Lesson 4.1
Star Scientist
Lesson Overview

Students read about an investigation conducted by a team of astronomers, then begin to consider an astronomy question that they themselves will investigate. Students first read *Star Scientist*, which describes the investigations of astronomer Gibor Basri and his team. Students reflect on the steps that the team took as they planned and conducted an investigation, including deciding which and how much data to collect, organizing and recording this data, and answering questions based on the data. During this lesson, students learn more about the practice of investigation through reading about what one team of astronomers did, and they begin thinking about what question they will investigate independently in the next two lessons.

**Investigative Phenomenon:** We see different stars in the sky on different nights.

**Students learn:**

- Scientists choose questions to investigate that can be answered through measurement and observation.
- Scientists can sometimes use the same data to answer new questions.
- Reading about the work of scientists can help students plan their own investigations.
- Scientists use a variety of methods, tools, and techniques when they conduct investigations.
- Science findings are based on recognizing patterns.
- Science uses tools and technologies to make accurate measurements and observations.
- Science findings are limited to what can be answered with evidence.
Introducing Star Scientist

Students are introduced to Star Scientist as preparation for planning their own investigations about stars.

Instructional Guide

1. Introduce new Chapter Question. Refer to the classroom wall.

   So far in your work as astronomers, you have been investigating why we see different stars at different times. You have planned and completed investigations using the Patterns of Earth and Sky Simulation. Now, you are going to use what you’ve learned to plan and complete your own investigations about why we see different stars on different nights.

2. Introduce Star Scientist. Let students know that before they begin to plan their own investigations, they will read a true story about the investigation of a team of astronomers who wanted to find out more about the stars they observed. Reading about how a team of astronomers investigated a question can help students plan their own investigations.

3. Encourage students to visualize as they read. Remind students about using the photos and text to make movies in their minds that will help them understand how things that are difficult to observe can move or how big or far away something is.

Teacher Support

Instructional Suggestion

Providing More Experience: Today’s Daily Written Reflection

In what ways have you been like an astronomer? For today’s daily written reflection (page 61 in the Investigation Notebook), students are prompted to respond to a question that provides an opportunity to reflect on the practices of a working astronomer. Their responses may give you insight into questions students have about the scientific practice of investigation.
Background

Literacy Note: About Star Scientist
In *Star Scientist*, students meet Gibor Basri, an astronomer who investigates how stars form, how they change over time, and relationships between stars and planets. This book follows one particular investigation: Basri, along with a group of other scientists, gathered data to discover whether stars other than the sun have orbiting planets. Students read about Basri’s process of deciding which data would help answer the question, gathering measurements using the Kepler telescope, creating models to compare different scenarios, and analyzing the data to arrive at a conclusion. This book models the investigative process for students, giving them a real-world example of how data can answer a fascinating astronomy question, but also how it can lead to new questions.

Rationale

Literacy Note: Visualizing
In Chapters 1 through 3, you provided the scaffold of modeling visualizing as you read before students did the same while they read. In this last reading lesson, however, you do not model visualizing for students; instead, you provide the opportunity for students to use this strategy independently.
Partner Reading

Students read Star Scientist and reflect on the investigation described in the book.

Instructional Guide

1. Distribute books and sticky notes. Distribute one copy of Star Scientist to each pair and three sticky notes to each student. Remind students that they should mark places where they visualize with a sticky note.

2. Have students read with a partner. Circulate and offer support as needed.

3. Pairs discuss visualizing. Have each student choose one place in the book that they visualized. Then have pairs discuss what they visualized and how it helped them understand the text. If there is time, call on several students to share how they used the visualizing strategy.

4. On-the-Fly Assessment: Visualizing as a Sense-Making Strategy. As partners share, circulate to listen to how students are discussing their use of the sense-making strategy of visualizing. For information on what to look for and how to maximize learning by all students, press the hummingbird icon and select ON-THE-FLY ASSESSMENT.
Embedded Formative Assessment

On-the-Fly Assessment 12: Visualizing as a Sense-Making Strategy

Look for: At this point in the unit, students have had many opportunities to visualize as they read and investigate. As students read *Star Scientist*, they are encouraged to use everything they have learned so far about visualizing in order to better understand the book. As students discuss their visualizations after reading, take note of how students are describing their visualizations. Are they able to use both the text and the diagrams to visualize? Are they visualizing motion? Do they use the Sim (or other class models) to help them visualize?

Now what? If students are having trouble visualizing, you can provide additional support by modeling visualizing with another example. Meet with students individually or in a small group and read page 5 together. Read the caption under the picture. Point out that since it is difficult to get photographs of planets and stars outside our Solar System, artists create images that use information from astronomers so they make actual pictures, not just pictures in their minds. Focus students on using this picture in order to make a movie in their minds of how the planets might move in this situation. Reread page 5, then ask students what they visualized. If necessary, provide an example of how you visualize the planets in the picture orbiting the star.

Teacher Support

Background

Crosscutting Concept: Patterns Across Chapter 4

In Chapter 4, students read an informational text about a scientist and his team who are looking for patterns of change in brightness as they investigate whether there are planets orbiting distant stars. Next, students choose a question to investigate about a constellation and look for patterns as they make observations. Students have an opportunity to discuss their findings with another group and discuss the patterns they observed throughout their investigations.
Returning to the Book

Student pairs work together to answer questions about how the scientists in Star Scientist planned and conducted the investigation.

Instructional Guide

1. **Set purpose for returning to the book.** Explain that students will answer some questions that will help them prepare to plan their own investigations.

2. **Introduce notebook page 64.** Have students turn to page 64, After Reading: Thinking About an Investigation, in their notebooks. Point out that each question has a page number that will help students find information about that question.

3. **Pairs reread sections of the book and record answers.** Circulate and assist pairs as necessary.

4. **Review page 64 and focus on aspects of a systematic investigation.** Step through each question on page 64, and call on students to share their responses. Then, ask students to reflect.

   - **How were the observations of Dr. Basri and his team systematic? Provide examples.** [They collected data over a long period of time. They used a telescope to collect very accurate data. They collected data about the brightness of each star at many points in time.]

5. **Point out that science focuses on natural phenomena and empirical evidence.**

   - Scientists investigate phenomena we can observe in the natural world, and the knowledge we gain from scientific investigation is based on collecting the right data to provide evidence of how those phenomena work.

6. **Conclude the activity.** Let students know that they will begin to plan their own investigations.
Teacher Support

Rationale

Pedagogical Goals: Understanding the Nature of Science

One goal set forth by the Next Generation Science Standards (NGSS) is for students to understand the nature of science as a discipline and how scientific knowledge develops over time. The NGSS call out eight understandings about the nature of science that are woven throughout the Amplify Science curriculum. The Patterns of Earth and Sky unit gives students an opportunity to experience the following understandings through reading Star Scientist.

- **Scientific Investigations Use a Variety of Methods.** Star Scientist specifically illustrates the idea that science investigations use a variety of methods, tools, and techniques on page 4 when it states “To answer his questions, Basri needs data: measurements and observations gathered in different ways.” Dr. Basri and his team sent a telescope into space to gather data on the brightness of stars, and used graphs and models to analyze the data.

- **Scientific Knowledge Is Based on Empirical Evidence.** Star Scientist exhibits the ideas that science findings are based on recognizing patterns in empirical evidence, and in model results used to explore and explain the patterns in data on page 11 when it states “Basri made models comparing planets and sunspots and the ways they would affect the light coming from a star. He was able to show that sunspots would cause very different patterns in the data than orbiting planets would.” Dr. Basri’s work also shows that science uses tools and technologies to make accurate measurements and observations on page 9 when it states “The scientists sent a telescope called Kepler out into space to gather the data they needed. The Kepler telescope was able to measure the brightness of stars very accurately. With such accurate measurements, Basri and the other scientists could observe tiny differences in the brightness of a star over time.” Accuracy of empirical evidence is essential to building scientific knowledge.

- **Science Addresses Questions About the Natural and Material World.** Star Scientist demonstrates for students the kinds of questions about natural phenomena that scientists ask, and the kinds of data they collect and model in order to answer those questions on page 3, when Dr. Basri wonders “How do stars form? What are the smallest stars like? How do stars change over time?” and then works with a team to use a powerful telescope to collect the data needed to support answers to these questions with empirical evidence. More specifically, on page 5, Dr. Basri asks “Do other stars besides the sun have planets orbiting them?” and uses data collected with the Kepler telescope to answer this question. On page 14, he also points out that scientific investigation often leads to asking new questions about a phenomenon such as “How long do sunspots last, on average? Does that depend on how many sunspots there are? Does it depend on how fast a star is spinning?” and that more data analysis is the way to find answers to these questions. Dr. Basri’s questions and use of data analysis to answer them illustrates the idea that science findings are limited to questions that can be answered with empirical evidence.

Possible Responses

Investigation Notebook
After Reading: Thinking About an Investigation (page 64)
1. What question did Gibor Basri and other scientists help answer? (page 5) Do other stars besides the sun have planets orbiting them?

2. Which data did the scientists choose to collect and why? (page 6) Data about the brightness of stars. They collected it because when a planet passes between Earth and a star, the star gets less bright.

3. Why was it important to collect data for several years? (page 8) So they could see the patterns they were looking for.

4. The scientists made a graph with the data they collected. How did making a graph help them understand their data? (page 11) By making graphs of brightness over time, they were able to tell the difference between the dips caused by sunspots and the dips caused by planets passing in front of stars.

5. What did the scientists find out? (page 12) There are lots of planets that orbit other stars.
After Reading: Thinking About an Investigation

Use Star Scientist to answer the following questions.

1. What question did Gibor Basri and other scientists help answer? (page 5)

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2. Which data did the scientists choose to collect and why? (page 6)

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3. Why was it important to collect data for several years? (page 8)

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5. What did the scientists find out? (page 12)

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Introducing Star Scientist

Students are introduced to *Star Scientist* as preparation for planning their own investigations about stars.

**Instructional Guide**

1. **Introduce new Chapter Question.** Refer to the classroom wall.

   Hasta ahora en su trabajo como astrónomos, han estado investigando por qué vemos diferentes estrellas a diferentes horas y épocas. Han planeado y completado investigaciones usando la Simulación *Patrones de la Tierra y del cielo*. Ahora, van a usar lo que han aprendido para planear y completar sus propias investigaciones sobre por qué vemos diferentes estrellas en diferentes noches.

2. **Introduce Star Scientist.** Let students know that before they begin to plan their own investigations, they will read a true story about the investigation of a team of astronomers who wanted to find out more about the stars they observed. Reading about how a team of astronomers investigated a question can help students plan their own investigations.

3. **Encourage students to visualize as they read.** Remind students about using the photos and text to make movies in their minds that will help them understand how things that are difficult to observe can move or how big or far away something is.

**Teacher Support**

**Instructional Suggestion**

*Providing More Experience: Today's Daily Written Reflection*

*In what ways have you been like an astronomer?* For today's daily written reflection (page 61 in the Investigation Notebook), students are prompted to respond to a question that provides an opportunity to reflect on the practices of a working astronomer. Their responses may give you insight into questions students have about the scientific practice of investigation.
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5. **Point out that science focuses on natural phenomena and empirical evidence.**

Los científicos investigan fenómenos que podemos observar en el mundo natural, y el conocimiento que obtenemos de la investigación científica está basado en recopilar los datos correctos para proporcionar evidencia de cómo funcionan esos fenómenos.

6. **Conclude the activity.** Let students know that they will begin to plan their own investigations.
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Rationale

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5. What did the scientists find out? (page 12) There are lots of planets that orbit other stars.
Después de la lectura: pensar en una investigación

Usa Científico de estrellas para responder las preguntas siguientes.

1. ¿Cuál fue la pregunta que Gibor Basri y otros/as científicos/as ayudaron a responder? (página 5)

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2. ¿Qué datos eligieron recolectar los/as científicos/as y por qué? (página 6)

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3. ¿Por qué era importante recolectar datos durante varios años? (página 8)

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4. Los/as científicos/as hicieron una gráfica con los datos que recolectaron. ¿Cómo eso los ayudó a entender sus datos? (página 11)

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5. ¿Qué descubrieron los/as científicos/as? (página 12)

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