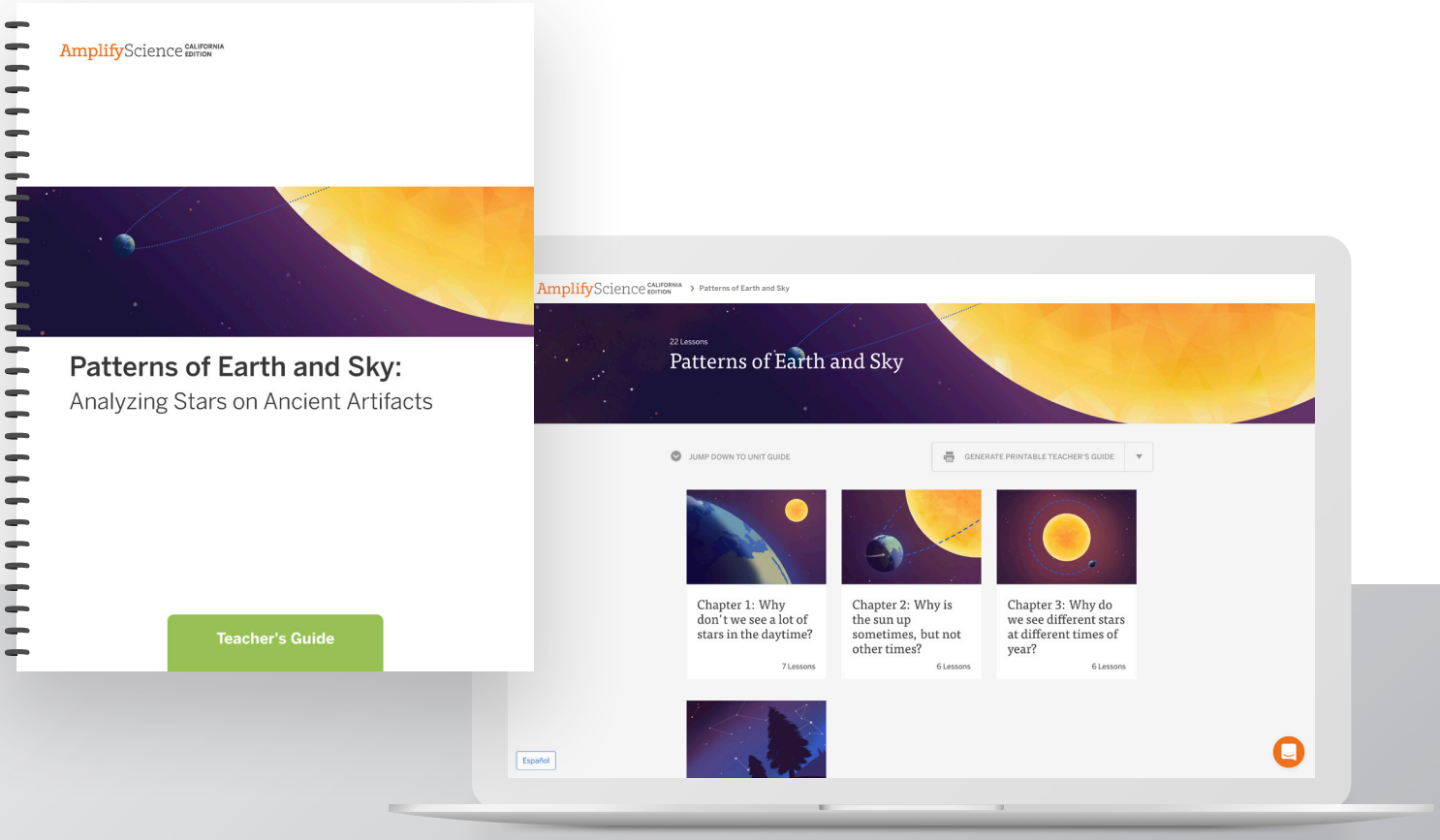
Amplify Science
CALIFORNIA

Grade 5

UNIT GUIDE

Patterns of Earth and Sky



Amplify.

THE LAWRENCE HALL OF SCIENCE
UNIVERSITY OF CALIFORNIA, BERKELEY

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Welcome to Patterns of Earth and Sky

The spatial reasoning involved in understanding many space science ideas is challenging. It involves understanding the position of stars in relation to Earth and the sun, as well as figuring out how Earth's spin and orbit cause us to see different things across a day and across a year. Amplify Science California makes learning concrete and accessible through a series of experiences with various models (kinesthetic models, physical models, computer models) and texts. These repeated opportunities to use models help students begin to develop a sense of the large distances and scale of objects in the universe.

> Unlike a typical curriculum, Amplify Science California anchors learning by inviting students to take on the role of scientists and engineers.

In this unit, students take on the role of astronomers. Their job is to help a team of archaeologists at the fictional Museum of Archaeology figure out the significance of the illustrations on a recently discovered thousand-year-old artifact with a missing piece. Working together, they learn that stars are all around us in space, develop an understanding of scale and distance in the universe, and discover how the spin and orbit of our planet causes us to observe daily and yearly patterns of stars.

Unit Type: Investigation

Student Role: Astronomers

Phenomenon: An ancient artifact depicts what we see in the sky at different times—the sun during the daytime and different stars during the nighttime—but it is missing a piece.

Core Concept: Understanding the relationship between the sun, other stars, and the movement of the Earth

Target Performance Expectations:

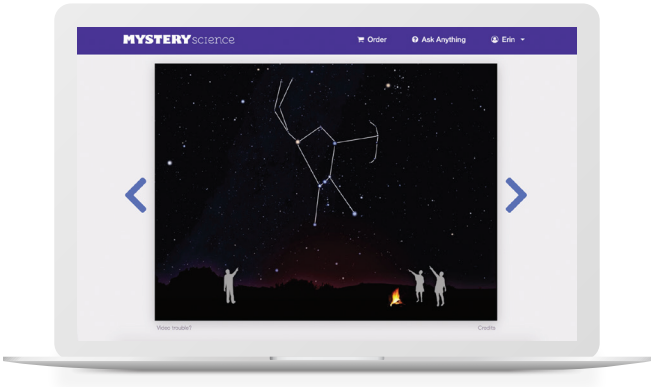
- 5-PS2-1: Gravity
- 5-ESS1-1: Apparent Brightness of Stars
- 5-ESS1-2: Patterns of Daily and Seasonal Changes

Students figure out the unit phenomenon through the use of a variety of resources.

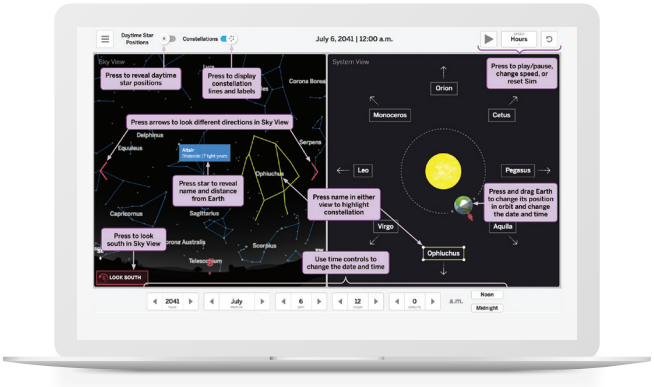
Student Books

Hands-On Kit

Videos



Simulations



About technology in this unit:
Amplify Science California gives you the flexibility to use technology in the way that meets your needs best. In 3–5, teachers have the option of using:

- **Student digital licenses** that allow for online completion of work, teacher feedback and grading, and digital class management.
- **Traditional consumable resources** that allow for a more familiar paper and pencil experience.

Whether students use the student digital experience or print workbooks, there are some technology-based activities all students will experience from time to time.

In grade 5, technology-based activities include Practice Tools and digital Simulations. In this particular unit, 12 of the 22 lessons incorporate the use of devices with 16% of the unit's activities involving the use of a digital tool.

When the use of a digital tool is called for in a lesson, teachers have several implementation options:

- **If limited student devices are available,** students can do activities in pairs or small groups.
- **If no student devices are available,** teachers can project the digital tool to the class and create a whole class experience.

Chapter 1: The storyline begins

What students investigate:

Why don't we see a lot of stars in the daytime?

What they figure out:

The stars are all around Earth in every direction. Because the sun is much closer to Earth than all other stars, it appears bigger and brighter. During daytime, the sun's brightness overwhelms the brightness of other stars, and that is why we can only see the sun during the daytime. This is why the artifact depicts the sky in different scenes: the sun in the sky is distinct from depictions showing all other stars in the sky.

How they figure it out:

- Considering how distant and how huge stars actually are as they read the student book *How Big Is Big? How Far Is Far?*
- Gathering data about the size and distance of objects in space relative to Earth using the Sim
- Creating a physical model demonstrating the distances of various stars and the sun from Earth
- Analyzing the distance of Earth from other stars along with the sun's proximity to Earth
- Gathering additional evidence from text, photos, and a video about why we can't see other stars in the daytime

KEY


CLASS


HANDS-ON


MODELING


READING


SIM


STUDENT-TO-STUDENT DISCUSSION


TEACHER


TEACHER-LED DISCUSSION


WRITING

DAY 1 | LESSON 1.1

Pre-Unit Assessment

- Introducing the Unit (10 min)
- Introducing the Artifact (10 min)
- Pre-Unit Assessment (30 min)
- Previewing the Reference Book (10 min)

Pre-Unit Assessment

DAY 2 | LESSON 1.2

Earth and Stars in Space

- Modeling the Shape of Earth (20 min)
- Exploring a Simulation of Earth and Sky (20 min)
- Sharing What We Discovered (10 min)
- Ideas About Where the Stars Are (10 min)

On-the-Fly Assessment

DAY 3 | LESSON 1.3

How Big Is Big? How Far Is Far?

- Introducing *How Big Is Big? How Far Is Far?* (15 min)
- Partner Reading (35 min)
- Thinking About Scale (10 min)

On-the-Fly Assessment

DAY 4 | LESSON 1.4

Distances to the Stars

- Preparing to Measure Distances (10 min)
- Investigating Distances to Stars (20 min)
- Modeling the Sun and Other Stars (20 min)
- Reflecting on Where Stars Are (10 min)

DAY 5 | LESSON 1.5

Investigating Size and Distance

- Observing Artifacts (10 min)
- Investigating Stars in Daytime and Nighttime (20 min)
- Investigating Distance and Size (30 min)

DAY 6 | LESSON 1.6

The Brightness of Starlight

- Discussing Distance and Size (15 min)
- Returning to the Reference Book (15 min)
- Reflecting on Brightness (15 min)
- Word Relationships (15 min)

On-the-Fly Assessment

DAY 7 | LESSON 1.7

Explaining When We See Stars

- Discussing Ideas (10 min)
- Introducing Scientific Explanations (15 min)
- Writing Scientific Explanations (25 min)
- Reflecting on the Artifact (10 min)

Critical Juncture Assessment
Self-Assessment

Chapter 2: The storyline builds

What students investigate:

Why is the sun up sometimes, but not other times?

What they figure out:

The sun is only up sometimes and not at other times because Earth spins once per day. Since gravity pulls us down toward Earth, we are carried with Earth as it spins. What we see up above us changes as we spin. When the side of Earth we are on faces the sun, the sun is up in the sky. When Earth spins to face away from the sun, the sun is not up, and we can see other stars. This is why each artifact panel shows a repeating pattern: The sun is in the sky, then other stars are in the sky, and so on.

How they figure it out:

- Investigating what causes the daily pattern of sun and stars that can be seen from Earth using the Sim
- Exploring the meaning of the directions *up* and *down* in various locations on our spinning, spherical planet as they read the student book *Which Way Is Up?*
- Participating in a kinesthetic model
- Gathering video evidence
- Creating a model to demonstrate Earth's gravitational pull

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DAY 8 | LESSON 2.1

Observing Patterns

- Looking for Patterns (10 min)
- Making Observations from Mount Nose (20 min)
- Reflecting on the Model (10 min)
- Preparing to Investigate Stars (20 min)

On-the-Fly Assessment

DAY 9 | LESSON 2.2

The Daily Pattern

- Reviewing the Investigation Plan (10 min)
- Investigating Daily Patterns in the Sim (25 min)
- Using Data in an Investigation (10 min)
- Reflecting on the Practice of Investigation (15 min)

On-the-Fly Assessment

DAY 10 | LESSON 2.3

What We See as We Spin

- Spinning Earth (15 min)
- Returning to Mount Nose (10 min)
- Modeling Our Ideas (20 min)
- Discussion Among Astronomers (15 min)

Optional Flextension: *Shadow Patterns*

DAY 11 | LESSON 2.4

Which Way Is Up?

- Making Predictions (10 min)
- Observing The Way Things Fall (10 min)
- Partner Reading (30 min)
- Reflecting on the Reading (10 min)

On-the-Fly Assessment

DAY 12 | LESSON 2.5

How Does Up Change?

- Up and Down at One Time (20 min)
- Spinning Globes (25 min)
- Positions of the Moon as it Orbits Earth (20 min)
- Up and Down at Two Times (15 min)

On-the-Fly Assessment

DAY 13 | LESSON 2.6

Explaining the Effects of Earth's Spin

- Reviewing Important Ideas (15 min)
- Two New Scientific Explanation Guidelines (10 min)
- Writing Scientific Explanations (20 min)
- Returning to the Artifact (15 min)

Critical Juncture Assessment
Self-Assessment

Chapter 3:
The storyline goes deeper

What students investigate:

Why do we see different stars at different times of year?

What they figure out:

As Earth spins, it also orbits around the sun once a year. Since Earth is moving, this means that throughout the year, Earth is in different places in its path around the sun. Our view of the stars in the nighttime sky changes in a pattern that repeats each year because Earth is traveling along its orbital path. This is why the artifact shows different constellations in the different nighttime panels.

How they figure it out:

- Investigating what constellations can be seen over the course of a year and across multiple years using a kinesthetic classroom model and the Sim
- Looking for and analyzing patterns in data using the Sim
- Exploring ancient ideas about astronomy that have been disproven through observation and investigation, and how the Dog Star served as a guide to important events in the lives of ancient people, as they read the student book *Dog Days of Summer*

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DAY 14 | LESSON 3.1

Stars Through the Year

- What Pattern Explains the Stars on the Artifact? (10 min)
- Preparing to Investigate (20 min)
- Investigating Stars Through the Year (20 min)
- Reflecting on the Data (10 min)

On-the-Fly Assessment

DAY 15 | LESSON 3.2

Modeling Earth's Orbit

- Making Constellation Posters (25 min)
- Setting Up the Model (10 min)
- Modeling Earth, Sun, and Stars (25 min)

On-the-Fly Assessment

DAY 16 | LESSON 3.3

Seeing Stars for a Year

- The Relationship Between Spin and Orbit (5 min)
- Planning a Systematic Investigation (15 min)
- Investigating Star Visibility for One Year (20 min)
- Timing of Star Visibility and the Yearly Pattern (15 min)
- Discussing with Partners (5 min)

On-the-Fly Assessment

DAY 17 | LESSON 3.4

Dog Days of Summer

- Introducing *Dog Days of Summer* (15 min)
- Partner Reading (30 min)
- Placing the Dog Star in the Classroom Model (15 min)

On-the-Fly Assessment

DAY 18 | LESSON 3.5

Modeling Constellations over Time

- Modeling Orbit and Stars (30 min)
- Identifying Another Constellation on the Artifact (20 min)
- Identifying a Third Constellation (10 min)

Critical Juncture Assessment

DAY 19 | LESSON 3.6

End-of-Unit Assessment

- Identifying the Missing Constellation (20 min)
- Writing Final Explanations (40 min)

End-of-Unit Assessment
Self-Assessment

Chapter 4: Application to a new context

What students investigate:

How can we investigate why we see different stars on different nights?

What they figure out:

We can investigate many different questions about the stars using systematic observations.

How they figure it out:

- Learning about Gibor Basri, an astronomer who investigates how stars form, how they change over time, and relationships between stars and planets, as they read the student book *Star Scientist*
- Considering several questions about patterns related to when and where certain constellations can be seen
- Selecting one question to investigate further
- Planning and conducting their investigations using the Sim
- Sharing the results of their investigations with peers

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DAY 20 | LESSON 4.1

Star Scientist

- Introducing *Star Scientist* (5 min)
- Partner Reading (25 min)
- Returning to the Book (15 min)
- Choosing a Question (15 min)

On-the-Fly Assessment

DAY 21 | LESSON 4.2

Planning Investigations

- Modeling Planning an Investigation (10 min)
- Providing Feedback (15 min)
- Drafting an Investigation Plan (25 min)
- Modeling Data Collection (10 min)

On-the-Fly Assessment

DAY 22 | LESSON 4.3

Students' Investigations of Constellations or Stars

- Conducting the Investigation (15 min)
- Reflecting on Investigations (15 min)
- Returning to the Investigation (25 min)
- Concluding the Unit (5 min)

Optional Flextension: *Making Artifacts*

Self-Assessment

All students. All standards.

Rather than treating the standards simply as a list of topics to cover, we designed Amplify Science California to allow for truly in-depth and integrated coverage of the disciplinary core ideas (DCIs), science and engineering practices (SEPs), and crosscutting concepts (CCCs). Unlike other programs, however, ours makes the NGSS' vision of "all students, all standards" a reality by creating a unit-specific learning progression for every unit called a Progress Build.

Each Progress Build defines several levels of understanding of the unit's anchoring phenomenon, with each level integrating and building upon the knowledge and skills from lower levels. In this way, each Progress Build provides a clear roadmap for how students' understanding of the phenomenon is expected to deepen and develop with each successive chapter and lesson.

What's more, the program's system of assessments is also tied to these Progress Builds. This carefully crafted integration provides teachers with credible, actionable, and timely diagnostic information about student progress toward the unit's learning goals and grade-level performance expectations. Armed with this powerful data, teachers have the ultimate flexibility to decide when to move on and when to slow down and dive deeper.

Patterns of Earth and Sky Progress Build

The Progress Build in this unit consists of three levels of understanding. At each level, students add new ideas and integrate them into a progressively deeper understanding of why we see different stars at different times.

Progress Build Level 1:

The sun looks bigger and brighter than all other stars because it is much closer to Earth than all other stars.

Progress Build Level 2:

As Earth spins, what we see in the sky changes throughout the day.

Progress Build Level 3:

As Earth orbits the sun, the stars we see in the night sky change throughout the year.

Examples of differentiation in this unit

In addition to providing unit-specific Progress Builds that break learning goals into smaller, more achievable levels of understanding, Amplify Science California makes learning accessible for all students through a variety of scaffolds, supports, and differentiation strategies for every lesson. **For a complete list of strategies, see the Differentiation section of every Lesson Brief**.

Below are a few examples of strategies embedded in this unit.

For English learners:

Use of realia (Example from Lesson 1.2)
Providing some English learners with concrete materials can help them connect the language of science to an experience. If you feel that your students would benefit from this kind of support, you can provide them with physical materials, such as a ball and a plate, and invite them to discuss their observations of these materials as they relate to what they know about Earth, prior to working with the map and globe during Activity 1.

For students needing more support:

Supporting readers with Anticipation Guides (Example from Lesson 3.4)
The Anticipation Guide for this book is on page 53, Getting Ready to Read: *Dog Days of Summer*, in the Investigation Notebook. Anticipation Guides are helpful for all students and are especially recommended for English learners. If you choose to use this optional activity, have students indicate whether they agree or disagree with each statement and discuss their responses with a partner. Remember to have students come back to the Anticipation Guide after reading and discuss with their partners any changes they wish to make based on what they read.

For students ready for a challenge:

Find evidence to support another question (Example from Lesson 2.4)
For students who need more challenge, you may want to explain that patterns are extremely important for scientists who study Earth and the universe. Challenge them to consider the question, What patterns do scientists study about the moon, the sun, and Earth?, and come up with a list of possible answers. You may also ask these students to research one or two of their responses in order to better understand the patterns they have identified.

3-D Statements

In order to help teachers recognize the three-dimensional structure of every unit, chapter, and lesson, each unit contains a 3-D Statement document that makes the integration clear.

Making the 3-D statement document all the more effective, the three dimensions are color-coded for easy recognition.

Patterns of Earth and Sky 3-D Coverage

SEPs
Science and Engineering Practices

DCIs
Disciplinary Core Ideas

CCCs
Cross-Cutting Concepts

Unit Level

Students investigate why we see different stars at different times, using digital and kinesthetic models to figure out what causes (cause and effect) daily and yearly patterns (patterns) of Earth and sky.

Chapter Level

Chapter 1: Why don't we see a lot of stars in the daytime?

Students investigate where stars are in space and obtain information from video, text, and models, to figure out that the difference in the scale of the sun and other stars' distances from Earth (scale, proportion, and quantity) affects what we see when we look up at the sky (cause and effect).

Chapter 2: Why is the sun up sometimes, but not other times?

In a digital model (systems and system models), students observe a daily pattern of when we see the sun and other stars (patterns). Then they investigate what causes (cause and effect) this pattern and obtain information from video and text about the role of Earth's gravity in what people see when they look up.

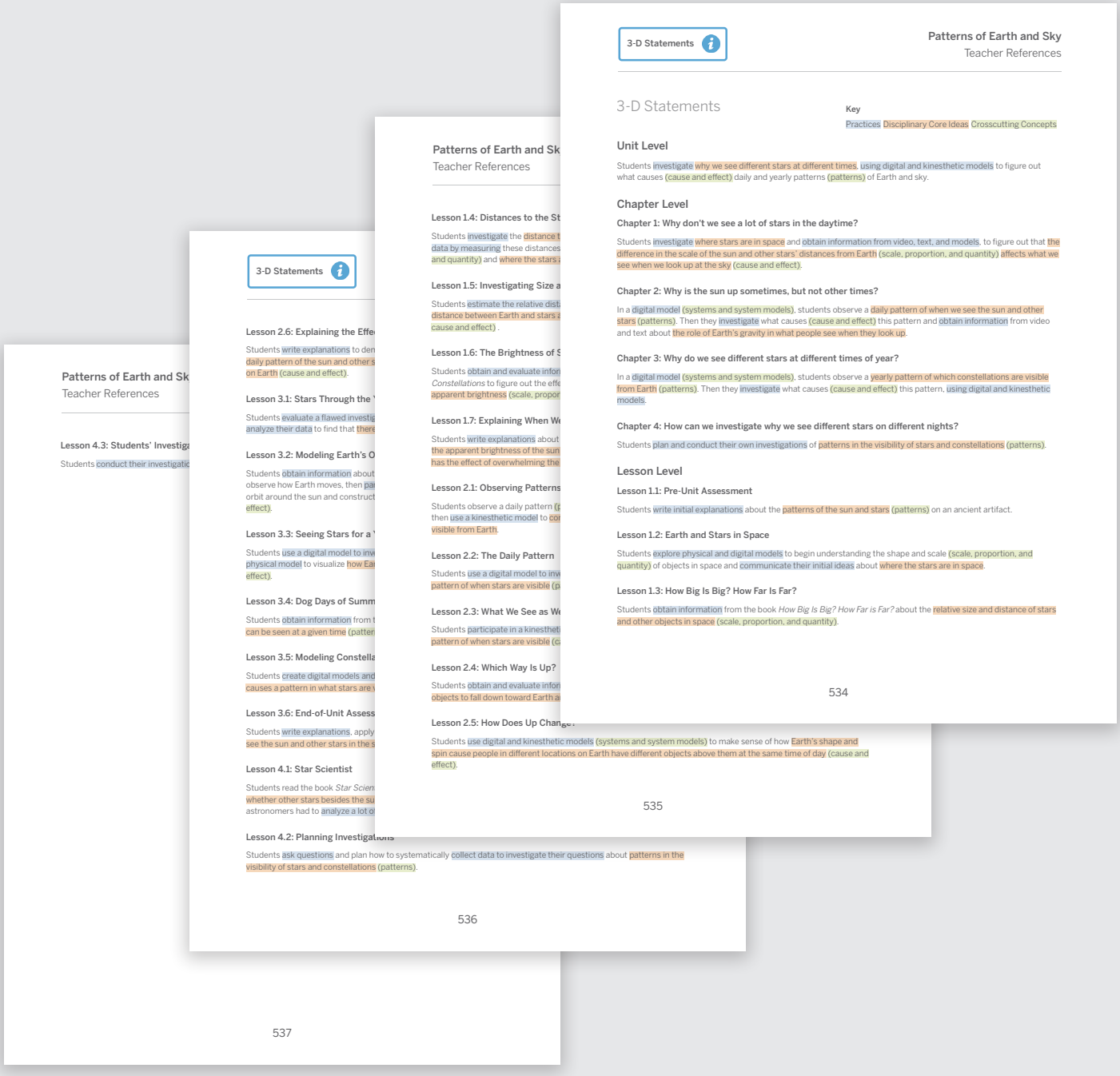
Chapter 3: Why do we see different stars at different times of year?

In a digital model (systems and system models), students observe a yearly pattern of which constellations are visible from Earth (patterns). Then they investigate what causes (cause and effect) this pattern, using digital and kinesthetic models.

Chapter 4: How can we investigate why we see different stars on different nights?

Students plan and conduct their own investigations of patterns in the visibility of stars and constellations (patterns).

To review the 3-D Statements at the lesson level, see the Lesson Brief section of every lesson.



Notes

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For more information on Amplify Science, visit **amplify.com/science/california**.

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