A Different Water World

As I watch the water pour from the tap, I think about how plentiful water seems to be and how we think of water as a "normal" or "standard" fluid in science. The vital blood of our world runs all around us: from our taps, on our lawns, through the sewers, from the sky and then collects in our rivers, lakes and oceans. Water is the fluid that literally sustains all life. One of the reasons why water is vital for all living things is because of its unusual and exceptional physical properties. Of these unique properties, one of utmost importance is the density of water and ice. Most substances are more dense in the solid state than the liquid state. A block of pure solid substance will normally sink in a tub of the pure liquid form of that substance ("Water (molecule)," 2006). By contrast, a block of ice will float in a tub of water because solid water is less dense than liquid water ("Water (molecule)," 2006). This brings up some interesting questions: What would the world be like if water was more dense as a solid than a liquid? Why is the density of water less in solid form than in liquid?

In a world where water is more dense as a solid than a liquid, all water in most parts of the world would freeze solid from top to bottom including oceans, lakes and rivers. Water frozen at the surface would be denser and sink, which would help to create currents that cool the entire water body. The coldest water would remain near the surface, and the necessary warming phenomenon could not occur in summer, because the warm surface layer would be less dense than the solid frozen layer below. The large heat capacity of the oceans and seas allows them to act as heat reservoirs. As a result, the sea temperatures do not vary much, and the ocean temperature helps to moderate our global climate. Therefore, the temperature of the entire earth would decrease, the animal and plant life would decrease, and most of the world's population would be near the equator. The frozen ice caps would be very large, and the colder regions of the world would be not be highly populated. Since the density of ice is less than water, only the top layer of water freezes and it provides insulation for the rest of the water underneath. This allows animals and plants above and below the ice to survive.

The density of ice is less than the density of water due to the characteristics of hydrogen bonding in liquid and solid water. The liquid water molecule has a structure that allows many temporary bonds to form between several water molecules. The oxygen is bound to the hydrogens through covalent bonds, which means that they share a pair of electrons. The shared electrons are pulled closer to the oxygen than the hydrogens. This disproportionate sharing of electrons causes the hydrogens to have a partial positive charge and the oxygen has a partial negative charge. The water molecules are attracted to each other since opposite charges are drawn toward each other ("Chemistry Tutorial: The Chemistry of Water," 2003). This "attraction" is actually called hydrogen bonds. Since water is made exclusively of hydrogens covalently bound to oxygens, one can recognize why there are so many hydrogen bonds in water ("Water, pH, and Non-Covalent Bonding," 2002). "The molecules are in constant motion and the hydrogen bonds are constantly being broken and reformed" ("Water, pH, and Non-Covalent Bonding," 2002). They approach each other closely due to the partial collapse of the open hydrogen bonded network. In ice, the molecule is in a fully hydrogen-bonded structure with strong and straight hydrogen bonds, therefore, has a total of four bonds. Water molecules are more distant from one another in ice than they are in the liquid water. Therefore, ice is not as dense as liquid water at standard conditions ("Water (molecule)," 2006).

What, then, can we conclude about the possibility of the world having ice more dense as a solid than a liquid? It seems that much of the phenomena that we take for granted on a daily basis is an enigma, and cannot fully be explained by science. If the properties of water were different, the earth would be a much different place, and much less suited for life.

Works Cited

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