Think Like A Scientist

Be A Sky Sleuth

NSTA eBooks+ Kids

TEACHER'S GUIDE

They will compare how the shadow's length and direction relate to the height and position of the Sun in the sky.

After exploring daytime patterns, readers will solve mysteries with Ana and Zane about nighttime patterns. They will use patterns to identify that the Sun is a star that appears in the daytime sky. The other stars appear in the nighttime sky. They will investigate pictures of the sky in different regions of the world taken at the same point in time. Readers will determine that the stars are always present in the sky, but they cannot be seen when the Sun is shining on the region of Earth where one is located.

Finally, readers will investigate the Moon. They will track the Moon's path and determine that it appears to rise, set, and move across the sky. Students will also determine that the Moon appears at night and sometimes during the day. They will then learn about moon phases and predict which phase is missing from a sequence.

The Driving Question

A driving question is one that drives the teaching and learning for a given unit, or even an entire school year. It provides context for student exploration and understanding of a phenomenon. In this book, students will explore the phenomenon that the appearance of objects in the sky changes over time. Students will explore the positions of the Sun, Moon, and distant stars at different times of the day and investigate the changes in moon phases. This e-book is written around the driving question:

How can patterns be used to predict the positions of the Sun, Moon, and stars?

Three-Dimensional Learning and the *Be a Sky Sleuth!* E-book

You will notice throughout the document that certain words and phrases are highlighted in different colors: blue, green, and orange. These colors correspond to the science and engineering practices (blue), crosscutting concepts (green), and disciplinary core ideas (orange). The book also incorporates engineering design (purple). This will help you quickly notice how each of the three dimensions and engineering design are used on a page. Refer back to this section for the full descriptions.

This e-book does not use all of the grade-level elements for the practices and crosscutting concepts, but that does not mean that you should not be aware of the other practices and concepts your students need to know. For a full list of all grade-level elements for the science and engineering practices and crosscutting concepts, refer to Appendix A. For engaging in literacy ideas, refer to Appendix B.

Topic 1

Observing Daytime and Nighttime

This topic is meant to **engage** students and help the teacher assess what students already know about the patterns of daytime and nighttime. Students will **explore** the causes of day and night by using an interactive simulation of the Earth's rotation. They will also use the model to **explain** whether Boston, Massachusetts and Beijing, China have daytime at the same time.

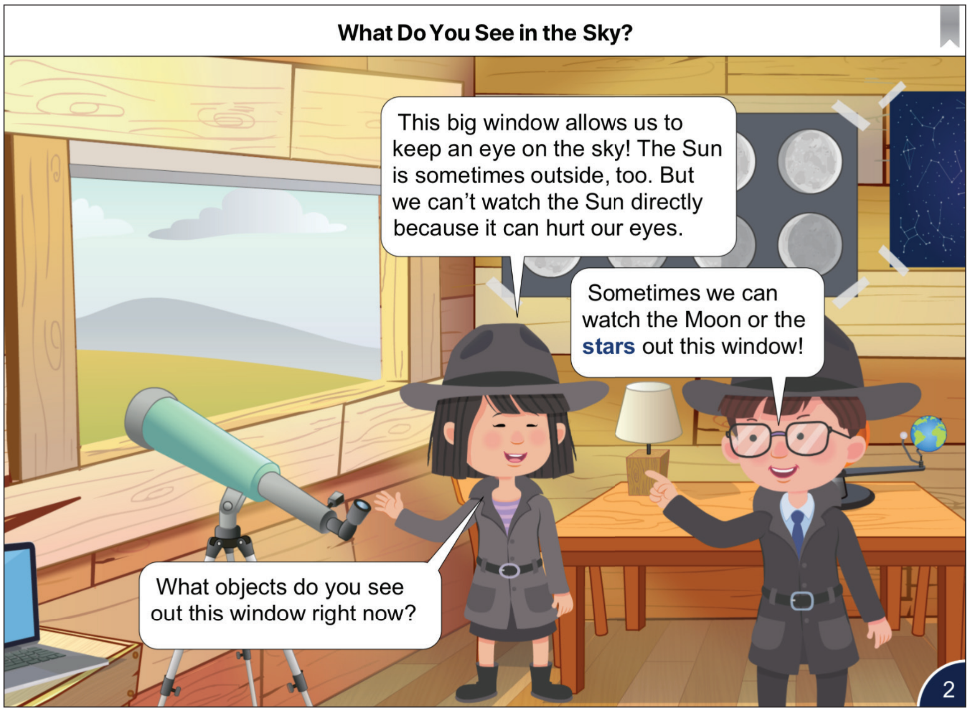
By the end of the topic, students will be able to:

- use observations from an interactive simulation to describe patterns of daytime and nighttime;
- use patterns to explain the cause-and-effect relationship between the Earth's rotation and day and night;
- explain the gradual changes that occur between day and night;
- use models of the Earth and Sun to explain that the patterns of the Sun can be observed, described, and predicted; and
- carry out an investigation to determine whether two locations on opposite sides of the world have daytime and nighttime at the same time.

Teacher's Note

The models used in this book are not to scale. Scale models use ratios to show accurate representations of the sizes and distances of objects. For example, a scale model that shows the distance between Earth and the Sun may use a scale of 1 centimeter to equal 10 million kilometers of actual distance. The models in this book are designed to clearly show patterns in the movement and shapes of space objects, not actual representations of size or distance.

Page 2



On this page, students will use what they know about patterns in the sky to identify whether it is daytime or nighttime where Ana and Zane live based on what they see out the Sky Sleuth window. They will obtain information from the image and construct an explanation about whether it is day or night.

Differentiated Instruction

Zane asks the question: What objects do you see in the sky out this window right now? English Language Learners may need a definition for the word *object*. Some students may think the word *object* only describes small things that they can hold in their hand or can physically touch. Explain that an object is any non-living thing that can be observed. Emphasize that observations are not limited to sight; hearing, touching, smelling, and tasting are also ways to make observations. We can refer to the Sun, Moon, and stars as objects because they are non-living things that can be observed.

Misconceptions

Misconceptions can be used as stepping off points to help students make sense of phenomena. When possible, use misconceptions as initial ideas to spur learning and investigations. Students should be given opportunities to make-sense of phenomena. By making sense of the phenomenon, students will be able to revise their initial thinking. One of the goals of this e-book

How to Use

In this interactive, students will watch two locations (Beijing, China and Boston, Massachusetts) as Earth rotates. Students should conclude that since these two locations rotate into and out of daylight at different times, they must have day and night at different times. At the start of the interactive, the “Start” and “Stop” buttons will appear. Beijing, China (marked with an O) will be in the daylight. Boston (marked with an X) will be on the nighttime side of the Earth. Students press “Start” to begin the Earth’s rotation and “Stop” to pause the rotation.

Investigation

If there is a globe in the classroom, you can recreate the interactive using a flashlight. Mark your location on the globe with an X. Then pick a location in a different time zone and mark it with a O. Look up the time difference between each location and give the students the following scenario: When it is 9:00 a.m. where we live, it is (state time) in (state location of the O). Hold the flashlight so that the light shines most directly on the equator. Ask for a volunteer to slowly spin the globe and see what happens to the X and O. Have the students explain the time difference based on what they see on the globe.

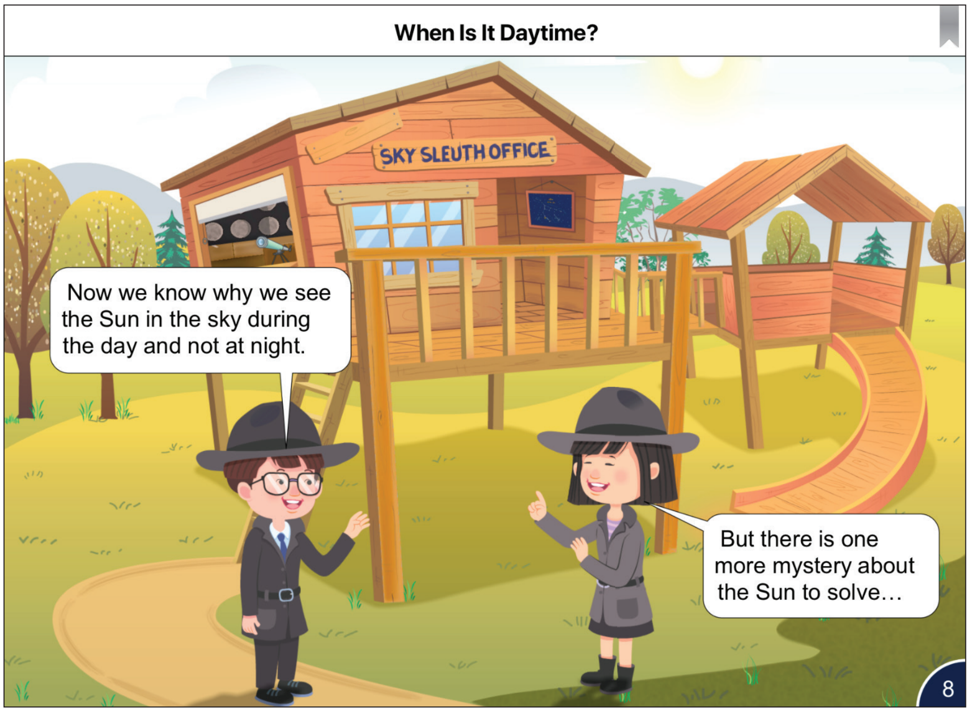
Math Connection

CCSS.MATH.CONTENT.1.OA.A.1

Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem.

Students of this age can do simple addition and subtraction to determine time differences using a clock. For example, give students a problem like: When it is 11:00 a.m. in New York City, it is 8:00 a.m. in Los Angeles, California. How many hours difference is this? Students can count the hours using a clock. Have students relate time differences to the locations of these two places on a map and the rotation of the Earth.

Page 8



This page will engage students by asking them to try to guess the next mystery they will solve.

Discourse

Say: We've learned how the Sun and the Earth cause daytime and nighttime. What other patterns does the Sun have? Provide students time to think. Students might state that the Sun rises and sets or that it seems to move across the sky. Ask: Does the Sun always have this pattern or do the Sun's patterns change? Ask students to give specific examples of the pattern and allow other students to add on or disagree. This can help you assess prior knowledge on the topic and identify any preconceptions.

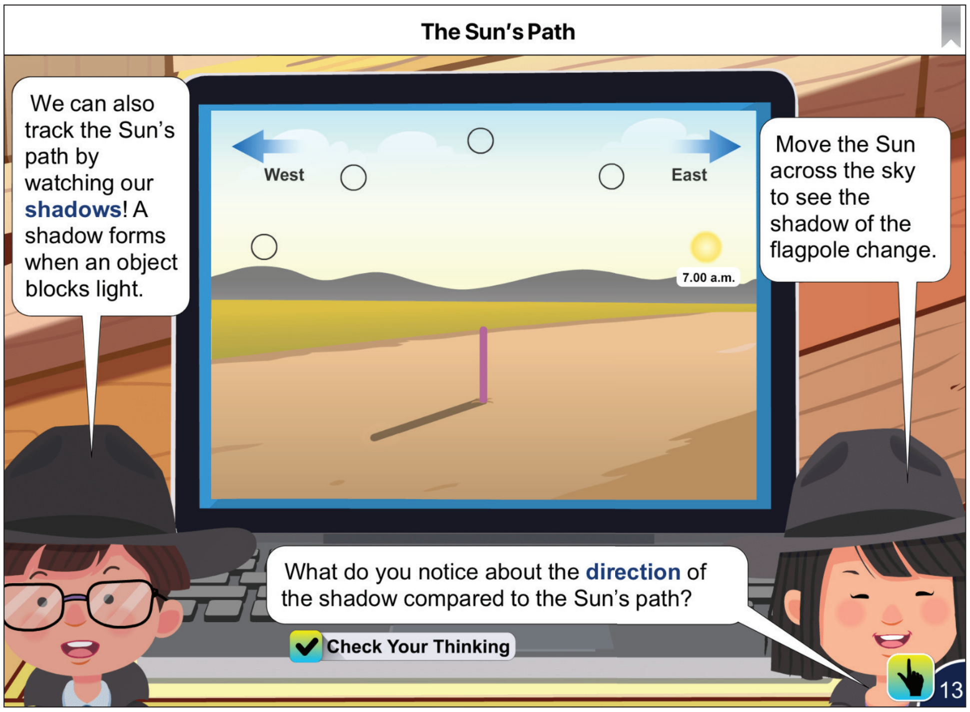
Language Arts Connection

CCSS.ELA-LITERACY.RI.1.7

Use the illustrations and details in a text to describe its key ideas.

To help students guess the next mystery of the Sun that they will solve, have them look at the Sun in relation to Ana and Zane on the page. Ask students if the Sun is always in this position in the sky. Students will most likely say no. Ask them to describe other positions where they have noticed the Sun. Students may have noticed that the Sun is lower in the sky during sunrise or sunset and higher in the sky near solar noon. The Sun's position in the sky also depends on geographical location as well.

Page 13



On this page, students will use a model to explain the cause-and-effect relationship between the Sun's apparent motion and the direction of shadows. Students will explain that the Sun's position and, therefore, the position of the shadows are patterns that can be observed and predicted.

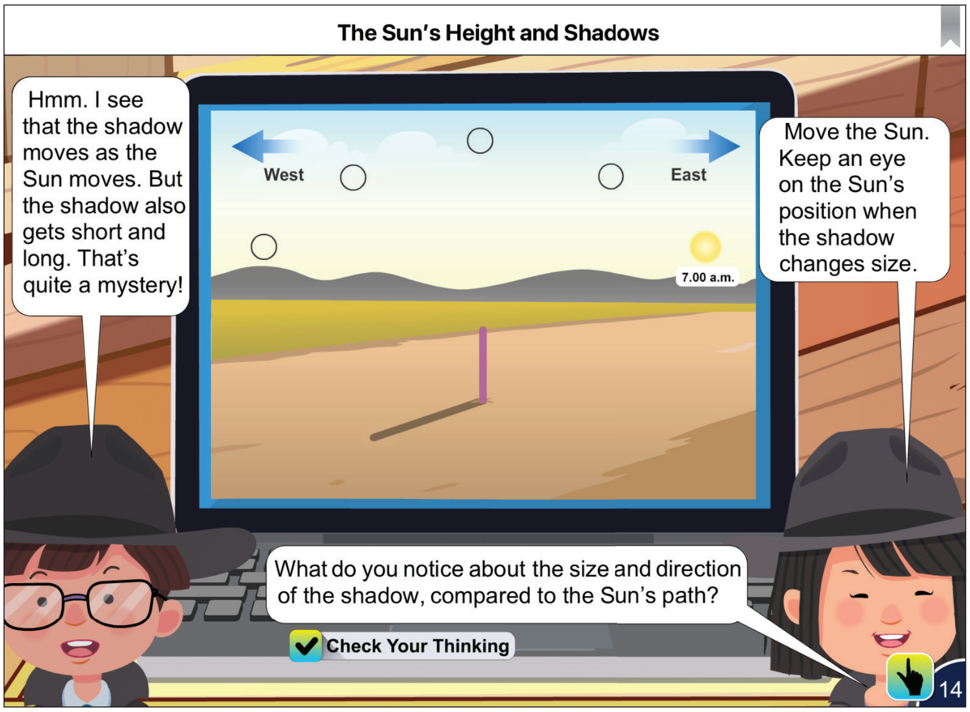
How to Use

In this interactive, students will move the Sun and see how the flagpole's shadow changes. When the interactive starts, students will see five empty circles where they can put the Sun. It will be started on the 7:00 a.m. position. Students will click on one of the empty circles to put the Sun in that position. When they select a circle, they will see the time of day and the shadow of the flagpole when the Sun is in that position. Students should conclude that the Sun and the shadow make a straight line with each other and that the shadow always points in the exact opposite direction of the Sun's position.

Misconceptions

Students of this age will often draw an object with a shadow, but they may not know that light is needed to make a shadow. Assess student preconceptions by asking them to draw how a shadow forms. If the student does not draw a light source, ask: Do you think a shadow will form in complete darkness? How can you test this? If time allows, allow students to test their question and revise their drawing based on what they've learned.

Page 14



On this page, students will identify patterns of the Sun's movement and relate it to shadow length. Students will also use mathematical and computational thinking to determine that the flagpole shadow is short around solar noon (when the Sun is at its highest point in the sky) and longest in the early morning and late afternoon hours.

Teacher's Note

In this lesson, students will use mathematical and computational thinking to determine time of day based on the shadows of the flagpole. They will also use the concept of longer or shorter regarding shadow length.

To encourage students to think mathematically during the interactive, give them two positions to place the Sun (for example, far east and solar noon.) Ask:

- Which of these two positions occurred earlier in the day? How do you know?
- Can you show me on a clock how many hours passed between these two Sun positions?
- Did the shadow get shorter or longer between these two times? Can you use a ruler to model how the length of the shadow changed?

Differentiated Instruction

Some students may need additional assistance with using the model. If desired, students can work in pairs or small groups on the model and then discuss any patterns they noticed about the