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Astrobiology Expository Essay 1

Is the Structure of Life Universal?

The Earth is the only place in the universe known to harbor life, but does that mean it is the *only* place that harbors life? That is, of course, one of the major questions astrobiology aims to answer: does life exist elsewhere beyond Earth? For the sake of this question/essay, let's assume life *does* exist beyond Earth. Is it fair to assume these other life forms are "similar" to life on Earth?

Let's start at the smallest scale: atoms. The structure and physical properties of atoms are very well understood – chemistry, atomic physics, quantum mechanics, and astronomy have made it very clear that the elements on the periodic table are the Legos of the universe. One may argue that the periodic table is not and may never truly be complete. New elements are being created and discovered through experiments, however these very heavy elements are not common throughout the universe, so we will take the periodic table to be completed. Thus, a safe conclusion to make is that other life will be constructed from elements on the periodic table.

Moving up a step, let's analyze molecules. At its most basic level, molecules are multiple atoms held together by some kind of bond. According to page 15 of the textbook, "There are five basic types of bonding that hold atoms and molecules together to give rise to the structure of ordinary matter and life... They are: Ionic Bonding, Covalent Bonding, Metallic Bonding, van der Waals' Interactions, [and] Hydrogen Bonding." These bonds, like the periodic table, are well understood and found all throughout the universe – in stars, planets, planetary nebulae, the interstellar medium to name a few. Because of how prevalent these bonds are in the universe, I believe it is also safe to assume that other life will make use of these bonds.

I believe this is where the concreteness of how we can assume other life is constructed ends. We understand that on Earth, these molecules and bonds will begin to form more complicated structures which then form to living cells and more complicated life beyond this. The reason I claim that concreteness ends here is because once the building blocks of the universe (atoms ~ molecules, and their bonds) are established, one can begin to construct essentially anything falling within the laws of physics and chemistry. This includes non-living things and living things. Like Legos, once you have the right pieces, one can build something small like a model plane, or something insanely complicated like a working car. How non-living matter organizes to form living matter, however, I cannot say, nor will I try.

Because we are now faced with the freedom to construct "anything," we can no longer say we know everything that *can* or *will* be constructed. As stated in the question's description, other life may be constructed in a way humans would never be able to recognize – though that does not necessarily mean that it is not living (according to the definition of life given on page 9 of the textbook).

Also, a fun thought: dark matter, which makes up the majority of the matter in the universe, may have its own periodic table and may thus be able to form life in a different way than we could even imagine.