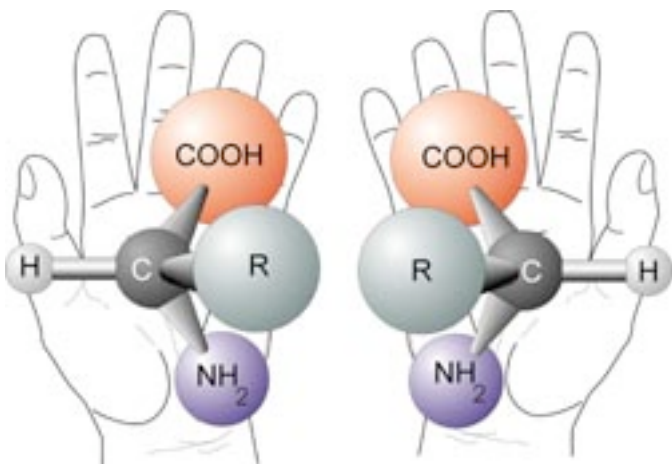


## Meteorites left “seeds” of Earth’s left-handed life

Flash back three or four billion years to a hot, dry, lifeless Earth. All is still. Suddenly, a meteor plunges in to the desert several times faster than a speeding bullet. With it, scientists believe, this crash may have planted the chemical seeds of life on Earth.



A "chiral" molecule is one that is not superimposable with its mirror image. Like left and right hands, which are mirror images but not the same, chiral molecules have the same elements attached in the same order, but are distinct. Most amino acids can exist in both left and right handed forms, but life on Earth is made almost entirely of left handed amino acids. (Image courtesy NASA Ames Research Center)

Re-searchers are now presenting evidence that desert heat, a little water, and meteorite impacts may have cooked up an early prerequisite for life: the dominance of “left-handed” amino acids, the building blocks of Earthly life.

Chains of amino acid molecules make up the protein found in people, plants, and all other known life. There are two orientations of amino acids, left and right, which mirror each other in the same way your hands do. This is known as “chirality.”

In order for life to arise, proteins must contain only one “chiral” form of amino acids, left or right, according to chemist Ronald Breslow of Columbia University.

“If you mix up chirality, a protein’s properties change enormously. Life couldn’t operate with just random mixtures of stuff,” he said.

In a report Sunday at the annual meeting of the American Chemical Society in New Orleans, Breslow described new research suggesting how our amino acid signature may have come from outer space.

With the exception of a few types of bacteria, left-handed “L-amino acids” prevail on Earth.

Breslow said amino acids delivered to Earth by meteorite bombardments left us with those left-handed protein units.

These rocks brought “the ‘seeds of chirality,’” said Breslow. “If you have a universe that was just the mirror image of the one we know about, then in fact, presumably it would have right-handed amino acids. That’s why I’m only half kidding when I say there is a guy on the other side of the universe with his heart on the right hand side.”

These “seeds” formed in interstellar space, possibly on asteroids as they careened through space, Breslow said. At the outset, they have equal amounts of left and right-handed amino acids. But as these rocks soar past a type of super-dense star known as a neutron star, the light rays trigger the selective destruction of one form of amino acid. The stars emit circularly polarized light—a type in which light waves are aligned together and twist like a cork-screw.

Breslow said experiments have confirmed that circularly polarized light selectively destroys one chiral form of amino acids over the other. The result is a five to ten percent excess of one form, in our case, L-amino acids. Evidence of this left-handed excess was found on the surfaces of these meteorites, which have crashed into Earth even within the last hundred years, landing in Australia and Tennessee, Breslow added.

Breslow simulated what occurred after the dust settled following a meteor bombardment, when the amino acids on the meteor mixed with the primordial soup. Under “credible” conditions simulating early Earth—desert-like temperatures and a little bit of water—he exposed amino acid chemical precursors to those amino acids found on meteorites. Breslow and Columbia chemistry grad student Mindy Levine found that these cosmic amino acids could transfer their chirality to simple amino acids in living things.

Breslow next simulated the chemistry that he said led to the amplification and eventual dominance of left-handed amino acids. He started with a five percent excess of one form of amino acid in water and dissolved it.

Breslow found that the left and right-handed amino acids would bind together as they crystallized from water. The left-right bound amino acids left the solution as water evaporated, leaving behind increasing amounts of the left-amino acid. Eventually, the amino acid in excess became ubiquitous as it was used selectively by living organisms.

Other theories have been put forth to explain the dominance of L-amino acids. One, for instance, suggests polarized light from neutron stars traveled all the way to earth to “zap” right-handed amino acids directly. “But the evidence that these materials are being formed out there and brought to us on meteorites is overwhelming,” said Breslow.

The steps afterward that led towards the genesis of life are shrouded in mystery. Breslow hopes to shine more light on early Earth as he turns his attention to nucleic acids, the chemical units of DNA and its more primitive cousin RNA.

“This work is related to the probability that there is life somewhere else,” said Breslow. “Everything that is going on on Earth occurred because the meteorites happened to land here. But they are obviously landing in other places. If there is another planet that has the water and all of the things that are needed for life, you should be able to get the same process rolling.”

Source: American Chemical Society and World Science staff