

aurora borealis... colorful lights that stream across the sky in the northern hemisphere, the result of solar wind colliding with Earth's gases

solar wind: a stream of charged particles that the sun constantly emits

magnetosphere: Earth's magnetic field

The electrical energy in the atmosphere during auroras can cause electrical disturbances on Earth.

For example, it can cause power outages and interfere with satellites, TV transmissions, jagers, and cell phones.

Earth isn't the only planet to experience aurora. They occur on other planets that have an atmosphere and a magnetic field, such as Jupiter, Mars, Uranus, and Neptune. Auroras even occur on Io, one of Jupiter's moons. The Hubble Space Telescope has taken images of these aurora.

The aurora borealis can generally be seen in the northern parts of the United States, Canada, Russia, and Nordic countries, like Norway and Finland.

What causes the northern lights, and where can they be seen?

Imagine looking up on a clear night and seeing streaks of red, purple, and green shimmer and dance across the sky. It might seem hard to believe, but this colorful light show is put on by nature. The northern lights, also called the **aurora borealis**, can usually be seen during the spring and fall in northern parts of the world. The aurora can also be seen in the southern hemisphere. There, they are called the **aurora australis**. The southern and northern lights together are known as **aurora polaris**, which means "polar lights." Ever since human beings first caught sight of these colorful lights in the sky, they have been creating myths and legends to explain them. Today, a more scientific answer is available.

The sun plays an important role in the creation of the auroras. **Solar wind** is a stream of gas containing electrically charged particles. Although it moves extremely quickly—at speeds of more than a million miles per hour—it still takes two to three days for solar wind to travel the 93 million miles to Earth.

Earth's core is like a giant magnet. At either end of the planet are Earth's magnetic poles. They create a magnetic field called the **magnetosphere** that captures the solar particles as they approach Earth. Earth's atmosphere serves as a sort of shield or defense against solar wind. When the gases in the atmosphere come in contact with the charged solar particles, a collision occurs, which produces light. If this happened only once, the light wouldn't be visible. Because there are millions of collisions at once, though, enough light is generated to see the aurora from Earth.

No two auroras are ever alike. They can take a number of shapes, such as an arch, a band, curtains, and streamers. The colors that are produced have to do with what types of gas the particles strike and where in the atmosphere the collision occurs. Remember, Earth's atmosphere is made almost completely of nitrogen and oxygen. Green and red auroras tend to be the result of collisions with oxygen atoms. Blue and purple lights are usually created when the solar particles hit nitrogen atoms. Auroras can last from a few seconds to a few hours, depending on the conditions.

If you're ever lucky enough to see an aurora, try to capture a photograph of it. People often travel long distances with the hope that they'll get a chance to witness one of nature's most beautiful spectacles.



Chapter 4 Lesson 6

Circle the letter of the best answer to each question below.

- In which of the following places would you be most likely to see the aurora borealis?
 - Virginia
 - New Mexico
 - Maine
 - Louisiana
- What does a planet need to have in order for auroras to take place?
 - a moon
 - a magnetic field
 - an atmosphere
 - Both b and c
- Which of the following statements is true?
 - The color of an aurora depends on what type of gas the solar particles hit.
 - Auroras can be seen only in the northern hemisphere.
 - It takes solar wind nearly a week to reach Earth.
 - Another name for aurora borealis is aurora australis.

Write your answers on the lines below.

- What is solar wind?

- What effect can auroras have on Earth?

- What happens when solar wind approaches Earth's atmosphere?

- Why do you think no two auroras are ever the same?

Whether the evidence of billions of stars and other celestial bodies throughout the universe is

Do we know all there is to know about the universe?

Human beings have studied the skies for thousands of years and learned a great deal about the universe. Still, some great mysteries are yet to be solved. Here are just a few examples:

- In 1912, careful observations of the **galaxies** showed that they are all moving away from each other—the universe is expanding in all directions. It took several years and the work of many astronomers, but this discovery eventually led to the Big Bang Theory. This theory—widely accepted by **cosmologists** today—describes how the universe began as a single point of extraordinarily dense matter. No one knows why, but this matter suddenly exploded with great force and expanded almost instantly to the immense size of our universe today. Then, over billions of years, the pieces of matter combined to form stars, planets, and everything else in the universe. These pieces of matter are still forming today. This idea is **controversial**, but discoveries made since the Big Bang Theory was first proposed continue to support it. In the 1990s, research showed that the universe is not only expanding, but it's actually expanding at an increasing speed. What will happen as the universe and everything in it continues to spread out?

- Soon after galaxies were proven to exist, astronomers realized that they moved through space much more quickly than they should. By measuring a galaxy's mass, and then considering how gravity from other galaxies would affect it, astronomers made a prediction about its speed. When they actually measured the speeds, though, it was as if the galaxies had much greater masses than their stars would have provided. Astronomers concluded that the universe must contain huge amounts of "dark matter" that we can't detect, which would give the galaxies the mass they need. But what is dark matter, and will we ever be able to see it?

- In November of 2008, NASA plans to launch the Kepler Mission. It will be a space-based observatory searching for planets outside our solar system. Scientists know that a planet similar to Earth will have a greater chance of containing life. Evidence of water and carbon will be searched for because they are the basis of all life on Earth. Billions of galaxies, each one filled with billions of stars, leads many scientists to think that life exists somewhere else in space. When will we find the evidence?



Circle the letter of the best answer to each question below.

1. The Big Bang Theory states that
 - a. the universe will end with a giant explosion.
 - b. dark matter was created when a supernova exploded
 - c. the universe began as a single particle of matter.
 - d. galaxies contain billions of stars.
2. Scientists know that
 - a. galaxies are much heavier than they appear.
 - b. the universe is expanding more quickly as time passes.
 - c. water and carbon are found in all life forms on Earth.
 - d. All of the above

Write your answers on the lines below.

3. What tells scientists that dark matter exists, even though it can't be seen?

4. So far, astronomers have identified 236 planets outside of our solar system. According to the selection, what evidence do scientists look for to determine whether or not a planet might have life?

5. Do you think human beings will ever find life in another part of the universe? Explain your answer.

What's Next?

The subjects mentioned in this selection are just three examples of many questions still facing cosmologists. Find out what is known and unknown about other cosmic mysteries, such as black holes, dark energy, and the shape of the universe.