shipwreck from looking at the mosaic, their existing interest could be capitalized upon to bring them into this activity. Although this activity could easily be used at large table events or interchangeable with Artifacts Tell a Story, but instead a brief story of the shipwreck would be given before talking about its parts, again to provide context for what the kids were looking at on the mosaic. Other activities were found to be more engaging for large table events and those other activities were favored more than Parts of a Ship, but for when there were children who could stay for all activities available, this was another activity held in reserve for that instance.

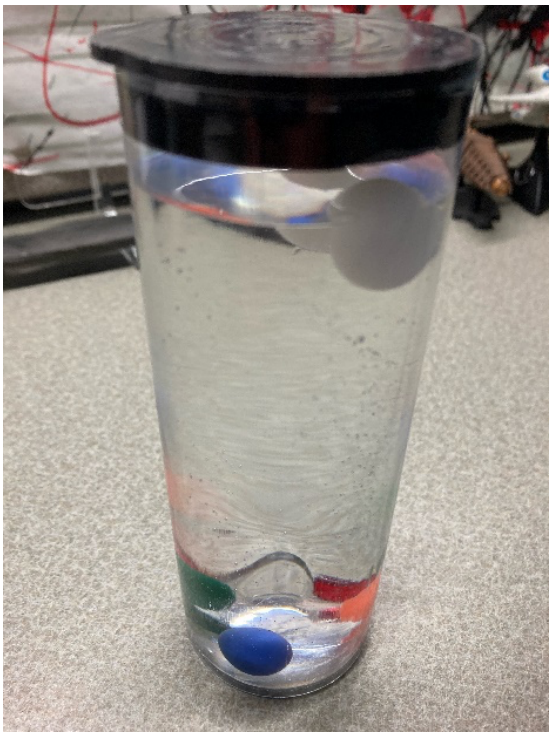

Figure 8. Density sphere experiment bottle (Jordan Ciesielczyk-Gibson, WHS)

VII. Density Sphere Experiment

This activity is reserved for small groups, due to its complexity. There are many moving parts, it relies on participation, and the activity itself is very small. We attempted several times to incorporate this activity into large table events, but it did not work well. This activity takes time and cleanup is required. This is another activity that illustrates the scientific principles of the Archimedes principle, buoyancy, density, mass, positive, negative, and neutral buoyancy, solution, and volume. There's a variety of ways this activity can be conducted, but it's good to go through the different materials that produce different results so the kids can make observations and comparisons. This is a supplementary activity which can be used to reinforce the concepts behind buoyancy, floating, and sinking.

The density sphere experiment consists of one plastic experimental tube along with its lid and six density spheres. Under different circumstances the density spheres will behave differently depending on what medium they are immersed in between water, salt water, sugar water, and corn syrup. Each sphere along with other plastic pieces are each of a different density and therefore will become positively, negatively, or neutrally buoyant in each different medium. Even different mixtures of each medium produce different results. The educator takes the students through each experiment to fully make use of its educational utility.

Methods

Setting up the experiment, the educator fills the tube with regular water and then drops the density spheres into the water, replacing the cap. The educator then explains buoyancy and all the scientific concepts that the density sphere tube illustrates. The educator asks: “each of the density spheres is a different color, what do you notice? Which ones are floating and which one’s sink?” It invites the students to make observations. The educator would add either salt or sugar to the water to make a solution.

After adding enough salt, some of the spheres will now float or become positively buoyant that were previously sunk. The educator asks “What do you notice with the spheres, what’s different now? Which ones are now positively buoyant?” The kids will identify the change. Depending on the amount of time the educator has with the children, or level of engagement., the saltwater solution is poured out and replaced with the sugar water. Once again, the different solution makes different density spheres sink or float and the students are asked what they notice, which density spheres were positively and negatively buoyant.

If there isn’t enough time, the educator has the discretion to skip the sugar water and transition right into corn syrup. Corn syrup makes the density sphere act in a very interesting way. This has proven to be very visually interesting to the students. When the water solution was replaced with corn syrup and all the density spheres are dropped in, all the density spheres would become positively buoyant and float at the top of the density tube Again, follow up questions are asked and the final question: “With what we’ve seen and learned about density, what does this observation tell us about the density of corn syrup?”. The problem is clean up after using the corn syrup needs to be done immediately and it creates a very sticky mess. This activity is an excellent vehicle for teaching these concepts. It is just more intensive and less interactive than the other activities available that teach the concepts around buoyancy and is better suited for small groups.

Figure 9. Students enjoying finding a route (Jordan Ciesielczyk-Gibson, WHS)

VIII. Find a Route

This activity is the largest and most intensive activity of all of those developed. The map playmat used for the activity is very large and challenging to transport and deploy. Additionally, the map needs to be rolled in a very specific way when being transported or stored, adding to the challenge of its use as an educational tool. Lastly, the map could not be marked or modified to adapt it for use as an educational activity. This activity could take so much time that it could take up the entirety of a small group program and at the possible expense of the other activities. This activity was only used for small group events and should be reserved for those events.

The activity that was initially developed for Find a Route was found to be wanting. The online version worked well and had a nice interactive map that the kids could manipulate. Translating this activity into an in-person activity was much more challenging than other activities. Therefore, a new version of this activity was in the process of being developed during this iteration. The existing map could not be marked or modified in any way, and we attempted to create an overlay that could go over the top for gaming purposes. After attempting multiple possible companies to produce a component, each one contacted declined or stated that what was desired couldn't be produced. The activity developed proved to be too complicated for existing educational infrastructure, and in the end a happy medium between the existing activity and the new activity was developed and used to great effect.

Methods

This combines two activities into one. This activity needs a lot of space, so either a large conference room or on one occasion it was deployed outside on a lawn. The students are paired up and given a sheet. They are asked to replicate the voyages of real historic ships that are wrecked in Wisconsin. Each team gets a small boat of a different color to represent their team. Each of the ports mentioned on the cards have small 3D printed blocks colored to represent the type of cargo each ship would be carrying - brown for lumber, black for coal, yellow for grains, etc.

The students then "load" the cargo onto their little ship by sliding the boxes onto their boat. They pilot their ship from the port mentioned on the card to their destination. They are allowed to stand on the map and look for their destination port to devise the best route for their ship. The card has questions at the end of the journey for the kids to discuss and answer. The educator guides that discussion asking, "Why did you pick that route?" and so on. The children drop off their "cargo" at their destination port.

The kids have another voyage on their card. They pick up a new cargo at the new port and depart again. Each card has two voyages. At the end, teams will switch cards. A different historical ship will be assigned and the process of reenacting their historic voyages starts again. Each group rotates through the ship cards until each team has completed four cards. The kids enjoyed the visceral feeling of clicking the cargo into their little ship, the visual enhances the educational utility of this activity.

Although this program did not reach its full potential of what was envisioned, the adjustments made for an engaging activity. The participants were able to learn geography and map reading which enhanced the educational potential of this activity by teaching about historic ships wrecked in Wisconsin's waters. This activity also teaches about commodities commonly hauled on the Great Lakes and gives an insight into why the Great Lakes are an important resource and commercial highway. Lastly, this activity gives the students an opportunity to strategize and work together to find the best route across this map.

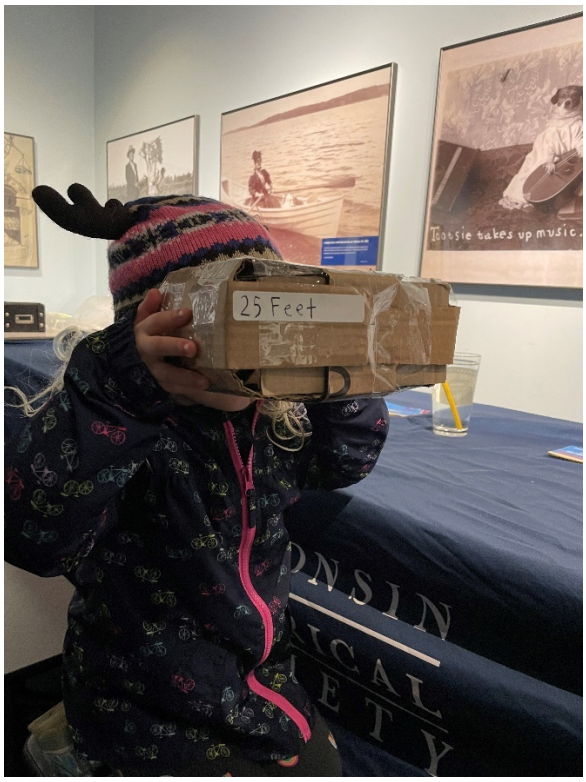

Figure 10. A Student Viewing Color Change Underwater at 25 feet (Abby Pfisterer. WHS)

IX. Refraction and Underwater Color Change Activity

This activity was developed for a singular programing event, the 2022 Science on the Square held 14 October 2022 in downtown Madison, Wisconsin. This was a joint program between the WHS Maritime Preservation Program and the WHS Education Department held at the Wisconsin History Museum. The WHS Education Department generously offered space for this educational event. Science on the Square was a themed event. The theme for 2022 was the "International Year of Glass" and educational activities were centered around glass. After much careful consideration and collaboration with our partners at the WHS Education Department an activity centering around refraction and underwater color change was developed.

Methods

Water distorts and guides our perception underwater. Typically, refraction is illustrated by placing a pencil into a glass of water. To make this activity shipwreck themed, an aquarium decoration of a shipwreck was used and placed in a tub of water with only enough water to just cover the deck and with its masts sticking out of the water to illustrate refraction. The activity was arranged so the students file into the museum and have the refraction unit as the first activity, illustrating the scientific concept of refraction and distortion.

The “glass” portion of the activity was arranged on the next table. It was a series of scuba masks with a cardboard “viewer” attached to the mask. Inside the mask was a photoshopped image of a shipwreck. Each mask was labeled at a certain depth starting at the surface, 25 feet, 50 feet, 75 feet, and 100 feet. The shipwreck image inside each mask was modified to illustrate the color change at each corresponding depth when compared to a comprehensive video on color change underwater. The educator explained the electromagnetic spectrum, electromagnetic waves, and the visible light spectrum. As light waves penetrate water, much like refraction, light waves slow down with deeper of water until certain colors vanish completely or change dramatically. The educator guided students through each mask where they observed and noted each color change. Sometimes the dramatic color change elicited “wows” and surprised gasps. The educator also explained that when viewing objects through a mask, the optical effects of color change are slightly less due to the air space inside the mask. The educator then explained each of the color changes and why the longer the wavelength for the color, the lower the energy and the easier it is absorbed by water. The order in which colors absorb in water is in the order they appear in the rainbow ROYGBIV.

The WHS Education Department provided some large images of Lake Michigan Shipwrecks at over 100 feet of water where they noted the change. At the next table the participants were brought into the usual programming, followed by a table with coloring sheets and crayons provided by the WHS Education Department for the littlest students. Some students colored their sheets based on the color change activity. Although this activity was developed and used for one specific event, elements of the activity, namely refraction with the shipwreck model were incorporated into other activities at later outreach events. This activity worked perfectly for this event. Having a themed event created an educational challenge to link to historic Wisconsin shipwrecks. Many adults commented that even they didn’t know this much about the visible light spectrum. The modified scuba mask viewers were retained so this activity could be duplicated in the future.

X. Word Scramble & Pictogram

From the first iteration worksheets of these two activities were printed out. As the in-person variant of these activities is intensive and far less interactive, they were not used in programming events. It was felt that having students quietly working on worksheets took time away from other educational activities. Often, these were held in reserve in case there was extra time at small group events. Sheets were given out as "Take Me" items at large table events or given out as supplementary material for certain specific small group events. These activities were also shared widely with our partners who were seeking a worksheet activity like it alongside the answer sheets.

Figure 11. Students Enjoying Puzzles (Jordan Ciesielczyk, WHS)

XI. Puzzles

A physical puzzle of each different kind of Great Lakes vessel was made from the imagery used for virtual or online puzzle activities. These were printed onto acrylic puzzles which worked very well and made a very visceral click when putting the pieces together. Although cardboard versions of each puzzle were also made and held in reserve, the acrylic pieces were the superior choice. The problem became that over time the images of the puzzles would be scratched by use. Later the backside of the puzzles was treated with Mod Podge by Becky Skibo. This helped with the durability of the puzzle pieces. However, another issue arose from transporting the puzzles in a hot car during the summer months. The Mod Podge was prone to melting from heat and the puzzle pieces became sticky and stuck together. After thorough washing and cleaning with a mild detergent, the issue was alleviated.

Methods

These puzzles were another educational boon. At large table events they were arranged front and center at the edge of the table. Passersby could stop by and do the puzzles. They were very simple and the graphics on them are eye catching and attract kids and adults alike. Attraction to the puzzles created the opportunity for the children to engage with other educational activities. The puzzles added educational utility because when the kids looked at the shipwrecks, they then referred back to the puzzle and when guided by the educator saying, “the shipwreck you’re looking at looks like the puzzle you just worked on while it was still sailing.” The educator also described the type of ship the student was working on while they were completing the puzzle. For adults it started a simple conversation about shipwrecks with the educator saying, “maritime archaeology is much like putting a puzzle together between the shipwreck, the artifact, the logs, the journals, the historic records, and images.” The puzzles were also accessible to the very young children who otherwise were not able to engage with any other of the activities. These were used to great effect at large table programs, and that is where the puzzles performed best. For the small group programs, the puzzles were only used with groups that had younger children who had trouble with the more advanced activities. Another advantage was that the acrylic puzzles could be cleaned and sanitized between events.

Figure 12. 3D printed model of Canoe #1 (Print by Travis Banegas) (Jordan Ciesielczyk, WHS)

XII. 3D Printed Artifacts: Canoe #1

The last tool that was added to this educational toolkit was a 3D printed model of Lake Mendota Canoe #1, the 1200-year-old canoe recovered from Lake Mendota in 2021. This artifact is currently undergoing preservation at the SAPF facility and is not on display to the public. It won't be on display until the completion of the new Wisconsin History Center. 3D printed representations of artifacts represent a quantum leap in archaeological education. Rather than using a teaching collection, or possibly damaging or losing an artifact, a 3D printed facsimile can easy be shared. This was an educational boon and was used at every event - large table, or a small group. At large table events it was another display piece to attract passersby to the table and at small group events. It was incorporated into the introduction to the program and passed around to each of the kids. Children had the opportunity to interact with an artifact that most of them had heard about through media coverage of the discovery. They could touch it, they could see it, they could notice the tool marks on the inside and the lines of the actual wood. Giving the students something tangible to interact with made the artifact more real to them and spurred curiosity. Some kids asked questions about the canoe. In one case, the child wondered out loud if a nearby lake had a dugout canoe sunk in it. As a tool used to tell a story, it gave an opportunity to provide interaction without concern about preservation, collections issues, or the artifact becoming lost or broken.

PART III:
CONCLUSIONS

This program was widely successful reaching just over 2,000 children and adults during the duration of the project. The success is largely due to assistance from our partner institutions. Many of the partner institutions and organizations strongly desired this content and expressed interest that program continue. Many requested returns to the same events in the future. The objectives of the educational portion of this grant were achieved. Without funding and support from Wisconsin Sea Grant Institute, none of this work or outreach would have been possible.

An educational toolkit was created that provides educators with many options to educate children at different levels. It provides a canvas for sharing the story of Wisconsin's maritime history using shipwrecks as a springboard to discuss the technology surrounding the study of these resources. Including a combination of history and STEM programming, and it is robust with 12 separate and distinct activities for all ages. The program provides space for future educators to adjust the focus to their local area and make it their own. It will be utilized at future events by WHS archaeologists as well as our partner institutions to share the story of shipwrecks, maritime archaeology, and critical thinking.

Figure 13. Wisconsin Maritime Educator's Workshop 2022 (Jordan Ciesielczyk, WHS)

PART IV:
EDUCATION: ABOVE AND BEYOND

Opportunities arose for this program to go above and beyond the scope of the grant. The Wisconsin Sea Grant Institute along with other Sea Grant organizations across the Great Lakes have created and contribute to the Great Lakes Literacy Education Exploration (or GLLEE). GLLEE has a collection of resources for teachers to incorporate Great Lakes Education into their lesson plans through a series of online classes. A special shipwreck module was developed for GLLEE in collaboration with Wisconsin Sea Grant Institute that focused on shipwrecks and maritime resources of not just Wisconsin, but all the Great Lakes.

In November 2022 the first "Wisconsin Maritime Educators workshop" was held at the Mead Public Library in Sheboygan, Wisconsin. For the first time educators from each of Wisconsin's maritime institutions were brought together to discuss education. The luxury of employing a dedicated museum education coordinator, or even museum educator at many of Wisconsin's maritime museum is a recent phenomenon. This opportunity created a place to interact and create a "community of practice".

This workshop had representatives from the Wisconsin Historical Society, Wisconsin Sea Grant Institute, Superior Public Museums, Door County Maritime Museum, Wisconsin Maritime Museum, and the Crossroads at Big Creek. Others were invited across this project's partner institutions but were unable to attend. At the day-long workshop, it was the Wisconsin Historical Society's role to moderate and guide the discussion and ensure everyone had enough time to express their opinions and share their experiences while adhering to the schedule. Many institutions have been using the online game *Legend of the Lost Emerald* as a primer for young visitors and students before coming on a field trip to their respective maritime museums. The workshop was a place sharing of ideas, discussions on what works and what doesn't, and hindrances to their educational programs.

Two institutions participated to get inspiration for development if educational programming. Each attending institution was asked to bring an activity to share and discuss. At the end of the workshop, Wisconsin Sea Grant offered funding for participants to develop further educational projects.

PART V:
THE FUTURE

The educational materials developed worked successfully. However, future work is needed, and adjustments should continue. For the Oculus to show shipwrecks, a virtual tour that points out the prominent features of a shipwreck would be helpful. It may be easier for children to navigate around a site if the shipwrecks shared had numbers pointing to features where the user could click, to gain information about the feature.

Free range exploration of shipwrecks with the Oculus has worked. However, mistakes are often made where the educator needs to take the headset to fix it for the child. Having guardrails with this activity would still allow participants to view the shipwreck but would target prominent features and enhance learning. Additionally, having a large screen on hand where imagery from the Oculus could be broadcast, would be helpful. Waiting kids (and adults) could view of what they are going to see when their turn comes around, and this prevents crowding when children become impatient waiting for their turn to use the device.

For Artifacts Tell a Story, incorporation of 3D printed models of actual shipwreck artifacts would enhance the activity. These objects could be used as part of the matching game as an updated version of the artifact cards. The downside to this is that the back of the cards has a simple description for kids to read. This feature of the activity would be lost. A large mosaic image of a steamship made to the same standard and scale as the existing mosaics would expand the type of ships discussed. Parts of a Ship would benefit with the addition of a card to designate the mizzenmast for three-masted sailing vessels. There should be foremast, mainmast, and mizzenmast cards added to upgrade existing card sets. Lastly, the online activities from the prior grant work are available at education.wisconsinshipwrecks.org should receive promotion and the links on the website made more visible.

PART VI:
WALKTHROUGHS

I. EDUCATIONAL SHIPWRECK PROGRAM WITH OCULUS HEADSET

With Oculus II Headset

*This activity can be used at both large table events & small group events
*Needs access to a stable internet connection
*Needs plenty of space in a room
*Cutting edge
*Eye catching

Key Concepts: This activity fills in the T in STEM, Technology. Technology is the sum of techniques, skills, methods, and processes. Technology describes the tool used in the creation of a product or for the accomplishment of objectives in STEM.

Photogrammetry: The process of taking many pictures of an object from many different angles and then stitching them together to create a 3D Models

Oculus Headset Activity:

In the testing phase of this activity, the headset that was used was much more sensitive to the internet environment and the batteries would drain even while the headset was shut off and not in use. The Oculus II is a dramatic improvement over this and has an added battery pack for extended use.

Small Group Setting:

This activity takes time regardless of how many kids that are present. Therefore, a timer needs to be used either on a personal cellphone or a physical timepiece. In practice, at most each child would receive as much time as 1:30 minutes on the headset down to 30 seconds each depending on the number of kids and time constraints. Some kids would want to use all the time available, and some would find using the Oculus headset so overwhelming that they would want to finish early. The same is true for adults. Due the length of time this activity requires, it's a challenge to mix this the other existing activities, in practice it is best reserved until the end of the program after the rest of the activities are completed and is a good motivator for children to get through the activities first before using the headset. It is highly suggested that a monitor or computer screen accompany the headset so that the headset be casted it. While the children are waiting their turn to use the Oculus, they can see the same things that the child using it is seeing. This alleviates any impatience or hard feelings between students and any anxiety that children may develop about using the headset.

Large Table Events:

This activity is perfect for large table events and will be a big draw to the table for both children and adults. Using Oculus headset is much easier at large table events and using a timer isn't necessary. The Oculus may be used to motivate the kids into doing another activity first and then they get to explore a shipwreck with the Oculus. If more than one kid or a large group of kids come to the table to use the headset, then that's just an opportunity to take them through another activity while they wait to use the headset. It would be advantageous to have a monitor at the table with the headset casting to it, to attract passerby to the table and also alleviate impatience for the kids that come to the table.

Directions – Methodology

This is the best policy developed over field testing.

1. When you put on the headset you will see a 3D image of a shipwreck. It may be a little disorienting because you will be in a 3D environment and you can't see your feet, or walls, or world around you.
2. When you have the headset on, you will see a blue boundary on the floor, that is the boundary for the 3D environment and you don't need to step or walk outside of it, stand in place, and look with your eyes.
3. When you have the headset on, you will see a blue laser beam coming out of the end of the controller, when you point that blue laser beam at any part of the wreck you will see a yellow circle. Click the lower trigger button on the controller and you will be teleported to that spot. This is how you change your vantage point; you do not need to walk or physically move around the wreck.
4. Left or right on the joystick on the controller controls zoom. It brings you closer or further away from the 3d model that you are viewing.
5. Do not point the laser out into space in the gray area or else you will be teleported far away from the wreck and the instructor will have to reset it.
6. You only have __amount of time on the headset and when that time is up it will be the next person's turn.
7. For educators, the (O) button will reset the wreck at the center of viewing. Then pressing the bumper button on the top of the controller above the trigger button will open a menu in the distance you may point the laser to this menu, Click the top button and it will exit or bring you out of viewing the shipwreck on Sketchfab.
8. Have fun! Instead of going out to the shipwreck, I'm bringing the shipwreck to you to virtually dive.

II. CARTESIAN DIVER ACTIVITY WALKTHROUGH

With the Clawsome! Cartesian Diver

*This activity is best used for table type events

Key Concepts: The following scientific concepts make this activity work:

Archimedes Principle: This principle states that an object will float when its weight is less than the weight of the water that it displaces.

Boyle's Law: This law describes how the pressure of a gas (like air) tends to decrease as the volume of a container increases. Or as water pressure changes, the volume of gas in the diver's body also changes. In the case of this game, when we squeeze the bottle, the volume of air inside the cartesian diver decrease allowing it to sink. The diver is denser than the water it is in. This same concept applies to SCUBA divers.

Buoyancy: The opposite of gravity is Buoyancy, the upward pressure that is applied to an object in water which keeps it afloat. A body of water supports objects floating in it.

Displacement: displacement is when an object pushes aside water. An object will float if it weighs less than the water that it pushes out of the way or displaces. Displacement is the volume or weight of a liquid displaced by a floating object of equal weight.

Setting Up Cartesian Diver:

1. Pour the provided gravel into the bottle.
2. With the bottle standing upright, fill it with cool tap water. Make sure to fill all the way up to the brim. Let the bottle sit for a few minutes to allow any air bubbles to escape.
3. Drop the artifacts into the bottle one by one and let them sink to the bottom.
4. Insert diver into the bottle with claws pointing down.
5. Once diver is in place insert the rubber seat in the top and secure the cap tightly.
6. Lightly tap the side of the bottle. This allows any bubble caught in between the diver's claws to escape. Test diver by squeezing the bottle gently.
7. Squeeze the bottle until the diver becomes neutrally buoyant in the middle of the bottle.
8. The gravel will collect at the base of the bottle and artifacts will rest atop the gravel. The positively buoyant diver will float at the top. Place bottle in the base and keep it on a flat surface.

Cartesian Diver Game:

This Cartesian Diver game is based on a science experiment conducted by Rene Descartes demonstrating Archimedes Principle. Cartesian divers have an air bubble inside which causes them to float in water. In this sealed bottle of water, the Cartesian diver will float at the surface when positively buoyant. When the bottle is squeezed the pressure inside increases and the air

bubble gets smaller. As the bubble inside is compressed the diver fills with water causing it to become negatively buoyant and sink. The diver now weighs more than the water it displaces. Releasing the pressure causes the bubble inside to expand again pushing out the water and allowing the diver to float again, becoming positively buoyant. The diver goes back to weighing less than the water it displaces. If you can match the weight of the diver to the weight of the water it displaces, the diver will not sink or float, but will be neutrally buoyant and hover in the water.

Maritime Archaeology Game:
Now you're ready to dive! Notice that when you squeeze the diver the claws on the bottom open up. There are five artifacts on the bottom - a canon, an anchor, a sword, a ship's wheel, and an amphora. This Cartesian Diver is going to recover these artifacts but first, before archaeologists even think about recovering artifacts, they must fill out an Archaeology Permit. This permit promises that you will be very careful about recovering artifacts, how you will be recovering artifacts (with the cartesian claw diver), how you will store and take care of the artifacts after you recover them – like putting them in a museum!

Older Kids: This type of permit is called an ARPA Permit or Archaeological Resources Protection Act Permit. This is one of the laws that protect archaeological sites including shipwrecks. You must fill out a permit stating that you intend to conduct ethical archaeological studies, use proper methods for data recovery and that you have a place to store and curate the artifacts in perpetuity. Even if you are scanning a shipwreck with an ROV you still need a permit.

Hand the Kiddo an archaeology permit and then they can do the activity
Squeeze the diver and retrieve artifacts.
To add a level of challenge to this activity you can set a timer for 5 minutes and see if the kid can recover all artifacts inside of five minutes.

Discussion Opportunities
You can then tell the kids that with exception to the Lake Mendota canoes that maritime archaeologists don't typically recover artifacts from shipwrecks. We usually leave them In Situ or in place. In Situ artifacts on shipwrecks are in the spot they originally were or where they shifted to when a ship sank. This can tell us how the ship sank and where the artifact was originally located. It allows us to reconstruct the ship as it was. Leaving artifacts where they are preserves them for future study by maritime archaeologists and for future enjoyment by divers and kayakers.

Additionally, you can talk about how these scientific principles apply to real SCUBA Divers. We have gases inside of our bodies that expand and contract when we dive in the water. If a SCUBA diver rises to the surface too fast the gases inside of their bodies expand too quickly causing the bends, so be sure to slowly ascend your Cartesian Diver.

Troubleshooting The Cartesian Diver:

Diver has sunk or its claws are stuck in open position
Reason: There is no air bubble in the diver: this can happen if the bottle is shaken too hard or turned upside down too rapidly.
Fix: Pour out the contents reserving the gravel, the artifacts, and the Cartesian Diver. Replace the water in bottle and reset artifacts and diver.

Bottle Leaks
Reason: Make sure that cap is screwed on tightly and that no gravel has been caught between the seal and the bottle cap.
Fix: Rinse the cap thoroughly.

Diver cannot lift artifacts but can become positively buoyant
Reason: Diver may have become less buoyant due to loss of air
Fix: Return the diver

Artifacts will not sink
Reason: Tiny air bubbles can form around an artifact which will prevent it from sinking right away.
Fix: Tap the bottle or use the recovery tool to tap the treasure.

III. BAKING POWDER SUBMARINE DIVER WALKTHROUGH

With Neato! Diving Sub

*This activity is best used for large table events

*Needs access to water and a container to hold water

*Eye catching

Key Concepts: The following scientific concepts make this activity work.

Acid: is a substance that in a water solution tastes sour, reacts with bases to form salts and promotes certain chemical reactions. In this activity the cream of tartar inside of the baking powder is an acid.

Archimedes Principle: This principle states that an object will float when its weight is less than the weight of the water that it displaces.

Base: is a substance that in a water solution that is slipper to the touch, reacts with acids to form salts and promotes certain chemical reactions. In this activity the baking soda inside of the baking powder is a base.

Boyle's Law: This law describes how the pressure of a gas (like air) tends to decrease as the volume of a container increases. Or as water pressure changes, the volume of gas in the diver's body also changes. In the case of the submarines in this activity when the volume of carbon dioxide gas increases inside of the submarine, the gas increases until its greater than the volume of water pressure and the submarine rises to the surface. When the submarine surfaces the gas is purges and the submarine fills with water, the remaining gas decreases as the submarine dives to the bottom.

Buoyancy: The opposite of gravity is buoyancy, the upward pressure that is applied to an object in water which keeps it afloat. A body of water supports objects floating in it.

Density: Object/Substance mass per unit of volume. The number of things like water molecules inside of a certain area.

Displacement: displacement is when an object pushes aside water. An object will float if it weighs less than the water that it pushes out of the way or displaces. Displacement is the volume or weight of a liquid displaced by a floating object of equal weight.

Homogenous Mixture: is a mixture of substances that are blended so thoroughly together that you cannot observe the individual substances.

Negatively Buoyant: (or **Negative Buoyancy**): occurs when an objects average density is denser than the density of the liquid into which it is immersed, resulting in the object sinking down to the bottom.

Neutrally Buoyant (or **Neutral Buoyancy**): occurs when an objects average density is equal to the density of the liquid into which it is immersed, resulting in a balance between the forces of buoyance and the force of gravity.

Positively Buoyant: (or **Positive Buoyancy**) occurs when an objects average density is less than the density of the liquid into which it is immersed, resulting in the object floating at the surface.

Solution: is a homogenous mixture (alike) of two or more substances (or solutes) in relative amounts dissolved in a solvent that can be varied continuously up to what is called the limit of solubility. In this case the baking powder itself is made up of baking soda (a base) and cream of tartar (an acid) and the water the baking powder is reacting to is a solvent.

Solvent: The substance into which a solute dissolve into to produce a homogenous mixture. In this activity the water is a solvent.

Solute: The substance that dissolves in a solvent to produce a homogeneous mixture. In this activity the baking powder is a solute.

Chemical Reaction:

Components of Baking Soda Submarine:

1 Tank or tub of Water
4 Submarines
Baking Powder
Spoon
Additional – but not Required
Baking Soda

Setting Up Baking Powder Submarine

1. Fill tub with water.
2. Open tops on submarines.
3. Spoon baking powder into bubble chamber, removing the excess.
4. Replace tops on submarines
5. Grasp the submarine by the sail and shake underwater several times. Let the submarine go and the sub will submerge and surface automatically.
6. Stir the water and the sub will swim in circles
7. **Additional:** Do the same steps 1-6 except fill the bubble chamber with baking soda and drop into water. Then ask the question: “Why didn’t it work?”

Baking Powder Submarines:

These submarines work through a chemical reaction. Baking powder is made up of two substances, baking soda, and cream of tartar along with a little cornstarch. When the baking powder (solute) is added to water (solvent) the baking soda (base), cream of tartar and water (acid) will start a chemical reaction which produces carbon dioxide bubbles. The combination of

the baking soda, cream of tartar and water combine to form a chemical solution. Carbon dioxide bubbles build inside of the submarine eventually forcing it to rise to the surface as it is less dense as the water it is submerged in. Initially the plastic submarine will be negatively buoyant, heavier than the volume of water it is submerged in, adhering to Boyle's Law. As the carbon dioxide gas builds inside of the submarine while the baking powder reacts with the water, the gas will expand overcoming Boyle's law and the submarine will become positively buoyant rising to the surface of the water. When surfaced the submarine will float for as long as it is lighter than the water it displaces. When the submarine surfaces the carbon dioxide will be purged and become negatively buoyant sinking back down.

Additional: When you fill the submarine with baking soda instead of baking powder, you will find that the submarine will remain submerged and the activity will not work. Why not? Baking soda is a base. When there is no acid for the base to react with (unlike the cream of tartar that exists in baking powder) there is no chemical reaction, and no carbon dioxide bubbles are produced therefore the submarine will not surface.

IV. DRESS THE DIVER WALKTHROUGH

What is the diver wearing?

Exposure Suit: Water can be very cold and so scuba divers wear special suits to help keep them warm. One type of suit is a wetsuit. This is like another skin for the diver and traps a thin layer of water between the suit and the skin. Your body warms it up. This warm water moves inside the suit with the diver and keeps them warm. The other type of suit us called a drysuit. Drysuits keep all the water out of the suit and away from the diver. When a diver uses a drysuit and they get out of the water, the only part of their body that will be wet is their face because that is the only part of their body not covered by the suit. A diver chooses which suit to wear based on how cold they get and how cold the water is going to be. People who get cold love drysuits because you can wear your clothes underneath and they won't get wet!

Scuba Tank: The tank is a hollow piece of metal that holds the air that the diver is going to breathe while they are underwater. It is heavy and so it is strapped onto the diver's back, so they don't have to carry it in their hands. As the diver breathes the air in the tank, it gets lighter and so at the end of the dive it is much easier to carry than when the dive started. scuba tanks come in different sizes and hold different amounts of air so divers can choose how long they want to be underwater. Think about the gas tank in your car-as long as it is full, the car can move. As long as a scuba tank has air in it, a diver can breathe.

Mask: The mask is like a pair of big, fancy goggles and is what allows the diver to see all the amazing things underwater without getting water in their eyes. Just like goggles in a pool! Masks are worn on the diver's face and cover their eyes and nose. Before each dive one of the most important steps is to clean your mask so can see clearly. Masks also make everything underwater look a little bigger, so it is easy for a diver to see small things.

Snorkel: The snorkel is a long tube that is next to the mask. When a diver is swimming on the surface to where they are going to dive, they breathe air through the snorkel instead of using the air in their tank. It can be a long swim to where the diver wants to go underwater, so the snorkel helps them breathe while they swim on the surface, but they can't be used once the diver is underwater.

Regulator: Think about a straw. When you drink something with a straw it travels from the cup to your mouth through the straw. For a diver the tank is the cup full of air and

the straw is the regulator that brings the air from the tank to their mouth. Regulators make lots of bubbles because when the diver breathes out, the air escapes from the regulator into the water. But the regulator doesn't look like a straw, it looks more like a hose that way it bends and moves as the diver moves through the water.

BCD Vest: BCD stands for Buoyancy Control Device. Buoyancy is a big word for being able to float. When divers are underwater, they want to be able to stay there without sinking to the bottom or floating up to the surface. The vest helps them do that. It is connected to the tank and allows the diver to put in a little bit of air to help them stay off the bottom, but not too much air that they float to the surface. These vests look like a backpack and are attached to the tank to help keep it in place on the back of the diver. The vest also has lots of clips and pockets for divers to hold on to things.

Gloves: Gloves are used underwater just like we use them on land-to keep our hands warm! Divers want their gloves to be thick enough to keep their hands warm but thin enough to be able to move and do things with their hands.

Gauges: A gauge is a tool that measures something. In your car, there is a gauge that tells your parents when the gas tank is full and when it is going to be empty. Scuba gauges work the same way, they are attached to the tank and show the diver when it is full of air and when it is going to be empty. It is important that divers check their gauges all the time, so they always know how much air they have left. Gauges called dive computers remember all the information from the dive so the diver can keep track of it and record the information when they reach the surface.

Compass: Compasses help divers know what direction they are going while they are underwater. Sometimes it can be very difficult to see because the water is dirty or because it is dark, so a compass helps a diver not get lost in these situations. Divers usually wear their compass on their wrist, like a watch, or clipped to their gear. It needs to be somewhere close by so the diver can check it whenever they need to. Divers also need to keep track of which direction they have gone so they can "retrace their steps" and get back to their boat when the dive is over.

Fins: Fins are long pieces of plastic, rubber, or other material that divers wear on their feet to help move them through the water. Have you ever noticed that you swim faster with flippers in a pool? Fins work the same way by helping divers move faster through the water. Dive gear can be very heavy, and fins help divers to swim without getting

tired while carrying everything. Fins come in all shapes and sizes and some divers even get crazy colors, so they stand out underwater.

Camera: Divers want to take pictures of the cool things they see, and cameras let them do that. But cameras don't usually work underwater, so divers get special waterproof boxes to put around their cameras to protect them. These boxes have buttons just like a camera and they let the diver hold and use the camera without it getting wet. It is very dark underwater so most underwater cameras also have a light with them, so the pictures turn out better.

Dive Slate: A dive slate is like an underwater clipboard that allows divers to write messages or draw pictures of what they see. Some scientific divers use dive slates, mechanical pencils, and special underwater paper to record things while diving.

V. ARTIFACTS TELL A STORY WALKTHROUGH

Which shipwreck story would you like to read? Choose a ship:

Atlanta

It seemed like a normal trip for the steamship *Atlanta* on the morning of March 18, 1906. The 65 passengers rode in comfort as the crew watched the steam pressure gauge and thought about how they would make sure the fine dishes, cookware, metalware, leather, furniture, and human cargo would travel safely from Sheboygan to Milwaukee.

But the smooth journey was not meant to be. Around noon, crewmen found a fire in the hold, where the cargo was stored. The well-trained crew tried their best to fight the fire, but even with the new sprinkler system they couldn't stop the blaze. The crew knew then that they had to get the passengers transferred to the lifeboats.

Just by chance, the fishing tug *Tessler* saw the troubled *Atlanta* and came to help. The fishermen and steamship crew worked together to get all the passengers transferred safely to the *Tessler.* One of the fishermen, Charles Klein, bravely saved the cook of the *Atlanta* who was trapped in the pantry by widening a porthole near the pantry and pulling the cook to safety!

The *Atlanta's* passengers were transferred onto the *Georgia*, another steamship that was nearby, and were taken safely back to Sheboygan. The *Tessler* towed the burning *Atlanta* closer to shore and left it to burn down to the waterline with all its cargo and equipment still on board. The value of the ship and cargo was $200,000. What was left sank 17 feet to the bottom of Lake Michigan. Some of the cookware and other cargo is still seen when divers explore the wreck today.

Now that you have read the story of the *Atlanta*, let's discuss which artifacts might have been found on the shipwreck. Drag the picture of the artifact to one of the boxes to see if you are right. Artifact photos courtesy of the Wisconsin Maritime Museum.

These artifacts were found on the passenger steamer *Atlanta*!

-Griddle: a thin, cast-iron pan used for cooking
-Mixing Bowl: dishware used for cooking or baking
-Steam Gauge: a circular instrument that measured steam under pressure

Home

It was October 16, 1858, at the docks in Manitowoc, Wisconsin. Captain White and his crew of the schooner *Home* were busy loading a cargo of wood, cedar posts, and merchandise bound for Chicago.

Schooners were wooden sailing ships with canvas sails and rigging made of rope. The tools they used to hold the sails and rigging in place were also made of wood. The crews moved the ships from one port to another when wind filled the sails. They didn't have modern lights, radios, or engines. Their speed and safety were dependent on the weather.

At 4:00 the next morning, the *Home* and the schooner *William Fiske* crashed in a thick fog on Lake Michigan southeast of Manitowoc. The *William Fiske* was not damaged, but the starboard side of the *Home* was crushed in, and the masts toppled. The *William Fiske* came alongside the *Home* and took the crew aboard their ship to safety.

The location of the crash was incorrectly reported at the time, so the shipwreck was not discovered until April 1981 by diver Steve Radovan.

Now that you have read the story of the *Home*, let's discuss which artifacts might have been found on the shipwreck. Drag the picture of the artifact to one of the boxes to see if you are right.

These three artifacts were found on the schooner *Home*!

-Belaying Pin: a removable wooden pin fitted into the rail of a ship used to hold ropes in place

-Deadeye: a flat, grooved hardwood disk with three holes used to fasten ropes attached to sails

-Fid: a cone-shaped wooden peg used to open strands of rope

Milwaukee

October can be a dangerous month to be on the waters of Lake Michigan. That was surely the case on October 22, 1929. The car ferry *Milwaukee* had made a trip across the lake from Grand Haven, Michigan to Milwaukee, Wisconsin earlier in the day when the seas were already getting rough.

By 3 PM the ferry was filled with train cars loaded with a variety of goods including bathtubs, food, and automobiles, ready to go back across to Grand Haven. Captain

Robert “Bad Weather” McKay had sailed rough waters many times over his long career, and he felt confident that his crew would keep engines oiled and running and the ferry afloat despite huge waves. He and a crew of about 50 headed out into the terrible gale that proved to be more powerful than the *Milwaukee.* After the *U.S. Lightship No. 95* saw the *Milwaukee* pass by at 3:45, the car ferry was never seen again.

At first people thought the captain had found a safe place for the car ferry to wait out the storm or had just been slowed down by it. But two days later wreckage started showing up along the Wisconsin shoreline. None of the crew survived. One of them did leave a note in a message case aboard a lifeboat. Part of the message said, “The ship is making water fast. We have turned around and headed for Milwaukee…Seas are tremendous. Things look bad. Crew roll is about the same as the last payday.”

In 1972 divers found the ship resting upright in 120 feet of water ten miles away from Milwaukee. Rail cars filled with bathtubs and automobiles can still be seen by divers visiting the site. Photo courtesy of the Wisconsin Maritime Museum.

New: October can be a dangerous month on the waters of Lake Michigan, and that was the case on October 22, 1929. The car ferry *Milwaukee* had made a trip across the lake from Grand Haven, Michigan to Milwaukee, Wisconsin earlier in the day when the seas were already getting rough.

By 3 PM the ferry was filled with train cars loaded with a variety of goods including bathtubs, food, and automobiles, ready to go back across to Grand Haven. Captain Robert “Bad Weather” McKay had sailed rough waters many times over his long career and knew that his crew would keep the engines oiled and running, stay on course, and keep the ferry afloat despite the huge waves. He and a crew of about 50 headed out into the terrible gale that proved too much for them. After the *U.S. Lightship No. 95* saw the *Milwaukee* pass by at 3:45 PM, the car ferry was never seen again.

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In 1972 divers found the ship resting upright in 120 feet of water ten miles from Milwaukee. Train cars filled with bathtubs and automobiles can still be seen by divers visiting the site.

Now that you have read the story of the *Milwaukee*, let's discuss which artifacts might have been found on the shipwreck. Drag the picture of the artifact to one of the boxes to see if you are right.

These three artifacts were found on the car ferry *Milwaukee*!

-Crewman's Shoes: footwear worn by an adult man in the 1900s

-Engine Oiler: a part of the engine that held oil, so the moving parts worked smoothly

-Radio Compass Brass Pedestal Base: the bottom part of a radio compass that helped ships of the early 1900s find their position

Definitions

-**Belaying Pin**: a removable wooden pin fitted into the rail of a ship used to hold ropes in place

-**Crewman's Shoes**: footwear worn by an adult man in the 1900s

-**Deadeye**: a flat, grooved, hardwood disk with three holes used to fasten ropes attached to sails

-**Engine Oiler**: a part of the engine that held oil, so the moving parts worked smoothly

-**Fid**: a cone-shaped wooden peg used to open strands of rope

-**Griddle**: a thin, cast-iron pan used for cooking

-**Mixing Bowl**: dishware used for cooking or baking

-**Radio Compass Brass Pedestal Base**: the bottom part of a radio compass that helped ships of the early 1900s find their position

-**Steam Gauge**: a circular instrument that measured steam under pressure

ARTIFACTS TELL A STORY
With shipwreck mosaic image mats

Collision for the *Silver Lake*
It was the morning of May 27, 1900 when the wooden scow-schooner *Silver Lake* departed Eagle Harbor, in Door County with a cargo of lumber bound for Racine, Wisconsin. That same day the steam-powered steel car ferry *Pere Marquette* was loading its cargo of railroad cars at Ludington, Michigan bound for Manitowoc, Wisconsin.

Schooners were wooden sailing ships with canvas sails and rigging made of rope. The tools they used to hold the sails and rigging in place were also made of wood. The crews moved the ships from one port to another when wind filled the sails. They didn't have modern lights, radios, or engines. Their speed and safety were dependent on the weather. Scow schooners like *Silver Lake* were a special type of schooner that had boxy shaped hulls with flat bottoms. This allowed them to go into shallower harbors like Eagle Harbor while also able to carry a lot of cargo. Anyone could build a scow schooner, if you could build a barn, you could build a scow schooner. Another feature that made *Silver Lake* special is that it was a double centerboard schooner. This meant that the *Silver Lake* could sail closer to the wind and be able to take cargo to market much faster. The *Silver Lake* might be the only double centerboard Scow Schooner ever built.

At 2:30 in the morning, Eastman, the first mate aboard the *Silver Lake* was on watch sailing through dense fog southeast of Manitowoc. He was regularly sounding the fog horn when he had heard the faint sound of a steamer's fog signal. At 2:50 alarmed at the sound of the fog signal was growing louder, Eastmen had woke up the sleeping crew and they had gotten on deck when the massive bow of the *Pere Marquette* appeared from out of the fog and smashed into the *Silver Lake*'s port side almost directly amidships.

The crew of the *Silver Lake* managed to make it into the ship's yawl, one of the crew even managed to jump onto one of *Pere Marquette*'s large anchors and climbed up onto the deck. The mangled *Silver Lake* was cut free from the *Pere Marquette's* bow where it drifted for a few days before sinking into 210 feet of water. The wreck of the *Silver Lake* was discovered in the 1970s.

The Old Ship *Rouse Simmons*
It was late in afternoon on November 22, 1912, when the schooner *Rouse Simmons* departed Thompson, Michigan. As the barometer stated to drop, Captain Schuenemann had just loaded an important cargo of freshly cut evergreen trees for Christmas bound for Chicago.

Schooners were wooden sailing ships with canvas sails and rigging made of rope. The tools they used to hold the sails and rigging in place were also made of wood. The crews moved the ships from one port to another when the wind filled the sails. They did not have modern lights, radios, or engines. Their speed and safety were dependent on the weather.

The *Rouse Simmons* was built in 1868 and by the time of its sailing it was 44 years old. For a wooden sailing ship that's very old. It was still sailing long after schooners had become outdated and replaced with iron hulled steamships. Captain Schunemann had purchased the *Rouse Simmons* for very cheap and did not put any money into the vessel's upkeep. Therefore, the aged vessel creaked and leaked.

This was the last sail for the season and before he departed, he had invited the lumberjacks who cut the trees aboard to catch a ride back to Chicago so they could spend the holidays with their friends and family. The *Rouse Simmons* then sailed into history and remained an unsolved mystery for 59 years. The vessel was last seen at 4pm by the Kewaunee Life Saving Station flying a distress flag while being driven southward by a northwest gale.

The wreck of the *Rouse Simmons* was located in 1971 by Milwaukee diver Kent Bellrichard.

Popular Question: *Rouse Simmons* sank the same year as what famous shipwreck?
A: RMS *Titanic.* Most Children Know This!

VI. PARTS OF A SHIP WALKTHROUGH

With new Shipwreck Mosaic Image Mats

*This activity is good for both small group events and large table events

Key Concepts:

The parts of a ship and shipwreck and the function of those parts.

Part Definitions:

Aft Cabin: Square cabin structure at the stern of a ship
Bow: The front of a ship
Bowsprit: Spar or pole that extends from the bow of a ship that is used to carry sails and support the mast
Foremast: The forward most mast on a sailing vessel with two or more masts.
Mainmast: The principal (main) mast on a ship with two or more masts. It is usually the tallest mast and is aft of (behind) the foremast.
Hatch: Square or rectangular opening in the ships deck for loading and unloading cargo.
Port: Left side of a ship when facing the bow
Starboard: The right side of a ship, when facing the bow
Stern: The back of a ship
Windlass: Winch used to raise and lower a ship's anchor.

Materials for Parts of a Ship Activity:

Rouse Simmons shipwreck mosaic image mat
Silver Lake shipwreck mosaic image mat

12x Parts Cards (1 of Each Part and 3 "Hatch" Cards)

Setting Up Parts of a Ship Activity:

1. Unroll Rouse Simmons Mosaic Image Mat, on a large flat surface
2. Reserve (leave rolled up) the Silver Lake Mosaic Image Mat for later in the activity.
3. Arrange each of the ship parts cards randomly across the shipwreck.

Parts of a Ship:

1. Explain that each of these cards has the name of a part of a ship on it and when ready the kids can pick up the card, flip it over and read the back which will tell them what that part is and it's up to them to match that part to its location on the shipwreck mosaic mat.

2. Some groups might need help to get started with this activity and in those cases, ask the group if they know what the front of a boat is called and if they know, ask them to point at where the front is on the mosaic image mat, then have the kids pick up the card that's titled "Bow" and place it on that part. Then have the kids go from there on their own. If they still need guidance just continue to be the same kind of guide until the children have matched up all the parts.

3. Once the group finishes matching, take them through it and ask what their reasoning is. This is the point where if the children got the matching incorrect, ask them why they think what the part is and then guide them towards the correct answer.

4. Once completed depending on the group and if time allows unroll the mosaic image of the scow schooner *Silver Lake* on a flat surface. Ask the children if they can spot the differences between the *Silver Lake* and the *Rouse Simmons* and because each wreck looks so radically different ask the children to then match the same cards to parts on the *Silver Lake*. If they need guidance, ask them to guess where the bow is. Repeat all previous steps.

5. This activity is best used either before or following the Parts of a Ship activity It's prudent to build the ship and then fill it with artifacts or have the artifacts and then build the ship around the artifacts. It's an easy transition.

VII. DENSITY SPHERE EXPERIMENT WALKTHROUGH

With Educational Innovations Density Sphere Experiment Kit

*This activity is good for table events and teaching events
*Needs access to water
*Eye catching
*This experiment has a lot of options for conducting it
*This experiment is messy

Key Concepts: The following scientific concepts make this activity work:

Archimedes Principle: This principle states that an object will float when its weight is less than the weight of the water that it displaces.

Buoyancy: The opposite of gravity is Buoyancy, the upward pressure that is applied to an object in water which keeps it afloat. A body of water supports objects floating in it.

Density: Fundamental property of matter. Object/Substance mass per (or divided) by unit of volume. The number of things like water molecules inside of a certain area.

Mass: measure of the quantity of matter and is constant throughout the universe.

Negatively Buoyant (or Negative Buoyancy): occurs when an objects average density is denser than the density of the liquid into which it is immersed, resulting in the object sinking down to the bottom.

Neutrally Buoyant (or **Neutral Buoyancy):** occurs when an objects average density is equal to the density of the liquid into which it is immersed, resulting in a balance between the forces of buoyance and the force of gravity.

Positively Buoyant: (or **Positive Buoyancy)** occurs when an objects average density is less than the density of the liquid into which it is immersed, resulting in the object floating at the surface.

Volume: A three-dimensional space occupied by a solid, liquid, or gas.

Materials for Density Sphere Experiment:

Water
Corn Syrup
Salt
Sugar
Plastic Experiment Tube
Plastic Lid for Experiment Tube
6x plastic density spheres
Plastic Samples
Pipette
Spoon

Setting Up Density Sphere

1. Fill plastic experiment tube with water

1A. **Alternate:** Fill plastic experiment tube with corn syrup (If planning to demonstrate corn syrup skip part 2)

2. Mix in salt. **If planning on using salt for this experiment warm water works best to dissolve it.**

2A. **Alternate:** Mix in sugar. If planning on using sugar for this experiment, warm water works best to dissolve it.

2B. **Alternate:** Do not mix in any sugar or water and use plain water.

3. If using salt or sugar for experiment use spoon to stir mixture until thoroughly blended.
4. One by one, drop each of the density spheres into the mixture and replace plastic lid.
5. As a static display at a table event or as a program with a group, observations can be made, and questions can be asked about the density spheres.

5A. **Corn Syrup: Caution Messy!** If conducting experiment with corn syrup: being that the corn syrup is denser than all the density spheres all the spheres will seemingly float on the surface. Alternatively, you can place the density spheres on the bottom and pour the corn syrup on top thus making them appear negatively buoyant. Alternatively, you can fill the cylinder halfway with corn syrup, place all the density spheres in the middle of the cylinder and then fill the rest with corn syrup making the density spheres appear neutrally buoyant. This can give the appearance of different buoyancy without being buoyant. Corn syrup is sticky therefore cleanup is a challenge.

5B. **Salt:** If conducting experiment with salt water: the blue, clear, green, and red density spheres being negatively buoyant should all sink to the bottom. The two white density spheres being positively buoyant will float at the surface. The orange sphere and red bead should be *somewhat neutrally buoyant neither floating at the surface, or sunk at the bottom (but will be only just submerged from the surface). Though in a later experiment the orange density sphere was neutrally buoyant and hovered midway in the cylinder the way it should.

5C. **Sugar:** If conducting experiment with sugar water: the blue, clear, green, orange, and red density spheres being negatively buoyant should all sink to the bottom. The two white density spheres will float at the surface but will be just submerged. The second red bead will quickly sink to the bottom.

5D. **Water:** If conducting experiment with just plain water: the blue, clear, green, orange, and red density spheres being negatively buoyant, should all sink to the bottom. The two white density spheres will float at the surface. The second red bead should start as positively buoyant, but eventually sinks to the bottom becoming negatively buoyant.

Density Sphere Experiment:

This experiment illustrates density and buoyancy. Each of the plastic density spheres are at different densities. Some of the spheres are very dense and heavier than water. Some are less dense and lighter than water. Depending on which experiment you choose to follow, the results will differ. In one experiment some of the density spheres will submerge and in another they will float. The observations that can be made with this activity should center around explaining density and explaining buoyancy. Since the density spheres themselves do not always work perfectly, the best way to illustrate each aspect of buoyancy, is to follow direction 5A and create the illusion of buoyancy. After mixing whatever solution you choose, explain the Archimedes Principle. After you drop the density spheres into the plastic experiment tube and seal the top, ask the kids what they notice. Which spheres are floating? Which spheres are sunk at the bottom? Which sphere aren't doing either? Why are the spheres behaving in this way? Have that conversation. After making those observations, springboard into explaining density, positive buoyancy, negative buoyancy, and neutral buoyancy. Then explain how buoyancy is important for SCUBA divers diving on shipwrecks. Is it good for a scuba diver to be positively buoyant? Is it good for a scuba diver to be negatively buoyant? Where is the best place for a scuba diver to be?

VIII. FIND A ROUTE ACTIVITY WALKTHROUGH

Materials for Find Your Route Activity

1x Great Lakes Map
6x Ship Game Pieces
(1x Black, 1x Blue, 1x Green, 1x Orange, 1x Red. 1x Yellow)
20x Coal (Black) Cargo Pieces
20x Grain/Wheat (Yellow) Cargo Pieces
20x Lumber (Brown) Cargo Pieces
20x Limestone (Gray) Cargo Pieces
20x Salt (White) Cargo Pieces
20x Taconite (Steel) Cargo Pieces
14x Laminated Shipwreck Story Cards (2x of each)

- *Lumberman*
- *Atlanta*
- *Lakeland*
- *La Salle*
- *Pathfinder*
- *Sevona*
- *Appomattox*

Setting Up Find Your Route Activity (Updated)

*Unrolled Game Map
*Depending on numbers divide up ship pieces between players - 1 child per ship or kids can be divided up into teams of 2-3 for each ship.
*Divide up laminated shipwreck story cards between each team. Kids may require assistance with geography as each ship can be set up at the starting port described on each card. Depending on each card, place the cargo pieces discussed on the card at each starting port.

Find A Route Activity:

1. Each Team will play out the historical route of each ship on the laminated cards.
2. Each team can slide the cargo into each slot on the ship.
3. Each team will find the route from port to port based on the directions on the laminated card and maneuver their pieces across the map to their destination.
4. They drop off the cargo pieces at their destination port.
5. Once each team drops off their cargo take them through the discussion points on the card with the instructor.

6. Once each team finishes finding their route, then have them switch their cards with another team and maneuver their ship pieces to the new port.
7. Start the process over again until each team has transitioned through each card and had every discussion.

Find A Route Cards from Original Find a Route Game:

Schooner *Lumberman* 1872

-Load lumber in Grand Haven, MI

-Sail to Chicago, IL to unload lumber

-Sail light (empty) to Kewaunee, WI to pick up a load of shingles

-Sail back to Chicago, IL to unload shingles

Discussion:

Talk About It

*How close did you match your route with the shipping routes of the day?

Answers will be dependent on the kids. Ask about any difficulties with the drawing element?

*Which directions (north, south, east, west) did your ship go during the voyage?

Grand Haven to Chicago- Southwest, Chicago to Kewaunee-North and Kewaunee to Chicago-South

*Talk about ways your voyage would be different when your ship is fully loaded with timber/shingles compared to when it is empty.

Let them brainstorm first.

*Weight of the vessel-how high/low it sits in the water.

*Speed-it won't move nearly as quickly when it is full versus when it is empty.

*Space onboard.

Why Lumber/Shingles?

The state of Michigan was known for forests full of pine and hardwood trees. These were cut and hauled to rivers where they were floated to the shores of Lake Michigan. After being sawed at the mill, lumber was loaded on lumber schooners for delivery to the west. *Lumber was key in building the new communities forming in the west!

Name that Item!

Name at least ten things made from wood that people used 150 years ago and that we still use today.

Let them brainstorm first.

Some ideas: boats, tools, ladders, houses, toys, furniture, fences, crates, barrels, tableware (plates, bowls, etc.), sleds, carts/wagons, bridges, and buildings.

Steamer *Atlanta* 1905

-Load passengers in Grand Haven, MI

-Unload passengers in Sturgeon Bay, WI and pick up new passengers

-Unload passengers in Chicago

Discussion:

Talk About it

*Besides passengers, cargo also could include porcelain, metal ware and enamel ware, leather, and furniture.

*How close did you match your route with the passenger steamer routes of the day?
Answers will be dependent on the kids. Ask about any difficulties with the drawing element?

*Which directions (north, south, east, west) did your ship go during the voyage?
Grand Haven to Sturgeon Bay-Northwest and Sturgeon Bay to Chicago-South.

*Why were many people still using ship transportation rather than driving cars in 1905?
Let the kids brainstorm first.
Cost-cars were very expensive so spending money on a steamer ticket once in a while wasn't as bad.
Practicality-most people still lived fairly close to where they worked (didn't need cars for transportation), but when they wanted to get away, a passenger steamer could do that.
Faster-even if you had a car, it took much less time to go from Wisconsin to Michigan by water than by land (or vice versa).

Ticket to Ride

Summer resort traffic to upper Wisconsin and northern Michigan in the 1900s was primarily by passenger steamer. A trip from Chicago, IL to Harbor Springs, MI was a popular route. The *Manitou* steamship could make the trip in 24 hours and cost $5.00 (meals and sleeping berths were extra!). On board the *Petoskey* on the same route took 40 hours and cost $7.00 to ride-but that included meals as well as a sleeping berth.
Let the kids react to this. What can you buy now for $5 or $7?

Bulk Carrier *Lakeland* 1923 (more complex map-full GL rather than just Lake Michigan)

-Load Rollins automobiles in Cleveland, OH

-Steam to Chicago, IL to unload some of the cargo and load Kissel automobiles.

-Steam to Milwaukee, WI to unload more of the automobiles and load Nash automobiles.

*For this particular cargo, they were headed to a car show in Detroit, but they didn't make it.

Discussion:

Talk About It

*How close did you match your route with the bulk carrier ship routes of the day?

Answers will be dependent on the kids. Ask about any difficulties with the drawing element?

*Which directions (north, south, east, west) did your ship go during the voyage?

Cleveland to Chicago is West then North, then West, then Southwest and Chicago to Milwaukee is North.

*Which Great Lakes did your ship sail through?

From Cleveland you go through Lake Erie, up the Saint Clair River to Lake St. Clair and then into Lake Huron. You travel all the way through Lake Huron, through the Straits of Mackinac heading west into Lake Michigan and then down into Lake Michigan for Chicago and then up the western shore of Lake Michigan to Milwaukee.

*Why didn't people just drive cars from Cleveland to Chicago and Milwaukee to sell them instead of transporting them aboard ships?

Let the kids brainstorm first.

-Is it faster to drive or sail from Cleveland to Chicago? It is faster to drive, but that only moves one or a few cars at a time. Also, if the cars are driven, there is a higher likelihood that something could happen to them (like a crash) and they're no longer "new" when they reach Chicago. *Also think about cars then vs. cars now and the safety of driving that far.

-Number of vehicles-driving can only transport one or a few cars at a time whereas putting the cars on a ship meant that they could transport 30+ depending on the size of the ship. When the Lakeland sank in 1924 it was carrying between 40 and 50 cars.

-Chicago-raise your hand if you have driven through Chicago! What did you think? It can be a mess of traffic today and it was the same way in the early 1900s. People wanted to avoid driving through Chicago at all costs, so transportation on the lakes was one way to avoid that city.

Moving Cars Across the U.S.

*Can you name three ways (other than ships) that automobiles are transported today?

Let the kids brainstorm first.

Planes, trucks, on their own on the road, and trains. Any others?

Then and Now

*Compare and contrast this 1920 Nash with this 2005 Ford 500.
What differences do you see? What similarities do you see?

Schooner *LaSalle* 1874 (most complicated map 4 of 5 lakes)

-Load wheat in Chicago
-Sail to Kingston, Ontario, Canada to unload the grain.
-Sail light (empty) to Cleveland, OH to load salt.
-Sail to Milwaukee, WI to unload salt.

Discussion:

Talk About It

*How close did you match your route with the schooner routes of the day?
Answers will be dependent on the kids. Ask about any difficulties with the drawing element?

*Which directions (north, south, east, west) did your ship go during the voyage?
Chicago to the Straits of Mackinac-Northeast, South through Lake Huron down to Detroit, then further South into Lake Erie and East through the lake, and finally North into Lake Ontario and then Northeast through the lake to Kingston. Then that route is basically done in reverse to get back to Milwaukee. So, Southwest from Kingston to Cleveland. Then West, North, West, and Southwest to get from Cleveland to Milwaukee

*Which Great Lakes did your ship sail through?
Michigan, Huron, Erie and Ontario

*What major lock system(s) did you have to travel through to get to Kingston?
Welland Canal between Lake Erie and Lake Ontario to bypass Niagara Falls is the major lock system. They pass through the Straits of Mackinac to go from Lake Michigan to Lake Huron, use the St. Clair River and Lake St. Clair to get to Detroit, then the Detroit River to get into Lake Erie, and finally the Welland Canal to pass from Lake Erie to Lake Ontario.

Why Wheat?

Wheat seeds came to the U.S. from Middle Eastern countered. As our country spread west, settlers found that the Plains states were ideal for growing wheat. Use this link to see varieties of wheat, what foods are made with them, and which states grow each kind of wheat.

https://www.uswheat.org/working-with-buyers/wheat-classes/

Food for Thought

*Try to name at least ten foods you've eaten in the past week that had wheat as an ingredient. If you are gluten-free, name ten common foods you must avoid.

Let the kids brainstorm and have fun with this one! Get creative!

Bread, tortilla, cereal, pasta, pizza, cake, cookies, pie, doughnut, crackers, muffin, scone, brownie, rolls, etc.

Schooner *Lumberman* 1872

-Load lumber in Grand Haven, MI

-Sail to Chicago, IL to unload lumber

-Sail light (empty) to Kewaunee, WI to pick up a load of shingles

-Sail back to Chicago, IL to unload shingles

Discussion:

Talk About It

*How close did you match your route with the shipping routes of the day?

Answers will be dependent on the kids. Ask about any difficulties with the drawing element?

*Which directions (north, south, east, west) did your ship go during the voyage?

Grand Haven to Chicago- Southwest, Chicago to Kewaunee-North and Kewaunee to Chicago-South

*Talk about ways your voyage would be different when your ship is fully loaded with timber/shingles compared to when it is empty.

Let them brainstorm first.

*Weight of the vessel-how high/low it sits in the water.

*Speed-it won't move nearly as quickly when it is full versus when it is empty.

*Space onboard.

Why Lumber/Shingles?

The state of Michigan was known for forests full of pine and hardwood trees. These were cut and hauled to rivers where they were floated to the shores of Lake Michigan. After being sawed at the mill, lumber was loaded on lumber schooners for delivery to the west.

*Lumber was key in building the new communities forming in the west!

Name that Item!

Name at least ten things made from wood that people used 150 years ago and that we still use today.

Let them brainstorm first.

Some ideas: boats, tools, ladders, houses, toys, furniture, fences, crates, barrels, tableware (plates, bowls, etc.), sleds, carts/wagons, bridges, and buildings.

Schooner *Pathfinder* 1884

-Load coal in Cleveland, OH

-Sail to Milwaukee, WI to unload the coal and load corn

-Sail to Buffalo, NY to unload the corn

<u>Discussion:</u>

Talk About It

*How close did you match your route with the schooner routes of the day?

Answers will be dependent on the kids. Ask about any difficulties with the drawing element?

*Which directions (north, south, east, west) did your ship go during the voyage?

Cleveland to Milwaukee-West then North by Northwest, then West, then Southwest and Milwaukee to Buffalo is the reverse-Northeast, then East, then Southeast by South, then East all the way through Lake Erie to Buffalo.

*Which Great Lakes did your ship sail through?

Lake Erie, Lake Huron and Lake Michigan

*Because your ship has sails, how would the speed and direction of the wind make a difference in your voyage?

-Let the kids brainstorm first.

-If the wind is strong, the ship can sail, but if there is little to no wind, the ship won't move.

-Direction-if the wind is blowing against the ship, rather than with it or behind it, sailing is very difficult and requires many more adjustments.

-Storms can alter course (to escape it) or blow you off course entirely.

Why Coal?

*Unscramble the words below to find examples of things powered by coal in the 1800s.

Psitmsehas = Steamships

rolardai gensine = Railroad Engines

Roin dtopirunco = Iron Production

telse dtopirunco = Steel Production

Ctilereycit = Electricity

Why Corn?

Corn is an ingredient in a lot more than just food. Take a look at this website for ideas, then think about things in your house that use corn.

https://www.campsilos.org/mod3/students/c_history5.shtml

Household uses for corn from website: fabric (strengthened with cornstarch), chicken feed (egg production), soft drinks & other beverages (sweetened with corn syrup), books (cornstarch used in the binding), ink (contains corn oil), ethanol in your car (made from corn), glue, shoe polish, aspirin, marshmallows, ice cream, and cosmetics. What else can you think of? Corn chips, corn tortillas, corn (frozen, fresh or canned), drywall, soap (adhesive agent is corn based), Windex (ethanol), toothpaste (sorbitol-corn glucose), and even some plastics are made out of corn now!

Bulk Carrier *Sevona* 1898

-Load iron ore in Superior, WI

-Steam to Lorain, OH to unload the ore

-Then, you steam light to Marquette, Michigan but there is a storm on Lake Superior so, you have to stop at the locks in Sault Ste. Marie, Michigan to take shelter before continuing on to Marquette.

Discussion:

Talk About It

*How close did you match your route with the steamship routes of the day?

Answers will be dependent on the kids. Ask about any difficulties with the drawing element?

*Which directions (north, south, east, west) did your ship go during the voyage?

Superior to Lorain-East across Lake Superior then Southeast and South through Lake Huron and down into Lake Erie. Then the reverse back to Marquette North through Erie and (Lake St. Clair & Saint Clair River in between) Huron and then further north to stop in the Soo before continuing West to Marquette.

*Which Great Lakes did your ship sail through?

Lake Superior, Lake Huron and Lake Erie

*Why are storms so dangerous on the Great Lakes, and especially on Lake Superior?

Let the kids brainstorm.

Storms come up quickly and the wind can come from multiple directions, meaning that waves can come from multiple directions.

Lake Superior in particular-storms are even more fatal here because there are so few places for safe harbor along the Lake Superior shoreline-harder to outrun a storm and find shelter.

Why Iron Ore?

Almost all iron ore is used in steelmaking. Iron ore was discovered in three different Minnesota iron ranges between 1884 and 1911. Read more about it at: (Good Resource) **https://www.dnr.state.mn.us/education/geology/digging/history.html**

Pound for Pound

According to **MinnesotaIron.org**, every American will need 27, 416 pounds of iron ore in their lifetime. Multiply that by the number of people in your home to get a total! (Tool on the program page).

*I live by myself so my total is 27,416 but there are 7 people in my family so our family total would be 191,912 pounds of iron ore!!! How many people are in your house right now? Who has the biggest family?

*Where does this number come from? We use iron ore everyday sometimes without realizing it! Either iron or steel is a part of almost everything metal in our lives, and since iron is used to make steel, that means iron is everywhere! It in vehicles, appliances, bridges, construction materials, agricultural equipment, transportation (trains, ships, planes), power generation (wind turbines & solar panels), infrastructure and National defense (weapons).

Steamer *Appomattox* 1899

-Load iron ore in Superior, WI
-Steam to Cleveland, OH to unload ore
-Steam to Erie, PA to load coal
-Steam to Milwaukee, WI to unload the coal

Discussion:

Talk About It

*How close did you match your route with the steamship routes of the day?

Answers will be dependent on the kids. Ask about any difficulties with the drawing element?

*Which directions (north, south, east, west) did your ship go during the voyage?

Superior to Cleveland-East across Lake Superior then Southeast and South through Lake Huron and down into Lake Erie. Then Lorain to Erie is East. Erie to Milwaukee is West, then North by Northwest through Lake Huron, West through the Straits of Mackinac and then Southwest down to Milwaukee through Lake Michigan.

*Which Great Lakes did your ship sail through?

Lake Superior, Lake Huron and Lake Eerie for the first leg and then Lake Erie, Lake Huron and Lake Michigan for the second leg of the journey

*Do ships today still carry iron ore and coal?

Yes! Iron ore is the most common cargo for modern Great Lakes freighters. It is shipped as taconite pellets which look like small balls of iron that are produced by taking raw iron ore and grinding it into a powder and then combining it with binding agents. Coal is the second most common cargo on the Great Lakes today. Other common cargoes include grain, salt, sand, limestone, and other products.

Why Iron Ore? (Same resource used in *Sevona* section of the activity)

Almost all iron ore is used in steelmaking. Iron ore was discovered in three different Minnesota iron ranges between 1884 and 1911. Read more about it at: (Good Resource) https://www.dnr.state.mn.us/education/geology/digging/history.html

Using Steel

The amount of steel used in common appliances is amazing! They need to be built strong and durable to withstand the rigors of their workload and steel provides that strength and durability. Here are a few examples of how much steel is in common household appliances:

Kitchen sink-9 pounds, dishwasher-28 pounds, Microwave, 29 pounds, washing machine-95 pounds, clothes dryer-107 pounds and refrigerator-153 pounds.

IX. REFRACTION & UNDERWATER COLOR CHANGE ACTIVITY WALKTHROUGH

*Needs access to water

Key Concepts: The following scientific concepts make this activity work:

Distortion (Spatial Distortion): when something is altered from its true, natural, or original state. In this experiment water distorts how we see objects immersed in water. Water makes objects appear in different colors, water makes objects appear larger, water can make objects appear at a different depth, and water makes objects appear in a different place than where they are set in the water.

Electromagnetic Radiation: Energy that radiates in electromagnetic waves, including radio waves, infrared, visible light, ultraviolet, x-rays, microwaves, and gamma rays.

Electromagnetic Spectrum: is the range of frequencies in the spectrum of electromagnetic radiation and their respective wavelengths and energies.

Electromagnetic Wave: synchronized and patterned oscillations (or waves) of the electric and magnetic fields.

Order of Color (rainbow): Red, Orange, Yellow, Green, Blue, Indigo, Violet. ROYGBIV

Refraction of Light (Underwater): When light travels from air into water, it slows down causing the light wave to change direction slightly. This change in direction is refraction. Water is denser than air and therefore absorbs light quickly.

The Visible Spectrum: The range of wavelengths of the electromagnetic spectrum that is visible to the human eye.

Materials for Refraction and Color Change Activity:

Pencil
Large Drinking Glass
Aquarium Shipwreck
Plastic tub
Water
Clear Tape
Scuba Mask(s)
Color Change Image (Surface)
Color Change Image (25ft)
Color Change Image (50ft)
Color Change Image (75ft)
Color Change Image (100ft)

Setting Up Refraction and Color Change Activity:

1. Fill up water glass halfway with water and place pencil at an angle in the glass.
2. Gather Scuba Masks
3. Clean/Disinfect Scuba Masks (be sure to disinfect after each use)
4. Create image illustrating underwater color change (with a shipwreck)
5. Print out image illustrating underwater color change
6. Affix images to the inside of the mask with clear tape

Refraction and Underwater Color Change Activity:

These scientific principles guide how we observe, perceive, and study shipwrecks and everything underwater. When we look at things underwater its different than when we look at things on land in air. Water distorts the light waves that pass through it. Look at this pencil in this glass, notice that this pencil appears to magically bend (or refract) in the water without actually bending. *Take pencil out to reveal that the pencil is not bent and replace showing refraction again. This is due to refraction, when light travels from air to water, moving into water causes light energy to slow down a bit and causes light to bend slightly because water is denser than air. The pencil looks the way it does out of water because air is less dense, and this is how we are used to seeing it. An object under water appears larger, because refraction causes an illusion of the actual depth, this is due to the light waves reflected from the object submerged underwater are refracted at the surface of the water causing submerged objects to appear larger or slightly forward or backward. Water also effects how we see color underwater. When you look through the first pair of goggles you can see that all the colors appear normal. Now look at the same colors at 25 feet the colors have changed! Darker colors appear more blue and bright colors appear dull. This is because water absorbs different wavelengths of light at different degrees. The longer the wavelength the lower the energy, and the easier it is absorbed by water. The order in which colors are absorbed is the order they appear in the rainbow ROYGBIV. Red is absorbed quickly and had disappeared at 25 feet. Next pair of goggles at 50 feet, notice that red appears black, orange remains the same, but yellow now appears green. All of the darker colors appear blue. Next pair of goggles at 75 feet notice that Light Green now appears yellow, Orange and pink still remains bright. Green remains the same. In the final pair of goggles at 100 feet Brown now appears Blue, Purple appears Blue, Green appears the same, light Green now appears bright Yellow and Yellow appears Tan. Red remains Black and Orange appears the same. As a matter of fact, when viewing objects underwater through a mask, the optical effects are slightly less owing to the air space in the mask.

X. WORD SCRAMBLE & PICTOGRAM WALKTHROUGH

Word Scramble Key

Solve the word scramble below to learn some of the different causes of shipwrecks on the Great Lakes.

1. *Niagara*, a sidewheel steamer, burned in a **RFIE** in Lake Michigan near Belgium, Wisconsin.

Answer: FIRE

2. The schooner *Lucerne* sank in a winter **MRSTO** in Lake Superior.

Answer: STORM

3. A **HCARS** happened between the scow schooner *Silver Lake* and the car ferry *Pere Marquette* near Sheboygan. The *Silver Lake* was cut in two and sank in Lake Michigan.

Answer: CRASH

4. The captain of the bulk steamer *Appomattox* couldn't see because of thick fog and smoke, so the ship went out of the lake and got **KTUCS** on shore outside of Milwaukee.

Answer: STUCK

5. The steamship *Vernon* **DEFOLOD** after large waves crashed onto the fully loaded, unstable ship.

Answer: FLOODED

6. The schooner *Gallinipper* was not carrying any cargo and capsized, or **LIPFEDP** upside down, because of the strong winds of a storm.

Answer: FLIPPED

Shipwreck Word Scramble

Unscramble the words in the sentences below to learn different ways ships sank on the Great Lakes.

1. *Niagara,* a side-wheel steamer, burned in a **RFIE** in Lake Michigan near Belgium, Wisconsin.

Answer: _____ _____ _____ _____

2. The schooner *Lucerne* sank in a winter **MRSTO** in Lake Superior.

Answer: _____ _____ _____ _____ _____

3. A **HCARS** happened between the scow schooner *Silver Lake* and the car ferry *Pere Marquette* near Sheboygan. The *Silver Lake* was cut in two and sank in Lake Michigan.

Answer: _____ _____ _____ _____ _____

4. The captain of the bulk steamer *Appomattox* couldn't see because of thick fog and smoke, so the ship went out of the lake and got **KTUCS** on shore outside of Milwaukee.

Answer: _____ _____ _____ _____ _____

5. The steamship *Vernon* **DEFOLOD** after large waves crashed onto the fully loaded, unstable ship.

Answer: _____ _____ _____ _____ _____ _____ _____

6. The schooner *Gallinipper* was not carrying any cargo and capsized, or **LIPFEDP** upside down, because of the strong winds of a storm.

Answer: _____ _____ _____ _____ _____ _____ _____

Cryptogram Key

This is a cryptogram puzzle where you use a random letter code to solve the words or phrases that describe different reasons for shipwrecks. At the top of the page, there is a row of the crypto letters and a row beneath it of the actual letter they correspond to. Use the clues to figure out some of the reasons that ships wrecked on the Great Lakes.

We have helped you get started by giving you a few letters for the cryptogram. B=R, J=M and K=E. When you are finished, you can go to www.wisconsinshipwrecks.org to read about different types of shipwrecks.

Crypto letters are black and actual letters are red below.

A= W	B= R	D= G	F= P	G= U	J= M	K= E
L= D	M= Q	O= L	P= T	Q= F	S= A	T= S
U= H	V= B	W= N	X= O	Y= I	Z= C	

1. Ouch! That's hot!
   Answer: FIRE

2. What's the forecast?
   Answer: WEATHER

3. To collide with
   Answer: CRASH

4. A person's mistake
   Answer: HUMAN ERROR

5. Mechanical problems
   Answer: EQUIPMENT FAILURE

6. A problem with how it is built or created
   Answer: UNSTABLE SHIP DESIGN

SHIPWRECK CRYPTOGRAM

Solve the puzzle to learn different causes of shipwrecks on the Great Lakes. **Hints: J = M and B = R and K=E**

CRYPTO	A	B	D	F	G	J	K	L	M	O	P	Q	S	T	U	V	W	X	Y	Z
ACTUAL		R				M	E													

Q X B K (Ouch, that's hot!)

		R	E

A K S P U K B (What's the forecast?)

	E				E	R

Z B S T U (To collide with)

	R			

U G J S W K B B Y B (A person's mistake)

		M				E	R	R		R

K M G X F J K W P Q S X O G B K (Mechanical problems)

E					M	E								R	E

G W T P S V O K T U X F L K T X D W (A problem with how it is built/created)

							E							E				

XI. PUZZLES WALKTHROUGH

With acrylic puzzles

*This activity is good for both small group events and large table events
*Eye catching
*Attractive
*Good activity for young children

Key Concepts:

Types of historic ships used and developed on the Great Lakes

Passenger Steamer: A steamship is a ship propelled by a steam engine. Steamships are very large and carry lots of different types of cargo. If it is classified as a passenger steamer, the primary cargo is people.

Schooner: A schooner is a wooden sailing ship with two or more masts rigged fore and aft (from front to back). Schooners are completely dependent on the wind for propulsion.

Scow: A scow is a wooden sailing vessel that is rectangular in shape. They have a very shallow draft, which means they don't sit very low in the water. This allowed them to sail into ports that other vessels couldn't reach because the water was too shallow.

Sidewheel Steamer: Sidewheel steamers used an engine for propulsion and were made of both wood and metal. The engine is attached to large paddles (sidewheels) that turn to move the ship through the water.

Tugboat: A tugboat, or tug, is a small, engine-powered vessel that is very strong and designed to tow (pull) or push another larger ship. They are extremely sturdy, made of wood or metal, and built to endure very difficult work.

Materials:

1x Passenger Steamer Puzzle
1x Schooner Puzzle
1x Scow Schooner Puzzle
1x Sidewheel Steamer Puzzle
1x Tugboat Puzzle
Total: 5 Acrylic Puzzles
Setting Up Puzzles Large Table Events

1. Lay out each puzzle unassembled at the front of each table.

2. Be sure to keep each unassembled puzzle separate. Children tend to try to mix up the puzzles.

3. Puzzles are eye catching and a good way to draw people in. Once at the table offer them other programming.

4. This can be incorporated into other activities like Artifacts Tell a Story. “The schooner on the puzzle is what the *Rouse Simmons* or *Silver Lake*”

5. Explain that the process of maritime archaeology is like putting a puzzle together, between the shipwreck, historic photographs of the ship, newspaper articles on the ship, surviving journals from the crew, artifacts found on the shipwrecks and putting them all together to create a full picture of a ship.

Settling up puzzles - small group events

1. If there is extra time after the completion of other activities, set up the puzzles and divide each puzzle across the kids. If there are five children, one puzzle per kid and then pass the puzzle on after they are done. If there are ten kids have the kids pair off.

2. If you’re working with a group that skews younger, use the puzzles as it’s a simple tool to engage with younger kids.

3. Explain each type of ship that is seen on the puzzle once the puzzle is complete

XIII. 3D PRINTED ARTIFACTS WALKTHROUGH

With a scan of Canoe #1

*This activity is good for both small group events and large table events
*Eye catching
*Attractive
* Works with adults and children
*Cutting edge

Key Concepts:

3D Printing: The action or process of making physical object from a three-dimensional digital model, typically by laying down many thin layers of a material in succession.

3D Scanning: Three-dimensional laser scanning is a non-contract, non-destructive technology that digitally captures the shape of physical objects using a line of laser light. Three-dimensional laser scanners create "point clouds" of data from the surface of an object. Three-dimensional laser scanning is a way to capture a physical objects exact size and shape into the computer world as a digital three-dimensional representation.

Archaeology: The study of human history through physical remains. The "Stuff" people leave behind.

Dugout Canoe: Dugouts are the oldest type of boats. Native people used carefully controlled fire to hollow out a tree log and then the burned wood would be scraped out with a tool. They would burn more of the wood, put out the fire and scrape more. This process would be repeated until the log was canoe shaped.

LiDAR: A scanning system which works in the same principle of radar but with light from a laser.

Photogrammetry: The process of taking many pictures of an object from many different angles and then stitching them together to create a 3d Models

3d Printed Dugout Canoe:

The story of Canoe #1 is well known and has reached all corners of Wisconsin. People are curious about this object and its story. Canoe #1 is currently undergoing conservation and is currently unavailable to the public. Having a 3D printed replica made from the actual scans taken of the artifact is the closest that anybody can currently get to the artifact. In both small groups and large table events this object is a good way to introduce people to the concept of archaeology and introduce the rest of the educational activities.