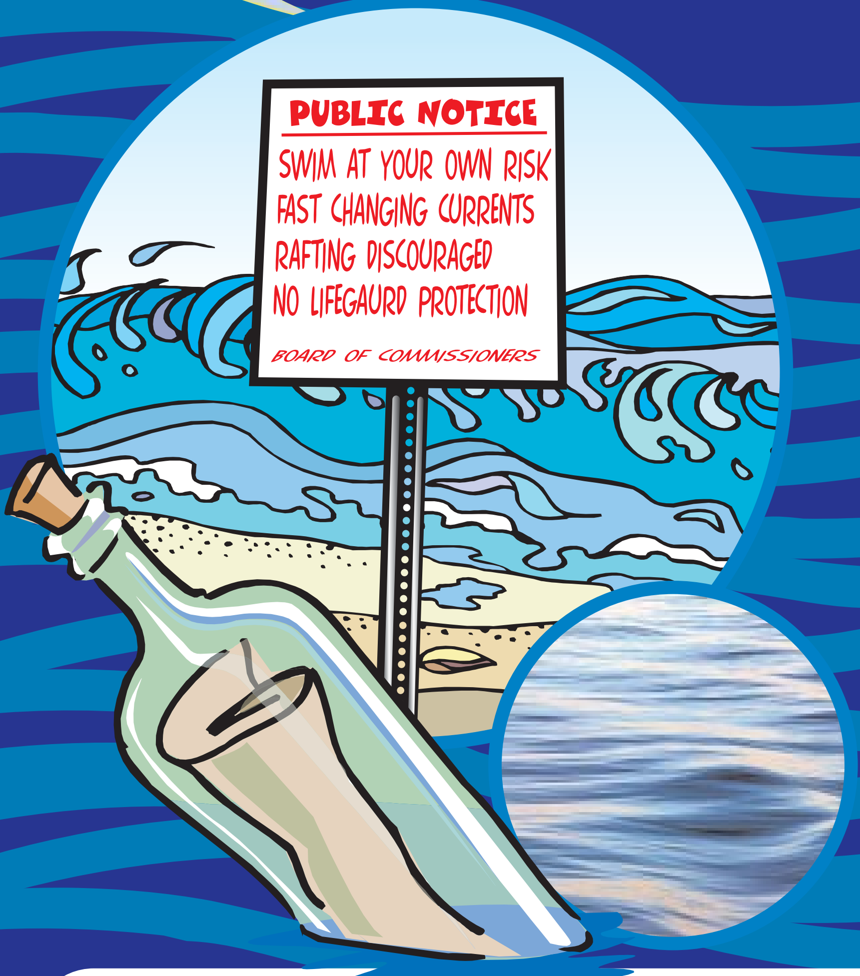
VOYAGER FOR KIDS!
ISSUE 20 • SUMMER 01

Currents: Water on



Can you name Earth's most important rivers? Would you guess the Nile, the Amazon, the Mississippi, or maybe the Yangtze? Did you know there are rivers that flow through the world's oceans? And that they are more important in shaping our environment than the major rivers on land? These mighty bodies of moving water are called currents.

Ocean currents move water continuously along specific pathways, often over very great distances. This happens both on the surface and in the deep ocean.

Currents driven by the wind travel thousands of miles across the ocean's surface. In the process, they move heat from warmer to cooler areas. Ocean waters also move vertically, mixing waters of different temperatures and salinities (amounts of salt).

Currents influence temperature, climate, plants, and animals in the ocean and

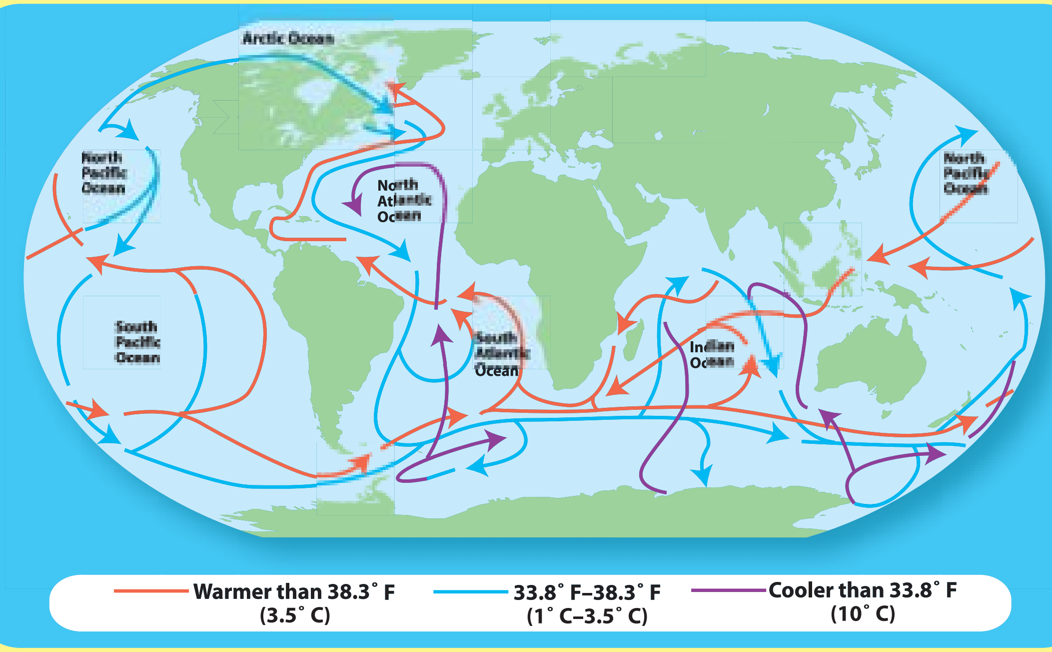
Ocean in Motion

Most of the currents in the upper half-mile of the ocean are caused by winds that blow year-round in one direction across Earth. Wind pushes directly on the ocean surface, causing the ocean's top layer to move. Surface winds also set in motion other currents that extend to the ocean bottom, far below the direct influence of the wind.

However, most ocean currents do not occur at the surface and are not directly caused by wind. Deep ocean currents may move across great horizontal distances in the same way as surface currents. They also may run through the ocean vertically, although vertical currents

OCEAN CURRENTS MAP

When wind-driven surface currents run into continents, the water must turn and flow toward either the poles or the equator (Earth's midsection). The effect of Earth's rotation causes moving objects on Earth to follow curved paths (a scientific principle known as the Coriolis effect),



Scientists Studying Currents

Surface currents have been studied by sailors for hundreds of years. Early ships depended on winds and currents. Understanding currents was important to people who used the ocean for fishing, trade, and travel.

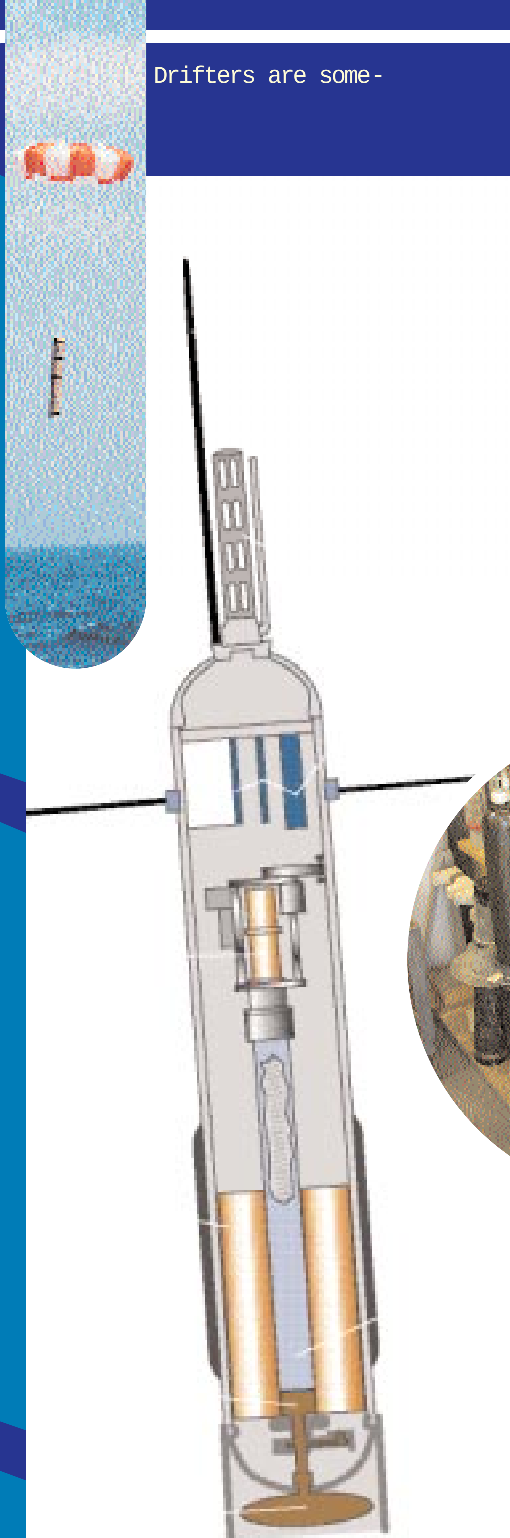
Scientific studies of currents date back more than 100 years. In early studies, researchers set afloat drift bottles and other types of floating markers from ships or into offshore currents. Their movement was then charted with the help of other scientists, sailors, or even beachcombers who would report finding them.

For the past 30 years scientists at Scripps, and around the world, have been involved in intensive efforts to understand currents in relation to world ocean circulation patterns. Most recently, the relationship between the ocean and the atmosphere and its effect on climate has become a major environmental issue.

The development of a worldwide network of communication satellites, and the invention of computers able to process huge amounts of information, set the stage for the current generation of instruments.

Drifters were invented that recorded the speed and direction of currents from the motion of the drifter within the current. Drifters able to take many different direct measurements simultaneously were also developed. They could record ocean temperature, salinity, pres-

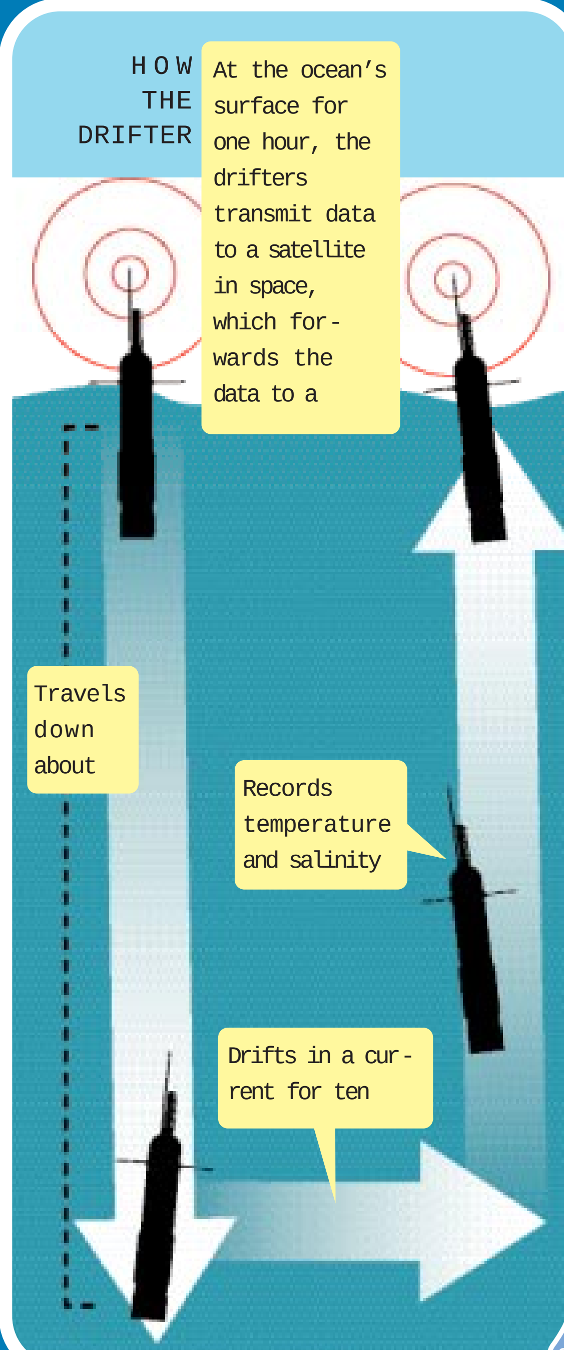
Drifters are some-

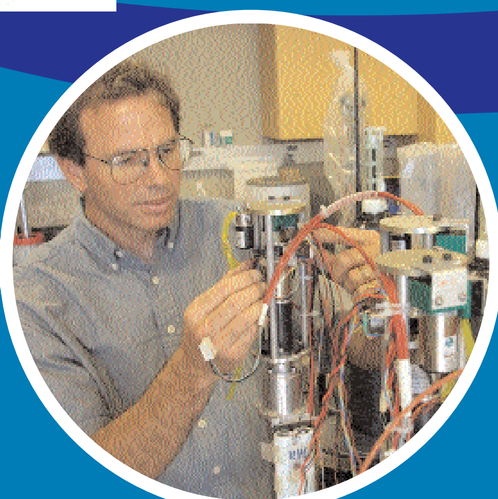


The New Generation

Scripps scientists, along with colleagues in the United States and nine other countries, are currently involved in a major program called Argo that will deploy 3,000 drifters (SOLO floats) into the world ocean by 2005. These instruments can collect and store many kinds of data, and then transmit them to satellites on a regular schedule. They also are capable of automatically descending to a depth of 6,560 feet (2,000 m), drifting for ten days, and then returning to the surface while recording temperature, salinity, and other data about water conditions on the way up. Scientists hope that this fleet of drifters

SOLO floats are being assembled in a Scripps lab. SOLOs, used by Scripps scientists in the ARGO program, were invented at Scripps.





Engineer Jeff Sherman checks a SOLO float in the lab of the Instrument Development Group

Properties of Water

In general, currents in the deeper ocean are caused by the mixing of bodies of water at different temperatures, salinity levels, pressures, and densities, although this may not be the

Salinity

Salinity is the scientific term for the amount of saltiness in water. All water has some dissolved salts in it, but the ocean has much more salt than fresh water.

Ocean water is always evaporating into the atmosphere, but the salt remains in the ocean. Thus, the ocean remains salty even though fresh water is continually being added by rainfall and by rivers and runoff from land.

Density is the scientific term for the weight of water. Salt water weighs more than fresh

Pressure

Pressure is a measure of the weight of the water and atmosphere pushing downward at any given point. There is 15 pounds per square inch of pressure at sea level. In the deepest parts of the ocean, pressure is around 15,000 pounds per square inch, an

Temperature

Temperature can vary a lot in the ocean. Shallow, tropical waters can reach close to 90°F (31°C), while water at the poles will be close to freezing (28.4°F, -2°C). Seawater freezes at a lower temperature than fresh water (32°F, 0°C) because of its salt content.

The warmest water in any area is at the surface, and the coldest water is at the bottom. This is partly because the sun warms surface water. However, cold water is heavier

Density

Density is a measure of weight, technically the weight of a liquid divided by how much space it takes up. Salinity, temperature, and pressure work together to create density.

Movement happens when two opposing forces are not in balance. When one part of the ocean is denser than the surrounding area, water movement will take place. This creates currents. Because of the many fac-

Of Toys and Tennis Shoes

Would you believe that tennis shoes, rubber duckies, and dolls' heads have all helped in the tracking of ocean currents? All of these things have fallen into the ocean as the result of spills from cargo ships during storms at sea.

Eighty thousand tennis shoes were washed overboard near the Alaskan Peninsula in 1990. Beachcombers from Alaska to northern California collected hundreds of them. Over the next few years shoes washed up in Hawaii, the Philippines, and Japan.

Yellow duckies and green frogs ended up on beaches from Alaska to Oregon from a spill of thousands of plastic bathtub toys in the North Pacific Ocean in 1992. Last year tens of thousands of Rugrats™ dolls' heads went overboard in the same area and are currently washing ashore.

What does this have to do with science? Some oceanographers have used the floating toys to plot ocean surface currents. Studies have shown that about 1 percent of a spilled cargo eventually washes ashore. The oceanographers have kept records of where the toys

Make Your Own SOLO Float

by Kevin Hardy

What You'll Need

1 clear 2-liter soda bottle filled with water to within 2 inches of the top

1 soda straw

1 small ball of clay

1 toothpick

3 to 4 pieces of clear tape

1 tall glass of water

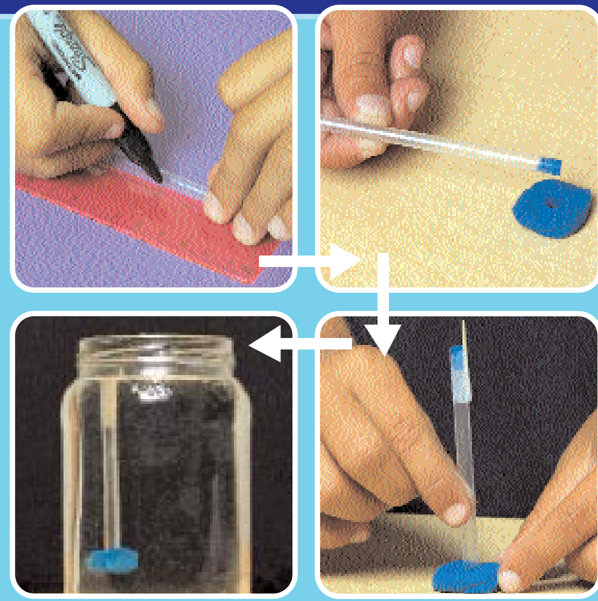
Building Your Float

1. Cut the straw to 4 inches long.

2. Cut the toothpick to 1 inch long.

3. Roll the clay flat to about 1/4 inch thick.

4. Plug one end of the straw by pushing it into the clay. Twirl the straw and remove it. There now should be a plug inside the straw. The clay represents the vehicle's endcap and the straw represents the hull.



5. Tape the toothpick against the side of the straw on the end with the clay plug. The toothpick should extend about 1/4 inch past the end. This is the antenna.

Ballasting

1. Place the model drifter in a tall glass of water to see how it floats.

2. The top of the straw should float no more than 1/8 inch above the water surface. If it sinks, remove some clay. If it floats too high, add more clay.

3. Watch for air bubbles sneaking out the top past the clay plug. It must be airtight.

Experiment 1

Step 1: Squeeze the sides of the bottle. What does the drifter do? Why?

Step 2: Watch the air inside the straw as you or a friend squeeze the soda bottle.

Step 3: Your drifter should sink when you squeeze the bottle and rise when you release it. Practice making the drifter

Experiment 2

Step 1: Hold the bottle with both hands on the table top, and give it one quick swirl so that the water swirls around inside. Your drifter will be riding along on the surface.

Step 2: Now squeeze the bottle and send the drifter down about halfway to the bottom. The drifter should be riding along below with the "current."

Step 3: Release the soda bottle and the drifter will rise to the surface, but now in a

What's Happening

When conducting both of these experiments, you're changing the drifter's density by changing its displacement, which is how much water is pushed out of the way for it to be there. The air inside the straw is part of the drifter. When you squeeze the soda bottle, you raise the pressure inside the soda bottle enough to compress the air inside the straw. Because the air now takes up less space, the drifter becomes a little heavier and sinks.

You can adjust how much you compress the air inside the straw and make the drifter sink, float, or stay at one depth. A real Scripps SOLO float changes its displacement by pumping oil