

**Science Benchmark: 06 : 01**

The appearance of the lighted portion of the moon changes in a predictable cycle as a result of the relative positions of Earth, the moon, and the sun.

**Standard 01:**

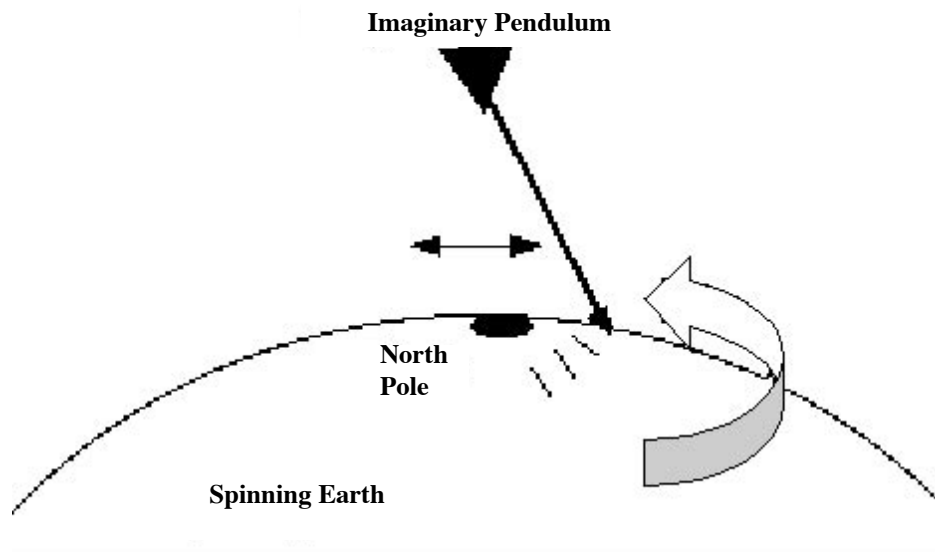
Students will understand that the appearance of the moon changes in a predictable cycle as it orbits Earth and as Earth rotates on its axis.

*STUDENT BACKGROUND INFORMATION*

## THE MYSTICAL MOON

When we look up into the sky, we see the sun, moon, planets and stars going across the sky. We may think Earth is standing still and everything is going around us. Hundreds of years ago people saw the same thing and believed Earth was the center of the universe. It seemed Earth stood still and everything in the sky circled Earth.

In 1852, a French scientist, Jean Bernard Foucault, did an experiment to show that Earth spins. He built a pendulum by attaching an iron ball with a pointer on it to a 200-foot wire hanging from a dome ceiling. After putting the ball into motion, it scratched a mark in sand spread out below it, each time it swung across. Throughout the day the scratch lines slowly and evenly shifted to the right. Foucault's swinging iron ball offered proof of the Earth's **axis of rotation**, *the spinning of objects around an imaginary center line*. Since a pendulum does not change course, it had to be Earth that was rotating beneath the pendulum. The North and South Poles mark Earth's axis. It is easiest to understand a pendulum at the North Pole. The pendulum would swing in the same path all day scratching marks in a complete circle as Earth rotated under it.



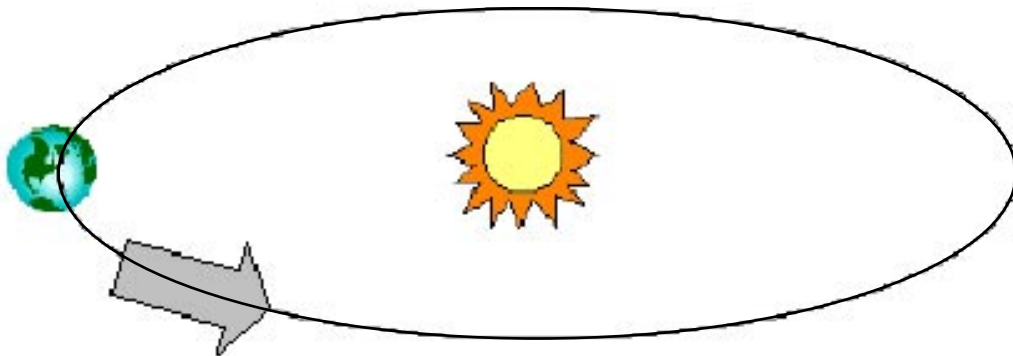
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When we see the sun move across the sky, it is the rotation of Earth that gives the sun this appearance. The sun is actually in the same place in the sky. As Earth rotates, it brings the sun in and out of view giving us daylight and darkness. Like the sun, the stars stay in the same place. As Earth rotates, all stars, except the North Star, appear to change their positions. Some stars will come into view or go out of view. Others will follow a circular pattern in the sky. Some night, pick a star in the eastern horizon to observe. During the night, it will appear to be moving across the sky just like the sun. It is the rotation of Earth that changes the star's positions during the night. On another night, pick a star near the North Star. It will appear to be circling around the North Star. Earth's axis is pointing directly at the North Star, so the star doesn't appear to move. The stars near the North Star seem to be circling it because of the rotation of Earth.

Earth rotates on its axis every 24 hours. Another major movement of planets and moons is **revolution**, *the circling of an object in space around another object in space*. It takes a year for Earth to revolve around the sun. It takes the moon about 29 days to revolve around Earth. *The path a planet or a moon takes during its revolution is called an orbit.*

### Movements of the Earth

#### Revolution



Side view of Earth's orbit makes the orbit look oval

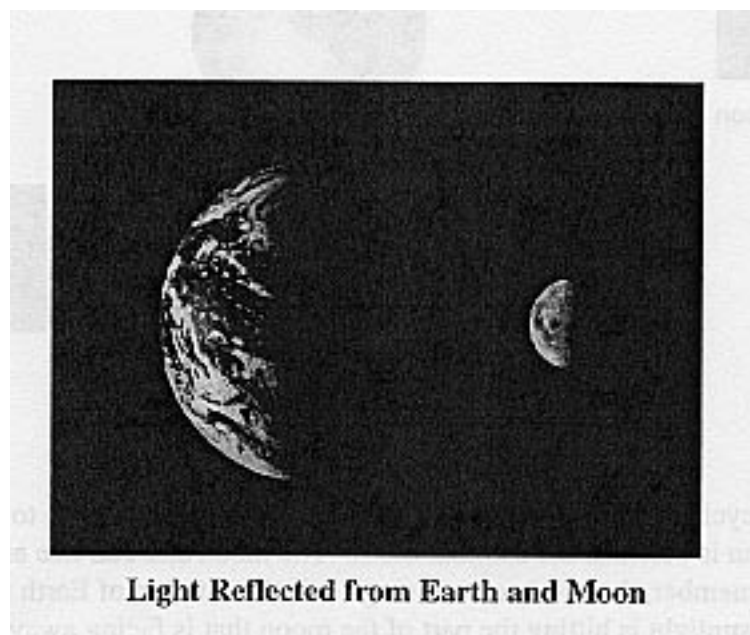
#### Rotation



Not only were early astronomers very interested in the sun and stars in the sky, they were also fascinated by the changing moon. It appeared to change size from day to day. This strange occurrence captivated people's imaginations for hundreds of years. There have been many stories, legends and myths written to explain why the moon changes shape. One story claims the moon is a cookie that is nibbled on each night by some mysterious creature, then magically reappears whole in a few days. Another story tells that Earth's shadow falls on the moon causing the light to gradually disappear then gradually reappear. Today we know these ideas are incorrect. In the next few pages, you will read why the moon appears to change and grow in the sky each month.



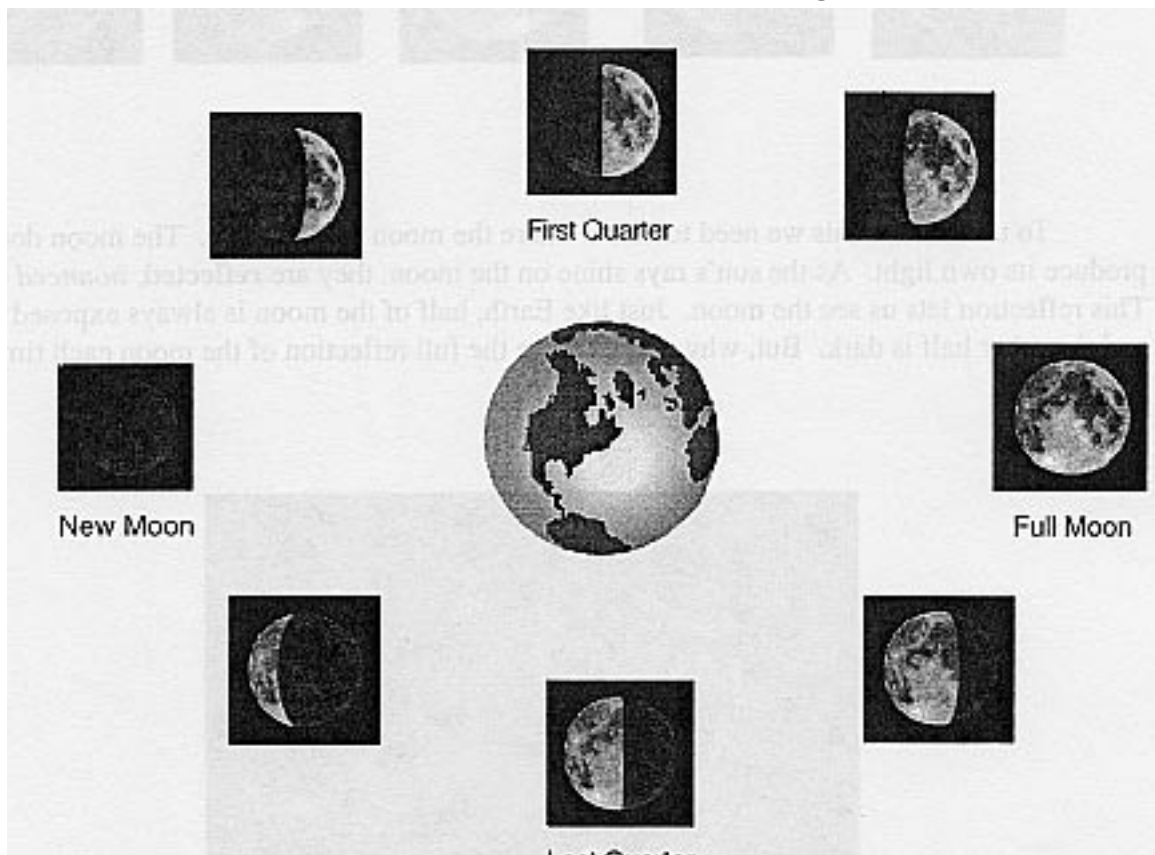
To understand this we need to know where the moon gets its light. The moon does not produce its own light. As the sun's rays shine on the moon, they are **reflected**, *bounced off*. This reflection lets us see the moon. Just like Earth, half of the moon is always exposed to light, and the other half is dark. But, why don't we see the full reflection of the moon each time we see the moon?



Remember, it takes the moon about twenty-nine days to revolve around Earth. The lunar cycle takes place during the revolution. During the lunar cycle the sun rises twenty-nine times. You have probably noticed that the moon doesn't always rise and set at the same time each day. Sometimes it rises with the sun, after the sun has been up a while or when the sun is setting. Sometimes it rises after the sun has gone down or in the middle of the night. The moon doesn't revolve around Earth as fast as the Earth rotates. Because of Earth's faster rotation, the moon rises about fifty minutes later each day.

You have probably noticed that each time the moon rises it appears to have a different shape. The shape of the moon seems to grow for a while and then shrink for a while. The **phases of the moon** are *the different shapes of the moon during a lunar cycle*. So, not only is the moon rising at different times each day, it also has a different shape each day.

**Some views of the moon from Earth during one month**



The lunar cycle begins with the New Moon—one that is not visible to our eyes. During this phase the moon is between the sun and Earth. The moon and sun rise and move across the sky together. (Remember, the sun is not moving. It is the rotation of Earth that brings the sun into view.) Since sunlight is hitting the part of the moon that is facing away from Earth, we see only the dark side of the moon. We cannot see any part of the moon's lighted reflection, so the moon is invisible. We call it a New Moon. The New Moon phase only takes place during daylight hours. As Earth rotates to nighttime, the New Moon is no longer in view, having disappeared behind the horizon.

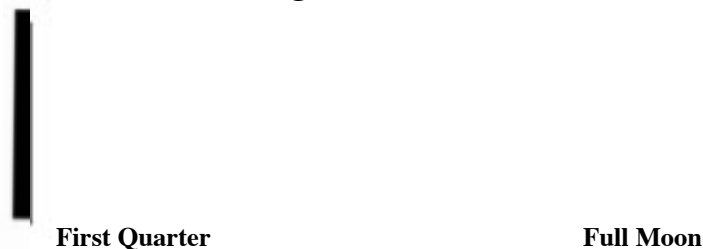
Since the moon rises later each day during the lunar cycle, we see more of the lighted side of the moon each time it rises. On the eighth or ninth day, the moon is in the First Quarter phase. It has traveled one-quarter of the way through its orbit. From Earth we can now see one-half of the lighted side.

#### New Moon to First Quarter



On the fifteenth or sixteenth day of the lunar cycle, the moon has orbited behind Earth, putting Earth between the sun and moon. The moon has traveled half way in its orbit. Each night we see more of the lighted side appear. The positioning of these three bodies lets us see the complete lighted side of the moon called the Full Moon.

#### First Quarter to New Moon



On the twenty-second or twenty-third day of the lunar cycle, the moon has orbited to the other side of Earth, opposite the First Quarter Moon's position. The moon now looks smaller as we see less and less of the lighted side. It appears as a half moon just as it did at the First Quarter Moon. But what is different about the Last Quarter Moon compared to the First Quarter Moon? You are right if you guessed that the lighted side is on the left or east side instead of the right or west side of the moon. This is called the Last Quarter Moon because the moon has traveled three-quarters of the way through its orbit.

#### Full Moon to Last Quarter



Finally as the moon approaches the last phase of the lunar cycle, the moon and sun are rising just about the same time. The reflected light we see from the moon has shrunk to a small sliver. The next day the moon will be positioned between the sun and Earth creating a New Moon. The lunar cycle starts over again.

#### **Last Quarter to New Moon**



Scientists can predict very accurately where the moon will be and what phase the moon will be in on any given day in the future. Because the sun, Earth, and moon are so reliable, we have based calendars and measured time on their motions. We also have the beautiful phases of the moon for our enjoyment and curiosity.

*Science Language Students Need to Understand and Use*

1. **axis of rotation:** the spinning of objects around an imaginary center line
2. **orbit:** the path a planet or moon takes during its revolution
3. **phases of the moon:** the different shapes of the moon during a lunar cycle
4. **reflection:** the process of bouncing off
5. **revolution:** the circling of an object in space around another object in space