

4.0

THRESHOLD 4 EARTH AND THE SOLAR SYSTEM

0:13–0:50 Today, about 98% of the atomic matter in the Universe consists of hydrogen and helium. But thanks to Threshold 3, that other 2% is made up of all the other elements in the periodic table.

MATTER AND OBJECTS

That makes some amazing things possible because these different elements can combine to form an almost infinite number of different types of matter. Objects that are much more complex than stars could now form. Objects like planets, and that was the work of Threshold 4.

0:50–1:52

**GOLDILOCKS
CONDITIONS**

Here's how it works. When new stars are formed, they're surrounded by huge clouds of chemically rich matter our ingredients for this threshold. These clouds spin in different orbits around the newly form-

ing star, creating Goldilocks Conditions that are just right for elements to combine. Some atoms combine chemically to form a variety of different molecules, but also, atoms and molecules often clump together to form bigger and bigger lumps of matter. This process is called accretion. And eventually it goes on to form entire planets.

Now, since lighter elements are much plentiful in the Universe many planets consist mainly of hydrogen and helium like Jupiter and Saturn. But because hydrogen and helium atoms are so light, intense radiation sometimes blasts them away from regions close to the new star. Those regions then contain a relatively high concentration of other heavier elements.

And eventually, these elements may clump together through accretion to form solid planets such as our Earth. In our planet's crust for example, the most common elements are oxygen, silicon, aluminum, and iron, not hydrogen and helium.

Our Earth formed about 4.5 billion years ago, but the very first rocky planets may have formed within a billion years or so of the Big Bang. These planets represent new forms of complexity because they contain a much greater diversity of chemical substances that had ever existed before, and that could create even more complex entities such as the first living organisms.

1:52–2:41

**NEW FORMS OF
COMPLEXITY**