Moon Phases Matching

Children match pictures of the Moon on cards with matching pictures on a banner that shows the Moon phase cycle. They notice patterns, ask questions, and share past experiences of looking at the Moon. This is an open-ended activity that works well as a facilitated drop-in, but could also be adapted for use in a workshop or camp.

5–20 minutes

Drop-in

1–4 children at a time

Content Learning Goals

- Children begin to understand that the Moon appears to change shape, or have different phases.
- Children begin to understand that there is a pattern to how the shape of the Moon's appearance changes over time.
- Children practice using scientific terms for lunar phases such as crescent, quarter, gibbous, and full.

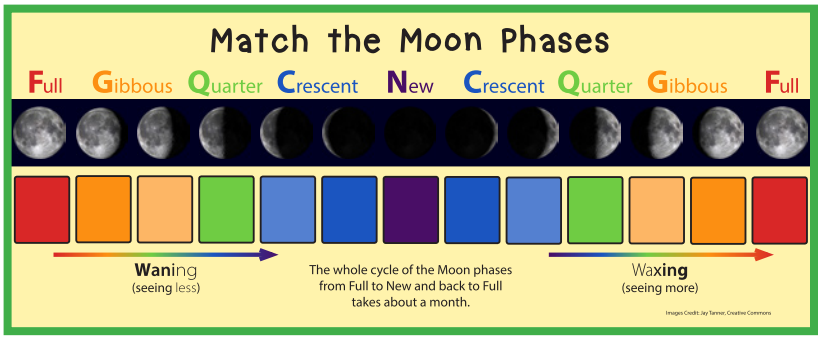
Science Practices

Children will begin to engage in science practices around the phenomenon of lunar phases by:

- Learning key features to notice when **comparing** their **observations** of photographs of the Moon.
- Planning to make future **observations** of the Moon.

Materials

- "Match the Moon Phases" banner
- Set of 12 Moon phases cards
- Tray with black paper (optional)
- Salt (optional)



SET-UP

- Hang the Moon Phases banner low on a wall, or lay it out on a low bench or table, so that children can easily see and reach it.
- If the banner is hanging on a wall (rather than lying flat on a bench or table), you'll need Velcro to hold the matched cards. Stick the Velcro strip under the line of phases on the banner, and place dots in the back corners of each card.
- Lay out the cards near the banner.
- If you are including the optional salt drawing, lay out a black paper in a shallow tray and cover it with a layer of salt, so that children can draw the Moon in the salt using their fingers.

ACTIVITY DESCRIPTION

This activity is an opportunity to help children learn what is important to pay attention to when **observing** the Moon. By focusing their attention on the different shapes of the Moon, you are helping them move beyond just *looking* at the Moon in ways that will help them start noticing a pattern in their observations — the Moon's appearance changes in a cyclical pattern.

One starting point is for children to choose a card and try to find the match on the banner. The Moon image cards are labeled so that they can use the words as clues to help them find the matches, which may also help with early literacy skills.

Inviting Children to Participate

Children often respond positively when activities are connected to their personal experiences.

- Let's talk about a time when you saw the Moon in the sky. What did it look like? Let's find a card that looks like that. That's called a Crescent / Gibbous / Full Moon!
- Do you see an image of a Crescent / Gibbous / Full Moon on this banner? Let's match your card to a picture on the poster!
- You found the matching picture! Let's try another one! Pick another moon image. Oh, that's a Crescent / Gibbous / Full Moon! Let's find a match on the poster again.

Adding Challenge

Children can try sorting the Moon image cards instead of, or in addition to, matching the cards to the poster.

- Let's sort the Moon cards. We can try to find all the Crescent Moons. Here's one, try to find another one. And here's a Gibbous Moon, there might be more images of a Gibbous Moon, let's try to find them.

Children may be interested in thinking about connections between the activity and actual observations they can make of the Moon in the sky.

- This is what the Moon looks like today. If a daytime is Moon currently visible, suggest: You can look for it in the sky right now! Let's find the Moon image card that matches!
- This is how the Moon will look in a few days. How does this phase of the Moon look different than it looks today? Does the Moon look bigger or smaller? (Help them notice how it changes gradually).
- Talk about the full cycle taking about one month. You could use something that the child may have experienced one month ago to help them think about this timing, e.g. "Did you watch fireworks for the 4th of July? That was the last time the Moon looked big and full like it will look tonight! See if you can find the Full Moon in the sky tonight before you go to bed."

Encourage the child to look for the Moon after leaving your venue so that the inquiry about the Moon can continue. Help the child understand when to look for the Moon by connecting it to activities he or she does. For example, the Third Quarter Moon will be high in the sky around sunrise. So talk to the child about what she does in the morning and when she might look outside to see the Moon. See the Astronomical Science section on page 5 for more information about what time of day to find the Moon when it is in a certain phase.

EXTENSIONS

Salt Drawing

Drawing the Moon as it appears on the banner and cards can help children focus on the details in the images. We recommend placing out one or two shallow trays lined with black paper that is covered in a layer of salt or white craft sand. Children can then use their fingers to draw the Moon as they see it in the images. The tactile sensory nature of this engaging activity might draw some children to the activity who might not otherwise show interest.

Moon Phase Memory Game

Included is a print-out version of matching moon cards (see page 7–8). This set of cards is not to be used with the Match the Moon Phases main activity. After printing and cutting cards, lay all cards face down. Each player gets to turn over two cards per turn. If they turn over two of the same matching cards, this player gets to keep the cards. If not, they must turn the cards back over (face down) and either give the next player a turn or play again until all cards have been matched.

DEVELOPMENTALLY APPROPRIATE STRATEGIES

Facilitators are likely to notice individual differences in children's interest in engaging with this activity. Some children may be eager to participate and immediately engage the materials in ways consistent with the goals of the activity. Others may need more explicit invitations and instructions. The "Add Challenge" tips described above are good ways to adjust the facilitation of this activity to match a child's interest and ability. The following additional DAP strategies can be used at any challenge level.

Acknowledge: Use *Behavior Reflections* paired with *Process Praise* to help children focus their engagement (e.g., *"You're really working hard to find the matching image on the poster."*). *Affective Reflections* can be paired with *Specific Feedback* and *Behavior Reflections* to further support and encourage children's participation (*"You found all of the Gibbous Moon cards! Your big smile shows me that you are super proud! Let's do it again with the Crescent Moon images!"*).

Model and Give Assistance: Help children remain positive about the activity by modeling your own strategy use. You can also aid their understanding by offering helpful cues about the meaningful differences in the moon card images (e.g., *"When I look at these Moon images, some of them look really similar to me. Hmmm. This Crescent Moon looks like a skinny banana with the light part over on this side* [point], *so I'm going to try to find a match that looks the same. Let me know if you see it before I do!"*)

BACKGROUND INFORMATION

The following information about the learning sciences and astronomy is intended for the educator who will facilitate the Moon Phases Matching activity. The activity is a developmentally appropriate first step toward the children eventually understanding the concepts explained below, perhaps years later. We do not intend the educator to cover most of these concepts with the children during the activity. This information is provided to give the educator a good basic understanding of the scientific concepts that the activity is moving toward and how many children think about these topics, and preparation to answer questions from very curious children or adults.

LEARNING SCIENCES

Children's Thinking about the Pattern of Lunar Phases

Though few studies have examined preschool-age children's ideas about phases of the Moon, studies of children in early elementary school can help us understand some of their early ideas about this phenomenon. My Sky Tonight researcher Dr. Julia Plummer and her colleague investigated 1st grade students' ideas about the shapes of the lunar phases and the pattern we observe them to appear in. Children's drawings of the phases of the Moon (N=26) suggested that more than half were familiar with the full Moon, half Moon, and crescent, but fewer represented the new or gibbous phases. Most of the children drew them in random or alternative patterns (77%) rather than showing a cycle of increasing or decreasing illumination (23%). When given photos of the Moon and asked to organize them according to how we would see them in the sky, children were far more likely to show a pattern of increasing or decreasing illumination (53%) and some even showed a repeating cycle (23%). However, when sorting the photos according to their phase and the amount of illumination, children often did not show consistent orientation of the phases. In other words, they would orient the phases back-to-back or sometimes 90 degrees to the phase next to it.

Yet, with a short intervention (part of a planetarium program and classroom lesson), the children improved significantly in their knowledge of different shapes of the Moon and their organization1, suggesting that it is possible for even short interventions to help students improve their conceptions of lunar phases.

Children's Thinking about the Length of Lunar Cycle

In the previously described study with 1st grade students, most children were not familiar with the length of the lunar cycle as only 27% believed that this would take about a month[1]. Similar to a previous study[2], many students believed that the Moon can change its appearance from one phase to another in less than a single night. This may relate to children's common alternative belief that lunar phases are caused by the movement of clouds in front of the Moon[3]. Learning about lunar phases as a sequence of observations over time may relate to how they are also learning about general temporal sequences and regular patterns in time. Children's understanding of the concept of time develops slowly across childhood[4]. Though children may be using language associated with temporal patterns, including relationships such as before and after, they may not have developed full understanding of temporal concepts unless they can also demonstrate an understanding through physical manipulation of objects.

Adults' Thinking about Lunar Phases

Adults often find the phases of the Moon to be challenging as well. A study of preservice elementary teachers (N=52) found that participants often did not draw all of the phases of the Moon and many gave nonscientific drawings for half moons and gibbous moons[5]. Their nonscientific drawings often looked more like aspects of partial lunar eclipses and may reflect graphics used in newspapers and other media. Further, few participants were able to draw the waxing (27%) or waning cycle (17%) of the Moon's phases; even fewer presented a scientific representation of the full cycle of lunar phases (4%). This research with adults suggests that the pattern of lunar phases is non-intuitive. However, the My Sky Tonight Moon Phase Matching activity will give children an opportunity to explore their thinking about the phases of the Moon, and perhaps even inspire them to observe more closely in the future. Early exposure to the pattern of lunar phases in this activity may help children as even brief interventions can show promise for student learning[6].

---

[1] Plummer, J.D. & Small, K.J. (2015). Connecting field trips to classroom learning: Using the planetarium to support students' engagement in science practices. Paper presented at the annual conference of the Great Lakes Planetarium Association, Grand Rapids, MI

[2] Plummer, J. D. (2009). Early elementary students' development of astronomy concepts in the planetarium. *Journal of Research in Science Teaching, 46* (2), 192–209.

[3] Baxter, J. (1989). Children's understanding of familiar astronomical events. *International Journal of Science Education, 11* (5), 502–513.

[4] Benson, J. (2014). The development of planning: It's about time. In S.L. Friedman & E.K. Scholnick (Eds.), *The Developmental Psychology of Planning: Why, How, and When Do We Plan?* New York: Psychology Press.

[5] Trundle, K. C., Atwood, R. K., & Christopher, J. E. (2006). Preservice elementary teachers' knowledge of observable moon phases and pattern of change in phases. *Journal of Science Teacher Education, 17* (2), 87–101.

[6] Plummer, J.D. & Small, K.J. (2015). Connecting field trips to classroom learning: Using the planetarium to support students' engagement in science practices. Paper presented at the annual conference of the Great Lakes Planetarium Association, Grand Rapids, MI.

ASTRONOMICAL SCIENCE

We do not intend nor recommend that you discuss the reason for the Moon's phases with young children. This activity is about noticing that the Moon's appearance changes, and that it does so with a regular pattern. Still, it will be helpful for the educator to have a deeper understanding of the Moon's phases while facilitating this activity.

The Moon does not make its own light, but is rather illuminated by the light of the Sun. Just like the Earth, the Moon is a sphere that always has one half lit up by the Sun (one half is light / daytime while the other half is dark / nighttime). Looking at the Moon from the Earth, we see different phases because we see different fractions of its day and night sides. For example, when we see a Full Moon, we are looking at the entire daytime side of the Moon; when we see a Crescent Moon, we are seeing most of the nighttime side of the Moon, and just a tiny sliver of the daytime side.

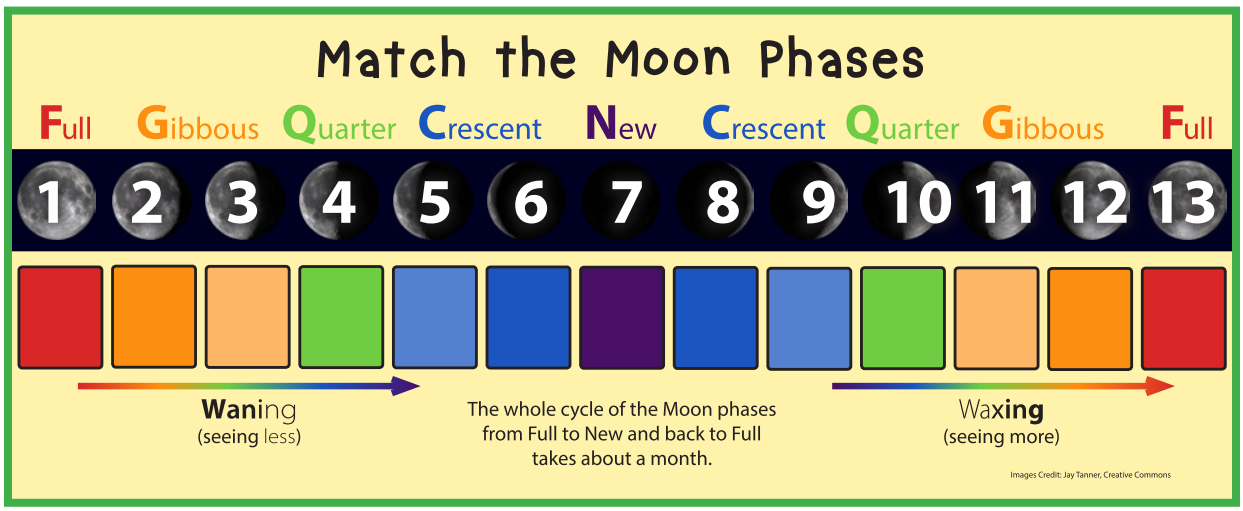
The best way to understand the Moon's phases is to watch how it changes over the course of a month (or several months) and record your observations. Notice where it appears in the sky each day or night, and how its appearance changes from one day to the next. As you observe these changes, consider the following:

- The phase of the Moon depends on the Moon's position relative to the Sun. As you observe the Moon, also notice the position of the Sun in the sky (or consider where it is below the horizon / on the other side of the Earth).
- The Moon rises in the east and sets in the west, just like the Sun, stars, and planets. This rising and setting is due to the Earth's 24-hour rotation.
- The Moon takes about one month to orbit the Earth.
- Because of this orbit, the Moon's position in the sky changes from one day / night to the next. The Moon appears to move about 12 degrees (the space covered in the sky by your fist held at arm's length) to the east each day, rising about 50 minutes later each day.

You can find a calendar with the phase of the Moon for each day here: https://stardate.org/nightsky/moon

If you know the phase of the Moon on a given day, you will know roughly what time of day it will rise and set, and when it will be high in the sky:

- **Full Moon** rises at sunset and sets at sunrise. Night is the best time to look for the Full Moon (Moons #1 & #13) and the Gibbous Moons just before and after Full Moon (Moons #2 & #12)
- **Waning Gibbous** (Moon # 3), **Third Quarter** (Moon #4), and **Waning Crescent** (Moons #5 & #6) are seen in the morning sky.
- **New Moon** (Moon #7) rises and sets with the Sun and is not visible.
- **Waxing Crescent** (Moons #8 & #9), **First Quarter** (Moon #10), and **Waxing Gibbous** (Moon #11) are seen in the afternoon and evening sky.

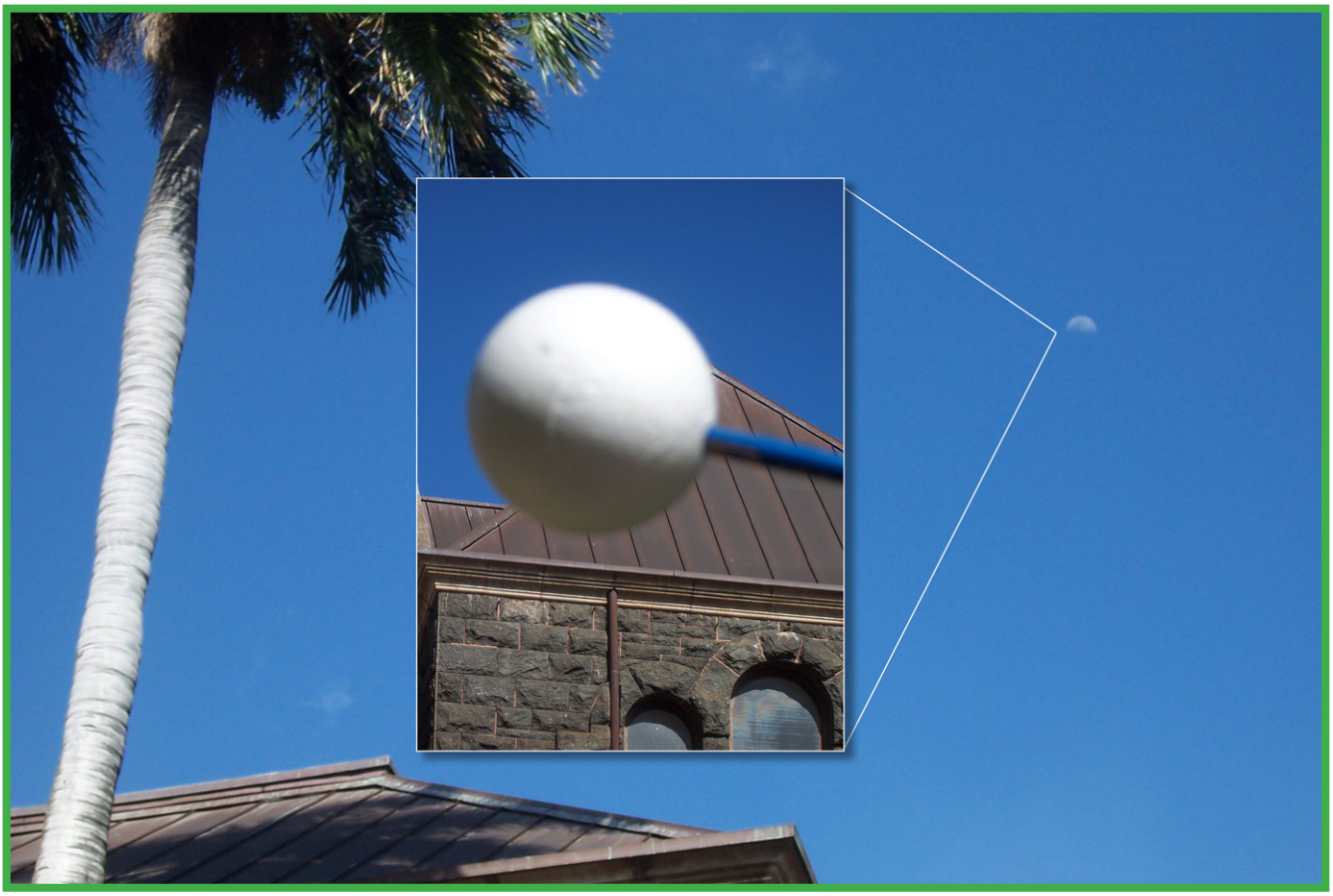


Many people believe that the phases are caused by clouds or by the shadow of the Earth, but neither of these are true. Again, we do not recommend that you try to explain the Moon's phases to young children, but to avoid these common misconceptions, as you discuss the images of the different phases, you can carefully choose your language, e.g. "This crescent Moon is so skinny, we are only seeing a small part of the Moon lit by the Sun." For more common misconceptions about the Moon, see: http://moon.nasa.gov/moonmisconceptions.cfm

To better understand the Moon's phases and why we see the Moon at different times of day and night, in addition to observing the Moon, we recommend this interactive tutorial: http://www.calvin.edu/~lmolnar/moon/

We also recommend trying this simple model at a time when you can see the Moon in the daytime sky: http://nightsky.jpl.nasa.gov/download-view.cfm?Doc_ID=329

This model will help your own understanding of the Moon's phases, but we do not recommend using it as an activity for young children. It involves holding up a small ball, lining it up with the Moon in the daytime sky. Because the angle between the ball and Sun is the same as the angle between the Moon and Sun, the ball will have the same phase as the Moon. This only works when the Moon is visible in the daytime sky, but for many people, this model really helps to solidify their understanding of the explanation for lunar phases. The photo below shows the activity in action: the Moon in a beautiful blue Hawaiian sky with an inset of a ball illuminated by the Sun having the same "phase" as the Moon.



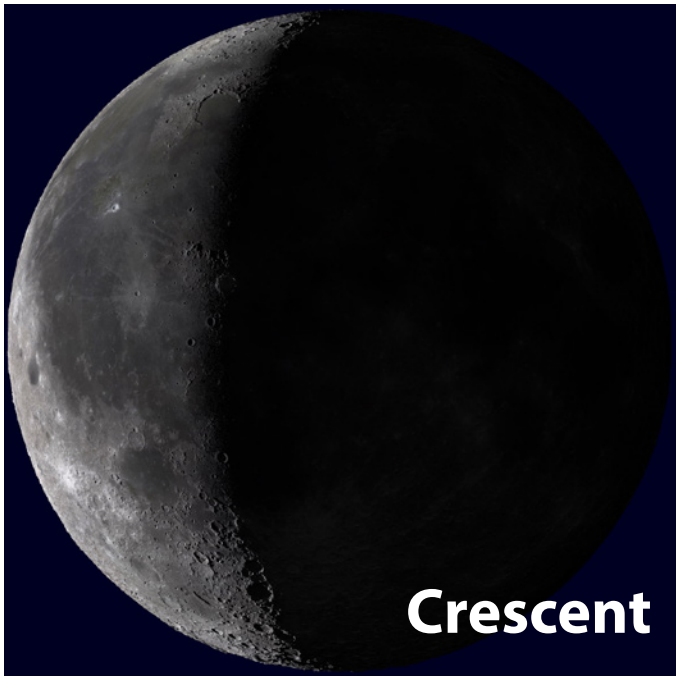
*My Sky Tonight is based upon work supported by the Division of Research On Learning (DRL) of the National Science Foundation under Grant no. AISL #1217441. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the National Science Foundation.

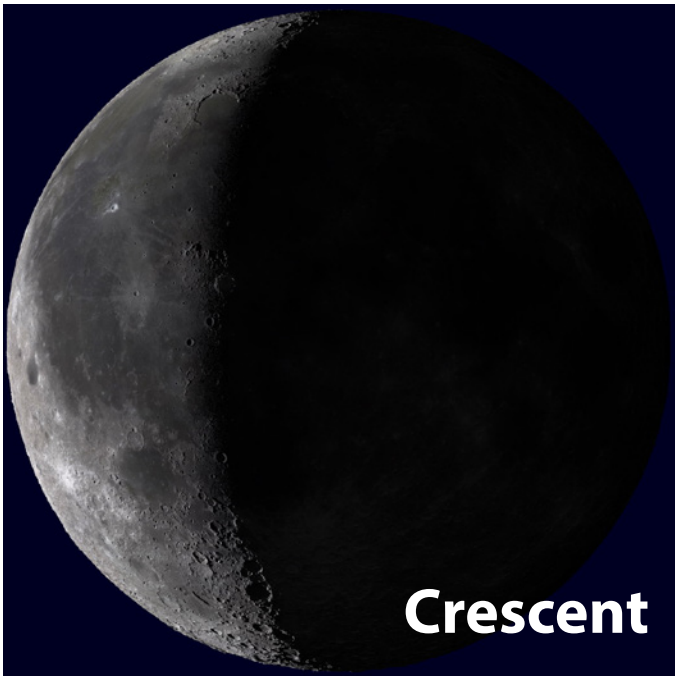

Full


Full


Quarter


Quarter


Crescent


Crescent


Gibbous


Gibbous