Does methane help life on Titan?

In 2034, a drone with eight propellers called *Dragonfly* will fly over the frozen surface of Titan, Saturn's largest moon. NASA will launch Dragonfly in 2026 as part of the *New Frontiers* research programme. The module transporting Dragonfly to Titan will take eight years to cover the distance of one billion and a half kilometres separating Earth from Saturn and its 62 moons (including rings). Titan is just a little larger than the planet Mercury, has a diameter measuring about one fifth of that of our planet and is particularly interesting because it is similar to Earth when it was much younger: this is why it is now being studied in depth, first by the Cassini probe, in the future by Dragonfly. Cassini travelled to Saturn with Huygens a small robot which, in December 2004, broke away to fly for a short time around Titan and then land on it after crossing its dense atmosphere mainly made up of nitrogen and methane: yes, precisely the gaseous hydrocarbon that fuels the cookers in our kitchen. Yet Titan is extremely cold, 180 degrees centigrade below zero; at that temperature, methane is liquid and therefore the seas, lakes and rivers, and even rainfall, are made up of methane. In that icy world, liquid methane may play the role that water played on Earth, making some form of life possible, perhaps a strange life but certainly based on carbon, like us.

Saturn and its largest moons

In our world, carbon is a life-giving atom. Indeed, a large part of all animals, plants, fungi, bacteria are composed of this atom. Our bodies contain 18% of carbon. Why is life based precisely on carbon and not on another of the 92 types of atom present in nature? The answer lies in the capacity of carbon to form both very simple and extremely complex molecules. For example, the carbon dioxide (CO_2) molecule is made up of one carbon atom and two oxygen atoms; in the methane (CH_4) molecule, one carbon atom is bound to four hydrogen atoms. The molecule of ethanol (C_2H_5OH), which is the alcohol in beer and wine, is made of a pair of carbon atoms, one oxygen atom and five atoms of hydrogen.

Con il patrocinio del Ministero dell' Istruzione, dell' Università e della Ricerca
e Ministero dell'Ambiente e della Tutela del Territorio e del Mare

Titan

It may seem complicated but the petrol that we use to fill up our cars is a mixture of long chains of carbon atoms bound to many atoms of hydrogen, molecules that are too large to be described in words: they are *hydrocarbons*. The word *hydrocarbon* means “made of carbon and hydrogen” and is almost the anagram of *carbohydrate*, taboo in all diets, because carbohydrates are fattening but, alas, are found in pasta, bread, pizza and in most of the food we love. Carbohydrates are very important because they act as the fuel that provides energy for our bodies; the Italian word for fuel is *carburante*, a word that, as it happens, identifies an energy source made from hydrogen and carbon. If we eat too many carbohydrates, our bodies are wise enough not to waste them: they turn them into fat and store them as fatty tissue for hard times. Fatty acids, proteins, enzymes and vitamins are structures that use carbon as essential building blocks. Carbon works very well on Earth. It is everywhere, in the atmosphere, in the sea, in life and it is part of the composition of the most common rocks. Air, water, life and soil continuously exchange carbon, according to a cycle that has been in progress for billions of years. Would carbon work elsewhere too as the atom of life? Perhaps. Can life be made only of carbon? Not necessarily.

We debase ammonia when we use it as a household cleaner, but somewhere in the universe there may be seas of this humble compound able to allow strange organisms to splash about in.

In a very hot world, silicon could replace carbon. Certainly, the planet would need to be really blisteringly hot, at least 1600°C, as hot as the furnaces of Murano, given that on Earth silicon (SiO_2), that is the molecule that could replace our carbon dioxide, is also called silica and is the main component of glass. Melted glass beings may exist in worlds that are inhospitable for life as we know it on our planet. But these, for now, are only flights of fancy. Let’s start by seeing whether anything moves in the oceans of methane… on Titan.

by Andrea Bellati