Welcome to the second session of **Big History – A Closer Look**! Thank you all for coming back.

I was asked last time whether the Big History Project had been shown anywhere other than the internet. The answer is yes. Let me read what Wikipedia says about the Big History Project background:

"The Big History Project was started by **Bill Gates** and **David Christian** to enable the global teaching of the subject of Big History, which is described as 'the attempt to understand, in a unified way, the history of Cosmos, Earth, Life and Humanity.' It is a course that covers history from the Big Bang through to the present in an interdisciplinary way. The Big History Project 'is dedicated to fostering a greater love and capacity for learning among high school students'.

Seven schools were selected for the initial classroom pilot phase of the project. In the United States, San Diego High School of International Studies (California); The Rivers School (Massachusetts); Northville High School (Michigan); Greenhills High School (Michigan) and Lakeside School (Washington) taught Big History in the 2011/12 school year. In Australia, Narara Valley High School in New South Wales and Nossal High School in Victoria taught the course in their 2012 school year. In 2011 the Big History Project team held conferences in Sydney and Seattle with the teachers from the schools. These conferences established a framework for developing a school-based curriculum for big history, and outlined a structure for planning specific lessons to be trialed in classrooms in 2011/12. Teachers are developing lessons for their specific schools, and these lessons will be pooled as part of a developing resource base to facilitate the teaching of the course internationally. "

And now let's see what the Big History Project website says more recently:

"Over the 2016/17 school year, the Big History Project (BHP) conducted studies to measure student growth in writing, the long-term impact of BHP on student learning and teacher practice, and student and teacher perceptions of BHP. All lines of research point to favorable results related to the quality and rigor of the course, especially in the areas of student writing and long-term learning, for those taking part in BHP. In addition, student and teacher perceptions of the course are generally positive, confirming the strength of BHP as a foundational course for preparing students for future studies not only in history, but across the disciplines."

In this session we will examine Thresholds 2 & 3 of the Big History Project: The Stars Light Up and New Chemical Elements.

So, now, let's watch the second Big History video, "The Stars Light Up". (Play video 2)
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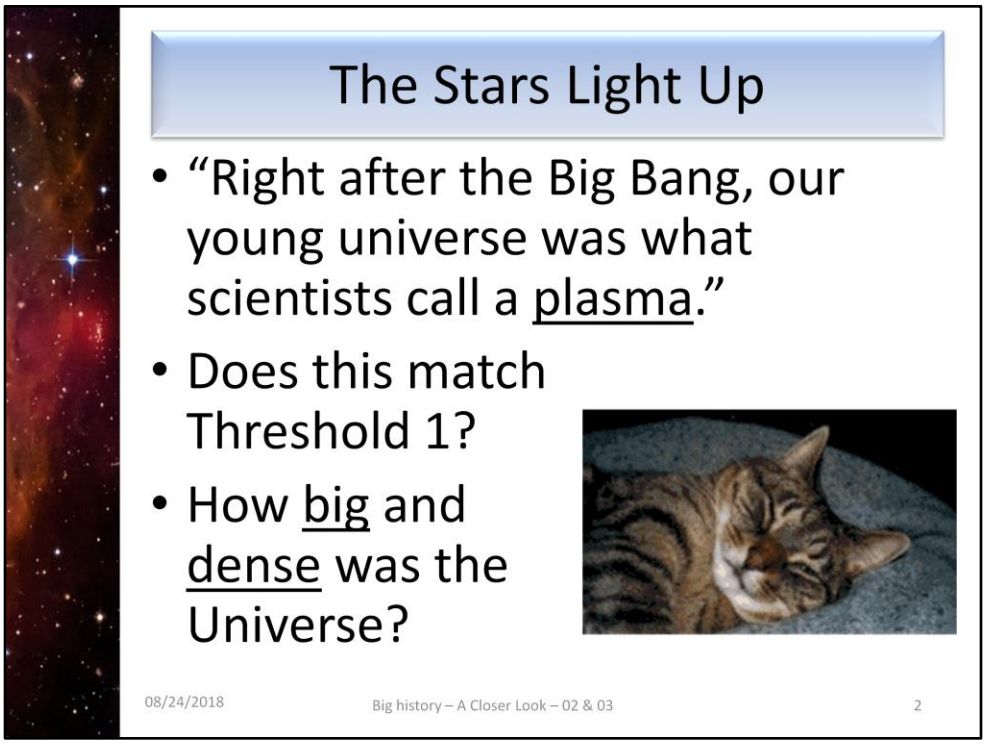


So, you are asking "What? Another cat?" I still like cats. Once again, it has nothing to do with this study. No, cats are not considered plasmas, despite their being somewhat mushy.

The video claims that right after the "Big Bang" took place the young universe was a plasma. This was defined as "an incredible hot mush of charged particles without much structure or complexity."

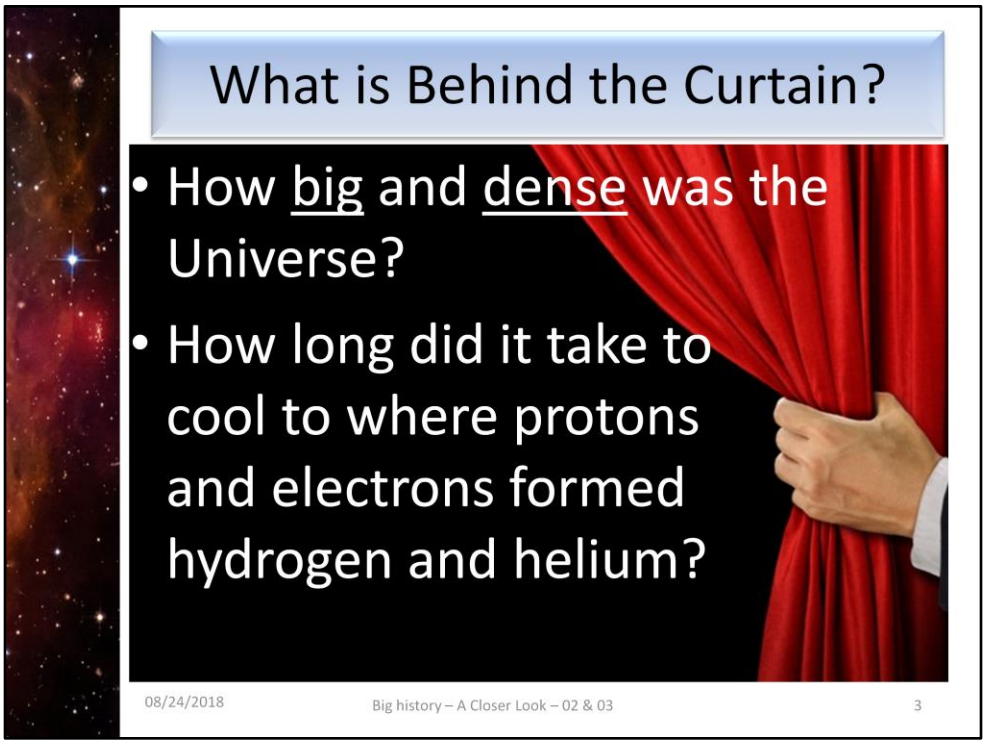
Plasmas are one of the four fundamental states of matter. The other three states are solid, liquid, and gas. Unlike the other three states, plasma does not exist freely on the Earth's surface under normal conditions. However, I don't see the need to get into the very technical aspects of plasmas.

Instead, let's ask if this description in fact matches what we were told in Threshold 1 last week.

We were told last week that the Big Bang created space, time, matter, and energy. But, matter and energy were so hot, that you could not distinguish between them. Do you remember how long it took for matter and energy to cool and separate? It happened in the first "billionth of a second"!

Remember that matter consisted of subatomic particles (i.e. electrons and quarks) that were moving away from each other at high speed in the newly formed and rapidly expanding space. However, gravity, which only appeared after energy was separated from matter, somehow caused the quarks to merge into protons, and that is where they left us.

What's wrong with that you say? Doesn't threshold 2 start with a "hot mush" of charged particles? Yes it does, but that makes it sound like the "Universe" was not that large, and it was very densely populated with these hot particles. If that were true, then it would make sense to call it a plasma. (next slide)



If you want a good technical explanation of all of this get "Dismantling the Big Bang" by Williams and Hartnett.

You may have noticed that Big History plays pretty fast and loose with timing and continuity. Thus, we have another slight of hand that occurs at this point.

Remember that the video claims that right after the "Big Bang" took place the young universe was a plasma. However, there is no mention of how large the rapidly expanding universe was or how densely populated it was with these "charged" particles.

The inference is that gravity will act in this dense plasma to create atoms.

So, how long did it take for the plasma to cool sufficiently to allow the formation of simple atoms like hydrogen and helium? It took 380,000 years! Ignoring where they got this number, just how dense would this plasma be by that point? We don't know, but it would be much less dense than at the start.

At his point the video is telling you, without actually saying it, that the universe is a giant gas cloud made up of hydrogen, helium, and a tiny bit of lithium.

This is where the video slips in its "Goldilocks" condition in order to get from gas to stars. And that Goldilocks condition is called "tiny variations in the density of matter throughout the universe".

So what you ask? Well, this Goldilocks condition, also called "density fluctuations" is a trick that Big Bang theorists use to get around a BIG PROBLEM that arises with the rest of the videos' description of star creation.

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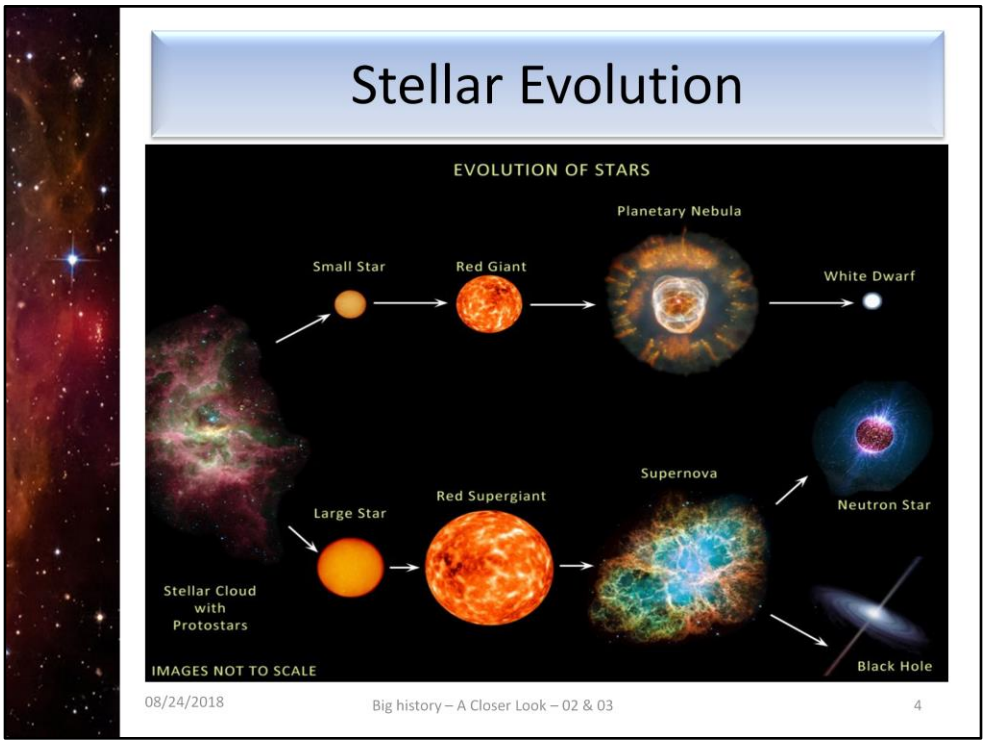

Nobody has seen the creation of, or any remaining of these original stars, because they would have died long ago, and the conditions are completely different now.

The tiny density fluctuations are supposed to cause the collapse of hydrogen and helium atoms in a region into a compressed mass that gets so hot that they form another plasma. Does that mean the original plasma was gone? This plasma goes on to get so hot, 10 million degrees Celsius, that protons fuse and part gets turned into energy via fusion. And this is how a star is born! Easy, right?

Unfortunately, the video skips entirely the problem with density fluctuations. The reason this mechanism was theorized is because collapsing clouds of gas will not compress to form a star. The increasing pressure will cause the gas to disperse rather than collapse. The only force available to make the cloud continue to collapse is gravity, so the theorists say that a density fluctuation, i.e. gravity, has to act on a whole portion of a cloud at the same time with just the right force to compress it to where gravity has the advantage. Too small a force and the cloud won't compress, and too large and you get a black hole.

But where do you get density fluctuations? The theorists either don't say, or they say they come from prior stars that have undergone supernova explosions. Well, you need to have a very large star first, before you can have a supernova. See the problem? You can't have a star without a supernova, and you can't have a supernova without a star.

Also, it takes about a million years for a massive star to supernova. This means that there would have had to have been many generations of huge stars that became supernovas. So in our galaxy there would be about as many black holes as there are stars. As you have probably guessed this is not the case, and there would probably very little galaxy left if it were true.
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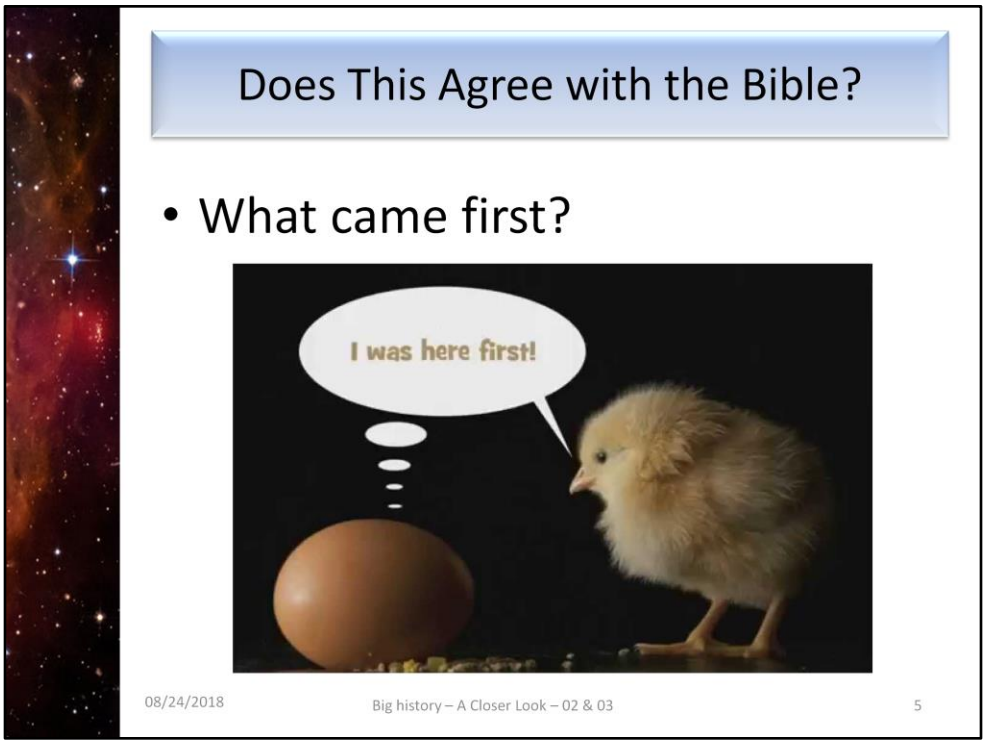

According to the video stars are created first, before any other complex structures (such as planets) or elements. But, what does the Bible say? Lets look at Genesis 1: 9-19:

9And God said, "Let the waters under the heavens be gathered together into one place, and let the dry land appear." And it was so.
10God called the dry land Earth, and the waters that were gathered together he called Seas. And God saw that it was good.
11And God said, "Let the earth sprout vegetation, plants yielding seed, and fruit trees bearing fruit in which is their seed, each according to its kind, on the earth." And it was so.
12The earth brought forth vegetation, plants yielding seed according to their own kinds, and trees bearing fruit in which is their seed, each according to its kind. And God saw that it was good.
13And there was evening and there was morning, the third day.
14And God said, "Let there be lights in the expanse of the heavens to separate the day from the night. And let them be for signs and for seasons, and for days and years,
15and let them be lights in the expanse of the heavens to give light upon the earth." And it was so.
16And God made the two great lights—the greater light to rule the day and the lesser light to rule the night—and the stars.
17And God set them in the expanse of the heavens to give light on the earth,
18to rule over the day and over the night, and to separate the light from the darkness. And God saw that it was good.
19And there was evening and there was morning, the fourth day.

So, the Bible says that the Earth came first, and the stars came later. By the way, the chicken came first.

Now let's watch the Threshold 3 video: New Chemical Elements. (play video 3)

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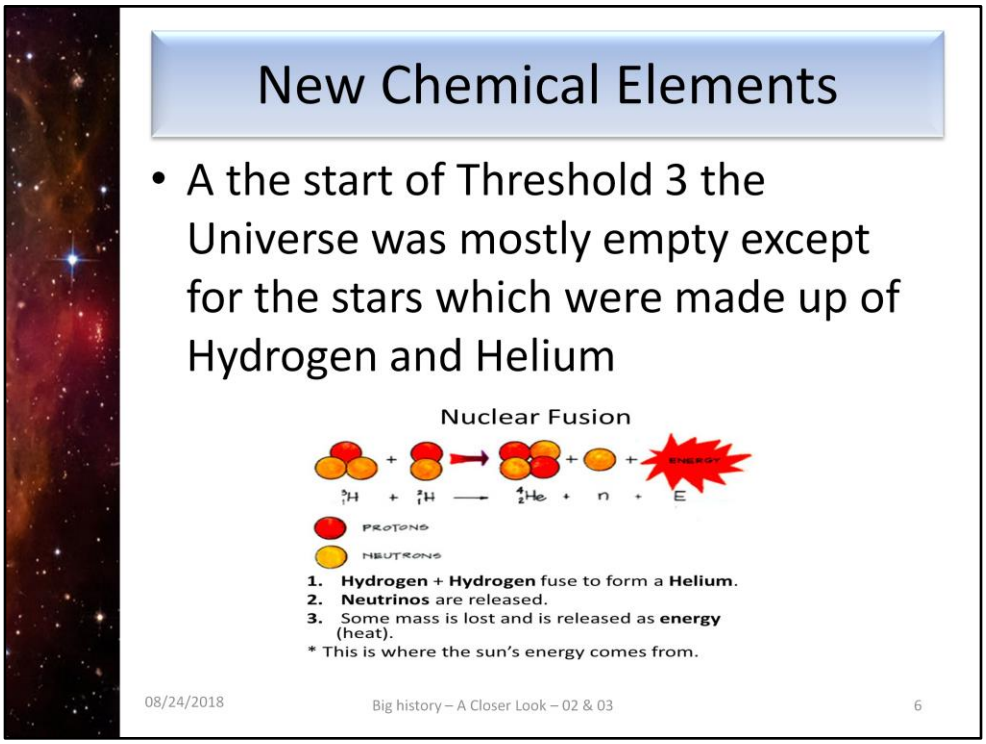

The Threshold 3 video starts by saying that there were now billions of stars, but the majority of the universe was cold, dark, and empty. All the matter in space was primarily hydrogen and helium.

At this point the video states that "the Universe **needed** more colors, more chemical elements." As we saw in the Threshold 1 video this is anthropomorphizing the Universe. It is making the Universe into some form of sentient being. The Universe does not "need" anything! If in fact there ever was such a state as is depicted in the video, the Universe would not care, because it is incapable of caring since it has no feelings. Hence, the creation of heavier elements may arise from these processes, but they do not arise because the Universe wants them to.

As you can see from the diagram stars use fusion to turn hydrogen into helium. This process releases energy in the form of heat.

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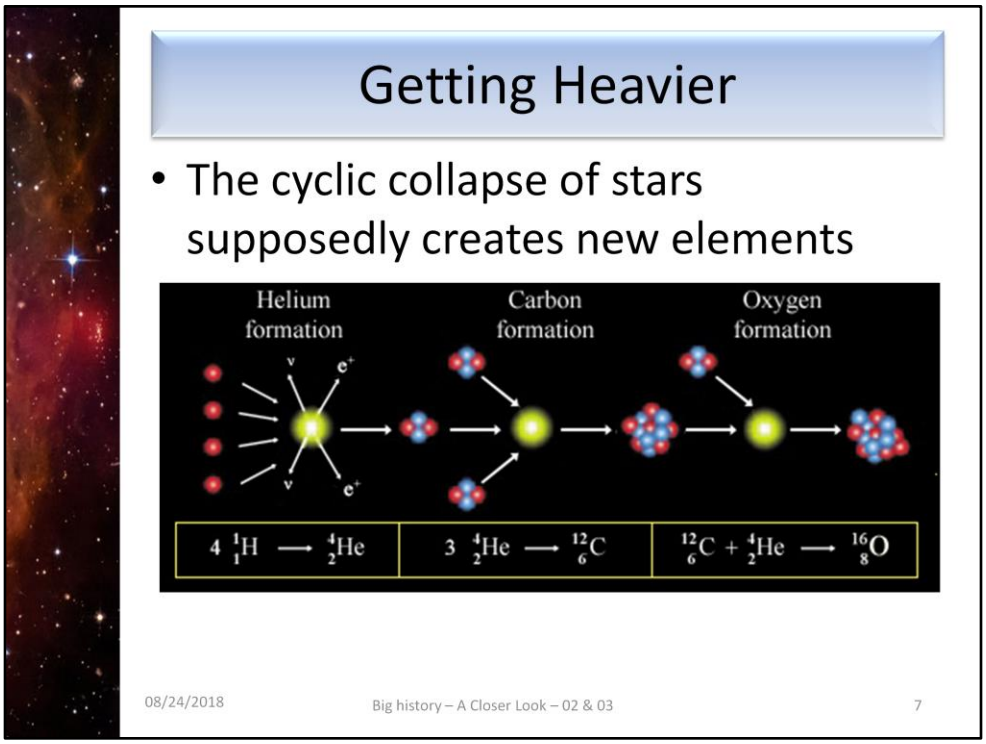

In order to get these heavier elements the video says that it requires very high temperatures and massive stars that are aging or dying. The video says that only these stars have the right Goldilocks conditions to create the new elements.

The video then states that when these massive stars use up their Hydrogen and Helium, they collapse. The tremendous pressure and heat build up fuses Helium nuclei to create heavier atoms, such as Carbon, Oxygen, etc. This is explained as a cyclic process.

If the star, according to the video, is really massive, then it will explode in a supernova with so much heat that it will create all the other elements in the periodic table. The resulting explosion then scatters those elements. And, voila, the universe is full of new elements.

Of course, as we said previously, these stars become black holes, so it is questionable how far the "scattered" new elements would get. Also, the Universe is a BIG place, so how does a bunch of floating atoms scattered far and wide do anything?

However, most stars do not become supernovas. Supposedly, more common stars, such as our Sun, become red giants and then collapse to white dwarf stars. This would not scatter any elements.

In case you did not catch it, the final chart in the video says that "Chemistry is born". We will see more about this next time.

Questions or comments?

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