Depth Line

Key Concepts

1. The design of submersibles has changed over time.
2. New advances in technology are making the deep sea more accessible to us.
3. There is much more to learn about the deep sea.

Background

It was only a matter of time before human curiosity and desire for gain would encourage the development of a method to explore the world under water.

Legend says that about 350 B.C., Alexander the Great descended beneath the sea in a glass barrel. In the early 1500's, Leonardo Da Vinci designed the face mask, a tube for breathing underwater, and workable flippers.

In 1620, Cornelius van Drebbel built two boats on the Thames River. Each boat carried 12 oarsmen and 12 passengers and could submerge for a short period of time.

During this same time, diving bells were used to salvage ships. The bells were actually barrels which were open at the bottom, and lowered by cables. The pressure would force the air into smaller and smaller portion of the bell, as it was lowered further into the water. The restricted air grew stale rapidly. In 1692, Halley designed a way to sink barrels of fresh air to diving bells already underwater. The barrels could be upturned and send fresh air bubbling in to the divers inside. Halley is recorded to have spent 90 minutes at a depth of 60 feet using this method.

The rigid helmet of the diving suit was actually just a smaller diving bell into which air was pumped through a hose. That 18th century design did not change much until the invention of SCUBA in the 1940's.

In 1772, John Day built a small submarine where he spent 12 hours at a depth of 30 feet. Shortly after that successful dive, he sealed up a 50-ton sloop and descended into the harbor by loading his boat with rocks until she sank. His plan was to dive to 300 feet and stay there for 24 hours, but he never returned to the surface. The boat was probably crushed by water pressure.

In 1776, during the Revolutionary War, George Washington directed Army Sergeant Ezra Lee to make an attack against Admiral Howe's *HMS Eagle*. The *American Turtle*, a small underwater boat, was designed by American, David Bushell. Lee navigated the *American Turtle* to the *HMS Eagle* by using a phosphorus-coated compass. Unfortunately for the cause of the Revolution, Lee was unable to attach his black-powder torpedo to the *Eagle's* hull.

The Civil War marked the first successful underwater military confrontation. The Yankee *Housatonic* was destroyed when the Confederate submarine, *David of Hunley*, rammed a gunpowder charge against the hull. The concussion from the explosion sank the *Hunley* as well.

The Bathysphere, developed by Dr. William Beebe and engineer Otis Barton, was the first underwater vessel designed solely for research. In 1932, the Bathysphere was lowered to nearly 3000 feet off Bermuda. Attached to the surface by a cable and with no means of propulsion, the explorers descended into the ocean knowing there was no way they could be rescued if the cable were to break.

Modern bathyspheres are attached to buoyant tanks filled with gasoline. The resulting underwater ship, called a bathyscaph, is similar to a dirigible flying underwater. Swiss physicist and balloonist, August Piccard, is credited with the first successful unmanned dive off Dakar in 1948. The *FNRS II* descended to a depth of 4600 feet. In 1954, the French Navy modified the *FNRS II* and took it to a depth of 13,284 in the same deep trench off Dakar.

Piccard and his son designed a new bathyscaph, the 60-foot*Trieste*, and took it to more than 10,000 feet in 1953. On January 23, 1960 Jacques Piccard and US Navy Lt. Don Walsh set depth record of 35,800 feet in the Marianas Trench.

Since that time, small and much more maneuverable research submarines have been designed and developed.

Recent technological advances have allowed humans to actually descend in the mid-water and benthic zones of the deep sea. By using small manned submersibles, such as ALVIN and JASON, direct access to the geology and biology of the ocean floor has been gained. Studies of the ocean floor have uncovered whole communities and habitats never before imagined.

Now, much of the ocean is being studied by remotely-operated vehicles (ROV's) descending into the mid-water zone and equipped with sophisticated video equipment. The ROV's have helped us realize that our original ideas about the number and types of organisms in the zone were unrealistic. Fast moving fish have been observed swimming in and out of open trawl nets; even fairly slow moving fish were easily able to avoid the nets. Many of the animals we pulled up in nets had been crushed beyond recognition. By watching them move freely within their own habitat, we are learning more and more every day.

The deep sea represents the largest and least known habitat on earth. So far, we have studied only about one percent of it. We have much more to discover.

Teaching Hints

In “Depth Line”, your students use adding machine tape to plot increasing ocean depths and deep sea historical events. Caution students to use care in marking the various depths.

Extensions

1. Have one group create a “depth line” that indicates the depth of the Marianas Trench (11,000 m) and attach it to the bottom of another depth line.

2. Students can color their depth lines to indicate the amount of light penetration:

   0-100 meters.............. light blue ....indicating light penetration
   100-200 meters .... dark blue ....indicating the lowest limits of visible light
   200-1000 meters......... almost black............indicating the “twilight zone”
   1000+ meters............. black ....indicating no light at all

3. Students may wish to cut out and paste drawings of various deep sea organisms on their depth lines at their appropriate depth range.

4. Students can use a spread sheet to calculate the amount of pressure (in pounds per square inch) that each submersible experienced at depth. One atmosphere of pressure per 10 meters; one atmosphere equals 14.7 pounds per square inch.

Answer Key

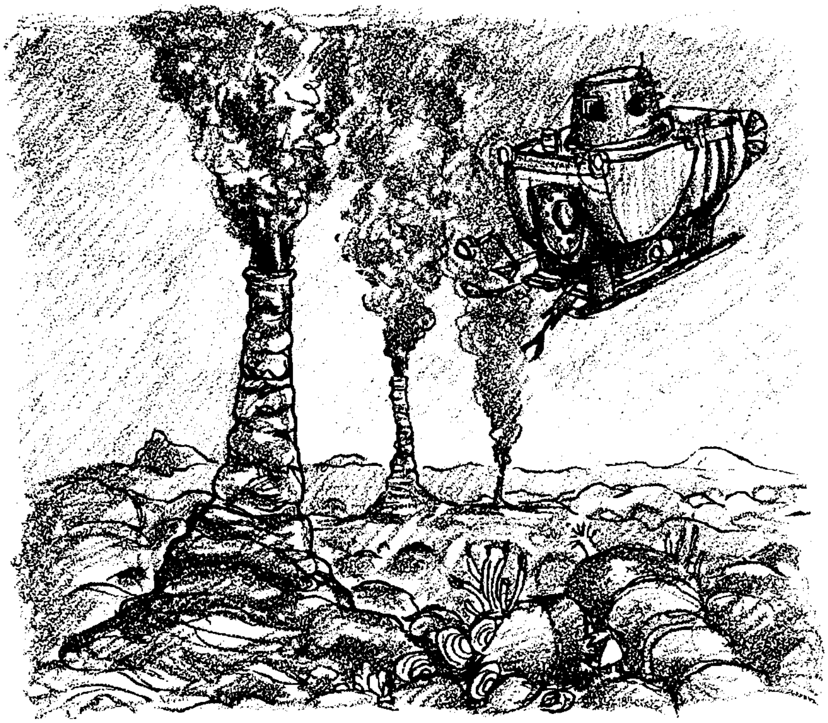
1. Answers will vary as to the kinds of discoveries students think marine scientists will make in the next 10 years or in their lifetimes. Since this asks for an opinion, any reasonable answer will suffice.

2. Answer will vary regarding the value of studying the deep sea. This may be a good time for a discussion of “value”; does something have to have a monetary worth or use to humans to be of value? Once again, since this asks for an opinion, any reasonable answer will suffice.

3. Among the potential threats to the deep sea habitats are: dumping of toxic chemicals, at sea "burying" of radioactive wastes, pollution, in general.

4. Education, no dumping of toxic/radioactive materials, and wise disposal practices for other wastes can help prevent abuse and misuse of the deep sea.

Depth Line



Humans have been designing submersible vehicles for over 300 years. Each new design has added to our knowledge about life in the ocean, and has encouraged us to reach even deeper.

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Materials

- adding machine tape; 1 piece, 4 meters in length
- metric ruler
- pencil and markers
- Deep Water Discovery Data Sheet

Procedures:

1. Measure and cut a piece of adding machine tape exactly 4 meters in length for your group.

2. Label one end of the tape SEA LEVEL.

3. Starting at sea level, carefully measure and mark off the tape at 1 meter lengths. Let each meter of the tape represent 1000 meters of ocean depth. Then each millimeter on the tape will represent one meter of ocean depth and one centimeter will represent 10 meters of ocean depth.

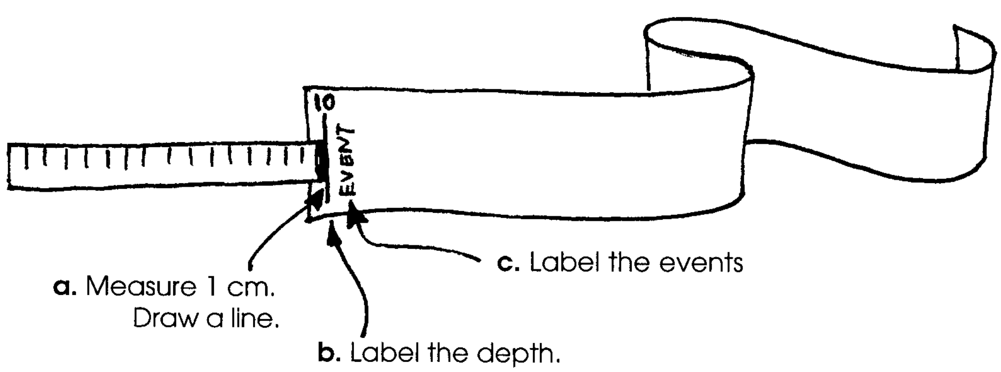
4. On the data sheet, convert the depths listed into the number of centimeters each depth will represent on your tape. (Hint: This is easy. Remember, each 10 meters equals one centimeter of length. Some have already been converted for you.)

5. For each event, measure the tape distance indicated on the data sheet and draw a line the width of the tape. On the line, label the depth and event represented by the line.

For example, using the first two events:

10 ___1 cm_____ 1772John Day built a tightly fitted ship that could be submerged in the Thames River.

10 ___1 cm_____ 1962Continental Shelf Station (Conshelf), one led by Cousteau. Researchers lived submerged for seven days off Marseille.



a. Measure 1 centimeter from “Sea Level” and draw a line.
b. Label the depth represented by that line: 10 meters
c. Label the events represented by that line: John Day’s ship
Conshelf One, Cousteau

6. Repeat step 5 for the rest of the events.

7. Post your completed depth line for the rest of the class to see and enjoy.

Analysis and Interpretation

1. What kinds of discoveries do you think marine scientists will make in the next 10 years? in your lifetime?

2. What is the value of studying the deep sea?

3. What are the potential threats to the deep sea habitats?

4. What can be done to prevent abuse and misuse of the deep sea?

Depth Line Data

Depth (meters)	**Tape distance**	**Date**	**Event**
10	1 cm	1772	John Day built a tightly fitted ship that could be submerged in the Thames River.
10		1962	Continental Shelf Station (Conshelf) One led by Cousteau. Researchers lived submerged for seven days off Marseille.
15		1690	Edmond Halley designs a diving bell that uses weighted barrels of air to renew divers' air supply
20	2 cm	1715	John Lethbridge develops and uses first armored diving suits.
30		1663	Using a diving bell, salvagers recover cannon from warship Vasa.
50		1899	Louis Bouton takes underwater pictures using a remote control device.
60		1964	Sealab I; 4 navy divers stay 11 days submerged off Bermuda.
70		1943	Jacques-Yves Cousteau and Emile Gagnan perfect the Aqua Lung and test it to 70 meters.
100	10 cm	1915	Salvagers recover submarine F-4 off Honolulu
100		1935	Jim Jarratt wearing an "Iron Man" suit, locates the sunken Lusitania.
100		1948	Frederic Dumas makes a record dive using the Aqua-Lung.
100			Lower limit of the photic zone.
170		1970	Aegir, sponsored by NOAA, 6 people submerged off Hawaii.
200	20 cm		Absolute limit of sunlight; beginning of the "twilight zone."
200			Average depth of the continental shelf.
225		1961	Record scuba dive
300			Average depth of deep sea shrimp.
350			Average depth of the hatchetfish.
450			Average depth of the lanternfish.
475		1930	Beebe's first dive in Bermuda using the bathysphere.
500	50 cm	1948	Piccard tests bathyscaph, FNRS II, off Dakar, Senegal.
610		1983	Record depth of WASP
725		1932	Beebe's second record dive in Bermuda.
950		1932	Beebe's final record dive in the bathysphere.
1000	100 cm (1 m)		Upper limit of the bathypelagic zone.
3000	300 cm (3 m)		Half the earth's surface lies below this point.
3000			Average depth of the anglerfish.
3300		1953	Trieste, designed by Piccard, sets depth record.
3600			Alvin's range.
3800			Titanic's resting depth.
4000	400 cm (4 m)		Average depth of the abyssal plain.
4400		1954	FNRS 3 piloted to record depth off Dakar, Senegal
4750			Bismark's resting depth.
6000			Jason's limits.
7700		1978	Glomar Challenger drills into seafloor sediment.
11000		1960	Trieste descends into the Marianas Trench.