BHP Unit 3 Overview | OER Project

In Unit 3 the Universe gets more complex and a whole lot brighter with the birth of stars. The earliest stars in our Universe began forming about 100 million years after the Big Bang. But that's not the only new complexity in this unit. When stars die, or run out of fuel, they scatter the Universe with new chemical elements. Those elements will be very important for the creation of planets, life, and us!

0:05

Host Rachel Hansen stands in front of neon sign.

Okay! On this episode of The Rachel Hansen Show we have a special guest star. Yeah Bob. Bob's my producer. uh-huh uh-huh okay, got it, thanks So it's not called The Rachel Hansen show, it's actually the overview for Unit 3, stars and elements.

Illustration by ancient Chinese astronomers.

And in this context guest star is not a famous person but it is— wait for it— an ancient Chinese science term! You're welcome.

0:47

Image of an observatory under the night sky.

Our night sky seems so permanent. You look up every night and the constellations are right there where you expect them. Always in the same shapes. The north star and southern cross have helped sailors navigate for thousands of years.

Ancient illustration of night sky.

Ancient astronomers thought of the sky in much the same way. They believed that stars were fixed on a sphere surrounding us. Sometimes called the firmament.

Illustrations of constellations.

But is our sky really so stable? Humans have been observing and cataloging the stars for over 3,500 years. and we've noticed some dramatic changes in that time. Stars are born, stars die, and some very lucky humans were in the right place and the right time to witness it.

1:32

Animation of a super novae.

For example, a supernova is what happens whenever a really big star dies in a massive explosion of incredible size and brightness. You're going to learn more about them in this unit.

Montage of ancient Chinese astronomers and models of the solar system with caption "Han Dynasty China (202 BCE-220 CE)" and definition of Dynasty.

The very first supernova recorded by humans was observed by Chinese astronomers working for the Han Dynasty in the year 185 CE.

Time lapsed video of a super novae as seen from Earth.

The event suddenly lit up the night sky and shone for about eight months. The astronomical observations were recorded in a later history of the Han dynasty called the book of the later Han. The astronomers called it a guest star, which explains my confusion earlier. They recorded its size and its position in the night sky that it was multi-colored and that it dimmed over time.

Astronomers of the past might have thought about the heavens as fixed and unchanging, but even 18 centuries ago they were uncovering the first hints that our universe is vast and in a constant state of change.

2:31

There I go again, mixing science into your history class. But, this supernova story is what Big History is all about!

Sequence of images and illustrations of a telescope and of supernovae.

To understand supernovae, astrophysicists sometimes have to rely on the work and tools of historians. You might be asking, "Why would today's scientists, with all their space age technology, need to worry about stories written down thousands of years ago by Chinese astronomers?" Well, for one thing, stars don't blow up all the time. The last supernova recorded in our galaxy was observed 400 years ago in 1604 CE.

Illustration of Han Dynasty astronomers and the documents they made.	So, historians and astronomers turn to ancient texts for clues. And Ancient China has some of the best texts for that task. That's because Han dynasty astronomers were government appointed, full-time professionals, who regularly observed and made detailed records of changes in the night sky. No other society in the ancient world kept such detailed records.
3:37 *Carving made by ancient Chinese astronomers.*	In 185 CE Chinese astronomers recorded a bright guest star in the sky and warned that it predicted rebellion. That's the main reason the Chinese emperors kept so many professional astronomers on the payroll. They believed astronomy was a tool for guiding government policies and predicting the future.
Animation of a super novae compared to a comet.	When guest stars are recorded in Chinese texts historians look for a few clues about what astronomical phenomenon was being observed. Clues such as the color, position, movement shape, and brightness can help tell us what was a supernova, and what was just a comet.
Sequence of ancient Chinese astronomy document and modern astronomers.	Astronomers then combine historical evidence with modern astronomical data.
Image of RCW86.	For example, in order to confirm that this was actually a supernova, astronomers today searched the area of the sky mentioned in the Chinese text and found the remnants of a supernova: clouds of expanding gas. Our universe is littered with ghosts, and this is one of them. RCW 86. This dusty cloud is all that remains from the supernova observed 18 centuries ago. Okay, it's not that scary, but it is impressive how astronomers created this image by combining x-ray and infrared data from three separate telescopes.
4:58	By studying the knowledge and records passed down through history astronomers gain a better understanding of our universe. The ancient Chinese astronomers might not have understood how stars are born and die, but their observations helped astronomers today form a more complete picture of our early universe.
Text definition of the Big Bang.	In the last unit, we learned about the origin of the universe, which began as an incredibly dense, incredibly hot speck that exploded to create all of space-time, gravity simple elements like hydrogen and helium, and nuclear forces that helped hold it all together.
Text definition of Collective learning.	We also discovered how our understanding of this origin story changed over time thanks to collective learning.
Illustrations and text definitions of heliocentric and geocentric models of the solar system.	From the geocentric model of Ptolemy to the heliocentric model of Copernicus to the discovery of gravity in a rapidly expanding universe. We've come a long way in the last 500 years. A tiny moment in time compared to the 13.8 billion year history of the universe.
6:00 *Text definition of Interdisciplinarity.*	Then, we learned about how using interdisciplinary thinking, for example by combining history and astronomy, helps us form a more complete understanding of the past. Interdisciplinary thinking is a core concept in Big History, just like collective learning. It helps us understand how our knowledge has changed over time. You'll continue your exploration of collective learning and interdisciplinarity at the end of unit 3.

Animation of the birth of a star.

Unit 3 begins with the cosmic dawn, which started 13.7 billion years ago as the first stars lit up. In this unit, you're going to learn about the birth and death of the first stars and how they shaped the fabric of the early universe.

6:45

Text definition of Thresholds of increasing complexity alongside graphics of Threshold 2 and Threshold 3.

In this unit, we'll cross two thresholds the first, threshold two, is the formation of stars, which added a lot of complexity to a cold, dark universe. Then, threshold three, the death of stars, adds even more complexity.

Illustration of the Sun wearing a scarf compared to close up videos of the Sun.

Stars are cool, right? Actually, I'm wrong, because they're super hot masses of hydrogen and helium.

Thanks to the pressure of gravity, these masses get hotter and hotter until the hydrogen atoms break apart and then fuse back together as helium. That's called nuclear fusion. And that's what happened at the end of the dark ages of our universe to birth the first stars and begin our cosmic dawn.

7:32

Animation of the death of the Sun.

But stars aren't immortal, and eventually all stars, including our sun, will run out of fuel and die. For really massive, super gassy stars, that usually means they'll explode as a supernova, like the one Chinese astronomers witnessed in 185 CE.

Color graphic of the periodic table of elements.

The extreme heat and gravity involved in star death produces all the naturally occurring elements of our periodic table. In their, death stars create the building blocks for all life. Hydrogen, oxygen, nitrogen, carbon, calcium, and phosphorus.

Image of the universe with the outline of a human drawn on top.

These six elements make up 99% of our human bodies. And they were all created in supernovae.

Image of Carl Sagan.

That's why the astrophysicist Carl Sagan once said that we're all made of star stuff.

8:21

Text "How do we know what we know?", "Interdisciplinary thinking".

How do we know what happens inside a dying star? Well, you're going to use interdisciplinary thinking to find out. You'll practice thinking like an astrophysicist to solve the mystery of the first star births. And then, you'll think like a chemist to determine exactly how star deaths generated all those new elements.

Claim Testers graphic.

But, like any historian or astronomer reading a 2000 year old text, you'll need your claim testers ready to evaluate the narratives you encounter.

Animation of super novae.

Are you ready to watch some stars blow up?

Host stands in front of an animation of the constellations.

All right, Bob, that's a wrap on unit three. Hey, for unit four I'd like to get some real guest stars in here. Can we do that? You know, like somebody really famous like from the Yankees, or a movie star or something? Or— You don't need to stay for this, I'll see you in the next unit. What do you mean we blew our entire budget on paperclips and time machines? I thought those were returnable?