

## Patterns in the Night Sky

For thousands of years, people the world over have been fascinated by the night sky. Many civilizations, both in the past and present, believe that celestial objects are connected to events that occur on Earth. For example, many First Nations groups noted that the appearance of certain patterns of stars marked the changing seasons. This information helped them determine when to plant and when to harvest crops.

Stars were also used for navigation. People living in areas surrounded by water had no land to use as a reference point, and often used stars for navigation. Polynesians, for example, navigated among the Pacific Ocean islands by observing and recording patterns of stars.

### Constellations

Over the centuries, many cultures have noticed that some stars in the night sky appear to form patterns. They began naming these star patterns after their heroes, mythical monsters, and animals, such as Leo the lion (Figure 1). In everyday language, we often call these star patterns constellations. However, in astronomical terms, constellations are regions of the sky. It is the stars found within a **constellation** that can appear as a pattern in the sky. Ursa Major, for example, is the constellation where the Big Dipper can be found. There are 88 constellations recognized by the International Astronomical Union (IAU).

Historically, people formed these star patterns using their imagination to link up the stars in the sky like connect-the-dots puzzles. Different cultures linked up the stars in different ways. For instance, ancient Greek astronomers thought that the stars that make up the constellation Orion depicted a great hunter (Figure 2(a)), whereas some First Nations peoples of North America thought that the same stars looked like a canoe floating down a river (Figure 2(b)). Many of the official constellation names that exist today come from Greek or Arabic mythology. 🌐

#### DID YOU KNOW?

##### 88 Constellations

There are as many constellations in the sky as there are keys on a piano—88.



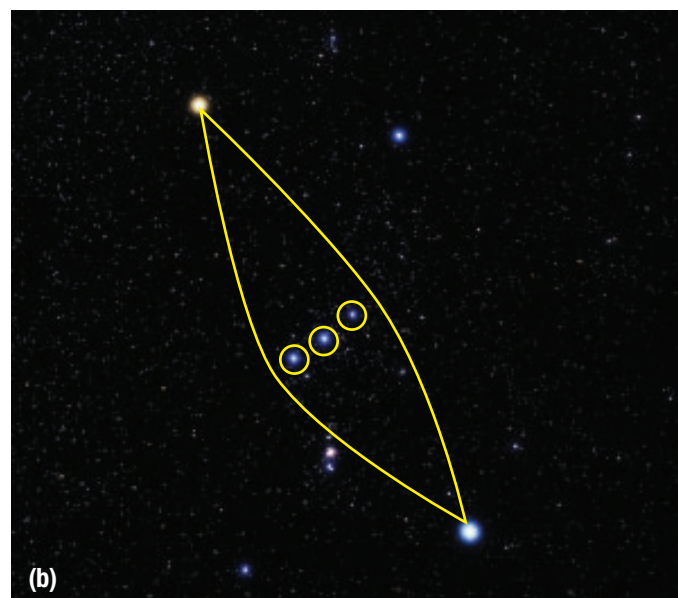
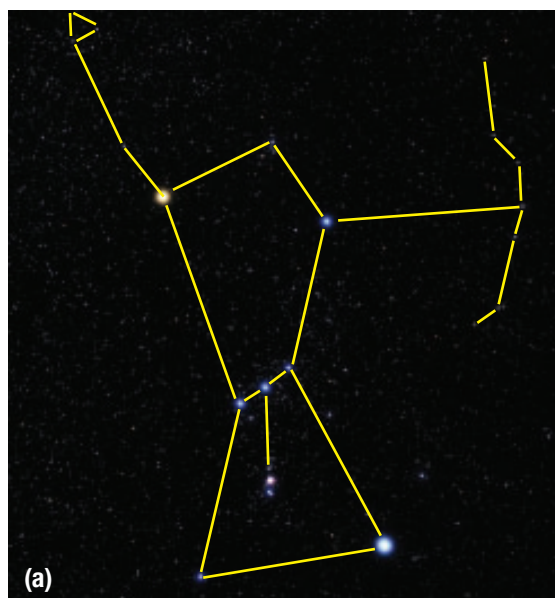
**Figure 1** Ancient Egyptians worshipped the stars of Leo because when the Sun was among its stars, the Nile River rose.

**constellation** a grouping of stars, as observed from Earth

To learn more about the history and legends of constellations,

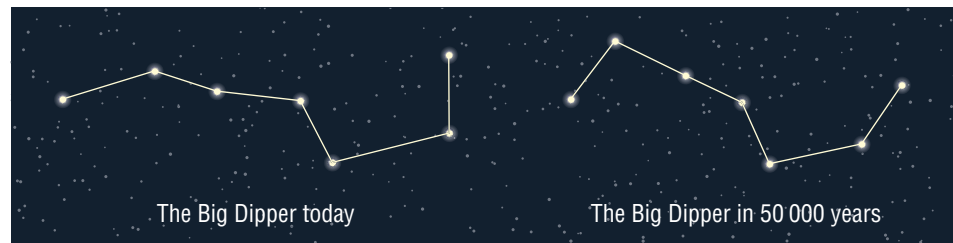


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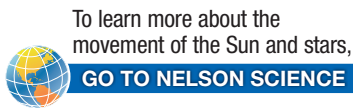
**Figure 2** The constellation Orion can appear in the pattern of a hunter (a). The same stars can appear as a canoe (b).

Although we can mark out the same constellations our ancient ancestors saw thousands of years ago, their component stars are not in exactly the same location as they were then. Precise observations of stars reveal that they move relative to each other in space, but these changes in position occur slowly, over many years. Since most stars are so far away from Earth, when we observe them in the night sky, they do not appear to be moving relative to one another. These changes can be seen only in photographs taken through high-powered telescopes over many years. Resulting shifts in star patterns such as the Big Dipper will become noticeable only in tens of thousands of years (Figure 3).



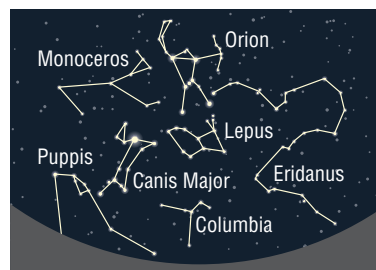
**Figure 3** The stars of the Big Dipper are moving, but so slowly that the change is only noticeable over many years.

Astronomers also noticed that celestial objects that are closer to the Sun appear to move faster relative to more distant ones. This visual effect is similar to the effect seen while driving in a car along a country road. Nearby trees appear to move more rapidly by your window, whereas more distant trees appear to move by much more slowly. 🌐



### MAPPING THE STARS

A star map is a map of the night sky that shows the relative positions of the stars in a particular part of the sky (Figure 4). Some star maps show only those objects that can be seen with the unaided eye, while others show objects that can only be viewed using a telescope or other instrument. A star map can be used to recognize celestial objects in the sky, and to observe the motions of these objects. By making use of star maps, people are able to determine both their location on the Earth's surface and the direction in which they are going. For this reason, star maps have been used for navigation for centuries. To learn more about star maps, go to the Skills Handbook, section 2.C.



**Figure 4** Star maps show the stars in a certain region of the sky.

A planisphere is a very useful type of star map that is used to display only those stars that are visible at a given date and time. A planisphere can be used for locating stars, constellations, and galaxies.

# The Celestial Sphere

From Earth, we observe the sky as it appears, not as it is. In the Middle Ages, people believed the sky to be a solid sphere with celestial objects in fixed positions. This imaginary sphere onto which all celestial objects are projected is called the **celestial sphere**. Today, we know that it is Earth that rotates, and not the sky. The celestial sphere extends around Earth. However, an observer on Earth can only see half of the sphere, the same way you can only see what is in front of you, and not behind (Figure 5).

**celestial sphere** the imaginary sphere that rotates around Earth, onto which all celestial objects are projected

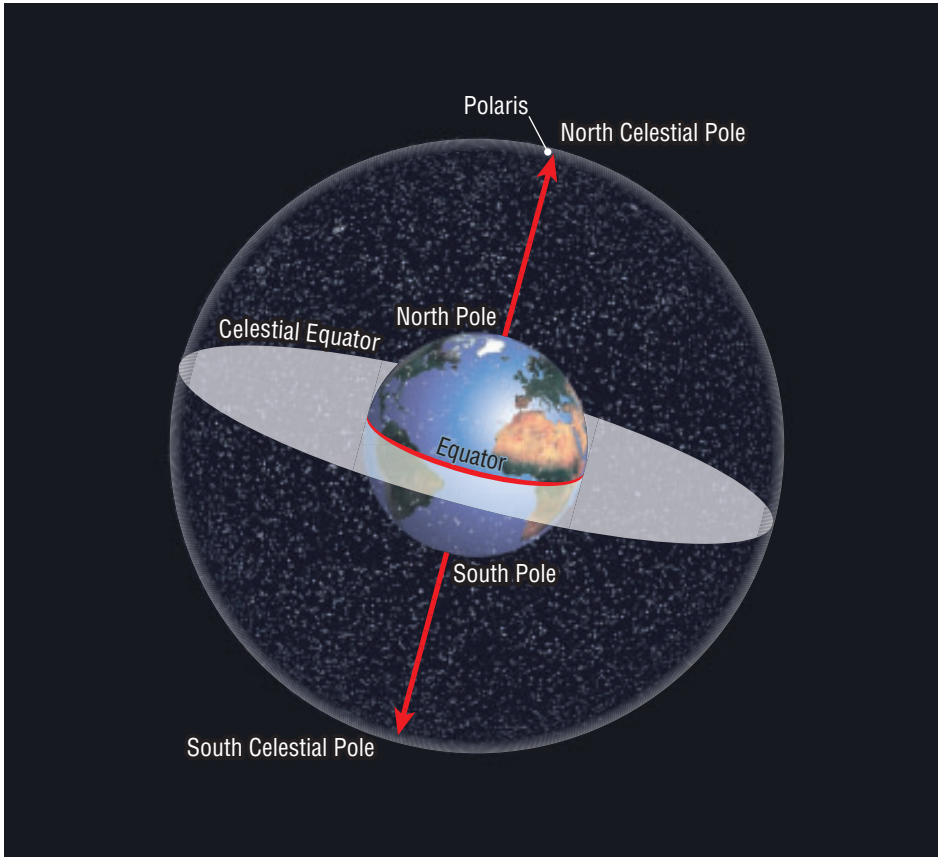


Figure 5 The celestial sphere

Early astronomers realized that the celestial sphere is a useful tool for determining location using the stars, known as **celestial navigation** (Figure 6).

The celestial sphere is divided into northern and southern hemispheres by the celestial equator, which is an imaginary extension of Earth's equator, projected into space. Astronomers mark the position of stars and other objects in the sky of each hemisphere using a grid system similar to latitude and longitude used on Earth. The North and South Celestial Poles are the imaginary points where Earth's axis of rotation extends out onto the celestial sphere above the North and South Poles on Earth. For observers in the northern hemisphere, the North Celestial Pole points very close to Polaris, the North Star. Even today, celestial navigation is widely used by sailors.

## DID YOU KNOW?

### See the Night Sky Inside

A planetarium offers people the opportunity to view the stars and constellations projected onto a domed ceiling, which mimics the night sky. A projector can show the night sky seen from any part of the world, at any time of night, on any day, including the past, present, and future.

**celestial navigation** the use of positions of stars to determine location and direction when travelling

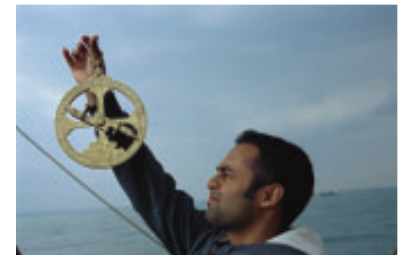


Figure 6 An astrolabe measures angles to determine location.

## Calendars Based on the Sky

Scientific historians recognize that many cultures have developed calendars by observing the sky. Historically, keeping accurate calendars was important for timing crucial agricultural and religious events. Ancient Egyptian farmers noticed that the annual flooding of the Nile River, used for crop irrigation, would occur once every 365 days when the Sun was passing through the constellation Leo. Other ancient peoples marked the beginning of the summer season using stones. By lining up the stones with the Sun's path in the sky, they were able to track the start and end of each season.

To find out how to be a scientific historian,



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### READING TIP

#### Finding the Main Idea

Use the title and headings to get a sense of what a passage is about. For example, "Calendars Based on the Sky" suggests the 365-day orbit of Earth around the Sun. Similarly, "Cultural Significance of Solstices and Equinoxes" helps you distinguish the main idea in the first two sentences from the examples in the remaining sentences of the paragraphs.

## Cultural Significance of Solstices and Equinoxes

For many cultures, solstices and equinoxes have historically been astronomical events that held significant spiritual meaning. On the Yucatán Peninsula of Mexico, the ancient Mayans built a giant pyramid, El Castillo, that is aligned to the Sun's movement in the sky. At sunset on the spring and fall equinoxes, a corner of the structure casts a shadow that resembles a plumed snake slithering down the pyramid steps (Figure 7).

Another famous ancient monument marking the solstice is the prehistoric astronomical observatory known as Stonehenge, in England (Figure 8). Stonehenge is a circular arrangement of giant stones and boulders that may have been used as an astronomical calendar to predict the movement of the Sun, the Moon, and their eclipses. Who built Stonehenge, and why, remains a mystery, but it is known that the alignment of the monument is so precise that at sunrise on the summer solstice every year, the Sun's first rays strike a particular stone.



**Figure 7** At sunset on each equinox, the plumed serpent, known as "Kukulcan," forms along the west side of the north staircase at El Castillo, Chichen Itza.



**Figure 8** An early observatory called Stonehenge located near Salisbury, England

## Aboriginal Views of the Sky

Cultures around the world have passed stories from generation to generation to explain what they see in the sky. Some legends are about astronomical phenomena, such as eclipses of the Moon or the Sun.

Other legends offer various explanations for the formation of celestial objects, such as the Moon and stars. A West Coast Tsimshian legend tells of the stars being formed when the sleeping Sun's mouth spewed sparks through the smoke hole of its house. As the Sun slept, its brother, the Moon, rose in the east. In other First Nations legends, lunar eclipses are the result of monsters in the sky swallowing the Moon.

Some Aboriginal legends in Canada view the stars as living beings who wander the skies forever. According to an Iroquois legend, the stars that make up the bowl of the Big Dipper are, in fact, a giant bear. The stars of the handle are three warriors hunting the bear. As the constellation sets close to the horizon in autumn, the hunters injure the bear. The blood of the injured bear turns the leaves of the trees on Earth red.

### UNIT TASK Bookmark

How can you apply what you have learned about star maps to the Unit Task described on page 446?

## IN SUMMARY

- The sky is divided into 88 regions associated with patterns of stars, or constellations.
- Star maps show the arrangement of celestial objects in the night sky.
- The celestial sphere is a convenient way to describe the positions of stars and their apparent movement in the sky.
- Ancient peoples often built structures to acknowledge and utilize their understanding of the movements of celestial objects.
- Aboriginal peoples in Canada, as well as other cultures, have observed the patterns in the night sky for cultural, agricultural, and navigational reasons.

## CHECK YOUR LEARNING

1. Give three reasons why ancient peoples carefully observed the patterns in the night sky. **K/U**
2. Do the stars that make up constellations change their position over time? How might this change the shape of the constellation? **K/U**
3. Using a globe as a guide, describe where you might find the celestial sphere, celestial equator, and celestial poles. **C**
4. The North Celestial Pole is very close to the star shown in Figure 9. What is its name? **K/U**
5. Explain why it might be beneficial to use the geocentric model when describing the positions and motions of the stars in the night sky. **T/I**
6. Name two ways that ancient cultures recognized the importance of solstices and equinoxes. **K/U**
7. Identify two structures built by ancient peoples to reflect their beliefs about the motions of objects in the sky. **K/U**
8. In your own words, describe two First Nations legends about astronomical phenomena as if you were explaining to a friend. **K/U**

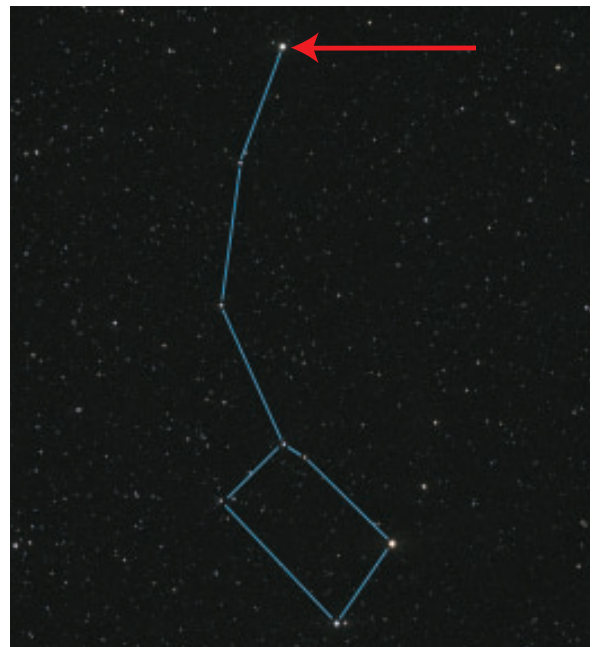


Figure 9 Little Dipper in Ursa Minor