Chapter 9 The Mysterious Universe

What You Will Learn

In this chapter, you will learn how to...

- **identify** the three main types of galaxies
- **describe** the shape and size of the Milky Way galaxy
- **describe** the evidence that supports the big bang theory and an evolution model of the universe
- **identify** spinoff technologies that have resulted from studying space

Why It Matters

Gaining a better understanding of the universe gives us more insight into the possible origin of everything around us.

Skills You Will Use

In this chapter, you will learn how to...

- **model** the size of the Milky Way galaxy
- **model** the expanding universe
- **estimate** the age of the universe
- **evaluate** the costs and benefits of space exploration

There has been an explosive growth in technology for space exploration. This technology has revealed that the universe is a mysterious place, with black holes, exploding stars, and colliding galaxies, such as those pictured here. The planets, stars, and galaxies that we see, however, make up only about 4 percent of the universe. What could make up the rest of the universe?

Activity 9-1

Matter in Motion

A galaxy is a huge collection of stars, planets, gas, and dust held together by gravity. Like stars and planets, galaxies also rotate. Can you model galaxy rotation? In this activity, you will model the rotational motion of a galaxy using different materials to simulate stars.

Add a few drops of food colouring to the swirling water.

Safety Precautions

Materials

- 600 mL beaker or plastic cup
- warm water
- medicine dropper
- small samples of food colouring, cocoa powder, and powdered milk

Procedure

1. Create a table to record your sketches. Include a row for each sample and three columns: "First Rotation," "Slower Rotation," and "Faster Rotation." Give your table a title.
2. Put on the safety goggles and apron.
3. Pour warm water into the beaker until the beaker is approximately half full. Carefully holding the beaker in one hand, lift it up and make the water swirl by slowly moving the beaker in small circles.
4. With the water still swirling, put the beaker back on the table. Carefully place a few drops of food colouring on the centre of the water surface.
5. Observe what happens. Sketch your observations in your table immediately, while the water is still swirling.
6. Discard the water. Then repeat steps 3 to 5 twice, first swirling the water more slowly than before and then swirling it faster than before.
7. Repeat steps 3 to 5 for each of the dry materials, adding a pinch of each material to the water.

Questions

1. How did the different materials react when they were dropped in the swirling water?
2. How did changing the speed of rotation affect the pattern you observed?
3. Infer how this activity is similar to galaxy motion.

Study Toolkit

These strategies will help you use this textbook to develop your understanding of science concepts and skills.
To find out more about these and other strategies, refer to the Study Toolkit Overview, which begins on page 561.

Reading Effectively

Skim, Scan, or Study

Not all parts of a textbook should be read at the same speed. In general, the speed at which you read a chunk of text is determined by your purpose for reading. The table below shows three reading speeds, each suiting a different purpose for reading.

Purposes of Reading Speeds

Purpose	Reading Approach (Skim, Scan, or Study)
Preview text to get a general sense of what it contains.	Read quickly (skim).
Locate specific information.	Read somewhat quickly (scan).
Learn a new concept.	Read slowly (study).

Sometimes, you can determine your reading approach by the placement, treatment, or features of the text. For example, text placed at the beginning of a chapter or unit is often meant to stimulate interest and may not include important definitions or concepts. Marginal text with a heading such as "Sense of Time" can probably be skimmed. But text with several **boldfaced** words should be read slowly and carefully.

Use the Strategy

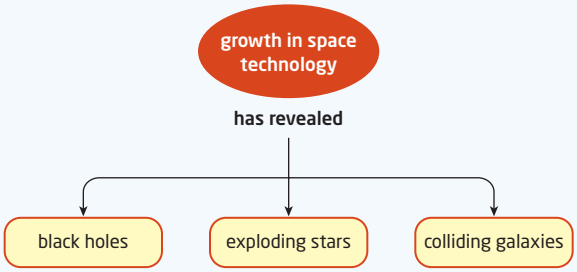
Turn to Section 9.3, "Unsolved Mysteries." With a partner, identify two sections of text that should be read slowly and carefully. Then identify two sections of text that could be skimmed. Make sure you can justify your choices based on the placement, treatment, or features of the text.

Organizing Your Learning

Using Graphic Organizers

Sometimes changing text into a visual format can help you understand and remember it. Graphic organizers come in many forms (see page 566 in this textbook). You can even design your own to organize important information and relationships. Circles and squares can be used to indicate different levels of importance. Lines and arrows can show sequence or cause-and-effect relationships. For example, the text below can be "translated" into the following graphic organizer.

"There has been an explosive growth in technology for space exploration. This technology has revealed that the universe is a mysterious place, with black holes, exploding stars, and colliding galaxies...."



Use the Strategy

Turn to the section called "Star Clusters" on page 363. Draw a graphic organizer to show the information in the first two paragraphs. Be sure to reflect the relative importance of the facts and the relationships among them.

Word Study

Base Words

Understanding a word's *base* can help you understand the word's meaning. For example, if you do not know what *radiation* means, you might think about the word's base, which is *radiate*. If you know that *radiate* means "emit energy," you might be able to figure out that *radiation* is "the process of emitting energy" or the energy itself.

Use the Strategy

Think about the word *globular*. What is the base? Use that word to predict the meaning of *globular*. Use a dictionary to check your prediction.