3

A BIG HISTORY OF EVERYTHING

0:00–0:29

THE THIRD THRESHOLD

Big History's third great threshold...the creation of complex elements. Within the dying cores of stars, simple elements fuse into larger and more complex atoms. For the first time, hydrogen and helium create brand-new elements that will make the modern Universe possible.

0:29–1:19

THE ELEMENTS ARE CREATED

As stars begin to run out of hydrogen, they heat to higher and higher temperatures, they start converting helium to more complex elements, and this whole process continues right up the periodic table.

As it dies, each star becomes an element factory... creating just the right conditions to form the elements. And once they're formed, the Universe will never be the same.

A star uses the ashes of one set of nuclear reactions as the fuel for the next set. Hydrogen to helium, helium to carbon and oxygen, carbon and oxy¬gen to neon and magnesium, then silicon and sulfur and then iron.

1:19–2:55

NEUTRON STARS CREATE THE HEAVIEST ELEMENTS

So more than 12 billion years ago, stars are creating the element that will make possible everything from the Iron Age to the ironclads. But these dying stars don't have enough energy to create anything heavier than iron until they explode as supernovas...the biggest blasts since the Big Bang. The intense heat and pressure produces elements heavier than iron. But even these mega-blasts are not enough to create the heaviest elements...like the gold that will draw Europeans across the Atlantic and cause millions to flood into California. For that, you need the biggest blast of all, the collision between the ruins of two supernovas known as neutron stars. These new elements billow out into space, forming new clouds that come together in new, second-generation stars. Each time the process repeats, more elements are created.

2:55–3:22

ORDER AND DIFFICULTY

As you head further up that periodic table, you are basically seeing the order of creation and the difficulty of creation and how much energy is required to create them.

Some elements will be abundant, others rare. Their proportions will have profound effects on all of history to come.

3:22–4:42

STARS GIVE BIRTH TO LIFE

For example, there is more silver in the Universe than there is gold because it requires more energy and is more rare to get those events where gold can be created.

But that is all waiting for a distant future. It will take eons before dying stars create enough of the raw materials — like iron, nickel, and calcium — to form rocky planets like Earth. So during the first few generations of stars, Earth-like planets can't exist, and neither can life. But billions of years after the Big Bang, a newer generation of stars appears, including our sun. This time, there are enough new minerals and metals to create rocky planets as well.

It is truly mind-blowing when you realize that the elements that are present on our Earth and in our sun cannot exist unless there has been at least two generations of star systems before us that have lived and died.

Can you imagine, the elements in our body have to have been through this event twice before, before you can get a creature like us?

Early thresholds reveal that the first atoms in the Universe are reincarnated throughout billions of years from one element to another, from star to exploding star, from isolated early atoms to the elements that form everything around us. Some of the atoms in our bodies are more than 13 billion years old. These are the building blocks that will lead us to the next threshold and the most mysterious turning point in the Big History of the Universe, the one that will finally lead to us.

4:42–5:42

WE COME FROM STARS