OpenSciEd Massachusetts Standards Guidance 6th Grade: Earth in Space

This document is to provide guidance to Massachusetts 6th grade teachers who are implementing OpenSciEd. This guidance assumes the OpenSciEd curriculum is being implemented across grades 6-8, following the MA coherent sequence by grade level *(download)*. The following guidance identifies the MA standards addressed in the *Earth in Space* unit, and the most effective use of the OpenSciEd materials for 6th grade teachers.

Scope and Sequence Recommendation

Implement the *Earth in Space* unit in 6th grade, after the *Forces at a Distance* unit and before the *Plate Tectonics & Rock Cycling* unit. *Earth in Space* has significant coherence when building on experiences from the *Forces at a Distance* unit (recommended for 6th grade in MA). *Earth in Space* addresses four 6th grade earth & space and physical science standards, and two 8th grade earth & space standards. Refer to the MA coherent sequence by grade level *(download)* for the complete scope and sequence recommendation.

6th Grade Standards in *Earth in Space*

Standards in unit	Lessons building towards standards
6.MS-ESS1-1. Develop and use a model of the Earth-Sun-Moon system to explain the causes of lunar phases and eclipses of the Sun and Moon.	Lessons 1, 6-8
6.MS-ESS1-5. Use graphical displays to illustrate that Earth and its solar system are one of many in the Milky Way galaxy, which is one of billions of galaxies in the universe.	Lessons 15-17
6.MS-PS2-4. Use evidence to support the claim that gravitational forces between objects are attractive and are only noticeable when one or both of the objects have a very large mass.	Lesson 14
6.MS-PS4-2. **[Partial]** Use diagrams and other models to show that both light rays and mechanical waves are reflected, absorbed, or transmitted through various materials. • **Why partial?** This unit focuses primarily on the behavior of light rays. This unit does not address all behaviors of light waves. • Transmission, reflection, and absorption of light waves is fully addressed in the *Light and Matter* unit. • Mechanical wave behavior is partially addressed in the *Sound Waves* unit. See the Massachusetts instructional guide for *Sound Waves* in order to identify extension activities to fully address reflection, absorption, and transmission of mechanical waves.	Lessons 9-12

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Additional Standards in *Earth in Space*

Standards in unit	Lessons building towards standards
8.MS-ESS1-1. Develop and use a model of the Earth-Sun system to explain the cyclical pattern of seasons, which includes Earth's tilt and differential intensity of sunlight on different areas of Earth across the year.	Lessons 1-5
8.MS-ESS1-2. **[partial]** Explain the role of gravity in ocean tides, the orbital motions of planets, their moons, and asteroids in the solar system. • **Why partial?** This unit addresses the role of gravity in the orbital motions of planets, moons, and asteroids. This unit does not address the role of gravity in ocean tides. **See recommendations below** for extension activities that incorporate the role of gravity with tides.	Lessons 13-15

See recommendations below **for addressing these 8th grade standards.**

Recommendations for Addressing Standards in *Earth in Space*

Include, and teach 8.MS-ESS1-1 and 8.MS-ESS1-2 with *Earth in Space* as planned in the unit. These standards are integral to the understanding of other standards in the unit. Depending on your students' prior knowledge of these standards, support for students should be adjusted to assist students in complex modeling of several components of the Earth-Sun system at once and in developing grade-appropriate explanations for the role of gravity in the solar system. **Excluding these standards would require substantial redesign of the unit, which is not recommended.**

Include an extension activity between lessons 14 and 15 to fully address standard **8.MS-ESS1-2.** To best address standard **8.MS-ESS1-2** students should explore the effect of gravity on ocean tides.

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Lesson	Support for maintaining content coherence

Extension after lesson 14	It is recommended to complete this extension sometime after lesson 14 as students will have both an understanding of the lunar cycle as well as the effects of gravity.
	
	Add to the Learning Plan in the Teacher Guide:
	
	• If students have asked about the role of gravity on the tides on the DQB, or something else that is similar, use that to motivate the overarching question: How does gravity affect the tides on Earth? Otherwise you might have students recap what they've learned so far about gravity, and then pose the question – we know how gravity affects the earth as a planet, but how does gravity affect people and objects on the earth?
	• Students may have varying levels of knowledge about the tides and the impact of gravity on Earth. Facilitate a conversation around how else gravity might affect people and objects on the Earth. Ask students: how could we know whether gravity from large objects outside of the earth is affecting things on the earth?
	• Explore tide data for one location for one day. Tide data for Massachusetts is available at Tide Predictions - NOAA Tides & Currents
	• Allow students time to notice and wonder about the tide graphs.
	• Address questions that arise, making sure to discuss what peaks and valleys in the graphs mean and what the axes represent.
	• Repeat the process for one month's worth of data. The objective is to have students understand that:
	  ○ The peaks mean that the tide is at its highest point each day.
	  ○ The height of the peaks cycles over the course of the month.
	
	This would likely be the end of one day of investigation.

Lesson	Support for maintaining content coherence

Extension after lesson 14, continued	• Prep: generate the month's moon phases on StarDate Online. Print out the graphic for the month for each student.
	• The next day, have students recap what they discussed. Then ask students: what other objects in the sky change over the course of a month? You can prompt students to look back at their notebooks to nudge them to think about the moon.
	• Ask: what data would help us figure out whether the moon's position affects the tides on Earth? If necessary, remind them that the moon phases change because of the moon's position relative to the earth.
	• Pass out the moon phase graphic from StarDate Online. Have students work in groups to mark up the graphic - you can choose to have them record the exact tide height each day, or simply mark when the tides are highest and lowest.
	• Check in with small groups at this time. If they seem to understand the relationship, you may go ahead to the scientists' circle. If not, see the option to explore animations.
	• Bring students into a scientist's circle with their data.
	• Key takeaways to support:
	  ○ The tides follow a cyclical pattern
	  ○ The most extreme tides are associated with the full and new moon
	  ○ The least extreme tides are associated with the quarter moons
	  ○ Remember that during the full moon, the moon and sun's gravity are pulling opposite each other, while during the new moon they are pulling in the same direction.
	  ○ The tides are highest when the sun's and moon's gravity are pulling in the same direction, lowest when they are opposed, and less extreme everywhere in between
	
	Option to explore animations: If students are still struggling with this, you may choose to show an animation that illustrates the changes in the tides. Some options are available at:
	○ https://moon.nasa.gov/resources/444/tides/
	
	Tides - JavaLab (you will need to explain that the orange arrow refers to the sun's position)