Unit 2: Measuring the Ocean

Unit Focus

This unit describes how oceanographers measure the ocean's chemical and physical characteristics. Students will learn specific chemical and oceanic physical features, such as salinity, density, and temperature, and the instruments used to measure these features.

Student Goals

1. Define salinity.
2. Identify methods used to determine salinity.
3. Recognize the relationship between salinity and density of the oceans.
4. Give examples of how humans employ technology to study the ocean floor.

Vocabulary

Study the vocabulary words and definitions below.

clarity ..... the state or quality of being clear or transparent to the eye; clearness of water; depth to which light can travel in water

corer ..... a cylindrical device used to obtain a sample of sediment from the ocean floor

decompression ..... the gradual return of persons (such as deep-sea divers) or conditions to normal atmospheric pressure

density ..... in *science*—the mass (amount of matter) of an object per unit volume (space occupied);
density = mass/volume (d) = $\frac{m}{v}$

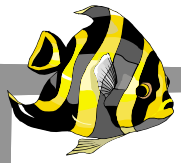
dredge ..... a scoop-like device used to collect rock samples from the ocean floor

drift bottle ..... an instrument used to measure the direction and speed of ocean currents

echo sounding ..... a method that uses sound waves to determine the depth of the ocean floor; also called the *precision depth recorder*

grab sampler ..... a device that picks up sediment from the ocean floor

hydrometer ..... an instrument that measures the density of water



ion ..... an electrically charged atom or molecule formed by gaining or losing one or more electrons

Nansen bottle ..... an instrument that records the temperature at the ocean's surface and at various depths below the surface

plankton ..... small, usually microscopic plant or animal organisms that float or drift in the ocean

plankton net ..... a cone-shaped net of fine mesh that is pulled through water to collect plankton

salinity ..... the measure of the amount of dissolved salts (solids) in seawater

SCUBA ..... acronym for **s**elf-**c**ontained **u**nderwater **b**reathing **a**pparatus; portable air tank used by divers

secchi disk ..... an instrument used to measure the clarity (clearness) of water

seine net ..... a fishing or sampling net that hangs straight in the water, separating one area from another

seismic profiling ..... echo sounding using powerful sound waves that reach below the surface of the ocean floor

side scan sonar ..... a method that uses sound waves to view a wide area of the ocean floor; provides pictures of objects on the ocean floor

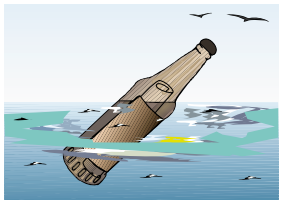
sodium chloride ..... NaCl (chemical formula); common table salt; the most common salt in seawater

titration apparatus ..... an instrument that measures the amount of substances in seawater

trawl ..... a large net pulled along the bottom of the ocean to gather animals that live on the ocean floor

Introduction: Measuring the Ocean—Collecting Information

Most oceanographers study the ocean with a specific purpose in mind. Some may study the chemical composition of seawater. Others may study its physical properties. For example, a *chemical oceanographer* may measure the amount of dissolved salts in seawater. This would help to detect changes that could affect different organisms. On the other hand, a *physical oceanographer* may want to discover the direction and speed of the ocean's currents. To collect this information, the oceanographer may use something as simple as a bottle with a message sealed inside it, which drifts across the ocean until someone along a coast discovers it. In contrast, a *geological oceanographer* may have to use complex instruments capable of bouncing sound waves off the ocean floor in order to chart the ocean's topography.



Oceanographers may use something as simple as a bottle with a message sealed inside it.

The Ocean's Chemical and Physical Features and How They Are Measured

Salinity. **Salinity** is the measure of the amount of dissolved solids, or salts, in seawater. Water dissolves many materials. It's easy to see this when we spoon sugar into a glass of tea, but it's rare—in fact nearly impossible—to observe rainwater percolating through the soil and dissolving weathered rock and minerals. Whether we see it or not, that is what happens. After passing through soil, rainwater carries dissolved minerals (mostly salts) into rivers, and rivers then carry these minerals into the ocean.

Knowing the salinity of specific regions helps scientists determine the location of different organisms. Certain kinds of ocean life thrive in certain salinities. Interestingly, ocean water has a similar salinity to that of our own body fluids—about three percent.

Major Ions Found in Saltwater

Ion	Symbol	Percentage of Ions in Seawater by Weight
Chloride	Cl^-	55.07
Sodium	Na^+	30.62
Sulfate	SO_4^{2-}	7.72
Magnesium	Mg^{2+}	3.68
Calcium	Ca^{2+}	1.17
Potassium	K^+	1.10
trace elements*		.64
		100.00

* Elements in amounts less than on part per million.

To measure salinity, oceanographers use several methods. One method is measuring the **ions** concentrated in the water sample (see previous page). When salts dissolve in water they form ions.

A total of six major ions are responsible for about 99% of the dissolved salts in the ocean. Some of these ions are sodium (Na) and chloride (Cl), the two ions that make up **sodium chloride** (NaCl), or salt. Other ions that can be measured are sulfate (SO_4), magnesium (Mg), calcium (Ca), and potassium (K). Other elements dissolved in seawater and present in concentrations less than one part per million are called *trace elements*. For example, bicarbonate (HCO_3) is a trace element found in seawater at .40 percent. By measuring these ion concentrations, oceanographers obtain the approximate salinity of seawater. Conductivity testing is another method used to determine salinity. An electrical current is passed through the water. The more NaCl ions there are, or the higher the salinity, the more easily the electrical current flows. Oceanographers also use a *refractometer* to measure the *refraction* (bending) of light through a sample of water. The change in angle of the light changes as the salinity changes.

Density. Recall a documentary you've seen on whales, or giant sea turtles. Remember how you watched them glide gracefully through the water, moving their thousands of pounds with seemingly little effort? Why didn't that blue whale weighing 150 tons sink to the bottom? Now remember a documentary or movie that depicted dinosaurs, or rhinoceros, or even elephants using their feet to walk over land. Note how much harder it is for huge land animals to travel. What accounts for the ease with which large animals can move through the water as compared to the large animals traveling on land?

Large land animals have to balance and support their own weight, carrying a thousand or so pounds across the ground. But ocean animals are assisted in carrying their weight by the **density** of ocean water. To understand the concept of density, carry out this simple experiment. First, pass your hand through air. Then pass your hand through water. Which movement took more effort? Which is more dense, air or water? As you've discovered, water is more dense than air. (In fact, water is 800 times more