

## Module 1: What is Oceanography?

### Topic 3 Content: Tools of the Oceanographer Notes

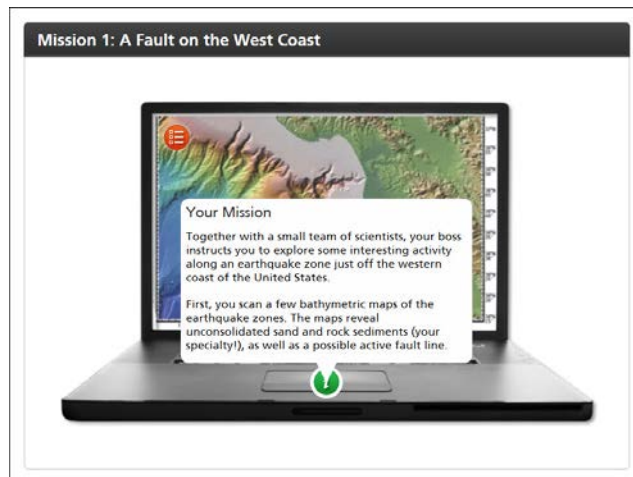


Imagine that you just finished graduate school and accepted an exciting job opportunity as a geological oceanographer

It's only your first day on the job, but your boss suddenly calls you in for an urgent meeting

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### Your Mission

Together with a small team of scientists, your boss instructs you to explore some interesting activity along an earthquake zone just off the western coast of the United States.

First, you scan a few bathymetric maps of the earthquake zones. The maps reveal unconsolidated sand and rock sediments (your specialty), as well as a possible active fault line.

### Bathymetric Map

A bathymetric map displays the depth measurements of a body of water, similar to how a topographic map displays height measurements of land features.

This particular map shows the land and ocean areas around Monterey Bay, just south of San Francisco.

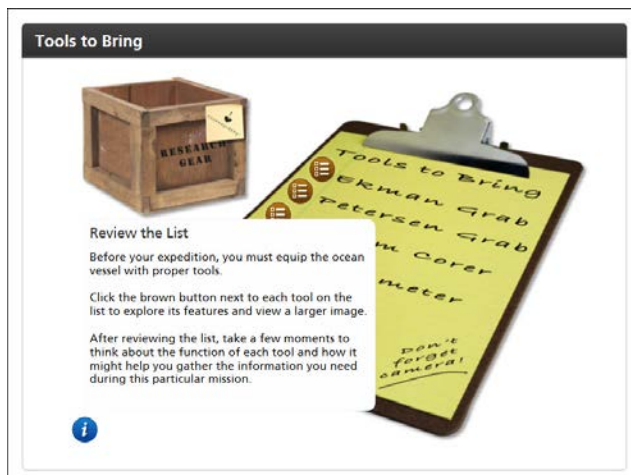
### Learn More

<http://media.marine-geo.org/image/monterey-bay-2008>

Image source: LDEO: Marine Geoscience Data System

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### Review the List

Before your expedition, you must equip the ocean vessel with proper tools. Click the brown button next to each tool on the list to explore its features and view a larger image.

After reviewing the list, take a few moments to think about the function of each tool and how it might help you gather the information you need during this particular mission.

### Ekman Grab

The Ekman grab is a brass device used to take samples of soft sediments from the ocean floor. Image source: Genevieve Anderson

### Petersen Grab

The Petersen grab is a metal device used to take samples of rocky areas from the ocean floor. This device is extremely heavy. Image source: Genevieve Anderson

### Bottom Corer

A bottom corer collects small, cylindrical samples from the bottom layer of sediment without disturbing the rest of the layer. Image source: Genevieve Anderson

### Seismometer

The seismometer is an instrument that measures ground motion. Image source: USGS

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Based on the recommendations from your colleagues, you decide you'll need two types of tools that grab the ocean bottom and bring up sediments and rock samples.

The Ekman grab helps sample the sandy areas of the ocean floor, while the Petersen grab helps sample the rocky areas of the ocean floor. You take both of these from the lab and make sure they get on the boat.

However, you'll need more than these two tools to get the job done. What if you need to get a deep sample of the ocean floor below the first few layers of sediment and rock? You had better take a bottom corer with you

In addition, since your maps reveal an active fault, you think about bringing a seismometer to place near that fault. This device will monitor the ocean floor for any seismic waves released when an earthquake occurs. You locate a small seismometer and make sure it's properly stored on the boat.

Once all of these items are on the boat, you and your crew take the rest of the evening off. You'll need to get an early start the next day.

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Finally After two weeks of non-stop research, you return to the office fresh from your voyage studying the west coast ocean floor.

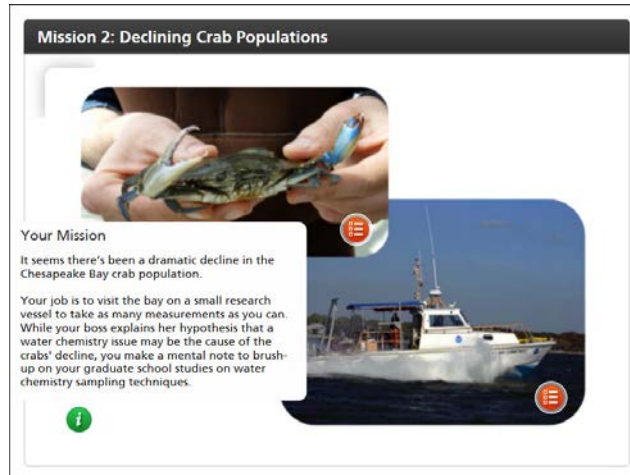
Even before you can sit down, your boss has yet another urgent mission for you.

Unfortunately, some of the senior chemical oceanographers came down with the flu, but this is good news for you. Your boss informs you that you'll be filling in for them during the next vital mission

Are you up to the task?

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**Mission 2: Declining Crab Populations**

**Your Mission**

It seems there's been a dramatic decline in the Chesapeake Bay crab population.

Your job is to visit the bay on a small research vessel to take as many measurements as you can. While your boss explains her hypothesis that a water chemistry issue may be the cause of the crabs' decline, you make a mental note to brush-up on your graduate school studies on water chemistry sampling techniques.

### Your Mission

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### Maryland Blue Crab

“While the overall crab population in the Chesapeake Bay rebounded significantly last year, the number of juvenile crabs remains well below the historical average...” Image source: NOAA

Learn More [http://www.noaanews.noaa.gov/stories2009/20090707\\_crabs.html](http://www.noaanews.noaa.gov/stories2009/20090707_crabs.html)

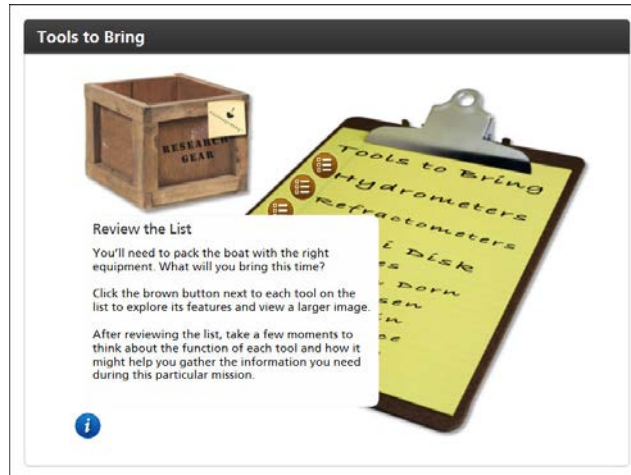
### Your Research Vessel

The R/V Bay Commitment will be your transportation and research base while collecting samples during your mission.

Image source: NCBO

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You'll need to pack the boat with the right equipment. What will you bring this time?

Click the brown button next to each tool on the list to explore its features and view a larger image.

After reviewing the list, take a few moments to think about the function of each tool and how it might help you gather the information you need during this particular mission.

### Hydrometer

A hydrometer is an instrument used to measure specific gravity, or density, of liquids.

Image source: NOAA

### Refractometer

A refractometer is an optical instrument that determines salinity based on light refraction through a seawater sample.

Image source: NOAA

### Secchi Disk

A Secchi disk is a circular device used to measure water clarity.

Image source: NOAA

### Van Dorn Bottle

A Van Dorn bottle is one of several types of devices that collect water samples at different depths.

Image source: Genevieve Anderson

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### **Nansen Bottle**

A Nansen bottle is one of several types of devices that collect water samples at different depths.

Image source: Genevieve Anderson

### **Niskin Bottle**

A Niskin bottle is one of several types of devices that collect water samples at different depths.

Image source: Genevieve Anderson

### **Surface Sample Bottle**

A surface sample bottle is a device that collects water samples on the ocean surface.

Image source: Genevieve Anderson



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After reviewing the list, the first thing you need to pack is a device to measure salinity. You go into the lab and pick out a few hydrometers and refractometers. Both of these devices will let you know the amount of salt content in the ocean water. If the salt is too high or too low, you'll be able to tell.

Next, you find a Secchi disk. This disk helps you to observe the water's turbidity, or the amount of sediment present in the water. Again, too much sediment and the crabs will have a problem.

Finally, you'll need to take numerous water samples at a variety of depths. You see in the lab dozens of Van Dorn bottles, Nansen bottles, and Niskin bottles. All of these bottles will do very similar jobs, so you take a few of each just to be safe.

But wait, you'll also need to sample the surface water! Crabs don't live on the surface, but it can't hurt to have too much data. On the way out, you grab several surface sample bottles, and then hit the lights.

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After returning from the bay, you, along with your lab partners, analyze all of the water chemistry samples. However, even with all the data you collected, you still have no conclusive evidence as to the cause of the crab population's decline.

As a scientist, you're frustrated with this development, but this is a demanding job, and there's a lot more work to be done.

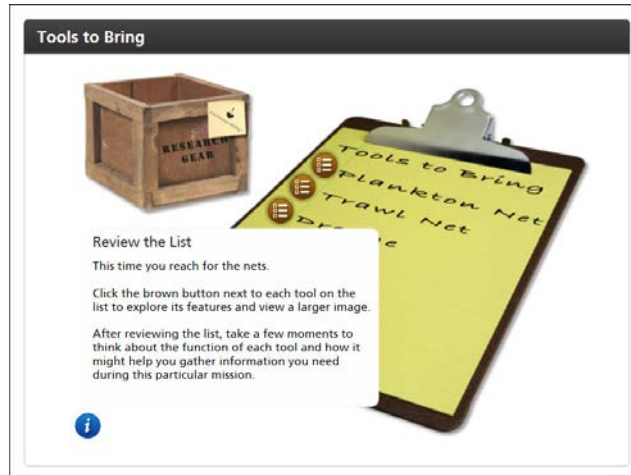
Your boss sends you to the next mission with expert biological oceanographers for assistance.

You already know it's your job to pack the boat Image

source: NOAA/OER

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### Review the List

This time you reach for the nets.

Click the brown button next to each tool on the list to explore its features and view a larger image.

After reviewing the list, take a few moments to think about the function of each tool and how it might help you gather information you need during this particular mission.

### Plankton Net

A plankton net is a special net that is dragged behind a ship to collect samples of plankton and other tiny ocean organisms.

Image source: EPA

### Trawl Net

A trawl net is a special, tapered net that is dragged by a ship to collect samples of larger ocean organisms such as fish and crabs.

Image source: NOAA

### Dredge

A dredge is a metal collection device that is dragged along the ocean bottom to sample rock, sediment, and various bottom-dwelling organisms.

Image source: NOAA

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After consulting with the biological oceanographers, you realize you're going to need at least two nets: a plankton net and a trawl net. Both of these nets attach to the back of the boat, and are dragged behind as the boat moves forward. The plankton net will collect microscopic organisms, and the trawl net will collect larger, swimming ocean life.

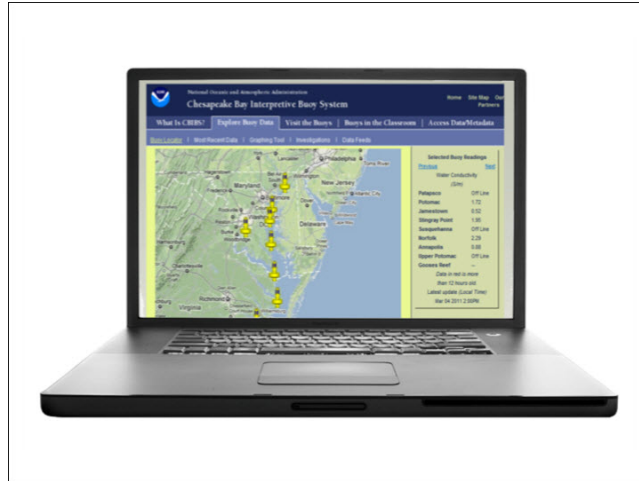
The biological oceanographers suggest that it's not necessary to bring any quadrats, transects, or succession plates. None of these devices will collect information of value to the problem the crabs are facing.

However, the biological oceanographers do recommend bringing a dredge. This will help collect samples of organisms by dragging along the ocean floor.

Maybe this time you'll find the answers; if not, you fear another long voyage with yet another crew

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Unfortunately, after many hours of analyzing their data, the biological oceanographers have no clear evidence as to the decline of the crab populations.

You studied the chemistry, you studied the biology, and you've concluded that the cause must be some part of the physical ocean.

Thinking quickly, You open up your laptop and view the data from all of these buoys for the last few years. In the Chesapeake Bay, a series of ocean buoys constantly measure sea surface temperature, wave speed, wave height, and ocean currents. Thanks to the process of remote sensing, these buoys connect with satellites to send back volumes of data for collection and processing.

After some calculations, you notice that over the last decade, the sea surface temperature has increased more than 0.3 degrees.

Aha! The rising temperatures are probably the cause of the declining numbers of crabs! You're excited to find a solution and rush to share the information with your boss and co-workers.

Learn more about how scientists use buoys to monitor temperature.

<http://www.buoybay.org/site/public/classroom/app1.php>

Image source: NCBO

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The next day when you return to the office you see a note on your desk from your boss. Oh no, she wants to see you yet again. Thoughts of heading back out to sea on another mission fill your mind with dread.

As you make the long walk down the hall to her office, you think of what your family will say when you tell them you'll be away on a voyage for the next few months.

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Reaching your boss's office, you knock, enter, and sit down. The boss has a huge smile on her face and then stands up and shakes your hand. Your boss tells you how proud she is of your appropriate choice in tools, effectively recording useful data, and coming up with insightful solutions.

“All part of being a good scientist,” she says.

Your boss makes a point to congratulate you on placing a functioning seismometer on the fault in the first mission. Data from that device may even help predict the next underwater earthquake

She also tells you how much you helped the biologists and chemists in the second and third missions. They're pouring through the samples and collections in hopes of finding more information.

Lastly, she invites you to draft a full report for the Senator on the rising ocean temperatures. Your boss tells you that this report may be just the evidence the Senator needs to pass some important environmental legislation

Ecstatic, you leave her office hoping that you are closer to that well deserved raise...right after you finish drafting the report, of course!