SAN FRANCISCO MARITIME
NATIONAL PARK ASSOCIATION

EXPLORERS

Pre- and Post Visit Activities



Dear Explorers Teacher,

This packet is designed for your use in the classroom. The activities included here introduce various themes relating to exploration and maritime history. They aim to be informative, as well as to heighten your students' excitement about their upcoming trip on the Gaslight. While we encourage using as many of these activities before and after the program as you see fit, none of this material needs to be mastered for the students to have an educational experience aboard.

While on the Explorers Program, your students will work together on the boat as they hoist and trim the sails. They will then rotate through four learning stations while Gaslight sails the bay. These stations are called: Trick at the Helm and Watch, Tools of Navigation: Charts, Compass, GPS and Dead Reckoning and the Maritime History of San Francisco Bay.

Students who participate in the Explorers program are encouraged to see themselves as young explorers who have much yet to discover. May these activities assist you and your students on your journey!

We Wish You Fair Winds,
Explorers Crew

PS… As this packet and our technology have evolved, some of the formatting has proven troublesome, and we apologize for any unusual spacing.

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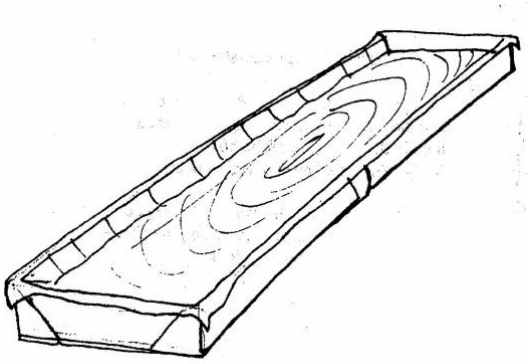
Trick at the Helm



Trick at the Helm At this station, your students will take turns steering the vessel. While awaiting their turn at the helm, students may practice knot tying and will learn about the history of San Francisco scow schooner. Additionally, they will be recording their observations on an informal ship's log. The following classroom activities are designed to give your students a feel for the rich history of our maritime past. Most of all, they are meant to peak your students.' interest and get them excited about their upcoming sail.

Activity #1: Exploring the Past Students can read the two-page history, "Exploring the Past," that recounts contributions from Asia, Africa, the Mediterranean and Arab world that made 15th Century European exploration possible. Then you can hand out the "Exploring the Past." crossword puzzle. All the crossword puzzle answers can be found in the "Exploring the Past." history mentioned above. You can also give your students a word-search puzzle. The answers to the crossword puzzle are all hidden in there somewhere! None of the words are backward. Some are on the diagonal. Answer keys to both puzzles are provided.

Activity #2: Build Your Own Boat Pass out the "Build Your Own Boat." handout, as well as the necessary materials. These are listed on the handout. You might want to give the students construction paper, so they can make more sturdy sails; although they can also cut out the sail pattern found on the handout. If you build a water tank, your students can then race their boats. To build a water tank, follow these steps: 1) Take two cardboard under-bed storage boxes and assemble them so one side is left open. 2) Tape the two boxes together at the open ends. 3) Place an open plastic bag in the boxes lengthwise, so that it completely covers the boxes. 4) Fill the plastic with water. Your students can time how long it takes for their boat to get from one end of the water tank to the other using wind as their power. Flapping a piece of cardboard creates a fine wind, although you must be careful not to create a small gale and blow your boat over!



Water Tank

Activity #3: Thump Mats Provide each student with the ."Thump Mats." handout and five feet of polyester clothesline. Clothesline is very inexpensive, and easy to find at any hardware store. The students will also need tape to hold down the form of the thump mat while they are working on it. After they have finished with this activity, your students can glue their thump mats to colored pieces of construction paper and hang these on the wall.

Exploring the Past

Over 500 years ago, Christopher Columbus set off on a long journey, hoping to find a sea route to Asia. Like many Europeans of the time, he admired the riches that came from other lands. Columbus hoped to return home with boats full of silk, porcelain, spices and gold. Yet these are not the only treasures that distant lands had to offer Columbus! These cultures were also rich in knowledge and technology. Knowledge and technology from Asia, Africa, the Mediterranean and the Arab World made cross-Atlantic journeys like Christopher Columbus.' possible!

One of the first "explorers" that we know by name came from Africa. His name was Harkhuf. He was an Egyptian nobleman who lived over 4,000 years ago! He set off on a great journey and returned home with gifts such as incense, ivory and grain. The Egyptians had developed very good sailing ships for travel on the Nile River. An Egyptian named Ptolemy, who lived 2,000 years after Harkhuf, influenced Columbus greatly. Ptolemy was a mathematician and **astronomer**. An astronomer is a person who studies the stars. Ptolemy knew that the earth is a sphere, and that it would be hard to make flat maps of a non-flat planet! Yet he worked very hard to do so and became "the father of **cartography**." Cartography is the making of maps.

Ptolemy drew imaginary lines on his maps. He drew lines of **latitude** that ran east-west and lines of **longitude** that ran north-south. Although Ptolemy was very smart, he was not always right. He thought that the world was much smaller than it actually is. Christopher Columbus believed Ptolemy.'s calculations, and thought that Asia was closer to Europe than it actually is!

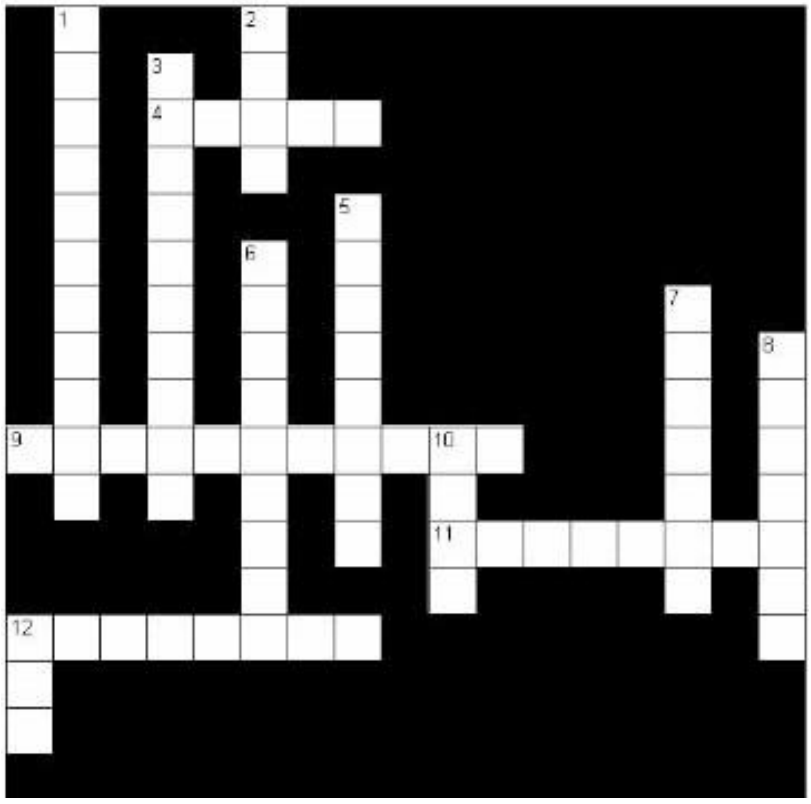
In the ancient world the Greeks and Phoenicians were great traders. The Phoenicians were centered in present-day Lebanon. Their trading ships had a long **keel** on the ship's bottom that was strengthened by a rope running from the **stern** to the **bow**. The stern is the back of the ship and the bow is the front. These ships were very strong, and could carry many goods. For exploration, both the Greeks and Phoenicians used boats called "penteconters." that were rowed by 50 men! Over 2,300 years ago a Greek named Pytheas solved many problems that had been bothering explorers. For instance, Pytheas found a good way to determine latitude using a sundial. He also tried to work out the position of **true north**. True north is not exactly the same as **magnetic north**, which means that magnetic compasses are always a little bit off.

The Arab World produced much of the mathematical knowledge that made later exploration possible. Geography and astronomy were very important to Arab civilizations, and beautiful observatories were built in this part of the world. The **lateen sail** was also developed in the Arab world. The lateen sail is triangular and attached to a short mast. This type of sail allows a boat to sail across and even somewhat into the wind. The lateen sail was also used on Chinese junks. It was later adopted by the Europeans for cross-Atlantic exploration, and is still used by sailors today!

The Chinese have a very rich **maritime** past. The word "maritime." means "relating to the sea." The Chinese invented the magnetic compass, which became one of the European explorers' most valued tools. The Chinese invented gunpowder, the bomb, the cannon and the rocket. They were also the first people to put efficient **rudders** and good **bulkheads** on their ships. A rudder is a plate in the water that is mounted to the stern of the ship and helps to direct the ship's course. A bulkhead is a wall that divides the ship into compartments. Bulkheads make the ship sturdier and help to contain water that enters the ship!

These ideas and tools, such as the compass, were among the many riches that helped make European exploration possible. You might even say that these ideas and tools were as valuable as gold!

"EXPLORING THE PAST· CROSSWORD!



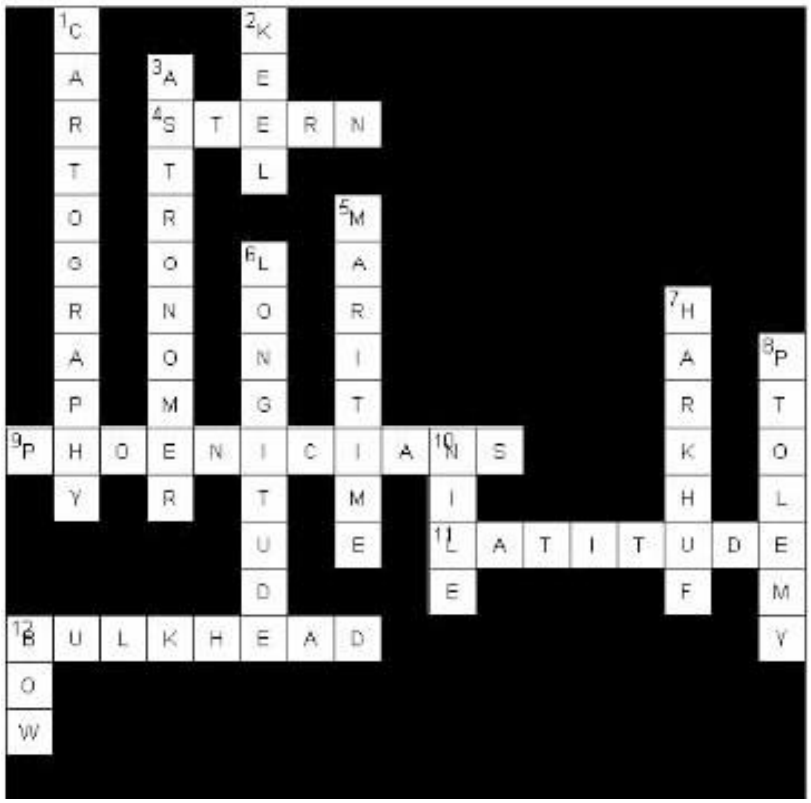
Across

4. The back part of a ship
9. **These famous** explorers lived 1n present day Lebanon
11. An imaginary **line running** east-west across the earth's surface
12. The name for a wall on a ship

Down

1. The Study making or maps
2. Phoenician trading ships had a long
3. **One who** studies the stars
5. This word **means** "relating lo the **sea•**
6. An imaginary line running **north-south across the** earth's surface
7. The first explorer we know by name
8. **This famous** astronomer believed the world to be smaller than ii actually is
10. A famous river in Egypt
12. The forward part of a ship

"EXPLORING THE PA.sr· CROSSWORD!



Across

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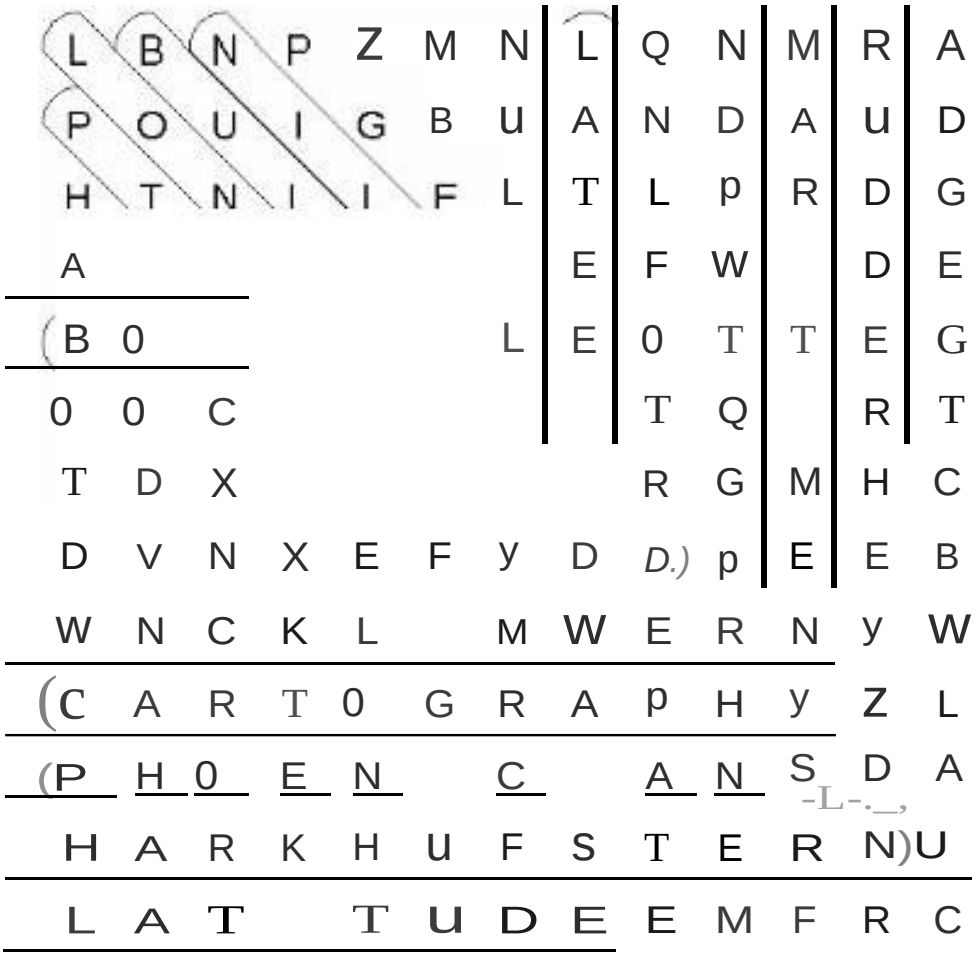
10. A famous river in Egypl
12. The forward part of a ship

"EXPLORING THE PAST" WORDSEARCH!

L B N p Z M N L Q N M R A
p 0 u G B u A N D A u D
H T N L L E L T L p R D G
A u 0 G K E E E F W D E
B 0 W L H L E 0 T T E G
0 0 C Q E T E N T Q R T
T D X C M u A R G M H C
D V N X E F y D D p E E B
W N C K L M W E R N y W
C A R T 0 G R A p H y Z L
p H 0 E N C A N S D A
H A R K H u F S T E R N u
L A T T u D E E M F R C

bow
bulkhead
cartography
Harkhuf
lateen
latitude
longitude
maritime
Nile
Phoenicians
ptolemy
rudder
stern

FIND THE CROSSWORD PUZZLE ANSWERS!



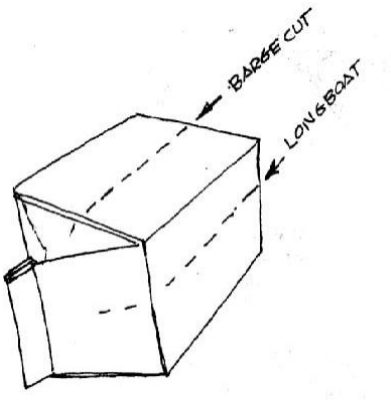
bow
bulkhead
cartography
Harkhuf
lateen
latitude
longitude
maritime
Nile
Phoenicians
Ptolemy
rudder
stern

BUILD YOUR OWN BOAT

You can be the Captain of your very own boat. All you need are a few simple supplies and some imagination!

You Will Need: An empty juice box 7• Scissors 7• A Straw 7• Toothpicks 7• Modeling Clay 7• Crayons (optional) 7• An Imaginary Crew, Imaginary Seas and a Gust of Imaginary Wind!!

Step #1: Make sure that your juice box is clean and dry.

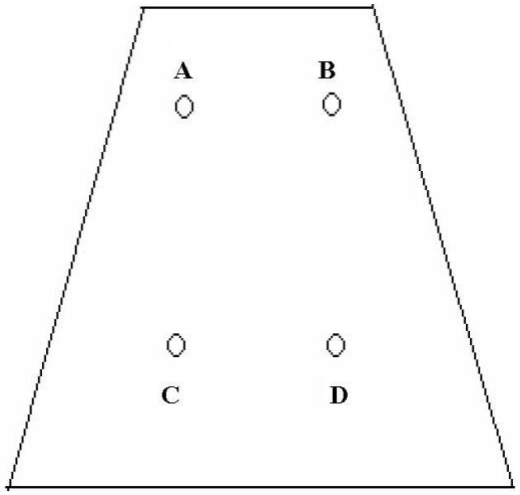


Step #2: Cut the juice box in half lengthwise. Use either the barge cut or longboat cut, or cut a hole in the large side of the box. Now you have yourself a boat!

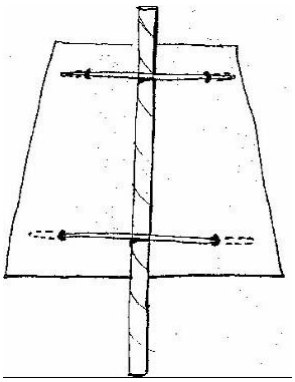
Step #3: Take a small piece of modeling clay, and place it in the center of your boat. Put the straw into the clay. There is your mast!

Step #4: Make a sail by cutting out the sail pattern below or a cutting a similar pattern out of construction paper. If you would like, you can waterproof your sail by coloring both sides with a crayon. While you are at it, decorate your sail!

SAIL PATTERN



Step #5: Use a toothpick to poke through holes A, B, C and D. Place the straw against the sail pattern and attach the sail using the toothpicks so that it looks like this. A

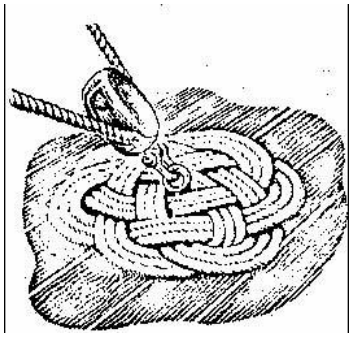


Step #6: Choose a name for your new boat, and let the adventures begin!

Thump Mats

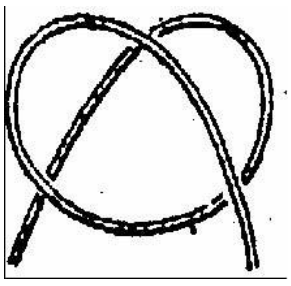


What does a ."thump mat." do? Imagine that you are out sailing on a boat. You can hear the loud rattles and bangs of deck blocks hitting the deck. If you put a thump mat down, it helps to absorb some of the shock and to lessen the noise. That means that it will help to protect your boat! Look at the picture below. It shows a thump mat between the deck and the deck block.

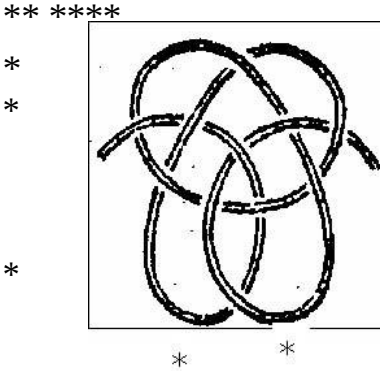


A Thump Mat in Use!

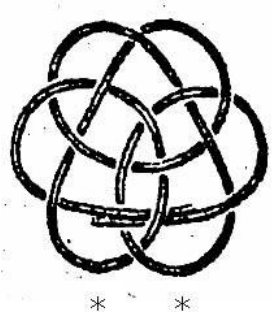
Below you can see the three steps involved in making your own thump mat. Use about five feet of rope to make a small thump mat of your own. You can also use polyester clothesline. After each step, tape down the form. You only need six pieces of tape. Put one piece of tape down at each of the * symbols you see below. When you are finished, you can glue your thump mat to a piece of colored construction paper and hang it on the wall. Thump maps are both useful and attractive!



Step 1



Step 2



Step 3

Navigation: These activities will supplement the Navigation Station aboard. Activities #1 and #3 are designed to teach the concept of latitude and longitude. Activity #2 is designed to give your students a feel for the complex landscapes hidden below earth.'s oceans. All three of these activities are meant to familiarize your students with physical aspects of our planet.

Activity #1: Make Your Own Globe The "Make Your Own Globe" handout can be copied and given to your students along with the two cut-outs that are provided. You might want to construct a model globe in advance. It would help to illustrate to the students how large their globes will be. If you want your students to make bigger globes, you can enlarge the cut-out patterns on a copier.

The students should color in their oceans and add details before cutting out and assembling the globe patterns. They might want to mark the Prime Meridian, the Equator, the approximate location of San Francisco, etc.

Activity #2: The Ocean's Landscape You can copy the "Ocean's Landscape." handout and the "Emilyland." illustration and give these to your students. The students are asked to draw their own picture of the ocean's landscape, including an island, a ship or a boat, a few fish, etc. After they have completed this activity, you might ask the class the following questions: What names did you give to your islands? What details did you include in your scene? Can you think of things that sailors have to pay attention to? (The handout poses this question, and your students might come up with answers such as ."the weather," "wind direction," "their location and course," etc.)

Make Your Own Globe
It Really is a Small World!

To make your own globe, you will need: A balloon, scissors, 4 pieces of tape, A blue and a black crayon or colored pencils or markers, the two Globe Cut-Outs

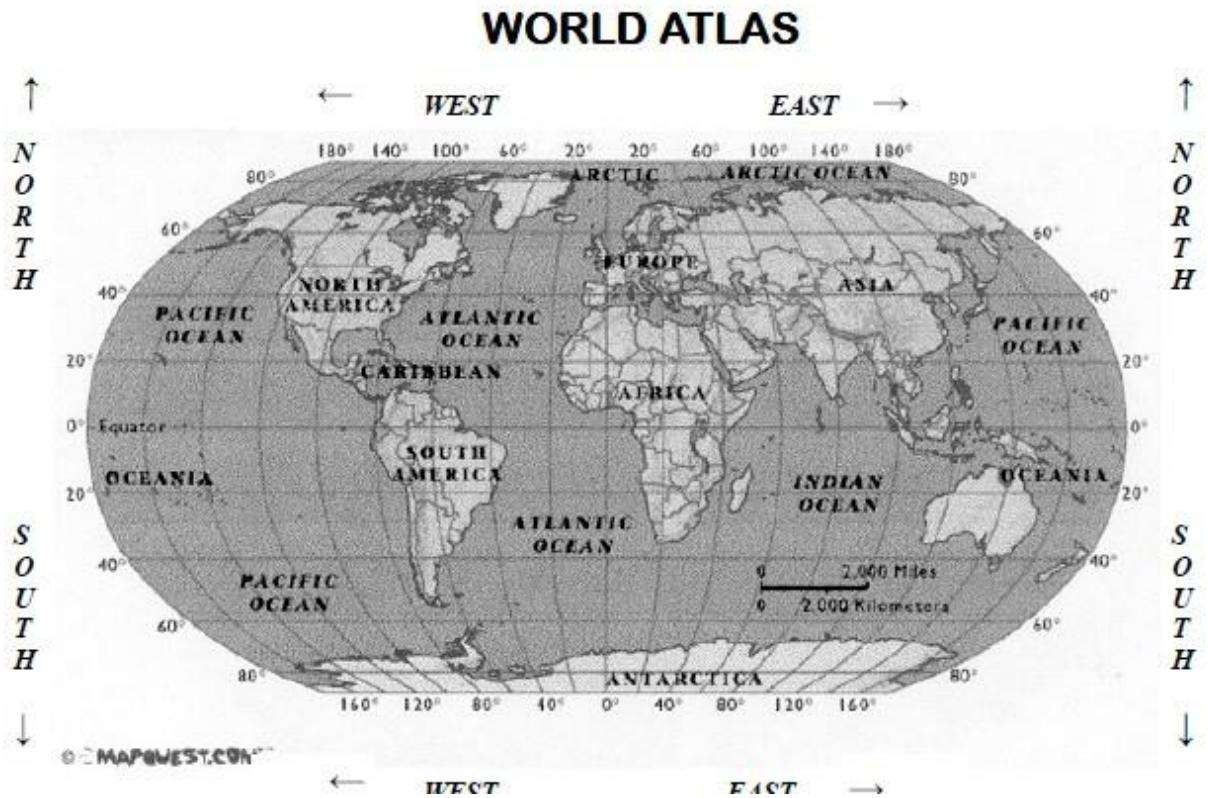
Step #1 Color the earth's oceans blue! If you have any questions about where the land ends and the Oceans begin, you can look at the WORLD ATLAS below.

Step #2 Cut out both parts of the GLOBE CUT-OUT.

Step #3 Blow up your balloon. Before you tie your balloon, make sure that it is the right size. You need to be able to connect the "North Pole." of your cut-out to one end of the balloon, and the "South Pole" of your cut-out to the other!

Step #4 Tie your balloon. Then, use tape to fasten the "Poles." of your cut-out to the "Poles" of your balloon. Leave the lip of your balloon hanging out at the North Pole. You can tie a string around this lip, and hang your globe from the ceiling!

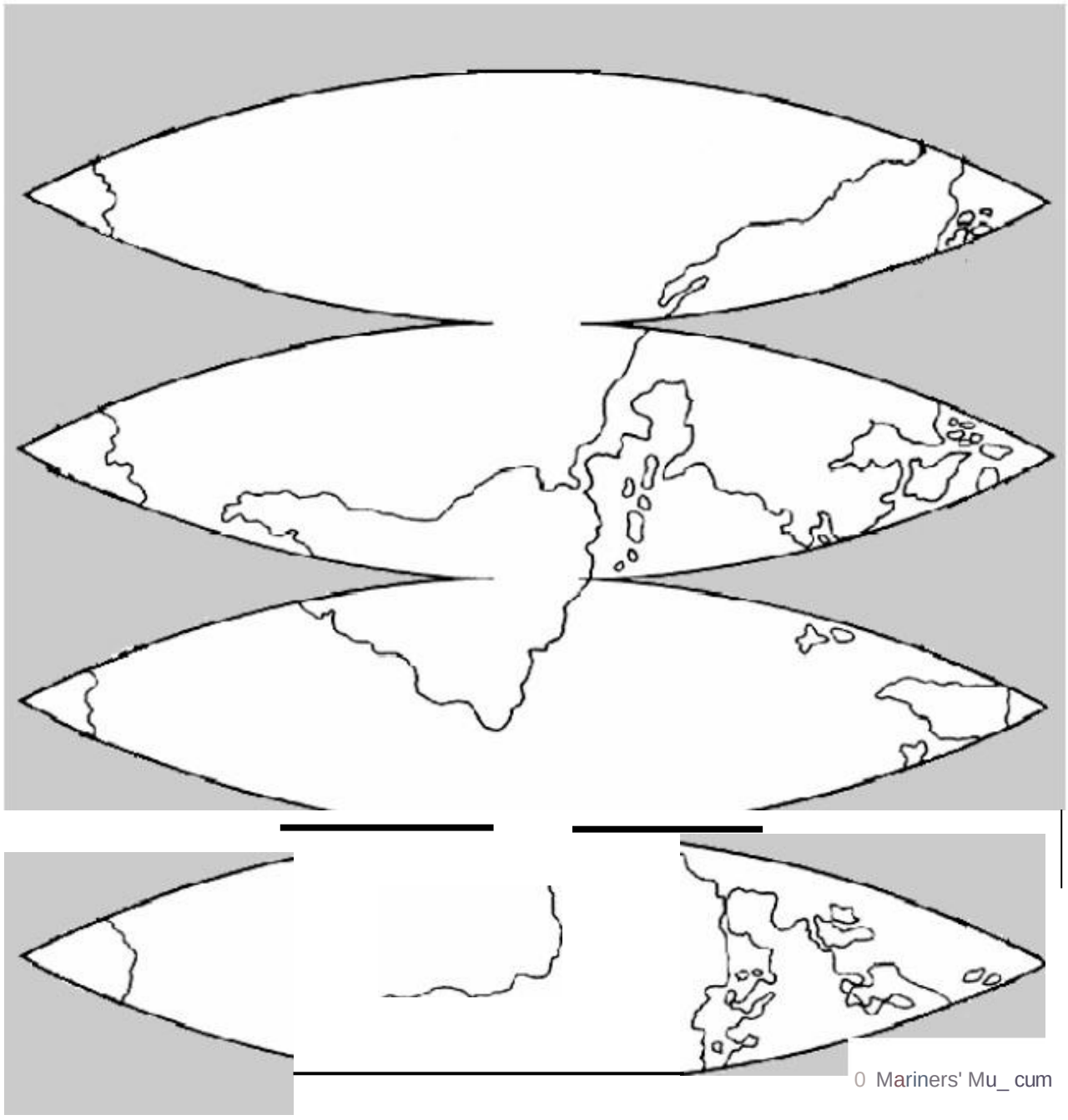
Step #5 Use the World Atlas below to locate the Equator. Draw the Equator onto your globe. You can also write the names of Earth's continents onto your globe and the names of earth's oceans. This small world belongs to you decorate it in your own style!



Globe Cut-Out #1

Cut out the gray area. Tb.is cut-out is one piece.

+-- **SOUTH** **NORTH** --t



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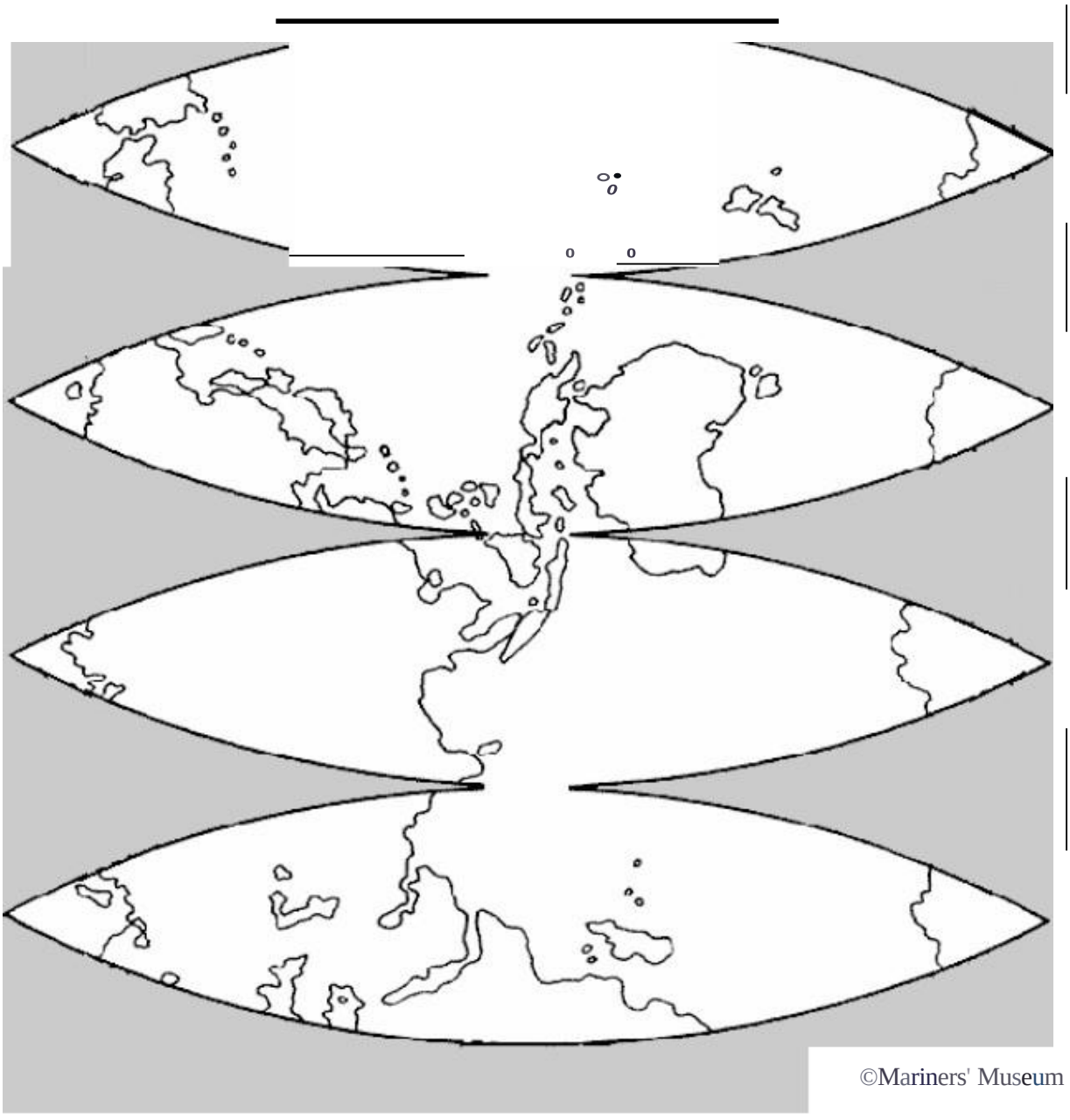
Globe Cut-Out #2

Cut out the gray area. This cut-out is one piece.

NORTH **SOUTH**



©Mariners' Museum

The Ocean's Landscape

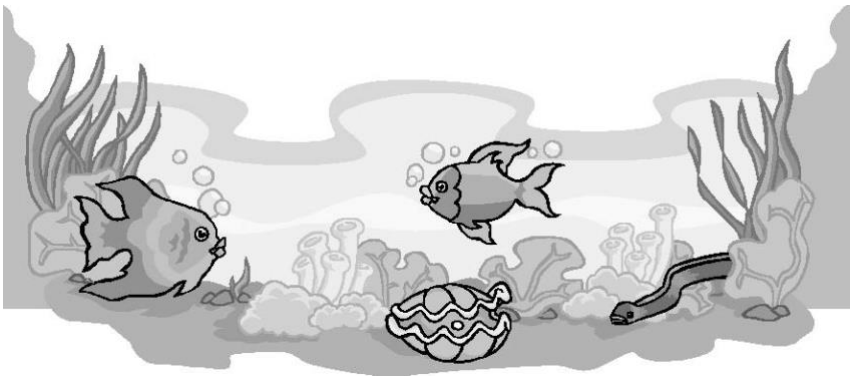
When you think of the word "landscape,." what images come to mind? Perhaps you imagine rolling hills, large oak trees and a giant rock. When you think of the word "ocean," what comes to mind? My guess is that most of you are thinking, "Water, of course!." and that very few of you are thinking: "Rolling hills, large oak trees, and a giant rock." Am I right? You might be interested to know earth's oceans have very complex landscapes! Underneath all of that water there are rolling hills, giant rocks, and many varieties of large plants. Perhaps instead of landscapes we should call them oceanscapes!

Look at my drawing of myself and my island. My name is Emily, and I live on the small island of "Emilyland." Now, draw your own picture of the ocean's landscape! What will you draw in your oceanscape?

Be Sure To Include:

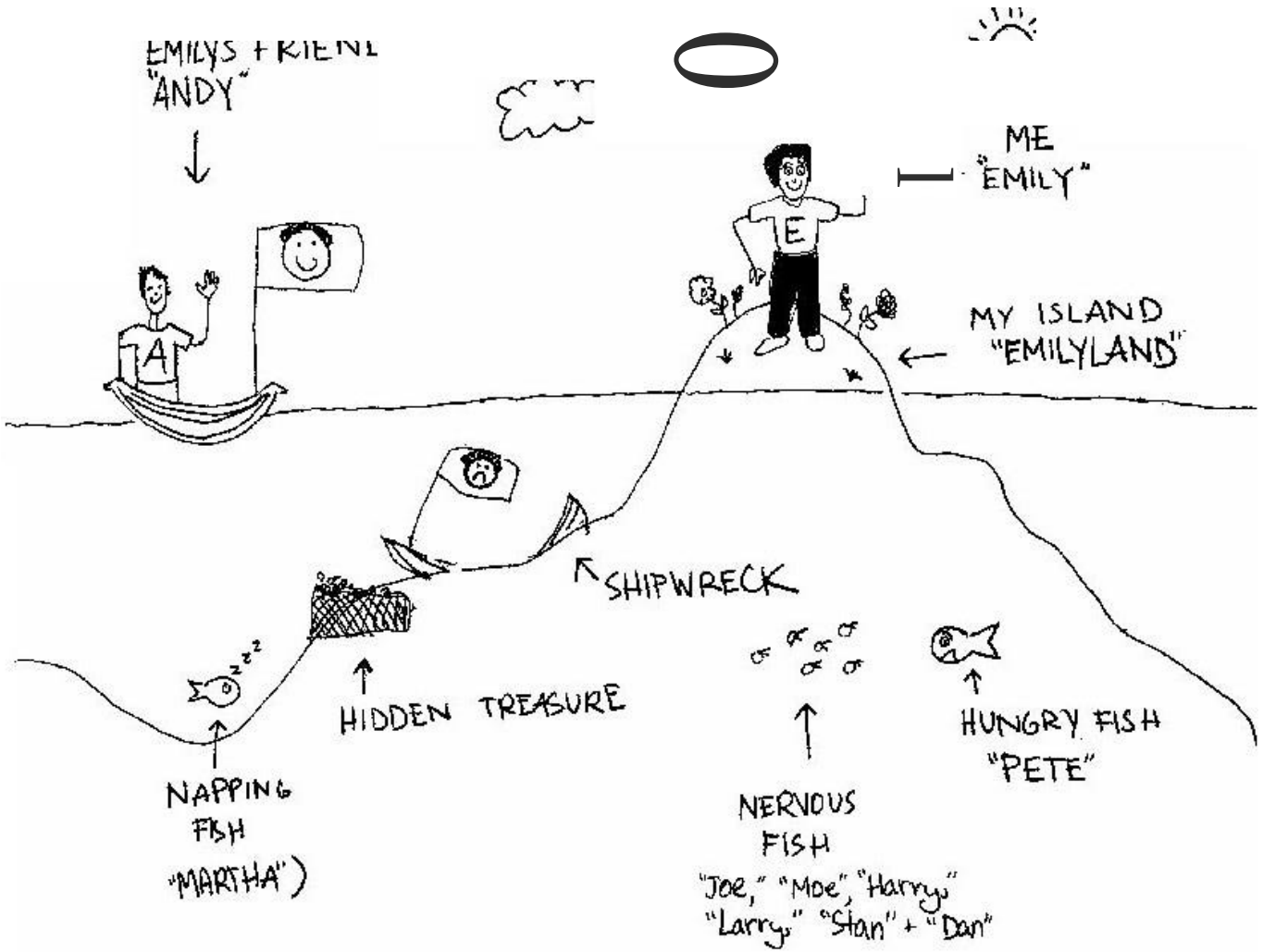
The landscape under the water.
Include one island and name it!
The surface of the ocean. Any ripples or waves?
One surface boat or ship.
At least two people. Are you in the scene?
The sky Can you see the sun, clouds, or signs of an approaching storm?
At least three fish. This is an ocean, after all!
Some form of plant life

You Might Also Include:



A shipwreck.
A giant whale.
A lost city.
A submarine.
A diver.
A variety of fish! Other objects that might be found on the ocean floor!

So, how does your picture look? Are there any landmasses just below the surface of the water? Sailors use charts of the ocean to avoid these dangers! Can you imagine how many things a sailor has to think about? I can think of many things a sailor must consider. Can you think of five different ones?


EMILYS FRIEND
"ANDY"
ME
"EMILY"
MY ISLAND
"EMILYLAND"
SHIPWRECK
HIDDEN TREASURE
NAPPING
FISH
"MARTHA")
NERVOUS
FISH
"Joe," "Moe", "Harry"
"Larry," "Stan" + "Dan"
HUNGRY FISH
"PETE"

CHARTS OF
San Francisco Bay



Charts of the San Francisco Bay At the Navigation and History stations the students will be comparing the modern and historical charts with one another, as well as with the landmarks they see before them.

The following activities are designed to familiarize your students with certain aspects of historical and contemporary mapmaking. If you wish to do all three activities with your students, you might choose one area to focus on, such as your classroom or school. The students can draw a map of the area and a corresponding map cartouche and profile.

Activity #1: Design Your Own Cartouche You can simply photocopy the ."Map Cartouches." handout and the cartouche pattern, and pass these on to your students. The handout tells the history of map cartouches and gives your students an assignment. It is to decorate the cartouche pattern with words and pictures that tell the story of a particular area, such as their town or school. As mentioned above, you might decide to do all three of the activities described here. The students would then choose one area, such as their town, school or classroom, and draw a map, map cartouche, and profile of the area.

Activity #2: Drawing and Using Profiles Photocopy the "Profiles." handout and make sure that your students have paper on which they can draw their profiles. The handout tells the history of map profiles and asks your students to draw a profile of an area they know well. Their school or classroom are good examples. You might decide in advance what the students can draw, especially if you are planning on doing all three of these activities.

Activity #3: Mapping Your Area Ask your students to draw a map of an area they know well, such as their neighborhood, school or classroom. If they have not done **Activity #1**, you might give them the ."Map Cartouches." handout from that activity, and ask them to decorate their maps with both a cartouche and other relevant illustrations.

Map Cartouches

A map cartouche (kar-TOOSH) is any decoration on the map that is self-contained. If you see words or pictures that are contained in a box or a circle or a seal, it is a cartouche! Here are two examples of map cartouches from maps of the San Francisco Bay. The cartouche on the left was drawn in 1803 when California still belonged to Mexico. That is why the text is written in Spanish.



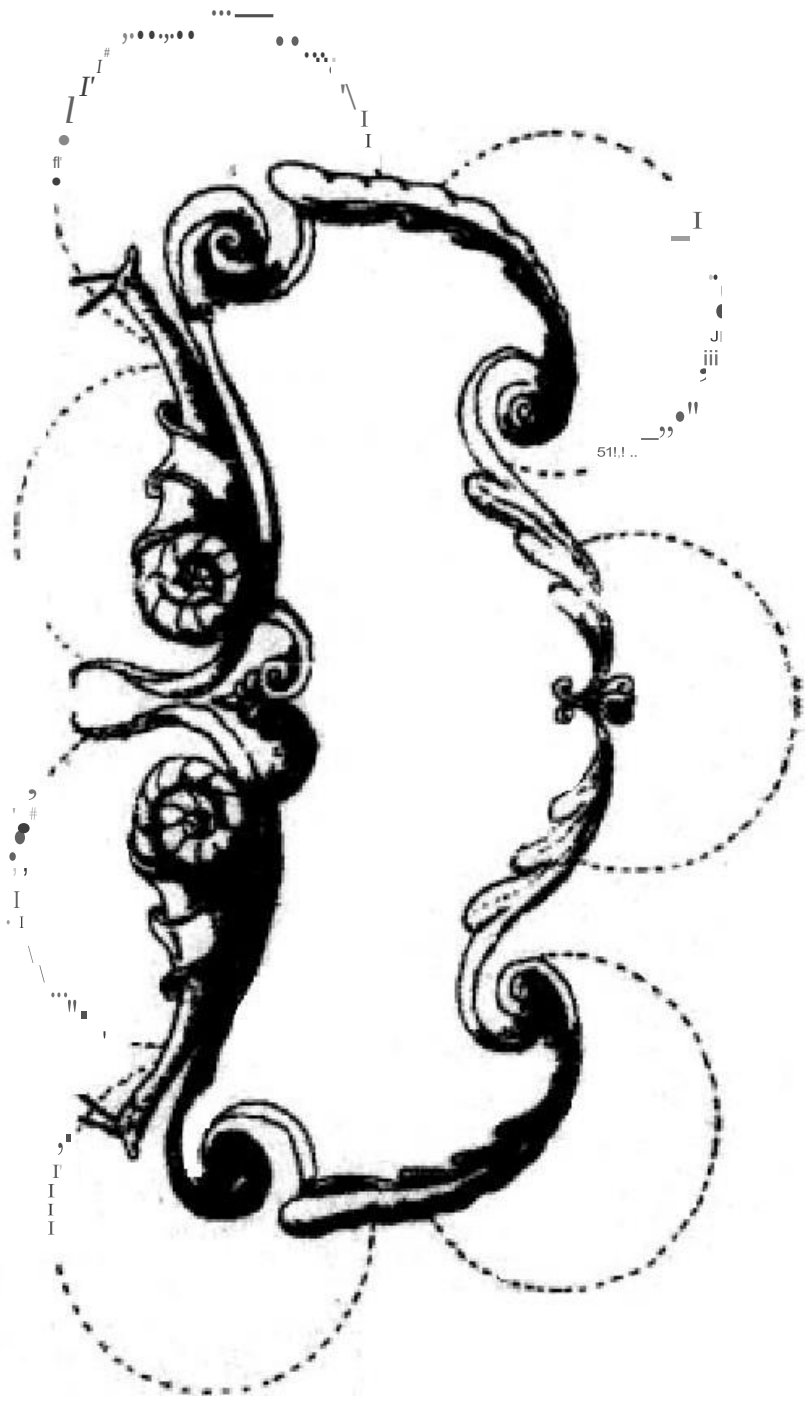
Mapmakers are also called cartographers. Sometimes they will draw other designs on maps, such as a dragon or a sea monster. These pictures are not cartouches. A mapmaker could turn them into cartouches by putting boxes or circles or seals around them. See the example below. Now do you understand what a cartouche is?





NOT A CARTOUCHE! **A CARTOUCHE!**

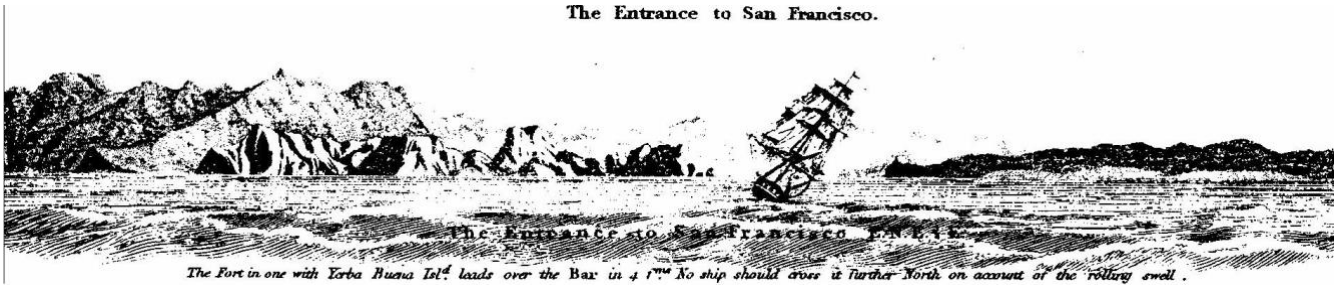
So, what kind of information do mapmakers put in their cartouches? They might write their own name, the date the map was made, the name of their leader, or their country.'s seal. Sometimes they also show products of the area represented by the map. Imagine a map of Fisherman.'s Wharf in San Francisco. A cartouche on that map might contain drawings of a tourist, a lobster, and an old sailing vessel. Draw a map cartouche for a map of your town, neighborhood, or school!



PROFILES

Have you ever helped someone to find their way by reading a map? Maps can be very useful on car trips or on walks through a town that you don.'t know well. You might look at the map and say, ."We are here, and now we need to turn left on Jackson St.." Great! But, what if you can.'t see the street signs? They can be especially hard to spot when you are driving. The streets rush by and you say, ."Oh, I couldn.'t read that street sign!." While you are saying that, another street sign flies by your window!

When we give somebody directions to our house, we usually give them not only street names, but landmarks as well. ."Turn left on Jackson Street by the Pet Store. There is a big statue of a cat outside. You can.'t miss it.." Now, that is helpful! While maps show you what an area would look like from the sky, profiles show you what an area looks like from eye level. Look at this profile of the entrance to the San Francisco Bay.



PROFILE OF THE ENTRANCE TO THE SAN FRANISCO BAY

When the time this profile was made, profiles were used mostly for decoration. Still, this picture would help a sailor to recognize the San Francisco Bay and to safely enter the bay.

Earlier profiles provided sailors with even more information than this one. They showed church steeples and other buildings that might help a sailor to see where he or she must go.

Draw a profile of the outside of your school. Show a student safely entering the main entrance. Or draw a profile of the outside of your classroom with a student safely entering the right room! Draw as many landmarks as possible. For example, there might be a fire extinguisher outside of your classroom door Imagine that these profiles will be used by new students who are not yet familiar with your school!

Tools of Navigation At this station, your students will use various tools of navigation to chart the Alma's course. They will take compass bearings to determine their current position. Once they have plotted this information on to a chart, students will use simple math to solve problems concerning the Alma's course.

The following activities are designed to teach your students about other traditional tools of navigation.

Activity #1: Hands-on Measurements The ."Hands-on Measurements." handout can be photocopied and passed on to your students. Your students will have different answers for Step #4 that depend on where they are sitting. If they do this activity from their desks or some other fixed point, they can check their measurements later using a quadrant or astrolabe. See Activities #2 and #3. After they have filled out the handout, you might take them outside to measure the angle of the sun. Because the sun appears to move 15º every hour, your students can easily measure how many hours in 15º increments it will pass before it sets. Make sure they do not look directly at the sun.

Activity #2: Make Your Own Quadrant Your students can each make their own quadrants by following the directions on the ."Make Your Own Quadrant." handout. All of the materials needed for this project are listed on the handout. After they have finished this activity, they can work in pairs to put their quadrants to use. If they have done **Activity #1**, they can return to the desk from which they made their original measurements and compare these to the new measurements given by the quadrant. For homework, they can also determine their latitude in degrees by finding the altitude of Polaris.—the North Star.

Activity #3: The History of the Sextant You can photocopy the ."History of the Sextant." handout for your students. Students can go online and research one of the tools of navigations shown on the handout. How was this tool different from those that came earlier and later? Can they find and print photographs of the navigational tool they are researching? Perhaps your students can make collages and give presentations on what they have discovered. Have your students present the tools in order from oldest to newest, so they can all watch the history of the sextant unfold. If your students want to make their own astrolabes, they can find instructions at www.astrolabes.org/MARINER.HTM.

HANDS-ON MEASUREMENTS!!

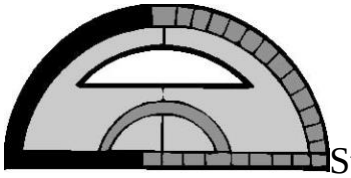
Do you know what ."Polaris." is? Polaris is the star that is located directly above the North Pole. Early Arab sailors knew how to use Polaris to find their way. Home. Before setting off on a journey, a sailor would outstretch his hand and measure the



On his return journey, he would simply sail in the right direction until Polaris was once again located in the right spot in the sky. The fixed star of Polaris and his own hand measurements would lead the sailor to his homeport.

You can use your hand to make some measurements as well.

Step #1 Draw a 180º arc on your paper by tracing the curved edge of a protractor. Mark every 15º.



Step #2 Stretch both of your arms out to the side so that they form one perfectly straight line like the bottom of your protractor. Imagine a perfect 180º arc going over your head from one hand to the other. Look up. The 90º point is right there above your head.

Step #3 Form two fists. Make a fist of one outstretched hand. Measure out your arc using your fists by putting one fist on top of the other and then taking the bottom fist out and putting it on top. Six fists should add up to 90º and 12 to 180º . If that is not the case, then move your hands towards or away from your face to





make your fists larger or smaller.

Step #4 Each one of your fists now measures 15º . Find objects in the classroom that are located at: 0º _____ 180º _____

90º 15º _____ 165º _____

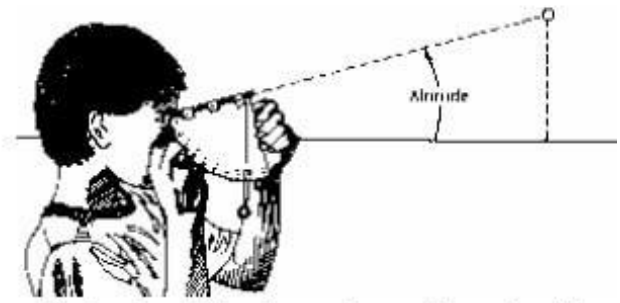
0°

30° _____ 140° _____ 45° _____ 135° _____ You can list the objects next to the arc you drew earlier.

Step #5 For finer measurements, see how many fingers you would use to measure out 1° , 5° and 10° !

MAKE YOUR OWN QUADRANT





Christopher Columbus used a quadrant just like the one shown here!

<u>To Make Your Quadrant, You Will Need</u>

7• The quadrant pattern

7• Light Weight Cardboard

7• Scissors

7• Paper Punch (optional)

7• Tape

7• A Drinking Straw

7• String

7• A Weight

7• Glue

Step #1 Glue the page with the quadrant pattern to a piece of light weight cardboard. Then cut out the quadrant pattern.

Step #2 Use your scissors or paper punch to cut out a little notch at each of the lines marked along the curved edge of your quadrant.

Step #3 Cut your drinking straw to the same length as the side of your quadrant that is marked ."attach straw along this edge.." Tape the straw along that edge!

Step #4 Carefully poke a small hole through the small black circle in the corner of your quadrant. Put a piece of string through this hole, and tape the string to the blank side of the cardboard.

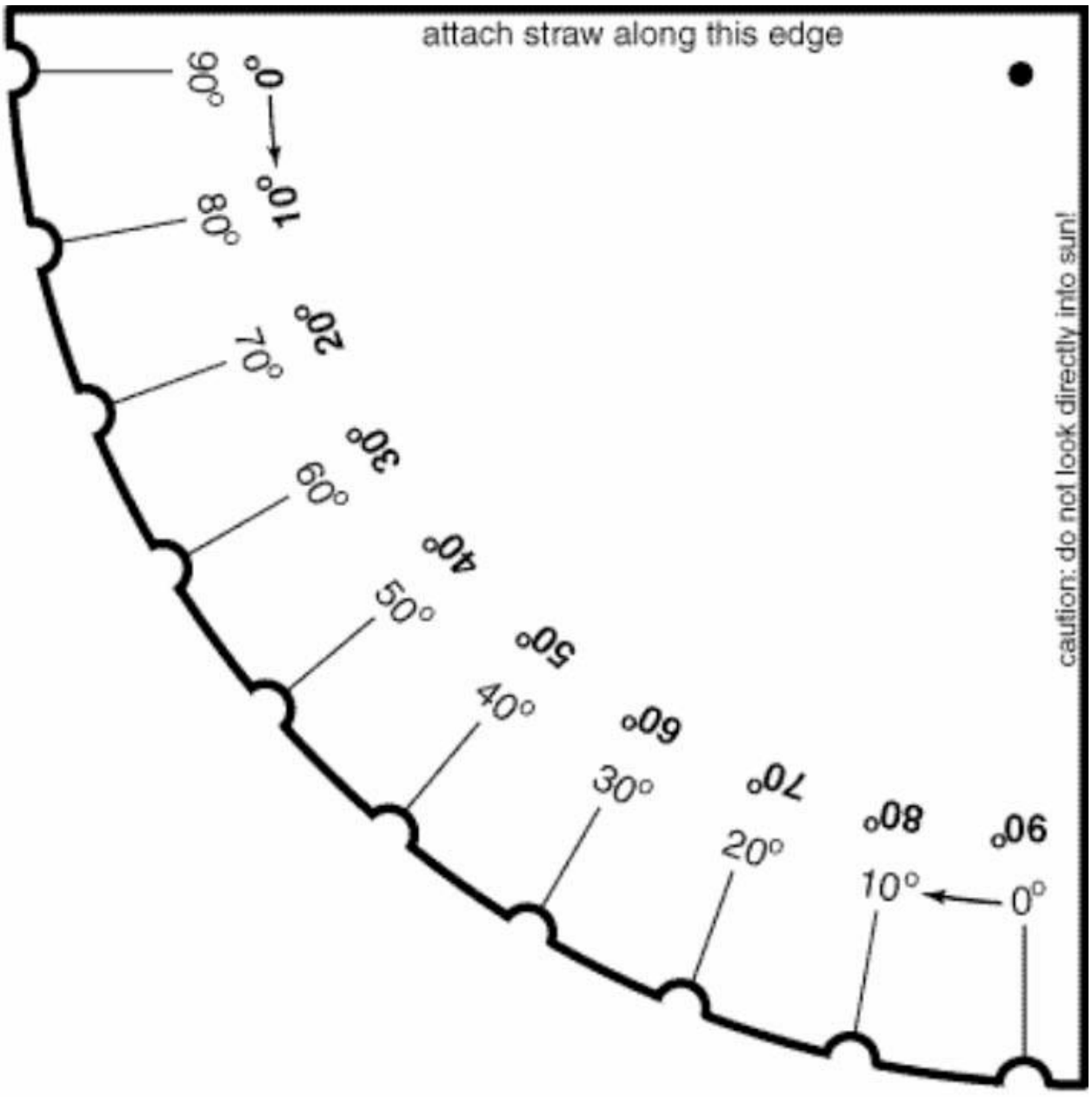
Step #: Tie a weight to the end of the string that is hanging down over your quadrant pattern. It should look like the quadrant seen above!

To Use Your Quadrant You Will Need: 7• A friend 7• Objects to Measure 7•

Step #1 If you want to find the altitude of an object, look at that object through the straw. Flagpoles, stars and tall buildings work well.

Step #2 The point where the string crosses the scale gives you your measurement. Have your friend read the angle on the lower scale. That is the object.'s altitude!

QUADRANT PATTERN



HISTORY OFTHE SEXTANT

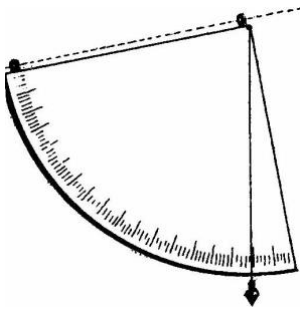
It's all done with angles from star to horizon.

1



KAMAL

2



QUADRANT

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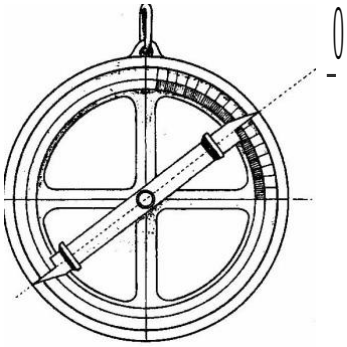
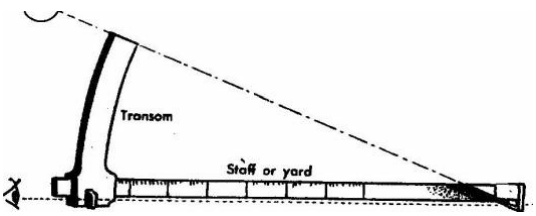


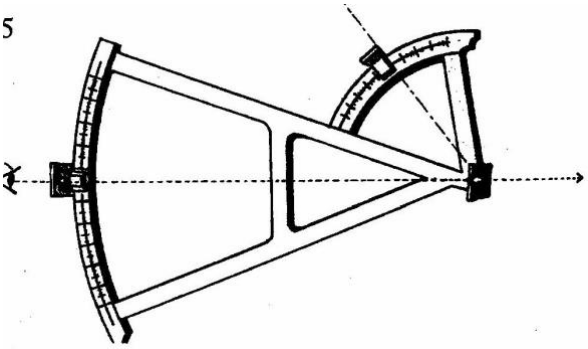
ASTROLABE

4



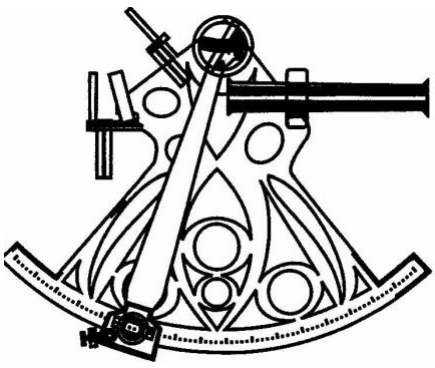
BACKSTAFF

5



I>AVIS QUADRANT

6



SEXTANT

COPYRIGHT INFORMATION AND ONLINE RESOURCES FOR TEACHERS

The Globe cut-out in the .“Make Your Own Globe.” activity is from the Mariners.’ Museum.’s website: www.mariner.org. We thank the Mariner.’s Museum for their permission to republish this activity here. The .“Age of Exploration.” section of their website is a wonderful resource for elementary and middle school teachers who are looking for historical information and classroom activities.

The cartouche pattern in the .“Design Your Own Cartouche.” activity is from the University of Southern Maine.’s website: www.usm.main/edu/maps/lessons/ nrindex.htm. They have developed a curriculum for teachers entitled .“Charting Neptune.’s Realm: From Classical Mythology to Satellite Imagery..” Our .“Profiles.” activity was also inspired by information found on this website.

The .“Solve One of History.’s Greatest Riddles.” activity was inspired by the .“Crack the Code.” activity found at www.nationalgeographic.com. In .“Crack the Code,.” students use latitude and longitude to catch a couple of .“crafty robbers..” This website has a great introduction to the coordinate grid system of latitude and longitude. Many of the Xpeditions activities found at this site are both informative and fun.

For more maritime related activities, check out the Woods Hole Sea Education Association.’s site at www.sea.edu/k12lessonplans/k12StarToSteer.htm.

You can find short biographies of many explorers at www.infoplease.com/spot/ scibio3.html.

You can also find more information about us, the San Francisco Maritime National Park Association, at our website: www.maritime.org.

EXPLORERS

Post-Visit Activities



The Skies Above To sailors, weather can be both useful and destructive. Sailors depend on the winds to direct their vessels. They also understand that storms can pose great dangers. The following activities are concerned with weather. They teach the causes of various weather patterns and provide insights on how we can predict what weather will be coming our way.

Know What the Winds will Bring **.—** How to Build and Use a Weather Vane For this activity, students can work alone or in pairs. Have a compass ready so that students can orient their weather vanes. There are two ways to form the letters N, S, E and W. Students can either write the letters on the corners of a piece of cardboard, or form the letters out of paper clips. The latter can be difficult, however, and more time consuming. The worksheet .“What Your Weather Vane and Barometer Can Tell You.” shows how wind direction and barometer readings can be used to predict the weather. Your students can keep a log of wind direction and barometer readings and see if their predictions come true. You can simply use a store bought barometer, or do the following activity as well.

Build Your Own Barometer Students can work in pairs or small groups to complete this activity. Building a barometer requires a fair amount of materials, and working in groups cuts down on the materials needed. You might also have a store bought barometer on hand so that the students can calibrate theirs. Once they have completed their barometers, students should take frequent readings and log the changes that occur. They can use the worksheet .“What Your Weather Vane and Barometer Can Tell You.” to predict the weather. They should also keep track of local weather patterns to see if their predictions come true.

Use Your Senses to Predict the Weather This worksheet contains hand-me-down maritime and landlubber lore on how to predict the weather. To help them to remember some of these indicators, students might draw a picture of what they can expect to see when the weather is about to turn bad. They might also compose poems or songs that will help them to remember some of the information.

Know What the Winds will Bring

How to Build and Use a Weather Vane

What is a Weather Vane?

A weather vane is a tool that shows wind direction. Wind direction can help us to predict the weather. For instance, what type of weather does southern California tend to get? That.'s right, hot weather. Winds from the south tend to bring this heat to us, while winds from the north often bring cold weather. East winds .— that is, winds from the east .— generally bring rain, while west winds bring clearing. Those are the rules for the Northern Hemisphere. In the Southern Hemisphere, they are exactly the opposite for every direction!

You Will Need 7• A Plastic Bowl or Old Flowerpot 7• A Lump of Clay 7• A Pencil with an Eraser 7• A Straight Pin 7• A Drinking Straw 7• Scissors 7• Glue 7• An Index Card or Piece of Light Cardboard 7• A Red Marker 7• A Compass 7• 4 Large Paper Clips **or** Another Index Card/Piece of Light Cardboard



What to Do

1. Form the letters N, S, E and W from pieces of paper clips. Wind these around the pencil, just below the eraser. **OR** poke a light piece of cardboard through the pencil and write the letters N, S, E and W on the cardboard.'s four corners.
2. Use the scissors to make a one-inch vertical slit in one end of the drinking straw. Cut out an arrow tail from an index card or light piece of cardboard. Glue this arrow tail into the cut end of the straw. Mark the other end of the straw with the red marker.
3. Insert the straight pin through the straw about two inches from the arrow. Push the pin into the eraser end of the pencil. Be sure the straw can move freely.
4. Prop the pencil up by its point in a lump of clay. **OR** prop it up in the dirt of a shallow flowerpot or in a plastic container filled with sand, marbles or any other heavy material.
5. Place the weather vane in a spot where the wind is not blocked by buildings. Use a compass to make sure your N, S, E and W letters are set up correctly. Watch your weather vane turn!

Log the wind direction and predict what weather these winds will bring. Were you right?

Build Your Own Barometer

What is A Barometer? A barometer is an instrument that measures air pressure. Air pressure is caused by the Earth.'s gravity. Earth.'s gravity pulls on the air, causing the air to press down on the Earth. This weight is called air pressure.

Cool air is dense. When cool air is present, the air pressure is usually high. Warm air is less dense. When warm air is present, the air pressure is usually low. High pressure usually brings clear weather, while low pressure brings bad weather and strong winds.

Big changes in air pressure tend to bring winds. That is because changes in air pressure mean that dense, cool air is rushing in and forcing the less dense warm air out. Think about that the next time the wind is whipping through the trees!

What Your Need 7• A Jar with straight edges. Peanut butter jars work well. 7• A Balloon or other latex material large enough to slip over the top of the jar 7• A Drinking Straw 7• A 2." x 7." Cardboard Strip 7• A Block of Wood or other heavy object with a straight side 7• A Rubber Band large enough to fit around the top of the jar 7• Masking Tape 7• Glue



What To Do Step 1: Make sure that the jar is at room temperature. Stretch the balloon/latex tightly over the top of the jar. Use the rubber band to secure the balloon/latex in place. The rubber band should form an air-tight seal.

Step 2: Place a drop of glue onto the middle of the balloon and glue one end of the straw there. The other end of the straw should extend over the edge of the jar. Allow the glue to dry.

Step 3: Glue the Cardboard Strip to the Block of Wood so that the cardboard stands upright. Place it next to the end of the straw that is extending over the edge of the jar. Use a pen to mark the position of the straw onto the card. You can mark it with a simple line, with the date, or with the reading from a calibrated barometer.

Step 4: As the air pressure changes, the straw will respond by moving up or down. When air pressure increases, the pressure outside the jar is greater than the pressure inside the jar. Therefore the balloon rubber/latex pushes down, and the pointer end of the straw moves up. When the air pressure goes down, the air inside the jar presses harder than the outside air. The rubber/latex pushes up and tightens, and the pointer moves down.

What Your Weather Vane and Barometer Can Tell You

Using Wind Direction and Air Pressure to Predict the Weather

What You Need To Know

Wind direction and air pressure are the two main keys to predicting weather. With the help of the following table, you can be your own meteorologist.

#	Lat, Long	First	Country	Last
1.	(40ºN, 85º E)	C	Canada	A
2.	(47ºN, 19ºE)			Y
3.	(50ºN, 45ºE)			N
4.	(35ºN, 53ºE)			N
5.	(30ºS, 25ºE)			A
6.	(40ºN, 30ºE)			Y
7.	(20ºN, 55ºE)			N
8.	(45ºN, 1ºE)			E
9.	(52ºN, 0ºW)			M
10.	(44ºN, 26ºE)			A
11.	(2ºN, 23ºE)			A
12.	(15ºN, 44ºE)			N



Use Your Senses to Predict the Weather

How to Predict the Weather Explorers used hand-me-down maritime lore to predict the weather. People on land .— who sailors call landlubbers .— have used their own signs to predict the weather. Below you will find signs used by both mariners and landlubbers. Make a daily weather log where you record your observations and predict the weather. Be sure to record the day.'s weather as well so you can see if your predictions came true!

How to Remember Some of these ."Signs." Draw a picture of some of the things you can expect to see when the weather is about to turn bad. Draw another picture of things you might see when the sun is going to shine. You can also write rhyming poems or songs to help you remember some of these signs.

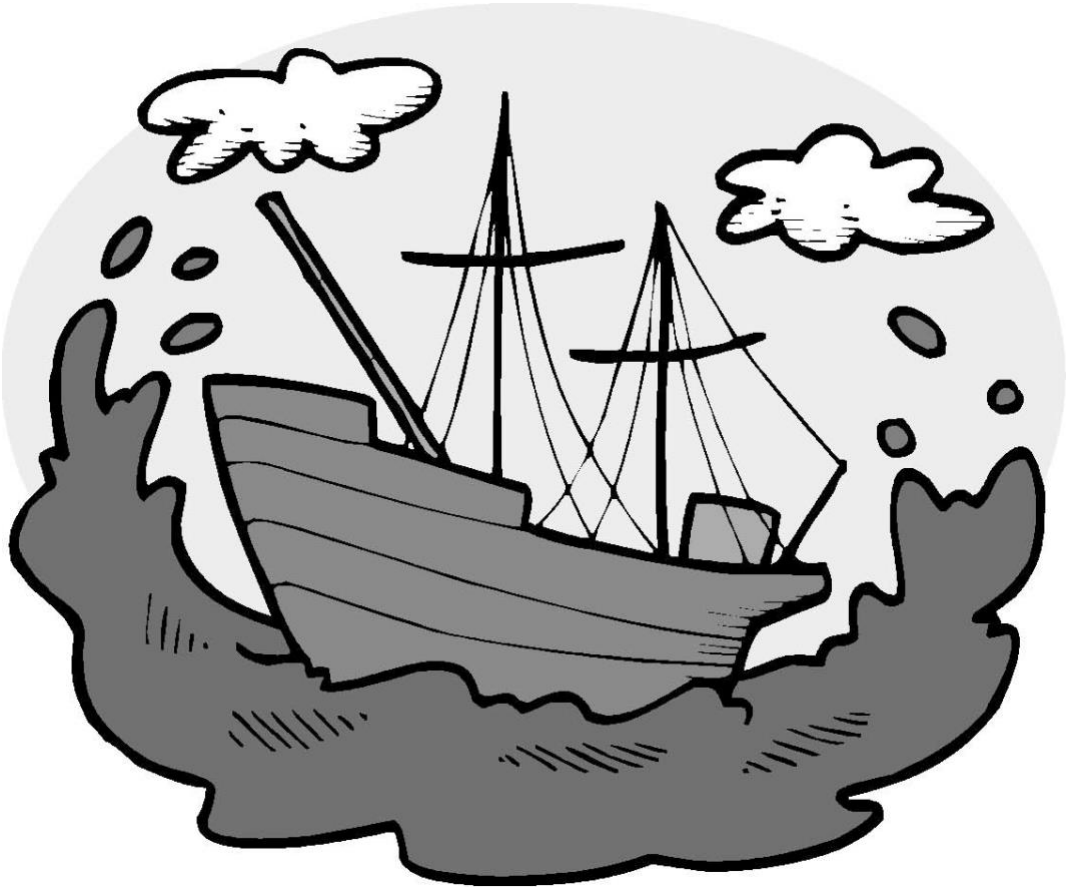
Expect Bad Weather when:
Clouds travel at different heights and speeds, and in opposite directions. Clouds fly against the wind. The sky is red at sunrise. Yellow streaks are visible in the sky at sunset. There is a strong wind early in the morning. Fog settles down toward the ground. The sun looks blurry or hazy, or has a halo. There is a ring around the moon. The larger the ring, the sooner rain will come. Stars twinkle more than usual. Flowers are especially fragrant. Trees show the undersides of their leaves. Birds fly low, or do not fly at all. Birds are noisier than usual. Cows huddle in the field and turn their tails toward the coming storm. Bees stay close to the hive and will not swarm. Insects bite more, and the bites itch more.



Expect Good Weather when:
Clouds are high. The higher the clouds, the better the weather. The wind is from the west. The sky is red at sunset. Fog comes from the direction of the ocean. Fog rises. Birds fly high in the sky.



The Waters Below



The Waters Below The Earth's oceans appear vast and mysterious even today. However, we understand much more about the oceans than people did in the past. For example, early explorers along the American east coast could not understand why they would drift almost forty miles to the north with very little wind when their sails were down for the night. We now know that the Gulf Stream was responsible. The following activities explore some of the mysterious ways in which the oceans influence our world.

How the Ocean Influences Weather Students can work in pairs or small groups to complete this activity. However, you might ask one or two students to do so while the other students do the next activity. This activity requires two goose-necked lamps per group, and also has a fair amount of ."dead time." between readings. If you only have one or two students take readings, ask them to share the information they have gathered with the whole class. Your class can then work together to analyze the information. This activity complements the following activity.

Onshore and Offshore Wind Patterns .— How the Ocean Influences Wind Patterns In this activity, students learn about onshore and offshore winds. You might suggest that students create drawings that illustrate the principles described in the worksheet. Once your students understand this information, they then proceed to make their own land/ocean dioramas. On the outside of the box, students can write information about onshore and offshore winds. An arrow pointing towards the land would indicate an onshore wind pattern while an arrow pointing away from the land would indicate an offshore wind pattern.

As the World Turns .— Understanding the Coriolis Effect This activity teaches about the effects of Earth.'s rotation on winds and ocean currents. Students learn that the earth.'s rotation causes winds to swirl off of their straight course. To illustrate this principle, students use an eyedropper to place a drop of water on a swirling ."Earth.." They should clear their papers off the desks and have paper towels on hand in case of a spill. You can make the water more visible by dying it blue. However, regular water should work fine.

The World.'s Major Currents Have students work in groups of three or four. Hand out the ."World.'s Major Currents." worksheet and ask them to memorize the names, locations and directions of the currents that are in bold-type as well as three others of their choosing. Make an overhead of the map that contains current directions but not the currents.' names. Test the students by pointing to a current and asking for its name. You might have the students perform research to determine which currents are cold and which are warm.

How the Ocean Influences Weather Compare the Weather on Land and at Sea

What You Need

Lamps with 60-watt bulbs x_ A Pencil

#	Lat, Long	First	C
1.	(40ºN, 85º E)	C	C
2.	(47ºN, 19ºE)		
3.	(50ºN, 45ºE)		
4.	(35ºN, 53ºE)		
5.	(30ºS, 25ºE)		

What You Will Do

1. Fill one cup with water and the other with dirt.
2. Hold a thermometer just below the surface of each. Observe and record the temperatures. Remove the thermometers.
3. Place a lamp over each cup, about two inches above the surface. Turn the lamps on. Wait five minutes. Again, take and record the temperature of the water and the dirt.

4. Continue to take readings every five minutes. After twenty minutes, turn the lamps off. Take readings every five minutes until you have filled in the chart completely.

What do these Readings Tell You? Towns near the ocean tend to have different weather patterns than towns that are further inland. Answer the following questions and see if you can figure out why that is the case.

1 Which heated up faster, the ."ocean." or the ."land?." _____

2 Think about answer to question #1. Do you think that inland areas or waterfront areas would likely be hotter in the summer? _____

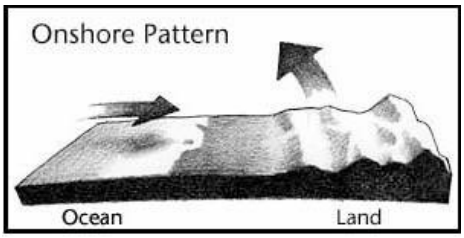
3 Which cooled down faster, the ."ocean." or the ."land?." _____

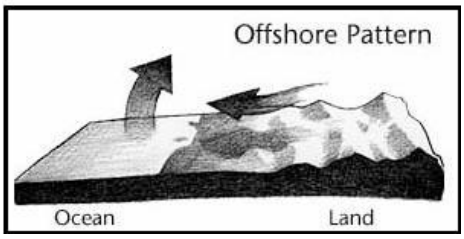
4 Think about your answer to question #2. Do you think that inland areas or waterfront areas would be more likely to retain some heat in the winter? _____

5 Do you live inland or by the sea? What are the seasons like in your area?

Onshore and Offshore Wind Patterns

How the Ocean Influences Wind Patterns





What are Onshore and Offshore Wind Patterns? An .“onshore.” wind blows toward the shore. An .“offshore.” wind blows off the shore and towards the water. Sailors must pay very close attention to these wind patterns when near land.

What Causes these Local Wind Patterns? Onshore and offshore winds are caused by differences in temperature between the land and the ocean. **High pressure areas** (cool air) move towards **low pressure areas** (warm air). Wouldn.’t you do the same? x_ When the ocean is warmer than the land, air

rushes toward the warmer ocean creating an **offshore wind**. x_ When the land is warmer than the ocean, air rushes toward the warmer land creating an **onshore wind**.

When exposed to the heat of the sun, soil warms more quickly than water. As the land warms, so does the air directly above it. As this warm air rises, cooler air from over the ocean flows toward the land. This **onshore** wind may provide a cooling effect for what would otherwise be an extremely hot region. As the sun goes down, the land cools more rapidly than the water. In early evening the air over the ocean is warmer than the air over the land, and the flow of air is reversed producing an **offshore** wind.

Make an Onshore/Offshore Wind .“Information Box.” Create an ocean and land inside the box by covering one half with blue construction paper and the other with beige or brown paper. Decorate these as you wish. For example, you might draw a boat on the ocean and a house on the land. On the outside of the box, illustrate an onshore wind on one side and an offshore wind on the other side. Use arrows to indicate wind direction and red/blue markers to indicate which side is warmer .— the land or the ocean. You might cover the outside of the box with white construction paper first, so that it is easier to draw on.

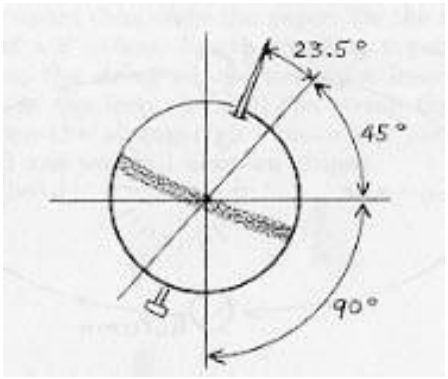
You Will Need x_ A Shoebox 7• Scissors 7• Glue 7• Construction Paper: White, Blue and Beige 7• Markers **or** Colored Pencils **or** Crayons

As the World Turns

Understanding the Coriolis Effect

You Will Need 7• Newspaper to Cover Your Desk 7• Paper Towels in case of a small spill 7• A Compass for making circles 7• One Piece of Cardboard at least 7 in. x 7 in. 7• A Pencil 7• An Eyedropper filled with water

What To Do Step 1: Find a partner. Decide who will be Student A and who will be Student B. Step 2: Use the compass to draw a six inch wide circle on the cardboard. Mark the center of the circle. Then cut the circle out. Step 3: Push the pencil through the very center of the circle. Imagine that the circle is the Earth. The Earth rotates on its axis .— in this case, that is the pencil. Step 4: Student A should hold the pencil at a bit of a tilt. Look at the picture of the Earth on its axis. You can see that the Earth.'s axis is tilted 23.5°. You need not be so exact!

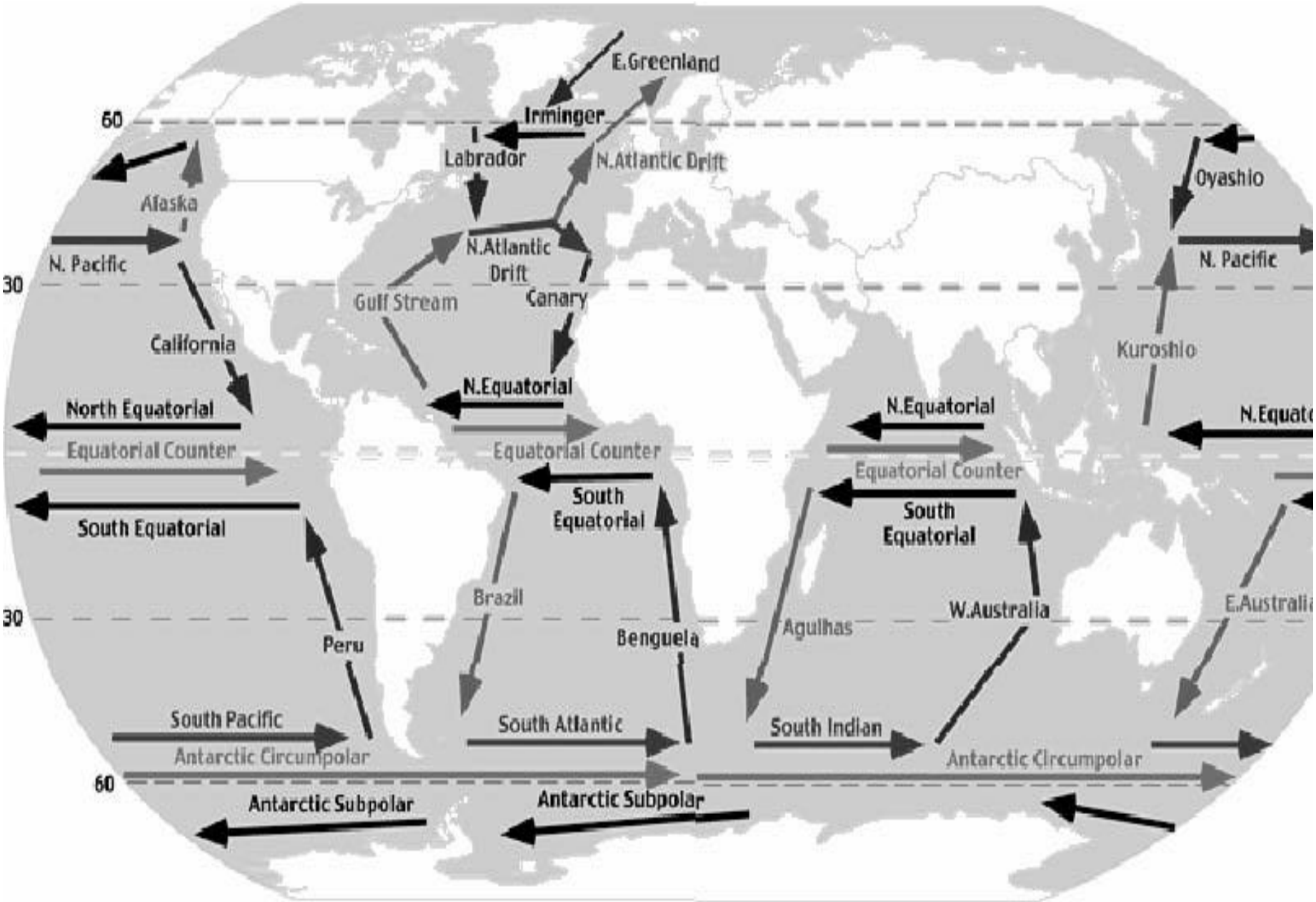


Step 5: Student A should turn the pencil in a counterclockwise direction. While the pencil is rotating counterclockwise on its axis, Student B should place one small drop of water near the center of the circle. Keep rotating that pencil, Student A, until the drop of water has taken its course. Which way does the water move? Clockwise or Counterclockwise? _____

Step 6: While rotating the pencil in a counterclockwise direction, Student A should flip the pencil over. Notice that the circle is now rotating in a clockwise direction. While Student A continues to rotate the pencil, Student B should place one small drop of water near the center of the circle. Which way does the water move now? Clockwise or Counterclockwise? _____

What is the Coriolis Effect? You might have noticed that the water swirled in the opposite direction from the way the circle was spinning. The water would have dripped in a straight line, but the rotating cardboard moved out from under the water. The result is a swirling effect. Coriolis Effect is the swirling effect on air currents that is caused by the rotation of our planet.

When you look at the north pole from above, the Earth is rotating in a counterclockwise direction. When you look at the south pole, the Earth is rotating in a clockwise direction. So in the northern hemisphere, the coriolis effect causes the winds to swirl clockwise. In the southern hemisphere, the opposite is true! The same holds for major ocean currents .— which are formed by strong winds dragging the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Labrador
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Canary
California
Kuroshio
N.Equatorial
N.Equatorial
North Equatorial
Equatorial Counter
Equatorial Counter
Equatorial Counter
South Equatorial
South Equatorial
South Equatorial
Brazil
W.Australia
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Agulhas
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South Atlantic
South Indian
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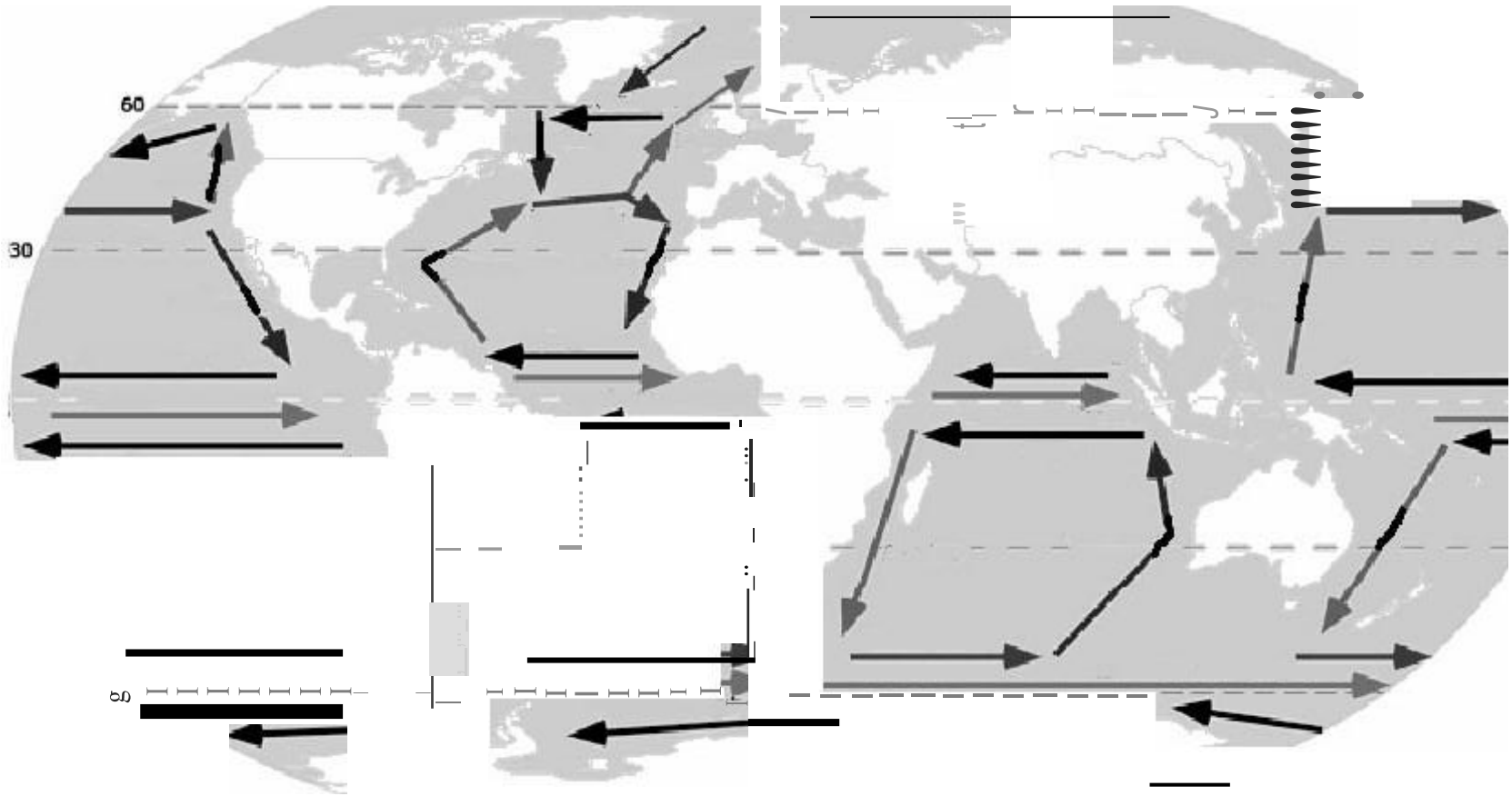
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LIFE
AT
SEA



Hardtack and Other Hardships

Imagine living and working on a ship during the Age of Exploration. Do you think it would be fun to sail the seas to distant and unknown lands? Perhaps the sailor.'s life was fun, but it was not always easy. Sailors worked hard and often suffered from hardships such as thirst, hunger and disease.

Sailors would work in four hour shifts. There is a great deal of work to be done on a sailing ship. For example, somebody must work the sails at all times. The deck must also be cleaned regularly and the bilge pumped. The bilge is the lowest part of the vessel.'s hull where water would collect. After a hard day.'s work, a sailor would sleep wherever he could find room. Only the Captain had his own quarters!

A sailor only received one hot meal a day. A sailor.'s diet often consisted of pickled or salted meat, dried peas, cheese, wine and fresh-caught fish. Sailors also ate hardtack .— which they called ."sea biscuits.." Sea biscuits are very hard pieces of bread. If they sold sea biscuits in a grocery story today, I doubt that anybody would buy them!

Diseases were also a problem on ships. Sailors would come on board with chicken pox and measles. It would not take long for these diseases to spread. Because of their poor diets, sailors sometimes contracted a disease called scurvy. Sailors with scurvy would lose their teeth and all of their energy. In the end, a sailor would die of scurvy unless he received the Vitamin C that his body needed.

Scurvy, the Sailors.' Curse .— A ***Teachers„Guide*** to Testing for Vitamin C

Activity Overview Before beginning with this activity, have your students read the ."Hardtack and other Trials." page. It describes some of the hardships that sailors experienced during the Age of Sail .— including scurvy. Scurvy is a disease that is caused by a lack of Vitamin C. Your students will use the chemical procedure of titration to test various food items for levels of Vitamin C. They can then use this information to plan out a diet that would help sailors to fend off this terrible disease.

You Will Need x_ Cornstarch-Iodine Solution also known as the indicator solution x_ 1 Pipet for each pair of students x_ A variety of fruits, vegetables and potatoes. Try to include a mix of foods that do and do not contain Vitamin C; such as oranges, apples, strawberries, bananas, lemons, tomatoes, etc. x_ 1 Glass or Plastic Container for each pair of students x_ 1 Blender x_ Paper Coffee Filters x_ 1 Piece of White Construction Paper for each pair of students x_ 1 Bucket

What To Do Step 1: In preparation for this classroom activity, make an indicator solution. Mix 2 tablespoons of cornstarch in 500 ml of water. Filter the starch solution through 2 to 4 of the thicker brand paper coffee filters until you have a clear liquid. The solution may be clear to slightly cloudy. It should not be milky white. Now add tincture of iodine by drops with constant stirring until the solution turns a deep, dark blue. If you add too much iodine, the solution will become brownish. Iodine is a poison. However, it is used in water treatment and is safe for children to use and dispose of.

Step 2: Make solutions out of each food item. You can squeeze the juice directly from some of the foods such as oranges and lemons. Or you can blend the foods with water and filter the pulp through paper coffee filters. Place each solution in a separate, labeled container.

Step 3: Demonstrate the process of titration for your students. Using a clean pipet, drop one drop at a time of a food solution into the indicator solution. Make sure you ."swirl." the indicator solution after the addition of each drop of food solution. To do so, hold the container at the top and circle the bottom of the container to stir the liquid. Count the number of drops needed to reach the end point .— where the indicator solution appears colorless against a white background. A piece of white construction paper can serve as this background. Remember that food solutions that do not contain Vitamin C will never turn the indicator solution colorless.

Step 4: Have your students work in pairs to test the various food solutions for levels of Vitamin C. They should carefully record their data. A new indicator solution will be needed for each food solution. Students can raise their hands when they need a refill. You can bring them a refill along with a bucket to pour their old solution into.

Step 5: Collect all of the data that your students have gathered. Ask them to average the findings for each food solution. They should then rank the food sources according to the amount of Vitamin C they contain relative to one another. The fewer drops of food solution needed to reach the end point, the more Vitamin C the food solution contains.

Step 6: Ask your students to write out a diet that would have kept sailors from contracting scurvy. They must remember that foods that spoil are not well suited to long voyages at sea. If needed, they can perform online research in order to determine other sources of Vitamin C.

The .“Magic.” Needle .— Make a Magnetic Compass

Water Compasses Have you ever heard of a lodestone? A lodestone is a type of stone, as you might expect. It is also a natural magnet. It is attracted to certain metals such as iron. Part of Earth.’s outer core contains a large amount of liquid iron. The spot where this collection of liquid iron is found is known as magnetic north. Magnetic compasses are attracted to this spot much the same way that a regular magnet is attracted to your refrigerator!

Over 4,000 years ago the Chinese noticed that small pieces of lodestone point north when they float in water. Later they realized that lodestone can be used to magnetize needles. These needles can be placed on a small piece of wood and put in the water. These early compasses looked much like the one you will make today.

You Will Need 7• A Waterproof Marker 7• A Small Strip of Waterproof Tape 7• A Metal Paper Clip 7• A Magnet 7• A Plastic Bowl 7• A Thin Piece of Cork 7• A Thumb Tack 7• Water 7• Paper Towels in case of a spill

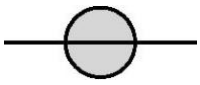
What To Do Step 1: Using a waterproof marker, write your initials on your piece of cork. Step 2: Straighten one of your paper clips so that the two ends are pointing in opposite directions. This is the hardest part of the activity, as straightening a paper clip can take time and effort!

Step 3: Rub one end of the paper clip against the magnet. Be sure to rub in one direction, and not back and forth. Rub until that end of your paper clip is magnetized. This will take at least thirty seconds. When it is magnetized, your paperclip will be able to attract the thumbtack. That is a good test.

Step 4: Attach the paper clip to the center of the cork using a small piece of waterproof tape. Your cork and paper clip should look like this:

Step 5: Fill your waterproof bowl 1/3 of the way to the top with water.

Step 6: Gently place your cork in the water with the paper clip facing up. Watch as the cork settles into position. Your paper clip should be pointing north-south.



Step 7: Note which end of your paper clip is pointing to north. Use a store bought compass to do so if need be. Take the cork out of the water. Use a waterproof marker to mark the end of the paper clip that is pointing north. Place the cork back in the water. Your compass is complete!

Navigating with a Magnetic Compass

Introduction In the days of Christopher Columbus, people did not understand how magnetic compasses work. Some Captains even thought that onions had an effect on magnetic compassed! Columbus relied heavily on his compass. On his first journey to the New World, he sailed on a magnetic westward course for weeks at a time. Actually, he was not going directly west despite what his compass said! Magnetic compasses are almost always .“off..” That is, they are usually wrong. Why? Because of variation and deviation.

What is Variation? The magnetic compass is attracted to a point that we call .“magnetic north..” Magnetic north is not the same as true north. In fact, magnetic north is located at 77º north latitude. If you were to stand north of this position, your magnetic compass would point to south instead of north! Variation is the difference between magnetic north and true north at any given position. People use special charts to determine their variation.

What is Deviation? If you were to place a large iron bolt next to a magnetic compass, the bolt would attract the compass needle. We must consider the things around us and the effect they have on magnetic compasses. Imagine that you are sitting in your car, taking a reading from a magnetic compass. The car itself has a magnetic field, as does the engine! These magnetic fields attract the needle on your magnetic compass. This effect is known as deviation.

Using Mathematics to Find the Way! There is a formula we can use to correct a magnetic reading and find our true course. Sailors remember it by the phrase: .“**C**an **D**ead **M**en **V**ote **T**wice? **Add East**..” Perhaps the phrase makes little sense, but it is easy to remember! The first letter of each word stands for something else: **C**ompass = the degree reading that our compass gives for our course **D**eviation = the number of degrees our surroundings throws the compass off **M**agnetic = Our magnetic course **V**ariation = The difference in degrees between our magnetic course and our true course **T**rue Course
The two-part formula for converting magnetic to true is: **C**ompass +/- **D**eviation = **M**agnetic Magnetic +/- **V**ariation = **T**rue

Add East means that you add eastward degrees and subtract westward degrees.

Magnetic to True *fl* Word Problems

Use this two-part formula to solve the word problems that follow:
Compass +/- Deviation = Magnetic Magnetic +/- Variation = True Add eastward degrees and subtract westward degrees.

Sample You are the Captain of a large vessel that is carrying important cargo. You must deliver this cargo in a timely fashion, and cannot afford to get lost! You know that your ship has a deviation of 5º east. Your declination chart shows that at your position, your variation is 14º west. You pull out your magnetic compass. The compass says that you are on a course of 90º. What is your true course?

90 + 5 = 95, 95.– 14 = 81. You are heading on a course of 81º!

1. You are lost in the desert with nothing but a declination chart, a magnetic compass and an old car. You know that if you drive due west, you will get out of the desert soon enough. Your car has a deviation of 4º east. The declination chart tells you that your variation is 10º east. According to your compass you are going due west, which is 270º. What is your true course?

2. You were given a magnetic compass, a declination chart and a scooter for your birthday. Now you are traveling around the world on your scooter .— visiting friends and making new ones. You want to head north to Canada. You know that your scooter has a deviation of 1º west. According to your declination chart, your variation is 5º east. Your compass says that you are heading due north at 0º. Is that the case? What is your true course?

3. You and your scooter find the way to Canada. However, you realize that you dropped your comb somewhere along the way. You want to go back the way that you came so you can look for your comb. That means heading due south at 180º. Your compass says that you are heading 180º. Your declination chart says that your variation is 30º east. Once again, your scooter.'s deviation is 1º west. What is your true course?

Know What the Winds will Bring

How to Build and Use a Weather Vane

What is a Weather Vane?

A weather vane is a tool that shows wind direction. Wind direction can help us to predict the weather. For instance, what type of weather does southern California tend to get? That.'s right, hot weather. Winds from the south tend to bring this heat to us, while winds from the north often bring cold weather. East winds .— that is, winds from the east .— generally bring rain, while west winds bring clearing. Those are the rules for the Northern Hemisphere. In the Southern Hemisphere, they are exactly the opposite for every direction!

You Will Need 7• A Plastic Bowl or Old Flowerpot 7• A Lump of Clay 7• A Pencil with an Eraser 7• A Straight Pin 7• A Drinking Straw 7• Scissors 7• Glue 7• An Index Card or Piece of Light Cardboard 7• A Red Marker 7• A Compass 7• 4 Large Paper Clips

or Another Index Card/Piece of Light Cardboard

What to Do

1. Form the letters N, S, E and W from pieces of paper clips. Wind these around the pencil, just below the eraser. **OR** poke a light piece of cardboard through the pencil and write the letters N, S, E and W on the cardboard.'s four corners.
2. Use the scissors to make a one-inch vertical slit in one end of the drinking straw. Cut out an arrow tail from an index card or light piece of cardboard. Glue this arrow tail into the cut end of the straw. Mark the other end of the straw with the red marker.
3. Insert the straight pin through the straw about two inches from the arrow. Push the pin into the eraser end of the pencil. Be sure the straw can move freely.
4. Prop the pencil up by its point in a lump of clay. **OR** prop it up in the dirt of a shallow flowerpot or in a plastic container filled with sand, marbles or any other heavy material.
5. Place the weather vane in a spot where the wind is not blocked by buildings. Use a compass to make sure your N, S, E and W letters are set up correctly. Watch your weather vane turn!

Log the wind direction and predict what weather these winds will bring. Were you right?

Build Your Own Barometer

What is A Barometer? A barometer is an instrument that measures air pressure. Air pressure is caused by the Earth.'s gravity. Earth.'s gravity pulls on the air, causing the air to press down on the Earth. This weight is called air pressure.

Cool air is dense. When cool air is present, the air pressure is usually high. Warm air is less dense. When warm air is present, the air pressure is usually low. High pressure usually brings clear weather, while low pressure brings bad weather and strong winds.

Big changes in air pressure tend to bring winds. That is because changes in air pressure mean that dense, cool air is rushing in and forcing the less dense warm air out. Think about that the next time the wind is whipping through the trees!

What Your Need 7• A Jar with straight edges. Peanut butter jars work well. 7• A Balloon or other latex material large enough to slip over the top of the jar 7• A Drinking Straw 7• A 2." x 7." Cardboard Strip 7• A Block of Wood or other heavy object with a straight side 7• A Rubber Band large enough to fit around the top of the jar 7• Masking Tape 7• Glue



What To Do Step 1: Make sure that the jar is at room temperature. Stretch the balloon/latex tightly over the top of the jar. Use the rubber band to secure the balloon/latex in place. The rubber band should form an air-tight seal.

Step 2: Place a drop of glue onto the middle of the balloon and glue one end of the straw there. The other end of the straw should extend over the edge of the jar. Allow the glue to dry.

Step 3: Glue the Cardboard Strip to the Block of Wood so that the cardboard stands upright. Place it next to the end of the straw that is extending over the edge of the jar. Use a pen to mark the position of the straw onto the card. You can mark it with a simple line, with the date, or with the reading from a calibrated barometer.

Step 4: As the air pressure changes, the straw will respond by moving up or down. When air pressure increases, the pressure outside the jar is greater than the pressure inside the jar. Therefore the balloon rubber/latex pushes down, and the pointer end of the straw moves up. When the air pressure goes down, the air inside the jar presses harder than the outside air. The rubber/latex pushes up and tightens, and the pointer moves down.

What Your Weather Vane and Barometer Can Tell You

Using Wind Direction and Air Pressure to Predict the Weather

What You Need To Know

Wind direction and air pressure are the two main keys to predicting weather. With the help of the following table, you can be your own meteorologist.

#	Lat, Long	First	Country	Last
1.	(40ºN, 85º E)	C	Canada	A
2.	(47ºN, 19ºE)			Y
3.	(50ºN, 45ºE)			N
4.	(35ºN, 53ºE)			N
5.	(30ºS, 25ºE)			A
6.	(40ºN, 30ºE)			Y
7.	(20ºN, 55ºE)			N
8.	(45ºN, 1ºE)			E
9.	(52ºN, 0ºW)			M
10.	(44ºN, 26ºE)			A
11.	(2ºN, 23ºE)			A
12.	(15ºN, 44ºE)			N



Use Your Senses to Predict the Weather

How to Predict the Weather Explorers used hand-me-down maritime lore to predict the weather. People on land .— who sailors call landlubbers .— have used their own signs to predict the weather. Below you will find signs used by both mariners and landlubbers. Make a daily weather log where you record your observations and predict the weather. Be sure to record the day.'s weather as well so you can see if your predictions came true!

How to Remember Some of these ."Signs." Draw a picture of some of the things you can expect to see when the weather is about to turn bad. Draw another picture of things you might see when the sun is going to shine. You can also write rhyming poems or songs to help you remember some of these signs.

Expect Bad Weather when:
Clouds travel at different heights and speeds, and in opposite directions. Clouds fly against the wind. The sky is red at sunrise. Yellow streaks are visible in the sky at sunset. There is a strong wind early in the morning. Fog settles down toward the ground. The sun looks blurry or hazy, or has a halo. There is a ring around the moon. The larger the ring, the sooner rain will come. Stars twinkle more than usual. Flowers are especially fragrant. Trees show the undersides of their leaves. Birds fly low, or do not fly at all. Birds are noisier than usual. Cows huddle in the field and turn their tails toward the coming storm. Bees stay close to the hive and will not swarm. Insects bite more, and the bites itch more.



Expect Good Weather when:

Clouds are high. The higher the clouds, the better the weather.

The wind is from the west. The sky is red at sunset. Fog comes

from the direction of the ocean. Fog rises. Birds fly high in the sky.