

Unit Overview

Astronomy Unit

Curiosity and wonder have always been powerful drivers of scientific inquiry. People before us have been propelled by wonder to answer deep questions about our universe through observation and data collection, which our current knowledge is indebted to. How can we harness this same wonder that spurred our ancestors in order to explore our universe? In this unit, learners will explore the patterns that the Earth's movement creates from within a historical context grounded in the Islamic Golden Age of science.¹

[Lesson 1](#)

Al-Jawza' Folktale

Learners are introduced to the Al-Jawza' folktale. Learners complete a gallery walk of the thinking routine "What do you already know? What do you wonder about? What have you learned today?"

[Lesson 2](#)

Astronomical Instruments

Learners explore the parts and function of different astronomical tools throughout the ages.

[Lesson 3](#)

Rotation of the Earth

Learners are introduced to the rotation of the Earth through a video and the thinking routine 'see, think, wonder.' Learners read a short informational text about the rotation of the Earth and the patterns it creates.

[Lesson 4](#)

Data

Learners explore the concept of a pattern and practice interpreting data.

[Lesson 5](#)

Shadows

Learners investigate the relationship between shadows, an object and a light source and begin to understand that the rotation of the Earth causes a change in length and direction of shadows.

[Lesson 6](#)

Shadows Continued

Learners observe the relationship between shadows, an object and a light source by going outside and practicing scientific behaviors. Learners practice creating data about shadows.

[Lesson 7](#)

Revolution of the Earth

Learners will be introduced to the revolution of the Earth and investigate a new pattern the movement of the Earth creates - the seasonal appearance of stars in the night sky. The investigation takes place through a folktale and an informational text.

[Lesson 8](#)

Constellation Tour

Learners will investigate the seasonal appearance of stars in the night sky using movement and storytelling.

¹ One of the authors of this unit taught the NGSS science standard, without the integrated social studies, while teaching at Dhahran Ahliyya Schools (DAS). She would like to acknowledge how the creativity and brilliance of the educators, coaches and students at DAS have informed the writing of this unit.



[Lesson 9](#)

The House of Wisdom

Learners will watch a short video on astronomy in the medieval Islamic empire and investigate the special contributions of Islamic astronomers.

[Lesson 10](#)

Final Project

Learners choose a phenomenon created by the movement of the Earth and a way to represent it through a graphical display of data. Learners create a folktale that explains the phenomenon including an understanding of why this mattered to our ancestors.

Lesson 1

Lesson One: Al-Jawza' Folktales	
Grade level	5
Subject	Science Social Studies
Materials	<p>Included Materials: AlJawza constellation images (slides 1-3) AlJawza folktale Astronomy unit vocabulary</p> <p>Needed Materials: Science journals Thinking routine gallery walk printouts/papers</p>
Lesson objectives	<p>I can use my powers of observation to understand the world around me.</p> <p>I can harness my curiosity to think like a scientist.</p>
Essential questions	<p>Why did our ancestors care so much about the stars and planets? How can I act like a scientist? What are ways I use science to understand the world around me? How can learning about our past help me understand our present?</p>

Launch
<p>Begin by showing students images and/or drawings of the Al-Jawza' constellation (see slides). Pause for curiosity, allowing students to make observations and propose theories. Ask questions like: What do you see? What do you think this is? What does this remind you of?</p> <p>Before telling the Al-Jawza' star folktale, set the scene by describing the setting. You can even turn off the classroom lights for ambiance, keeping the projection of the constellation on screen. For example:</p> <p><i>When was the last time you went to the desert? What do you remember about nighttime in the desert? Our ancestors (our great great grandparents and their parents and grandparents before them), used to experience that every night! The cold desert nights, the bright stars in the sky, the quiet of the wind blowing. Let's imagine that's where we are now!</i></p> <p>Perform the folktale for your learners:</p> <p><i>In the winter, when our ancestors were gathered around the fire, they would see this constellation, or group of stars, in the sky and wonder how they came to be. It is said that a</i></p>



beautiful woman named Jawza' lived on one side of a river. Across the river, lived a man named Suhayl. Jawza' and Suhayl were finally married one day but on the night of their wedding, she disappeared, never to be found. Jawza' family felt betrayed and angry, they thought that Suhayl may have hurt her and wanted revenge. Fearing for his life, Suhayl fled far to the south. He left behind his two sisters. One of his sisters chose to follow her beloved brother and crossed the river, thinking that she was following him. And so she was named Shi'ra Who Crossed Over. Suhayl's other sister was not as courageous. She stayed home and cried and cried for her lost brother. And so she was named the Little Bleary-Eyed Shi'ra.

Folktale adapted from Danielle Adams' project [Two Deserts. One Sky.](#)

Connection

Ask students to guess which star is which character from the story then quickly make the connection between the folktale and the constellation (see slides).

If you'd like, you can show illustrations from other cultures and time periods who have different stories about the same constellation (included on the [third slide](#)) to emphasize cross-cultural contributions.

Discussion

Display questions on the board for learners to chat about collaboratively in their table groups before sharing out.

Why did the night sky matter so much to our ancestors? And to people all over the world? Why do you think they made up stories about the stars? What is the role of wonder in science?

Our ancestors looked up at the same sky that we see, wondered about it, made art and told stories about it. We haven't stopped doing that. Wonder has always been a strong driver of scientific inquiry, and is a strong human impulse that connects us to our surroundings and each other, past and present.

Thinking routine / closing

What do you already know? What do you wonder about? What have you learned today?

Write or print each prompt on an A4 paper with guiding questions and post them around the room. You may choose to print more than one copy of each to allow students to spread out.

With a partner, students visit each prompt, sharing ideas with their partner before jotting answers to each prompt in their journals or on shared chart paper.

Wrap up by hearing some student responses.

Note to teachers: You may choose to engage in a protocol called Wonder Wednesday where one day a week students answer one question of their own. This can be done individually where



learners do independent research or as a whole class where one learners' question is researched in real time utilizing [Wonderopolis](#) or similar search engines.

Extension

We love these books as a possible extension:

بركة الأسئلة الزرقاء , مايا أبو الحيات

Look Up With Me, Jennifer Bern

Both speak of harnessing wonder to spur discovery. We have also suggested these books as a possible extension in lesson seven.

Lesson 2

Lesson Two: Astronomical Instruments	
Grade level	5
Subject	Science Social Studies
Materials	<p>Included Materials: Slides: Astronomical tools thinking routine Astronomical tools teacher guide</p> <p>Needed Materials: Printouts of astronomical tools (enough copies for each table group)</p>
Lesson objective	<p>I understand that scientists make sense of the world around them through observation and data collection.</p> <p>I understand that scientific knowledge is built through collaboration between cultures across space and time.</p>
Essential questions	<p>Why did our ancestors care so much about the stars and planets? How can I act like a scientist? What are ways I use science to understand the world around me? How can learning about our past help me understand our present?</p>

Launch
<p>Ask students to recap the last lesson.</p> <p><i>Last class we learned about AlJawza' and the story our ancestors told about it. Who can remember what ancestor means? Who can tell me a few details of the story? Today, we're going to continue wondering about our ancestors, learning more about the kind of science they did and how creative they were.</i></p> <p>If possible, connect with some questions your students asked in the previous lesson. For example, if a student asked about scientific tools or processes, point out that this will be your direction for the day.</p>
Thinking routine
<p>Invite learners to complete a thinking routine that looks at astronomical tools from different moments in place and time². Give each table a set of images of the astronomical tools (included</p>

² A similar learning experience exists on [The Metropolitan Museum of Art's](#) website. We have used their lesson to enrich ours.



in slides). Learners will jot notes about each tool's parts and its function, then try to place the tools in chronological order. See slides for instructions and images of tools. Before beginning with the instructions, contextualize the activity:

Our ancestors were amazing scientists, and in fact, the Muslim empire a thousand years ago was famous for the work its scientists did in studying the night sky. But people all over the world have always been interested, even obsessed, with stars and planets. You have in front of you pictures of different tools or instruments from different times and places.

Continue with instructions.

Invite students on a gallery walk for a chance to see how other groups completed their timelines.

Show the class the correct timeline and briefly [name and introduce each instrument](#) before the discussion. Allow students to amend their timelines. Make sure to display the timeline somewhere on your wall as evidence of learning.

Discussion

First, have a general discussion about the instruments:

1. List some examples of instruments you have learned about today. Remind students that the human eye is the greatest scientific instrument.
2. What do you notice about when and where these instruments were invented?
3. Do you think we could have gotten to the telescope without the sundial? Without the astrolabe? Why or why not?
4. Do we need instruments to be scientists?

Return to the central question from last class:

Now that we've explored a few of the tools our ancestors created and used to help them understand space, let's return to the same question we started thinking about last class. Why did our ancestors care so much about the sun's movements, the stars and the planets? That they spent all this time and effort creating these tools?

Invite students to chat in pairs first for deeper, more collaborative meaning making.

Making conclusions

Once students have shared ideas as a class, ask that they record their thoughts either in their journals or on strips of paper that you display on your inquiry wall. You may also choose to record their big ideas in your teacher presentation to keep track of growing understanding.

Possible prompts to help your students make conclusions:

- *Why did our ancestors care so much about the sun's movements, the stars and the planets?*



- *How do scientists learn about the world around them? (tools, wonder, observations, everyday experiences)*

Extension

Show an [instructional video](#) of how to use an astrolabe.

If you live in Abu Dhabi, a visit to the Louvre to see their [astrolabes and celestial globes](#) could be rewarding.

If you live in Qatar, Doha's [AlTuraya Planetarium](#) is geared specifically towards kids and accommodates school bookings.

Lesson 3

Lesson Three: Rotation of the Earth	
Grade level	5
Subject	Science Social Studies
Materials	<p>Included Materials: Informational text about the rotation of the Earth Astronomy unit vocabulary</p> <p>Needed Materials: Science journals Timelapse of the sun’s “movement” across the sky</p>
Lesson objectives	<p>I understand that scientists make sense of the world around them through observation and data collection.</p> <p>I understand that scientific knowledge is built through collaboration between cultures across space and time.</p>
Essential questions	<p>Why did our ancestors care so much about the stars and planets? How can I act like a scientist? What are ways I use science to understand the world around me? How can learning about our past help me understand our present?</p>

Note to teachers: The NGSS skill we are engaging with this unit is about the patterns created by the Earth’s movement. This includes day and night, shadows and seasonal appearances of stars. We suggest you create a space on your wall to keep track of the patterns and their causes as you learn about them. You may title this space “Patterns created by Earth’s movement.”

Launch
<p>Recall previous learning.</p> <p><i>We have been exploring the connection our ancestors had with the sun, stars and planets and wondering about why they found it so important to learn about space. Can someone remind me of some of the ideas we have learned so far?</i></p> <p>Fill in any gaps your learners leave. Make sure to make the connection between past scientific discoveries and our present day knowledge and the importance of wonder and observation.</p>
Thinking routine and discussion
See, Think, Wonder

Have your students set up their notebooks to prepare for a ‘see, think, wonder’ routine. Show them a [timelapse](#) of the sun’s “movement” across the sky over the course of a day. Ask your students to jot down what they see. What do they notice?

Skipping to the ‘wonder’ column, remind them of the curiosity and wonder that all scientists must have to investigate the world around them. Set the scene by orienting your learners to a time and place.

Scientists, let’s think back to our ancestors again. Imagine what it must have been like to spend your entire days outside, looking up at the sun. Either waiting for its arrival in the early morning, or praying for it to set and for the day’s heat to be over. Imagine their wonder at this great fiery orb in the sky that seems to move, everyday without fail on its own. What questions do you think they must have asked out loud and in their hearts? What do you think they wondered about?

Guide your students now and pose the question of what might be causing this phenomenon of the sun “moving” in the sky to jot ideas about in the ‘think’ column. Finally, ask your students what scientific instrument we are using here. Emphasize that observation (the instrument of sight!) is a powerful scientific tool.

Building content knowledge

Note to teachers: Depending on how much instructional time you have, you may choose to assign the reading for homework the day before. This gives you more time in class to practice skills and deepen understanding.

Learners read a [short informational text](#) about the rotation of the Earth and what patterns it creates.

Students will:

- Work in productive partnerships
- Use an agreed upon reading comprehension strategy like read, cover, retell³
- Answer comprehension questions in their journals
- Draw a model of the rotation of the Earth
- Ask two questions

Brain break

Depending on how long your class is, when it is in the day or how long your learners can sustain focus, you may choose to invite your learners to a brain break. Set a time for 4 minutes, put some instrumental music on and allow them to stretch, get a drink of water, or chat with a neighbor. A more focused brain break, like [this one](#) from Kira Willey could also be nice.

³ Intentional use of reading comprehension strategies across subject areas is a helpful scaffold for multilingual students. Snyder, Sydney, and Diane Staehr Fenner. *Culturally Responsive Teaching for Multilingual Learners*. Corwin Press, 25 Jan. 2021.

Closing

Have one learner come up to draw their model on the board for a discussion. Ask the class to use the model to explain how the rotation of the Earth creates day and night in scientific language.⁴

Add “Earth’s rotation - day & night” to the wall space mentioned at the beginning of this lesson to keep track of patterns created by the Earth’s movement.

Extension

Over the weekend, students might be encouraged to take note of how the sun “moves” across the sky. They might draw a simple drawing of their house or another landmark like a tree, and draw the position of the sun in the sky every one, two or three hours. Remind your learners that observation is the beginning of all scientific inquiry!

⁴ If your learners struggle to use scientific language, consider taking a class to help them practice. In pairs, learners can create a model of the rotation of the Earth using their bodies and movement. Provide a word bank for each of the following roles: the Earth and the sun. Each student takes turns while moving their bodies in the appropriate way and using the scientific words. End by co-creating a scientific description of day and night, while asking how this version is stronger. This activity is adapted from Sydney Snyder and Diane Staehr Fenner’s book *Culturally Responsive Teaching for Multilingual Learners* (Corwin Press, 25 Jan. 2021).

Lesson 4

Lesson four: Data	
Grade level	5
Subject	Science Social Studies
Materials	<p>Included Materials: Slides Video of rotation of the Earth Astronomy unit vocabulary</p> <p>Needed Materials: Science notebooks Flashlights (3-5) depending on number of groups</p>
Lesson objectives	<p>I can interpret data.</p> <p>I can represent data to reveal patterns of daily changes in day and night (NGSS 5-ESS1-2).</p>
Essential questions	<p>What patterns does the movement of the Earth create? How can we represent this data? How else? Why do scientists use data? Why do you think there are different ways to represent the same data?</p>

Note to teachers: We are going to introduce two new keywords today. This might be a good time to prepare a word wall⁵. If your wall space is limited, consider hanging the words vertically from the ceiling or horizontally on a string running the length of your classroom. The words introduced today are data and astronomy. In previous lessons, we have introduced the words ancestor, constellation and pattern, all of which should also be included on your word wall. You might utilize the vocabulary [words](#) provided here.

We have been making progress towards understanding the patterns created by the Earth’s movement, while keeping the unit contextualized within a historical and contemporary Islamic lens. Today we are taking up the NGSS standard 5-ESS1-2 “Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky” in a concrete way by introducing our students to different forms of data. The concept of data may be new to your learners. Take your time with it. Make connections to math content students are familiar with.

⁵ A word wall is a space on your classroom wall where you display unit vocabulary.

Recall

Recall previous learning.

So scientists, we have already learned so much! We've learned about a folktale our ancestors used to tell about a constellation, or group of stars. We have learned about some scientific instruments used to study the sun and the stars. What else did we learn about yesterday?

Fill in the gaps, making sure to mention what the rotation of the Earth is and what pattern it creates.

Does anyone know what this branch of science is called? When we study the stars, planets and space? It is called astronomy! Let's remember that word and try to use it from now on.

This could be a good opportunity for a call and response, where learners are prompted to repeat a statement with corresponding hand gestures to help understanding and retention. For example, whenever you say "astronomy," learners respond by making binoculars with their hands and holding them up to their eyes and chanting "the study of stars, planets and space."

Make sure the word 'astronomy' is already on the wall or include it in your slides for students to be able to have a point of reference for this new scientific word.

Launch

Show students [this video](#) of Earth rotating in space.

Ask how this relates to the video we watched yesterday of the sun "moving" across the sky. What does this video make clear?

Mindmap of the concept of a 'pattern.'

Ask the class to recall the definition of 'pattern' from their reading yesterday. Tell your learners that the concept of a pattern will play a central role in their learning. Introduce the activity by instructing your learners to jot down the following about patterns in the form of a mind map or the Frayer graphic organizer⁶ in their journals:

- The definition
- As many examples they can think (scientific or otherwise)
- Examples of non-patterns (scientific or otherwise)

Ask students to use 'pattern' in a sentence orally.

Finally, ask how the rotation of the Earth is a pattern while playing the video.

⁶ [Frayer graphic organizers and explanations.](#)

Introduction to data collection
Share slides with students digitally, or print out slide three to distribute to each pair of students. Once you introduce the definition of data and share some examples, allow students to practice interpreting the four examples given on slide three in pairs.
Practice
Each pair or group of students will be given a specific graphical display of data (pictograph, bar graph, table, etc) and a set of instructions. Each group will be responsible for creating data that explains how the rotation of the earth creates day and night using their specific graphical mode. Several pairs or groups will have to do the same graphical display. See slides for instructions. Either share the slides digitally or print out the relevant slide for each group. Depending on how long your classes are, you may have to extend this activity over two lessons. Display your students' graphical displays.
Sharing
Students can create videos to share with the class or post on a sharing platform you may use, like Seesaw. Students may present their data to the class in oral presentations, or simply invite students to a gallery walk to see other groups' displays.
Closing
Debrief today's learning experience with a whole class discussion of what data is and what we learn from different representations of data. Point to the "Patterns" space on the wall to remind learners that the Earth's rotation creates day and night.
Extension
Based on today's classwork, students might make an infographic or poster responding to the question 'what is data?' Posters should include a definition and 2-3 examples from today's lesson. Students must also respond to one of the questions below: <ul style="list-style-type: none">- What do different representations of data tell us about the same phenomenon?- How does data help us understand the world around us?- Why is data so important to scientists? You may choose to attach an instructional video like Data for Kids - What is Data .

Lesson 5

Lesson Five: Shadows	
Grade level	5
Subject	Science Social Studies
Materials	<p>Included Materials: Video of timelapse of the sun</p> <p>Needed Materials: Science journals Two prompts displayed on slide or anchor chart Flashlights (10-15) depending on how many pairs Classroom objects to create shadows (pencils, erasers, etc)</p>
Lesson objective	I can represent data to reveal patterns of daily changes in length and direction of shadows (NGSS 5-ESS1-2).
Essential questions	What patterns does the movement of the Earth create? How can we represent this data? How else? Why do scientists use data? Why do you think there are different ways to represent the same data?

Recall
<p>Point to the “Patterns” wall space that shows “Earth’s rotation - day & night” and ask learners to explain the rotation of the Earth and what pattern it creates in small groups of three or four. Encourage learners to use their bodies, hands or everyday objects (like pens or erasers) to better illustrate the pattern. Make sure to draw their attention to the fact that a pattern repeats.</p>
Launch
<p>Explain that the rotation of the Earth also creates another pattern. Share with your students that there was a specific position in the medieval Islamic empire called the Muwaqqit. It was the Muwaqqit’s job to advise the Muezzin of the times of prayer⁷. Ask how time was told before clocks and watches.</p> <p>Tell your learners that time was told by keeping track of the shadow cast by the position of sun overhead. Point to the sundial from lesson two if you displayed the timeline on the wall. Ask how they think this works. Encourage your learners to connect their previous learning about the rotation of the Earth and what that does to the sun’s position in the sky throughout the day. Ask what they think the pattern here might be.</p>

⁷ Steele, John M. *A Brief Introduction to Astronomy in the Middle East*. London, Saqi, 2012. Page 86, eBook.

Scientific modeling

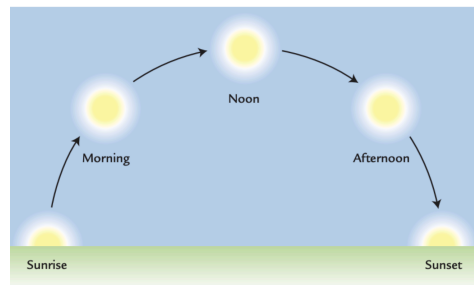
Learners will investigate the relationship between shadows, an object and a light source. Students will create models in groups of two or three using flashlights and an object of choice to observe how shadows are affected by the movement of the light source. Encourage students to experiment first without necessarily thinking about the sun or the Earth's rotation, writing down their observations in their science journals.

Display the following two prompts for students to respond to:

- What happens to the shadow when the light source changes distance from the object?
- What happens to the shadow when the light source changes direction?

Making connections

Ask students to then try to simulate the sun's "movement" across the sky with their flashlights or hands. You may choose to show the same [timelapse](#) of the sun's "movement" from lesson three. When all groups are making an accurate simulation of the sun's arc across the sky, map out five points on the board that would correspond to the sun at its rising, at around 9am, 12pm, 2pm, and sunset⁸.



Now draw a stick right in the middle of the image on the ground. The stick will represent the object they were working with to make shadows.

Instruct students to simulate the movement of the sun with their flashlights, while tracking the changes in shadow length and directions. Students can snap pictures of the different positions of the sun in relation to its shadow, or choose to draw what they see.

As you walk around, ask students how their model explains the relationship between the rotation of the Earth and the pattern of shadows to allow them to practice verbally making the connection.

Sharing

Invite student groups to explain to the class how the rotation of the Earth affects shadows, while modeling with a flashlight and object.

Making meaning

Add to the "Patterns" wall space. Begin with "Earth's rotation - " and allow students to help fill in the pattern. Prompt students to remember what creates a pattern. What pattern does Earth's rotation create when it comes to shadows?

⁸ Diagram taken from [PPS Sci8 - Earth in Space - Week 2 - What causes Day and Night? - Susan Holveck | Library | Formative](#).



Add "Earth's rotation - shadows change direction and length"

Extension

Create a rudimentary sundial! If you place a long object like a stick or a water bottle outside in a sunny area, you and your students can mark the shadow it creates every hour while at school. Make sure to draw the length of the shadow as well as its direction to keep an accurate measure of how it shrinks then grows throughout the day. You may assign this for homework over the weekend as well.

Lesson 6

Lesson six: Shadows continued	
Grade level	5
Subject	Science Social Studies
Materials	<p>Included Materials: Shadow tracker Video of shadows changing throughout the day</p> <p>Needed Materials: Science journal Ruler</p>
Lesson objectives	I can represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows (NGSS 5-ESS1-2).
Essential questions	How can I answer questions through observation? How can I act like a scientist? What patterns does the movement of the Earth create?

Launch
<p>To recall and extend last class's learning, show a video that summarizes how shadows change throughout a day. Ask learners what they notice about the shadows and encourage them to make connections to the previous day's learning - where do you think the sun is in relation to the shadows? Why are the shadows moving? Why are they getting longer? Ask what causes these changes to happen (Earth's rotation).</p> <p>If the weather allows, go outside to observe the sun and the shadows it creates! This is a casual activity, acting as an opportunity to take concepts being studied into the real world. If you would like this to be a more formal exercise, students may write prompts in their journal that they must respond to outside.</p> <p>Some questions to discuss outside:</p> <ul style="list-style-type: none"> - Where is the sun and where is your shadow? - How is this the same as your flashlight model? - Where did the sun rise from? Where will it set? - How would the sun move throughout the day? - Where would the sun be at noon? What about 5pm? - What would happen to your shadow at noon? At 5pm?

To wrap up the launch, link this exercise to the observation and wonder at the heart of scientific inquiry.

Scientists, remember when we thought about our ancestors gazing up at the sun and the stars and wondering about the mysterious forces that make up our universe? This wondering is at the heart of scientific inquiry! And the tool used to explore it? Observation! What we're doing now - gazing up at the sun, finding patterns, asking questions - scientists have always done this and will always continue to do this. They are the most valuable tools scientists have.

Creating data

Students will create data using a simple shadow tracker (included), by measuring each shadow length and recording the different measurements in a table. The table's columns will include the time, the shadow length (measured by a ruler in cm), the shadow direction and the sun's direction. See [Wonder of Science's sample assessment](#) of this standard for sample data.

Time	Shadow length (cm)	Shadow direction	Sun's direction
Sunrise 6am			
10am			

After filling in the table, learners explain in writing: What pattern is created here? How does the Earth's rotation create daily patterns in shadow length and direction?

Discussion

What shadow patterns does the Earth's rotation create? Explain.
 What are all the kinds of data we have come across so far?
 How else can we represent this pattern?

Extension

Support your learners in creating a graph of shadow lengths by using the measurements collected in their tables. This will help give your learners more practice with different forms of data.

Lesson 7



Lesson Seven: Revolution of the Earth	
Grade level	5
Subject	Science Social Studies
Materials	<p>Included Materials: Thuraya's folktale Informational text about the Earth's revolution Astronomy unit vocabulary video of the Earth revolving</p> <p>Needed Materials: Science journals</p>
Lesson objective	I can understand that the Earth revolves around the sun, which leads to the seasonal appearance of some stars in the night sky (NGSS 5-ESS1-2).
Essential questions	What patterns does the movement of the Earth create? Why did our ancestors care so much about the stars and planets? How can I act like a scientist? What are ways I use science to understand the world around me? How can learning about our past help me understand our present?

Note to teachers: In this lesson, we are moving on to study the Earth's revolution. However, if you'd like to deepen your learners' skills with interpreting data before moving on, we suggest giving students displays of data to practice interpreting data. For example, a chart of daylight hours in different locations, a chart of time differences, a bar graph of shadow lengths, etc.

Recall
<p>Debrief last lesson and recall previous learning. The debrief can be a whole class discussion, an individual written reflection, a short quiz, or a game of charades for a more interactive opening. If you'd like to go the charades route, write the unit's keywords on small pieces of paper for your learners to act out. Some options include ancestor, Earth's rotation, data, pattern, folktale, the sun, day and night, etc.</p> <p><i>What is one way the Earth moves in space? Show me with your body.</i> <i>What pattern does this movement of the Earth create? Explain.</i> <i>How can we represent this data? How else?</i> <i>How does data help us understand the world around us?</i> <i>How does science help us understand the world around us?</i></p>
Optional Launch - Wonder Wednesday check in

Depending on how much time you have, this might be a good time to check in with your learner's questions from day one. We originally called this routine 'Wonder Wednesday,' however you don't have to be limited by the day of the week. You can also encourage your learners to ask more questions at this stage of their learning, possibly after reading [Look Up With Me by Jennifer Bern](#) or [بركة الأسئلة الزرقاء , مايا أبو الحيات](#). Learners can independently research a question or the class can choose one learners' question to research in real time utilizing [Wonderopolis](#) or similar search engines.

Folktale

Share the [story of Thuraya](#) with your students. This is a story about the first appearance of the summer star in the sky, marking the beginning of the heat.

You may also share two lines of poetry from Qutrub, writing in 821 CE.

إذا طلع النجم فالحر في حدم والعشب في حطم والعانات في كدم
إذا طلع النجم أتقي اللحم وخيف السقم وجرى السراب على الأكم
Qutrub (d. 821 CE)

Discuss and explain the lines of poetry. Ask your learners how a star could only appear in the sky sometimes, at the exact same time of year every year. What might be happening? Allow students to chat amongst themselves to generate excitement.

Introduce the idea that the Earth also moves in space in a second equally important way, in addition to rotating around itself. Ask your students to guess how else the Earth moves in space. Tell your students that just like the Earth's rotation has consequences for us (it creates day and night), the Earth's revolution also has consequences.

Qutrub's poem is taken from Danielle Adams' One Sky project, [When Thuraya Rises](#).

Investigate

Show a [video](#) of the Earth revolving around the sun. Point out the different words we have for rotating and revolving. Clarify that the Earth is moving in two ways at all times. Ask students to model this with classroom instruments (eraser and sharpener, for example) or their bodies.

Ask students how the revolution of the Earth might cause the appearance of Thuraya at the beginning of summer.

Investigate

Learners read [a short text](#) about the revolution of the Earth and the patterns it creates. The text will introduce features like the equator, Northern and Southern hemispheres, and the tilt of the axis.



Students will:

- Work in productive partnerships
- Use an agreed upon reading comprehension strategy like read, cover, retell
- Answer comprehension questions
- Draw a model of the revolution of the Earth
- Ask two questions

Closing

Add the new pattern to the wall space that should already have “Earth’s rotation - day & night.” Today you can add “Earth’s revolution - seasonal appearance of stars.”

While you play the video of the Earth revolving around the sun, ask your learners to describe the movement and the pattern. Ask them to explain why this is considered a pattern.

Extension

Introduce an app like Sky Guide for learners to explore at home. Have them try to find the different constellations we have studied so far like AlJawza’ and Thuraya. Students may jot down other constellations that catch their eye - what kind of story could they make up about this constellation?

Lesson 8

Lesson eight: Constellation Tour	
Grade level	5
Subject	Science Social Studies
Materials	<p>Included Materials: Well bucket constellation Pictures of Seasonal Stars printed Constellation tour student roles printed Constellation tour script printed</p> <p>Needed Materials: A lamp, flashlight or other prop for the sun Highlighters</p>
Lesson objective	<p>I can understand that the Earth revolves around the sun, which leads to the seasonal appearance of some stars in the night sky (NGSS 5-ESS1-2).</p> <p>I can use my powers of observation to understand the world around me.</p>
Essential questions	<p>Why did our ancestors care so much about the stars and planets? How can I act like a scientist? What are ways I use science to understand the world around me? How can learning about our past help me understand our present?</p>

Note to teachers: This lesson requires a lot of logistics. Make sure to read through the instructions ahead of time and prepare your students to be independent. It is important to understand that this lesson is a simplification of the rising and setting of seasonal stars in order to support students in grasping how the Earth's revolution creates changes in the night sky; two different seasonal stars can share the same night sky and stars in the polar regions appear to be fixed in the sky.

Launch
<p>To recap last lesson, share with students an image of the group of stars known as the well bucket or الدلو (included in the slides). Although the cluster of stars is known today as the square of pegasus, some of the individual stars are still known by their Arab names like AlMankab (المنكب), Algenib (الجنب), and Alpheratz (السرة). Explain that this group of stars marks the beginning of the rainy season.</p> <p>Discuss this line of poetry from 'Adi ibn Zayd al-'Ibadi writing in the 6th century CE:</p> <p style="text-align: right;">في خريف سقاه نوء من الدلو تدلى ولم توار العراقي</p>

Daniella Adams explains: “For many tribes of Arabia, the year consisted of six seasons of varying length. The last of these was called *kharif* because it was the time when people harvested (*kharafa*) dates and other kinds of fruit. The first rains to follow the drought of summer fell during *kharif*, but the new year began with the onset of the autumnal rainy season called *wasmi*. This season was so named because its rains literally marked (*wasama*) the earth with the intensity of their falling, and because the vegetation that quickly followed would rapidly mark the desert in vibrant shades of green... It is fitting that, in the transition from the lighter rains of *kharif* to the marking *wasmi* rains of the new year, many of the Arabs saw a magnificent stellar Well Bucket pouring out water onto the earth.” [Desert Rains from the Celestial Well Bucket](#)

Ask your students why we only see certain stars at certain times of the year? How did our ancestors use the stars to mark their calendars?

Constellation tour preparation

In a collaborative effort, your class will model the seasonal appearance of stars with movement and storytelling. Each pair or group of students will receive a role to play in the solar system. For example, two students will be the Earth, another two will be the constellation Thuraya, and still another two may be a group of our ancestors looking up at the coming of Thuraya knowing that the summer heat has arrived. Students will practice their roles using [role cards](#) and a whole [class script](#), then model the revolution of the Earth around the sun, stopping at different constellations to narrate the seasonal changes.

Distribute the following roles amongst your students using the [role cards](#):

- Two students stand in the middle to represent the sun, maybe with a flashlight or other prop.
- Two students represent the Earth.
- Groups of three are each given a constellation to represent, for a total of four constellations.
- Another set of groups of three will represent our ancestors. Each group will be responsible for one constellation for a total of four groups of ancestors. Ancestors will be watching the night sky for changes.
- The teacher may read the part of the narrator in the class script.

Instruct students to read and complete the role cards and divvy up the roles between their pairs or group members. **Be advised that while the class is familiar with the constellations of Thuraya and the well bucket, Al-Jawza’ and Al-Simak are new to them. These groups may need extra guidance.** Set a timer for 15 minutes. Once groups are done filling out the role cards, hand out the class script. The script brings together all the roles and matches their role cards with some narrative additions. Have students transfer their information to the script and prepare for the simulation by familiarizing themselves with the entire script and their group’s placement. They may highlight their parts.

The performance may have to take place during the next lesson.

Constellation tour performance

Print and place constellation images from each season around the classroom (each side of the classroom is a season). Pictures are included in the slides.

Winter: Al-Jawza' (Orion) → cold, long nights

Spring: Al-Simak *al-A'zal*, السمك الأعزل (Spica) → renewal, planting

Summer: Thuraya (Pleiades) → heat, find water, harvest dates

Fall: Well-Bucket (Pegasus Square) → rain, planting, end of heat

Groups begin acting out the script with associated movements.

Making conclusions

While your students are still in their spots in the simulation, ask a series of reflective questions:


- Why do we see different stars in different seasons?
- Why do you think people care about stars enough to make up stories about them?
- How did our ancestors use the night sky?
- How do these stories change our relationship with nature and the cosmos?
- How does the Earth's movement in space affect our lives?

Point to "Earth's revolution - seasonal appearance of stars" displayed under "Patterns" on your wall display and emphasize the relationship.


Extension

Students create a diagram of the seasonal appearance of stars with a short explanatory statement.

Lesson 9

Lesson Nine: The House of Wisdom	
Grade level	5
Subject	Science Social Studies
Materials	<p>Included Materials: Informational text on medieval Islamic science</p> <p>Needed Materials: Science journals  هارون الرشيد وابنه المأمون.. زمن بغداد الذهبي</p> <p>Optional Materials: بيت الحكمة تأليف بدور القاسمي مريم وتنين الشمس</p>
Lesson objective	<p>I understand that scientists make sense of the world around them through observation and data collection.</p> <p>I understand that scientific knowledge is built through collaboration between cultures across space and time.</p>
Essential questions	<p>Why did our ancestors care so much about the stars and planets?</p> <p>How can learning about our past help me understand our present?</p>

Note to teachers: This lesson is a dive into the history of science in the Islamic empire. Even if you are teaching science, this lesson extends the transdisciplinary nature of learning and deepens the unit's ongoing themes of wonder and ancestral knowledge by giving our young learners a peek into a specific period of scientific discovery.

Launch
<p><i>We have already gotten a sense of how important the night sky and the study of astronomy (call and response) was to our ancestors. Did you know that about 2/3rds of all the stars in the night sky are named by Arab astronomers? What are some star names we have learned about so far?</i></p> <p>Begin with this video from Al-Jazeera:  هارون الرشيد وابنه المأمون.. زمن بغداد الذهبي</p> <p>You also have the option of the two read alouds included in the optional materials.</p> <p>As you watch the video, prompt your learners to think about why Harun Al-Rashid and his son</p>

were determined to translate scientific texts from different empires like Greece and India. Why did science and astronomy in particular mean so much to them?

Discuss: What propels Harun AlRashid on their quest for knowledge? What impact do they have on their community? What about all the scientists who flourished under their patronage?

Investigating medieval Islamic science

Mindmap

Each learner will make a mindmap in their science journals to brainstorm the unit's big question: Why did astronomy matter so much to our ancestors?

This is a synthesizing activity before reading a short informational text that will ground their learning in history. Encourage your learners to think about previous learning experiences. Remind them of the different astronomical tools they learned about early on, and the stories about constellations they experienced, and how our ancestors used the night sky and the patterns of the Earth (to measure prayer time and track seasonal changes, for example).

Investigate

Students read an [informational text](#) about why astronomy flourished in the Islamic empire and the contributions of Islamic astronomers. The text is four pages long but accessible. Pre-read it to decide what parts are the most relevant to your students and the lesson objective.

While reading, learners will add new information to their mindmaps using a different color. Learners may work in pairs.

Making meaning

Discussion⁹

*Why did our ancestors care so much about astronomy? What are the different needs that pushed the study of astronomy forward? (time, direction, faith, travel, seasons)
Which need pushed astronomy forward the most? Defend with evidence.
How is astronomy different today? What does this tell us about how our society has changed?
How will astronomy be different 100 years in the future?
Why do you think there are so few women in science?
What will it take to change this?*

Add the different needs that pushed the study of astronomy forward to your learning wall.

Extension

Naming your own star and creating an original story. Give learners a picture of the night sky and

⁹ Adapted from Project Zero's thinking routine '[Projecting Across Time](#)'



have them trace a shape/image and make up a story about its origins. The story must show learning from the unit. This is a good opportunity to practice for the final project.

Lesson 10

Lesson Ten: Final Project	
Grade level	5
Subject	Science Social Studies
Materials	<p>Included Materials: Final project planning sheet and rubric</p> <p>Needed Materials: Science journals Class materials (see note to teachers below)</p>
Lesson objective	I can represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky (NGSS 5-ESS1-2).
Essential questions	How can I share my learning with others? How can I show my understanding of the patterns Earth's movement creates through data? How can I use what I know to create a meaningful folktale?

Note to teachers: Make sure that your learners have access to class materials so they can refer back to them during their independent work. They should have access to lesson 1's folktale about AlJawza', lesson 4's slides on data and lesson 7's folktale on Thuraya. Depending on how much support you choose to give, you could also make sure your students have access to the informational texts from lessons 3 and 7 about the rotation and revolution of the Earth and the patterns they create. The patterns created by the movement of the Earth should still be displayed on your learning wall for reference.

Launch
<p>The final project for this unit consists of the following: learners choose a pattern created by the movement of the Earth and a way to represent it through a graphical display of data. Learners then create a folktale that explains the phenomenon including an understanding of why this mattered to our ancestors. See the final project planning sheet for details and rubric.</p> <p>You have the option of a short synthesis activity before introducing the final project. Below are two options.</p> <p><u>Synthesis activity option 1 (10 minutes):</u> Write the following on the board: Pattern → cause → meaning for people And have students work in pairs to complete the following sentence frames.</p>



One pattern we studied is...

This pattern happens because the Earth...

For people long ago, this pattern mattered because...

Synthesis activity option 2 (20 minutes):

This activity is a combination of a mindmap and a hexagonal thinking routine that forces students to make connections between related concepts.

- Each pair chooses a key term or concept from the unit (rotation, seasonal stars, pattern, shadows, etc) and places it in the middle of a page in a bubble.
- Learners then must write 3-4 related key terms or concepts around it and explain the connection.

For example, if the middle bubble says 'rotation' and an outer bubble says 'shadow,' learners must explain that the rotation of the Earth creates the appearance of the sun moving in the sky, which affects the length and direction of shadows. This happens because the distance and direction of light from an object will change a shadow's length and direction. If a third bubble says 'pattern,' students must explain that because the Earth's rotation repeats every 24 hours, shadows change direction and length in the same way every 24 hours.

Closing

As an end of unit celebration, invite learners to share their folktales with their classmates in a 'campfire' setting - turn the lights down and have learners gather around on the floor with snacks. Play a [campfire video](#) in the background. Encourage your learners to practice beforehand to captivate their audience!