# Lesson: Why is the Sea Salty?

71% of the Earth is covered with water, and we find 97% of that water in the oceans.

Everyone who has taken in a mouthful of ocean water while swimming knows that the ocean is really salty. Ocean water is about 3.5% salt. That means that if the oceans dried up completely, enough salt would be left behind to build a 180-mile-tall, one- mile-thick wall around the equator. And more than 90 percent of that salt would be sodium chloride, or ordinary table salt.

The oceans sure contain a lot of salt. How did that salt come to be there?

Does the salinity of ocean water vary around the world? Salinity, expressed in parts per trillion (ppt), does not vary greatly from place to place, but there are differences. For example, the middle of the Pacific has a salinity of over 35 ppt, whereas the middle of the Atlantic has a salinity of over 37 ppt.

Readings from the Red Sea and the Mediterranean Sea can be even higher. How can the high salinity in these two seas be explained? Both seas are in hot areas with high levels of evaporation and less precipitation than open oceans at the same latitude. When water evaporates from the ocean, salt is left behind. Thus, evaporation increases the salinity of an ocean, especially if it is a small, enclosed sea such as the Mediterranean.

Badwater is a basin in California's Death Valley, noted as the lowest point in North America, with an elevation of 282 feet (86.0 m) below sea level. The site itself consists of a small spring-fed pool of water next to the road; however, the accumulated salts of the surrounding basin make it undrinkable, thus the name "Badwater". The pool does have animal and plant life, including pickleweed, aquatic insects, and the Badwater snail.

Adjacent to the pool, where water is not always present at the surface, repeated freeze-thaw and evaporation cycles gradually pushed the thin salt crust into curiously hexagonal honeycomb shape. The pool itself is not actually the lowest point of the basin: the lowest point is several miles to the west and varies in position. However, the salt flats are hazardous to traverse (in many cases being only a thin white crust over mud, and so the sign is at the pool.

At Badwater, significant rainstorms flood the valley bottom periodically, covering the salt pan with a thin sheet of standing water. Each newly-formed lake does not last long though, because the 1.9 inch average rainfall is overwhelmed by a 150-inch annual evaporation rate. This, the United States' greatest evaporation potential, means that even a 12-foot-deep, 30-mile-long lake would dry up in a single year. While flooded, some of

the salt is dissolved, and then is redeposited as clean, sparkling crystals when the water evaporates.

Salinity also varies with latitude. The salinity is lower at the equator because it rains more there. Rain dilutes the ocean, making it less salty. At the 20 degrees north and south latitudes, there is less precipitation and more evaporation. The lower rainfall and greater evaporation cause the ocean water in this area to be slightly saltier than the water at the equator.

You may live near the coast where a river or stream enters the ocean. Freshwater from these sources lowers the salinity of the nearby ocean. Rainwater runoff from the land also lowers the salinity of ocean water near the coast.

Salinity also varies with the depth of the ocean. The salinity at the bottom of the ocean is greater than at the surface. However, the change in salinity that occurs with increasing depth does not occur at a uniform rate. There is a layer of water, located at a depth between 100 and 200 meters, called the halocline. The halocline layer shows a rapid change (increase) in salinity.

Why does salinity increase with depth? It has to do with the temperature of the water. Water is much colder at great depths than at the surface. You may recall that cold water contains molecules that are closer together. Cold water also causes salt ions to move closer together, thus increasing the salinity. In warmer surface water, the ions are farther apart, making the water less salty.

The salty taste of ocean water is mainly due to the presence of sodium chloride, one of various salts found in ocean water. The ocean gets its salts from several different sources. Salts eroded from streambeds and riverbeds, and from adjoining land areas flow toward the sea.

These salts are important to life in the ocean in various ways. Some marine organisms use salts directly. For example, to make their shells of calcium carbonate (a type of salt), mollusks remove calcium from ocean water. Silica is absorbed by diatoms (unicellular organisms) and used to make up their glassy cell walls. The sodium and chloride ions in NaCl are not removed in large amounts from the water, so these ions accumulate in the sea.

Another source of salt is the ocean floor itself. In ancient times, the Norse people believed that a giant “salt mill” ground salt from rocks on the ocean floor. Actually, this folktale was not too far from the scientific truth.

Recently, oceanographers have discovered hot water spewing from hydrothermal vents on the seafloor. This hot water contains minerals dissolved from deposits found beneath the ocean floor. These minerals include sodium and chloride, the main components of sea salts.