Patterns in Space

Scope Planning and Overview

Scope Overview

In this instructional unit, students delve into observational astronomy by studying the sky's appearance and the lunar phases. They document celestial patterns, noting the positions and visibility of the Sun, Moon, and stars at various times, which enhances their understanding of predictable astronomical phenomena. Through hands-on use of Moon Phase Cards and laminated cards for identifying celestial objects, students deepen their grasp of the natural cycles and the enhanced observational capabilities provided by telescopes. This unit fosters students' ability to predict celestial patterns and understand the tools used in astronomy.

Student Wondering of Phenomenon

How do you know whether the Sun will rise and set tomorrow?

Student Expectations

The student will–

- use observations or models of the sun, moon, and stars to describe patterns that can be predicted.
- observe natural objects in the sky that can be seen from Earth with the naked eye and recognize that a telescope, used as a tool, can provide greater detail of objects in the sky.

Scope Vocabulary

The terms below and their definitions can be found in Picture Vocabulary and are embedded in context throughout the scope.

Sun
The star that Earth moves around and that gives energy to Earth

Stars
Objects in the sky that make their own light and can be seen at night

Moon
An object that orbits Earth and appears as a pale disc in the night sky

Motion
How an object moves from one place to another

Pattern
Something that repeats

Telescope
A tool used to make things that are far away look bigger

Notes

Engage Activity Summaries

APK

Accessing Prior Knowledge:

In this activity, students analyze peer responses to questions about space patterns to identify potential misconceptions. They independently review statements on a handout, deciding if they agree or disagree and articulating their reasoning. Following individual assessment, students pair up to discuss their decisions and reasoning. This exercise not only encourages engagement with astronomical concepts but also fosters communication skills and critical thinking as they justify their thoughts and understand different viewpoints.

SP

Scope Phenomenon

In this observational activity, students watch a video demonstrating the Sun's daily motion and engage with related concepts about celestial patterns. They use creative methods like doodling to express their understanding and answer questions about the video content. This method aims to deepen their grasp of astronomical phenomena through visual and informal responses, enhancing their comprehension of why celestial bodies like the Sun, the Moon, and the stars appear to move in predictable patterns.

Explore Activity Summaries

Explore 1

Scientific Investigation - Observing Objects in the Sky

In this scientific investigation, students actively observe and record the sky's appearance at different times of the day over a four-day period. They note the positions and visibility of celestial objects like the Sun, Moon, and stars. Additionally, students use laminated cards to distinguish objects visible with the naked eye from those needing a telescope, enhancing their understanding of observational astronomy. This activity integrates prediction and observation, aiming to develop students' ability to describe sky patterns and the functionality of telescopes.

Explore 2

Activity - Moon Phases

In this activity, students explore the sequence of lunar phases by arranging Moon Phase Cards in the correct order, demonstrating the predictable pattern of the Moon's appearance from Earth. They engage in discussions about their personal observations of the Moon and the tools astronomers use, like telescopes, to enhance these observations. The task includes integrating visual aids into their Student Journals and reinforcing concepts through a group collaborative process, enhancing their understanding of lunar cycles.

Notes

Patterns in Space

Accessing Prior Knowledge

Activity Preparation

Students will read different student responses to a posed question on patterns in space, decide whether they agree or disagree with the student, and explain their reasoning. This element is designed to uncover student misconceptions. It should not be taken for a grade.

Materials

Printed Material

- 1 Student Handout: Patterns in Space: Agree or Disagree? (per student)

Reusable

- None

Consumable

- None

Preparation

- If not assigning the Accessing Prior Knowledge digitally, print one Student Handout for each student.

Procedure and Facilitation

ACTIVITY TIP

Print and project the student statements for Amber, Joe, Ella, etc. and read them aloud with students. Consider pre-teaching any core vocabulary needed prior to having students choose who is correct/incorrect.

CLASSROOM MANAGEMENT TIP

Allow students to think, pair, share about the Student Handout rather than complete it in writing independently. Consider using assigned partners.

Activity

1. Instruct students to complete the Student Handout independently.
2. Once students have completed the activity on their own, have them stand up.
3. Instruct all students to walk around the classroom with their hands raised in a high-five position.
4. On your instruction, students will stop and each will high-five the closest person. This will be their partner.
5. Give students a couple of minutes together to discuss their answers.
6. You may then have students continue as many times as you want with different partners.
7. Discuss the responses as a class.

Identifying Misconceptions

Accessing Prior Knowledge activities help you identify possible student misconceptions. The following misconceptions may be revealed during this APK. These misconceptions will be addressed as students move through the scope and do not need to be clarified at this point.

- If a student believes Amber or Joe is correct, they may need more instruction on how the Sun, the Moon, and the stars all move in patterns across the sky from Earth's surface.
- If a student believes Ella is incorrect, they may need more instruction on how Earth's rotation causes the Sun, the Moon, and the stars to all move in patterns across the sky from Earth's surface.

Notes

Patterns in Space

Scope Phenomenon

Activity Preparation

Students will watch a video of the Sun rising and setting to learn about patterns of the Sun, the Moon, and the stars. Students should build on their knowledge and understanding of the phenomenon as they move through the different activities in this scope.

Materials

Printed Material

- 1 Student Handout: Up in the Sky (per student)

Reusable

- 1 Pencil (per student)

Consumable

- 1 Piece of blank paper (per student)
- 1 Sticky note (per student)

Preparation

- If not assigning the activity digitally, print one Student Handout per student.
- Prepare to project the Student Handout.
- Brainstorm additional questions you may want to discuss beyond the Student Handout during the activity.

Procedure and Facilitation

ACTIVITY TIP

As a supplement to the Patterns in Space video, curate some sunrise and sunset images or videos of local landmarks to provide additional context.

ACTIVITY TIP

Provide some lead up questions prior to the Student Wondering question: "What do you know about the sunrise/sunset?" "What do you notice about sunrise/sunset?". Record additional student questions and use them to guide instruction through the scope.

Activity

1. Distribute the Student Handouts.
2. Show students the video.
3. Ensure that students have a blank piece of scrap paper and a writing utensil.
4. Ask the whole class the questions from the Student Handout.
5. Instruct students to doodle their answers. Encourage students to not write in sentences but instead use images, pictographs, or funny phrases to answer.
6. When students finish their doodles, have them turn over their papers.
7. After everyone has had a chance to doodle, call on a student.
8. Introduce students to the Student Wondering of Phenomenon question below:
    - How do you know whether the Sun will rise and set tomorrow?
9. Let students know that, as they move through the scope, they will be doing a number of activities to help them answer the Student Wondering of Phenomenon question and to learn the information that is needed to describe the events in the Scope Phenomenon.
10. When the scope is completed, have students look back at the Scope Phenomenon. As you lead them in answering the question, encourage them to use the information that they learned throughout the scope.

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Patterns in Space

Explore 1: Scientific Investigation - Observing Objects in the Sky

Activity Preparation

Timestamp: 30–45 min. per day for 3–5 days

In this investigation, students will observe the sky at different times.

Materials

Printed

- 1 Student Handout: Observing Objects in the Sky (per student)
- 1 Objects in the Sky Cards (per group)
- 1 Observing Objects in the Sky Claim-Evidence Reasoning (per student)

Resealable

- 1 Resealable plastic bag (per group)

Consumable

- None

Preparation

- Print a Student Handout and an Observing Objects in the Sky Claim-Evidence Reasoning for each student.
- Make accommodations to take your class outside three times per day (morning, lunchtime, and afternoon) for four consecutive days.
- You may choose to send a note home letting parents know that their children should observe the sky before bed for these four days as a homework assignment to extend observations that are made at school during the day. Also, include a reminder to parents and guardians that children should never look directly at the Sun.
- Print and laminate the Objects in the Sky Cards for each group. Cut apart the cards, and place each set of cards in a resealable plastic bag.

Connections

SEP Connection

Analyzing and Interpreting Data

During this activity, students will analyze and interpret data with appropriate data presentation (graph, table, statistics, etc.), identifying sources of error and the degree of certainty. Data analysis is used to derive meaning or evaluate solutions.

While students work through this activity, they should do the following:

- Analyze and interpret data
- Identify sources of error
- Present data in an appropriate manner, such as graphs or tables

Once students have completed this activity, ask these questions:

- What is the best way to present the data you have collected?
- How would you identify sources of error in your data?
- How certain are you in your data's validity? How do you know this?

CCC Connection

Patterns

During this activity, students will explore observations and explanations of patterns.

Ask students the following questions:

- Where do you see observations and explanations of patterns in this activity?
- Where have you seen observations and explanations of patterns before this activity?
- Where do you see observations and explanations of patterns outside the classroom?
- Where do you think you will see observations and explanations of patterns in other science lessons?

Procedure and Facilitation

1. Distribute a Student Handout to each student.
2. Explain to students that the class will be going outside to observe the sky at different times. They should only record what they actually see, not what they think they could see during the day.
    a. Also, remember that it is not safe to look at the Sun because it is so bright. They will know if the Sun is up without looking right at it.
3. Before going outside, have students predict what they will see in the sky on their Student Handouts. Instruct students to share their predictions with partners.
4. Go outside, and instruct students to record everything that they see in the sky at that time of day and where those objects are in the sky on their Student Handouts.
5. Repeat steps 5 and 6 every morning, lunchtime, and afternoon for four days. If possible, have students observe the sky at night while at home for these four days and record their observations.
6. Lead the class in a post-activity discussion.
    a. What did you notice about the sky each morning? Answers may vary. Possible student responses could include the following: The Sun was always closer to the ground. Sometimes, I could see the Moon.
    b. What did you notice about the sky at lunchtime each day? Answers may vary. Possible student responses could include the following: The Sun was always up above us. Sometimes, I could see the Moon.
    c. What did you notice about the sky each afternoon? Answers may vary. Possible student responses could include the following: The Sun was almost above us, but it moved some since morning. Some days, I saw clouds; some days, I didn't. Sometimes, I could see the Moon.
    d. What did you notice about the sky each night? Answers may vary. A possible student response could include the following: I could see stars and the Moon but not the Sun.
7. As an extension, ask students to predict what the Moon will look like one week from the completion of the lesson. Have students draw their predictions on sticky notes and post them on the calendar as a reminder to check the Moon on the selected date.
8. On that date, remind students to check the Moon, and then have them discuss what they observed the next day in class. In particular, have them note when they saw it, where it was in the sky, and what it looked like. Have students explain if their predictions were correct, why or why not, and how they correctly predicted (if they did).
9. Give each student or group of students a bag of Objects in the Sky Cards.

SAFETY TIP

Clarify the importance of eye safety. Students may think that sunglasses protect their eyes or be very curious about looking directly at the sun.

ACTIVITY TIP

Clarify what types of objects you expect them to record. Students may consider tall buildings, birds, planes, blowing leaves/seeds.

CLASSROOM MANAGEMENT TIP

Be aware that for a variety of reasons, some students may not be able to successfully gather night sky observations that include stars or moon.

Notes

Patterns in Space

Explore 1: Scientific Investigation - Observing Objects in the Sky

ACTIVITY TIP

Rather than having students sort the cards at their tables, print them and conduct a class discussion about ways to sort. Curate some additional images that illustrate the difference between telescope vs. naked eye.

10. Have students sort the cards based on what they can see using a telescope compared to what they can see with only their eyes. Explain to students that a telescope is a tool that we use to see greater details of objects in the sky.
11. Have students make two groups: objects that we can see with only our eyes and objects that we need telescopes to see.
12. Lead the class in a discussion.
    a. What did you notice about your cards? Objects were larger and more detailed in some photos.
    b. Why do you think some objects looked larger? A telescope was used.
    c. How do telescopes help us? We can learn more about the objects that we are looking at when we use a telescope than when we use only our eyes.
13. Distribute an Observing Objects in the Sky Claim-Evidence-Reasoning to each student.
14. Instruct students to complete their CERs by writing conclusions and scientific explanations about how objects in the sky appear different during the day and night.

Phenomenon Connection

Once students have completed this learning activity, revisit the Student Wondering of Phenomenon and use the following questions to guide a class discussion.

How do you know whether the Sun will rise and set tomorrow?

- How does this activity connect to or answer the question above?
- How does this activity change your thinking about the phenomenon?
- Do you have any additional questions or observations about the connection between the phenomenon and the activity?

Notes

Notes

Patterns in Space

Explore 2: Activity - Moon Phases

Activity Preparation

Timestamp: *30–45 minutes*

Students will place pictures of the Moon phases in order to show that they follow a predictable pattern.

Materials

Printed

- 1 Student Handout: Moon Phases (per student)
- 1 Moon Phase Cards (per group)
- 1 Student CER (per student)

Consumable

- None

Reusable

- 1 Resealable plastic bag (per group)
- 1 Nickel (optional if students need it for tracing) (per group)

Preparation

- Print a Student Handout and Student CER for each student.
- Print the Moon Phase Cards, cut them out, and place each set in a plastic bag.

Connections

SEP Connection

Developing and Using Models

During this activity, students will develop and use models to develop explanations for phenomena, to go beyond the observable and make predictions or to test designs.

While students work through this activity, they should do the following:

- Use models to develop explanations for phenomena
- Use models to make predictions
- Use models to test designs

Once students have completed this activity, ask these questions:

- How did the model help to explain the phenomenon?
- What were some limitations of the model?
- How could the model be improved so that it is a better representation of the phenomenon?

CCC Connection

Patterns

During this activity, students will explore observations and explanations of patterns.

Ask students the following questions:

- Where do you see observations and explanations of patterns in this activity?
- Where have you seen observations and explanations of patterns before this activity?
- Where do you see observations and explanations of patterns outside the classroom?
- Where do you think you will see observations and explanations of patterns in other science lessons?

Procedure and Facilitation

1. Divide the class into groups.
2. Have students open their bags and review the Moon Phase Cards with their groups. Discuss the following questions:
    a. Is this what the Moon looks like to you when you look up in the sky? Explain. No, the Moon just looks like a bright shape to me. I can't see this much detail.
    b. What tool do you think was used to take these pictures of the Moon? A telescope
    c. What does a telescope do? A telescope makes faraway things look closer.
    d. What do you think pictures of the Moon would look like with an even stronger telescope? Answers will vary. A possible student response could include the following: I would be able to see more details, like what is on the surface of the Moon, such as craters, rocks, and dust.
3. Instruct students to place the cards on their desks so that the arrows on all of the cards point away from them. This will keep the cards in the correct positions as they are sorted.
4. Explain that some cards are numbered and some are not. It is the students' job to place them all in order.
5. Have student groups work together to place the cards in order.
6. When students are finished, check their card placements to ensure that they are correct. Then, have students draw each Moon phase in order on the Student Handout.
7. Discuss the following questions with the class:
    a. Does the Moon change a lot or just a little at a time? A little at a time
    b. Have you ever seen the Moon during the day? Sometimes, I can see it in the morning on my way to school even though the Sun is up.
    i. If students say that the Moon cannot be up during the day, search the internet to find a day when the Moon will be up in the morning, and take students outside to observe.
    c. What happens when you get to the end of the Moon cycle? It starts over again. The phases just keep repeating in this order.

CLASSROOM MANAGEMENT TIP

Discuss the questions a-d prior to distributing the Moon Phase Cards. Consider projecting the card images to the whole class and collect student observations.

CLASSROOM MANAGEMENT TIP

Consider coloring the arrows on the cards to help students correctly position them and so that adults can clearly see that they are correctly positioned as students order them.

Phenomenon Connection

Once students have completed this learning activity, revisit the Student Wondering of Phenomenon and use the following questions to guide a class discussion.

How do you know whether the Sun will rise and set tomorrow?

- How does this activity connect to or answer the question above?
- How does this activity change your thinking about the phenomenon?
- Do you have any additional questions or observations about the connection between the phenomenon and the activity?

ACTIVITY TIP

Many schools have moving 3D models that include earth, moon, sun and planets that demonstrate the movements of the spheres in space. Collaborate with staff in higher grades.

Patterns in Space

Scope Resources and Assessment Planner

Scope Resources

Explain

- ☐ **Picture Vocabulary**
  A slide presentation of important vocabulary terms along with a picture and definition.
- ☐ **STEMscopedia**
  Reference materials that includes parent connections, career connections, technology, and science news.
- ☐ **Linking Literacy**
  Strategies to help students comprehend difficult informational text.

Elaborate

- ☐ **Math Connections**
  A practice that uses grade-level appropriate math activities to address the concept.
- ☐ **Reading Science: Read Aloud - Watching the Clouds Go By**
  A reading passage about the concept that is designed to be guided by a teacher or parent. Includes five comprehension questions.
- ☐ **Engineering Connections**
  A creative, kinesthetic extension into engineering and design that uses concepts addressed in the scope.

Evaluate

- ☐ **Claim-Evidence-Reasoning**
  An assessment in which students write a scientific explanation to show their understanding of the concept in a way that uses evidence.
- ☐ **Open-Ended Response Assessment**
  A short-answer and essay assessment to evaluate student mastery of the concept.
- ☐ **Multiple Choice Assessment**
  A standards-based assessment designed to gauge students' understanding of the science concept using their selections of the best possible answers from a list of choices

Intervention

- ☐ **Guided Practice**
  A guide that shows the teacher how to administer a small-group lesson to students who need intervention on the topic.

Acceleration

- ☐ **Extensions**
  A set of ideas and activities that can help further elaborate on the concept.

Notes

Assessment Planner

Use this template to decide how to assess your students for concept mastery. Depending on the format of the assessment, you can identify prompts and intended responses that would measure student mastery of the expectation. See the beginning of this scope to identify standards and grade-level expectations.

Student Learning Objectives	What Prompts Will Be Used?	What Does Student Mastery Look Like?
use observations or models of the sun, moon, and stars to describe patterns that can be predicted.		
observe natural objects in the sky that can be seen from Earth with the naked eye and recognize that a telescope, used as a tool, can provide greater detail of objects in the sky.		