Unit 2. Lesson 4. Equipment and Sounds People use to Explore the Oceans

Lesson Objectives: Students will gain knowledge and appreciation for research vessels and equipment found on them.

Vocabulary words: satellite, Argos, tether, autonomous, buoy, iodiophone

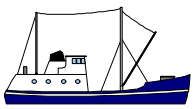
Vessels and Vehicles

Vessels

The ocean provides oceanographers will a difficult environment to study. Deep water, high pressure, and low light all hinder ocean exploration. In many cases is it necessary to reach locations far from land, conduct experiments over a long period of time, and bring samples and specimens back to the onshore laboratories. How would one go about studying this vast realm?

Universities and research institutions have solved the problem of getting to the area in the ocean they want to study by having ships devoted solely to research processes. Research vessels roam all waters of the earth. The ships are equipped to provide housing for the researchers, electronic capability to support almost any kind of equipment, and **satellite** equipment to transmit data back to land. Ships are equipped with winches, cranes, A-frames, small boats, and other gear to do over-the-side work. They also have laboratory space for sample analyses and data processing. Most ships stay out for prolonged periods of time; several days to several months, while there are others that are only capable of handling a one-day cruise.

Some ships provide a 'base' from which scientists can work. The ship serves as a center to deploy instruments. Some of these

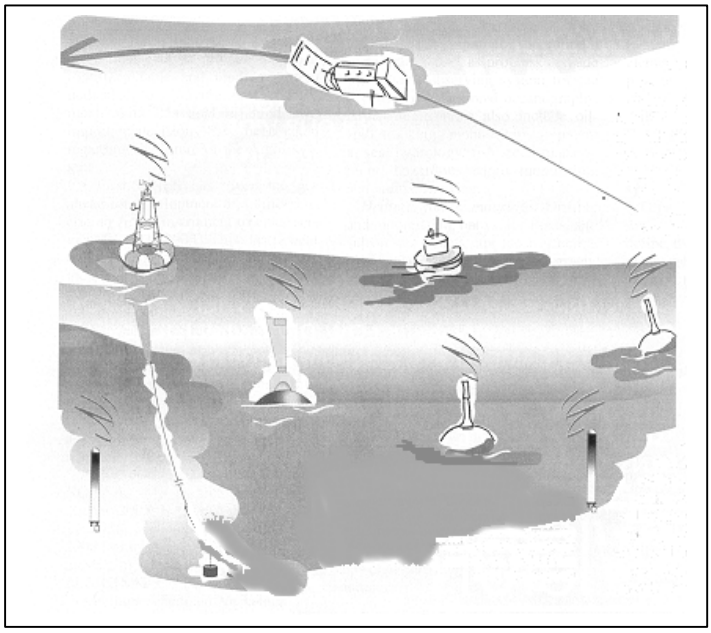


include manned, and unmanned submersibles, remotely operated vehicles, buoys, **CTD**'s and other sampole collection devices, like bottles and nets.

At any given time, it might be possible to find vessels in the Pacific Ocean, the Polar Regions, Lake Baikal, and the Mediterranean Sea, as well as along coastlines.

SATELLITES

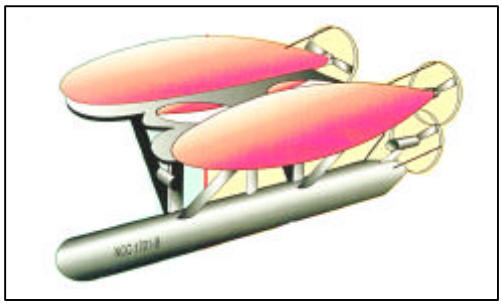
The world's oceans contain almost 3,000 drifters, buoys, and other objects collecting oceanographic data. These items are monitored by the only satellite system dedicated to monitoring and protecting the environment. This system is called **Argos**. The satellite flies at a low altitude, which means it can receive transmissions from low-power transmitters. Briefly, the system receives transmissions from floating and deep-sea **buoys** and other platforms. The message is then transmitted back to a land or ship-based operation. The land-based scientist can easily retrieve the data without removing the instrument from the water and data analysis can begin immediately using the Argos system.



The most attractive aspect of using drifting buoys and other platforms that are monitored by Argos is that they can operate unattended for up to two years, and deep-sea floats can operate for up to four. Argos-monitored systems are more economical because expensive ship time and valuable man-hours are not necessary.

Robots

Advancement in technology has allowed the use of unmanned and un**tether**ed robots. Created and designed



at Woods Hole Oceanographic Institution, ABE is the first of its kind, and still in the development stages. ABE stands for **Autonomous** Benthic Explorer. It was designed because scientists have the need to monitor an area over long period of time, and go very deep. ABE will be programmed to move on its own without a pilot (unlike the submersibles Alvin or Jason) or tethered to a ship, and perform a set of tasks over several months.

ABE has a 'body', muscles (thrusters), nerves (cabling power to operate the motor, cameras, and sensors), and brain (computer systems for power, and determining where to go and make measurements). The data will not be available until the instrument is recovered.

Initially, ABE will only be able to perform the tasks that it is pre-programmed to do, but as technology advances that is expected to change. Ultimately, scientists hope to use underwater acoustic data transmission systems to allow scientists anywhere in the world to receive live video and data from ABE, as well as control its movement and sampling.

Buoys and Probes

Buoys and probes are useful because they can be left for long periods of time, and outfitted to collect many different pieces of data. Some of the data they collect includes salinity, water velocity, temperature, light, pH, underwater geography and sound.

The size of the buoy varies due to the instruments that it carries, and also depending on the length of time that the buoy is to remain in the water. The buoys are dropped in the ocean using a large crane on a research vessel, and left unattended until the vessel retrieves it. Some of the are equipped with satellite transmitters.

Sound Used in Ocean Research

There are four major categories of sound exploration. The first involves the use of receiving devices called **hydrophones**. Hydrophones listen to ambient or background, noises such as those emitted by whales, fish or submarines. The second is SOund Navigation And Ranging, abbreviated **SONAR**. This involves sending and receiving signals reflected from objects (fish, submarines) within the water or the seabed. Using the time it takes the signal to return to the receiver, water depth and much more can be calculated. **Echo-sounding** techniques are very useful for depth determination, and mapping the seafloor. These instruments have become very sophisticated and can detect groups of very small zooplankton. There is really no difference between echolocation and SONAR, except that echolocation is much more informative than SONAR. It allows much more detail and description to be interpreted, where SONAR finds objects and the distance they are away. Marine mammals that use echolocation could distinguish if something is a live animal, or an object. Finally, **sidescan-imaging** systems produce the equivalent of aerial photographs or radar images using sound. The names of a few of these systems are GLORIA (Geological Long Ranges Inclined Asdisc), and TOBI (Towed Ocean Bottom Instrument).

Future of Ocean Research

Ocean Research is big business. It is important to researchers, engineers, politicians, mining, fisheries and marketing business people. As technology advances, so does the equipment used for ocean research. More data are available, better resolution is achieved, and continuous data collection is now possible through satellite monitoring. What is even more exciting is that scientists can often forgo the lengthy and expensive research trips that have been customary in the past!! The study of the ocean is only going to become more complete and more accurate as technology continues to advance.

Activity 4-1. Phone a Friend

Alexander Graham Bell built the first telephone. Many years ago, it was necessary to lay underwater cables across the ocean for people to call across the ocean. Today, cables are not necessary, and the signals are bounced through satellites as waves. Experiment with the following activity to understand how sound travels.

Materials and Methods

Hammer
Nail
2-3 empty 540 mL cans
heavy string
a friend

Procedure:

1. Use a hammer and nail to punch a hole in the center of the bottom of each can.
2. Cut a piece of string 7m (21feet) long. Push one end though each end of the can, and tie the string so that the knot is inside the can.
3. With your friend, take the phone outside and hold the cans far enough apart so that the string is stretched tightly.
4. Talk into the can while your friend holds the can to his/her ear.
5. Make the same phones with strings of other lengths and notice how sound is different.
6. Now add a third person. Tie a string, with can attached to the middle of the original string. How does this change the sound?

How it works

When you speak, the metal on the bottom of the can vibrates. This causes the string to vibrate. The vibrations travel through the string, and into your friend's can.

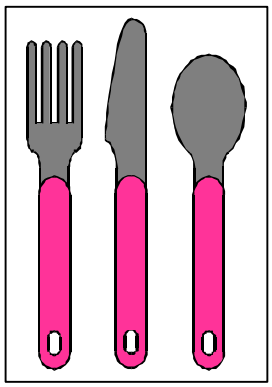
A real phone has a metal disc that vibrates. This disc causes tiny grains of carbon to vibrate. Electricity flows through them, and passes through the telephone wires to the receiver at the other end. A tiny magnet in the phone receiver changes the electric current into sound vibrations that can be heard.

Activity 4-2. Play the Table Settings

Have you ever tapped your fingernail on a glass, drummed your finger on a closed can of vegetables, or rubbed your finger across the rim of your glass? Have you ever scraped your fingernails over the chalkboard or a mirror??! This is called playing an idiophone. In Greek, *Idio-* means self and *phone* means sound. An **idiophone** is something that naturally makes sounds when it is rubbed, struck, shaken or scraped.

Materials:

Water
Several wine glasses



Procedure:

1. Fill the wine glasses with different amounts of water.
2. Wet a fingertip, and rub it on the rim of each glass until it 'sings'.

How it works

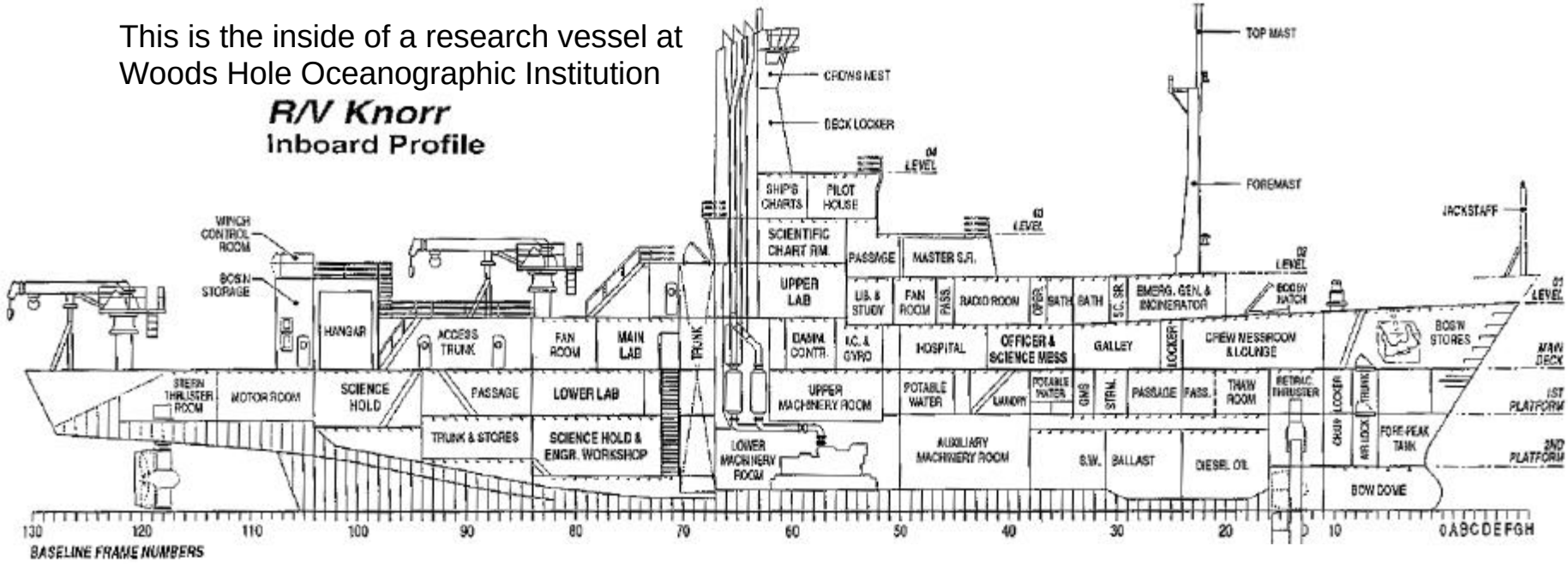
Look at the water! It vibrates as the glass vibrates. The water in the glass slows down the vibration down. That is why the glass with the most water makes the lowest sound.

Student Activity Sheet

Attached is a Student Activity Sheet that illustrates how a research vessel is organized. Every inch of the vessel is utilized. Have the student discuss how close the quarters are, and how different research would be conducted on the ship. Examples of different types of research would include cruises to study sediment samples, fish ecology, conduct water quality testing, nutrient experiments, deploying bouys and arrays, and remote sensing.

Unit 3. Lesson 4. Student Activity Sheet 4. How to Live on a Ship

This is the inside of a research vessel at Woods Hole Oceanographic Institution



How would you like to spend several months on a ship this size?