Space Compilation: Crash Course Kids

Compilation
https://youtube.com/watch?v=Td_A9H69eE8
https://nerdfighteria.info/v/Td_A9H69eE8

===== Intro (0:00) =====

Space. It's really cool! Actually, it's really cold, and really big, and really awesome!

Space has inspired a lot of us to do a lot of really cool things. But probably one of the best things it's inspired many of us to do is just simply learn about it. The more we learn about stars, other planets, galaxies, and asteroids, the more we learn about the universe, and even ourselves.

So let's start this off by talking about one specific star, one that's really close to us.

===== Here Comes The Sun (0:27) =====

Pop quiz: What's the closest star to Earth? It's called Sol. Never heard of it, you say?

Sure you have. Sol is the sun.

Ancient Romans, who once worshipped the sun, called it Sol, and it's become the kind of official scientific name for the sun. It's where the term "solar system" comes from.

Sol, or the sun, is the star at the center of our 8-planet solar system that provides us with energy. Without the sun, earth would be a dark, frozen world with no life. But how does the sun's energy get to us?

(Big Question)

Well first, let's talk about what the sun is. It's a 5 billion year old big ball of super hot gas. The hottest part of the sun is its core, or center, which is about 15 million degrees Celsius.

Whoa.

Its surface is not quite as hot, but it's still almost 5,600 degrees Celsius, which is pretty toasty if you ask me.

And as for its size, the sun is so huge, you could line up over a hundred Earths along the face of it, and more than a million earths could fit inside it.

But the sun's size isn't what makes it seem so big and bright to us on Earth. It's because it's so close to us that it seems way, way, way, way bigger and brighter than other stars.

So, you know that the sun is hot. And bright. And that heat and light are both kinds of energy that we get from the sun.

Let's take a look at a model to see how the sun's energy gets from good old Sol to our planet.

(Investigation)

Here's the sun. Energy is created in its super-hot, 15 million degree core. That energy then travels outward from the core to the surface of the sun. But this journey from the center of the sun to its surface can take over 100 thousand years to complete.

But, once the energy deep inside the sun finally gets to the surface, it travels, as light and heat, all the way to Earth. In fact, it only takes about 8 minutes for light to travel approximately 150 million kilometers through space to Earth over here. That's not such a long time.

(Conclusion)

So to sum up, energy is created in the sun's core. It travels very slowly to the sun's surface, before it take a super-speedy trip to Earth in the form of light and heat. And you and I can can see and feel that energy as sunlight.

Without the heat and light we get from the sun, Earth would be just a frozen ball floating around in space. Which would be a total bummer.

So thanks, Sol. You're a real star.

===== Break (03:13) =====

So, yeah. The sun is big. Really big. But understanding the universe is sometimes about perspective. The sun is big to us, sure, but it's nothing compared to the galaxy. Or even, some of the other stars. And compared to the universe... Well, our sun is pretty tiny compared to the universe, because the universe is huge.

How huge?

===== Spaced Out (03:33) =====

The universe is big. Really big. Bigger than that. No, you're not thinking big enough.

It's so massive that it makes my brain hurt. It's so ginormous, we teeny, tiny humans can barely, just barely get our brains to comprehend it. But, just because we can't really fully understand how big the universe is, doesn't mean it's not important.

The universe is our home. We should at least poke around. So, how big is the universe?

(Big Question)

Let's start off with our cosmic address. That's where we live in the universe. You could say my current cosmic address is the Crash Course Kids Studio, Toronto, Canada, North America, Earth, the solar system, the Milky Way galaxy, the observable universe, the universe.

Knowing our cosmic address helps us understand where the things in the sky are. Things like stars, asteroids, planets, even other galaxies. Every time we go up and out a level in our cosmic address, the actual space we're talking about gets more spacious.

Distances in space are so large that scientists had to come up with a whole new way of measuring them. You can't talk about space using miles or kilometers. The numbers get so big that they just sound like nonsense.

That's where a light-year comes in. It sounds like a measure of time, because it has the word year in it, but it's really a measure of distance. Light is the fastest thing we know in the whole universe, clocking in at a whopping 300,000 kilometers per second! In one second light can travel around the Earth, the whole Earth, seven times! It's moving so fast our brains can't detect that it's moving at all.

So, a light year is the distance that light can travel in one year. Does your head hurt yet? Well, buckle up because we're just getting started.

Back to our big question. How big is this universe of ours? Nobody knows! Really! That's pretty weird, right? Well, that's partly because the only part of the universe we know about is what we call our observable universe, the parts that we can actually see or observe in any direction.

Some things are so far away that light from those objects haven't even reached us yet. That is the limit of our observable universe. Beyond that, we don't know what's out there. But even sticking to the observable universe, we're going to need to scale things way down to understand any of it.

(Investigation)

Let's try to visualize our cosmic address, on a scale that we can handle. Let's use this room as our scale. It's about ten meters, by ten meters, the size of an average classroom. If the sun were the size of this room, the Earth would be about this big. Okay, not too crazy.

Now, imagine our whole solar system were the size of this room, this would be the sun. Don't see anything? That's because it's just a grain of salt. A grain of salt! Yeah! That's our sun. And the Earth's orbit around the sun would be about the size of this disk. At this scale, the earth is just a microscopic bacterium. We can't even see it. At this size, our whole big huge solar system is just a grain of salt.

Now, what if the entire Milky Way galaxy were the size of this room? Our solar neighborhood would be this big. Ho-Boy! Now, for the finale, the biggest thing we know, the observable universe.

Imagine the observable universe is this room. Can you spot the Milky Way? Nope! It's just way too small. It's not that it's just unseeable, it's smaller than microscopic, the whole Milky Way. Are you dizzy? I'm dizzy.

So, that gives you an idea of the size of the things in the universe, but what about the size of the space?

You know that the sun is the closet star to the Earth. But what is the second closest? That would be Proxima Centauri; it's 4.24 light-years away. That means that it takes light from that star four years to reach us. By comparison, it takes the sun's light 8 minutes to get to Earth. If you want to visit the sun's closet star friend, traveling in the fastest object humans have ever built, it would still take 19,000 years to get there! And that's only 4.24 light-years away.

The observable universe is, are you ready for this? 93 billion light-years across. Even using light years, it's so big, it still sounds kind of like nonsense, huh?

(Conclusion)

So, space. It's big. Really big. Mind-bogglingly big, but it's also our home. Even if we're just unbelievably small, little things floating on a speck of dust in a teeny, tiny galaxy, we're still here. And we know where we are in the universe and that's pretty awesome. But, I think I need to go lie down now.

===== Break (08:25) =====

Okay, now that we have a little perspective, let's start looking a little deeper into the stars. Stars aren't all like our sun. Actually, they're all really different! From white dwarfs, to red supergiants, stars have all kinds of appearances and personalities.

===== Star Personalities (08:40) =====

My brain still hurts from last time. It's like intergalactic whiplash. You too?

But there's a reason we zoom through the mega-giant unbelievably huge vastness of space. It helps us understand how big the universe really is, not just how big it appears from our perspective down here on our itty bitty Earth.

If you glance up at the night sky, the stars seem like they're all on the same plane. That is, at the same distance from Earth. And the stars all seem pretty similar, but don't let your eyes fool you.

Some stars are relatively close, just four or so light-years away, and some are hundreds of thousands of light-years away.

The furthest stars are billions of light-years away. BILLIONS, people! And in the big, huge spacey-ness of space, there's a lot of

room for variety. Even in our galaxy, the Milky Way, there's a wide range of stars, so stop stereotyping them.

Let's take a look. What are the different kinds of stars?

(Big Question)

Well, scientists organize stars by their color and size. Which also happens to be how I organize my rock collection.

We've learned that stars glow because they create energy through nuclear fusion, but not all stars produce the same amount of energy, and stars can produce different amounts of energy throughout their lifetimes.

I mean, they're not alive, but in a sense, stars are born, grow up, age, and eventually die once they burn through all of the hydrogen in their core. And don't feel bad, this all happens over billions and billions of years.

Now, first thing to remember, stars that produce less energy glow red. These stars are relatively cool, with a surface of about 2,760 degrees Celsius. But the very hottest stars in the universe glow blue-white. Put on your shades because these stars can have a surface temperature of over 30,000 degrees Celsius.

Our sun, by the way, is a perfect mellow yellow temperature, right in the middle with a surface temperature around 10,000 degrees.

Stars also come in a range of sizes. The smallest known star is just a little bit bigger than Jupiter. Pretty small considering you could fit about a thousand Jupiters inside our sun. Meanwhile, the largest star that we know of is many hundreds of times larger that the sun. If it were in our solar system, it would extend past Saturn's orbit! Once again, our sun is in the middle of this range. We're in a real-life Goldilocks situation, here.

So now that we know how stars are classified, let's see if we can identify two of our star neighbors. I've got the perfect stars in mind, a foot and an armpit. Oh, have you met Orion?

(Investigation)

He's one of the most recognizable constellations, and he's got two body parts that are made from totally different kinds of stars. Remember Betelgeuse? We talked about this star in a previous episode. It's the right shoulder, some people like me call it the armpit, of Orion. And let me introduce you to Rigel, Orion's left foot.

Betelgeuse and Rigel are both in our home galaxy, the Milky Way. Take a look at this picture of Orion. Based on the evidence that you can see, which would you argue is hotter? Does one star look kind of reddish, and another, kind of blue? You smarty-pants, I bet you already guessed the answer.

Betelgeuse, the armpit star is a red supergiant. It's much, much cooler than Rigel, and sadly, it's nearing the end of its starry life. On the other hand.... er, foot, Rigel is a blue-white supergiant star. This star is in the prime of its life, burning super-hot and super-bright. But stick around a few million years and Rigel will probably start to look like Betelgeuse, red and cool.

Now, since Rigel shines more brightly, you might assume that it's closer to us, and that would be a great guess, but using brightness to judge distance can be tricky. Rigel has much greater true brightness, or luminosity, than Betelgeuse, so the foot outshines the armpit.

(Conclusion)

So in summary, a star isn't just a star. From here on Earth, the stars may look similar, but you know better now. They come in different colors and different sizes; you could say they've got their own personalities. Stars: they're just like us. Except millions or billions of miles away. And gigantic. They're not really like us.

===== Break (12:47) =====

Now that we've talked about stars and their places in the universe, let's have a look at a couple of episodes that show us how we have used the stars throughout history to both help us tell stories, and actually guide us, like points on a map.

I'm talking about constellations!

===== Super Stars (13:00) =====

Now you might be thinking, “but we've already learned about stars.” Well, you're right, or at least you've been paying attention. But we learned about individual stars. Basically, how they do what they do as solo acts out there in the universe.

But what happens when a bunch of stars band together to form a super-group, sort of like The Avengers of the night sky? Well, then they're called a constellation. Today we'll talk about these groups of stars and why they're so important to astronomers, besides being just plain cool... or hot... you know what I mean.

So what exactly is a constellation?

(Big Question)

A constellation is a cluster of stars in the sky that have been grouped together in a pattern or shape and have been given a name.

But before we take a closer look at constellations, let's review what a star is. Remember, a star is a bright object in space that gives off light through energy that it makes in its core.

The Sun is the most famous star to us Earthlings. We've already talked about a few other well-known stars though, like bright Betelgeuse. Astronomers use bright stars like Betelgeuse as markers in the sky to help find other less bright objects in space.

For example, if you were looking for a dim star like Sirius B, you might have to look for a long time to spot it among the many, many, many, many other stars in the sky. But if you're able to spot a much brighter star like Sirius A, and you know that Sirius B is located to the lower left of Sirius A, then it'll be much easier to find Sirius B.

Like I said, there are so many stars in the sky that trying to spot just one can be tough, especially if it's not near a bright one like Betelgeuse or Sirius A.

That's where constellations come in. Astronomers use constellations to help them better map the night sky. Think of stars like cities on a map and constellations like countries. Finding a large shape in the sky made of many stars is a lot easier to spot than trying to find one single speck.

Plus there only 88 named constellations, which is a much more reasonable number to deal with than a billion. And most of the 88 recognized constellations came from the ancient Greeks. The stars in a constellation aren't related in any particular way, they just form a shape that the Greeks used to tell stories about their gods, goddesses, and mythical creatures, like flying horses and giant scorpions.

Now that we know what a constellation is, why don't we get to know some of the more famous ones?

(Investigation)

Harry Potter fans will recognize the name of our first constellation. Its name means "dragon" in Latin, and also happens to be the name of Harry's biggest nemesis... well second biggest, after Vol-- he-who-must-not-be-named, of course.

Yep, it's Draco. According to legend, Draco was a dragon killed by the goddess Minerva, and was tossed into the sky. Draco was one of 48 constellations described way back in the second century by Egyptian astronomer Ptolemy. People have been seeing this dragon-like shape in the night sky for a long time.

Constellations aren't just named after creatures though, some are named after a mythical people, particularly gods and goddesses.

One of the more well-known Greek gods has his own constellation. And a Disney movie. I'll give you a hint: he'll go the distance. It's Hercules! The stars in the Hercules constellation take the shape of the mighty hero, as if he's holding a bow after just releasing an arrow. You go, Hercules!

The name of our next notable constellation also made an appearance in Hercules movie as a super cute winged horse. Say hello to Pegasus!

According to Greek mythology, Hercules never actually rode Pegasus like in the movie, but the flying horse did spend some time with Zeus, king of the gods. Zeus liked Pegasus so much he transformed him into a constellation, and placed him in the night sky for everyone to see.

Now, you're familiar with at least three of the 88 constellations in our sky, only eighty five more to go. As the Earth rotates you'll see Draco, Hercules, and Pegasus, plus all the other constellations over the course of a year, but more on when and where you can see the constellations in the next episode.

(Conclusion)

So now you know what a star is, and that a cluster of stars in the sky that are grouped together in a particular pattern is called a constellation. Besides having really cool shapes and stories behind their names, constellations help astronomers, and us, map the night sky. Since space is so huge and massive and ginormous, our map is far from complete, so anything that helps us navigate that vast, well, space of space is okay by me.

===== The Zodiac Constellations (17:24) =====

People have been studying the skies for centuries, and who can blame them? It is beautiful up there. On any given clear night there are probably more than two thousand stars that you can see; and that's without a telescope.

Way before telescopes were even invented, ancient astronomers tracked the movement of objects in the sky, and over time, one group of objects ended up getting a lot of attention. I'm talking about the thirteen constellations that make up something called the Zodiac.

So, what's the Zodiac and which constellations are part of it?

(Big Question)

We'll get to that in a just a sec, but first, do you remember what a constellation is? Sure you do! A constellation is a cluster of stars in the sky that are grouped together in a particular pattern and have been given a name.

We've talked about a few famous constellations before, like Draco, Hercules, Pegasus, Ursa Major and Crux. But none of these constellations are part of the Zodiac. You might recognize some of the constellations that are in the Zodiac though. Do the names Gemini, Leo, or Sagittarius sound familiar? They're among the thirteen Zodiac constellations and they actually form a kind of pattern in the sky.

This pattern makes it easier for observers to know where to find each constellation throughout the course of the year. So, what are all of the constellations in the Zodiac – and what pattern do they form? Let's take a look.

(Investigation)

You know this guy. Hi, Earth. At the beginning of the year, January, the constellation of Sagittarius is highly visible to us on Earth. The Greeks called Sagittarius "the archer" because it looked like, well, a guy shooting a bow and arrow.

Capricornus is also highly visible in January toward the end of the month. It's sometimes called "the sea goat" since it happens to have the head of a goat and the tail of a fish. Which is not something you see every day.

Next up in February is Aquarius, or "the water bearer." A group of ancient people called the Babylonians thought that this group of stars looked like an old man pouring water from a pitcher.

Moving on to March, this is Pisces, or "the fishes." Pisces represents Venus, a Roman goddess who is said to have turned into a fish and jumped into a river to escape an evil monster.

Ares is up in April. In Greek mythology, Ares is a ram with wings. The constellation of Taurus, visible in May, looks like a bull. It's named for the Roman god Jupiter, who could supposedly turn himself into a bull when he swam.

June's prominent constellation, Gemini, is sometimes called "the twins" because it reminded the ancient Greeks of the twin sons of Zeus. Cancer, which we can see pretty well in July, is called "the crab" because that's what it remained some folks of.

August's constellation is called Leo and it looks like a ferocious lion. Seen in September, Virgo is called "the maiden" since it looks like a lady holding grain, which symbolized the harvest to the Greeks and the Romans.

This constellation of Libra appears in October, when days and nights are roughly equal and is considered a symbol of balance.

I bet you can guess what the Scorpius is named for. Yep, it looks like a scorpion. Finishing off the year in late November is Ophiuchus, which was once called Serpentarius because it looked like a man holding a serpent or a snake. Hey, better him than me.

All right, now that you've met all of the constellations in the Zodiac, let's light 'em up and see if we can spot a pattern... Looks like a circle to me. And here's a fun fact, "Zodiac" loosely translates to "Circle of Animals" or "Circle of Life" in Greek.

(Conclusion)

So the Zodiac isn't just a random bunch of stars. It's a group of constellations that form a circular pattern in the night sky, and now you know which constellations are part of this pattern. And that people have been observing these constellations for centuries.

The Zodiac has helped astronomers figure out how other objects travel in space. Objects like the sun and even our own planet.

===== Break (21:11) =====

So, constellations are super-important for many, many reasons. We use them as markers to help us find our direction on Earth, but also to help us find other stars.

It's neat!

But now let's pull this all together and see how the sun affects how and when we see the Zodiac constellations. Which is something that is also neat!

===== What's The Ecliptic? (21:31) =====

I've still got my eye on the sky, particularly those 13 constellations in the Zodiac that we learned about earlier. We found out that the Zodiac constellations follow a circular path around our planet. Today, we're going to learn more about where our sun falls in this path. I'll give you a hint: it involves something called the Ecliptic. Intriguing!

So what is the Ecliptic?

(Big Question)

Before we head into imaginary space to find out, it's time for a quick, well, crash course on astronomy. You know what a constellation is - a cluster of stars in the sky that are grouped together in a particular pattern and have been given a name.

Some of the constellation we've visited so far include Hercules, Pegasus, and Draco. And last time we met a group of constellations that form something called the Zodiac, 13 constellations that have been studied and tracked since ancient times.

The constellations in the Zodiac are all highly visible from Earth during different months of the year, starting with Sagittarius in January, and ending with Ophiuchus. And last time, we saw how these constellations form a sort of belt-like shape around the Earth. Well, this time, we're going to see what the sun's up to while the constellations take turns popping up in our night sky.

(Investigation)

Okay, so there's Earth in the middle of space. Looking good, home planet! And here are the zodiac constellations that surround Earth, but we've got to make room for another major player in space. You remember the sun, of course. Earth, scooch over. Sun, head to center stage, you're on.

Okay, you already know that Earth rotates on its axis, making a complete turn in one day. While it's rotating it also revolves around

the sun, making one full trip around the star every year. This movement of the Earth also makes it seem as if the sun is moving through the stars over the course of the year. This is because during any given month, the sun sits between the Earth and a different zodiac constellation.

But we know the sun's not really moving, it's the Earth's movement that makes it seem that way, and astronomers have come up with a nifty way to track the sun's apparent path through space. They draw an imaginary line from the Earth through the sun and toward the stars beyond it. As the Earth moves, so does this line with it while the sun stays steady in the middle.

As Earth follows its orbit around the sun, this imaginary line spins pointing to different stars throughout a complete trip around the sun, forming an imaginary circle. Astronomers call this imaginary line that the zodiac sits on, and that tracks the sun's apparent path through space, the Ecliptic. Eventually, over a year, the Earth will return to Sagittarius where it started and the cycle, or pattern, will start all over again.

(Conclusion)

So, that's what the sun's doing as one Zodiac constellation in the night sky moves to the next. Not a whole lot. It remains in the same spot while Earth makes its annual journey.

And now you know that even though the sun's not really moving. The path it appears to take – and the path that the Zodiac sits upon, is what astronomers call the Ecliptic. No one ever said understanding what happens in space would be easy, but isn't it fun to try?

===== Break (24:35) =====

And that wraps up our little journey through the cosmos. The universe is big, the sun is big, stars are big. It's all big, big, big, big! But understanding what happens in space is fascinating. Don't you agree?

If you enjoyed this, check out the rest of our channel, and subscribe!

===== End Sequence (24:52) =====