



Science Assessment System Through Course Task

Lunar Phases

Grade Level:

6

Phenomena:

Lunar Phases

Science & Engineering Practices:

Developing and Using Models
Constructing Explanations and Designing Solutions

Crosscutting Concepts:

Cause and Effect

Designed and revised by Kentucky Department of Education staff
in collaboration with teachers from Kentucky schools and districts.



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Preparing to implement Through Course Tasks in the Classroom

What is a TCT?

- TCTs are 3-dimensional tasks specifically designed to get evidence of student competency in two dimensions, Science and Engineering Processes (SEPs) and Crosscutting Concepts (CCC), untethered from Performance Expectations (PEs)/standards. Tasks are sense-making experiences.
- Tasks are to be used formatively. The goal is for both students and teachers to understand areas of strength and improvement for the SEP(s) and CCC assessed within the task.

How do I facilitate a Through Course Task (TCT)?

- TCT facilitation is a collaborative process in which teacher teams calibrate understanding of the expectations of the task and refine strategies to be used during task facilitation.

Before the task:

1. Complete the TCT as a learner – compare understanding of task through the lens of success criteria (identified in the task) in order to understand expectations.
Success criteria include:
 - What is this task designed to get evidence of?
 - What is the task asking the students to do?
 - What might a student response look like?
2. Identify the phenomenon within the task. Consult resources to assure teacher teams have a deep understanding of associated science concepts.
3. Collaborate to generate, review and refine feedback questions during facilitation.
4. Identify potential “trouble spots” and plan for possible misconceptions.

During the task:

5. Collect defensible evidence of each student’s competencies in 3-dimensional sense-making for the task.
6. Ask appropriate feedback questions to support student access and engagement with the task in order to elicit accurate evidence of student capacities.

After the task:

7. Reflect on the task as a collaborative team.
8. Review student work samples to identify areas of strength and areas of need.
9. Determine/plan next steps to move 3-D sense making forward through the strengthening of the use of SEPs and CCCs.

Using the materials included in this packet:

- **Task Annotation:**
 - The task annotation is a teacher guide for using the task in the classroom. Additionally, the annotation gives insight into the thinking of developers and the task overall.

- Each task has science and engineering practices, disciplinary core ideas, and crosscutting concepts designated with both color and text style:
 - **Science and Engineering Practices**
 - *Disciplinary Core Ideas*
 - Crosscutting Concepts
- **Student Task:** The materials to be used by students to complete the TCT.

Lunar Phases Task Annotation

Task Template: After **evaluating a model** for its usefulness in supporting why we see *a waxing crescent moon for a given arrangement of the sun, Earth, and moon*, **revise the model** so that it is more useful in helping someone understand what causes someone on Earth to see this particular moon phase and **explain why the revised model is useful**.

Phenomenon within the task

The predictable interaction between the Earth, moon, and sun causes lunar phases. Interactions within the system include the moon's revolution around Earth and the Earth's rotation on its axis. As these movements occur, the illuminated part of the moon that is visible from Earth changes. Half of the moon is always illuminated by the sun (with the exception of during a lunar eclipse), and the part of the moon that is visible from Earth determines the observed lunar phase.

A common student misconception is that the moon produces its own light, rather than reflecting the sun's light. Students also commonly assume that a lunar eclipse occurs every time there is a full moon, even though their experiences indicates otherwise.

How the phenomenon relates to DCI

This task relates to the 6th grade study of Space Systems. By the end of 5th grade, students should understand that "The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. (5-ESS1-2)" In 6th grade, students build on this understanding to "Develop and use a model of the Earth-sun-moon system to describe the cyclic pattern of lunar phases.(06-ESS1-1)" This phenomenon allows students to use a given model to help see those patterns and make predictions.

What information/data will students use within this task?

It is expected that students will have some foundational understanding of the role of the Earth, moon, and sun in producing lunar phases. Students also need an understanding that, depending on the purpose of the model, some aspects help develop understanding and other aspects may hinder understanding. To quote an unknown source, "All models are flawed, some models are useful."

Ideas for setting up the task with students

In order to increase the likelihood of getting useful evidence of a student's understanding of how models are effective in understanding moon phases with this task, prior to using this task we suggest giving students authentic experiences with developing models, specifically related to Earth, moon, and sun interactions. For example, the teacher can give students a ping pong ball and a lamp and ask them to develop a model of the Earth, moon, and sun in order to understand how their relative positions cause lunar phases. Various computer simulations are also available to help students make sense of why we see the moon phases we do, or develop their conceptual understanding for why we see various moon phases.

Intent of the Task for Assessment

This task elicits much evidence of students' ability to effectively use a 2 dimensional model to explain what causes us to see a waxing crescent moon. Part 1 shows a model that has some features that are useful for understanding why we see a waxing crescent moon, and other features that might negatively affect a person's understanding. By asking students to identify and explain which features of the model help or hurt understanding, the students must think deeply about the model as presented, and not simply regurgitate something memorized about modeling moon phases.

Telling students that the moon phase presented by the model is a waxing crescent moon (even showing a picture of what the phase looks like) removes a potential stressor for the students – many times tasks ask students to identify a phase for a given configuration and students get hung up on vocabulary, such as waxing/waning or crescent/gibbous, when what we really want them to be able to tell us is what causes a particular Moon phase that we see from Earth. In the task, students are told and shown what the model's configuration should reveal, and then are asked to think about how the model is useful or not. This requires students to think about the model and provides useful evidence of their understanding of how the model is or is not effective.

Part 2 asks students to revise, or improve, the model so that it is more effective in developing understanding for why we see a waxing crescent moon for the given configuration, and then explain why the changes made would cause better understanding for someone.

Even if a student has a true understanding for why we see a waxing crescent moon, they may not be able to recognize, or may overlook, limitations of an existing model. They may not understand how to improve a model to make it more useful to facilitate understanding, or they may have difficulty in explaining their intended use of their revised model. Developing deep understanding for why we see the moon phases we do is almost always supported by using models, and this task offers in-depth opportunity to reveal a student's struggles with modeling Moon phases from these various perspectives, even though the context is only a waxing crescent moon.

Success Criteria

Evidence of Learning Desired based on Progression from Appendices

Develop and Using Models

- Evaluate limitations of a model.
- Revise a model to show the relationships among variables, including those that are not observable but predict observable phenomena.

Constructing Explanations

- Construct an explanation using models or representations.

Cause and Effect

- Cause and effect relationships can be used to predict phenomena.

Success Criteria

- Part 1a: Student identifies and explains which aspects of the given model are useful for understanding what causes a waxing crescent moon to be visible from the Earth for the given configuration of sun, Earth and moon.
- Part 1b: Student identifies and explains the which aspects of the given model are not useful for understanding what causes a waxing crescent moon to be visible from the Earth for the given configuration of sun, Earth and moon.
- Part 2: Student creates a model using the relevant components (moon, sunlight, Earth, person on Earth (optional)) and explains why their model is useful for understanding why we see a waxing crescent moon phase from Earth for the configuration shown in the model.

Possible Student Responses

- Part 1 A: “The moon is in the correct position. The sunlight will reflect very little on the right side of the moon since the moon is so close to the sun.
- Part 1 B: “Two things are not useful. The sizes are not to scale. The Sun should be larger than the Earth and the moon should be smaller than the Earth. The sun is also too close to both the Earth and moon so that it doesn’t look like the sun is shining on the moon”.
- Part 2: “When the moon is between the Earth and the sun, no sunlight reflects off the moon. In my diagram, the moon has moved slightly counterclockwise. Because of this a small part of the right side of the moon will be reflecting sunlight. This is why you would be seeing a waxing crescent moon.”

Other information teacher teams might find useful when preparing to use this task in the TCT process

After facilitating this with students, I noticed that they had the hardest time with their explanation in Part 2. Next time that I facilitate this task I will incorporate strategies for CER (claim-evidence-reasoning). Students are familiar with this model but did not make the connection between this task and that model. They did not see that their revised models were their claims.

Extensions and/or other uses after the task is implemented

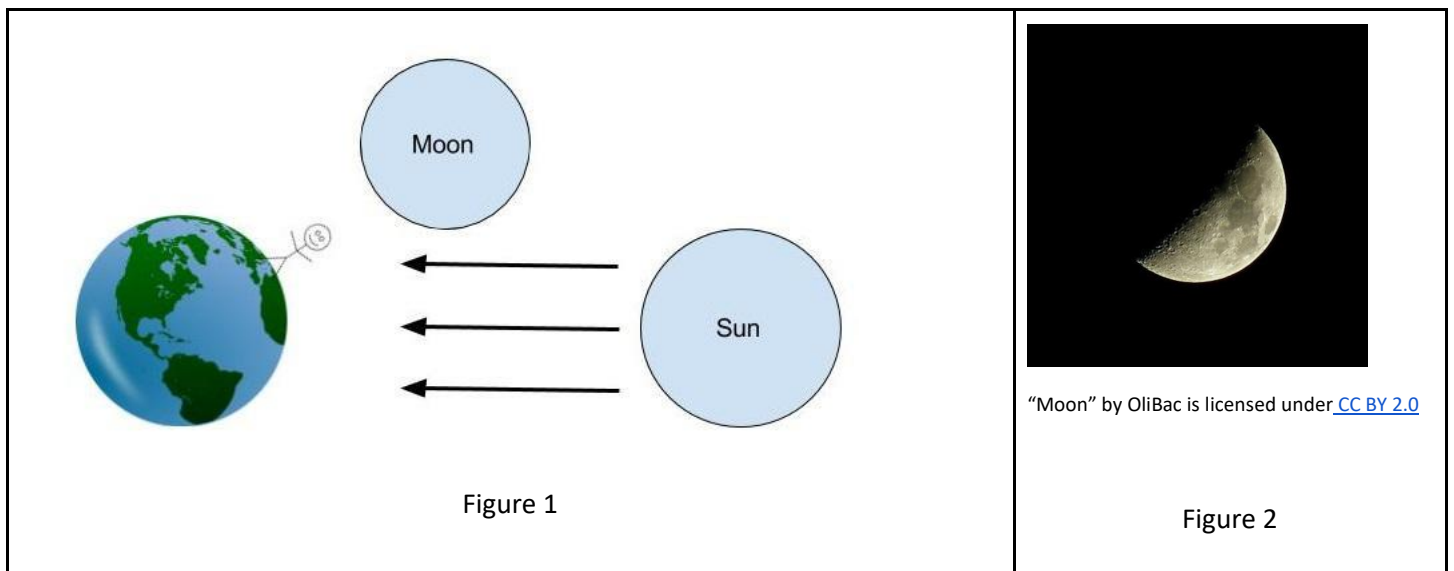
A follow-up discussion during a future class period provided the opportunity for a productive class discussion where, as a group, my students summarized the strengths and weaknesses of the given model and synthesized those ideas into a revised class model. After implementing this task, further study of phenomena related to interactions between the Earth, moon, and sun could be explored. For example, why is the moon sometimes visible during the day? Why does the moon sometimes appear to be red in color? Why don't lunar eclipses occur every time there is a full moon? Why don't solar eclipses occur every time there is a new moon?

Through Course Task – Lunar Phases

Name: _____

A scientific model uses something to represent a particular phenomenon, in order to make the phenomenon easier to understand. Because models are approximations, they have scientific inaccuracies and limitations; however, a good model should not hinder our ability to use it to explain the phenomenon.

Figure 1 below shows a model of the sun, the moon and the Earth with a person standing on it. Arrows represent light rays traveling from the sun to Earth. The purpose of Figure 2 is to show what the moon would look like from the perspective of the person standing on the Earth according to how the Earth, moon and sun are positioned in Figure 1. Figure 2 shows a waxing crescent moon.



Part I: Analyze the model in Figure 1.

- a. Identify features about this model (Figure 1) that you believe **are useful** to the purpose, which is to explain why Figure 2 is what a person on Earth would see for this particular arrangement of the Earth, moon and sun. Describe these features below.

- b. Identify features about this model (Figure 1) that you believe **are not useful** to the purpose, which is to explain why Figure 2 is what a person on Earth would see for this particular arrangement of the Earth, moon and sun. Describe these features below.

Part II: Revise the Model

- a. In the space provided below, redraw the model in Figure 1 to make it more useful for understanding why we see a waxing crescent moon (i.e., to make the Earth, moon and sun more closely match what Figure 2 depicts). As you redraw your model, indicate which parts of the moon and/or Earth would be light and dark by shading the darkened areas.



b. In the space provided below, explain the features of your model that help someone to better understand why we see a waxing crescent moon for the sun, Earth and moon arrangement shown.
