EXPLORING
the MOON and STARS Grades 5-8

Key ideas:

Observation of shadows can provide evidence for the changing orientation of the Earth and Sun, which causes the seasons and differences in the length of each day. Direct observation of the Moon's apparent shape and movement can yield inferences about the Moon's orbital and axial motions. Observation makes it possible to predict how the stars move across the night sky and how the night sky changes from season to season.

Specific Learning Objectives

Unit 1: The Reasons for Seasons

Exploration 1: Seasonal Change

- Seasonal patterns occur with predictable changes in temperature, weather, plant cycles, animal behavior, and hours of daylight.

Exploration 2: Tracking the Change in the Length of the Day

- Times of sunrise and sunset change daily as the orientation of the Earth to the Sun shifts throughout the year.
- Changes in seasons are linked to the pattern of changes in the hours of daylight and darkness throughout the year.
- For areas north or south of the equatorial region, the number of hours of daylight are greatest around the start of the local summer season and shortest around the start of the local winter season.

Exploration 3: Building the Astronomy Lab

- Modeling is the way scientists understand nature.
- Scientists use models to predict how nature behaves under different conditions.
- All models have limitations.
- Day and night occur at a location on the surface of the turning Earth as that location moves into or out of sunlight.
- At any given moment, about half of the Earth's surface area is illuminated by sunlight, but the particular half changes daily and throughout the year.

Exploration 4: Daylight and Darkness at Different Times of the Year

- The number of hours of daylight and darkness gradually changes throughout the year as the orientation of the Earth to the Sun shifts.
- On the northern summer solstice, regions north of the equator have the greatest number of daylight hours of the year.
- On the northern winter solstice, regions north of the equator have the fewest number of daylight hours of the year.
- On the days of the fall and spring equinoxes, the number of daylight hours is about equal to the number of darkness hours everywhere on Earth.

Exploration 5: Daylight and Darkness at Different Locations

- Throughout the year, the number of hours of daylight and darkness are about equal for locations near the equator.
- Throughout the year, locations closest to the Earth's poles have the greatest variation in the number of hours of daylight and darkness.
- On most days of the year, the hours of daylight and darkness for most locations along a north-south line vary from one site to another.
- On any given day, the hours of daylight and darkness for locations along an east-west line are approximately the same for each site.

EXPLORING the MOON and STARS *continued*

When students collect, graph, and interpret their own data, they develop a deeper understanding of what scientists do. In *Exploring the Moon and Stars,* students learn to make reasoned inferences about natural phenomena such as the seasons, the phases of the Moon, and the path of the stars across the sky.

Specific Learning Objectives

Exploration 6: Tracking the Path of the Sun

- The path of the Sun across the sky gradually changes throughout the year as the orientation of the Earth to the Sun shifts.
- For regions outside the equatorial belt (23.5° north or south of the equator) the angular height above the horizon of the Sun's path across the sky is greater in the spring and summer than in the fall and winter.

Exploration 7: The Heat Is On!

- The amount of sunlight striking a specific site on Earth gradually changes throughout the year as the angular height of the Sun above the horizon changes.
- The variation from summer to winter in the amount of sunlight striking a specific site is greatest in regions outside the equatorial belt.
- The greater the angular height of the Sun, the more direct the sunlight, resulting in greater warming. The changing angular height of the sun at noon is one of the reasons for seasons.

Unit 2: Tracking the Moon in the Sky

Exploration 8: Keeping a Moon Journal

- The Moon's apparent shape changes daily and follows an easily observed, repeating cycle.
- Throughout a month, the Moon is visible for some portion of the daylight hours on all but a few days.

Exploration 9: The Moon's Size and Distance from Earth

- Relative to the Earth, the Moon is considerably smaller in volume and mass.
- The distance between the Moon and the Earth is considerably greater than most people estimate.
- The diameter of the Earth is about four times that of the Moon.
- Thirty Earths placed side-by-side would span the average distance from the Earth to the Moon.

Exploration 10: Modeling Moon Phases

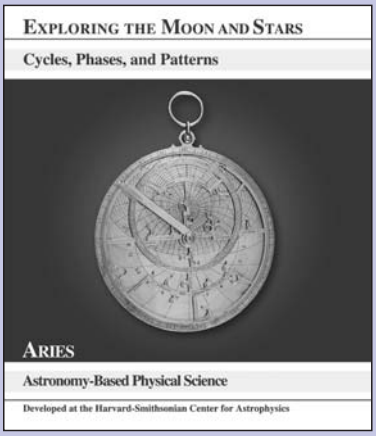
- The phase or appearance of the Moon depends upon the relative positions of the Earth, Moon, and Sun.
- The Moon is illuminated by sunlight.
- The portions of the Moon facing the Earth but not visible during many of the phases are hidden in the Moon's own shadow.

Exploration 11: Estimating the Distance to the Moon

- The distance to any object can be calculated if both its angular size and at least one of its dimensions is known.
- The Moon is about 380,000 kilometers (240,000 miles) away from the Earth.

Important content:

- The changing length of the day
- The apparent motion of the Sun
- The changing distribution of sunlight
- Moon phases
- The relative size of the Moon and its distance from the Earth
- The orbital and axial motions of the Moon
- The apparent motion of the stars
- Constellations and star groups



Exploration 12: Observing Lunar Surface Features

- The surface of the Moon visible from the Earth has large, relatively smooth regions, numerous craters, and extensive mountain ranges.
- The direction of the Moon's orbit around the Earth is from west to east.
- The Moon spins once on its axis in approximately the same time it takes to make one complete orbit of the Earth.

Unit 3: Looking at the Starry Sky

Exploration 13: Observing Star Groups or Constellations

- Most stars appear to move from east to west throughout the night as a result of the Earth's spin.
- The arrangements of star groups or constellations remain the same throughout the night.

Exploration 14: Building and Using the ARIES Star Projector

- A star projector can be used to investigate the apparent motion of the stars and the change in appearance of the night sky from season to season.

Exploration 15: Modeling the Nighttime Sky with the ARIES Star Projector

- To an observer facing north, stars in the northern hemisphere appear to move counterclockwise around Polaris or the Pole Star.
- Polaris appears to move little or not at all throughout the night.
- The apparent motion and change in location of star groups and constellations are predictable nightly and annually.
- Most stars in the northern hemisphere appear to move from east to west throughout the night.

Exploration 16: Making and Using the ARIES Star Tracker

- Constellations, star groups, and individual stars show little or no change in their relative position to one another during the span of a human lifetime.
- Some constellations and stars appear only at certain times of the year and not at others.

Exploration 17: A Nighttime Star Party

- Constellations, star groups, and individual stars show little or no change in their relative position to one another during the span of a human lifetime.
- Some constellations and stars appear in the night only at certain times of the year.
- Familiar constellations and stars can be used to locate and identify unfamiliar stars and star groups.