Grade Level: 3-5

Time Estimate: 1-3 days

INTRODUCTION TO CARTOGRAPHY / INSTRUCTOR INFO

Summary

This lesson includes vocabulary, content, examples, and activities to help students learn and understand the science of mapping, also known as cartography. Students will collect real data from the OCEARCH Global Shark Tracker™ and implement basic mapping practices to create a map showing the migration patterns of sharks.

Part 1. Introduction
Part 2. Parts of a Map
Part 3. How Does OCEARCH Use Maps?
Activity 1. Mapping Sharks

Goals & Objectives

The students will:

- Identify the five basic elements of a map;
- Collect data and construct maps using key features: title, compass, legend, symbols, scale, grid system, etc.;
- Use a gridline system to locate items on a map;
- Use a map to calculate the distance between two points.

Helpful Tips

1. The content in this lesson is based on the conservation work of OCEARCH™ and the Global Shark Tracker™. Spend a few minutes getting familiar with the website and the tracker if you have not done so already. The Global Shark Tracker™ is also available as an app for iPhone and Android
2. This lesson plan is designed to be adaptable to suit your specific needs. Use the entire lesson plan or just parts of it. This material can be expanded to be an entire unit or condensed for just one day in the classroom.
3. Vocabulary words will be underlined as they first appear in the lesson plan. A complete list of vocabulary words is included as well.
4. Answers to questions and prompts for discussions will appear in italics.
5. Optional activities and content (side notes) will appear in a box. Use these to enhance your lesson and adapt it to suit your needs!
6. Have questions for OCEARCH Expedition Leader, Chris Fischer? Email info@OCEARCH.org to schedule a Skype session and let your students/child talk directly to Chris and the OCEARCH crew!
7. Email all questions about this lesson to info@OCEARCH.org.

Grade Level: 3-5

// STANDARDS

STEM

This lesson plan aims to assist teachers in implementing a STEM-based program into their classroom while inspiring the next generation of explorers, scientists, and stewards of the ocean. Based on real science and the Global Shark Tracker™, "Introduction to Cartography" is intended to promote environmental awareness and to prepare students for STEM careers.

This lesson aligns with the following TEKS:

Grade 3 Science: 1A, 1B, 2A, 2B, 2C, 2F, 3A, 3D
Grade 4 Science: 1A, 1B, 2A, 2B, 2C, 2D, 2F, 3A, 3D
Grade 5 Science: 1A, 1B, 2C, 2D, 2F, 2G, 3H, 3D

Grade 3 Math: 1C, 1D, 2A, 4A, 4B
Grade 4 Math: 1C, 1D, 4A, 4G, 4H
Grade 5 Math: 1C, 1D, 2A, 2C, 3A, 3K

This lesson aligns with the following Next Generation Science Standards:

Framework

1. Asking questions and defining problems.
2. Developing and using models.
3. Analyzing and interpreting data.
4. Using mathematics and computational thinking.
5. Constructing explanations and designing solutions.
6. Obtaining, evaluating, and communicating information.

4. Earth's Systems: Processes that Shape the Earth - 4-ESS2-2

Disciplinary Core Ideas

ESS2.B: Plate Tectonics and Large-Scale System Interactions

• The locations of mountain ranges, deep ocean trenches, ocean floor structures, earthquakes, and volcanoes occur in patterns. Most earthquakes and volcanoes occur in bands that are often along the boundaries between continents and oceans. Major mountain chains form inside continents or near their edges. Maps can help locate the different land and water features areas of Earth. (4-ESS2-2)

Grade Level: 3-5

INTRODUCTION TO CARTOGRAPHY / VOCABULARY

Cardinal Directions – The directions of north, south, east, and west.

Cartography – The study and practice of making maps.

Compass Rose – A printed symbol used to find direction on a map.

Coordinates – A set of numbers or letters located on a grid.

Geographic Coordinate System – A coordinate system covering the entire globe, typically uses latitude and longitude.

Grid System – A system of imaginary lines (known as latitude and longitude) used to find the location of any place on the surface of the earth.

Key (or Map Legend) – A list of words or phrases that explain the meanings of symbols used on a map.

Intercardinal Directions – The directions of northeast, southeast, southwest, and northwest.

Latitude – Gridlines that run in an east-west direction in the geographic coordinate system.

Longitude – Gridlines that run in a north-south direction in the geographic coordinate system.

Map – A drawing or a picture of selected features of an area.

Scale – A line on a map or chart that shows a specific unit of measure (such as an inch) used to represent a larger unit (such as a mile). Helps the map reader determine distance.

Symbol – A drawing or sign that represents an object or a place.

Grade Level: 3-5

Time Estimate: 5-15 mins

INTRODUCTION TO CARTOGRAPHY / PRE-LESSON ASSESSMENT

Use the following true/false, fill in the blank, and multiple-choice questions as an introduction/warm-up to the lesson topics. You can do this in a verbal or written format, as a game, individually, or as a whole class! A handout is provided if you wish to hand the questions out in a quiz format.

The questions do not need to be graded. They are intended to give the students an idea of what they will be learning and to see what they already know.

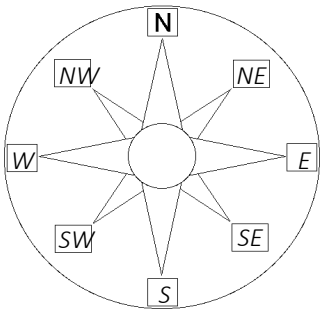
1. True or False: A key (or legend) is used to explain the meaning of symbols on the map.
Answer: True

2. You would use a compass to_____.
- **a.** Find the exact location of an object or a place.
- **b.** determine distance.
- **c.** determine direction
- **d.** represent an object or a place.

Answer: *c*

3. Which feature do you use to measure the distance between two objects or places?
a. Scale **b.** Legend **c.** Compass **d.** Grid
Answer: a

4. Fill in the missing directions:



5. True or False: Latitude is an imaginary set of lines that run North and South.
Answer: False

6. True or False: Lines that run east and west are called longitude.
Answer: False

Grade Level: 3-5

Name: _____

Date: _____

Pre-Lesson Assessment: Introduction to Cartography

Select the correct answer(s) to each of the following questions.

1. **True** **or** **False**

A key (or legend) is used to explain the meaning of symbols on the map.

2. You would use a compass to_____.

a. Find the exact location of an object or a place.

b. determine distance.

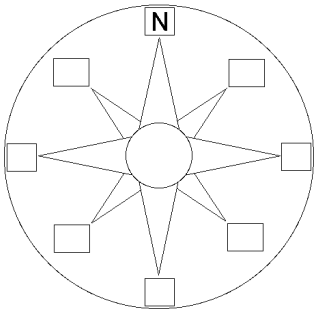
c. determine direction

d. represent an object or a place.

3. Which feature do you use to measure the distance between two objects or places?

a. Scale **b.** Legend **c.** Compass **d.** Grid

4. Fill in the missing directions:



5. **True** **or** **False:**

Latitude is an imaginary set of lines that run North and South.

6. **True** **or** **False:**

Lines that run east and west are called longitude.

Grade Level: 3-5

INTRODUCTION TO CARTOGRAPHY / LESSON PLAN

PART 1. INTRODUCTION **5-15 mins**

Cartography is the study and practice of making maps. Whether travelling around your hometown or across the globe, maps are crucial for navigation! A map is a drawing or a picture of selected features of an area. For example, a map showing the oceans of the world or a map showing the classrooms inside a school.

The OCEARCH crew uses many different maps every day to navigate the ocean, locate sharks to tag, and track the migrations of sharks they have already tagged (Figure 1). Without maps, OCEARCH would not be able to study great white sharks the way that they do!

Figure 1. Map showing the migration pattern of Katharine, a great white shark.

There are many different types of maps, each with its own purpose. Climate maps show information about weather. Physical maps show Earth's physical features such as mountains, rivers, and lakes. Road maps show streets, highways, towns, and cities. Topographic maps that show the elevation of an area. Political maps show boundaries of cities, states, countries, etc.

Maps also come in many different forms. A globe is a spherical model of Earth and is most helpful in locating countries, large physical features such as oceans and mountain ranges, and in understanding where one place is located relative to another. Paper maps are more versatile and can show more details about a place than a globe. A paper map can show the whole world or just the inside of your classroom.

Activity – Similarities and Differences (optional) (10 minutes)

Materials – You will need one globe and one paper map, preferably a world map but any paper map will be fine.

Show the students the globe and the paper map side by side. As a class, discuss the similarities and differences. What map features do they share? Discuss the actual shapes of the globe and the paper map. What are the benefits of using each type of map?

PART 2. PARTS OF A MAP **30-60 mins**

Creating maps is easy and fun! In order to make a map we must first understand the basic parts. Each of these parts is vital to translating what is on a map into real world information. Maps can give you tons of information about places in some far off country or right down the block, but in order to understand it, you have to know what each basic part means.

There are five main parts of a map (Figure 2):

1. Title
2. Compass rose
3. Key
4. Scale
5. Grid

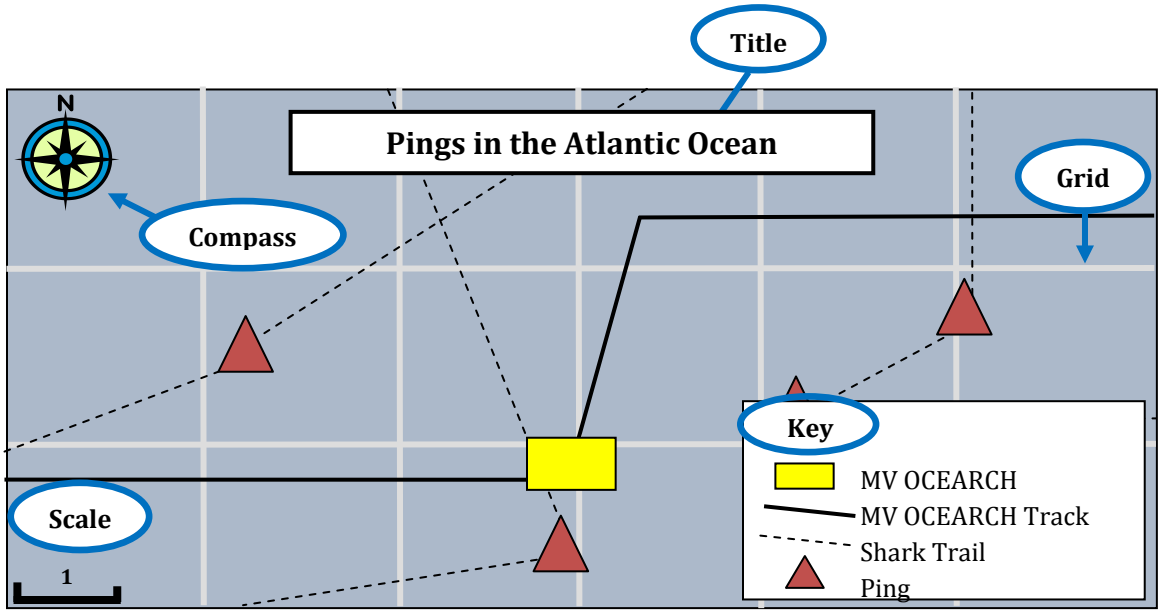


Figure 2. Basic Map depicting sharks and their pings.
Illustration Credit: Brittany Gates – Landry's Downtown Aquarium

A title is usually found at the top of the map and describes what the map is depicting. The title should describe both the location of the map and the content of the map. For example let's say that we wanted to look at locations where data are collected from a shark's SPOT tag (Smart Position and Temperature Tag), the map would need to say "Pings" and let us know where we were looking (such as the Atlantic Ocean). The compass rose typically shows the four cardinal directions: north, south, east, and west as well as the four 'intercardinal' directions: northwest, southwest, northeast, southeast. An easy way to remember where the cardinal directions are located on the compass is with a simple mnemonic device. If you start at the top of the compass and go around clockwise, the directions are north, east, south, and west. Just remember: **N**ever **E**at **S**oggy **W**affles. The intercardinal directions fit in between the four cardinal directions (clockwise, starting at north): northeast, southeast, southwest, and northwest. All eight directions are usually abbreviated to N, S, E, W, NE, NW, SE, and SW (Figure 3).

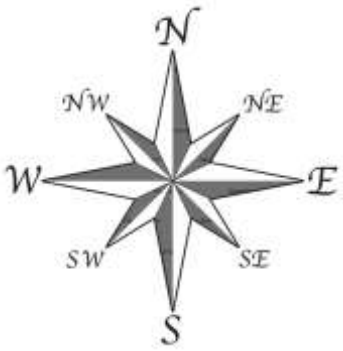


Figure 3. Compass Rose

Symbols are pictures on a map that represent real world objects. The key (sometimes called a legend) is a list that explains the meaning of these symbols (Figure 4). For example, in Figure 2, a red triangle marks a ping, a yellow rectangle marks the location of the M/V OCEARCH, a straight line marks where the M/V OCEARCH has traveled, and a dotted line is the shark's track. Keys and symbols are very important in maps. If we used words rather than symbols, the map would be very crowded and would be difficult to read.

The map's scale displays a ratio for measurement on the map. Since the map is smaller than real life, the size of items, or distance between items, on the map must be translated so that we can know their actual size or distance, respectively. If the scale line on a map is one inch long and is labeled 'one mile', then one inch on the map equals one mile in real life. Therefore, if two pings on the map are 2 inches apart, we can assume that, in real life, the shark's pings are two miles apart.

Figure 4. Map key and a map scale from Figure 2.

The grid, a pattern of imaginary lines, exist so that specific places or objects can be located on a map using coordinates. Coordinates are a set of numbers or letters located on the grid. The system of latitude and longitude, or the geographic coordinate system, is the largest global grid system because it covers the entire earth. Latitude consists of lines that run east to west on the globe and longitude consists of lines that run north to south on the globe. The most commonly recognized line of latitude is the equator (Figure 5). It splits the Earth in half horizontally. This separates the globe into two

hemispheres, the northern hemisphere, and the southern hemisphere. This division of the globe is very important to marking locations on the earth as well as in navigation. When coordinates for this system are written they are listed latitude first and longitude second. For Example, Houston, TX would be stated as 29.7° N (Latitude), 95.4° W (longitude). This system can help people identify locations accurately all over the world.

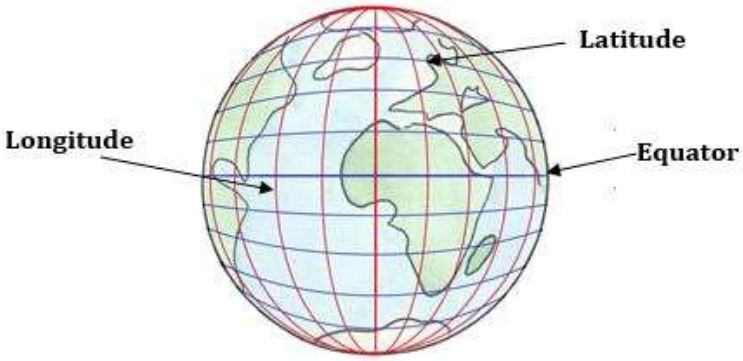


Figure 5. Image depicting the lines of latitude and longitude patterned on the earth.
Illustration Credit: Sarah Rich – Landry's Downtown Aquarium

Grids vary in what they represent from map to map, but all are read in generally the same way. For example, lines that run north and south are labeled with letters and lines that run east and west are labeled with numbers (Figure 6). To state where an object is located using this coordinate system, you would first locate the intersection on the grid closest to the object. Next, follow the lines north/south and east/west to find the associated number and letter for that part of the grid. For example, if you wanted to describe the location of the shark ping farthest to the east (the right) you would say that it is just south of the coordinates 2,F. Also, if someone were to say, "The M/V OCEARCH is at coordinates 3,D" you could follow the gridlines associated with line D and line 3 and find where they intersect. The point of intersection for gridlines D and E is where you will find the MV OCEARCH on the map! For more practice on this topic see worksheet 1 on following page.

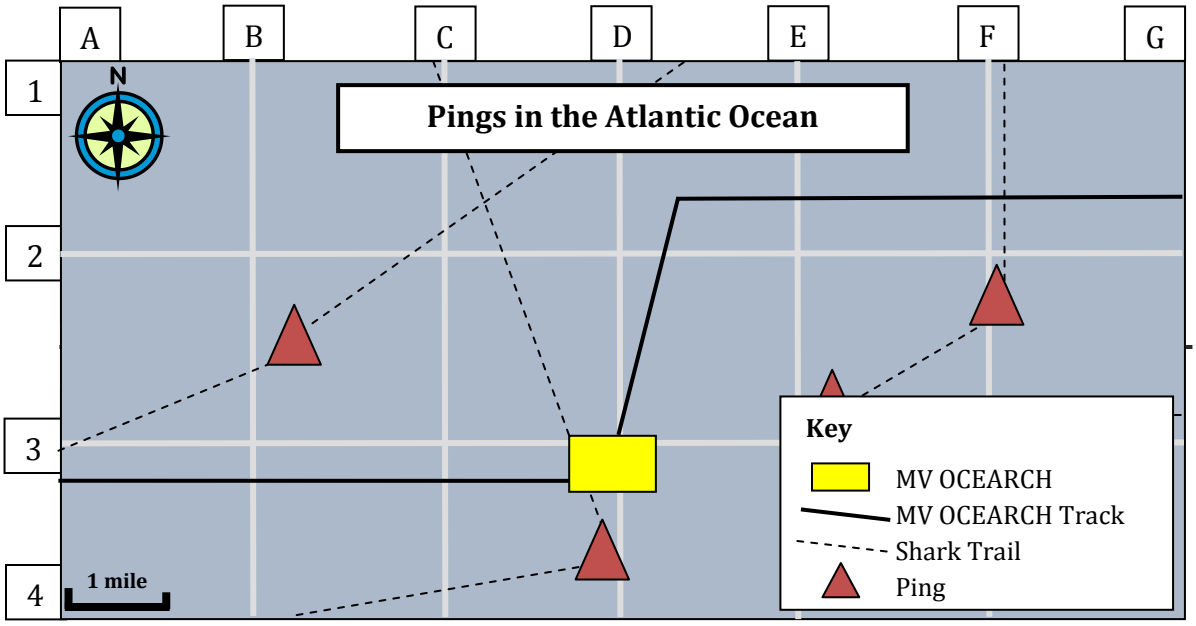


Figure 6. Example map showing numbered and lettered gridlines.
Illustration Credit: Brittany Gates – Landry's Downtown Aquarium

Grade Level: 3-5

Name: _____

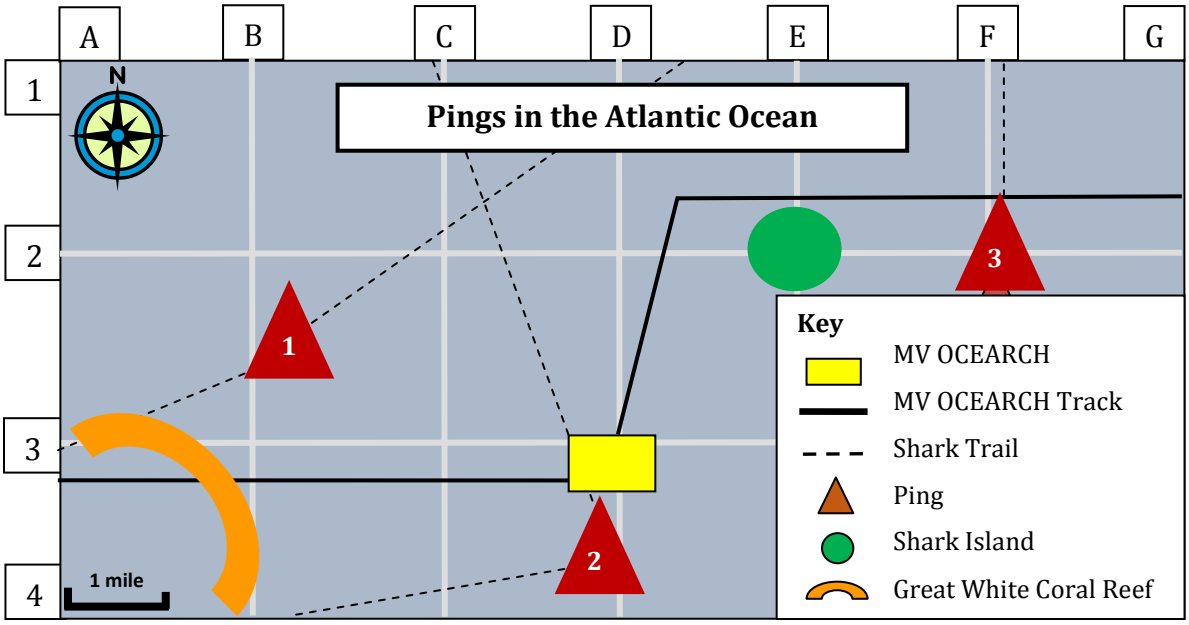
Date:_____

USING MAP GRIDS

Using what you have learned about map grids and coordinates, find the following items on the map provided.

Instructions

Write the correct coordinates next to each item. The first is completed for you as an example.



1. M/V OCEARCH *3,D*
2. Great White Coral Reef _____
3. Shark Ping 1 _____
4. Shark Ping 2 _____
5. Shark Ping 3 _____
6. Shark Island _____

PART 3. HOW DOES OCEARCH USE MAPS? **5-10 mins**

Not only are maps very helpful for navigating the MV OCHEARCH all over the world, but maps are also an integral part of OCEARCH's shark tracker and their research on shark migration patterns (Figure 7). When the tag on a shark's dorsal fin breaks the surface of the water, a signal is sent to a satellite. This then creates a "ping" on the map. This information allows the OCEARCH crew, other scientists, and students just like you to study where the sharks have been and make hypotheses about where the sharks might be going and why.

Figure 7. OCEARCH shark tracker showing migratory patterns of multiple sharks.

PART 4. REVIEW **5-10 mins**

Students should now know and understand the five basic elements of a map, how to use a grid system to find objects on a map, and how to construct their own map.

Ask some questions to review the lesson material:

1. What does a compass rose display on a map? *The cardinal and intercardinal directions*.
2. How is a key used on a map? *To identify symbols used on a map.*
3. What are the four cardinal directions? *North, South, East, West.*
4. What are latitude and longitude? *Imaginary lines that help locate objects and places on a map; latitude runs east to west direction and longitude runs north to south.*
5. What part of a map helps to determine the actual size or distance of an object on a map? *A scale.*

Grade Level: 3-5
Time Estimate: 30-60 mins

INTRODUCTION TO CARTOGRAPHY / ACTIVITY 1. MAPPING SHARKS

INTRODUCTION

This activity will help students understand how to create a map using the journey of a shark from the OCEARCH website. They will organize data collected from the OCEARCH Global Shark Tracker and create a map of where the shark traveled. Students will incorporate all aspects of a map. If desired, students can do additional research and add weather, elevation, the migration patterns of other animals etc.

MATERIALS

- Computer with Internet access
- Unlined paper
- Colored pencils or markers
- Rulers

INSTRUCTIONS

Students may work individually or in small groups.

First, students will need to choose a shark whose journey they will plot on a map. To chose a shark have the students:

- Go to the Global Shark Tracker ™ at www.ocearch.org
- On the left hand side under "Sharks" click on any name.
- Under "Tracking Activity" click on "All Activity". This will show the migratory pattern of that one individual shark.

Each dot on the map represents a "ping," or a signal sent from the shark's tracker when the shark's dorsal fin came above the surface of the water. To find the date of each ping, hover the mouse pointer over a specific dot.

By choosing "All Activity" under Tracking Activity, you will see all of the shark's pings. To filter the information, click on the Tracking Activity and choose "Last 24 hours," "Past week," or "Past month." If more than 10 pings show up, students can use anywhere from 3-10 pings or certain dates, depending on the time allowed for the activity.

Once students have chosen a shark, they will then create a map of the area where the shark traveled. For example, if shark "Judy" has pings near the Galapagos Islands, students would create a map of the ocean surrounding the Islands. Be sure to include the *closest* landmass for reference as well as the names of any places or bodies of water.

On the map, they will draw *approximate* locations for each ping, labeling them with a date. Using a ruler, they will connect the pings to make straight lines, in a color of their choice. Because the sharks only "ping" when the dorsal fin comes above the surface of the water, some of the pings on the OCEARCH website are connected with straight lines through land mass. In this case, students can infer how they think the shark traveled around the land mass and create new lines.

Each map should include a title, a grid with the location of each ping according to the grid, a key (explaining the ping symbol), a scale with approximate distance, and a compass. See the worksheet below to get the students started.

Name: _____ Date: _____

ACTIVITY 1. MAPPING SHARKS

Instructions

1. Go to the Global Shark Tracker ™ at www.ocearch.org
2. On the left hand side under "Sharks" click on any name.
3. Under "Tracking Activity" click on "All Activity". This will show the migratory pattern of that one individual shark. To filter the information, click on the Tracking Activity and choose "Last 24 hours," "Past week," or "Past month."

Questions to answer before mapping.

1. What is the name of the shark you are following?

   _____

2. What type of shark (e.g., species) are you following?

   _____

3. What tracking activity are you following (All Activity or Last 24 hours)?

   _____