

Understanding Astrochemistry

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Over the past few decades, astronomers have learnt more and more about the planets, moons, and asteroids of our Solar System – but we still have much to learn about the materials they are made from. For hundreds of years, we have used chemistry to study such materials on Earth, but there is no guarantee that they will behave in the same way in space – where they can exist in environments ranging from harsh, airless vacuums, to strange and exotic atmospheres.

Today, scientists study these different behaviours through a new branch of chemistry, called astrochemistry. It is still a very young field of research compared to chemistry, and not many people know about it yet. A recent survey of 50 students aged 11 to 14 found that only 6% of them had even heard of astrochemistry!

As a simple example of the kinds of questions astrochemists aim to answer, think about how you would mix a spoonful of sugar with water. On Earth, this would be easy: you could simply pour the sugar into a cup of water, and stir it in. But on a space station, where there isn't any gravity, the water would form a floating bubble, which would break apart if you touched it. How would you mix in the sugar in this case?

Over a century ago, scientists discovered that all matter is made up of tiny, indivisible particles named atoms, which can be combined together to form molecules. Later on, chemists developed ways to create new molecules and materials, by combining atoms together in their labs. At the same time, biologists have found that many living organisms have evolved to make new molecules and materials by themselves.

More recently, astronomers have managed to collect and analyse samples of rock from different parts of the Solar System: including the Moon, Mars, and even an asteroid. By studying these samples, astrochemists have discovered that molecules with strange and complex properties can exist in space: which incredibly, can also be found in living systems on Earth.

In total, 210 different types of molecules have been detected in space so far, many of which can't be easily produced by chemists in their labs.

We know that they aren't being created by aliens with advanced science labs – so where are they coming from? Many astronomers now believe that these molecules are being created by stars, but they still aren't sure how stars could be assembling atoms into new molecules and materials.

To find the answer, astrochemists have turned to a technique called 'spectroscopy'. In the 17th century, Isaac Newton first showed that sunlight passing through a glass triangular prism would split into seven distinctive colours, named a 'light spectrum'. Later on, scientists discovered that as certain molecules absorb certain frequencies of light, they can create distinctive gaps in the light spectrum. By picking up these gaps, scientists can use spectroscopy to show that certain types of molecules lie in the path of the light being split.

Today, astrochemists use advanced space telescopes – the modern versions Newton's light prism – to search for signatures of complex molecules in the light originating from different stars. Using this technique, astrochemists are coming closer to understanding where complex molecules come from, and how they could have arrived on Earth.