

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

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Groundwater- An Invisible Resource

Almost all of the water on Earth (96.5%) is salty, and the 3.5% left over is split nearly equally between groundwater and ice. There is also a drop in the bucket left over in lakes and rivers (actually just over 1/100th of a percent).

Nationwide, groundwater is the source for about 23% of all the fresh water we use, the other 77% comes from surface water such as streams, lakes and reservoirs. In the more arid western states, groundwater provides a much greater proportion of the water supply, in large part because many of the streams just don't provide a reliable year round source. During a drought, the reduction in stream flow is even greater. Historically, groundwater has provided about 40% of California's total water supply.

Where does that groundwater come from? Well, some water, whether from rainfall or stream flow, seeps into the ground, much like pouring a bottle of water onto a pile of sand. The water moves slowly downward through the cracks or voids in the soil, sediment or rock, until it reaches a layer through which it cannot easily flow. The water then will gradually fill up the empty spaces or cracks above that layer. Water that collects within rock or sediment is called groundwater and the upper surface of that layer is called the water table. This is what we would like to hit when we drill a water well. Sometimes we do and sometimes we don't.

Groundwater resides in aquifers, which are geologic materials that groundwater can easily move through. The amount of water that can flow through soil or rock depends upon the size of the empty spaces in the material and how well they are interconnected. Porosity is a measure of the amount of pore space within a rock, and permeability describes how well the spaces are connected. A sponge has both good porosity and permeability; Styrofoam or bubble wrap has lots of pore spaces but they aren't connected.

This reminds me of a story that not only explains porosity and permeability but also provides some life lessons.

A college professor stood before his class at the start of a new semester. Silently, he picked up a very large jar and filled it with golf balls. Then he asked the students if the jar was full. They agreed that it was.

The professor then picked up a box of pebbles and poured them into the jar. He shook the jar lightly, and the pebbles settled into the open areas between the golf balls. He then asked the students again if the jar was full. They again agreed that it was.

The professor next picked up a container of sand and poured it into the jar. He asked once more if the jar was full. The students again responded with a resounding "yes."

The professor then produced a beer from under the table and poured it into the jar, filling the empty spaces between the sand. The students laughed.

"Now," said the professor. "I want you to understand that this jar represents your life. The golf balls are the important things -- your family, friends and health. If everything else was lost and only they remained, your life would still be full." "The pebbles are the other things that matter -- your job, your house, your accomplishments, etc. The sand is everything else -- the small stuff. You know, the newest I-Phone, I-Pad or some other gadget."

"If you put the sand into the jar first," he continued, "there's no room left for the golf balls or pebbles. The same holds true for life. If you spend all your time and energy on the small stuff, you'll never have room for the things that are really important."

"Pay attention to the things that are essential to your happiness. Spend time with your friends and family. Sit by the oceans or in the woods. Listen to the birds and smell the flowers. Enjoy the beauty of your existence. There will always be time for the small things. Take care of the golf balls first -- the things that really matter. The rest is just sand."

One of the students then raised her hand and asked what the beer represented.

The professor smiled, "I'm glad you asked."

"The beer shows you that, no matter how full your life may seem, there's always room for a beer with a friend."