Introduction:

The Teacher Guide is designed to support teachers in teaching with the new Mystery Science Anchor Layer. This is a new feature, and we plan to revise and improve the Anchor Layer based on your feedback! Thank you!

What is the Anchor Layer?

In NGSS instruction, there is a distinction between *anchor* phenomena and *investigative* phenomena. Anchor phenomena are complex phenomena that students need an entire unit, and multiple scientific ideas, to explain. Investigative phenomena are specific, lesson-level phenomena that help students understand smaller conceptual pieces of a larger idea. As students investigate specific phenomena, they can use those learnings to make sense of the anchor phenomenon that guides the unit.

We think of our traditional lessons as investigative phenomena. This new Anchor Layer adds an anchor phenomenon to open and frame the unit. After each lesson, students return to the anchor phenomenon and apply what they've learned to develop increasingly sophisticated models, arguments, explanations or design solutions that help them make sense of the anchor phenomenon.

We've designed the Anchor Layer to be optional for teachers. Teachers can teach our lessons with or without the Anchor Layer.

Storylines:

Storylines provide a coherent overview of how the Anchor Layer unfolds, what students are figuring out at each step, and questions that lead to the next investigation. **View Anchor Layer Storylines**

Before Lessons

I. Anchor Phenomenon
Observe puzzling, complex real-world events explained through scientific evidence

II. Student Inquiry
Make observations and ask questions

III. Initial Student Ideas
Develop initial Conceptual Model, Argument, Explanation, or Design Solution

During Lessons

IV. Investigative Phenomena
Investigate specific real-world events that provide conceptual pieces to a larger idea

V. Student Revision
Revise Conceptual Model, Argument, Explanation, or Design Solution

After Lessons

VI. Performance Task
Demonstrate conceptual understanding in a new scenario

Spinning Sky Anchor Layer

Teacher Guide

TEACHER RESOURCE

Unit Overview

Key Concepts Overview:

- Shadows are created when objects block light.
- Shadows can move when light sources move or when the objects blocking the light move.
- The Sun's apparent motion in the sky causes the size and shape of shadows to change over the course of every day.
- The Sun's apparent motion follows a regular, predictable pattern that can be used to explain a variety of phenomena on Earth.

3-Dimensional Alignment	
Crosscutting Concepts	**Patterns**
Science and Engineering Practices	**Analyzing and Interpreting Data**
Disciplinary Core Ideas	**ESS1.A: The Universe and its Stars**
Performance Expectations	**1-ESS1-1. Use observations of the sun, moon, and stars to describe patterns that can be predicted.**

Unit Pacing Guide			
Anchor Phenomenon	1 hour	**Lesson 3**	1.5 hours
Lesson 1	1.5 hours	**Lesson 4**	1.5 hours
Lesson 2	1.5 hours	**Performance Task**	1 hour
Note: Using Optional Extensions for Lessons 1-4 can extend each lesson up to an additional 2 hours.			

Why do shadows change so much over the course of every day?

On a daily basis, the sky above our heads goes through some of the most dramatic changes of anything in our world. Over the course of just a few hours, the sky can change from a jet black background speckled with thousands of stars, to a uniform bright blue with the Sun as the only visible object.

Early cave paintings show that our ancestors paid great attention to the objects that can be seen in our sky, and the ways in which those objects move. While the *explanations* for how and why these objects move has changed over time, the *patterns* that can be observed in their movement are predictable and consistent.

The brightest object that can be observed in our sky is the Sun. As long as you are not close to the extreme north and south poles of the Earth, the Sun can be observed to rise in the east every morning and set in the west every evening. (Close to the poles, there can be multiple days in a row in which the Sun doesn't set, and multiple nights in a row in which the Sun doesn't rise!) During the late winter and throughout the spring, the days get longer and longer as the Sun rises earlier and sets later. Then, the reverse happens over the course of the remainder of the year. These daily, monthly, and yearly changes in the Sun lead to daily, monthly, and yearly changes in the shadows we see on the ground. By observing these patterns of light and shadow as they have happened in the past, we can make predictions about them far into the future.

While the Sun is only visible during the day, our Moon is an object that can be present in the sky during the day and the night. It follows a predictable pattern of rising and setting, just like the Sun, but the patterns are different. Its patterns repeat roughly each month. In fact, the word "month" is directly related to the word "moon." By observing objects in the night sky, just as our ancestors did thousands of years ago, we can describe, explain, and predict the behavior of those objects as well.

Spinning Sky Anchor Layer

Teacher Guide

BEFORE LESSON 1

Anchor Phenomenon

I. Anchor Phenomenon

Puzzling, complex real-world events explained through scientific evidence

1. Prepare your classroom for the Anchor Phenomenon lesson:
   a. Create a class See-Think-Wonder chart
2. Begin the Anchor Phenomenon lesson. The lesson includes visuals and text, and it presents the students with an introduction to one aspect of the mystery they will be solving: why do some shadows move, even if the objects making the shadows aren't moving?

Tip: *The unit anchor phenomenon is a real-world occurrence that motivates students to ask questions and learn more about scientific concepts. Encourage them to investigate throughout the unit.*

II. Student Inquiry

Students make observations and ask questions

1. Guide students through the first of the See-Think-Wonder slides.
2. Discuss class responses and write them in the first column of your class See-Think-Wonder chart.
3. Repeat for the second *(I think…)* and third *(I wonder…)* slides.

Tip: *The chart on the next page provides possible student responses. Use this resource to help you further the See-Think-Wonder discussion with your students.*

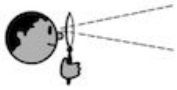
BEFORE LESSON 1

Anchor Phenomenon

II. Student Inquiry (continued)
Students make observations and ask questions

Sample student See-Think-Wonder responses

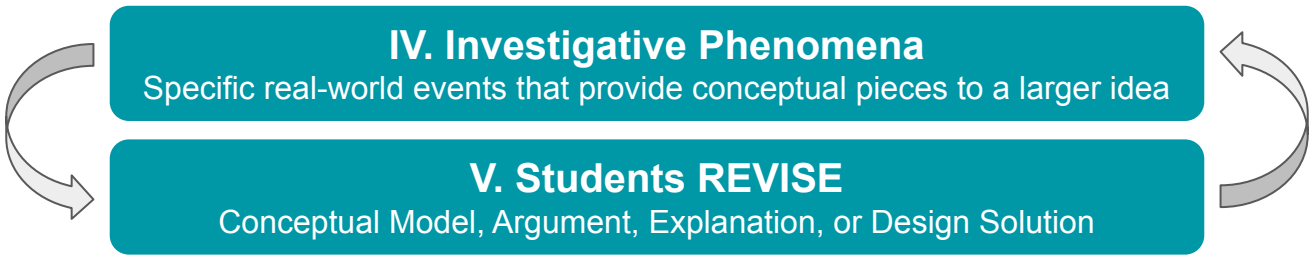
See-Think-Wonder Chart

See What did you observe? 	Think How can you explain what is happening? 	Wonder What questions do you have? 
• *Dark lines moving very slowly* • *People moving very fast* • *The sky is blue and it is bright out*	• *It's trees, and the trees are moving* • *The video is moving much faster than real life* • *It's trees that are growing*	• *Why are the trees moving?* • *Why are the trees moving so slowly?* • *Are the trees growing?*

Spinning Sky Anchor Layer

Teacher Guide

DURING LESSONS



1. Teach the lesson (Investigative Phenomenon).
2. **Anchor Connection (after Activity):**
    a. After the Activity of each lesson, continue advancing through the slides to the Anchor Connection.
    b. Discuss the **Anchor Connection** questions.
    c. You will update the See-Think-Wonder chart after each lesson. Students will add new things that they think will explain the phenomenon, answer any previously recorded questions, and record new questions that arise.

Lesson *(Investigative Phenomenon)*	**During the Anchor Phenomenon Connection slides, guide students toward these ideas:**	**Students will:**
Lesson 1: Could a statue's shadow move? *(1-ESS1-1)*	The object making a shadow can move, or the light source can move. Both of these situations can cause a shadow to move. The Sun appears to always be in motion in the sky, and this explains why shadows are constantly moving on Earth—even the shadows of stationary objects, like trees!	• revisit the See-Think-Wonder chart that they initially worked on during the Anchor Phenomenon, and add that the motion of the Sun is what causes the shadows of the trees to appear to move.
Lesson 2: What does your shadow do when you're not looking? *(1-ESS1-1)*	The apparent motion of the Sun in the sky causes shadows to change in predictable ways over the course of each day. In the mornings, when the Sun is low in the sky, shadows are long. As the Sun appears to move up and across the sky, shadows get progressively shorter. Then, as the Sun appears to begin moving down in the afternoons, shadows become long again.	• revisit the See-Think-Wonder chart that they initially worked on during the Anchor Phenomenon, and add that the shadows are getting longer, which tells us that the Sun is moving lower in the sky.

DURING LESSONS

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Lesson *(Investigative Phenomenon)*	**During the Anchor Phenomenon Connection slides, guide students toward these ideas:**	**Students will:**
Lesson 3: How can the Sun help you if you're lost? *(1-ESS1-1)*	The apparent motion of the Sun follows predictable patterns. It appears to rise in the east, move upward throughout the morning, move downward in the afternoon, and set in the west. This repeated pattern allows us to determine the direction of the Sun based on whether it appears to move up or down in the sky at any given moment.	• revisit the See-Think-Wonder chart that they initially worked on during the Anchor Phenomenon, and add that the Sun must be in the western part of the sky because it is moving downward.
Lesson 4: Why do you have to go to bed early in the summer? *(1-ESS1-2)*	The apparent motion of the Sun follows predictable patterns, and these patterns can be used to determine the time of day. If the Sun is appearing to move upward in the sky, it is morning. When the Sun begins to appear to move downward, it is afternoon or evening. This repeated pattern allows us to determine the approximate time of day based on how the Sun is appearing to move at any given moment.	• revisit the See-Think-Wonder chart that they initially worked on during the Anchor Phenomenon, and add that it must be the afternoon in the video because the Sun is moving downward. At this point, the students will have used the motion of shadows to determine cardinal directions, time of day, and the apparent motion of the Sun—all while not being able to actually see the Sun.

AFTER LESSONS

Performance Task Lesson

VI. Performance Task

Students demonstrate conceptual understanding

The performance task is an opportunity for students to apply their conceptual understanding to a new scenario.

Crosscutting Concepts: Patterns

This is a great opportunity to reinforce the crosscutting concept of **patterns.**

- The Sun appears to move in the sky in a variety of predictable patterns. The most easily observable pattern is daily. The Sun appears to rise in the east at the beginning of every day, it progresses up and across the sky over the course of the day, and it sets in the west at the end of each day. By identifying **patterns** in this apparent motion, we can use them to track the flow of time.

Matrix of Crosscutting Concepts in NGSS

1. Prepare in advance
   a. Students can work individually, in pairs, or you may choose to work with small groups.
   b. Print as many copies of the Where Will the Sun Be? worksheet as you will need for your students. One copy will be needed for each individual, each pair, or each small group.
2. Begin the Unit Review, which includes key concepts from the lessons in the unit and the Anchor Layer itself.
3. Begin the Activity. The activity includes a step-by-step guide and discussion questions throughout.