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Life could exist among the stars

A team recreated interstellar clouds in the lab, and found hints of DNA in the process

Simple molecules that make up the basic units needed for life could have formed in the giant clouds of gas lingering between stars, a study by Japanese researchers found in October.

Compounds called nucleobases, the essential building blocks that make up DNA, have been detected for the first time in a lab-based simulation designed to mimic the gaseous clouds that are found in the vast areas of space between stars. The finding brings us closer to understanding the origins of life on Earth, the researchers say. "This result could be key to unravelling fundamental questions for humankind, such as what organic compounds existed during the formation of the Solar System and how they contributed to the birth of life on Earth," said Dr Yasuhiro Oba of Hokkaido University's Institute of Low Temperature Science.

The basic structural unit of DNA is called a nucleotide and is composed of a nucleobase, a sugar, and a phosphate. Previous studies mimicking the conditions expected in interstellar molecular clouds have detected the presence of sugar and phosphate, but never nucleobases.

To make the discovery, the team set up a simulation of an interstellar molecule cloud by pumping a gaseous mixture of water, carbon monoxide and ammonia into a vacuum chamber filled with simulation cosmic dust and cooled it to -263°C. They then shone a pair of specially designed ultraviolet lamps into the chamber to kick-start chemical reactions. This led to an icy film forming on the surface of the dust.

Next, they warmed this substance up to room temperature and analysed its chemical composition using a high-resolution mass spectrometer. They were able to identify the presence of several nucleobases including cytosine, thymine and adenine – three of the four bases that make up all DNA. They also identified several amino acids, which are the building blocks of proteins, another key element for the formation of life.

The team suspects that past experiments simulating interstellar molecular cloud environments would have produced nucleobases, but that the analytical tools used were not sensitive enough to detect them in complex mixtures.

"Our findings suggest that the processes we reproduced could lead to the formation of the molecular precursors of life," said Oba. "The results could improve our understanding of the early stages of chemical evolution in space."

How does DNA work?

In 1953 James Watson and Francis Crick found that a DNA molecule is arranged like a long, twisted ladder, which is a structure that we call a double-helix. Each 'rung' of the ladder is made up of a base pair – two joined chemical building blocks called nucleotides. There are four different types of these nucleotides: adenine, cytosine, guanine and thymine, which we call A, C, G and T. An A always links to a T, and a C always links to a G.

The exact order that the different letters are arranged on the ladder varies, forming an enormously long code. Human DNA, for example, has about three billion 'rungs on the ladder'. This complex code will be different for every person and every organism (apart from identical twins), and is known as our personal DNA sequence or genome.