

LESSON 11: Can we see systems like our solar system around other stars?

PREVIOUS LESSON

We jigsawed a series of infographics to learn more about the diverse collection of objects in our solar system where we might look for life. We argued that there is potential for life in our solar system, both past and present, but that it is unlikely that it was or is intelligent. We decided to investigate outside of the solar system next.

THIS LESSON

INVESTIGATION

1 day



We consider what is outside of our solar system and brainstorm where to go next. We are wondering if there are systems around other stars, so we read an article about looking at images of stars through a telescope. The reading doesn't answer our questions because we don't see planets around other stars with our eyes, but we are not quite convinced that this means there are definitely not systems there. We want to look at other kinds of evidence.

NEXT LESSON

We will compare two arguments about whether or not other star systems include planets, and decide what additional evidence we need to support either argument. We will look at light curve data and see that there appear to be many stars with planets. Finally, we will consider the limitations of using light curves to detect planets.

BUILDING TOWARD NGSS

MS-ESS1-1, MS-ESS1-2, MS-ESS1-3, MS-PS2-4, MS-PS4-2



WHAT STUDENTS WILL DO

11.A Read a scientific text adapted for classroom use to obtain evidence about how light waves can be used to study stars that are too distant to visit, and the existence of systems orbiting around those stars.

WHAT STUDENTS WILL FIGURE OUT

- Light is the only way that we can get information about objects outside of our solar system because they are so far away.
- Telescopes collect light from space so that we can see objects more clearly.
- Because light can travel through space, it cannot be a matter wave, like sound or water waves.
- When we look at stars through one of the world's best telescopes we cannot see other planets around them.

Lesson 11 • Learning Plan Snapshot

Part	Duration	Summary	Slide	Materials
1	10 min	NAVIGATION Reorient students to where we have been and use a photograph of the night sky to consider what might be outside of the solar system.	A-C	<i>Observing Stars</i>
2	20 min	OBSERVING STARS READING Obtain information about observing stars with telescopes and notice that we cannot easily see planets outside our solar system going around other stars.	D	
3	12 min	MAKING SENSE OF THE READING TOGETHER Facilitate a building understanding discussion about telescopes and light to draw out the idea that light is a wave, and that stars are too far away to tell much about them just by looking.	E-F	
4	3 min	NAVIGATION AND EXIT TICKET Consider if the article answered our question and respond to an exit ticket about what this means for the possibility of planets around other stars.	G-H	

End of day 1

Lesson 11 • Materials List

	per student	per group	per class
Lesson materials	<ul style="list-style-type: none">Observing Stars		

Materials preparation (40 minutes)

Review teacher guide, slides, and teacher references or keys (if applicable).

Make copies of handouts and ensure sufficient copies of student references, readings, and procedures are available.

Prepare chart paper for posters. The posters you will make in this lesson are as follows:

- Outside of our Solar System

Be sure you have materials ready to add the following words to the Word Wall and/or a personal glossary: *light year, telescope*. Do not post these on the Wall until after your class has developed a shared understanding of their meaning.

Lesson 11 • Where We Are Going and NOT Going

Where We Are Going

In this lesson, students will develop some additional disciplinary core ideas related to the following performance expectation:

MS.PS4-2 Develop and use a model to describe that waves are reflected, absorbed, or transmitted through various materials.

While several DCIs related to **MS.PS4-2** were developed in *OpenSciEd Unit 6.1: Why do we sometimes see different things when looking at the same object? (One-way Mirror Unit)*, we have not yet established the following ideas:

- A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media. (MS-PS4-2)
- However, because light can travel through space, it cannot be a matter wave, like sound or water waves. (MS-PS4-2)

In this lesson, students encounter the idea that light is a wave, and review investigations from *OpenSciEd Unit 8.2: How can a sound make something move? (Sound Unit)* and *OpenSciEd Unit 8.3: How can a magnet move another object without touching it? (Magnets Unit)* to provide evidence for the difference between light and sound waves.

Where We Are NOT Going

Students will not yet consider how the wavelength explains the properties of light. They will develop this idea in Lesson 13 by investigating the relationship between wavelength and color in order to use absorption to infer the composition of planets.

LEARNING PLAN for LESSON 11

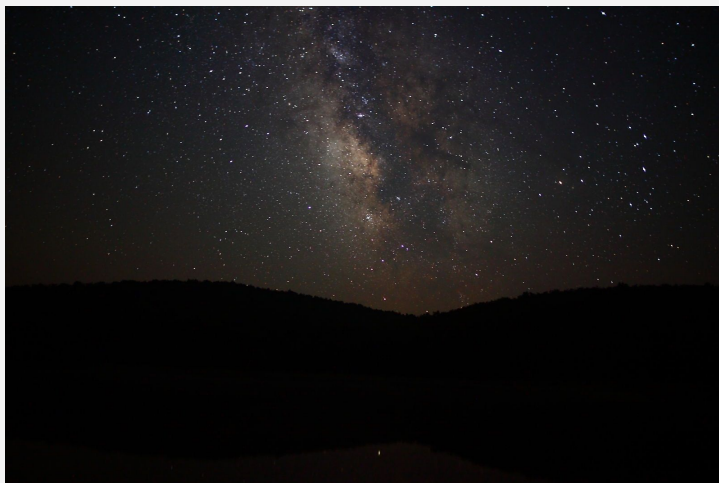
1 · NAVIGATION

10 min

MATERIALS: None

Consider what might be outside of the solar system. Say, *Last time we identified some potential places where we think scientists might want to look for life in our solar system. We decided based on what we learned that we probably aren't going to find INTELLIGENT life in our solar system, because we would have noticed it by now. But some people suggested that there might be additional places where we can look for places that could support life OUTSIDE of our solar system.*

Present **slide A**, which includes the image below. Say, *This is what the night sky looks like when there are no lights from the city, no clouds, and nothing blocking our view. What do we see here that is not in our solar system? What do you think is outside of our solar system that we don't see here? Turn and talk to your partner again.*



After a minute, accept several student ideas. Look for students to focus on the Milky Way. Push students about what the Milky Way is and accept all initial ideas. Students may also suggest stars and galaxies. Then focus students on what might be out there that we cannot see in this image. Look for students to suggest that there might be other planets and moons out there, in addition to exotic objects like black holes and wormholes. Record student ideas on a T-chart at the front of the room on chart paper titled “Outside of our Solar System.” The labels on the T-chart should be: “What we can see” and “What we can't see.”

Brainstorm where to go next. Present **slide B**. Pose the question on the slide: *Which of these places do we think we should start looking for life?* Circle the places students suggest. Look for students to suggest planets and moons.

ADDITIONAL GUIDANCE

If students have not suggested planets or moons yet, they may be stumped by this question. If that is the case, ask, *Where do we look for life in our solar system?* Students will suggest planets and moons. Then suggest, *Could there be planets and moons around other stars too?* If students approve, add these to the chart.

Say, *We think there may be planets going around other stars, and maybe even moons going around other planets. We are talking about potentially finding systems like ours but going around other stars! Wow! What data or information do we need to figure out if there are systems around other stars?* Present **slide C** and have students turn and talk. When students share out a minute later, look for suggestions like:

- We could go there with a probe.
- We could take close-up pictures of stars.
- We need data about how many planets there are around other stars.
- We need data about brightness or motion over time (this may come out if you have students in the class who have already learned about how we search for exoplanets).

2 · OBSERVING STARS READING

20 min

MATERIALS: *Observing Stars*

Introduce the reading. Say, *I wish we could look through a telescope right now to look more closely at other star systems and see if there are planets, but it's daytime so the sunlight would get in the way and we don't have a telescope here. In place of that, I have an article that summarizes some of the things others have seen through telescopes. This could help us answer some of our questions.* Note that this reading is long but is written at about a grade 5–6 reading level. Present **slide D** and go over the close reading protocol. This protocol is designed specifically to focus students on obtaining information from scientific texts. Handout *Observing Stars* to each student .

Obtaining Information from Scientific Texts	
Before	1. With your group: Identify the question(s) you are trying to answer. Record them in your notebook.
During	2. Read once individually for understanding to see what the reading is about. <ul style="list-style-type: none"> • Read for the gist - skim the title, headings, and images. <ul style="list-style-type: none"> • What is the central idea or claim? • Select methods for marking up the text. For example... <ul style="list-style-type: none"> • Keep track of questions you have in the margins. • Circle key words. • Put question marks by words you want to learn more about. • Underline main ideas. • Examine any images, graphs, or tables. Write one sentence about the central point of each image, graph, or table.
	3. Read a second time out loud with your group to identify the key ideas.
After	4. Summarize the key ideas in your notebook.



As students discuss the reading in their small groups, circulate the classroom and use probing questions to point them back to the text.

ASSESSMENT OPPORTUNITY

Building towards: 11.A Read a scientific text adapted for classroom use to obtain evidence about how light waves can be used to study stars that are too distant to visit, and the existence of systems orbiting around those stars.

What to look/listen for: As students share what they discussed about the reading, listen for students to pick out the following central ideas from the reading:

1. The sun is just a star that we are closer to, which is why it looks so big.
2. Stars beyond our sun are very far away, so far that we cannot travel there.
3. We use telescopes to study the light from stars.
4. Light waves can travel through space because they do not require a medium.

What to do: Ask students to point to evidence in the text to clarify their ideas. If you hear students struggling to answer a question, say, *Maybe we can go back into the text to find the evidence we need.* If students are struggling to articulate ideas about light waves, consider rewatching the videos from the *Sound Unit* and *Magnets Unit* to reinforce the distinction between light and sound.

3 · MAKING SENSE OF THE READING TOGETHER

12 min

MATERIALS: None

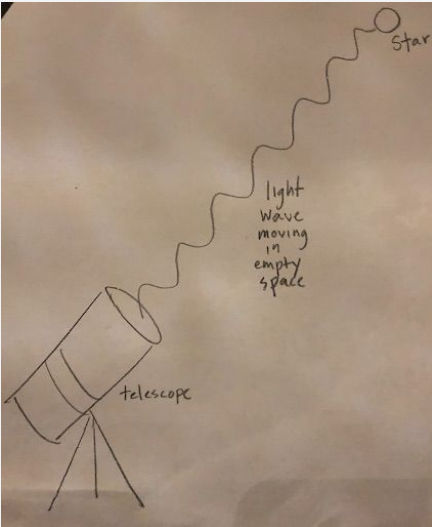
Make sense of the reading in small groups and then as a class. Display slide E.

Discussion questions:

- Why haven't we traveled to distant stars?
- How do we use telescopes to help us see distant stars?
- Why can light from far away stars reach us but sounds from them cannot?

Students' their ideas in their Progress Trackers. Say, *We've developed some really important ideas about light and what it can tell us about other stars when we look through a telescope. Let's start to keep track of some of these ideas in a Progress Tracker in our notebooks. Display slide F.*

Direct students to record the lesson question in the left column of the table (Can we see systems like our solar system around other stars?), along with the lesson number. Then have students add their ideas in the right column. Remind them that they can use any combination of words and pictures to record their ideas. An example of what students might record is shown below.

Question / Lesson #	What I figured out
Can we see systems like our solar system around other stars? (Lesson 11)	<ul style="list-style-type: none"> • Light is a wave, but it's not like a sound wave. It can move through empty space. • Telescopes collect light and then make images larger so that we can see things that are far away. • When seen through a telescope stars appear brighter, but we don't think we see any evidence of systems around them. 

4 · NAVIGATION AND EXIT TICKET

3 min

MATERIALS: None

Consider if the article answered our question. Ask, *What question were we trying to answer with the reading?* Look for students to say, “Are there planets and moons around other stars?”

Present **slide G**. Ask, *So did the article answer our question?* Look for students to say no, that they didn't see any planets in the photos, that planets just look like stars, or that there were no visible planets around the stars.

Exit ticket. Have students respond to the prompt as an exit ticket: *Does that mean the distant stars we see don't have systems of planets, moons, asteroids, etc., orbiting them?*