Name: _____ Date: _____

Bouncing Lasers Off Mirrors on the Moon

Circle group

Apollo astronauts left some things on the Moon. Scientists still use some of them. One is a set of special mirrors. Each mirror is made of many small glass corners. They send light straight back to where it came from. A flat mirror would bounce light off to the side. These mirrors send it back.

Some observatories on Earth shoot short pulses of laser light at the mirrors. The beam spreads as it goes. When it gets to the Moon, it covers a wide patch. Only a tiny bit of light comes back. Detectors count it. Scientists note the exact time of the round trip.

Light moves at the same speed in space. So the math is easy. Multiply the speed by the time. Then divide by two. The beam went to the Moon and back. The answer is how far away the Moon is.

After many years, scientists found something new. The Moon is slowly moving away from Earth. It moves a few centimeters each year. That is about as fast as a fingernail grows. The old mirrors still help us learn how the Moon moves.

Questions

1. What did Apollo astronauts leave on the Moon that scientists still use?

_____

_____

2. What do observatories on Earth shoot at the mirrors?

_____

_____

3. Why do scientists divide by two?

_____

_____

4. How do scientists find the distance to the Moon?

_____

_____

5. How fast is the Moon moving away from Earth?

_____

_____

6. Why would a flat mirror not work well?

_____

_____

Words to know

observatories: buildings with telescopes for studying space
pulses: quick, short bursts
detectors: instruments that sense or notice something

Talk together (every group has these)

1. Find one fact that every group read. How did your sheet say it?
2. What did your sheet tell you that you think another group's did not? Ask them.
3. What is one question about this topic that none of the sheets answered?

Name: _____ Date: _____

Bouncing Lasers Off Mirrors on the Moon

Triangle group

Apollo astronauts left a few unusual things on the Moon, and some of them are still being used. One is a set of special mirrors. Each one is built from many small glass corners that send light straight back to where it came from. A flat mirror would bounce a beam off to the side, but these mirrors return the beam toward the source.

Several observatories on Earth fire short pulses of laser light at the mirrors. The beam spreads out as it travels, so by the time it reaches the Moon it covers a wide patch of the surface. Only a tiny number of light particles make it back to the telescope. Detectors count them carefully, and the scientists note the exact time of the round trip.

Light always moves at the same speed in space. That makes the math simple. Multiply the speed by the time the light took, then divide by two, because the beam went to the Moon and back. The answer is the distance to the Moon, and the measurement can be very precise.

After many years of readings, scientists found something surprising. The Moon is slowly drifting away from Earth, by a few centimeters each year. That is about as fast as a fingernail grows. The mirrors left long ago keep helping people learn how the Moon moves.

Questions

1. What did Apollo astronauts leave on the Moon that scientists still use?

_____

_____

2. What do observatories on Earth fire at the mirrors?

_____

_____

3. Why do scientists divide by two in the math?

_____

_____

4. How do scientists work out the distance to the Moon?

_____

_____

5. How fast is the Moon drifting away from Earth?

_____

_____

6. Why would a plain flat mirror not work well for this job?

_____

_____

Words to know

observatories: buildings with telescopes for studying space
pulses: quick, short bursts
detectors: instruments that sense or notice something
precise: very exact and careful
source: the place where something starts

Talk together (every group has these)

1. Find one fact that every group read. How did your sheet say it?
2. What did your sheet tell you that you think another group's did not? Ask them.
3. What is one question about this topic that none of the sheets answered?

Name: _____ Date: _____

Bouncing Lasers Off Mirrors on the Moon

Square group

The Apollo astronauts left behind several unusual objects on the Moon, and a few of them remain in scientific use even today. Among them is a set of specially built mirrors. Each one is assembled from many small glass corners that return light directly to the place it originated. An ordinary flat mirror would deflect a beam off to one side, whereas these reflectors send the beam straight back toward its source.

Several observatories around the world fire brief pulses of laser light at the mirrors. The beam spreads out as it travels, so by the time it reaches the Moon it blankets a wide patch of the surface. Only a tiny number of light particles manage to make the whole journey back to the telescope. Sensitive detectors count them carefully, and the scientists record the exact time that the round trip required.

Light always travels at the same speed through space, which keeps the arithmetic straightforward. Multiply that speed by the time the light took, then divide by two, because the beam traveled to the Moon and returned. The result is the distance to the Moon, and the measurement can be remarkably precise.

After many years of readings, researchers discovered something surprising: the Moon is gradually drifting away from Earth, by a few centimeters every year. That is roughly the rate at which a fingernail grows. The mirrors placed there so long ago continue to teach people how the Moon moves.

Questions

1. What did the Apollo astronauts leave on the Moon that scientists still use today?

_____

_____

2. What do observatories fire at the mirrors?

_____

_____

3. Why do scientists divide by two in the calculation?

_____

_____

4. How do scientists work out the distance to the Moon?

_____

_____

5. How quickly is the Moon drifting away from Earth?

_____

_____

6. Why would an ordinary flat mirror be a poor choice for this task?

_____

_____

Words to know

observatories: buildings with telescopes for studying space
pulses: quick, short bursts
detectors: instruments that sense or notice something
precise: very exact and careful
source: the place where something starts

Talk together (every group has these)

1. Find one fact that every group read. How did your sheet say it?
2. What did your sheet tell you that you think another group's did not? Ask them.
3. What is one question about this topic that none of the sheets answered?

For the teacher: Bouncing Lasers Off Mirrors on the Moon

Each student sheet carries a shape, not a level. The same topic and facts, written three ways.

Circle: Bouncing Lasers Off Mirrors on the Moon

Easier · 187 words · Flesch-Kincaid grade 2.3

1. Special mirrors that send light straight back.
2. Short pulses of laser light.
3. The beam goes to the Moon and back, so the trip is counted twice.
4. They multiply the speed of light by the trip time and divide by two.
5. A few centimeters each year, about as fast as a fingernail grows.
6. It would bounce the beam off to the side, not back to the source.

Triangle: Bouncing Lasers Off Mirrors on the Moon

This passage · 224 words · Flesch-Kincaid grade 5.7

1. Special mirrors that send light straight back.
2. Short pulses of laser light.
3. The beam travels to the Moon and back, so the trip is counted twice.
4. They multiply the speed of light by the round trip time and divide by two.
5. A few centimeters each year, about as fast as a fingernail grows.
6. It would bounce the beam off to the side instead of back to the source.

Square: Bouncing Lasers Off Mirrors on the Moon

Harder · 242 words · Flesch-Kincaid grade 9.1

1. Specially built mirrors that send light straight back.
2. Brief pulses of laser light.
3. The beam traveled to the Moon and back, so the trip is counted twice.
4. They multiply the speed of light by the round trip time and divide by two.
5. A few centimeters every year, about as fast as a fingernail grows.
6. It would deflect the beam to the side instead of back toward the source.