# ASSESSMENT SYSTEM OVERVIEW

Each OpenSciEd unit includes an assessment system that offers many opportunities for different types of assessments throughout the lessons, including pre-assessment, formative assessment, summative assessment, and student self assessment. Formative assessments are embedded and called out directly in the lesson plans. Please look for the "Assessment Icon" in the teacher support boxes to identify places for assessments. In addition, the table below outlines where each type of assessment can be found in the unit.

## Overall Unit Assessment

| When | Assessment and Scoring Guidance | Purpose of Assessment |
|---|---|---|
| Lesson 1 | Patterns in the Sky<br><br>Initial models<br><br>Driving Question Board | **Pre-Assessment**<br>The student work in Lesson 1 available for assessment should be considered a pre-assessment. It is an opportunity to learn more about the ideas your students bring to this unit. Revealing these ideas early on can help you be more strategic in how to build from and leverage student ideas across the unit.<br><br>The initial model developed on day 2 of Lesson 1 is a good opportunity to pre-assess student understanding of which parts of the system are important to explaining patterns in the sky.<br><br>The Driving Question Board is another opportunity for pre-assessment. Reinforce for students to generate open-ended questions, such as how and why questions and to post to the board. However, any questions students share, even if they are close-ended questions, can be valuable. Make note of any close-ended questions and use navigation time throughout the unit to have your students practice turning these questions into open-ended questions when they relate to the investigations underway. |
| Lesson 4 | Student Assessment<br><br>L4 Assessment Scoring Guidance | **Formative + Summative**<br>In this assessment, students have an opportunity to demonstrate their understanding of the position of the Earth, Moon, and Sun during an eclipse. Students also need to consider the different perspectives one could view the positions of the Earth, Moon, and Sun and what that means for what we would see.<br><br>Students should be able to explain the position of the Earth, Moon, and Sun during an eclipse using the following ideas:<br>• The Moon blocks the sunlight because of its position in between Earth and the Sun.<br>• When the Moon is between Earth and the Sun, the light from the Sun hits the Moon on the side facing the Sun.<br>• From Earth, we cannot see the Moon in this phase because we are looking at the nighttime side of the Moon.<br>• When there is a solar eclipse, it must be a new Moon because the Moon has to be between Earth and the Sun. |
| Lesson 8 | Student Assessment<br><br>L8 Assessment Scoring Guidance | **Formative + Summative**<br>In this assessment, students individually model the solar system at different subscales to explain the patterns of constellations we see from Earth. At this point in the unit, student models explaining when we can see constellations should include:<br>• Sun, Earth, Earth's access tilted toward Polaris and the constellations, and stars in the constellations<br>• The interactions between Earth and the Sun and the stars moving at a larger scale<br>• The two points in time one when both constellations are visible and one where only one constellation is visible<br>• Two scales: the stars and the solar system and a zoom in from one system to another |

| When | Assessment and Scoring Guidance | Purpose of Assessment |
|---|---|---|
| Lesson 12 | Student Assessment<br><br>L12 Assessment Scoring Guidance | **Summative**<br>In this assessment, students use data from transits as evidence to support an argument that there are planets orbiting stars even when we cannot see them.<br><br>The big ideas students are bringing to this assessment are:<br>• Just because you can't see them with your eyes doesn't mean they aren't there<br>• When we see patterns of dips in light coming from a star in the data, it is likely that we are seeing the planet transit in front of the star and that the planet orbiting around that star<br>• We know a planet is likely to be there because:<br>  • dips in the light data mean less light detected on Earth<br>  • less light means a planet could be blocking some of the light<br>• What we can detect from these transit data patterns are because of our perspective on Earth and if a planet is orbiting around a star at a different angle and it doesn't pass between Earth and the star, we won't be able to detect it using this type of data |
| Lesson 13 | Student Explanation | **Summative**<br>In this lesson, students write explanations individually that explain how it is possible for artists to make images of exoplanets using information about the color of light waves even when the systems they are creating images of are at too big of a scale for us to see directly. |
| Lesson 14 | Student Podcasts | **Summative**<br>In groups, students create podcasts (or infographics) to communicate information they obtain on exoplanets, their discovery, what the planet is like, and what characteristics of the planet could support life. In addition to demonstrating their understanding of exoplanet discovery via the position of objects in space and electromagnetic radiation, students need to demonstrate their ability to obtain, evaluate, and communicate information. |
| After each lesson | Lesson Performance Expectation Assessment Guidance | **Formative Assessment**<br>Use this document to see which parts of lessons or student activity sheets can be used as embedded formative assessments. |
| Occurs in several lessons | Progress Tracker | **Formative and Student Self Assessment**<br>The Progress Tracker is a thinking tool that was designed to help students keep track of important discoveries that the class makes while investigating phenomena and figure out how to prioritize and use those discoveries to develop a model to explain phenomena. It is important that what the students write in the Progress Tracker reflects their own thinking at that particular moment in time. In this way, the Progress Tracker can be used to formatively assess individual student progress or for students to assess their own understanding throughout the unit. Because the Progress Tracker is meant to be a thinking tool for kids, we strongly suggest it is not collected for a summative "grade" other than for completion. |
| Anytime after a discussion | Student Self Assessment Discussion Rubric | **Student Self Assessment**<br>The student self-assessment discussion rubric can be used anytime after a discussion to help students reflect on their participation in the class that day. Choose to use this at least once a week or once every other week. Initially, you might give students ideas for what they can try to improve for the next time, such as sentence starters for discussions. As students gain practice and proficiency with discussions, ask for their ideas about how the classroom and small group discussions can be more productive. |

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|---|---|---|
| After Students Complete SubstantialMeaningful Work | Peer Feedback Facilitation: A Guide | **Peer Feedback**<br>There will be times in your classroom when facilitating students to give each other feedback will be very valuable for their three-dimensional learning and for learning to give and receive feedback from others. We suggest that peer review happen at least two times per unit. This document is designed to give you options for how to support this in your classroom. It also includes student-facing materials to support giving and receiving feedback along with self-assessment rubrics where students can reflect on their experience with the process.<br><br>Peer feedback is most useful when there are complex and diverse ideas visible in student work and not all work is the same. Student models or explanations are good times to use a peer feedback protocol. They do not need to be final pieces of student work, rather, peer feedback will be more valuable to students if they have time to revise after receiving peer feedback. It should be a formative, not summative type of assessment. It is also necessary for students to have experience with past investigations, observations, and activities where they can use these experiences as evidence for their feedback.<br><br>For this unit, Peer Feedback works best for Lessons 8, 10, 13, and 14 during the consensus moments where students are sharing their consensus models, or after an investigation where students share what they figured out with peers. |

For more information about the OpenSciEd approach to assessment and general program rubrics, visit the OpenSciEd Teacher Handbook.

## Lesson-by-Lesson Assessment Opportunities

Every OpenSciEd lesson includes one or more lesson-level performance expectations (LLPEs). The structure of every LLPE is designed to be a three-dimensional learning, combining elements of science and engineering practices, disciplinary core ideas and cross cutting concepts. The font used in the LLPE indicates the source/alignment of each piece of the text used in the statement as it relates to the NGSS dimensions: alignment to Science and Engineering Practice(s), alignment to Cross-Cutting Concept(s), and alignment to the Disciplinary Core Ideas.

The table below summarizes opportunities in each lesson for assessing every lesson-level performance expectation (LLPE). Examples of these opportunities include student handouts, home learning assignments, progress trackers, or student discussions. Most LLPEs are recommended as potential formative assessments. Assessing every LLPE listed can be logistically difficult. Strategically picking which LLPEs to assess and how to provide timely and informative feedback to students on their progress toward meeting these is left to the teacher's discretion.

| Lesson | Lesson-Level Performance Expectation(s) | Assessment Guidance |
|---|---|---|
| Lesson 1 | **1.A** Develop an initial model of systems in space to describe patterns we observe in the sky.<br><br>**1.B** Ask questions about systems in space that arise from observations of patterns in the sky. | **1.B Asking Questions; Patterns**<br>**When to check for understanding:** Notice the kinds of patterns students come up with as they begin to build the "Patterns in the Sky Poster" on Day 1.<br>**What to look/listen for:** Use this as a pre-assessment to gauge how much your students already know about space. Some students may be suggesting comets and galaxies, while other students might suggest that the Sun goes around the Earth.<br><br>**1.A Modeling; Systems and Systems Models; Patterns**<br>**When to check for understanding:** Circulate the classroom during the gallery walk on day 3 to observe students' models.<br>**What to look/listen for:** Look for students who are including parts or interactions in their system that might not be necessary to explain the pattern they chose.<br><br>**1.B Asking Questions; Systems and Systems Models; Patterns**<br>**When to check for understanding:** Take note as the class builds the Driving Question Board (DQB) on day 4.<br>**What to look/listen for:** Listen for (1) the subsystems and patterns that students are asking questions about and (2) how the questions relate to patterns and systems. |

| Lesson | Lesson-Level Performance Expectation(s) | Assessment Guidance |
|---|---|---|
| Lesson 2 | **2.A** Develop, revise, and use models of the Earth-Sun system to explain seasonal patterns of the motion of the Sun in the sky and of temperatures over the surface of Earth.<br><br>**2.B** Use data to refute the claim that distance from the Sun causes the patterns of seasonal temperature variation that we experience on Earth. | **2.A Developing and Using Models; Systems and Systems Models**<br>**When to check for understanding:** As students come to consensus, listen for the way that they are describing how the tilt of Earth affects seasonal temperature.<br>**What to look/listen for:** It is common for students to combine their ideas about proximity and warmth with the new ideas about the tilt of Earth to form a hybrid conceptual model for the system where proximity is still the primary cause of temperature patterns.<br>**What to do:** Use probing questions to help students clarify their thinking. Make sure the class has come to consensus on concentration of sunlight being the primary cause of seasonal temperature patterns before moving on.<br><br>**2.B Engaging in Argument from Evidence; Analyzing and Interpreting Data; Patterns**<br>**When to check for understanding:** On day 3, collect the home learning from students to provide feedback on their argument in part 3. Use this as a formative tool to both help students identify where they need to focus their efforts and get a sense of what the class needs to work on moving forward.<br>**What to look/listen for:** Students should critique Marnie's argument by providing evidence from the data that distance from the Sun is not related to seasonal temperature patterns.<br>**What to do:** Use the guidance in the *Teacher Guide* to provide formative feedback for students in using evidence to critique Marnie's argument. |
| Lesson 3 | **3.A** Develop and use a model of the Earth-Sun-Moon system to predict and explain patterns we observe in the way the apparent shape of the Moon changes over time. | **3.A Modeling; Patterns**<br>**When to check for understanding:** On day 1, collect the exit tickets from students to provide feedback on their model ideas. Also provide feedback on day 2 when students are manipulating their 3-D models and recording their ideas on *Shape Patterns of Earth-Sun-Moon System*.<br>**What to look/listen for:** Students should recognize that over time the position of the Moon in relationship to Earth and the Sun changes the apparent patterns they see each month. |
| Lesson 4 | **4. A** Construct an explanation and critique peer explanations for lunar phases, lunar eclipses, and solar eclipses using a revised model of the Earth-Sun-Moon system.<br><br>**4. B** Communicate information gathered from multiple appropriate sources about how the interactions in the Earth-Moon-Sun system change the appearance of the Moon from the perspective on Earth. | **4.A Argument; Explanation; Systems**<br>**When to check for understanding:** Day 2: Consensus Discussion, Day 3: *Modeling the Sun-Moon-Earth System Assessment*<br>**What to look/listen for:** Day 2: Reference the *Peer-Feedback Rubric for Explanation Using a Physical Model* and *Key for Modeling the Sun-Moon-Earth System Assessment*.<br><br>**4.B Obtaining, Evaluating, and Communicating Information; Systems**<br>**When to check for understanding:** Day 3: *Peer-Feedback Rubric for Explanation Using a Physical Model*<br>**What to look/listen for:** Students should communicate about the relationship of where an observer is on Earth, the movement of the Moon around Earth, and the Moon's position relative to the Sun and its light as reflected by the Moon that changes the shape of the Moon seen by the observer. |
| Lesson 5 | **5.A** Use a simulation of the Earth-Moon system to model the effects of changes to the system on the gravitational forces between orbiting objects. | **5.A Modeling; Cause and Effect**<br>**When to check for understanding:** While students are using the computer interactive to complete the data table on the *Moon's orbit simulation data sheet*, move around the classroom and listen in to student conversations.<br>**What to look/listen for:** Look for students who struggle to identify potential independent variables (mass and speed of Moon; distance between Earth and Moon), dependent variables (gravity force, Moon orbiting pathway), or the causal links between the independent variables and dependent variables. |

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| Lesson 6 | **6.A** Obtain information from text to describe the role of gravity in maintaining the balance necessary for an object to be in orbit. | **6.A Obtain, Evaluate and Communicate; Stability and Change**<br>**When to check for understanding:** Listen in as students complete guided reading and discuss and make sense of this reading in small groups.<br>**What to look/listen for:** Look for students who, in their explanations of observed and hypothesized motion, leave out the effect of gravity forces on a projectile launched from a cannon or an orbiting object. Look for students who make inaccurate claims about what causes projectiles to fall to the ground,- for example, that the motion energy given to the object at launch simply "runs out." |
| Lesson 7 | **7.A** Obtain and communicate information from a computer interactive and a video about the patterns of motion of other objects (e.g., planets, moons, and stars) in our solar system and how gravity created the stable system we see today. | **7.A Obtain, Evaluate and Communicate Information; Stability and Change**<br>**When to check for understanding:** Read what students record as big ideas on their papers in the final activity of this lesson.<br>**What to look/listen for:** Look for students to identify patterns in the movements of objects in the solar system and the role of gravity in the formation of the solar system. |
| Lesson 8 | **8.A** Develop a model of stars and our solar system by representing subsystems of systems at different scales.<br><br>**8.B** Respectfully provide and receive critiques about a model of systems in space that explains patterns we see in the shape and motion of objects in the sky.<br><br>**8.C** Construct an explanation of patterns we observe in the shape and motion of stars in the sky using a model of stars and our solar system. | **8.A Developing and Using Models; Systems and Systems Models**<br>**When to check for understanding:** Listen to the way students are talking about systems on day 1.<br>**What to look/listen for:** Use this moment to formatively assess the level of scaffolding your students will need around systems and subsystems.<br><br>**8.A Developing and Using Models; Systems and Systems Models; Scale, Proposition and Quantity**<br>**When to check for understanding:** On the third day of this lesson students will complete *Model of Star Patterns Assessment*. Look at students' responses to questions 1-3.<br>**What to look/listen for:** Look for students to model the Sun, Earth, and two Ojibwe constellations by representing subsystems of systems at different scales. Use *Key Model of Star Patterns*.<br><br>**8.B Engaging in Argument from Evidence; Systems and Systems Models**<br>**When to check for understanding:** After students have incorporated feedback from their peers into their physical models on day 2, they will self-assess using a handout.<br>**What to look/listen for:** This is a self-assessment, so students will get a chance to reflect on their use of peer feedback on their own.<br><br>**8.C Constructing Explanations and Designing Solutions; Patterns**<br>**When to check for understanding:** On the third day of this lesson students will complete *Model of Star Patterns Assessment*. Look at students' explanations in question 4.<br>**What to look/listen for:** Look for students to use their model of the Sun, Earth, and two Ojibwe constellations to explain how a constellation cannot be observed when Earth is on the opposite side of the Sun. Use *Key Model of Star Patterns*. |
| Lesson 9 | **9.A** Ask questions to identify evidence that we could observe that will support or challenge a claim about if there is life in the vast universe. | **9.A Engaging in Argument from Evidence, Scale; Scale, Proportion and Quantity**<br>**When to check for understanding:** When students defend their positions on the class barometer.<br>**What to look for/listen for**: Use this moment as a pre-assessment of how well students are supporting their claims with evidence.<br><br>**9.A Asking Questions and Defining Problems; Scale, Proportion and Quantity**<br>**When to check for understanding:** Students complete an exit ticket to reflect on the questions they asked, and the questions their peers asked.<br>**What to look for/listen for:** Look for students to imagine the data that would be needed to answer a question and consider how those data would support or refute a claim. |

| Lesson | Lesson-Level Performance Expectation(s) | Assessment Guidance |
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| Lesson 10 | **10.A** Obtain and communicate the central ideas from an infographic to support an argument from evidence about the potential for life on the various objects that make up our solar system, including planets, their moons, asteroids, and dwarf planets. | **10.A Obtaining, Evaluating and Communicating Information, Systems and Systems Models**<br>**When to check for understanding:** The exit ticket at the end of this lesson is intended as a moment of metacognitive reflection for students on how well they understood the solar system infographic, and what they did to communicate that information.<br>**What to look for/listen for:** When you collect these exit tickets, look for how students report they are communicating to help other students understand. |
| Lesson 11 | **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. | **11.A Obtain, Evaluate and Communicate Scientific Information, Scale; Proportion and Quantity**<br>**When it happens:** As students share what they discussed about the reading, listen for students to pick out central ideas from the reading related to the scale of our universe.<br>**What to look for/listen for:** Listen for students who are struggling to pick out the central ideas listed in the teacher guide. |
| Lesson 12 | **12.A** Use a model of a star system to generate light curve data to test ideas about what patterns could indicate the presence of planets orbiting a very distant star in our galaxy.<br><br>**12.B** Consider the limitations of using light curves to detect planets passing in front of a star that is so distant we cannot see the system directly and evaluate how this might affect the accuracy of the conclusions we draw from the data about the prevalence of planets in other star systems.<br><br>**12.C** Students compare two arguments about whether or not other star systems include planets, analyze the use of evidence, decide what additional evidence is needed to support either argument, and use patterns in the data to provide that evidence. | **12.A Modeling; Patterns**<br>**When to check for understanding:** Collect student notebooks at the end of day 1 to review the Stop and Jot.<br>**What to look for/listen for:** Look for students to recognize that making a physical model allows us to imagine what patterns we might see in our data.<br><br>**12.B Analyzing and Interpreting Data; Scale, Proportion, and Quantity**<br>**When to check for understanding:** Collect the exit tickets at the end of day 2.<br>**What to look for/listen for:** Look for students to begin to recognize some of the limitations of this kind of data collection for detecting patterns when stars are very far away. See examples in the teacher guide.<br><br>**12.C Argumentation; Patterns**<br>**When to check for understanding:** At the end of day 3, students are asked to return to the fictional arguments introduced at the beginning of the lesson.<br>**What to look for/listen for:** Look for students to use the evidence from the lesson to support Tomi's argument. |

| Lesson | Lesson-Level Performance Expectation(s) | Assessment Guidance |
|---|---|---|
| Lesson 13 | **13.A** Analyze and interpret data from star spectra to provide evidence for the existence of a planet that is too far for us to observe directly.<br><br>**13.B** Develop an explanatory model for how light changes as it passes through the atmosphere of an exoplanet using a wave model of light to explain how the structure of the wave determines color. | **13.A Analyze and Interpret Data; Scale, Proportion, and Quantity**<br>**When to check for understanding:** On day 3, during the *Construct an Explanation for Exoplanet Characteristics* assessment *Model light passing through an exoplanet atmosphere*.<br>**What to look/listen for:** Look for students to notice black lines in the spectra, identify the wavelength of these lines using the x-axis, and coordinate these wavelengths with the table of absorption wavelengths in order to pick out hydrogen and water vapor as the likely culprits.<br><br>**13.B Constructing Explanations and Designing Solutions; Structure and Function**<br>**When to check for understanding:** At the end of day 2, collect the exit tickets to formatively assess student understanding of how the structure of a light wave determines its function.<br>**What to look/listen for:** Look for students to say that the wavelength (structure) determines the color (function or property).<br><br>**13.B Constructing Explanations and Designing Solutions; Structure and Function**<br>**When to check for understanding:** On day 3, during the *Construct an Explanation for Exoplanet Characteristics* assessment *Model light passing through an exoplanet atmosphere*.<br>**What to look/listen for:**<br>• The wavelength of a light wave (at a scale we cannot observe) determines the color of light we see with our eyes.<br>• As starlight passes through the exoplanet's atmosphere, some wavelengths are missing because the matter present in the atmosphere absorbs it. |
| Lesson 14 | **14.A** Obtain, evaluate, synthesize, and communicate information about the discovery, location, and potential for finding life on an exoplanet that is too distant to observe directly, using a podcast format. | **14.A Obtaining, Evaluating and Communicating Information; Scale, Proportion and Quantity**<br>**When to check for understanding:** When Obtaining information for the *Obtaining Information from Scientific Texts Checklist*, Evaluating Information on the *Evaluating Information Checklist*, when Communicating Information on the *Communicating Information Checklist*, and during the podcast exhibitions and making sense of podcast discussion on day 3.<br><br>**What to look/listen for:** See the rubric found on page 2 of *Exploring Exoplanets Podcast Project*. |
| Lesson 15 | **15.A** Obtain and synthesize information across multiple sources about the organization of space systems in our universe from the human scale to the galactic scale.<br><br>**15.B** Develop a model of the universe that shows how gravity forces bound space systems at multiple scales.<br><br>**15.C** Compare and critique two arguments emphasizing the same evidence (images of galaxies) about the organization of systems in space. | **15.A Obtain, Evaluate and Communicate Scientific Information; Systems and Systems Models; Scale, Proportion, and Quantity**<br>**When to check for understanding:** During the Building Understandings Discussion after watching the *Powers of Ten* movie, use the whole-class discussion as an opportunity to formatively assess students' ideas and respond in the moment to push student thinking.<br>**What look/listen for:** Look for students to articulate their ideas about how gravity organizes the universe into clumps of something surrounded by a vast expanse of nothing.<br><br>**15.B Developing and Using Models; Systems and Systems Models**<br>**When to check for understanding:** Observe students as they are modeling in small groups and probe them to articulate their ideas clearly during the consensus model.<br>**What to look/listen for:** Look for students to include multiple scales and to be able to articulate the reasons why their model looks like that:<br>1. The space between each scale is enormous and empty, so we model only the interesting bits.<br>2. Gravity bounds space systems by holding systems together and/or keeping things in orbit.<br><br>**15.C Arguing from Evidence; Systems and Systems Models**<br>**When to check for understanding:** Use the whole-class discussion of the Shapley-Curtis Great Debate as an opportunity to formatively assess students' ideas and respond in the moment to push student thinking.<br>**What to look/listen for:** Look for students to notice that both models explain the evidence in different ways. Also look for students to seek out data related to how far away things are in space. |

| Lesson | Lesson-Level Performance Expectation(s) | Assessment Guidance |
|---|---|---|
| Lesson 16 | **16.A** Develop a mathematical model to predict the number of communicating civilizations in our galaxy based on what we know about systems in space, including galaxy clusters, galaxies, star systems, and moon systems around planets. | **16.A Developing and Using Models; Scale, Proportion, and Quantity**<br>**When to check for understanding:** While students are answering questions from the DQB, this is an excellent formative assessment opportunity used to address partial understandings and see if any pieces need to be revisited.<br>**What to look/listen for:** Notice how students are responding to these questions and compare to the pre-assessment opportunities in Lesson 1. |