

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.



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?
-

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.

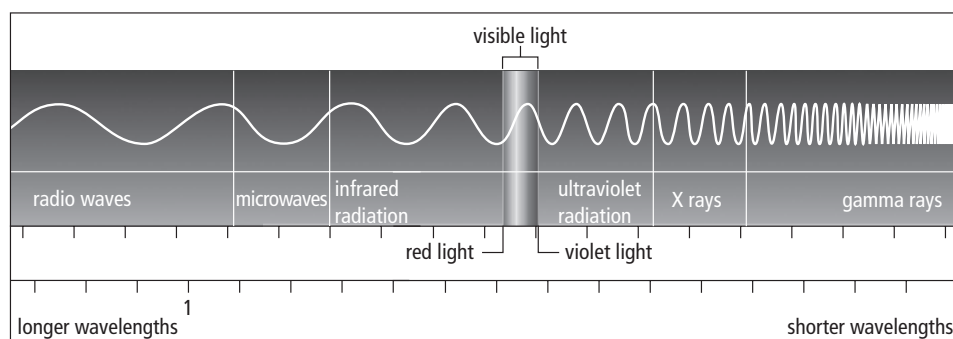
Why do scientists think that the universe is expanding?

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.

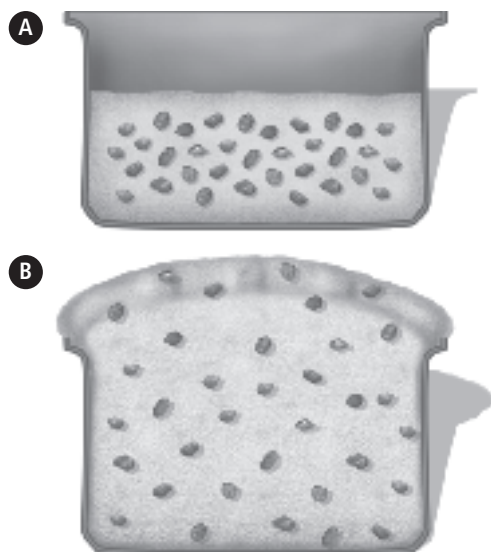
If a star is moving toward you, its wavelengths become compressed. They are shifted more toward the violet end of the spectrum. If the star is moving away from you, there is a **red shift**, which means its wavelengths get longer. They are stretched out and shifted toward the red end of the spectrum. 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.

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.

Use with textbook pages 348–349.

True or false?

Read the statements given below. If the statement is true, write “T” on the line in front of the statement. If it is false, write “F” and rewrite the statement to make it true.

1. _____ According to the Big Bang theory, when the universe began it was small, dense, and extremely cold.

2. _____ The Big Bang theory has now been proven to be true.

3. _____ According to the Big Bang theory, the universe began 17.3 billion years ago.

4. _____ The universe appears to be compressing because galaxies and stars are moving toward each other.

5. _____ Background radiation is transmitted in waves that were first detected by a spectroscope in the 1960s.

6. _____ If a star is moving toward you, there is a red shift, which means its wavelengths get longer.

7. _____ The distance between stars and galaxies of the universe is decreasing.

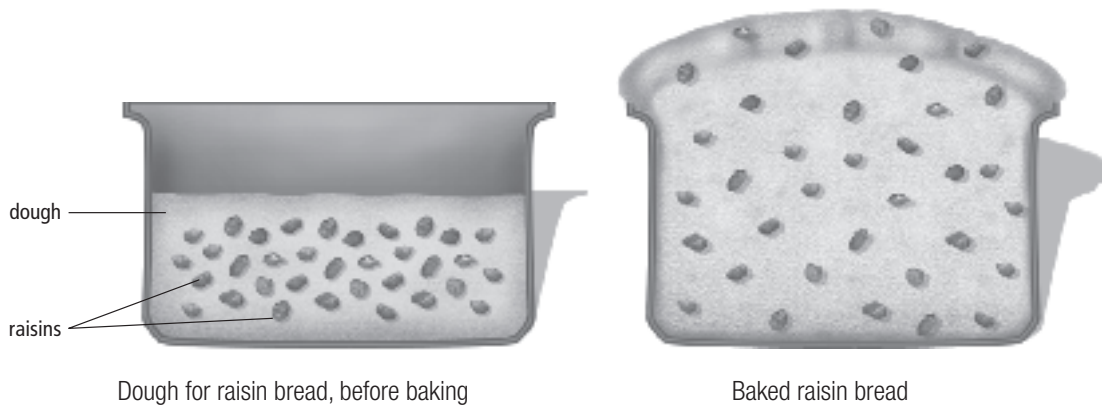
Name _____

Date _____

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Modelling an expanding universe

Examine the diagrams below. Then answer the questions.



1. How do the raisins in the dough model an expanding universe?

2. Draw and label your own model of an expanding universe.

3. How does your example model an expanding universe?

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Explaining the early universe

Match each Term on the left with the best Descriptor on the right. Each Descriptor may only be used once.

Term	Descriptor
1. _____ Big Bang theory	A. the Sun, other stars, the Moon, and planets
2. _____ celestial bodies	B. occurs as the object moves away from Earth
3. _____ red shift	C. occurs as the object moves toward Earth
4. _____ radiation	D. studies objects in space
5. _____ spectroscope	E. the universe formed approximately 13.7 billion years ago
6. _____ astronomer	F. separates light into its basic component colours
	G. energy that is carried in the form of waves

Circle the letter of the best answer.

7. Evidence indicates that galaxies are

- A.** stationary
- B.** moving away from each other
- C.** moving towards each other
- D.** always changing direction

8. The Big Bang theory

- A.** is now an accepted fact
- B.** states that galaxies make a loud sound when they collide
- C.** states that the universe began with an event
- D.** does not yet have evidence to support it

9. Which of the following statements are correct?

I.	Radio telescopes have detected the background radiation.
II.	Spectroscopes have shifted the background radiation toward the red end of the spectrum.
III.	Space probes have mapped the background radiation.
IV.	Astronomers have transmitted the background radiation.

A. I and III only

B. II and IV only

C. I, II, and III only

D. I, II, III, and IV

10. If a star is moving toward you,

- A.** its wavelengths become compressed
- B.** its wavelengths get longer
- C.** its wavelengths do not change
- D.** its wavelengths cannot be accurately measured

11. If a star is moving away from you,

- A.** its wavelengths become compressed
- B.** its wavelengths get longer
- C.** its wavelengths do not change
- D.** its wavelengths cannot be accurately measured