

## THE DEATH OF THE UNIVERSE

Match the words on the left to the definitions on the right.

1. A cosmologist	a. An explosion that some scientists believe started the universe
2. The Big Bang	b. An extremely large group of stars and planets
3. A galaxy universe	c. A person who studies the origin and nature of the universe
4. Gravity	d. A single star and the planets that go around it.
5. A solar system	e. A theoretical form of energy which makes the universe expand
6. Matter	f. Physical substance in the universe
7. Dark energy	g. The force that makes two objects with mass move towards each other.

What do you think will eventually happen to the universe? Match the following theories to their descriptions. Which scenario do you think is most likely for our universe? Watch the video to check your answers.

1. The Big Freeze	a. all galaxies suddenly move close together, causing the universe to become incredibly hot, possibly causing another Big Bang
2. The Big Rip	b. all matter will be broken into tiny pieces
3. The Big Crunch	c. objects in the universe (suns, stars, galaxies, etc.) move apart, causing the universe to become darker and colder

Watch the video and decide if the following statements are TRUE or FALSE.

STATEMENTS	T	F
1. Our universe is about 14 billion years old.		
2. The universe is expanding at a slower rate than before.		
3. In the Big Freeze scenario, the universe will stop expanding.		
4. In the Big Rip scenario, all matter will be destroyed.		
5. In the Big Crunch scenario, we can calculate how many Big Bang explosions there have been in the past.		
6. In the Big Freeze scenario, the universe will get colder after $10^{100}$ years		

Complete the sentences below with the following verbs and expressions in the correct form. Use a dictionary where necessary.

bring (sth) to a halt	clump	collide	compress
expand	hurtle	plummet	stretch

1. Last year, the company's sales.....to their lowest ever level.
2. Right now, the economy....., so there's a low unemployment rate.
3. The two players injured each other when they.....on the football field.
4. This chemical will cause bacteria and dirt to..... .
5. Currently, a large asteroid.....towards the earth.
6. After the last wash, my wool sweater doesn't fit anymore. Is there any way to.....it?
7. Try to .....the file before you email it to me.
8. The conversation was.....when the boss entered the room.

Look at the transcript from the video. There are six phrasal verbs in bold. Complete the definitions below with the infinitive forms of the phrasal verbs. Compare your answers with your partner.

Play out	wipe away	set in
stock up on	head for	win out

1. \_\_\_\_\_: to succeed after a lot of difficulty
2. \_\_\_\_\_: to completely remove
3. \_\_\_\_\_: to buy a large amount (of something) so that you will have enough for the future
4. \_\_\_\_\_: to be likely to experience (a bad situation) soon
5. \_\_\_\_\_: to happen or develop in a particular way
6. \_\_\_\_\_: (about a bad situation) begin

Now complete the sentences below with the phrasal verbs in the correct form.

1. Let's see how the situation \_\_\_\_\_ before we make a decision.
2. The shops will be closed over the next few days so we need to \_\_\_\_\_ food and other essential items.
3. This country is \_\_\_\_\_ a recession. The economy is in a bad state.
4. It was a competitive match, but the more aggressive tactics \_\_\_\_\_ in the end.
5. Make sure your wound is cleaned well, or an infection could \_\_\_\_\_.
6. Apologizing will not \_\_\_\_\_ what you did!

Three ways the universe could end-Transcript

We know about our universe's past: the Big Bang theory predicts that all matter, time, and space began in an incredibly tiny, compact state about 14 billion years ago. And we know about the present: scientists' observations of the movement of galaxies tell us that the universe is expanding at an accelerated rate. But what about the future? Do we know how our universe is going to end? Cosmologists have three possible answers for this question, called the Big Freeze, the Big Rip and the Big Crunch.

To understand these three scenarios, imagine two objects representing galaxies. A short, tight rubber band is holding them together. That's the attractive force of gravity. Meanwhile, two hooks are pulling them apart – that's the repulsive force expanding the universe. Copy this system over and over again, and you have something approximating the real universe. The outcome of the battle between these two opposing forces determines how the end of the universe will play out.

The Big Freeze scenario is what happens if the force pulling the objects apart is just strong enough to stretch the rubber band until it loses its elasticity. The expansion wouldn't be able to accelerate anymore, but the universe would keep getting bigger. Clusters of galaxies would separate. The objects within the galaxies – suns, planets, and solar systems would move away from each other, until galaxies dissolved into lonely objects floating separately in the vast space. The light they emit would be redshifted to long wavelengths with very low, faint energies, and the gas emanating from them would be too thin to create new stars. The universe would become darker and colder, approaching a frozen state also known as the Big Chill, or the Heat Death of the Universe.

But what if the repulsive force is so strong that it stretches the rubber band past its elastic limit and actually tears it? If the expansion of the universe continues to accelerate, it will eventually overcome not only the gravitational force – tearing apart galaxies and solar systems – but also the electromagnetic, weak, and strong nuclear forces which hold atoms and nuclei together. As a result, the matter that makes up stars breaks into tiny pieces. Even atoms and subatomic particles will be destroyed. That's the Big Rip.

What about the third scenario, where the rubber band wins out? That corresponds to a possible future in which the force of gravity brings the universe's expansion to a halt – and then reverses it. Galaxies would start rushing towards each other, and as they clumped together their gravitational pull would get even stronger. Stars too would hurtle together and collide.

Temperatures would rise as space would get tighter and tighter. The size of the universe would plummet until everything compressed into such a small space that even atoms and subatomic particles would have to crunch together. The result would be an incredibly dense, hot, compact universe – a lot like the state that preceded the Big Bang. This is the Big Crunch.

Could this tiny point of matter explode in another Big Bang? Could the universe expand and contract over and over again, repeating its entire history? The theory describing such a universe is known as the Big Bounce. In fact, there's no way to tell how many bounces could've already happened – or how many might happen in the future. Each bounce would wipe away any record of the universe's previous history.

Which one of those scenarios will be the real one? The answer depends on the exact shape of the universe, the amount of dark energy it holds, and changes in its expansion rate. As of now, our observations suggest that we're heading for a Big Freeze. But the good news is that we've probably got about 10 to the 100th power years before the chill sets in – so don't start stocking up on mittens just yet.

**KEY**