

Images of galaxies in the process of merging. Left: The antennae galaxies. Right: NGC4676A and B. With powerful modern telescopes it has been possible to find hundreds of similar galaxy mergers.

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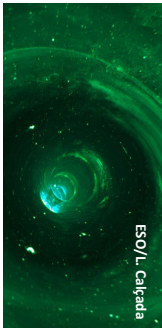


When the Sun is in the planetary nebula phase the Galaxy will merge with the Andromeda Galaxy. The montage of images above shows how this merger might begin (NASA, ESA, STScI).

### The future of the Galaxy

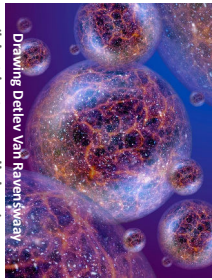
Our Galaxy will merge with the Andromeda Galaxy in about 4.5 billion years. Very few stars will collide with one other because the distances separating them are immense. On the other hand, clouds of gas and dust will form clusters where there will be bursts of star formation. We know when the Milky Way and Andromeda will merge because we know how fast they are approaching each other and we know the distance between them. Many galaxy mergers have been observed, some are only now approaching each other, while others are in full collision, forming a new, huge galaxy. Gradually the gas where new stars form will be used up and the galaxy resulting from the merger will have mostly old stars.

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This drawing depicts a wormhole, a shortcut in space-time that, according to Einstein's general theory of relativity, could exist. Wormholes are popular in science fiction.

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It is possible that parallel universes exist: structures in other spaces and times that may be similar - or totally different - from our own.

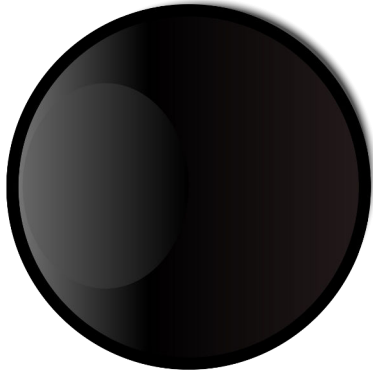


The impact of an asteroid on Earth caused the extinction of the dinosaurs.

### Asteroid impacts on the Earth

You may have heard that the extinction of the dinosaurs was caused by a huge asteroid colliding with the Earth 70 million years ago. The impact was so powerful that it created huge tsunamis and our planet was covered by a thick layer of dust from both terrestrial and asteroid fragments pulverised during the impact. Now we worry that something similar might happen in the future. That is why astronomers constantly monitor the skies to see if any asteroids or comet nuclei will hit us (see TUIIMP 2.1). Science can help us to prepare for adversity: NASA has already succeeded in deflecting an asteroid from its orbit.

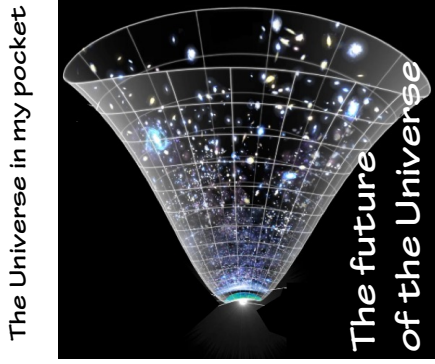
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### Riddle

Why is the Universe thought to be dark in the distant future?

Answer on page 15



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NASA succeeded in deflecting an asteroid from its orbit through an impact.

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**Predicting the future**

For centuries humans have wanted to predict the future. All the great cultures devised ways to do so. For example, the ancient Greeks turned to the oracle at Delphi for a wide range of predictions; for example, a general might want to know if he would be victorious in battle.

There are people who believe that by reading cards or the wrinkles in the palm of their hand they can know what will happen to them in the future.

In general, these supposedly divinatory practices end up comforting people and do not predict anything concrete.

In contrast, science can predict many things with great certainty, for example how fast a parachutist will fall or where a thrown ball will land?

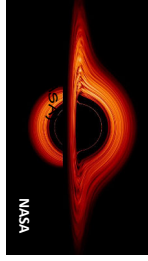
Translation: Stan Kurtz  
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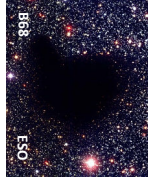
**Answer**

It will be because all the stars have gone out. The Universe will have finished its evolution.



Is it because there will be more black holes like the one in the centre of this image (this image actually represents matter very close to a black hole and NOT the black hole)?

Is it because there will be more starlight-absorbing dust as in this black cloud?

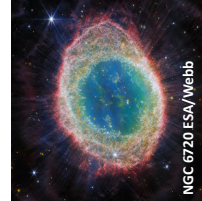
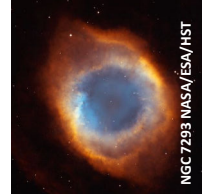


What would you think if someone told you that with this series of images they could predict your future? And what if later, someone else made the same offer, to foretell your future. It is possible that each person would make up a different story for you. You might even make up a new one yourself, depending on your mood. (Denise Lim/JF)



Model of the Templo Mayor. In the past, different cultures were concerned that the Sun might be extinguished.

For example, the Mexica of pre-Hispanic Mexico thought that to avoid this, every 52 years a new pyramid layer had to be built on top of the previous layer.

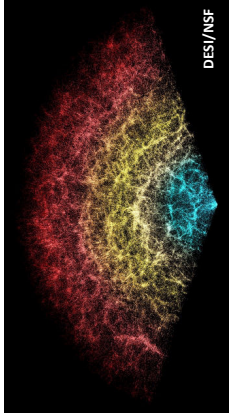


In about 5 billion years the Sun will become a nebula similar to those in the images above.

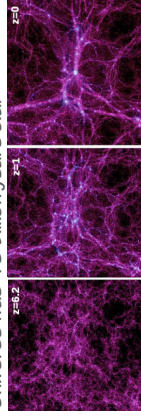
**The cosmic web**

There are over one hundred billion galaxies; on average each one has a hundred billion stars. They are distributed in the 'cosmic web' which is made up of a series of filaments and walls where matter clumps together. The stars and clouds of gas and dust that form the cosmic web make it shine. In the gaps of the web there are almost no stars (see TUMIP 13).

It is possible to measure the speed of groups of galaxies and this shows that they are moving away from each other faster and faster. In other words, the cosmic web is expanding more and more rapidly as the Universe evolves. As time goes by, the gaps without matter become larger and larger.



This is how the cosmic web looks in a section of the sky, when observed from Earth. The part closest to Earth is in blue. At the far side, galaxies formed when the Universe was 10 billion years old.



Numerical simulations of the cosmic web at different ages of the Universe (one thousand, three thousand and 13.7 billion years). The gaps are seen to increase in size as time passes.

**What if the Sun goes out?**

Ancient cultures thought that the Sun could be extinguished, for example, during eclipses (see TUMIP 28).

We now know that it will shine for another 5 billion years or so (for more about the Sun see TUMIP 26). Later it will become a planetary nebula (see TUMIP 36).

The Sun will grow in size and shed its atmosphere, which will then move out into space until it mixes with other clouds of gas and dust, where new planetary systems may form. The core of the Sun surrounded by this expanding envelope will be about 40 000 °C and slowly cooling. Perhaps by then humans will have evolved into another species.