7.2 The Constellations

Key Terms
constellation
light-year
apparent magnitude
latitude

When you look up on a clear, moonless night in a location far away from city lights, you can see thousands of stars, some twinkling very brightly and others shining more faintly. Most cultures imagined that the patterns formed by the stars in the night sky represented different people, animals, and objects. For example, the ancient Greeks gave the first star pattern in **Figure 7.7** the name "Orion." Orion was a mythological hunter. The Inuit interpreted the pattern of the three stars in Orion's belt as a bear and two hunters. The topmost star in the belt is the bear escaping by climbing high in the sky. The other two stars are the hunters chasing the bear. A third hunter came back to Earth because he dropped a mitten. He remained and tells the story.

Patterns in the Night Sky

Many groups of stars seem to form distinctive patterns. These patterns are called **constellations**. The stars in a constellation appear to lie close to each other and at exactly the same distance from Earth. They look close together because they lie on the same line of sight. They may, in fact, be light-years apart. A **light-year** is a unit of distance. It represents the distance that light travels in one year. At the speed of 300 000 km/s, light travels about 9.5×10^{12} km in one year.

constellation a group of stars that seem to form a distinctive pattern in the sky

light-year the distance that light travels in one year, about 9.5×10^{12} km

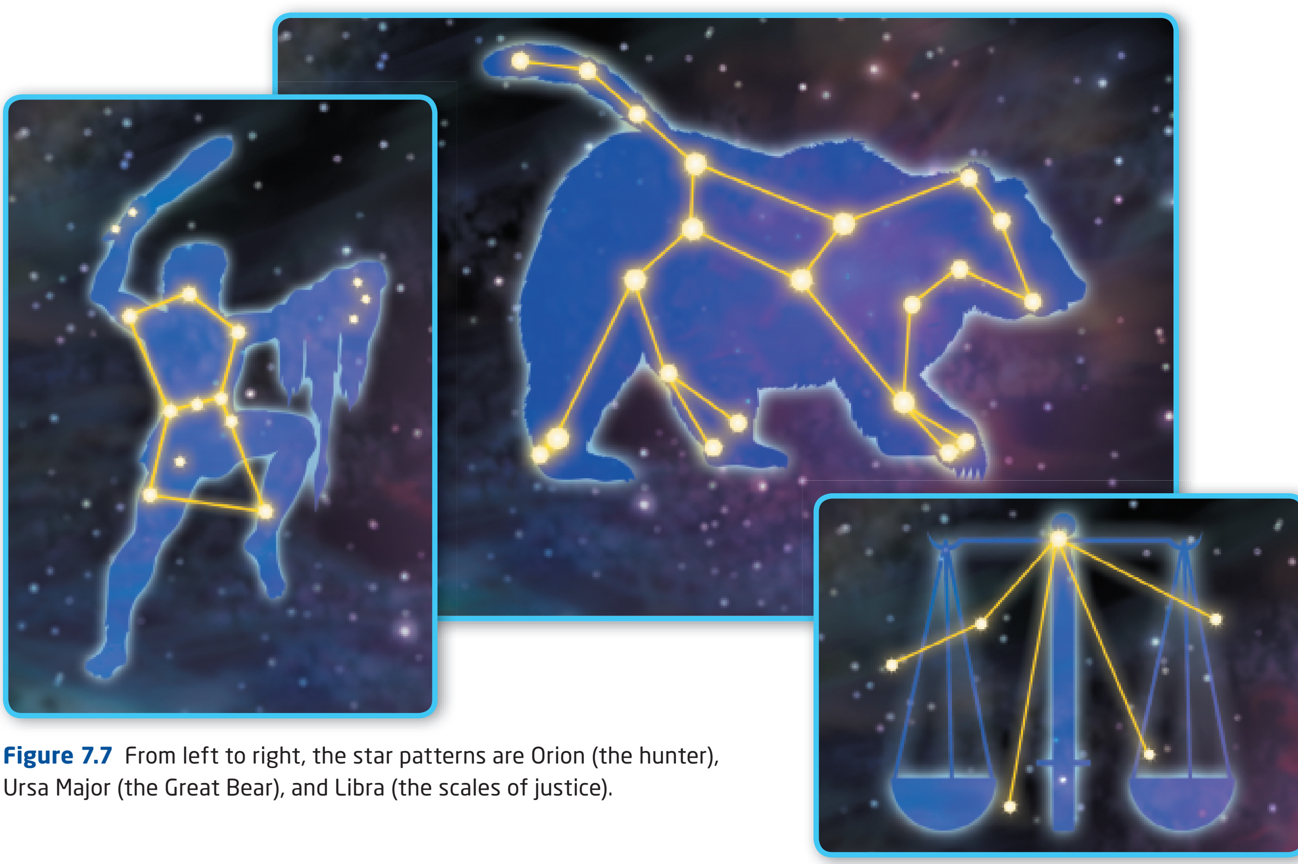

Figure 7.7 From left to right, the star patterns are Orion (the hunter), Ursa Major (the Great Bear), and Libra (the scales of justice).

Random Stars in Space

Figure 7.8 shows the constellation Cassiopeia as it appears from Earth. The figure also shows that the stars appear to be unrelated in space.

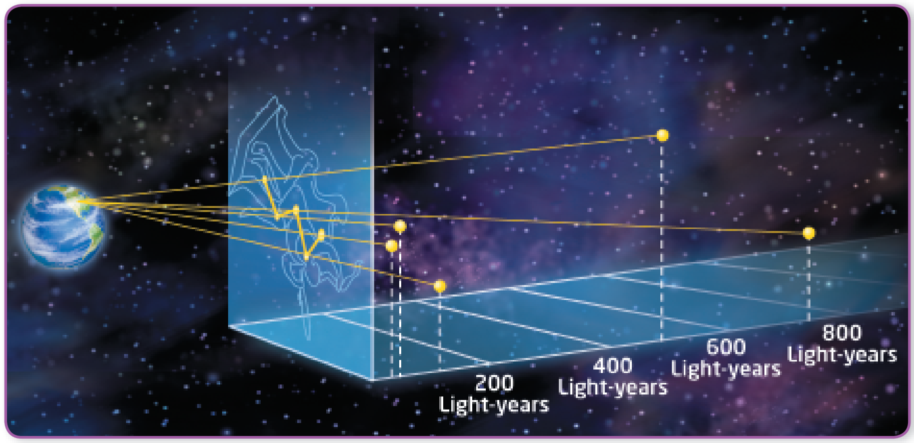

Figure 7.8 The stars in Cassiopeia are many light-years apart.

Apparent Magnitude

apparent magnitude the brightness of a star as seen from Earth

Star maps, such as the one shown in **Figure 7.9**, show constellations and individual stars. Star maps also represent the stars by dots of varying sizes. The larger the dot, the brighter the star is. Astronomers use the term *apparent magnitude* when they are describing the brightness of a star. A star's **apparent magnitude** is its brightness as seen from Earth.

The magnitude scale for star brightness was first developed by the ancient Greek astronomer Hipparchus, around 130 B.C.E. He assigned the number 1 to the brightest star he could see and the numbers 2 through 6 for sequentially fainter stars. A star of magnitude 6 is about the faintest star that the unaided human eye can see.

Hipparchus devised his stellar (star) magnitude scale based on the assumption that a magnitude 5 star was ⅕ the brightness of a magnitude 1 star. Similarly, a magnitude 3 star was ⅓ the brightness of a magnitude 1 star. A difference of five magnitudes actually represents a brightness difference of about 100. Today, the stellar magnitude scale goes beyond magnitude 6 and into the minus range, as well. The Sun, the brightest object in the sky, has an apparent magnitude of –26.

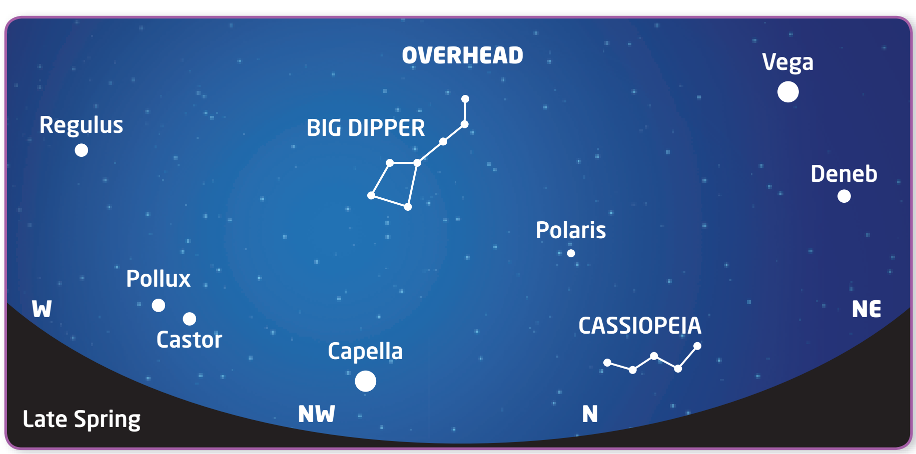

Figure 7.9 A star map shows the relative locations of stars in the sky at a certain time of night on a certain date.

Names of Constellations

The International Astronomical Union (IAU) is responsible for naming and classifying celestial objects. The IAU lists 88 official constellations. The star patterns in **Figure 7.7** are all constellations. Other examples of constellations are Cancer (the crab), Cassiopeia (the queen), and Ursa Minor (the Little Bear). Many of the constellation names, especially in the northern hemisphere, are ancient Greek and Latin names that represent mythological figures. For example, Cassiopeia is Greek for seated queen. The Romans used Latin names, such as Capricornus, which is Latin for sea goat.

Smaller groups of stars that form patterns within a constellation are called *asterisms,* from the Greek word *aster,* meaning star. An example of an asterism is the Big Dipper, seen in **Figure 7.10**. The Big Dipper is one of the most visible star patterns in the northern sky. It is part of the large constellation Ursa Major (the Great Bear).

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Figure 7.10 In the Big Dipper, the four bright stars at the lower right form the bowl of the dipper (a ladle or scoop). The three bright stars at the upper left of the bowl form the handle of the dipper.

The Big Dipper

Many cultures recognize the star pattern in the Big Dipper. The ancient Chinese saw the Big Dipper as a chariot for the emperor of the heavens. The early Egyptians saw the thigh and leg of a bull. For several North American Aboriginal cultures, such as the Algonquin, Iroquois, and Narragansett, the bowl of the Big Dipper is a bear. The stars in the handle are hunters who are following the bear. According to some stories, because the bear is low enough in early autumn evenings to brush the maple trees, blood from its wounds turns the leaves red. Another culture, the Snohomish, have a story that tells how three hunters chasing four elk became the seven brightest stars of the Big Dipper. One of the hunters is accompanied by a dog, which you can see if you look carefully at the middle star in the handle.

Sense of place

The Algonquin live in the Ottawa River Valley, at the current border between Ontario and Québec. The Iroquois live in the northeastern United States and eastern Canada. The Narragansett live in western Rhode Island, in the eastern United States. The Snohomish live along the coast of Washington State.

Polaris and the Pointer Stars

The Big Dipper's two end stars are called the pointer stars because they point toward Polaris, the North Star. You can see the pointer stars in **Figure 7.11**. The next time you go out and look at the night sky, find Polaris using the pointer stars.

For thousands of years, long before the invention of the compass, people in the northern hemisphere used Polaris to tell direction. Earth's rotational axis points to Polaris. So, as Earth rotates eastward on its axis, Polaris does not appear to move, unlike the other stars. During the night, the stars seem to revolve counterclockwise around Polaris, as shown in **Figure 7.12**. If you can see Polaris, then you know which way is north. Once you know which way is north, you can figure out the other directions: east, south, and west.

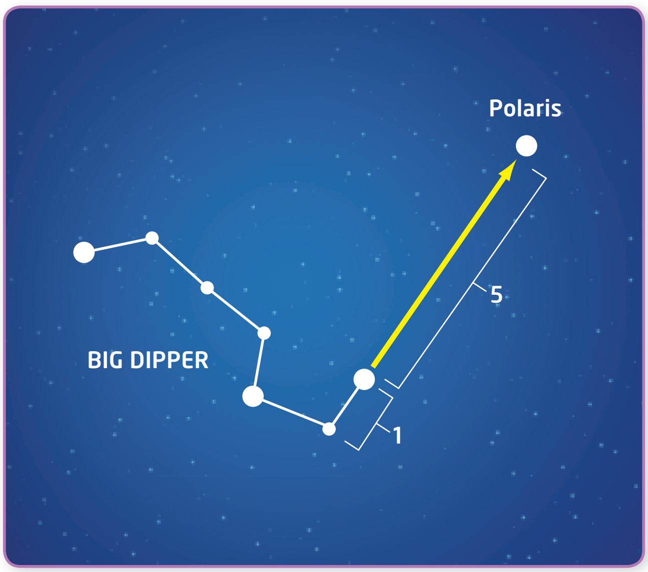


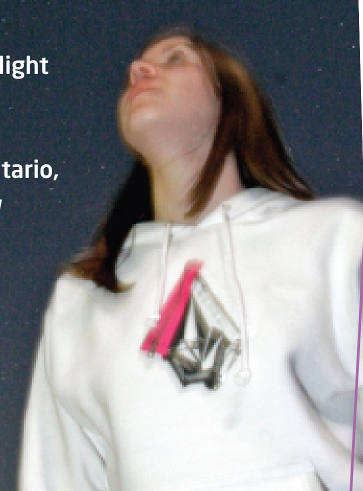
Figure 7.11 The distance from the pointer stars to Polaris is about five times the distance between the two pointer stars.

Figure 7.12 This time-exposure image, taken over several hours, shows how the stars in the northern sky appear to revolve counterclockwise around Polaris, the North Star.

Making a Difference

Star gazing is becoming more difficult because of light pollution. Light pollution is light that shines where it is not needed. A lit sign meant to be seen by people passing by produces light pollution if it also shines light into the sky where it isn't needed.

Shelby Mielhausen noticed that light pollution was increasing in Tobermory, Ontario, her home town. She studied the issue for a project in Grade 8. She wanted to know how light pollution affects the number of stars she could see. She counted visible stars in four communities and confirmed her prediction. Owen Sound, the largest community, had the most light pollution and the smallest star count. Shelby also studied outdoor lighting design and constructed a light shield that can help reduce light pollution. Shelby won an award of excellence from the Royal Astronomical Society at the 2005 Canada-Wide Science Fair in Vancouver.



What could you do to decrease light pollution in your neighbourhood?

Viewing Different Constellations

Due to Earth's revolution around the Sun, you see different constellations in the evening sky at different times of the year. The effect of Earth's orbital motion is illustrated in **Figure 7.13**.

> **Suggested Investigation**
> Inquiry Investigation 7-B, The Changing View of the Night Sky, on pages 308-309

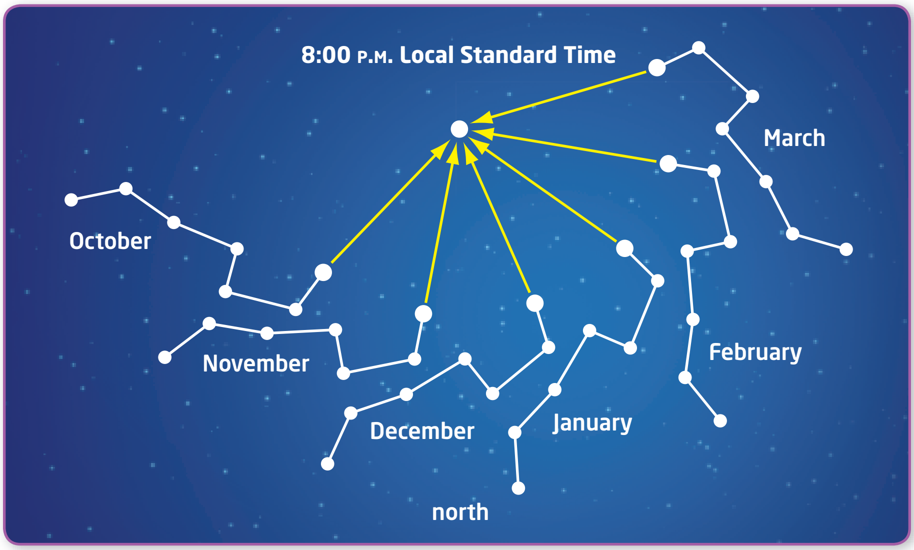


Figure 7.13 The westward creep of the constellations around Polaris is due to Earth's eastward orbit around the Sun.

The constellations that you can see also depend on your **latitude**. As you move northward, constellations along the southern horizon slip below the horizon so that you cannot see them. As you move southward, constellations, formerly unseen, rise above the southern horizon. For thousands of years, travellers have used the constellations to navigate on sea and on land. In **Figure 7.14**, compare the altitudes of contellations at two different latitudes.

> **latitude** the location above or below the equator

As European explorers sailed the oceans and entered the southern hemisphere in the 1600s and 1700s, they saw new star patterns that they had never seen before. The explorers created new constellations and gave them names such as "the Telescope," "the Microscope," and "the Sextant," after technologies that were important to the explorers at the time.

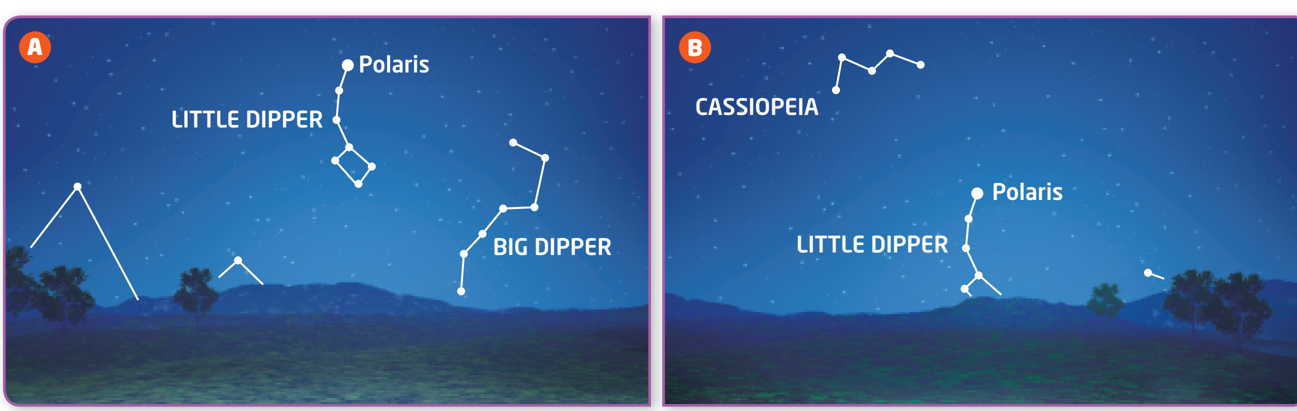


Figure 7.14 **A** The latitude of Ottawa, Ontario, is about 45°N, and **B** the latitude of Miami, Florida, is about 25°N. Polaris, in the Little Dipper, is very low in Miami compared with Ottawa.

Section 7.2 Review

Section Summary

- Constellations are groupings of stars that form distinctive patterns. The stars in these groupings appear to be close to each other, but they are not.
- A star's apparent magnitude is its brightness as seen from Earth.
- The Big Dipper is an asterism, which is a smaller grouping of stars within a constellation.
- Earth's rotational axis points to Polaris, the North Star. For thousands of years, travellers have used Polaris and the constellations to navigate.
- Different cultures have different interpretations of the night sky.
- A light-year is the distance that light travels in one year.

Review Questions

K/U **1.** Compare and contrast the terms *constellation* and *asterism* in a Venn diagram. Give an example of each.

C **2.** Draw the Big Dipper star pattern, and list two cultures that recognize this pattern.

K/U **3.** What is a star's apparent magnitude?

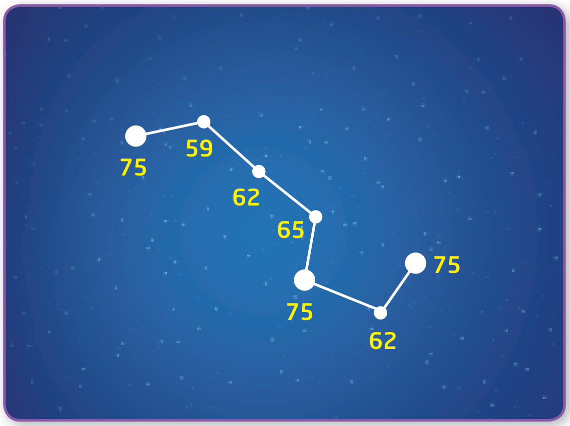
K/U **4.** Why do the stars in the northern hemisphere appear to revolve around Polaris?

K/U **5.** Define the term *light-year*.

T/I **6.** Do you think any of the constellations in **Figure 7.7** look like the person, animal, or object they represent? Explain your answer.

C **7.** Using a diagram, explain how people use Polaris and the constellations to navigate.

T/I **8.** Copy the diagram of the Big Dipper into your notebook. The numbers are distances from Earth, in light-years, of the stars. Show that the stars in the Big Dipper are not close together. Use **Figure 7.8** as a guide.



The Big Dipper