Wonder

Volume: **2** Number: **1** Theme: **Water and The Spirit**
Title: **The Nature of Water is Sanctified** Author: **William Kopcha**

"Water," "Adam's Ale," "aqua" as a prefix, "H-two-OHHH YEAH!"… This liquid that we know by many names is perhaps the substance with which we are the most intimately acquainted on Earth. And why not? Weighing in at an impressive 70% of the planet's surface, it's one of the most, if not THE most, common substance that we encounter on a daily basis. But why do we love it so much? Well, apart from the fact that it's also the number one ingredient in people (55 to 78%, not so different from the rest of the planet housing this water), and, as we know from the eternal wisdom of The Waterboy, that it's better than Gatorade, it also happens to be one of the most unique and intriguing chemicals that we know of – and many of the things that make it so unique also, consequently, enable the sheer existence of life as we know it.

The uniqueness of water rests largely in the existence of the hydrogen bond. Rather than being an actual bond between two atoms, a hydrogen bond is essentially a magnetic attraction between an atom that pulls electrons very strongly and a hydrogen that is directly attached to a similarly "strong" atom. The "weakness" of hydrogen in pulling electrons results in the "strong atom" pulling the electrons toward itself, thereby accumulating electrons and essentially becoming the negative pole of a minuscule magnet, leaving the hydrogen depleted and therefore the positive pole of this same magnet. Luckily for water, oxygen, the central atom in a water molecule, is the second strongest known element in "pulling" electrons and, unlike a vast number of other small molecules, contains not one, but two hydrogens, enabling two hydrogen bonds to be formed instead of one. (The strongest element, fluorine (F), is only able to bind one hydrogen, resulting in one possible hydrogen bond; HF (hydrofluoric acid) is also extremely corrosive and can result in bone damage by simply being absorbed through the skin.)

As a result, water holds together strongly. For comparison, it would take a non-hydrogen-bonding molecule about 5.5 times as large to equal water's boiling point (heptane, a major component of gasoline, specifically; it has a boiling point of 97oC and a molecular weight of 100.20 g/mol, compared to water's 100oC and 18.02 g/mol. Basically, water is the Takeru Kobayashi of the chemistry world. Removing one hydrogen bond results in a boiling point of only 65oC (methanol or "wood alcohol" – what made bootleggers go blind in the ′20′s), while swapping the oxygen out for a nitrogen results in compound that isn't even liquid at room temperature despite the ability to attach one more hydrogen to the molecule (ammonia, which boils at a measly -33oC. The stuff you buy in the store is probably mostly water. Interestingly, though, the third hydrogen-bonding site in ammonia means that it can help water to pack more densely (i.e., one gallon of water and one gallon of a concentrated ammonia solution do not make two gallons of liquid).

Another reason why water is so cool – ice floats. Ever think about that? My guess is that, given the prevalence of things you can throw into liquids and the small number of liquids that you can throw them into (basically, water and things made out of water), probably not. But if you really want a way to get a headache in 5 minutes or less, try wrapping your head around what makes a

solid a solid and a liquid a liquid, especially given that basically any pure substance can be either one (or a gas, or a supercritical fluid) depending on the temperature and pressure. From a chemistry or materials standpoint, solids are solids because some force stops or slows molecular motion, allowing something to hold a shape. In the vast majority of cases, this also means that the molecules get closer together (i.e., they stop knocking into each other, which generally causes expansion, like when you break in a game of pool), increasing density, and causing the solid to sink. Not so with water. Water is one of the few materials that is denser as a liquid than as a solid, thanks to – you guessed it – hydrogen bonding. The intense attraction that water molecules have for one another allows them to bunch up when in a flexible state (i.e., liquid). When forming ice crystals, on the other hand, the water molecules must fall into regimented columns with regularly-repeating patterns, actually forcing them farther apart. Ice floats.

Aside from causing my jaw to drop at the infinite complexity that goes into even the smallest, simplest component of creation, this has another important consequence – icebergs float. If all of the icebergs were to suddenly fall to the bottom of the sea, we would also suddenly have a much smaller patch of earth to live on, since the water that used to be at the bottom of the sea would now be on the streets of New York.

If we were to look still deeper into the nature of water, we would see that this double-hydrogen-bonding is responsible for a great many other crucial properties – the ability to retain heat energy like it's water's job, the ability to dissolve ions, the ability to have acidity and basicity, to name a very small fraction of all of the possible directions we could go. Really, though, that's the essence of this whole reflection – that even a slightly deeper look at the ordinary can open a world of shockingly vast complexity – the glory and infinite brilliance of the Creator reflected in His Creation. We say in the hymns for the Blessing of the Water on Theophany that "Today, the nature of water is sanctified." Truly, if we are to take the understanding that sanctification is the revelation of the original glory with which creation was created, then I can't imagine an easier or more beautiful case to embrace than good, old, plain water.

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Discussion Questions:

What do the chemical characteristics and properties of Water, the building block of life, make you think about the miracle of life and creation?