

Study Guide

Interactive Textbook

- Interactive Student Edition
- Self-Assessment with remediation
- Assessment reports for teachers

Apply the BIG Idea

Connect to Key Concepts

Reinforce the chapter's Big Idea by connecting it to important Key Concepts. For example, ask: **Describe, in detail, the sun's position in the universe.** (Sample answer: *The sun is at the center of the solar system, which is in one of the spiral arms of the Milky Way galaxy, which belongs to a group of galaxies called the Local Group, which is one of billions of galaxies in the universe.*)

Teaching Resources

Teaching Resources, Unit 4

- Chapter 15 Key Terms Review
- Chapter 15 Vocabulary Skill

Color Transparencies

- Transparency 8.164

Chapter Tests Levels A and B

- Chapter 15 Tests
- Chapter 15 Performance Assessment

Standards Review Workbook

Standards Review Transparencies

Progress Monitoring Assessment

- Screening, diagnostic, and benchmark tests

ExamView® Computer Test Bank CD-ROM



Students can take an online practice test that is automatically scored.

For: Self-Assessment
Visit: PHSchool.com
Web Code: cxa-4150

Key

AA Active Art
RNG-A Reading and Note Taking Guide, Level A
RNG-B Reading and Note Taking Guide, Level B
TR Teaching Resources

Chapter 15

Study Guide

The BIG Idea

Astronomers learn about the structure and evolution of the universe by studying stars, galaxies, and other objects in space.

1 Telescopes

Key Concepts

S 8.4.d

- The electromagnetic spectrum includes radio waves, infrared radiation, visible light, ultraviolet radiation, X-rays, and gamma rays.
- Telescopes are instruments that collect and focus light and other forms of electromagnetic radiation.
- Many large observatories are located on mountaintops or in space.

Key Terms

visible light
wavelength
spectrum
optical telescope
electromagnetic radiation
refracting telescope
convex lens
reflecting telescope
radio telescope
observatory



2 Characteristics of Stars

Key Concepts

S 8.4.b, 8.4.c

- Characteristics used to classify stars include color, temperature, size, composition, and brightness.
- The brightness of a star depends upon both its size and temperature.
- Astronomers use a unit called the light-year to measure distances between the stars.
- Astronomers often use parallax to measure distances to nearby stars.
- Astronomers use H-R diagrams to classify stars and to understand how stars change over time.

Key Terms

• constellation • spectrograph
• apparent brightness • absolute brightness
• light-year • parallax
• Hertzsprung-Russell diagram
• main sequence

3 Lives of Stars

Key Concepts

S 8.4.b, 8.4.d

- A star is born when gas and dust become so dense and hot that nuclear fusion starts.
- How long a star lives depends on its mass.
- After a star runs out of fuel, it becomes a white dwarf, a neutron star, or a black hole.

Key Terms

• nebula • protostar • planetary nebula
• white dwarf • supernova • neutron star
• pulsar • black hole

4 Star Systems and Galaxies

Key Concepts

S 8.4.a, 8.4.b

- Most stars are members of star systems.
- Astronomers classify most galaxies into the following types: spiral, elliptical, and irregular.
- Our solar system is located in a spiral galaxy called the Milky Way.
- Astronomers often use scientific notation to describe sizes and distances in the universe.

Key Terms

• binary star • eclipsing binary • open cluster
• globular cluster • galaxy • quasar
• spiral galaxy • elliptical galaxy
• irregular galaxy • universe
• scientific notation

5 The Expanding Universe

Key Concepts

S 8.2.g, 8.4.a

- According to the big bang theory, the universe formed in an explosion billions of years ago.
- About five billion years ago, a giant cloud of gas and dust collapsed to form our solar system.
- New observations lead astronomers to conclude that the universe will likely expand forever.

Key Terms

• big bang • Hubble's law
• cosmic background radiation • solar nebula
• planetesimal • dark matter • dark energy

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Diagnose and Remediate

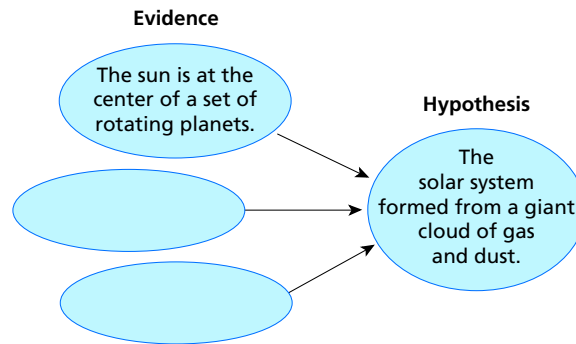
Also available on Success Tracker

Standard	Review and Assessment Items	Standards-Targeted Resources	Additional Resources
S 8.2.g	5, 8, 9, 10, 13, 15, 22	RNG-A, 269–275, 277–279; RNG-B 241–244, 246, 250–252	TR: Vocabulary Skill
S 8.4.a	5, 9, 10, 14, 15, 16,	RNG-A 273–279; RNG-B 246–252	TR: Key Terms
S 8.4.b	2, 3, 4, 7, 8, 9, 13, 14, 20, 21, 23, 24, 25, 26	AA cfp-5043; RNG-A 263–276; RNG-B 236–246, 248; Video Field Trip	Student Edition in MP3 (English/Spanish)
S 8.4.c	11, 12, 17, 18	RNG-A 263, 267; RNG-B 238–239, 248	Student Express with Interactive Textbook CD-ROM
S 8.4.d	1, 4, 6, 13, 19, 20, 23, 26	AA cfp-5043; RNG-A 259–267, 269, 271–272; RNG-B 232–238, 241–242	

Target Reading Skill

Identify Supporting Evidence

Create a graphic organizer that shows the evidence supporting the solar nebula theory.



Reviewing Key Terms

Choose the letter of the best answer.

- Visible light is a form of
 - spectrum.
 - electromagnetic radiation.
 - wavelength.
 - cosmic background radiation.
- An H-R diagram is a graph of stars' temperature and
 - apparent brightness.
 - main sequence.
 - absolute brightness.
 - parallax.
- A low-mass main sequence star will eventually evolve into a

a. white dwarf.	b. protostar.
c. black hole.	d. nebula.
- A star system in which one star blocks the light from another is called a(n)
 - open cluster.
 - quasar.
 - binary star.
 - eclipsing binary.
- Astronomers theorize that the universe began in an enormous explosion called the
 - solar nebula.
 - supernova.
 - big bang.
 - big crunch.

Complete the following sentences so that your answers clearly explain the key terms.

- Astronomy was revolutionized by the invention of the **telescope**, which is _____.
- More than 90 percent of stars are found on the **main sequence**, which is _____.
- Stars are formed in **nebulas**, which are _____.
- The Milky Way is an example of a **galaxy**, which is _____.
- Evidence for the big bang includes **cosmic background radiation**, which is _____.

Writing in Science

News Article Imagine that you are a journalist covering current research in astronomy. Write an article explaining what black holes are, how they form, and how they can be detected.



Target Reading Skill

Identify Supporting Evidence The size and composition of the inner planets differ greatly from these of the outer planets; all of the planets revolve around the sun in the same direction.

Reviewing Key Terms

- b
- c
- a
- d
- c
- an instrument that gathers and focuses light to form an image of a distant object
- a region on the Hertzsprung-Russell diagram that classifies stars according to surface temperature and absolute brightness
- enormous clouds of gas and dust
- a group of single stars, star systems, star clusters, dust, and gas held together by gravity
- leftover thermal energy from the big bang explosion that formed the universe

Writing in Science



Writing Skill

Research

Scoring Rubric

- Exceeds criteria by including accurate information presented in an interesting manner
- Meets criteria by including accurate information, but presentation is not interesting
- Includes only basic information about what a black hole is, how it forms, or how it is detected
- Is inaccurate and incomplete

Video Assessment

Stars, Galaxies, and the Universe

Show the Video Assessment to review chapter content and as a prompt for the writing assignment. Discussion question: **How are a star's mass and its lifespan related?** (More massive stars have shorter lifespans.)

Checking Concepts

11. A light-year is a unit of distance. It measures how far light travels through space in one year.
12. The distance that a star so far away would appear to move when seen from opposite sides of Earth's orbit would be too small to measure accurately.
13. A star is born when nuclear fusion begins.
14. Most star formation takes place in the spiral arms of our galaxy.
15. Hubble's law states that the farther away a galaxy is, the faster it is moving away from us.
16. Its presence can be inferred by observing the effect of its gravity on visible objects, such as stars, or on light.

Math Practice

17. Spica is about 2.5×10^{15} kilometers from our solar system.
18. The star Antares is 6.04×10^2 light-years from Earth.

Thinking Critically

19. The moon has no atmosphere that could interfere with the transmission of electromagnetic radiation.
20. Sample answer: High beams on car headlights have a greater absolute brightness than low beams do. Also, the closer an oncoming car is to you, the greater the apparent brightness of its headlights (on low or high).
21. Low-mass stars have longer lifetimes than do high-mass stars because low-mass stars use up their fuel much more slowly.
22. Because of high temperatures in the inner solar system, most gases escaped the gravity of planets forming in this region, causing the inner planets to be rocky. The outer solar system, being farther from the sun, was cooler. As a result, planets forming in this region were able to capture gases and so became gas giants.

Applying Skills

23. Aldebaran has a greater absolute brightness.
24. Rigel and Sirius B have higher surface temperatures than Sirius A.
25. Betelgeuse is most likely to be red.

Review and Assessment

Checking Concepts

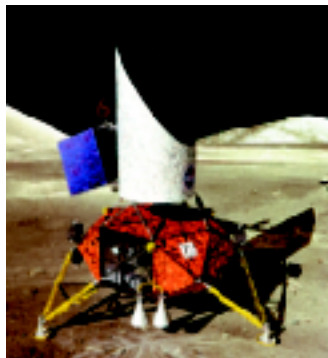
11. Is a light-year a unit of distance or a unit of time? Explain.
12. Why can't astronomers measure the parallax of a star that is a million light-years away?
13. At what point in the evolution of a star is the star actually born?
14. Where in our galaxy does most star formation take place?
15. What is Hubble's law?
16. How can astronomers detect dark matter if they cannot observe it directly?

Math Practice

17. **Calculating** The bright star Spica is about 262 light-years from our solar system. How many kilometers is this?
18. **Scientific Notation** The star Antares is approximately 604 light-years from Earth. Write this distance in scientific notation.

Thinking Critically

19. **Inferring** What advantage might there be to locating a telescope, such as the one shown below, on the moon?



20. **Applying Concepts** Describe a real-world situation involving absolute and apparent brightness. (*Hint:* Think about riding in a car at night.)

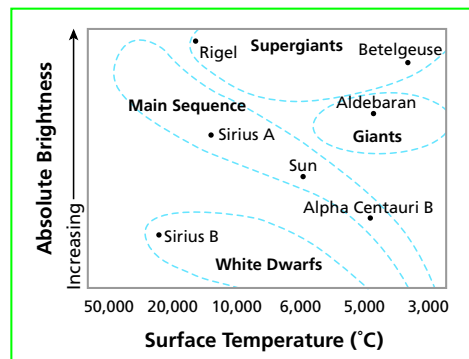
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21. **Relating Cause and Effect** How does a star's mass affect its lifetime?
22. **Comparing and Contrasting** Compare the conditions that led to the formation of the terrestrial planets with those that led to the formation of the gas giants.

Applying Skills

Use the data in the H-R diagram below to answer Questions 23–26.

Hertzsprung-Russell Diagram



23. **Interpreting Diagrams** Which star has a greater absolute brightness, Aldebaran or Sirius B?
24. **Interpreting Diagrams** Which stars have higher surface temperatures than Sirius A?
25. **Applying Concepts** Which star is most likely to be red: Rigel, Sirius B, or Betelgeuse?
26. **Comparing and Contrasting** Compare Aldebaran and the sun in terms of size, temperature, and absolute brightness.

Standards Investigation

Performance Assessment Check the final draft of your constellation story for correct spelling, grammar, punctuation, and usage. Then decide how you will present your story. For example, you could make a poster, read your story aloud, or perform it as a skit or a play.

26. The sun is a medium-sized star with average absolute brightness and a surface temperature of about $5,500^{\circ}\text{C}$. Aldebaran is a giant with a high absolute brightness and a surface temperature of about $4,000^{\circ}\text{C}$. So, Aldebaran is larger and cooler and has a greater absolute brightness than the sun.

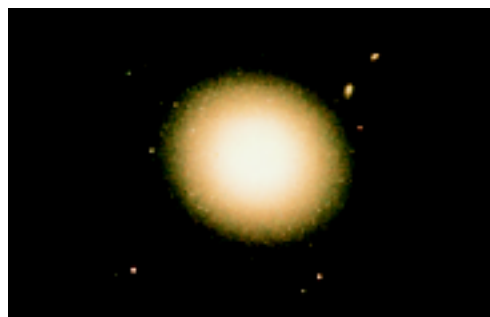
Choose the letter of the best answer.

- You can often see stars at night because
 - they produce light from nuclear fusion.
 - they reflect light from the planets.
 - they reflect light from the sun.
 - they have exploded as supernovas. **S 8.4.d**
- The most common chemical element in most stars is
 - oxygen.
 - hydrogen.
 - helium.
 - nitrogen. **S 8.4.b**
- The main factor that affects the evolution of a star is its
 - color.
 - apparent brightness.
 - mass.
 - parallax. **S 8.4.b**
- An astronomer would likely measure the distance between stars in
 - light-years.
 - kilometers.
 - astronomical units.
 - millimeters. **S 8.4.c**

The table below gives an estimate of the distribution of stars in the Milky Way galaxy. Use the table and your knowledge of science to answer Question 5.

Type of Star	Percentage of Total
Main sequence	90.75%
Red Giant	0.50%
Supergiant	< 0.0001%
White Dwarf	8.75%

- According to the table, the most common type of stars in the Milky Way are
 - main-sequence stars.
 - red giants.
 - supergiants.
 - white dwarfs. **S 8.4.b**



- The image above shows a galaxy with few or no new stars. It is most likely a(n)
 - spiral galaxy.
 - barred spiral galaxy.
 - irregular galaxy.
 - elliptical galaxy. **S 8.4.a**
- Which of the following correctly describes the evolution of a sun-like star from young to old?
 - white dwarf, red giant, main-sequence star, protostar
 - red giant, main-sequence star, white dwarf, protostar
 - protostar, main-sequence star, white dwarf, red giant
 - protostar, main-sequence star, red giant, white dwarf **S 8.4.b**
- What force pulled matter together in the solar nebula to form the solar system?
 - inertia
 - nuclear fusion
 - dark energy
 - gravity **S 8.2.g**

Apply the BIG Idea

- Describe the appearance of the Milky Way as you would see it both from Earth and from a point directly above or below the galaxy. Why does the galaxy look different from different vantage points? **S 8.4.a**

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Teachers can monitor student progress and supply remediation when necessary.

Standards Practice

- A; **S 8.4.d**
- B; **S 8.4.b**
- C; **S 8.4.b**
- A; **S 8.4.c**
- A; **S 8.4.b**
- D; **S 8.4.a**
- D; **S 8.4.b**
- D; **S 8.2.g**

Focus on the BIG Idea

- Sample: From Earth, the Milky Way looks like a thick ribbon of stars across the night sky. This is because we are looking at it from within one of its arms, so it is like looking at the edge of a dinner plate. From above and below, the Milky Way would look like a disc or a spiral because you would be outside of it and able to see the entire galaxy. The most recent evidence suggests that the Milky Way is a barred-spiral galaxy, that is, a spiral galaxy with a large bar-shaped region of stars and gas passing through its center. **S 8.4.a**

Lab zone Standards Investigation

S 8.4.b, 8.4.d

Performance Assessment Advise students to be ready to answer questions from you and from other students about the classical myths associated with their constellations. Encourage students who have studied the same constellation to compare their different approaches to writing new stories for it.

Encourage students to reflect on the research and writing process. Ask students to identify points on which they spent too much time, as well as points on which they spent too little time. Have students make suggestions on how they would improve their projects.

Teaching Resources

Laboratory Manual TE

- Standards Investigation Scoring Rubric

The Standards Investigation scoring rubric will help you evaluate students' work. If you shared the rubric in advance, students will know what is expected of them.