How Can We Use the Sky to Navigate?
Unit Storyline

Focus Question 1: What is the evidence for a spherical Earth?

Lesson 1: Set Sail
Ships sailing at the horizon provide evidence that Earth is spherical.

Students use a model to compare a ship sailing away from an observer on a spherical and flat Earth in order to explain why a ship disappears at the horizon.

Lesson 2: Boston and Santiago
Shadows provide evidence that Earth is spherical.

Students use a model to argue that the variation in the direction and length of shadows on Earth is caused by Earth's spherical shape.

Lesson 3: Gravity Around the World
Gravity is a force directed toward the center of a spherical Earth.

Students develop a model to show the pattern of gravity around Earth. Students use a model as evidence to argue that gravity is a force directed toward the center of a spherical Earth.

Focus Question 2: How can we explain daily observations of the sky?

Lesson 4: Distances Can Be Deceiving
The Sun appears larger and brighter than other stars because it is closer.

Students use a model to explain how distance impacts the apparent size of objects, then argue from evidence that the Sun appears larger and brighter than other stars because it is closer.

Lesson 5: Moving Shadows
The Sun's daily motion provides evidence that Earth rotates on an axis.

Students observe and then model how the Sun's daily pattern of motion causes changes in shadows over the course of a day. Students use a model to explain how the rotation of the Earth on its axis causes these changes in shadows and the Sun's daily pattern of motion.

Lesson 6: Pictures in the Sky
The daily motion of the stars provides evidence that Earth rotates on an axis.

Students analyze and interpret the motion of different constellations over the course of the night to find the stars' daily pattern of motion. Students use evidence of the Sun and stars' daily pattern of motion to support the claim that Earth rotates on an axis.

Focus Question 3: What causes the annual patterns of motion of the Sun and stars?

Lesson 7: Where is Orion
Some constellations are not visible all year.

Students carry out an investigation to identify the pattern of a constellation's movement throughout the year, including when the constellation is not visible in the night sky. Students develop and use a model to explain that the cause of disappearing constellations is Earth's revolution around the Sun.

Lesson 8: Modeling Daylight
Earth's revolution around the Sun causes variation in daylight.

Students use a model to measure the proportion of a day that the school's location will experience daylight on June 21, September 21, December 21 and March 21.

Lesson 9: It's Been a Long Day
Earth's revolution around the Sun causes variation in daylight.

Students graph the amount of daylight on the 21st day of each month and explain that the annual pattern of daylight is caused by Earth's rotation on a tilted axis and Earth's revolution around the Sun.

Source: Smithsonian Science Education Center, *How Can We Use the Sky to Navigate?* in Smithsonian Science for the Classroom. Carolina Biological, Burlington, NC, 2019.

Focus Question 4: How are tools and systems used to navigate?

Lesson 10: Where on Earth
Predictable patterns in the night sky can be used to solve a navigational problem.

Students use a model to collect star altitude data and interpret class data to identify the pattern that Polaris's altitude at a location is the same as the location's latitude.

Lesson 11: Things are Looking Up
Solutions to problems are designed to meet criteria and constraints and must be tested to determine which best meets them.

Students carry out an investigation to determine which of two solutions is better for measuring the altitude of Polaris.

Lesson 12: Finding the Way
Solutions to problems are designed to meet criteria and constraints but must be implemented correctly to be successful.

Students obtain information from a reading to identify a navigational problem and solutions that are designed around patterns in the sky.

Science Challenge
Focus Question 5: How could ancient Polynesians navigate the ocean without instruments?

Lesson 13: Sweet Potato Mystery Part 1
Ancient Polynesians navigated the ocean without instruments.

Students obtain information from text to use as evidence to support a claim about ancient Polynesians sailing from the Marquesas Islands to Peru, including an estimate of the length of time for the journey.

Lesson 14: Sweet Potato Mystery Part 2
Observations of the sky can be used to navigate a boat.

Students develop models to show how to navigate a boat based on the pattern of the Sun's apparent daily motion. Students use mathematics to find the latitude of the boat's location by measuring the altitude of the Sun and stars.

Lesson 15: Sweet Potato Mystery Part 3
Scientific arguments are based on evidence.

Students engage in argument about the plausibility of Polynesians sailing long distances without instruments by using evidence that the patterns of the Sun and stars can be used to navigate

Source: Smithsonian Science Education Center, *How Can We Use the Sky to Navigate?* in Smithsonian Science for the Classroom. Carolina Biological, Burlington, NC, 2019.