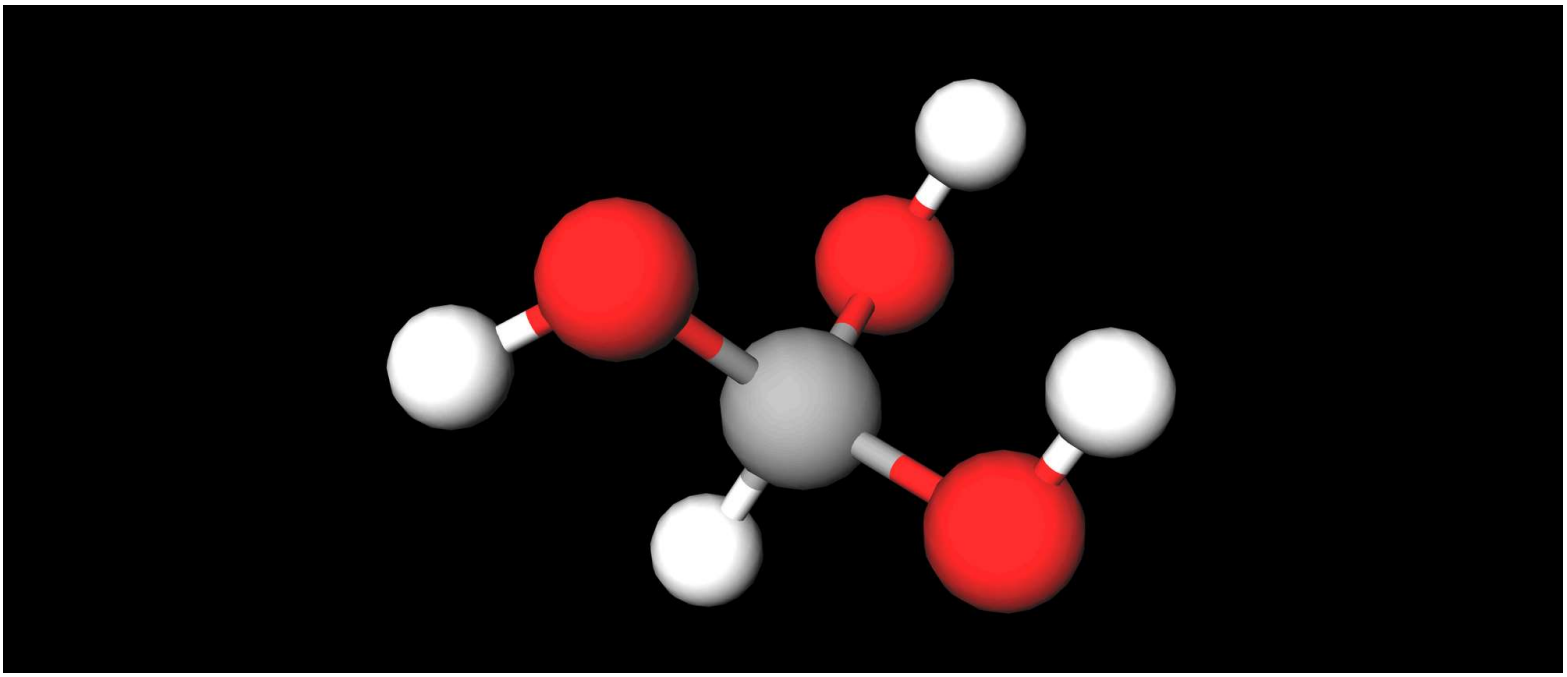
May 21, 2024

METHANETRIOL

Molecule breaks 150-year-old chemistry rule

Three OH groups at a time? It really doesn't work. But! A molecule that was previously considered almost impossible is formed in super-cold ice.

from Lars Fischer



Typically, a molecule with multiple OH groups on the same carbon atom would immediately split off a water molecule.

Of all the chemical structures that we encounter in everyday life, the hydroxy group is undoubtedly the most common. The atomic combination – OH is not only characteristic of the drinking alcohol ethanol, but is also found several times in sugar molecules. As often as it occurs in molecules in and around us – you will never find more than one of them on the same carbon atom. Almost 150 years ago, the German chemist Emil Erlenmeyer found the reason: Such molecules immediately break down into two low-energy building blocks. They split off water and a substance with a single double-bound oxygen atom remains.

Since then, experts have been trying to find molecules that contradict this rule and carry two OH groups on the same carbon atom. Because such molecules, however short-lived they are, appear as important intermediates in exciting reactions. For example, when removing pollutants in the atmosphere – but also in icy space, where they may help to construct the early building blocks of life. A team around Ralf I. Kaiser from the University of Hawaii has now used such conditions to create an even more exotic molecule. As the working group reports in the journal » Journal of

the American Chemical Society «, she has managed to produce the substance methanetriol: a single carbon atom that even carries three hydroxy groups at the same time.

The experts produced ice from methanol ($CH_{3rd}OH$) and molecular oxygen at temperatures of only 4.8 degrees above absolute zero. At such low temperatures, reactions take place extremely slowly, so that substances with several OH groups take much longer to disintegrate according to the Erlenmeyer rule. So you can examine such actually unstable substances. The working group irradiated the ice with high-energy radiation in order to move oxygen and methanol to the reaction. As she reports, this also resulted in the sought-after methanetriol. In addition to the scientific achievement of producing such an unstable molecule at all, the experts are now hoping for knowledge about the formation of atmospheric aerosols, which are important for air pollution and the climate.

Lars Fischer
is an editor for geosciences, chemistry and hideous diseases.