

# Explaining the Early Universe

Textbook pages 346–355

## Before You Read

What do you think of when you hear or read the word “universe”? What does the universe include? Record your thoughts on the lines below.

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### Mark the Text

#### Identify the Main Point

Skim the section and highlight the main point of each paragraph.



### Reading Check

- How old is the universe, according to the Big Bang theory?
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### What is the Big Bang theory?

Astronomers are people who study **celestial bodies**, which are objects in space such as stars, the Moon, and planets. Advancements in technology have allowed astronomers to gather evidence about the universe and propose a theory about its origin.

According to the **Big Bang theory**, the universe and everything in it began in an event that took place about 13.7 billion years ago. Before this event, there were no celestial bodies. There was no energy and there was no matter of any kind—not even atoms, protons, or electrons. According to the theory, the Big Bang event gave rise to all the energy and matter in the universe. ✓

### What evidence supports the Big Bang theory?

The theory speculates that the universe must have started out very small, hot, and dense and has been expanding and cooling ever since. Evidence for the Big Bang theory includes the following:

- ◆ Galaxies, which are collections of stars, are moving away from each other. In other words, the universe appears to be expanding.
- ◆ There is background **radiation**, which is energy transmitted in waves that can be picked up from every part of space. This radiation was first detected in the 1960s by a radio telescope and may be the remains of the radiation that was given off by the original Big Bang event.
- ◆ Space probes have mapped the background radiation.

## Why do scientists think that the universe is expanding?

Visible light is a spectrum of energy ranging from higher-energy, shorter-wavelength, violet-coloured light to lower-energy, longer-wavelength, red-coloured light. A **spectroscope** is an instrument that can separate white light into its wavelengths of colour.

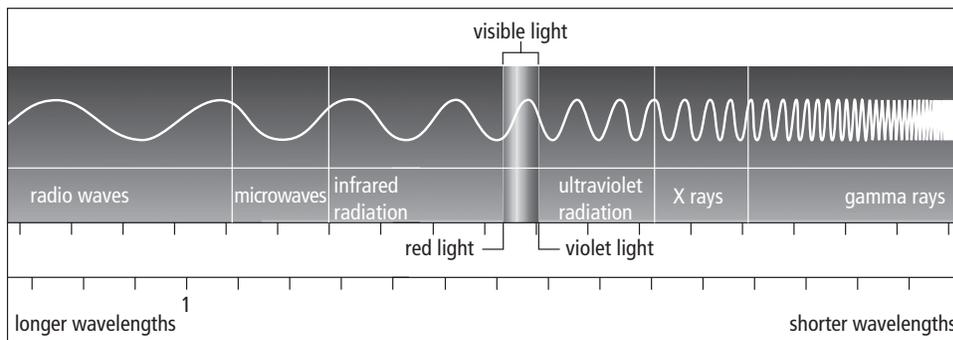
If a star is moving toward you, its wavelengths become compressed. They are shifted more toward the violet end of the spectrum. If the star is moving away from you, there is a **red shift**, which means its wavelengths get longer. They are stretched out and shifted toward the red end of the spectrum. This red-shifting of wavelengths has been observed with many individual stars, as well as with collections of stars. Astronomers infer that stars and galaxies are moving away from Earth and away from each other. This movement means that the distance between stars and galaxies of the universe is increasing. In other words, the universe is expanding. ✓

### ✓ Reading Check

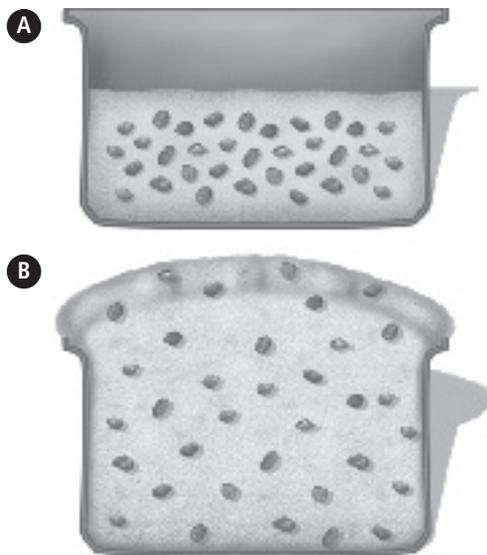
2. What happens to a star's wavelengths as the star moves away from you?

\_\_\_\_\_

\_\_\_\_\_



Visible light is part of a larger spectrum of energy.



A model for the expanding universe. The raisins in the uncooked bread dough (A) all move away from each other as the bread bakes (B). In a similar way, galaxies in the universe are moving away from each other as the universe expands.

Name \_\_\_\_\_

Date \_\_\_\_\_

Use with textbook pages 346–355.

## The early days of the universe

### Vocabulary

astronomers	radiation
Big Bang	radio telescope
celestial bodies	red shift
compressed	space probes
galaxies	spectroscope
longer	transmitted

Use the terms in the vocabulary box to fill in the blanks. You can use each term more than once. You will not need to use every term.

- \_\_\_\_\_ are people who study objects in space.
- \_\_\_\_\_ is a general term for all the objects in space, including the Sun, other stars, planets, and the Moon.
- \_\_\_\_\_ is energy that is transmitted in the form of waves.
- \_\_\_\_\_ are moving away from each other. In other words, the universe appears to be expanding.
- An instrument that can separate white light into its wavelengths of colour is the \_\_\_\_\_.
- This instrument first detected background radiation in the 1960s: \_\_\_\_\_.
- Background radiation has been mapped by \_\_\_\_\_.
- The term \_\_\_\_\_ is used when wavelengths of a star become longer as it moves away from you.
- If a star is moving toward you, its wavelengths become \_\_\_\_\_.
- The theory that suggests that 13.7 billion years ago a tiny volume of space suddenly and rapidly expanded to an immense size is the \_\_\_\_\_ theory.