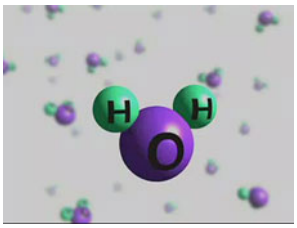
Water's Family Tree: Where Did It Come From?

Credit: Teresa Franco Collantes

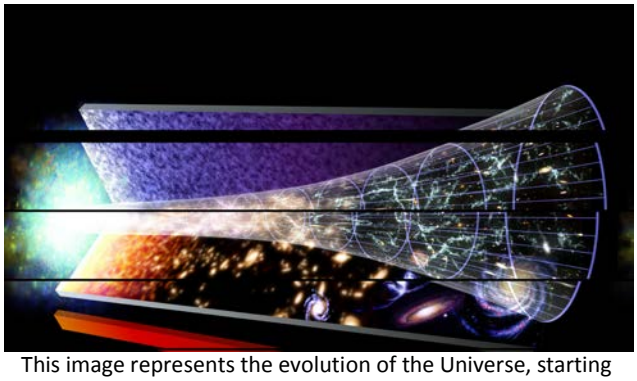
If we want to learn something about our ancestry, we can consult a number of sources for clues: the stories of family members; public records, such as birth certificates and census reports; and DNA sequencing. Scientists who study Earth's water also rely on a number of sources to try to explain where water came from. However, since no storyteller existed when Earth was forming into our blue planet, they must rely on the geologic record, and chemistry.

That's Intense! Heat Made The First Drops Possible.



Water molecule. Credit: NASA

What do we know about Earth's water? Its chemistry is fairly simple—two hydrogen atoms bonded with one oxygen atom make up the water molecule H_20. Hydrogen, one of the building blocks of water, was created very shortly—perhaps within minutes—after the Big Bang. Oxygen, however, took a little more time, and the work of stars.



This image represents the evolution of the Universe, starting with the Big Bang. The red arrow marks the flow of time. Credit: NASA

About a billion years after the Big Bang, the cosmos had abundant numbers of stars. Inside of the incredibly hot interiors of stars, more complex elements were created when simpler elements were fused together. Among these was oxygen. Dying stars—then and now—can become supernovae, exploding violently and hurling these elements into space. And here you have the recipe for water: hydrogen (present in space from the earliest moments after the Big Bang), oxygen (spewing out from supernovae) and a mighty source of ignition (the explosion) to combine the two. [More on this later.]

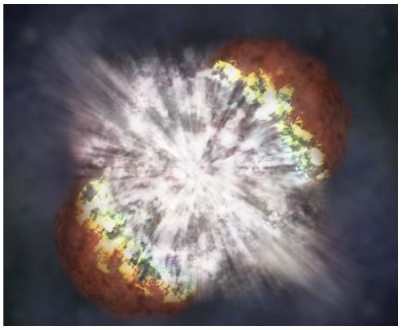


Illustration of a supernova. Credit: NASA

So why do scientists think the water we enjoy on Earth came here, instead of being part of the elements that made our planet some 9 billion years after the Big Bang? If we consider Earth's early history, which included vast periods of time with high temperatures and no protective atmosphere, we can guess what happened to the water molecules that may have been here. Evaporation back to space! So scientists think the water we treasure had to come to Earth after our planet cooled and developed an atmosphere. Earth's early microorganisms swam in it, dinosaurs drank it, your grandparents bathed your parents in it, your grandkids will play in it. All the same water

Water Delivery From the Cosmos Was Brutal.

Illustration of asteroid impacting Earth.
Credit: NASA/Don Davis

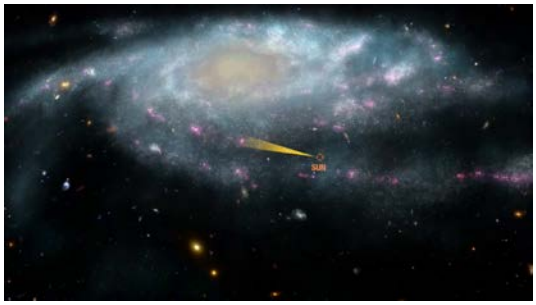
All we have to do is take a look at our moon to see what bombardment from comets and asteroids can do. Its cratered surface tells us it has been struck, and struck again. And again. Scientists believe that Earth could have received as much water as our blue planet contains from repeated bombardments. But are we drinking asteroid water or comet water? Or both? Recent studies are pointing to asteroids as the source of our water, with the chemistry of asteroid water more closely resembling Earth water. Of course, that's based on the samples to which we've had access. Space is big. Our sample number is small.

Making Water Is Simple, and Dangerous.

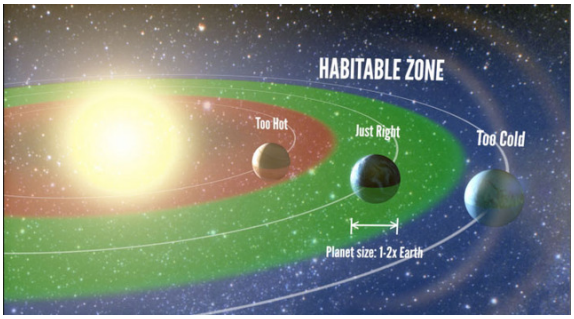
If people are worried about water shortages, and we know how to make water, why don't we make it? The ingredients are simple: Take two hydrogen atoms, one oxygen atom. The recipe is not: mixing the two doesn't do anything. The electrons orbiting around the nucleus of each atom don't have the drive to link up. It takes a big incentive—namely, a blast of energy—to make the hydrogen atoms link with the oxygen atom. Here's the problem: hydrogen is super flammable. Oxygen supports combustion. Putting the two together and adding a spark creates water, and also an explosion. History gave us a tragic example of this with the destruction of the Hindenburg, a hydrogen-filled, passenger-carrying airship that was consumed by fire in roughly 30 seconds.

Our water planet is unique in our neighborhood.

As far as we have yet discovered, our address in the Milky Way is unique with its complex life forms that have burst forth in so many creative niches. Water makes all of this life possible. But is Earth the only planet to support life as we know it, or maybe we don't know it? We're still trying to answer that with international space missions in which NASA plays a critical role.



Our Sun is just one out of over 200 billion stars in our galaxy, the Milky Way. The Sun is located in the Orion arm of our galaxy about 25,000 light years from the center of the Galaxy.
Credit: NASA Kepler Mission/Dana Berry



Artist's representation of the "habitable zone," the range of orbits where liquid water is permitted on the surface of a planet.
Credit: Petigura/UC Berkeley, Howard/UH-Manoa, Marcy/UC Berkeley

Links for more about the images used in this article:
"Cradled" by Teresa Franco Collantes, a winner of GPM's "Unique Perspectives" photo contest. http://go.nasa.gov/V6ffK7
Water molecule: http://go.nasa.gov/1mfvCxH
Big Bang: http://svs.gsfc.nasa.gov/goto?10128
Supernova: http://go.nasa.gov/1mfw0fs
Asteroid impact: http://go.nasa.gov/1mfw52L
Milky Way galaxy: http://go.nasa.gov/1mfwbaH
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