Mystery science

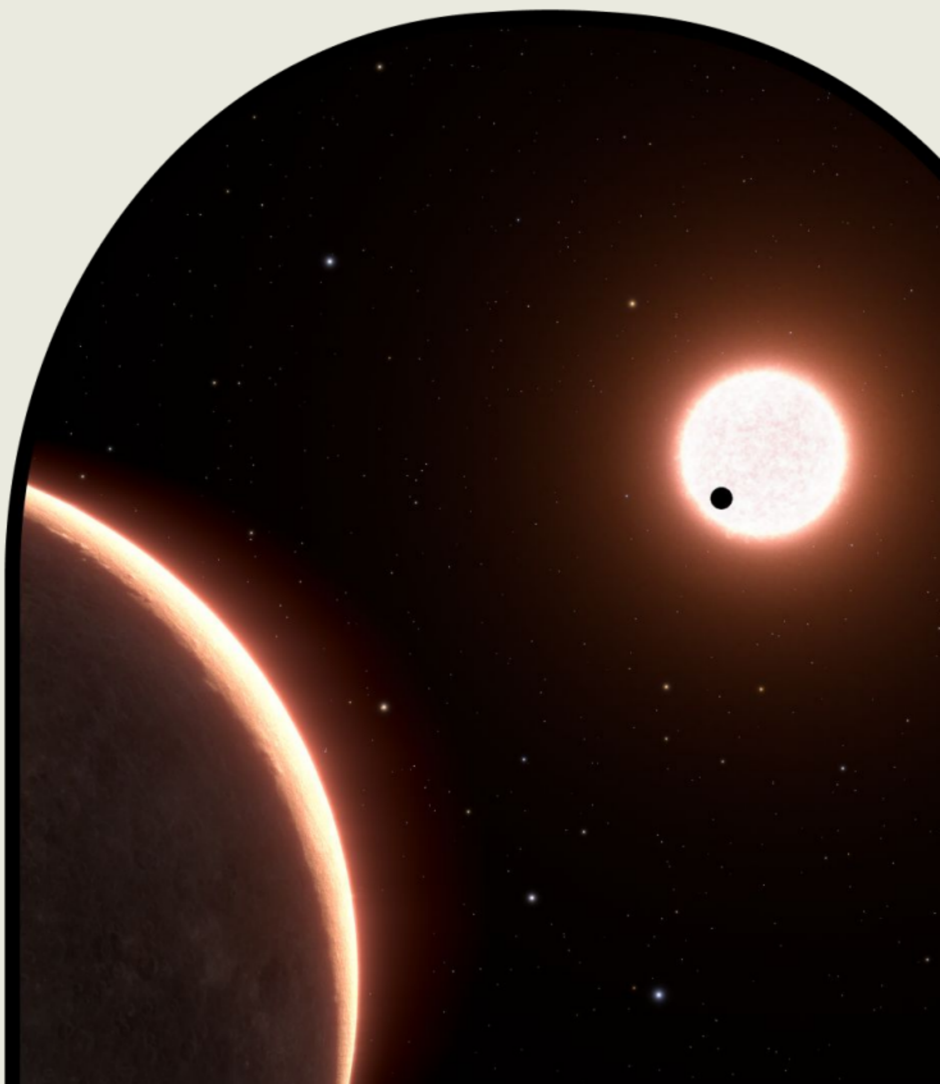
Anchor Layer Teacher Guide

A curriculum companion for Anchor Layer users

Grade 5

Stars & Planets

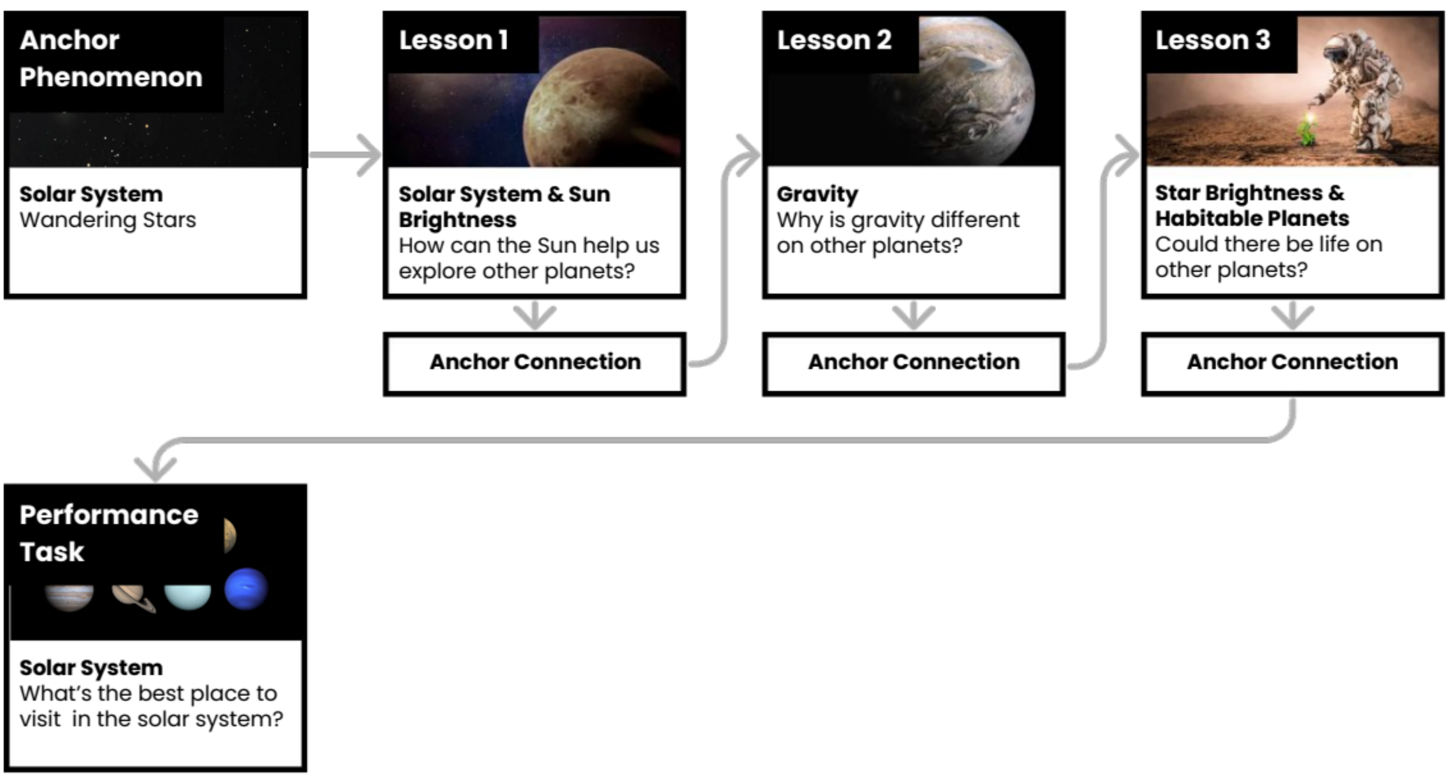
Unit Web Link • Pacing Guide • Other Units



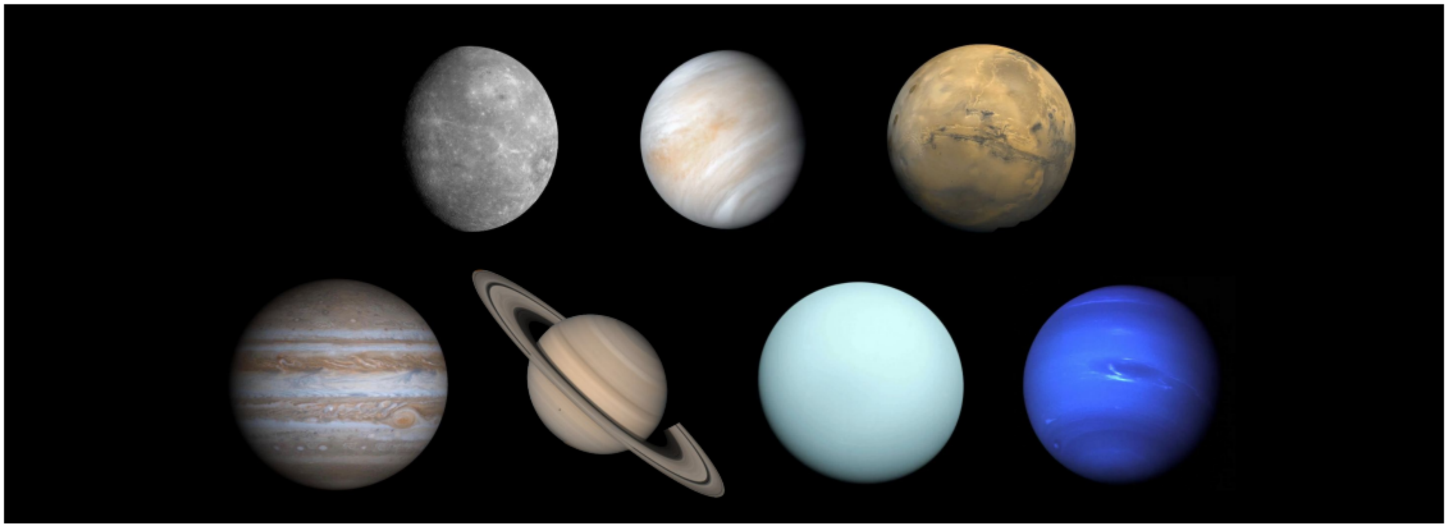
Unit Summary

In this unit, students explore our solar system! They investigate how bright the Sun appears from each planet in our solar system and from stars of other solar systems in galaxies far away. They also investigate gravity on Earth and gravity on other planets to discover patterns of this incredible force.

Performance Expectations	Science & Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
• 5-ESS1-1. Support an argument that differences in the apparent brightness of the Sun compared to other stars is due to their relative distances from Earth. • 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. • 5-PS2-1. Support an argument that the gravitational force exerted by Earth on objects is directed down.	• Developing and Using Models • Engaging in Argument from Evidence • Planning and Carrying Out Investigations • Analyzing and Interpreting Data • Using Mathematics and Computational Thinking • Obtaining, Evaluating, and Communicating Information	• ESS1.A: The Universe and its Stars • ESS1.B: Earth and the Solar System • PS2.B: Types of Interactions	• Cause and Effect • Patterns • Scale, Proportion, and Quantity • Systems and System Models



Anchor Phenomenon Background



Why does it look like some stars wander around in the night sky?

There is evidence that humans have watched the Sun, Moon, and stars in the skies for thousands of years. Through careful observation, people noticed that there are patterns in how these objects move from day to day, month to month, and year to year.

The stars are the most obvious objects to see in the night sky. And from one night to the next, almost all of the stars appear to behave as one big group. They don't move around and trade places.

However, people noticed a very small number of exceptions to this pattern. Some of the stars did trade places with the others. Sometimes they moved east, and sometimes west. It was almost like there was a very small number of stars that were wandering around. The ancient Greeks had a word for wanderers: planētēs.

As time went by, humans developed tools that allowed them to get a closer look at these objects. They quickly realized that they were not stars at all, but in fact other worlds similar to the Earth. They were planets! And these planets were significantly closer to Earth than the stars. The fact that they are so much closer is the reason we can easily detect their motion, as compared with the much more distant stars.

Eventually, scientists and engineers built ships that could visit these other worlds. They were able to gather photographs of what these worlds looked like, and gather measurements of all sorts of characteristics, such as temperature, brightness, gravitational field, and wind speeds.

This process of gathering information about the universe around us is one of the most important things that scientists do, and that is the journey that students take in this Anchor Layer.

Anchor Phenomenon: Wandering Stars
Solar System

Anchor Phenomenon
15 mins

Guided Inquiry
20 mins

Hands-On Activity
20 mins

Wrap-Up
2 mins

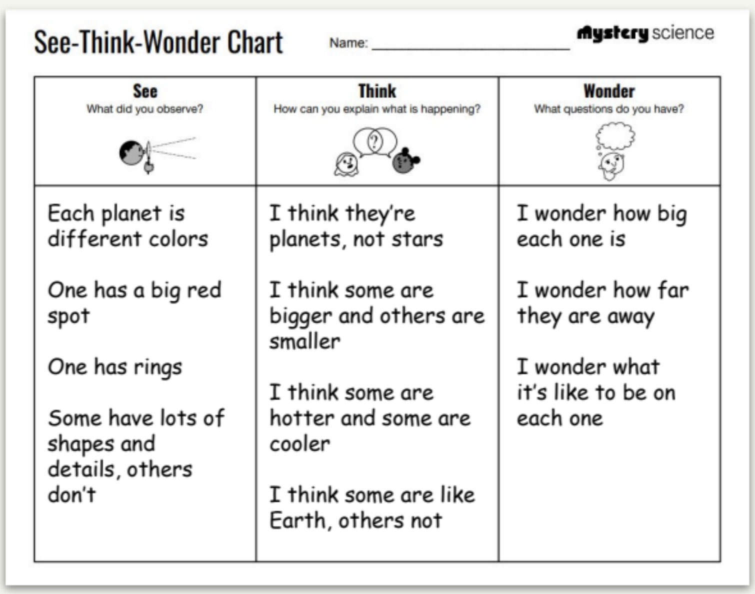
Anchor Phenomenon Lesson Overview

Note: This lesson is part of this unit's Anchor Layer. If you have the Anchor Layer turned on, we recommend teaching all lessons in the remainder of this unit in order.

The anchor phenomenon for this unit is the wandering stars: a small number of objects in the night sky that appear to move completely separately from all of the other stars. Students generate observations and questions about the phenomenon and document their initial thinking about what the characteristics are of the wandering stars.

Student Work Samples & Notes

Students will gather clues during and after each lesson to help them improve their explanation. It is important to encourage students to recognize that even if they don't know the perfect answer yet, they are going to learn a lot throughout the unit and will have an opportunity to change or add to their first explanation.



See-Think-Wonder Chart   Name: ____________________

See What did you observe?	Think How can you explain what is happening?	Wonder What questions do you have?
Each planet is different colors One has a big red spot One has rings Some have lots of shapes and details, others don't	I think they're planets, not stars I think some are bigger and others are smaller I think some are hotter and some are cooler I think some are like Earth, others not	I wonder how big each one is I wonder how far they are away I wonder what it's like to be on each one

Lesson 1: How can the Sun help us explore other planets?

Solar System & Sun Brightness (pg 1 of 2)

Exploration
15 mins

Hands-On Activity
35 mins

Wrap-Up
12 mins

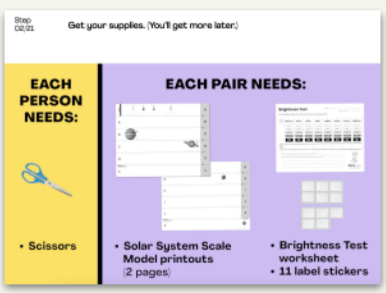
Assessment
25 mins

Anchor Connection
15 mins

Overview

In this lesson, students gather evidence to support an argument that the apparent brightness of the Sun is dependent upon an observer's distance from the Sun.

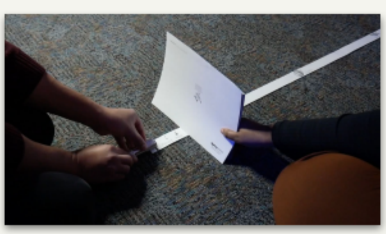
In the activity, Solar Energy Explorer, students construct a model solar system and gather observations of the Sun's apparent brightness from each planet within their model. Students then use those observations as evidence to support a claim about which planet is best suited to explore with a solar-powered planetary rover.



Activity Notes

We suggest students work in pairs. Cut enough label stickers so that each pair of students will have 11 half stickers. You can also use tape. See the lesson page for tips on planning your space.

The brightness of your classroom can significantly affect student answers on their brightness test worksheet. It's important to get your room as dark as possible while still having enough light for students to read their worksheets and move around safely. We suggest testing the brightness before students arrive!



Teacher Background: During the brightness test, students may notice that the circle of light shining from "the Sun" (flashlight) onto their worksheet gets bigger the farther away they move from it. This happens because light spreads out as it travels from its source. A larger circle of light on their worksheet does not mean that the Sun is brighter. It means that the Sun's light is spreading out, which makes it dimmer.

Anchor Connection on Next Page

Lesson 1: How can the Sun help us explore other planets?
Solar System & Sun Brightness (pg 2 of 2)

Exploration
15 mins

Hands-On Activity
35 mins

Wrap-Up
12 mins

Assessment
25 mins

Anchor Connection
15 mins

Anchor Connection

The brightness of the light from the Sun varies significantly between the planets. This is due to their varying distance from the Sun. As one moves farther and farther away from the Sun, the light becomes dimmer and dimmer.

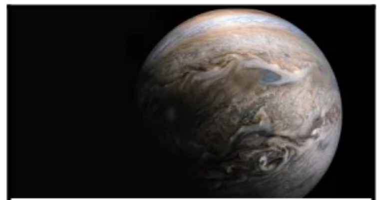
Students can revise their explanation and/or drawing by adding:

- Details about how the brightness of sunlight decreases with each planet's increasing distance from the Sun
- Details about the duration of days and nights on each planet
- The fact that Earth is much closer to the other planets than it is to stars outside of our solar system

Connecting Storyline Question

What else is different on each planet?

Lesson 2: Why is gravity different on other planets? (pg 1 of 2)
Gravity



Exploration
5 mins

Hands-On Activity
45 mins

Wrap-Up
10 mins

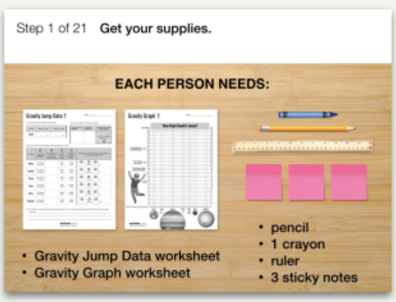
Assessment
25 mins

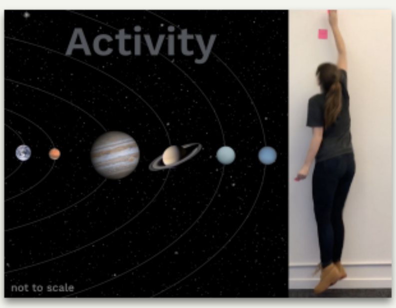
Anchor Connection
15 mins

Overview

In this lesson, students discover that gravity exists on all planets and moons, but the amount of gravity is different because it depends on how massive the object is.

In the activity, Gravity Jump, students measure how high they can jump on Earth and then calculate how high they would be able to jump on other planets and moons within our Solar System.





Activity Notes

We suggest students work in pairs. If possible, we recommend pairing students of similar heights together.

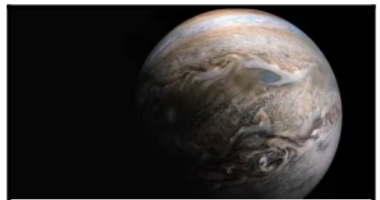
Decide where students will jump. Each pair of students needs a blank space (a wall or cabinet) where they can place their sticky notes and measure their jump height. Doing this in the classroom is ideal if you have enough space, but you can also use a hallway.

We suggest printing out two sets of the Planet and Moon Exploration Stations so that a maximum of 4 students are at each station at a time. Each student will only need to visit 4 stations. We suggest placing one set of these stations at opposite ends of the classroom or one station on desk clusters of 4 so that students have the most room to spread out.

For more teacher background, see the lesson page.

Anchor Connection on Next Page

Lesson 2: Why is gravity different on other planets? (pg 2 of 2)
Gravity



Exploration
5 mins

Hands-On Activity
45 mins

Wrap-Up
10 mins

Assessment
25 mins

Anchor Connection
15 mins

Anchor Connection

The force of gravity on each planet can vary significantly. It is dependent on the mass of the planet and how compact the planet is: more massive and more compact planets have stronger gravitational fields. This means that the weight of an object is not always the same: it can be heavier or lighter depending on the planet or moon on which it happens to be located.

Students can revise their explanation and/or drawing by adding:

- details about the force of gravity on each planet
- a general statement that gravity affects the motion of other objects
- that closer objects appear to move significantly more than more distant objects, and this is why the stars appear to move so much less in the night sky than the planets do

Connecting Storyline Question

Could you ever live on or visit another planet?

Lesson 3: Could there be life on other planets? (pg 1 of 2)
Star Brightness & Habitable Planets

Exploration
16 mins

Hands-On Activity
35 mins

Wrap-Up
4 mins

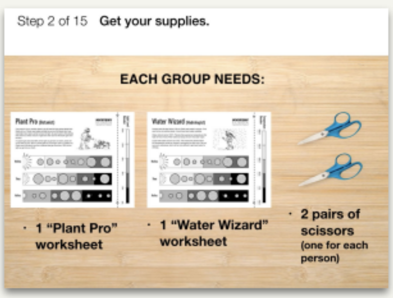
Assessment
25 mins

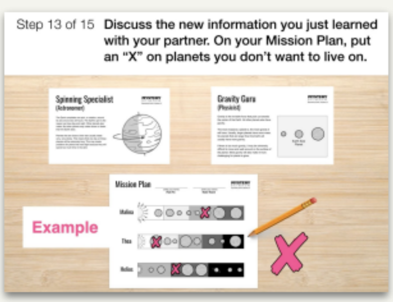
Anchor Connection
15 mins

Overview

In this lesson, students discover that the Earth is in the “Goldilocks Zone”—a distance from the Sun with the right amount of light and heat for life to exist.

In the activity, Star Explorer, students plan a space mission to another planet outside our Solar System based on the amount of heat and light that reaches the planet’s surface. Once students plan their space mission, they will reflect on what our Sun would look like from this far-away planet.





Activity Notes

We suggest students work in pairs.

The Mission Plan worksheets include greyscale shading that indicates the amount of heat and light that emit from each star in the three solar systems. The correct shading is essential for the activity, so we suggest printing out copies of these worksheets beforehand to ensure that everything prints correctly.

Teacher Tips: The solar systems and stars (Malina, Thea, and Helios) used in the activity are fictional, but they were inspired by real scientific discoveries. If you and your students would like to learn more about real stars and exoplanets that astronomers are investigating, there are several resources in our Extensions section for you to explore.

Anchor Connection on Next Page

Lesson 3: Could there be life on other planets? (pg 2 of 2)
Star Brightness & Habitable Planets

Exploration
16 mins

Hands-On Activity
35 mins

Wrap-Up
4 mins

Assessment
25 mins

Anchor Connection
15 mins

Anchor Connection

Ultimately, all other planets that scientists have discovered would be very hostile places for humans to live. However, each planet presents unique opportunities as an experience to visit. Students will begin to craft an argument about a given planet that they would like to visit themselves, or that they think a friend or family member would enjoy. This leads into the performance task.

Students can revise their explanation and/or drawing by adding:

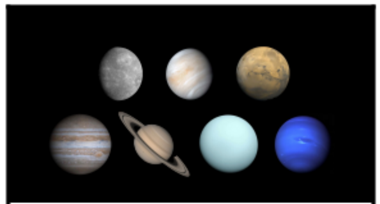
- Which planet would be best to visit.

Connecting Storyline Question

Which planet would be best to visit?

Performance Task: What's the best place to visit in the solar system?

Weather and Climate



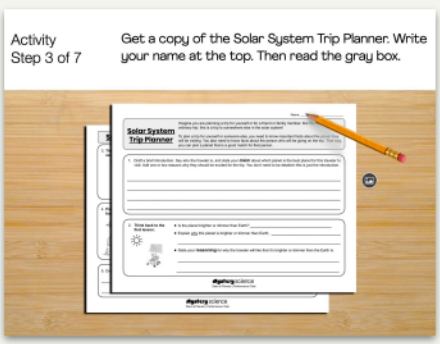
Unit Review
30 mins

Hands-On Activity
60 mins

Overview

In this performance task, students create an evidence-based argument about which planet or moon would be the best to visit for themselves, a friend, or a family member.

If you have time to extend the performance task, we recommend having your students put their argument into the form of a letter, a poster, a presentation, or something else! Students should be creative throughout the process.



Performance Task Notes

We recommend having students work individually or in groups of two.

The packet serves as an opportunity for students to draft the pieces of their argument. Once they have completed their drafts, you can extend their experience by having them write a letter, or turn their argument into a poster or presentation.

Crosscutting Concepts

Cause and Effect and *Patterns*: There are multiple cause and effect relationships that vary in a consistent pattern. For example, the brightness of sunlight varies with the distance from the Sun. Moving farther and farther away causes the brightness to decrease. There is also a cause and effect relationship between the mass of planets and their gravitational force. More massive planets have stronger gravity.