FYI Water

"Follow the water." This phrase is often heard when scientists discuss the search for life on other worlds. But what does it mean? On Earth, following the water is easy. We see water everywhere. We find liquid water in streams, lakes, and oceans. It's visible in gaseous form in the clouds and water vapor in the atmosphere. In solid form, water is locked in ice caps at the North and South Poles. On other worlds in our solar system, following water may entail looking for less obvious clues. We look for signs that water may have been present in the past, or of water that is now hidden from direct observation. This is the case on several planets and moons in our solar system. But why follow the water? What are the special properties of water that make it so important to life?

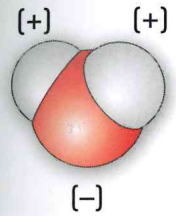

Figure 4-16: Diagram of the V shape of a water molecule, which makes one side more positive than the other

Why Follow the Water?

Liquid water is central to our search for life on other worlds. From studying life on Earth, we know that virtually any place with liquid water has life. Given this vital link between life and water here on Earth, it seems reasonable to believe that this link might also exist on other worlds.

What Are the Properties of Water?

A water molecule is composed of two atoms of hydrogen and one atom of oxygen. The three atoms assume a V-like shape, where, instead of being directly opposite one another, the hydrogen atoms are each to one side of the molecule (Figure 4-16).

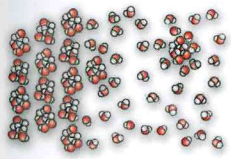

Figure 4-17: Diagram of water molecules dissolving and transporting larger molecules

The overall charge of a water molecule is neutral. However, the V-like shape of the molecule distributes the positive and negative charges in an uneven way. Because a water molecule has positive and negative regions, it is called a **polar** molecule.

The polar nature of water enables it to interact well with other molecules. For example, water is able to dissolve many substances. (**Dissolve** means to blend a solid, such as sugar, into a liquid, such as water.) Indeed, water can dissolve so many substances that it is called the **universal solvent**. Many molecules important to life dissolve readily in water. As water moves through rock or soil, it dissolves and transports many of the substances with which it comes in contact. Thus, liquid water is an important transport system. It can carry the raw materials needed by organisms.

In addition, water itself is an important molecule in some life processes. For example, it can be directly involved in reactions such as photosynthesis. Water also serves as a medium in which life reactions take place.

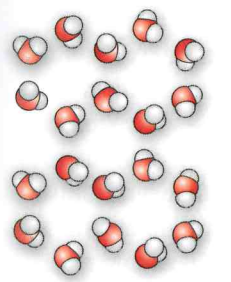

Figure 4-18: Diagram of the lattice formed when water molecules freeze to ice

An interesting property of water is that when it freezes, the solid state (ice) floats on the liquid state (water). When water molecules freeze, the slightly positive hydrogen side of one water molecule attracts the slightly negative oxygen side of another, locking the water molecules together in a lattice (Figure 4-18). This type of connection is called a hydrogen bond. The lattice or crystal structure of ice is less dense than liquid water, so ice floats on water. The fact that ice floats means that any life below a layer of ice will not be trapped or crushed by sinking ice! An ice layer also insulates the water beneath it, maintaining it

as liquid. Thus, the liquid in an ice-covered ocean, lake, or river can continue to serve as a supply and transport system for life beneath the ice layer.

Where Are We Looking?

Water is essential for life, and the search for life could conceivably be reduced to the search for liquid water. However, when you examined the planets and moons in the solar system, Earth was the only world with any observable liquid water. Because of our familiarity with our own planet, many people think that scientists are looking only for surface water. However, several worlds in our solar system exhibit evidence of water beneath the surface—subsurface water.

Checking In

1. In what ways is water thought to be important for supporting life?
2. What specific properties of water make it different from many other liquids?