

## **You're a Star Baby but You Don't Know Why**

“Who are we? Where do we come from? Why are we this way and not some other? What does it mean to be human?”

- Dr. Carl Sagan (1934-1996) -

You are stars or at least made from stars. How can that be? Well, 99% of the mass of the human body is made up of six elements: oxygen, carbon, hydrogen, nitrogen, calcium, and phosphorus. The remaining one percent is a combination of Potassium, Sulfur, Sodium, Magnesium, Copper, Zinc, Selenium, Molybdenum, Fluorine, Chlorine, Iodine, Manganese, Cobalt, Iron, and trace amounts of Lithium, Strontium, Aluminum, Silicon, Lead, Vanadium, Arsenic, and Bromine. But how does this relate to being made from stars?

If we subscribe to the “Big Bang” creation of the universe, the initial element to coalesce was simple hydrogen (one proton being circled by one electron). These hydrogen atoms were attracted to one another and as their masses grew greater and greater the first stars had their fusion furnaces spark into existence where they began fusing Hydrogen into Helium (two protons and two electrons). As these stars ran out of Hydrogen fuel some of them then began fusing Helium into still larger atoms and so on until some of these stars reached critical limits leading to their explosive destruction as Novas or Supernovas. Over billions of years every element in our bodies has at one point been forged in the very heart of a star, so we are indeed “star stuff.” It is even likely that many of these elements have at one time or another been the constituents of multiple stars over the eons.

These are what we think are essentially the facts whereby we came to be here, but it is true that we really don't know why. In fact, if we think the “Big Bang” idea is right, we are not even close to understanding why it is correct. This is because the bang itself violates causality (i.e., the scientific principle of cause and effect).

The scientific idea of causality basically says that everything that happens in the universe has a cause. When an apple falls to the ground it is the pull of gravity that causes the fall. When a star explodes it is the nuclear reaction reaching a critical point where the gravitational forces can no longer hold it together that allows the fusion reaction to cause an explosion. So, essentially, we are here because in the ancient past a lot of stars exploded. However, the very existence of the universe violates the idea of causality right at step number one. That is, from a scientific perspective, the Big Bang had no cause. This is why science only deals with the tiny fraction of a second immediately after the start of the Big Bang. They simply can't deal with its cause.

So, interestingly enough, the most profound effect, the coming into existence of the universe, has to be accepted as a matter of “faith” since it has no cause. However, many of the same scientists that have no problem with accepting the uncaused existence of the universe choke on the idea of something else that is accepted by faith as uncaused (the existence of a supreme creator). So ultimately science is just a form of religious belief where the fundamental articles of faith are simply different from many other religions.

If we believe the universe to be just some accidental uncaused explosion into existence we are

left with some interesting characteristics of the universe that should be considered. For example, the total content of the universe is a rather amazing balance for an accident. If the mass of the universe was slightly higher or energy slightly lower, the explosive creation of the universe would have collapsed shortly after its creation. There simply would have been no time for the very processes that have led to our being here. On the other hand if the mass had been slightly lower or energy slightly higher the universe would have expanded so quickly that the larger atoms would have never amounted to more than a thin dust that never coalesced into anything leading to life and the universe would be virtually empty.

Now, the rate of expansion or contraction is obviously rather important to our being here. However, there are extremely minor facts of nature without which we wouldn't be here. In addition to that, there are extremely important exceptions without which we wouldn't be here.

It is commonly known that as things get hotter they expand and as things get colder they contract. In fact, most liquids as well as solids have a quite simple behavior when they are cooled; they shrink. This is because as it is cooled a liquid typically contracts because the molecules are moving slower and they are less able to overcome the attractive intermolecular forces drawing them closer to each other. We also realize that as liquids freeze, most of them get smaller because the crystalline molecular structures are more compact than the liquid molecular structures. However, without one very important exception to this, the earth would be a very different and hostile place.

We've all had experience with the one very important liquid that is an exception. When liquid water is cooled, it contracts like one would expect until a temperature of approximately 4 degrees Celsius is reached. After that, it expands slightly until it reaches the freezing point, and then when it freezes it expands by approximately 9%. If not for this exceptional behavior, life as we know it would not exist here on earth.

Ice cubes float in a glass of water and icebergs float on the seas simply because of expansion of water as it freezes. This is because frozen water is slightly less dense than liquid water and will therefore float on the liquid. If not for this effect the earth would be one giant ice ball.

If ice contracted as it froze, then as ice formed on the high seas the ice would sink and remain frozen. Then the surface water would in turn freeze and sink followed by more water freezing and building layer upon layer of ice from the bottom of the seas up until all seas and all water everywhere was trapped as ice. The overall atmosphere of the earth would grow colder and colder as the seas became colder and colder filling with more and more ice. The earth would eventually be one giant ball of ice and life as we know it would simply not exist. So it is that one small exception where water expands as it freezes has made life as we know it possible. But why?

Sir Arthur C. Clarke, the famous science fiction writer well known for "2001 a Space Odyssey" and inventor of the concept of communication satellites back in 1945, explored the concept of "why" as part of his "Rama" series of books. At the end of the series Sir Arthur speculated that God has made many universes with slight differences while trying to achieve just the right mix. What is God looking for? God is trying to develop a universe where sentient life spreads from

one end to the other unabated. Is this universe his success? It seems doubtful. To quote both Captain James T. Kirk and Buzz Lightyear, sometimes there just seems to be “no sign of intelligent life anywhere.”