Lesson 4 – Explore the Seafloor

Objectives

- ✓ To understand how the ocean floor is mapped.
- ✓ To reinforce graphing skills by creating a profile.
- ✓ To identify, locate and describe underwater topographic features by interpreting bathymetric imagery.

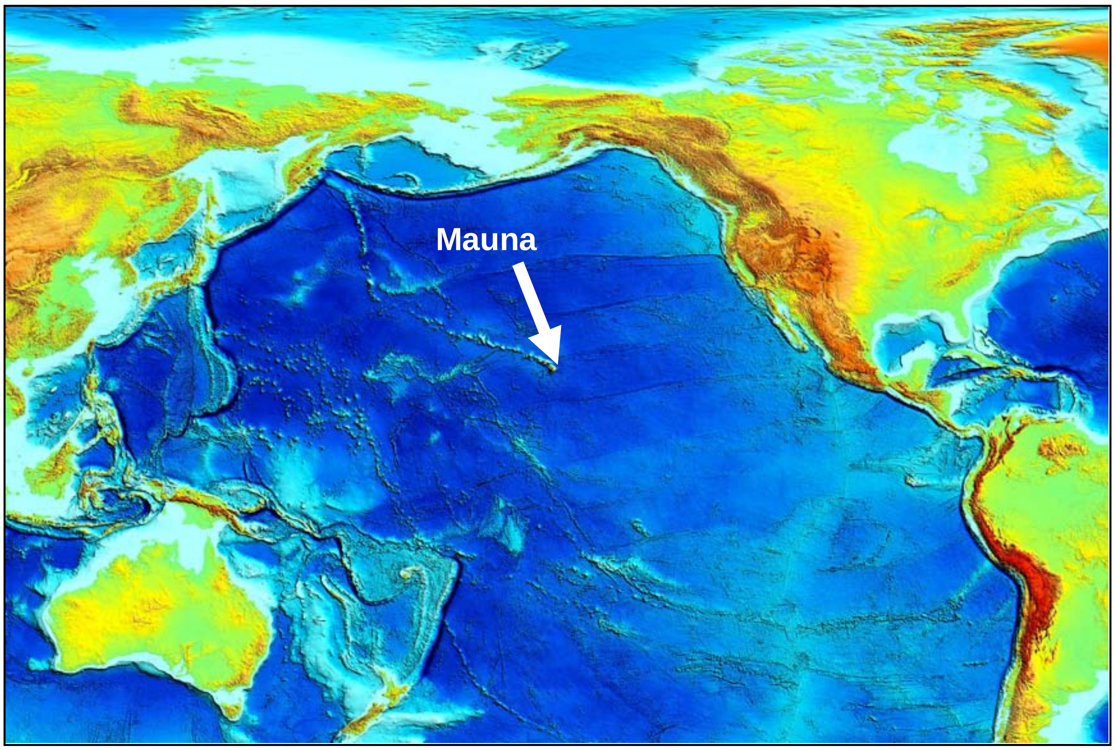
Classroom Activities and Procedures

Part 1

Measuring Ocean Depth

1. **Have you ever thought about what lies below the ocean's waves? In the space below, draw the surface of the ocean. Include what you think the ocean's sea floor is like.**

Looking at the ocean's surface, things look fairly uniform. Its appearance is predictable. There are waves, specks of white, birds swooping down to catch a fish. What about the ocean floor? Most people believe that it is flat and lifeless. In reality, the ocean floor is just as varied as the land. Want to know something startling? Earth's tallest mountain is not Mount Everest; it is actually Mauna Kea of Hawaii. Most of Mauna Kea is actually under water. Just like on land, the ocean floor has hills, plains, volcanoes, valleys, river deltas, moutains, trenches, and canyons. The ocean floor is home to Earth's tallest mountains, widest plains, and deepest valleys.

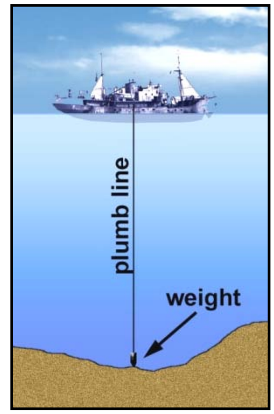


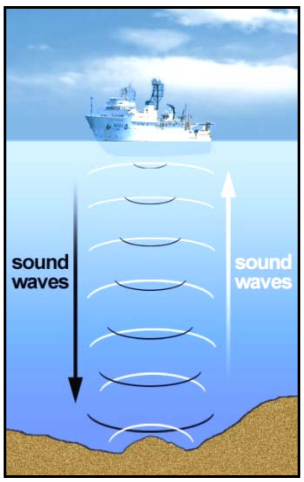
NOAA

.

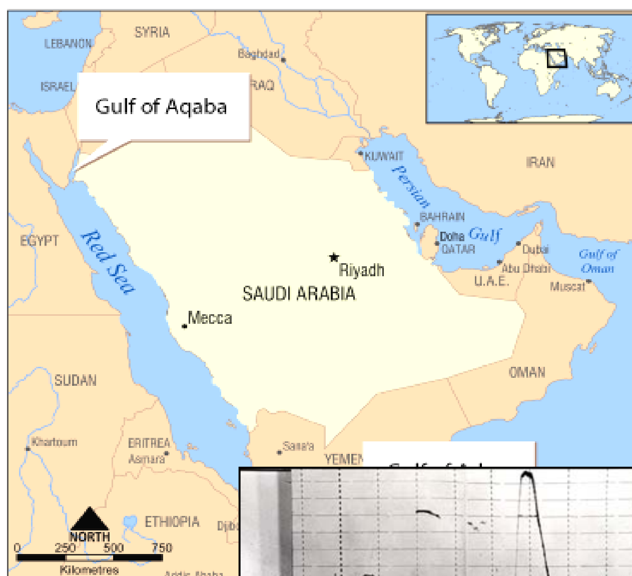
We Earthlings know more about our Moon and Mars now than we do about our own planet's ocean. Humans have only explored 5% of the ocean. Why? Unlike the Moon and Mars, which are observed through telescopes and other instruments right from the Earth's surface, the seafloor is covered by an incredible amount of water. Since it is hard to make observations of it, most of the ocean floor has not been explored. What lies beneath the ocean's surface has always been something to figure out.

Utilizing the ocean throughout history for transportation, and particularly for trade, it has been very important to know how deep the ocean is. Seafarers used to measure the depth of the ocean using a simple line with a weight on the end. Knots would be spaced at measured distances along the line. Crew members would simply throw the line, with a weight attached, over the side of the ship while holding on to the end. Once the weight hit bottom, the sailors would use the knots to tell the ocean's depth. These lines were called '*plumb lines*.' From these plumb line measurements, sailors began to create maps of the ocean floor.





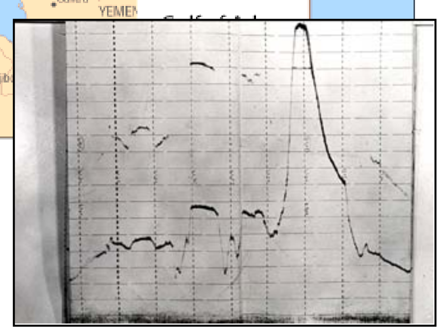
During World War I, people started to measure ocean depth a second way, using sound waves. The technique, **sonar,** is really just using an echo. When you shout in a large empty room, your sound bounces off the walls and returns; you hear the echo. On ships, for example, crew members direct a 'ping' sound below the ship. The sound bounces off of the seafloor and instruments record how long it takes the sound to return. Knowing how fast sound waves travel in water leads to knowing the ocean depth.



Credit: NOAA

As a ship is moving, the instruments create a profile, like a picture, of the seafloor beneath the ship. Observe this profile created by instruments on a ship in the Red Sea in 1967.

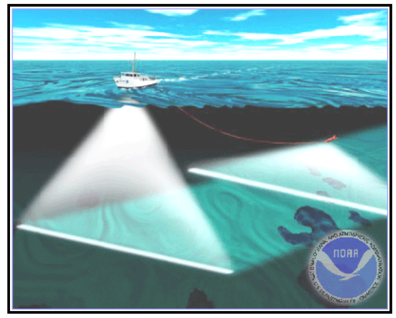
The profile to the right shows the shape of the ocean floor. It is easy to see that the Red Sea's floor is not a flat plain. It has hills and canyons.



1. **Two ships send out a sound, a ping, at the same time. Instruments on Ship A record that the sound returns in 22 seconds. Instruments on Ship B detect the sound's return in 10 seconds. Which ship is in deeper water? Use words and/or drawings to explain your answer.**

2. **If it takes 15 seconds for sound sent from a ship to return to the ship, what is the sea depth at the ship's location?**

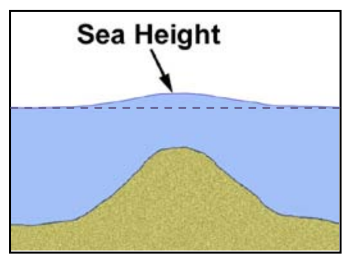
Today, the National Oceanic and Atmopsheric Administration (NOAA) researchers use very sophisticated sonar technology to map the ocean floor. The two sonar examples are called the *side-scan* and *multi-beam sonars*. The sonar instruments fan out in many directions from a ship on the sea surface to get very detailed images of the sea floor and other things beneath the ocean's waves. This includes schools of fish and shipwrecks.



Mapping the sea floor with weights or sonar is a very slow process. Also, since the ocean is so big, it would be extremely difficult to cover the entire sea floor. It turns out that there is another way to map the ocean floor—one that you might not expect!

The third way of mapping the ocean floor is with the use of satellites. This began in 1985 and continues today.

Satellite measurements show something remarkable. The ocean's surface is not smooth. It is "lumpy." The highs and lows of the sea surface actually mirror the sea floor features, the mountains and valleys beneath it. Therefore, scientists can use satellites to examine underwater topography, or **bathymetry.**



Due to gravity, water molecules 'pile up' over underwater mountains. They sink down over valleys and canyons. As a result, higher sea levels indicate underwater mountains. Lower sea levels indicate underwater valleys. Of course, the sea levels do not rise as high as the mountains on the floor. A sea surface rise of a few meters may indicate an elevation of hundreds of meters on the sea floor.

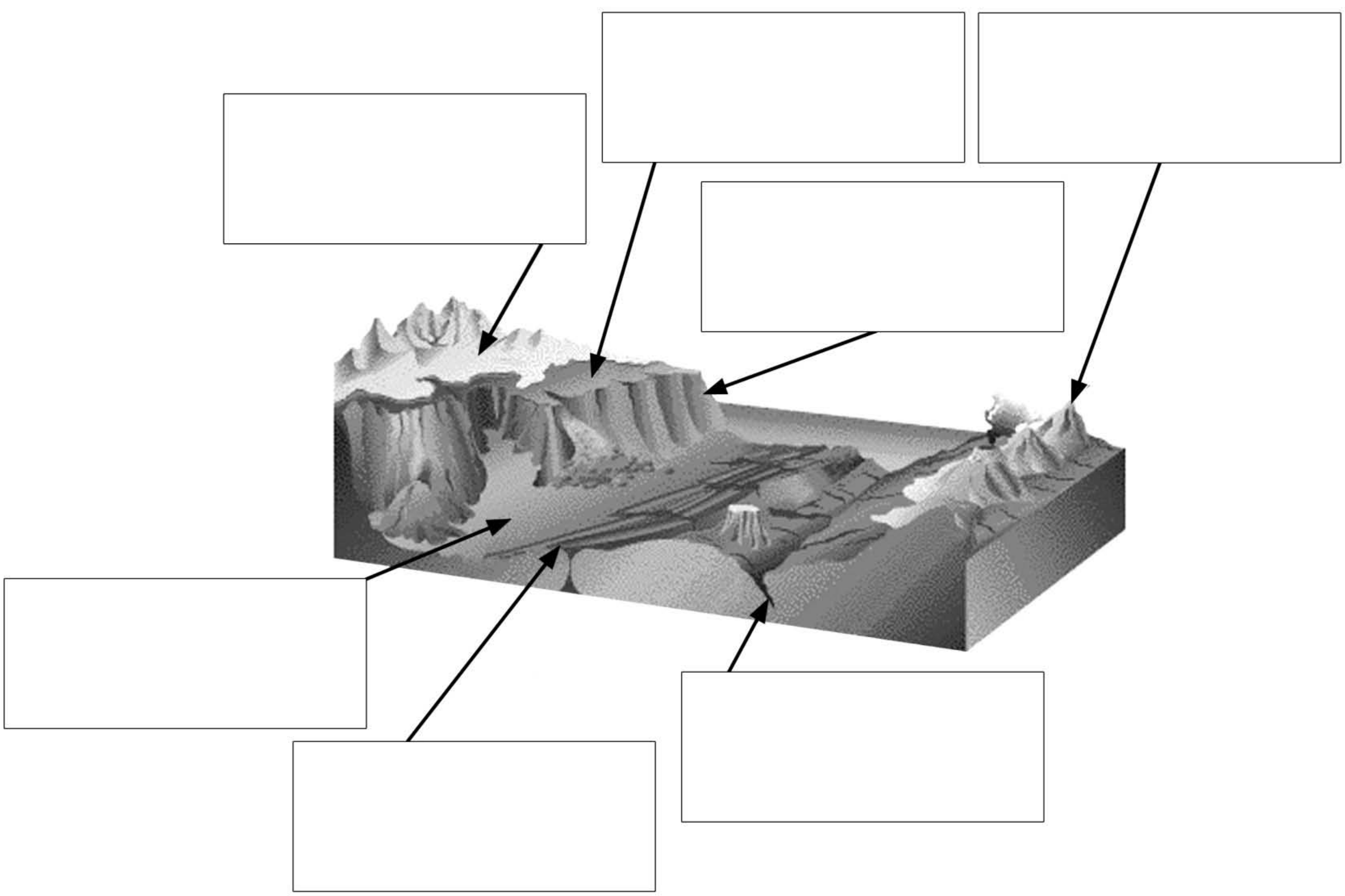
Satellite measurements of sea depth are compared with ship-based sonar measurements and are indeed accurate. Today, bathymetry maps are made from a combination of satellite and sonar data.

Part 2

Features of the Ocean Floor

Use the descriptions below to label the features in the picture.

1. **Continental Shelf—a gently sloping area along the edges of continents**
2. **Mid-Ocean Ridge—underwater mountain range caused by underwater volcanoes**
3. **Abyssal Plain—flat, featureless plain that makes up a large part of the ocean floor**
4. **Trench—deepest part of the ocean, plunging deep below the abyssal plain**
5. **Continental Slope—steep slope leading from the continental shelf down to the abyssal plain**
6. **Seamount— underwater mountain peak, usually caused by volcanic activity**



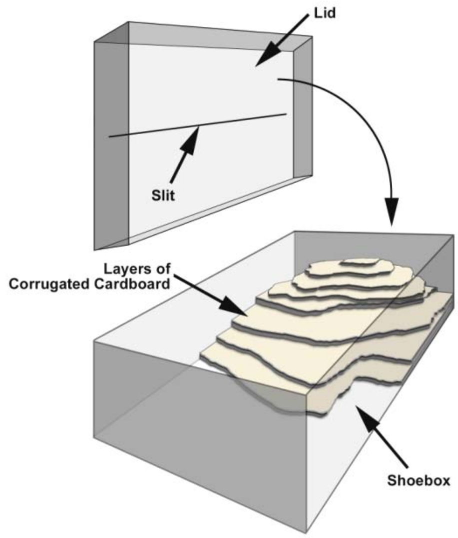
Part 3

A Classroom Model of the Ocean Floor

In this exercise, you will create your own ocean floor. Try to make it as interesting and diverse as possible. You will identify the features that you create below.

1. **With your group, gather your materials—a shoebox, cardboard, glue, and scissors.**

2. **Begin creating layers of cardboard to create a "seafloor" in your box as shown in the diagram. Be sure to create at least three distinct seafloor features.**



3. **Identify the ocean floor characteristics in your group's box.**

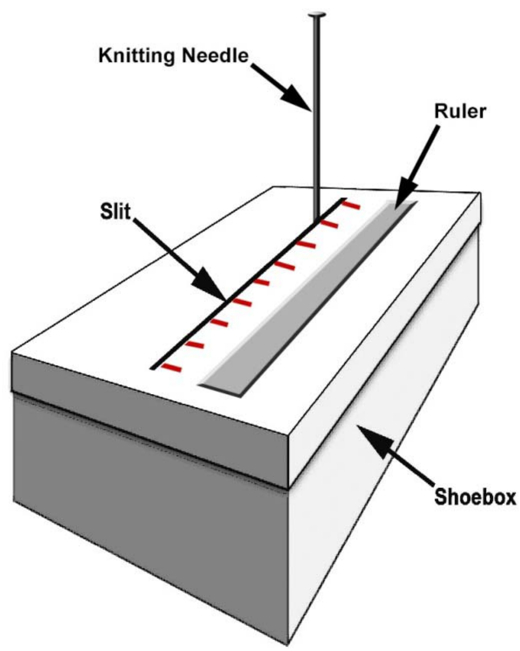
4. **Switch boxes with another group.** ***Don't look in the new box!*** **You are going to try and determine the 'sea floor features' in this box without opening it.**

5. **Place the ruler along the center line (slit) of your new box. Make a mark every two centimeters along the slit. These marks represent where you will take your depth measurements.**

6. **Record your data in the table on the next page. The marker distances are the marks that you made along the slit in the box. You will also measure the depth inside the box.**

Data Table:

Marker Distance (cm)	Depth (cm)
0	
2	
4	
6	
8	
10	
12	
14	
16	
18	
20	



7. **Insert a knitting needle or chopstick into the slit at the zero mark. You should push the knitting needle in gently until you feel that you have reached something.**

8. **Place your finger on the needle along the top of the box. Remove the needle and measure the length of the needle that was in the box. Record this depth in the data table and then repeat at each mark (every one or two centimeters) along the length of the box.**

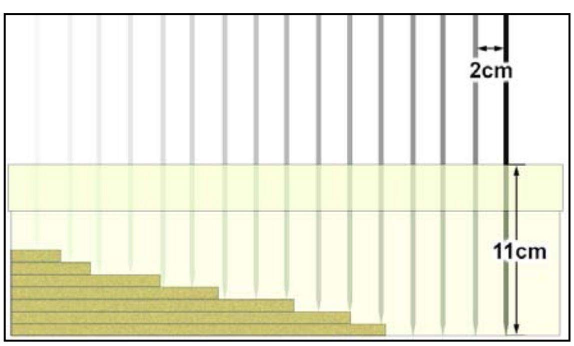
9. **Since this is a <u>model</u> of the sea floor, you will need to convert to a real-life scale. For marker distance, use the scale of 1 centimeter = 100 kilometers. For depth, use the scale of 1 centimeter = 100 meters.**

Record your conversions in the table on the next page.

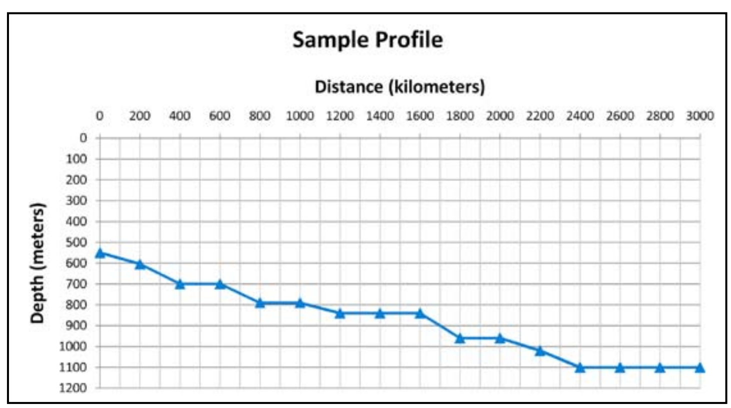
Distance (kilometers)	Depth (meters)
0	
200	
400	
600	
800	
1000	
1200	
1400	
1600	
1800	
2000	

10. Using your converted data, plot a graph of Distance vs. Depth.

Remember that you are measuring the depths *below* the zero line which represents the ocean's surface on your graph. *<u>Hint:</u>* *The "zero" depth line is at the top of the scale.*



Side of Shoebox



11. **Relate the profile that you drew to features that you might see in the ocean. If this were an actual ocean floor profile, what features would you be detecting or seeing? Label these features on the graph.**

12. **How is this activity similar and different to how scientists actually study bathymetry?**

13. **Draw the sea surface above your profile. Consider the relationship between features on the sea floor and the sea surface.**

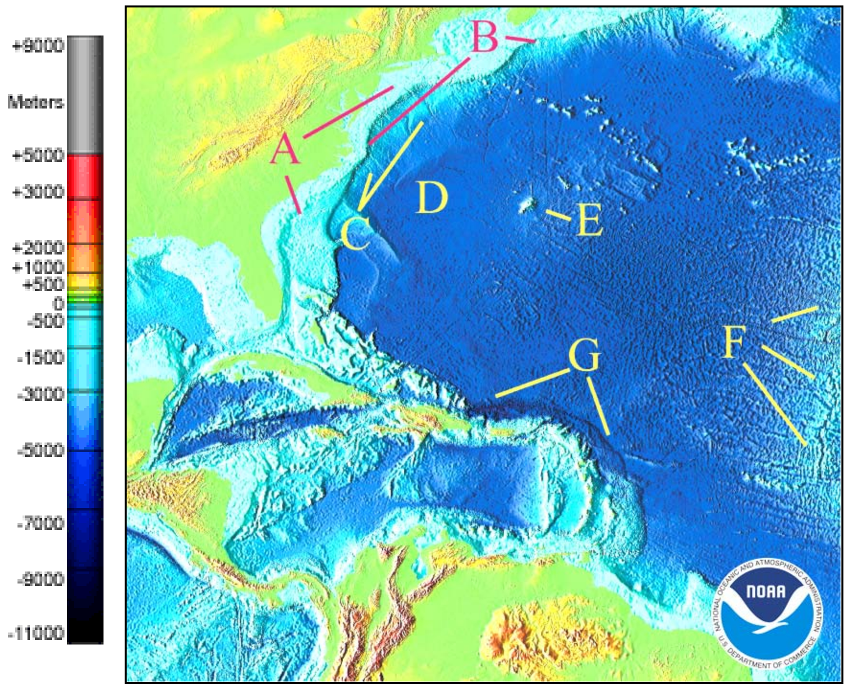
14. **How would you create an island with your shoebox?**

Part 4

Interpretation of Bathymetry Image

When tracking marine animals with Signals of Spring - ACES, you will examine the characteristics of the ocean floor along the animal migration route. This exercise will teach you how to interpret bathymetry images.

When looking at any type of Earth imagery, it is important to look at the color bar. In this example, each color represents a different depth in meters.



1. Which color represents the deepest depth?

2. Which colors are shown to be land?

3. **Using the topographic bathymetry image, identify and describe the major underwater features listed below.**

A. **Continental Shelf**

B. **Continental Slope**

C. **Continental Rise**

D. **Abyssal Plain**

E. Islands

F. Mountain Ranges

G. Trench

4. How does the bathymetry near the West Coast of the United States compare to the East Coast?

Part 5

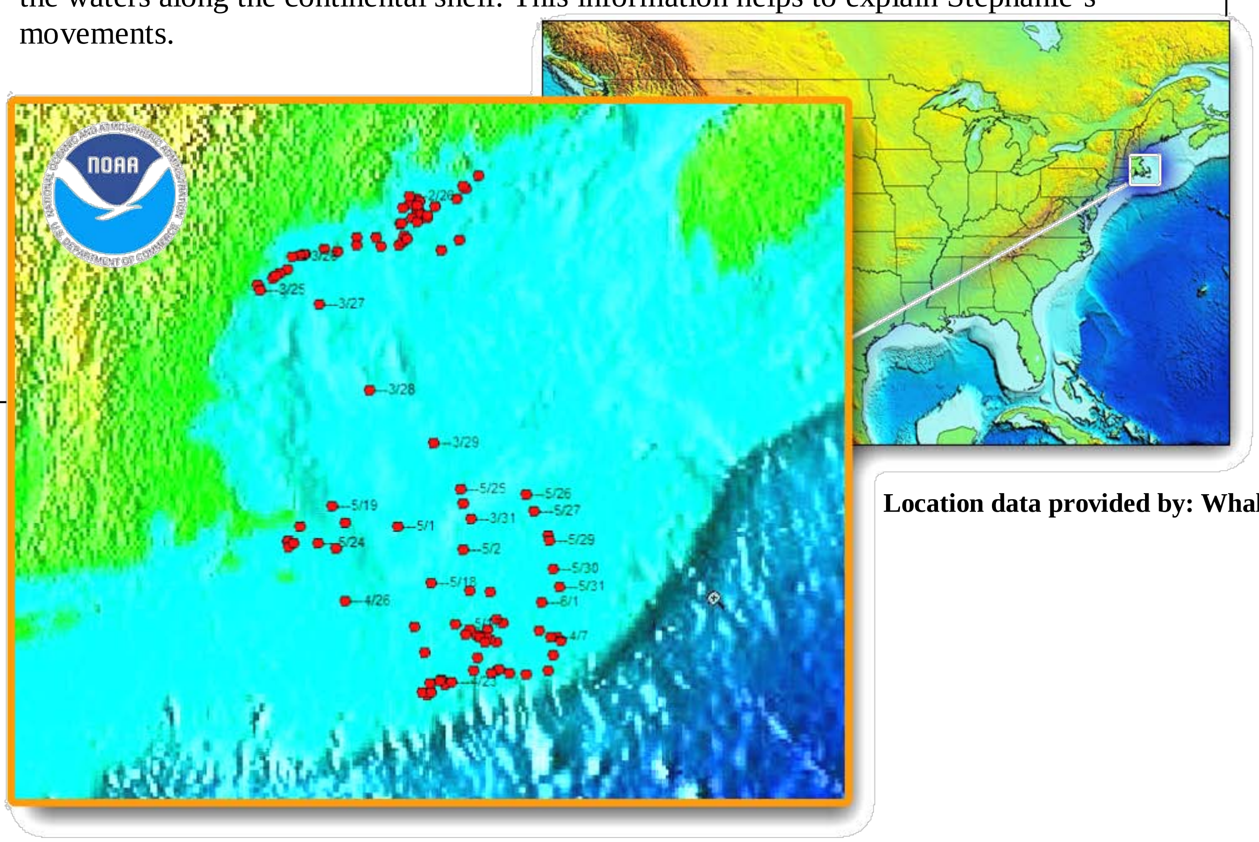
How Does Bathymetry Relate to Marine Animals?

Stephanie, the Gray Seal

The shape of the seafloor will often affect the movement paths of marine animals. Gray seals, for example, are marine mammals that tend to stick close to land. They come out of the water and take rests or ‘haul out’ on rocks or beaches. Look at the track of the Gray seal.

By looking at the dates, notice that Stephanie the gray seal spent a lot of time in March very close to shore. She moved along the coastline, and then ventured out toward the edge of the continental shelf, near the continental slope. Notice, though, that this seal never left the continental shelf’s shallow waters.

Gray seals eat a varied diet that includes fish, like herring and capelin, as well as invertebrates such as shrimp, squid, and octopus. All of these food sources can be found in the waters along the continental shelf. This information helps to explain Stephanie’s movements.



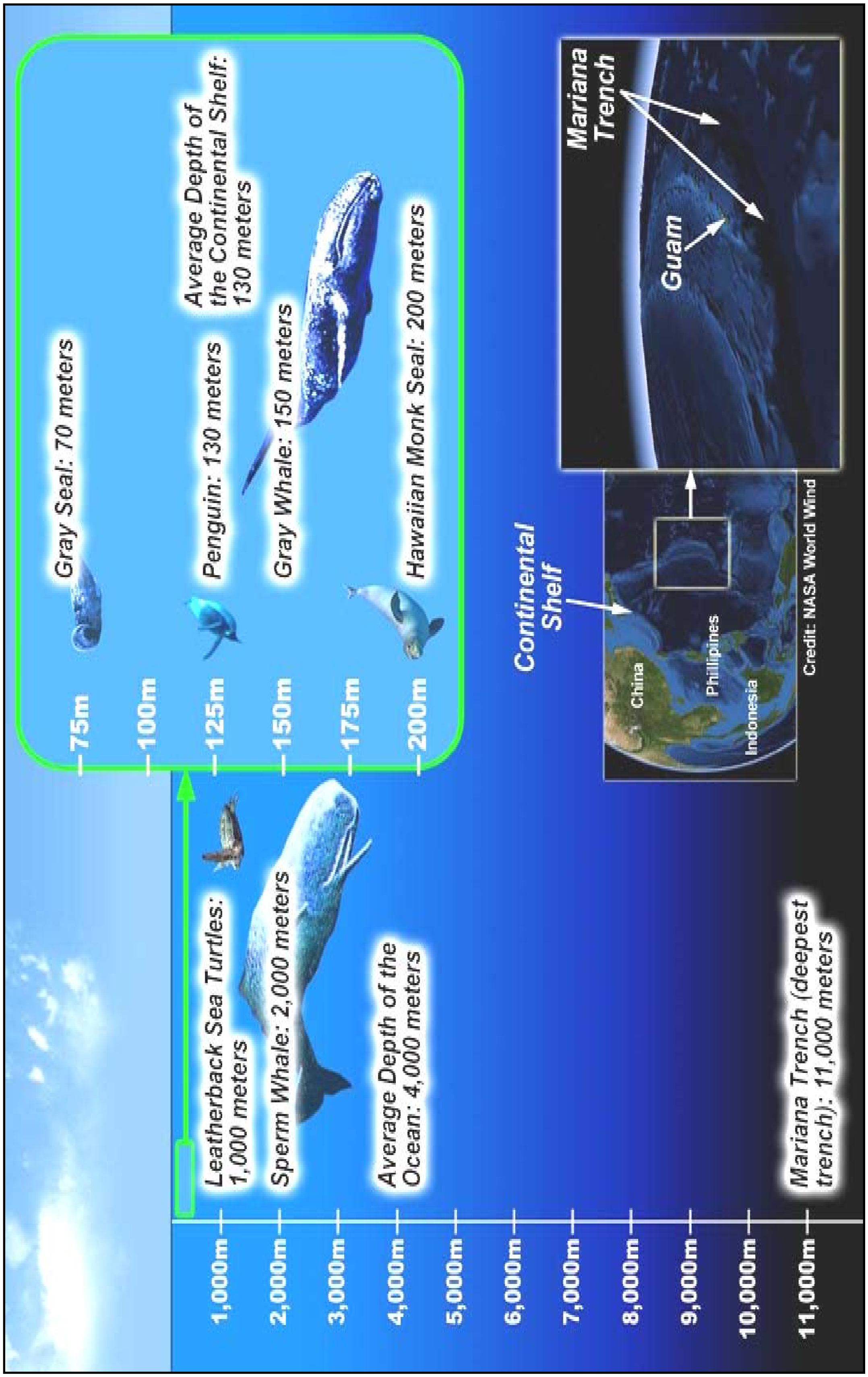
Location data provided by: WhaleNet

1. **Why might some other types of marine animals be found in deeper waters?**

How deep do they go?

Some scientists put satellite transmitters on marine animals to record just how deep they can go. Scientists hypothesize and have learned that some animals go very deep to look for food, others go deeper for protection from predators lurking above.

In this diagram, the depths given are the approximate maximum depth to which each of these species can dive. Of course, scientists are always learning, and new findings may change what we know.


1,000m
2,000m
3,000m
4,000m
5,000m
6,000m
7,000m
8,000m
9,000m
10,000m
11,000m
Leatherback Sea Turtles: 1,000 meters
Sperm Whale: 2,000 meters
Average Depth of the Ocean: 4,000 meters
Mariana Trench (deepest trench): 11,000 meters
75m
100m
125m
150m
175m
200m
Gray Seal: 70 meters
Penguin: 130 meters
Gray Whale: 150 meters
Hawaiian Monk Seal: 200 meters
Average Depth of the Continental Shelf: 130 meters
Continental Shelf
China
Phillipines
Indonesia
Credit: NASA World Wind
Mariana Trench
Guam

2. **Which animals can dive the deepest?**

3. **Why do you think some of these animals dive so deep, while others stick close to the surface?**