Underwater Mapping

Age: Middle School

Objective

- **To help students understand how underwater mapping was conducted before the invention of sonar.**

Background Lesson

Although people have observed that animals such as bats and dolphins use sound to navigate their surroundings, the technology to propagate sound waves (particularly through water) and analyze the resulting echo only became widely available to scientists after the 1950's. Sonar is now used for a wide variety of applications such as detecting fish, navigation and underwater communications. In the days of mast and sail, before GPS and sonar was available, underwater mapping was done by lowering a weighted rope or pole and measuring the distance between the bottom and the surface. Although crude and largely impractical for the vast open ocean, it was still useful for smaller, shallower areas such as near port cities, major shipping lanes, and narrow channels. Experienced sailors relied on compasses, sextants, star constellations and nautical charts to navigate and took great care to avoid hitting the water bottom or running aground to avoid damaging their ships or losing their valuable cargo.

The Activity

Materials

- **A large, deep opaque container, such as a cooler or basin**
- **Hard materials such as sand, pipes, flower pots, gravel, bricks and rocks**
- **Food coloring**
- **String with weight on the end**
- **Long rulers (meter sticks)**
- **Permanent marker**
- **Note taking materials (pen, pencil, paper, notebooks, clipboards)**

Preparation

Place the sand, rocks, bricks and other materials into the bottom of the container.

Try to create varying terrain; form mountains by piling up materials, submerge flower pots and pipes to create trenches, create overhangs with materials such as bricks or pieces of broken flower pots.

Using the marker, mark North, South, West and East on their respective side of the cooler, as well as ticks for a set of unit intervals (i.e. every 10 cm). Depending on the age and level of the students, prepare or have students draw a

corresponding grid map with the proper directions and measurements, with spaces to record the depths. Make sure students understand the basics of coordinates (x, y, z) or show them pictures of contour maps.
Fill the cooler with water and add enough food coloring to prevent students from seeing the bottom.

Procedure

1. **Divide students into groups to record depths and measure with the string. Have them take turns lowering the string into the water until they feel it touch the bottom, then measure the length of the string and record the depth at that spot.**
2. **Continue to measure and record the depth systematically (left to right, top to bottom).**
3. **Based on their measurements, have students guess what objects and types of terrain are on the bottom of the container. Have them draw pictures or simple contour maps of what they think it looks like. Ask them to guess what type of terrain, such as sand or rock is in each section of the map.**
4. **After students have completed their maps, drain the cooler and compare the bottom of the cooler with their pictures and contour maps. How much of each kind of terrain was there? Were areas such as overhangs and trenches detected?**

Post Activity Discussion

- **How did their guesses compare to what was really on the bottom of the container? What are the limitations of this method?**
- **What areas would be most easily and accurately mapped by this technique? (i.e. open lakes, ponds, rivers) What areas would be most difficult and least accurately mapped by this technique? (i.e. karst formations and areas with underwater caves)**
- **What are some other uses for sonar they have heard of or seen? Some examples might be if they or their parents had an ultrasound at the hospital, or if their parents use a fish finder device while fishing at the cottage.**
- **What kind of background knowledge and observations helped lead to sonar and GPS? (i.e. observing animals, sound waves, optics, satellite communications, computing power)**

Possible Assignments

- **Have students draw a map and chart the safest path for a ship to take through the terrain created on the bottom of the cooler.**
- **Have students research certain types of underwater landforms, what would be the best way to map them and what kind of safety precautions should be taken before mapping (i.e. karsts, underwater caves, trenches, ridges).**

- **Have students read about different types of legendary sea monsters (Kraken, Leviathan, Loch Ness Monster, Mermaids). Discuss how ancient people might come to believe that these creatures existed by comparing them to real sea animals (giant squid, whales, manatees) and natural phenomena (i.e. spigots, whirlpools).**

- **Have students research an animal that uses a non-visual form of navigation such as hearing (i.e. bats, dolphins, some birds, shrews), touch (i.e. the star-nosed mole), or electrical impulses (i.e. sharks, duck billed platypus, electric fish, eels and rays). Discuss why these animals would need to rely on a non-visual sense in their environment and what kind of physical features they would need to use their sense.**