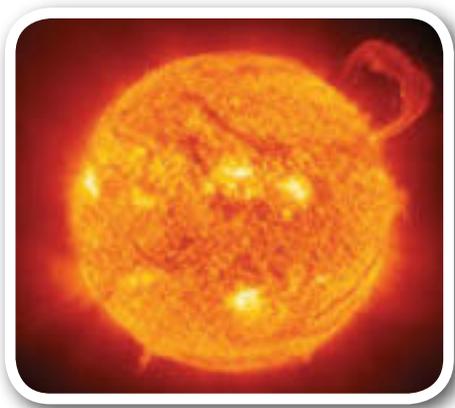


# Sun, Moon, and Stars



moon



sun



stars

changing position in the sky



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# Sun, Moon, and Stars



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# Sun, Moon, and Stars

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## The Mysterious Movement of the Moon

It is early in the morning on a school day. Lin sits at the kitchen table. It is still dark outside, and he is tired. It is hard to wake up on these dark, cold mornings! Sleepily, Lin looks out the kitchen window. The sky is just beginning to brighten. Lin can see the moon. "It's morning," Lin thinks. "Why is it still dark? And why is the moon still in the sky?"



Just before dinner that evening, Lin walks his dog, Luna. The sun is setting. It is starting to get dark outside. Lin again notices the moon in the sky. But it is in a different place. Again, he wonders why the moon is visible when it is not yet night. He thought the moon only came out at night. The appearance of the sky is changing all the time.



When he sits down to dinner, Lin looks for the moon through the kitchen window. But the moon is not there! Lin saw the moon when he walked Luna just a few minutes ago. He knows it is in the sky. So why can't he see it through the window like he could at breakfast this morning? He knows he saw the moon this morning when he was sitting in this same spot. He was looking through this same window.



Lin thinks back to the beginning of first grade. The mornings were bright and sunny, not dark. He walked the dog before bedtime instead of before dinner because it was still light outside later in the day.

“But where was the moon?” Lin thinks to himself. “Why can I only see the moon sometimes? And why does it seem to move from place to place?”

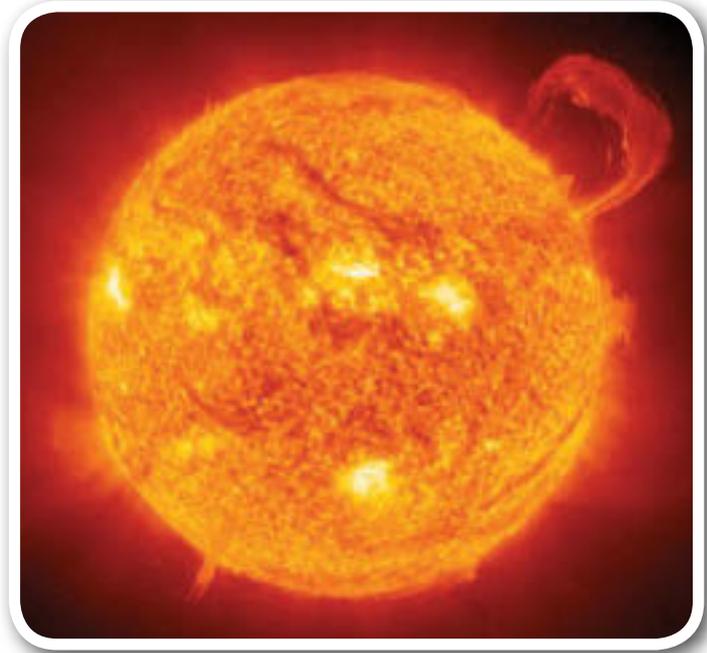


## What Causes Night and Day?

Lin saw changes in the day and night sky. What caused these changes? Think about the difference between day and night. It's the sun! When the sun is out, it's daytime. It is light outside. When the sun is not in the sky, it's nighttime. It is dark outside.



To learn about day and night, we first need to understand some things about Earth, the planet we live on. Earth gets light from the sun. The sun is a star! It looks much bigger and brighter than stars you see in the night sky. That is because it is much closer to Earth. Many other stars are larger and brighter than the sun. They just seem tiny because they are so far away.



How do we describe where the sun or moon is in the sky?  
You have probably heard people use the words *north*, *south*, *east*, *west*, *up*, and *down*. These are directions. Directions let us describe the locations of objects or places. They can help us tell where the sun or moon is in the sky.



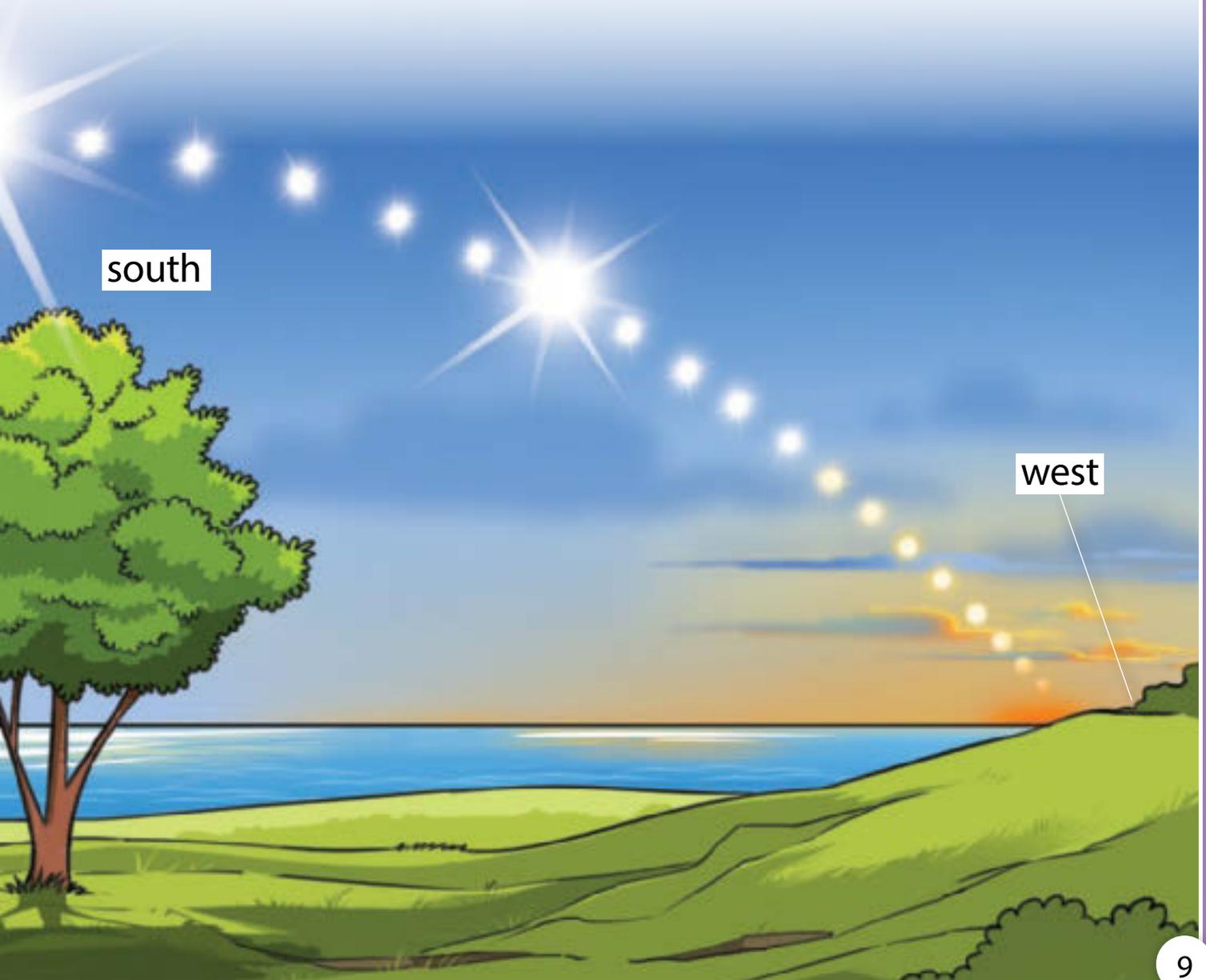
A compass is a tool that tells direction.

east

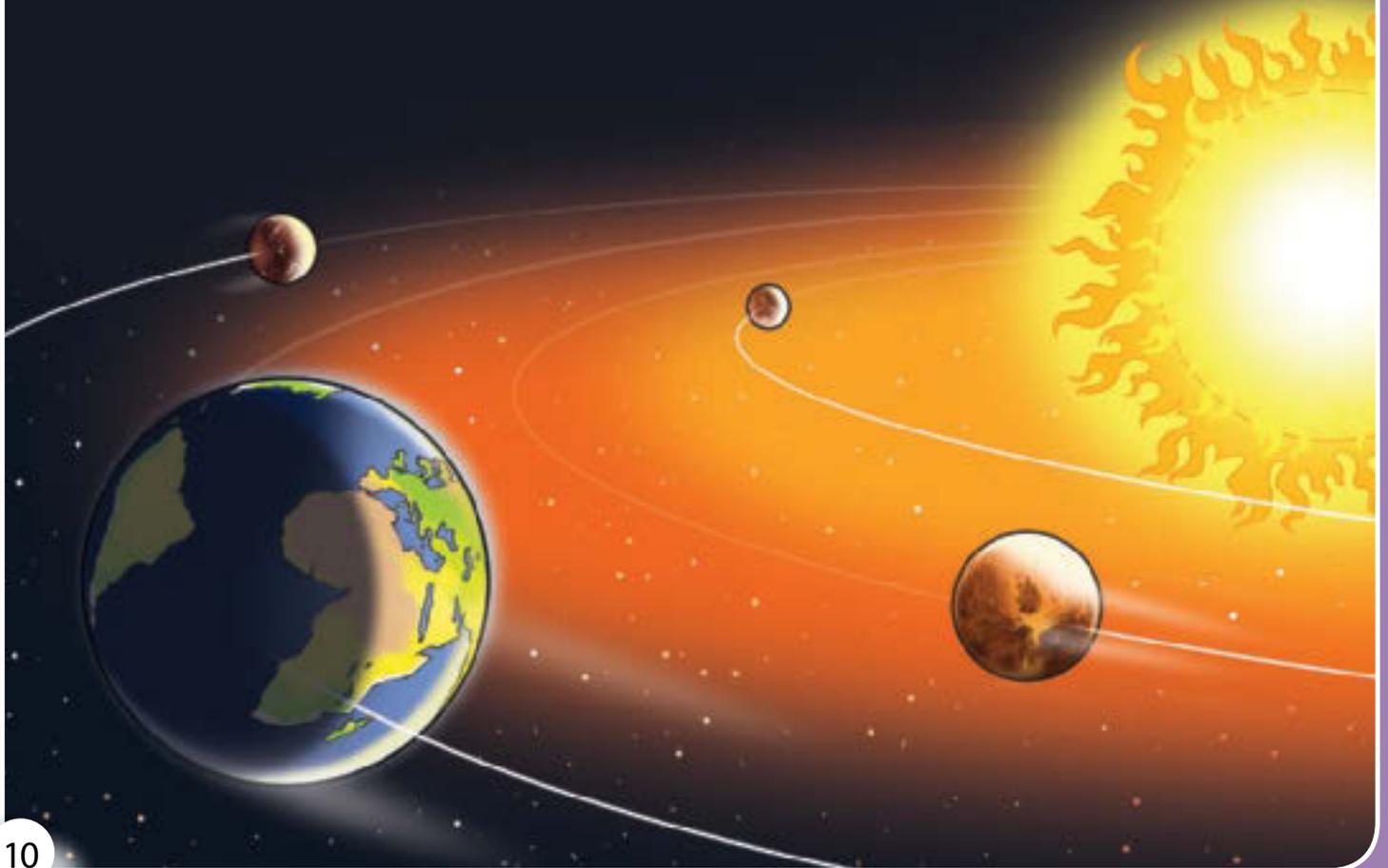


The sun always rises in the east. It appears to move across the sky during the day. Then it sets in the west. One daytime plus one nighttime make one Earth day. An Earth day is twenty-four hours long. Where Lin lives, the sun rises and sets once in every period of twenty-four hours.

Look at the labels for east and west. Can you point to where the sun rises and sets?

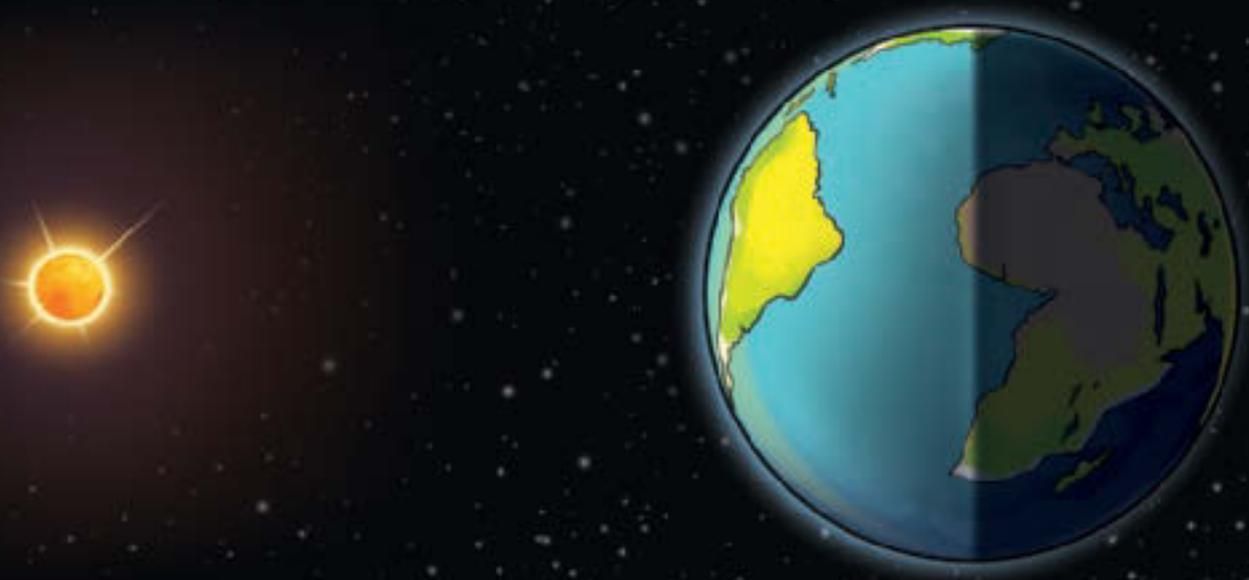


You may be wondering why you cannot see the sun in the sky all the time. We have sunrises and sunsets because Earth is shaped like a ball, and it spins. When one side is facing the sun, the other side is facing away from the sun.



Only one half of Earth at a time faces the sun. It is light, and daytime, on that side. It is dark, and nighttime, on the other side. But as Earth spins, the light side becomes dark. The dark side becomes light. This is why we have night and day. This pattern happens every twenty-four hours.

Where is it daytime in this picture? Where is it nighttime?



## Longer and Shorter Times of Daylight

Lin noticed that sometimes it was dark outside when he ate breakfast. Sometimes it was light. But he eats breakfast at the same time every day. That must mean that on some days the sun rises earlier. On some days it rises later. The length of day and night changes throughout the year. If you collect data, you can see a pattern.



Think about the changes Lin noticed. Then think about what you have learned about Earth and the sun. What time of year do you think it was when it was dark outside in the morning? What time of year do you think it was when he could walk his dog before bedtime?



By collecting data, you will see that the sun rises and sets at predictable times. The times change a little bit each day. You can play outside much later in the summer than you can in the winter. That is because the sun rises very early and sets very late in the summer. Summer has the most daylight.



In the fall, days get shorter and shorter. Winter has the least amount of daylight. The shortest day of the year is in December where Lin lives. As winter turns to spring, the amount of time between sunrise and sunset slowly grows longer. The longest day of Lin's year is in June. Then the amount of the daylight slowly decreases as summer turns to fall. The days get shortest in December. This pattern repeats every year.

It is the same time of day in both pictures. Why is it bright daytime in one picture and getting dark in the other?



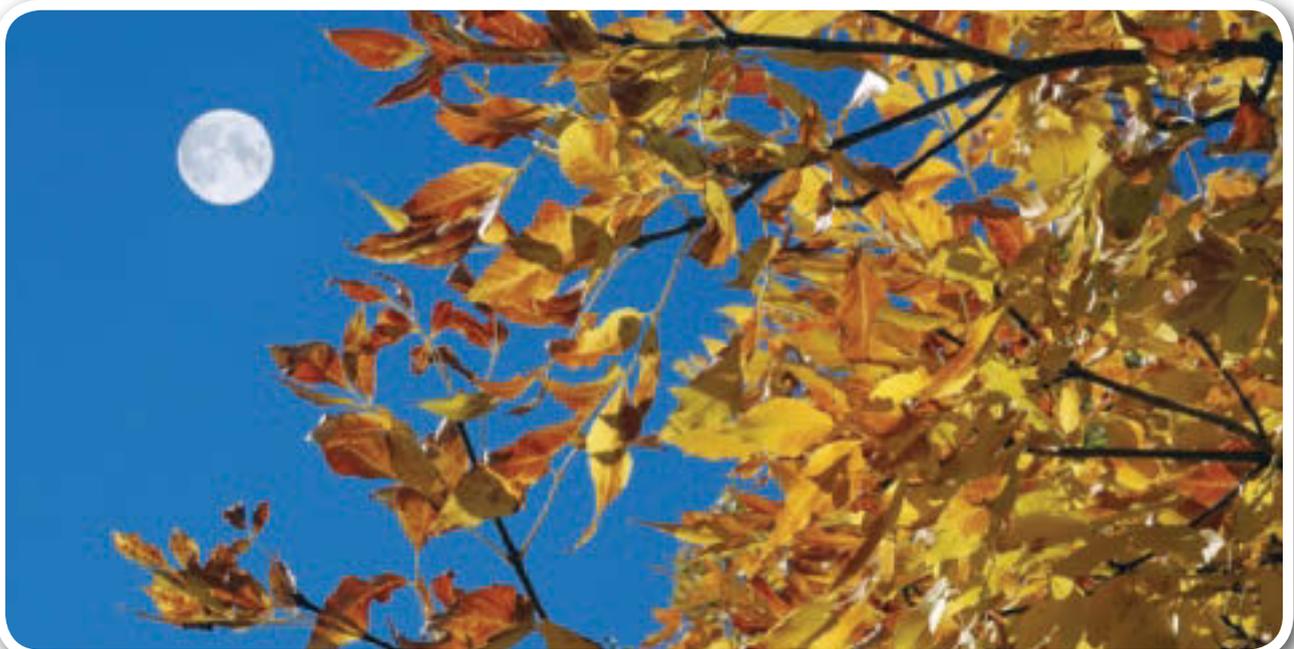
## Why Does the Moon Seem to Move?

What did Lin notice about the moon? He saw it in the morning and at night. He saw it when it was still light outside. He saw it when it was dark. He saw it in different places in the sky.

Just like the sun, the moon's place in the sky changes. And just like the sun, its movement follows a predictable pattern.



The moon is very bright against the dark night sky. But it is not only a night sky object. The moon appears in the sky both during the day and at night. The sun's bright light sometimes makes the moon harder or even impossible to see during the day.



Like the sun, the moon rises and sets. It rises in the eastern sky. Then it sets in the west. During the time that the moon is visible, it appears to move across the sky. Unlike the sun, the moon actually moves! It moves in a path around Earth. Earth also spins. So the moon's place in the sky changes.

Can you tell if the moon is rising or setting here? Not unless you know which direction the picture is facing. If the picture shows a view to the east, which is it?



Can you tell if the moon is rising or setting here? If the picture shows a view to the west, which is it?



The moon has the shape of a round ball. Because we see only one side of the moon, it sometimes looks like a circle. But sometimes its shape looks different. The moon's shape changes over the course of one month. These changes happen in a predictable pattern. The changes in shape are called the moon's phases.



The full moon has a complete circle shape.



The quarter moon is a half-circle shape.



The crescent moon looks like the shape of the white part of a fingernail.



During the new moon phase, the moon is hard to see. The whole circle is dark.

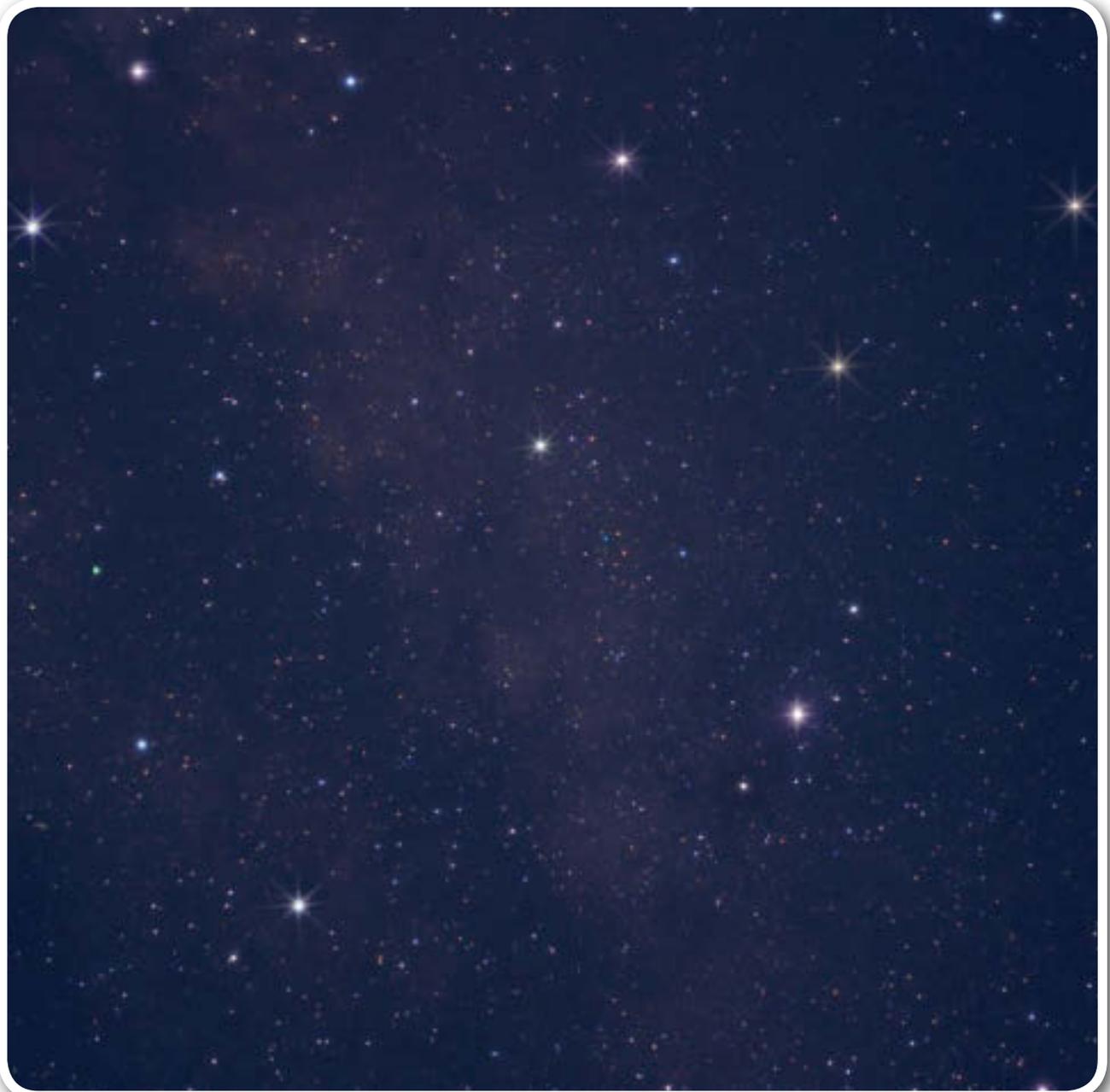
## How Does the Starry Sky Change?

Lin has figured out that the appearance of the sun and moon changes in the sky. But what about the stars in the sky? Do those change, too?

The sun is just one of many billions of stars. Except for the sun, stars are very far from Earth. They are so far away that they look like tiny points of light in the sky. You can see stars because they make their own light.

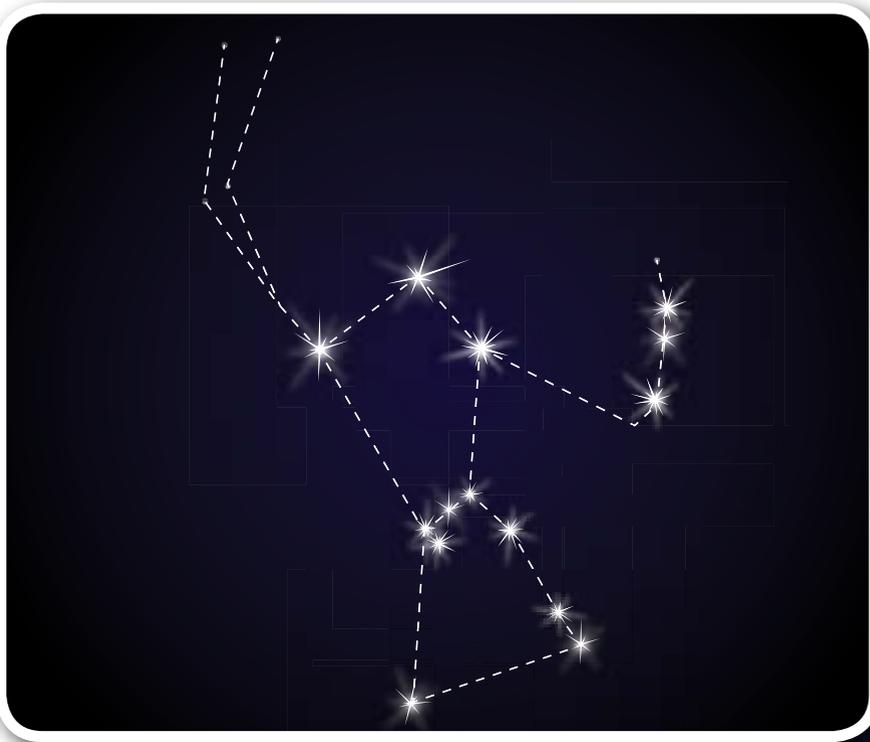
Stars are in the sky all the time. But we can only see them at night. During the day, the sun's bright light blocks out light from other stars. When the sun sets, the stars show up against the dark sky once again.

Some stars appear to be larger and brighter than others. Still, it is hard to tell them apart.



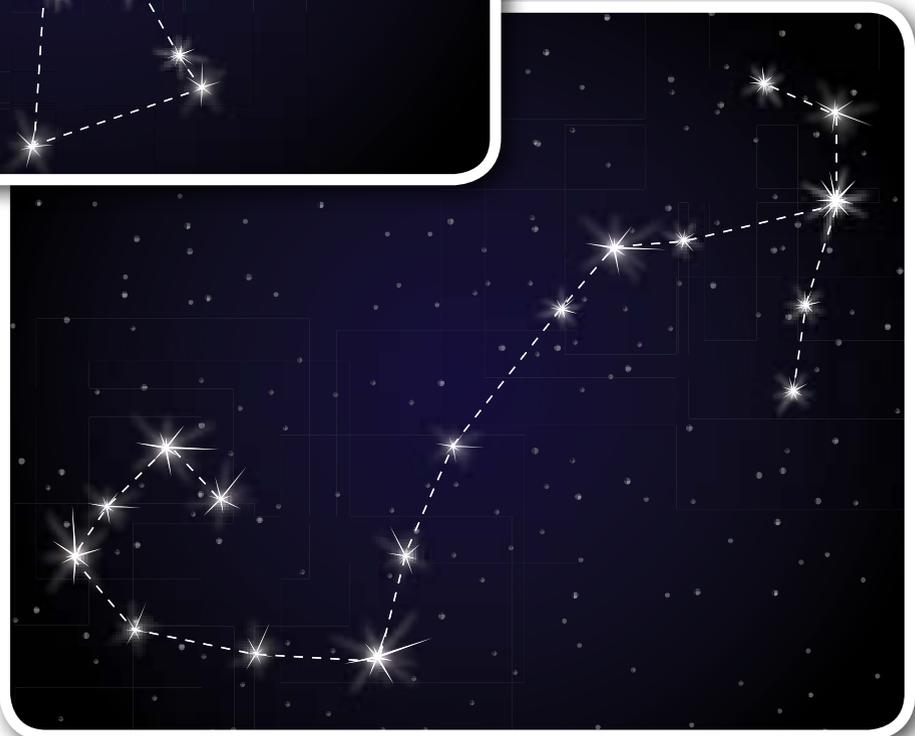
With so many stars in the sky, how can we tell which one is which? A long time ago, people imagined picture patterns from stars, much like you can connect dots to draw a picture. These star pictures are called constellations.

Look at these constellations. What do their shapes make you think of?



Does this look like a hunter?

Does this look like a scorpion?



Constellations can contain just a few stars or many stars. The Big Dipper is one of the easier groups of stars to spot in the night sky. The Big Dipper contains seven stars. It is shaped like a ladle. A ladle is a type of deep spoon. The Big Dipper is visible in the northern night sky.



Remember what Lin noticed about objects in the sky. He noticed the way the positions of the sun and the moon change. Do you think that the positions of stars change, too? How could you find out?

## Science in Action

### Meeting an Astronomer

Lin has learned a lot about the objects in the sky since he started noticing them through his kitchen window. He knows where the sun rises and sets. Sometimes, Lin sees a full moon. Sometimes, he sees a skinny crescent moon. At other times, he cannot see the moon at all. Lin has made enough observations that he knows the pattern. He can predict how the moon's shape will appear from one week to the next.



Now Lin is excited to be on a class field trip. The students are visiting a planetarium. The planetarium is a dark theater. Stars are projected on the curved ceiling. It makes the dome look like the night sky.

The planetarium operator is named Danielle. "The planetarium can show what the night sky will look like here tonight," Danielle says. "It can also show what the night sky would look like on any other night and from any other place on Earth!"

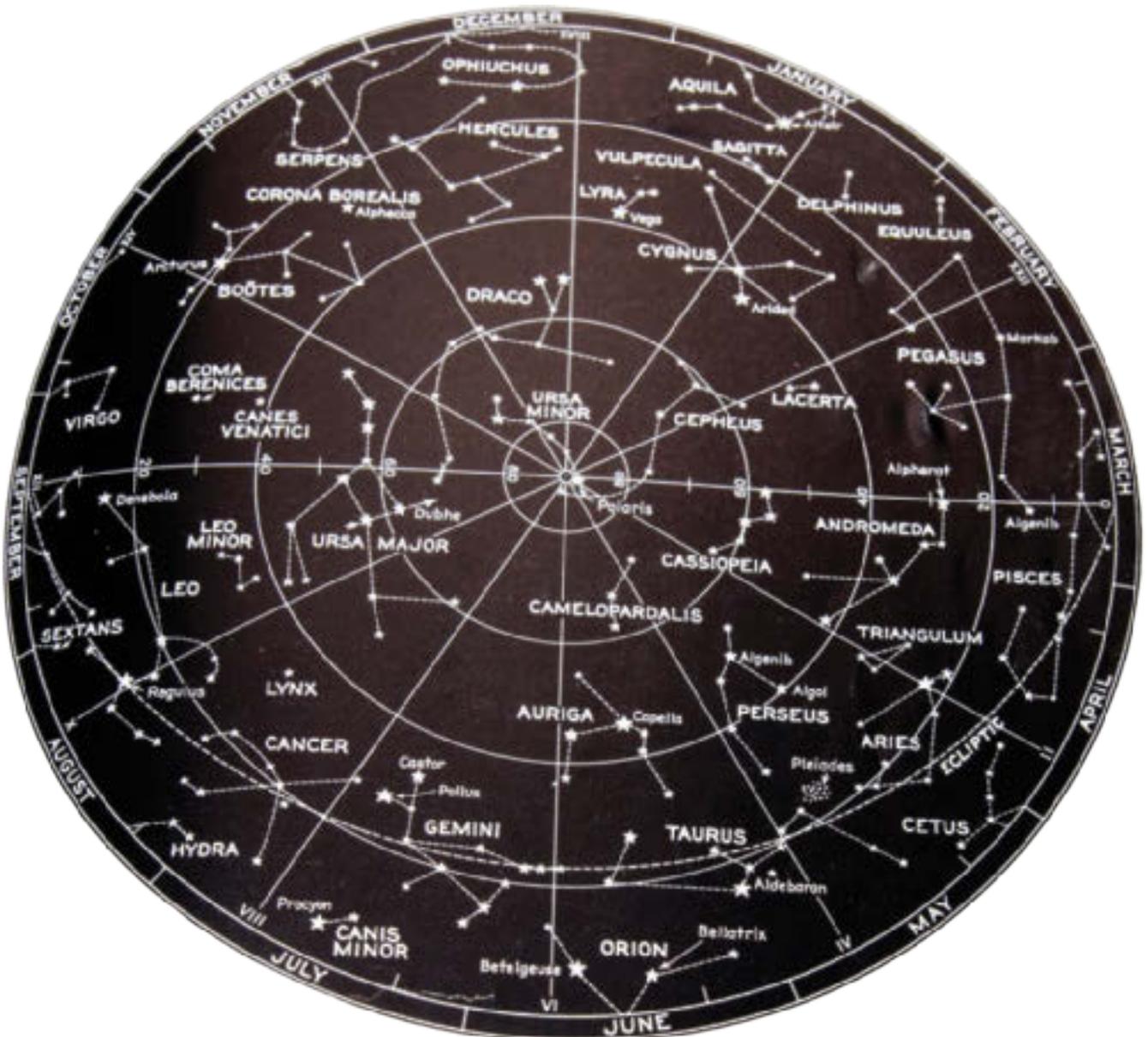


Danielle explains that scientists who study stars and other objects in space are called astronomers. “Astronomers have been observing the night sky for thousands of years,” she tells the class.

“Long ago, people looked at the stars. They noticed that they saw different groups of stars during different seasons. They recorded what they saw and discovered patterns. Now scientists know they can use those patterns to predict which stars they will see on any night. In a planetarium, we can display what that looks like.”



Astronomers a long time ago recorded what the stars looked like in the sky. They made maps of the stars. A planetarium combines information of many star maps, from many places. Danielle tells the students about some of the first makers of star maps. She also tells the students that some of the lights in the night sky are not stars at all. They are other planets!



# Shi Shen, Gan De, and Wu Xian

Danielle tells the class about Shi Shen, Gan De, and Wu Xian. They were Chinese astronomers. They lived more than two thousand years ago. They mapped the positions of stars. Their star chart used lines to connect groups of stars together into constellations. Those constellations are different from the ones Lin is used to. They imagined different pictures made from stars in the night sky.



# Galileo

Galileo Galilei was an Italian astronomer. He lived more than four hundred years ago. Galileo used a telescope to view objects in the night sky. He looked more closely at the moon than anyone had before him.

Galileo discovered that there were many more stars in the sky than people had ever seen before. He recorded the way they moved and changed. He found patterns. Galileo's data changed how people thought about the universe.







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