Our Ocean Backyard — *Santa Cruz Sentinel* columns by Gary Griggs, Director, Institute of Marine Sciences, UC Santa Cruz.

October 11, 2008
#13 Why the oceans are salty

The city of Santa Cruz and the Soquel County Water District have worked with the University to construct a pilot desalting facility at Long Marine Laboratory at the end of Delaware Avenue. This experimental plant is one of many that have been proposed along California's coast in recent years to augment our water resources through the process of desalination as our existing fresh water supplies are becoming insufficient to meet our needs. Why are the oceans filled with salt water anyway? Wouldn't it be a lot easier as well as a lot less expensive if the oceans were fresh and all we had to do was just pump the water out?

What may be surprising is that 97.2% of all of the water on Earth is in the oceans, is salty, and not terribly useful to us. Of the remaining 3%, about 2.2% is pretty much out of our reach because its frozen as ice caps and glaciers. This leaves less than 1% of all the water on Earth for us to fight over, which is what we have done in California and a lot of other arid or semi-arid places. In fact, Mark Twain wrote over 100 years ago that in California, "whiskey's for drinking and water's for fighting about".

How salty is the ocean anyway? Well, too salty to drink is the short answer. The total amount of salt in seawater is only about 3.5% by weight; a gallon of seawater contains about 3.6 ounces of salt. That's not much but its enough to make it totally undrinkable and of virtually no use for agriculture. The most common elements or ions that make the seas salty are sodium and chloride (which when combined make table salt), but there is also a long list of other dissolved materials in seawater. While there are only 3.6 ounces of salt in each gallon, if we took all of the salt out of the world oceans it would be enough to cover the entire planet with a layer about 500 feet thick!

So why is the ocean salty anyway? What may be a little surprising is that river runoff is the primary source of the salt in the oceans. While we think of the water in our streams as "fresh", our creeks and rivers actually contain small amounts of dissolved material from the erosion and weathering of the rocks in their watersheds. This dissolved material or salt has been accumulating in the oceans for billions of years. Some dissolved material is also added from thermal vents or hot

springs on the seafloor, and some from volcanic eruptions. Without a way to remove salts, however, seawater would continue to get saltier. We know from analyzing ancient marine organisms and sediments deposited on the sea floor, however, that the salt content or salinity of the oceans hasn't changed significantly over geologic time.

There must be some processes or mechanisms by which the salt in the ocean is removed at the same rate it's added in order to keep the salt content in balance. What may at first glance seem like an unimportant process is the salt spray that is created as waves break along the shoreline. You can feel the salt on your skin walking along the cliffs on a day with crashing waves when lots of spray is in the air. This process removes an enormous amount of salt. Water also seeps or infiltrates into the ocean bottom near hydrothermal vents on the seafloor, removing dissolved material. Large volumes of salt are also precipitated in salt flats or tidal embayments, such as San Francisco Bay, where seawater evaporates and leaves the salt behind. Additional minerals are used by marine organisms to make their shells, while still other elements are attracted to the surfaces of clays and biological particles as they settle to the seafloor to be incorporated into sediments.

The salinity or salt content of the oceans is in balance, and has remained more or less constant for hundreds of millions of years. Life in the sea has evolved to live comfortably surrounded by salt water. Desalting seawater, which today may seem like an exotic and expensive way to produce fresh water, will no doubt become increasingly more competitive in cost with other sources of fresh water in the future, particularly if global warming projections lead to a reduced fresh water availability.