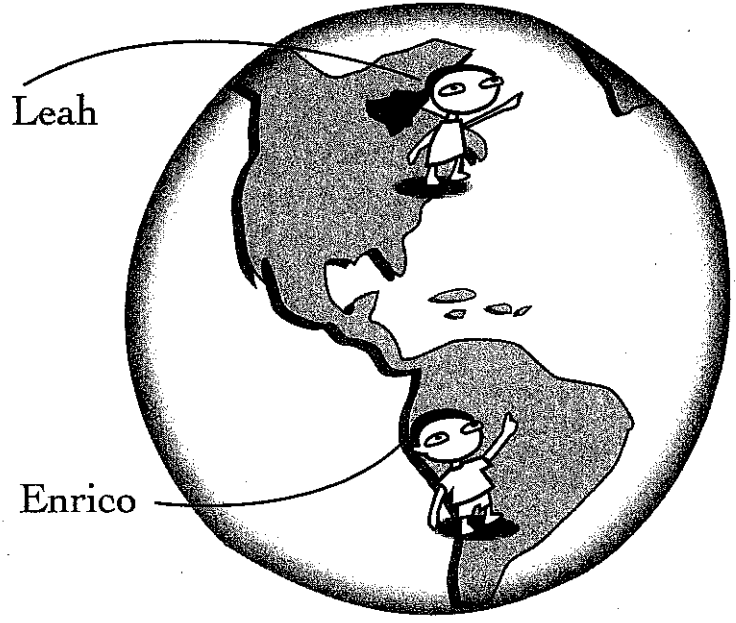


# Gazing at the Moon

Enrico and Leah live in opposite hemispheres. Enrico lives in Santiago, Chile, which is in the Southern Hemisphere. Leah lives in Boston, Massachusetts, which is in the Northern Hemisphere. They both gazed at the Moon on the same evening. Enrico noticed there was a full Moon when he looked up at the sky from his location (the Southern Hemisphere). What do you predict Leah saw when she looked up in the sky from her location (the Northern Hemisphere)?



- A** New Moon (no part of the Moon is visible)
- B** Crescent Moon (a quarter of the face of the Moon is visible)
- C** Half Moon (half of the face of the Moon is visible)
- D** Gibbous Moon (three-quarters of the face of the Moon is visible)
- E** Full Moon (the entire face of the Moon is visible)

Provide an explanation for your answer. How did you decide what the Moon would look like in the opposite hemisphere?

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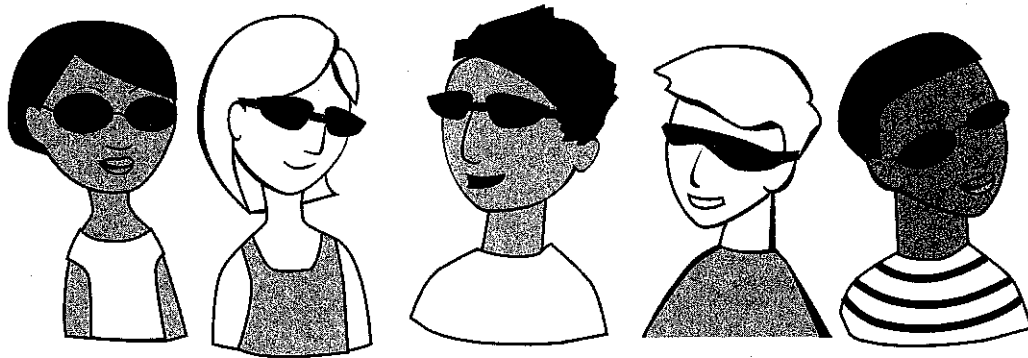


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# Summer Talk



Six friends were talking. They each had different ideas about why it is warmer in the summer than in the winter. This is what they said:

Werner: "It's because the winter clouds block heat from the Sun."

Ava: "It's because the Sun gives off more heat in the summer than in winter."

Raul: "It's because Earth's tilt changes the angle of sunlight hitting Earth."

Fernando: "It's because the Earth orbits closer to the Sun in the summer than in the winter."

Shakira: "It's because one side of Earth faces the Sun and the other side faces away."

Susan: "It's because the Northern Hemisphere is closer to the Sun in summer than in the winter."

Which friend do you most agree with? \_\_\_\_\_

Describe your thinking about why it is warmer in the summer than in the winter. Provide an explanation for your answer.

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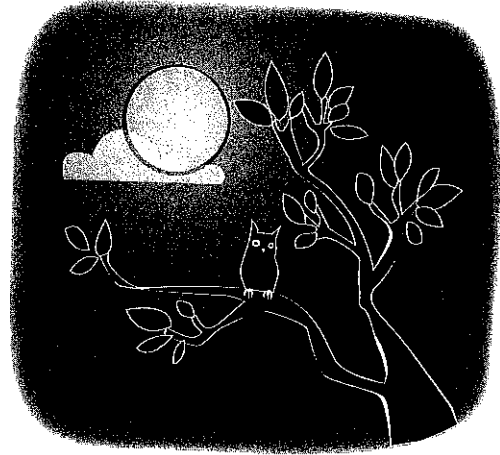
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# Moonlight

Five friends noticed they could see better at night when there was a full Moon. They wondered where the moonlight came from. This is what they said:



**Curtis:** "The Moon reflects the light from the Earth."

**Chet:** "The light from the Sun bounces off the Moon."

**Clarence:** "The Moon gets its light from distant stars."

**Fallon:** "The Moon absorbs light from the Sun during the day."

**Deirdre:** "There is light inside of the Moon that makes it shine."

Which person do you most agree with? Explain your thinking about moonlight.

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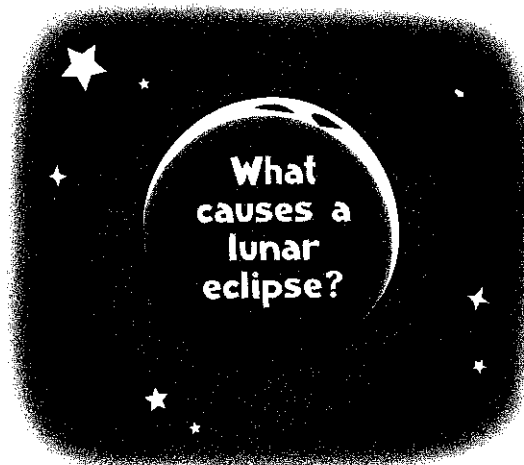
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# Lunar Eclipse

People have been fascinated by lunar (Moon) eclipses for ages. For a time, the full Moon seems to disappear as it changes color, darkens, and then reappears. Throughout time, people have had different ideas about what causes a lunar eclipse. Here are some of their ideas:



- A** A nearby planet passes between the Earth and the Moon.
- B** The Sun passes between the Earth and the Moon.
- C** The Moon passes between the Sun and the Earth.
- D** The Earth passes between the Sun and the Moon.
- E** The clouds block out the Moon.
- F** A nearby planet's shadow falls on the Moon.
- G** The Moon's shadow falls on the Earth.
- H** The Moon turns to the dark side and then back to the light side.

Circle the idea you think best explains what causes a lunar (Moon) eclipse. Explain your thinking about lunar eclipses.

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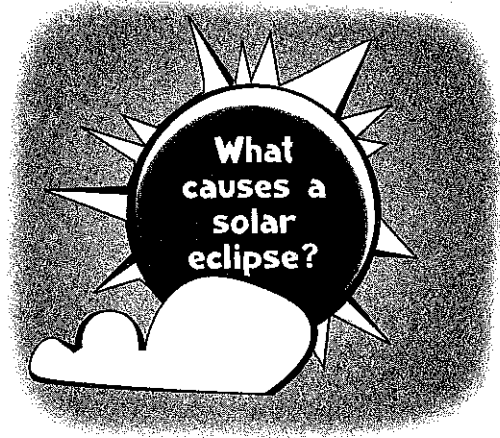
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# Solar Eclipse

People have always been fascinated by solar eclipses. During a solar eclipse, parts of the Earth experience darkness for a brief time during the day. Throughout time, people have had different ideas about what happens during a solar eclipse. Here are some of their ideas:



- A** One of the nearby planets passes between the Sun and the Earth.
- B** The Sun passes between the Earth and the Moon.
- C** The Earth passes between the Sun and the Moon.
- D** The clouds block out the Sun.
- E** The Earth's shadow falls on the Sun.
- F** The Moon's shadow falls on the Earth.
- G** The Sun shuts off light for a few minutes.
- H** The Sun moves behind the Earth for a few minutes then comes back again.

Circle the letter of the idea that you think best explains what happens during a solar eclipse. Explain your thinking about solar eclipses.

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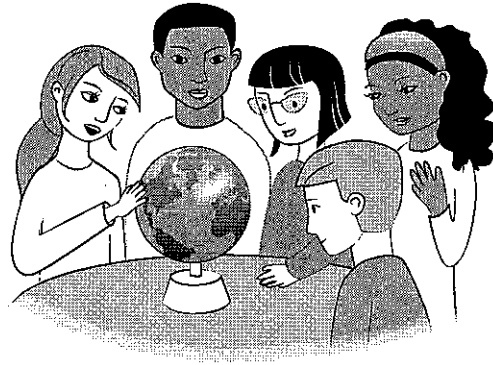


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# Is Earth Really “Round”?



Five friends were talking about the shape of the Earth. They each agreed the Earth is round. However, they disagreed about what “round” really means. Here are their ideas about a “round” Earth:

**Chuck:** “I read somewhere that Columbus or Magellan or someone proved the Earth is round like a round island. He sailed all around the island, and came back to the same port.”

**Sara:** “I know the Earth doesn’t look round. That’s just because we live in a flat area. Other people can see it’s round because they live near mountains and hills.”

**Takesha:** “‘Round’ means that the whole Earth is shaped like a ball. It just looks flat because we can only see a small part of the ball.”

**Arnold:** “You’re right that ‘round’ means ‘round like a ball,’ but it looks flat because we live on the flat part in the middle. The upper part of the ball is the sky, and the bottom part is the solid Earth, where people live.”

**Missy:** “Everyone knows that the round Earth is a planet in the solar system, like Mars and Jupiter. People get mixed up because ‘earth’ is also another name for the ground.”

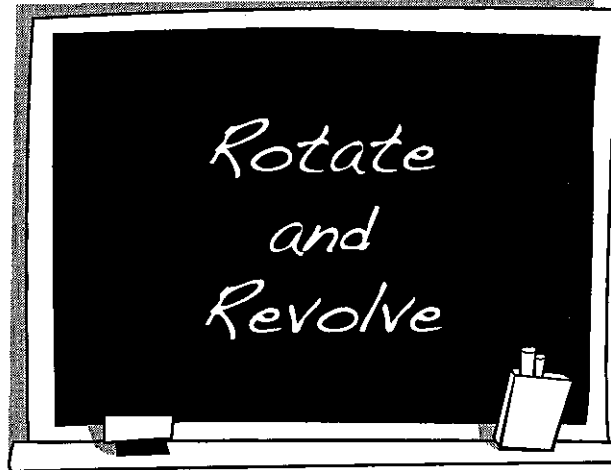
Who do you think has the best explanation? \_\_\_\_\_ Explain why you think it is the best explanation, and use a drawing to support your explanation.

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Include a drawing on the back of this page.

# The Two Rs



Different words are used to describe the motion of objects in space. Circle the answer that best describes the meaning of the words *rotate* and *revolve*.

- A *rotate* means spin; *revolve* means spin
- B *rotate* means spin; *revolve* means orbit
- C *rotate* means orbit; *revolve* means orbit
- D *rotate* means orbit; *revolve* means spin

Explain how these words describe Earth's motion. You may use a diagram to support your explanation.

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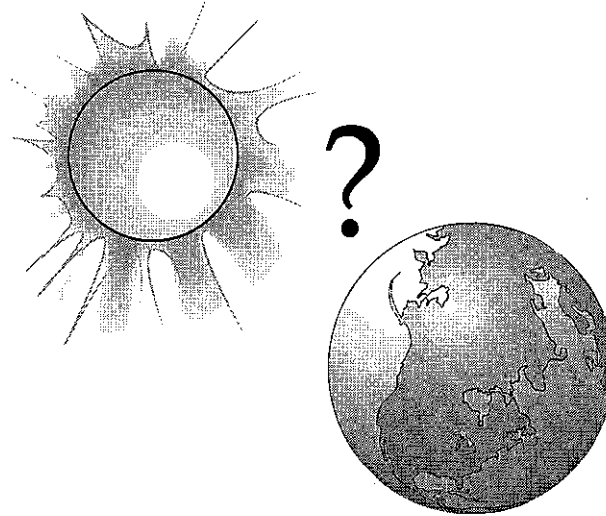
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# What's Moving?



Which statement best describes the movement of the Earth and Sun? Circle the answer that best matches your thinking.

- A** The Earth goes around the Sun once a day.
- B** The Sun goes around the Earth once a day.
- C** The Earth goes around the Sun once a year.
- D** The Sun goes around the Earth once a year. \_\_\_\_\_

Explain your thinking. Describe the evidence that supports your answer.

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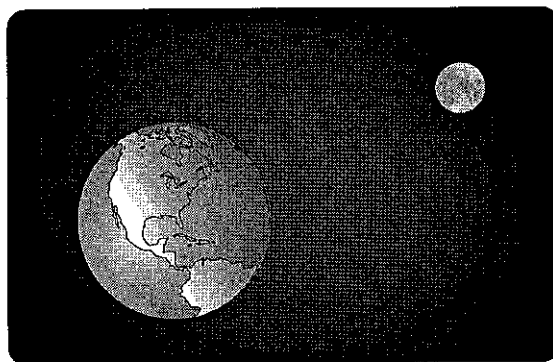
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# Does the Moon Orbit the Earth?

## Teacher Notes



### Purpose

The purpose of this assessment probe is to elicit students' ideas about the Moon's motion. The probe is designed to find out whether students recognize that the Moon orbits the Earth, and, if so, how long they think it takes to complete one orbit.

### Related Concepts

Gravity

Moon: orbit

Solar system objects: orbits, spin

### Explanation

The best answer is C: "The Moon orbits the Earth about once a month." It is this monthly orbit that results in the cycle of lunar phases we see each month. As observed from Earth, it takes the moon approximately 27.3 days to go around the Earth once. This complete orbit is referred to as a sidereal month.

### Administering the Probe

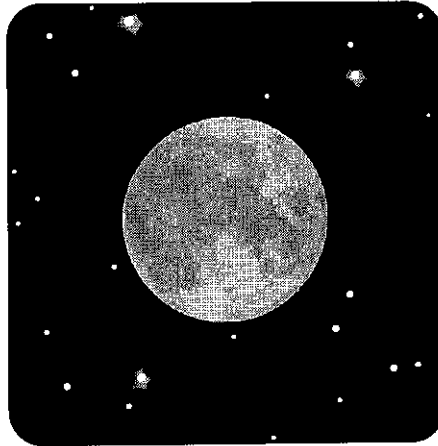
This probe is best used with upper elementary, middle school, or high school students, just before beginning lessons on Moon phases. It can also be used after students have had instruction in Moon phases to see how well students retain what they have been taught previously or whether they revert back to their preconceptions. For younger students or English-language learners, you can substitute *goes around* for the word *orbits*.

### Related Ideas in Benchmarks for Science Literacy (AAAS 2009)

#### 6–8 The Earth

- ★ The Moon's orbit around the Earth once in about 28 days changes what part of the Moon is lighted by the Sun and how much of that part can be seen from the Earth—the phases of the Moon.

# Moon Spin



People who observe the Moon notice that the same side of the Moon always faces the Earth. They also know that the Earth spins once a day on its axis. Does the Moon spin as well? If so, about how long does it take to make one full spin? Circle the answer that best matches your thinking.

- A** one hour
- B** one day
- C** one week
- D** one month
- E** one year
- F** Never. The Moon does not spin on its axis.

Explain your thinking. What evidence or model can you use to support your answer?

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# Chinese Moon



Belinda lives in St. Louis, Missouri. She looked up at the sky one evening and observed a crescent Moon. What would her friend Lian, who lives in Beijing, China, see if she looked up at the Moon on the same night? Circle the shape of the Moon that best matches your thinking.

- A** crescent Moon
- B** quarter Moon
- C** gibbous Moon
- D** full Moon
- E** new Moon

Explain your thinking. What rule or reasoning did you use to select your answer?

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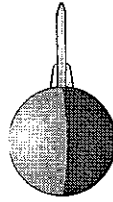
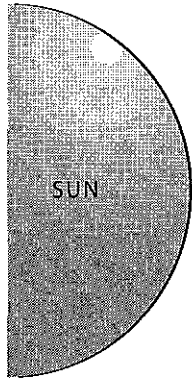
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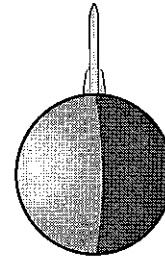
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# Gravity in Other Planetary Systems



PLANET A  
Fast Spin  
Low Mass  
Close to Sun



PLANET B  
Slow Spin  
High Mass  
Far from Sun

(Rocket and planet are not to scale)

Simon liked to dream about the day that people would travel to other worlds in other planetary systems. One day he got to thinking about what it might be like to take off in a rocket from planets that were different sizes and different distances from their sun. He drew a picture and showed it to some friends. He wanted to get their ideas about which rocky planet would be hardest for the rocket to take off from. Here is what his friends said:

**Juanita:** "No difference. It will be the same for both planets."

**Rufus:** "I think the rocket would have to work harder to get off planet A."

**Jojo:** "I think the rocket would have to work harder to get off planet B."

Whom do you agree with the most? \_\_\_\_\_ Explain why you agree.

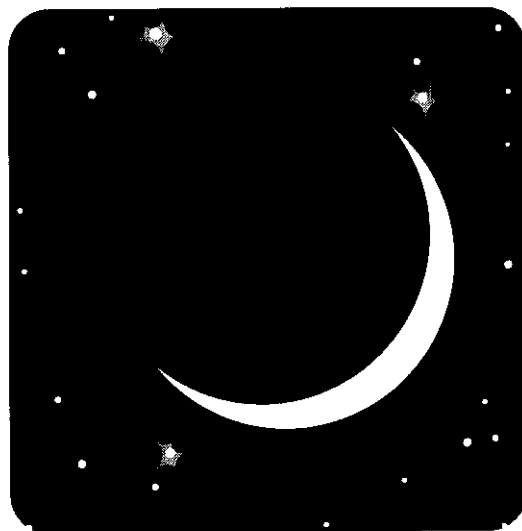
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# Crescent Moon



When there is a crescent Moon in the night sky, how much of the *entire* Moon's spherical surface is actually lit by the Sun? Circle the answer that best matches your thinking.

- A** quarter or less of the entire Moon
- B** half of the entire Moon
- C** three quarters of the entire Moon
- D** the entire Moon

Explain your thinking. Provide an explanation for your answer. \_\_\_\_\_

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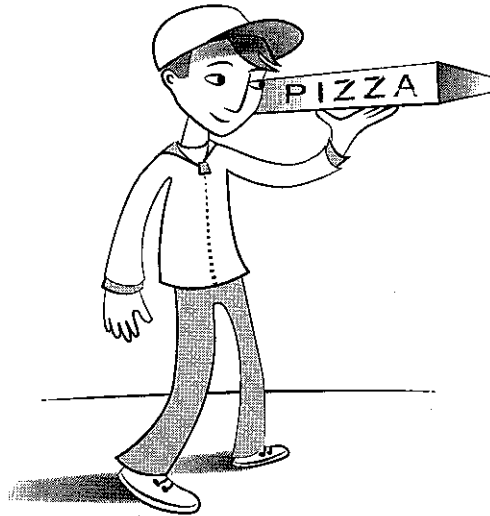
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# Pizza Sun



Imagine a pizza with slices of tomato, pepperoni, pieces of chopped green pepper, and grated cheese. If the pizza represents the Sun, circle what you think would best represent the Earth to show how big it is compared with the Sun.

- A** a round table that is about 10 times larger than the pizza, so that it would take 10 Suns to stretch across the Earth
- B** a slice of tomato that is about one-fifth the size of the pizza, so that it would take 5 Earths to stretch across the Sun
- C** a slice of pepperoni that is about one-tenth the size of the pizza, so that it would take 10 Earths to stretch across the Sun
- D** a piece of chopped green pepper that is about one-hundredth the size of the pizza, so that it would take 100 Earths to stretch across the Sun
- E** a speck of grated cheese that is about one-thousandth the size of the pizza, so that it would take 1,000 Earths to stretch across the Sun

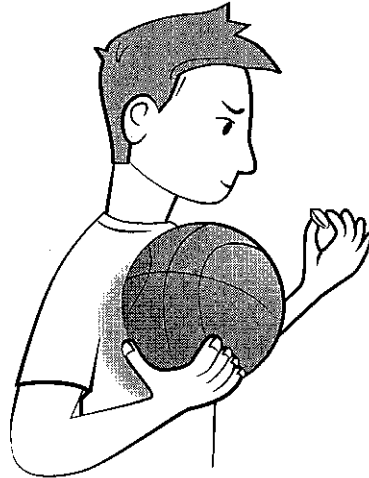
Explain your thinking. How did you decide how big the Earth is compared with the Sun?

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# How Far Away Is the Sun?



Imagine a basketball represents the Sun. A seed, about 100 times smaller than the diameter of the basketball, represents the Earth. About how far away from the basketball should you place the “seed Earth” to show its distance from the Sun in this model? Circle the answer you think is closest to the relative distance between the “basketball Sun” and the “seed Earth.”

- A** about 3 feet (or about 1 meter) away
- B** about 15 feet (or about 5 meters) away
- C** about 50 feet (or about 15 meters) away
- D** about 100 feet (or about 31 meters) away
- E** about 500 feet (or about 152 meters) away
- F** about 1,000 feet (or about 305 meters) away

Explain your thinking. Describe how you decided on your answer.

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# Sizing Up the Moon



Have you ever looked up at the Moon and wondered how big it is? Put an X next to the thing you think is closest to the size of the Moon.

- |                                     |                                    |
|-------------------------------------|------------------------------------|
| <input type="checkbox"/> penny      | <input type="checkbox"/> my school |
| <input type="checkbox"/> baseball   | <input type="checkbox"/> my city   |
| <input type="checkbox"/> basketball | <input type="checkbox"/> Earth     |
| <input type="checkbox"/> chair      | <input type="checkbox"/> the Sun   |
| <input type="checkbox"/> car        |                                    |

Explain your thinking. How did you decide how big the Moon is?

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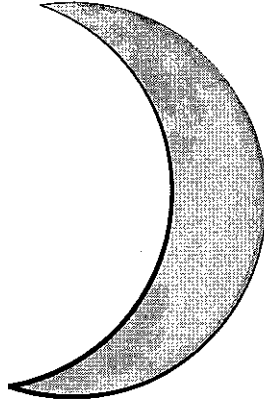
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# Seeing the Moon



How often have you looked up into the sky and seen the Moon? Put an X next to all the times when you think you can go outside and see the Moon.

- in the morning
- at noon
- in the middle of the afternoon
- in the evening before sunset
- in the evening after sunset
- at midnight

Explain your thinking. How did you decide when you could see the Moon?

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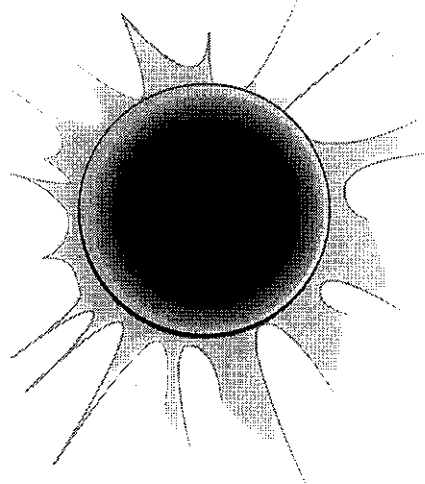
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# Moon Phase and Solar Eclipse



During a solar eclipse the Moon appears to completely cover the Sun. What phase is the Moon in just before and after a solar eclipse? Circle the answer that best matches your thinking.

- A** full Moon
- B** new Moon
- C** first quarter Moon
- D** last quarter Moon
- E** It can be in any phase.

Describe your thinking. Provide an explanation for your answer. \_\_\_\_\_

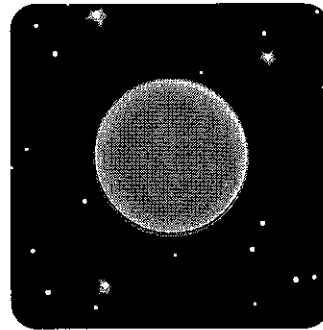
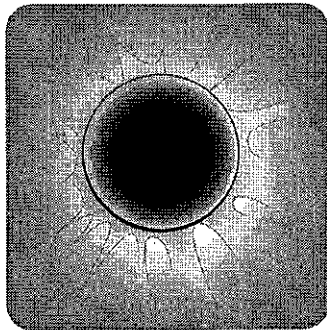
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# Comparing Eclipses



From any place on Earth a person can see more eclipses of the Moon than of the Sun. Why do you think this is so? Put an X in front of all the statements that support reasons why we see more lunar eclipses than solar eclipses.

- A** The Sun moves more quickly than the Moon.
- B** Anyone who can see the Moon when it enters Earth's shadow will see an eclipse of the Moon.
- C** The shadow of the Moon on the Earth is very small and moves quickly.
- D** The Moon goes in front of the Sun more often than the Sun goes in front of the Moon.
- E** The Moon's orbit around the Earth is faster than Earth's orbit around the Sun.
- F** The Moon spins on its axis faster than the Earth spins on its axis.

Describe your thinking. Use the ideas you marked with an X to explain why we see more lunar eclipses than solar eclipses. \_\_\_\_\_

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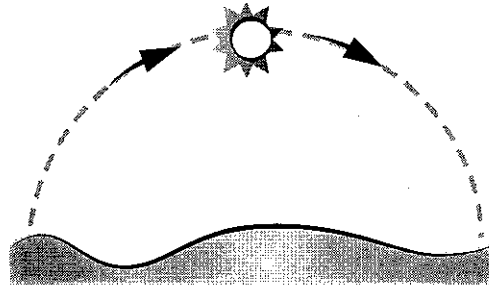


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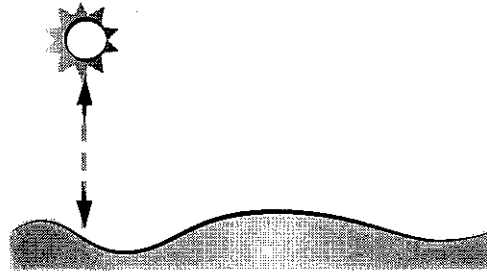
# Sunrise to Sunset

Two friends were talking about where the Sun is in the sky between sunrise and sunset. They each drew a picture to explain their ideas. Here is what they drew and said:

Avi: "I think the Sun rises on one side and sets on the other."



Jessica: "I think the Sun rises upward in the morning, then sets downward toward night. It looks like it goes up and down like this."



Whom do you agree with the most? \_\_\_\_\_ Explain why you agree.

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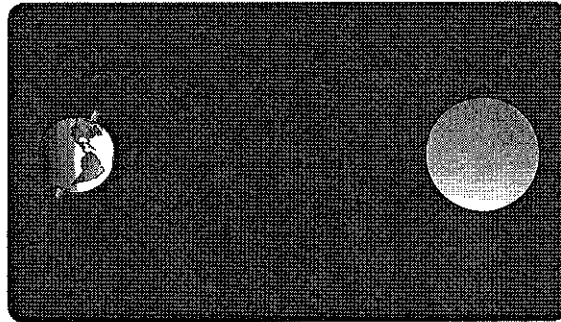
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# Why Is It Warmer in Summer?

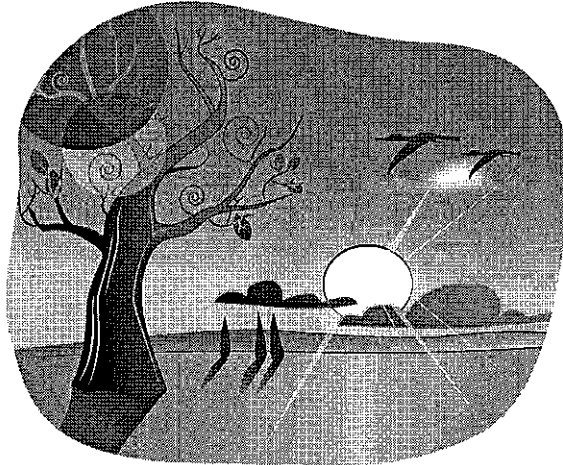


Many textbooks say that Earth's tilt causes the change of seasons. But *how* does the tilt cause the seasons to change? Put an X next to any of the statements you think can help to explain how the tilt of the Earth causes it to be warmer in the summer than in the winter.

- A As the Earth circles the Sun, the direction of tilt relative to the plane of Earth's orbit gradually changes.
- B The direction of Earth's axis always stays the same as we circle the Sun.
- C When the Northern Hemisphere tilts toward the Sun we are closer to the Sun, so it is warmer.
- D When the Northern Hemisphere tilts toward the Sun the days are longer, so there is more time for the Earth to warm up.
- E When the Northern Hemisphere tilts toward the Sun then the Sun appears higher in the sky viewed from the United States, so sunlight is more concentrated and intense.
- F The Earth's tilt causes the Sun to be directly overhead at noon in the summer when viewed from the United States.
- G As the Earth circles the Sun it changes the angle of tilt during different seasons of the year, which then changes the amount of direct sunlight the Earth receives.

Explain your thinking on the back of this page. In your own words, describe how Earth's tilt relates to the change in seasons.

# Shorter Days in Winter



Mrs. Moro's students checked the newspapers every morning for the times of sunrise and sunset. They used this information to determine the number of hours of daylight. The class started this project in September, and by November they could see that the days were getting shorter and shorter. The students asked their families and neighbors to explain why days get shorter as winter approaches in the North. Here are the ideas they came to class with the next day:

**Frank:** "My mom says it's because of daylight saving time."

**Jubal:** "My sister said Earth's tilt causes the Sun to be farther away in winter."

**Sybil:** "My father thinks the angle of sunlight must be the cause."

**Carter:** "My brother says the Sun moves across the sky faster in winter."

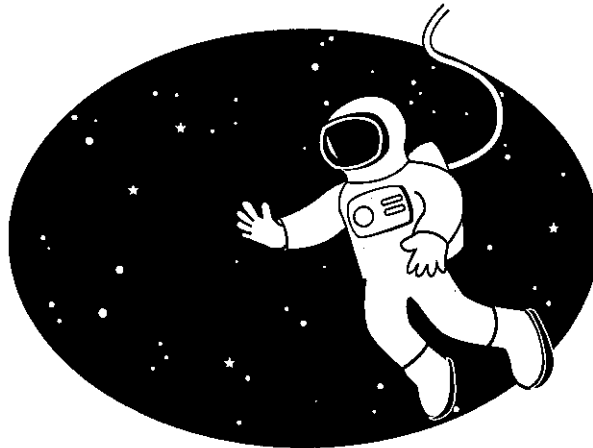
**Wendy:** "My neighbor thinks the Sun's path in the sky gets shorter in winter."

Which student came to class with the best idea? \_\_\_\_\_ Explain why you think that is the best idea.

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# Human Space Travel



An American astronaut, Neil Armstrong, was the first person to walk on the Moon. He made his historic Moon walk in 1969. Several decades have passed since the Apollo astronauts walked on the Moon. What do you think is the farthest distance humans have traveled in space since the year 2000? Circle the answer you think best describes the farthest distance astronauts have traveled recently.

- A** into the upper part of Earth's atmosphere
- B** about a quarter of the way to the Moon
- C** about halfway to the Moon
- D** to the Moon
- E** slightly past the Moon
- F** halfway to Mars
- G** to Mars
- H** slightly past Mars
- I** almost halfway through our Solar System
- J** to a nearby star
- K** to another planetary system
- L** to another galaxy

Explain your thinking. How did you decide how far recent astronauts have traveled?

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