

## The Moon

### Overall Reflection Questions

12/12/22

- What do I think the students learned? How do I know this?
  - I believe the students took away understandings from all the goals listed, including factual, procedural, and conceptual knowledge. I witnessed their learning through formative assessments such as the BING activity, use of Yup'ik vocabulary, and multiple moon phase depictions. I also reviewed their answers to the summative questions listed in LP 4 of this unit. All students showed an increase in understanding of the Moon, its phases, and predictive patterns. I have numerous student 'artifacts' I will bring to present with me at the symposium in April.
- What went well and why?
  - A huge positive to the timing of this unit were the two relevant major lunar events that happened in November; the lunar eclipse and the Artemis I launch! My students and I also really enjoyed the graphic novel, *First Woman*, by NASA. They all read graphic novels every day, so this was a great supplement. I also enjoyed that we got to take an entire month to cover this grand topic. It allowed for flexibility in topics covered, pacing of assignments and teachings, and customized learning. One of the surprises was my students interest in space-based art – I now have many NASA themed art pieces and drawings – many of which were done in the student's own time!
- What would I do differently and why?
  - I would have liked to spend more time on modeling the phases in unique ways. I noticed that the idea of the phases and why they occur clicked at different times for different students. In the future, I would have different ways of modeling sooner, so that more students could be on the same page in a similar time frame. The different ways could include the paper plates, the oreo cookies, the styrofoam balls and flashlight, and the moon calendar.
- What did I learn about NASA as an education resource?
  - What an immense and professional educational resource NASA is! I was consistently impressed with the quality of learning modules, activities, and articles that were relevant for all ages and abilities. I will use NASA education resources in the future for all things STEM.

-CT

Mentor certification signature:



Elaine Alvey, PhD 12/13/2022

Additional comments: I confirm that these lessons were developed and taught by Carly Tencza during her student teaching placement with the Lake and Peninsula School District. She worked in close partnership with the Yup'ik community to deepen the culturally responsive components of this lessons as she worked to develop exciting NASA related curriculum for her elementary students.

## The Moon

STEM Education Fellowship Awardee Lesson Plans, Fall 2022

### The Moon

These lesson plans are original works written by me, Carly Tencza. I taught them as part of a cohesive astronomy unit in my upper elementary classroom in rural Alaska in November 2022. The lesson plans can be adapted in various ways (time wise, content covered, frequency of data tracking, etc) to fit the needs for teaching of said unit in your classroom. You may use parts of these or whole lesson plans within your classroom.

In my experience, astronomy is a fascinating subject to teach and be taught. Your students will surprise you with the depth of their interests and curiosities. Before commencing with teaching, I recommend assigning a pre-assessment to understand the baseline knowledge of your students on this subject matter. The pre-assessment will vary based on what you decide to cover or teach. If your school uses programs such as IXL, there are astronomy and moon specific modules you can let your students take that will satisfy your inquiry. I used IXL's grade 4 -> Science -> Astronomy W.3 -> Identify Phases of the Moon module as my pre-assessment. Grades 3 and 5 have similar modules.

Ultimately, remembering the purpose of this unit will help guide in its teaching: to pique curiosity, engage learners in STEM, and connect with place and culture through science and exploration.

Have fun and good luck!

## The Moon

### The Moon

#### Goals for time in classroom –

| <b>Factual Knowledge</b><br>Students will know:                                                                                                                                                          | <b>Procedural Knowledge</b><br>Students will be able to:                                                                                                                                                                                                  | <b>Conceptual Knowledge</b><br>Students will understand:                                                                                                                                                                                                                                   |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>- Definitions of at least 16 tier I, II, III vocabulary words</li> <li>- Moon phases and why they occur</li> <li>- Yup'ik language related to the moon</li> </ul> | <ul style="list-style-type: none"> <li>- Document data through observation of the lunar phase cycle</li> <li>- Recognize patterns within data and how it relates to real life</li> <li>- Predict various scenarios through pattern recognition</li> </ul> | <ul style="list-style-type: none"> <li>- How living in Alaska may affect our viewing and experience with the Moon</li> <li>- Knowing local culture connects us to community</li> <li>- Studying the Moon and other STEM concepts can be applied to future career and life plans</li> </ul> |

#### Standards used –

| <i>Science</i>                                                                                                                                                                                                                                                                                            | <i>Math</i>                                                                                                                                                                                                                                                                | <i>Cultural</i>                                                                                                                                                                         |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>05.SC.SS Space systems: Stars in the Solar System<br/> <u>05.SC.SS.ESS1-2</u><br/> Represent data and graphical displays to reveal patterns of daily changes in length and direction of shadows day and night daily appearance of the moon and the seasonal parents of some stars in the night sky</p> | <p>04.M.MD.CL2 Represent and interpret data.<br/> <u>04.M.MD.CL04</u><br/> Make a line plot to display a data set of measurements in fractions of a unit. Solve problems involving addition and subtraction of fractions by using information presented in line plots.</p> | <p>04.CA - 5 Pillars - Local Culture Focus<br/> <u>03</u><br/> Student completes a project showcasing an awareness of local Native language – how to speak a common word or phrase.</p> |

## The Moon

### Supplementary and Integrated NASA resources –

The links below originate from NASA's educational/curriculum resources regarding the Moon. They include information about the Moon, lunar phases, hands-on activities like Moon cookies, pdf printouts including a Moon phase calendar and a Moon-cut out, as well as integral background information on Apollo and Artemis I. Many of these resources are used throughout this unit, and some are listed for further reading, activities, and prep recommendations.

- i. *Overviews:* [https://www.nasa.gov/audience/forstudents/k-4/more\\_to\\_explore/moon-to-mars.html](https://www.nasa.gov/audience/forstudents/k-4/more_to_explore/moon-to-mars.html), <https://moon.nasa.gov/>, <https://solarsystem.nasa.gov/moons/earths-moon/overview/>, <https://mysteryscience.com/mini-lessons/moon>, <https://moon.nasa.gov/inside-and-out/top-moon-questions/#moon-in-motion>.
- ii. *Lesson plans:*  
<https://www.lpi.usra.edu/education/explore/marvelMoon/activities/whatIf/lunarPhases/>,  
[https://www.lpi.usra.edu/education/step2012/participant/lunar\\_phases/PaperPlateMoonPhase.pdf](https://www.lpi.usra.edu/education/step2012/participant/lunar_phases/PaperPlateMoonPhase.pdf)
- iii. *Hands-on projects:*  
[https://www.nasa.gov/sites/default/files/atoms/files/paper\\_moon\\_cut\\_out-01.pdf](https://www.nasa.gov/sites/default/files/atoms/files/paper_moon_cut_out-01.pdf),  
[https://www.jpl.nasa.gov/edu/pdfs/mooncalendar\\_worksheet-2022-lowink.pdf](https://www.jpl.nasa.gov/edu/pdfs/mooncalendar_worksheet-2022-lowink.pdf)\*,  
<https://moon.nasa.gov/resources/12/moon-observation-journal/>
- iv. *Phase information:* <https://www.jpl.nasa.gov/edu/learn/project/make-a-moon-phases-calendar-and-calculator/>\*, <https://moon.nasa.gov/moon-in-motion/moon-phases/>, <https://nasaclips.arc.nasa.gov/video/ourworld/our-world-moon-phases>,
- v. *Sweet treats:* <https://spaceplace.nasa.gov/moon-cookies/en/>,  
<https://spaceplace.nasa.gov/oreo-moon/en/>
- vi. *Apollo and Artemis I:* <https://www.nasa.gov/specials/apollo50th/back.html>,  
<https://www.nasa.gov/audience/forstudents/k-4/stories/nasa-knows/what-is-the-artemis-program-k4.html>
- vii. *Supplementary:* <https://www.nasa.gov/multimedia/nasatv/schedule.html>,  
<https://www.nasa.gov/sites/default/files/atoms/files/forwardmoonexploreractivities-1.pdf>, <https://apps.apple.com/us/app/nasas-first-woman/id1574700198>,  
<https://play.google.com/store/apps/details?id=gov.nasa.firstwoman&pli=1>,  
<https://www.nasa.gov/audience/forstudents/5-8/career/index.html>

\* = synonymous activities

## The Moon

### Lesson Plan 1 - Moon introduction and journal creation

Pre-reading/planning: <https://solarsystem.nasa.gov/moons/earths-moon/overview/> , <https://moon.nasa.gov/moon-in-motion/moon-phases/> , <https://moon.nasa.gov/>

- *Plan a start-date* - think ahead about your vision for this unit – do you want your students to observe the moon every day? What phase will the moon be in when you start and end the unit?
- Also, review NASA's website and Youtube channel (<https://www.nasa.gov/multimedia/nasatv/schedule.html>, [https://www.youtube.com/watch?v=yCJ0OLAtRpQ&ab\\_channel=NASAJetPropulsionLaboratory](https://www.youtube.com/watch?v=yCJ0OLAtRpQ&ab_channel=NASAJetPropulsionLaboratory)) to see what moon-related events are happening during the time you are teaching.
- I taught this unit in November 2022 when Artemis I launched (11/16/22) and there was a total lunar eclipse (11/8/22). These events made for extra relevant and exciting lessons. The great news is that there will be countless more of these lunar events in the future. Just research and plan accordingly if you wish to utilize them when teaching.

#### Materials:

- large image of moon (on projector or poster)
- blank moon observation journals (one for each student and yourself)  
<https://moon.nasa.gov/resources/12/moon-observation-journal/>

#### Differentiation:

- Have individual photos of the moon, articles, or even magazines (National Geographic has some good ones) for each student to look and read through.

#### Unit hook:

- Display a large photo of the moon (or earth and its moon) as you begin the next exercise. Encourage open discussion and inquiry about what you're all looking at.

KWL – know, wonder, learn. Regarding the moon: what do your students know, wonder, and want to learn? Ask each student to write down at least two statements or questions on a shared, large poster that you will post in the classroom for the entirety of the unit as reference. Assign the module pre-assessment next if you so wish.

Watch: <https://nasaclips.arc.nasa.gov/video/ourworld/our-world-moon-phases> Discuss what a moon phase is and why it occurs.

Find a moon calendar for the month that you are teaching. I found mine at [https://www.calendar-12.com/moon\\_calendar/2022/](https://www.calendar-12.com/moon_calendar/2022/). The visuals here will be helpful to students starting to synthesize moon phases, pattern tracking, and definitions. Display the calendar as you move on to the next step. This will give the students an exemplar in which to model from.

Give each student a moon observation journal and have them write their name on it. Depending on when you teach these science lessons during the day, you may need the students to observe the moon at a different time in order to see it. I taught science at 2:30pm every day, but had my students observe the moon at 9:30am in the morning. It became a morning routine for us.

## The Moon

### Lesson Plan 2 – Vocabulary and integration of culture

Pre-planning: Today is the introduction of language and vocabulary into the moon unit. You will need to choose a language, or languages, spoken in your class or community and select moon-related words to integrate into the lesson. I taught in a Yup'ik community where there was a language teacher and Yup'ik dictionary for assistance with this step. If you are working with multiple cultures in your classroom, it may be neat to have a few words from each language used. You will need 16 words total. The list I used is below:

1. Agyat (stars) - astronomical objects comprised of luminous plasma, held together by gravity, produce light!
2. Ella (atmosphere) - the envelope of gases surrounding earth
3. Iralvak (full moon) – the phase when the moon appears to be fully illuminated
4. Iraluq avegtuq (half-moon) – when the moon appears half illuminated
5. Nayiparaq/qaluurin (little dipper/big dipper) - two common constellations (formations of stars)
6. Iraluq nalauq (lunar eclipse) - a complete blocking of the sunlight from reaching the moon. Can occur only when the moon is full.
7. Iraluq (moon) - a celestial body that makes an orbit around its parent planet, it reflects light from the sun.
8. NASA - National Aeronautics and Space Administration
9. Space mission – A journey, by a manned or unmanned vehicle, into space for a specific reason – ex: Artemis I and Apollo.
10. Spacecraft - vehicle or machine designed to fly in outer space. (Orion, Artemis I moon rocket)
11. Phase - One of the different shapes of the moon as seen from Earth.
12. Gibbous - More than half, but less than fully illuminated
13. Quarter- One half of the moon (facing Earth) appears to be illuminated
14. Crescent - Less than half of the moon is fully illuminated, looking like the tip of a fingernail
15. Waning - To decrease in size. When the illuminated part of the moon is getting smaller. (from full to new moon)
16. Waxing - To increase in size. The illuminated part of the moon is getting bigger. (from new to full)

Use these words for a BING activity (variation of classic Bingo game): students create a 16-square folded paper (regular printer paper, folded over four times into a square, then unfolded to reveal 16 boxes) with a vocabulary word in each box. They also will draw a reminder image for that word in each one. Play a definition and matching game. They must listen to the definition and/or watch hand gestures to match that definition to the correct word on their sheet. Once they have four words in a row (horizontally, vertically, or diagonally), they announce “BING!”

Creating the BING sheet can take upwards of 45 minutes. Each round only takes a few minutes. Plan to play many rounds over a period of days for concrete learning of the words.

## The Moon

### Lesson Plan 3

#### Materials:

- First Woman Graphic Novel and Audio - <https://www.nasa.gov/specials/calliefirst/> , <https://soundcloud.com/nasa/first-woman-issue-no-1-dream-to-reality> If you have iPads or tablets available, download the app and work towards the Mission Specialist badge with your students! <https://apps.apple.com/us/app/nasas-first-woman/id1574700198>, <https://play.google.com/store/apps/details?id=gov.nasa.firstwoman&pli=1>
- Moon phase calendar (extension activity for more discovery after the unit is complete!) - [https://www.jpl.nasa.gov/edu/pdfs/mooncalendar\\_worksheet-2022-lowink.pdf](https://www.jpl.nasa.gov/edu/pdfs/mooncalendar_worksheet-2022-lowink.pdf)

The First Woman novel/audio will take many days to get through as the audio is one hour total. I had my students watch and listen to about 20 minutes at a time, so we finished it within a week. I displayed the graphic novel on the white board via projector and played the audio at the same time. We also used the app to follow the bonus QR codes that showed VR material within our classroom. These modern mediums spoke to their strong personal interest in graphic novels, technology, and listening comprehension. I recommend discussing the story line with them daily. Ask questions such as, "What happened when..." and, "What do you think will happen next?"

The moon phase calendar takes at least 30 minutes to complete, which includes cutting, drawing, and piecing together. Then, discussion and teaching of how to use it.

You may also complete one of these activities for more cemented understanding of why and how moon phases occur: <https://www.lpi.usra.edu/education/explore/marvelMoon/activities/whatIf/lunarPhases/>, [https://www.lpi.usra.edu/education/step2012/participant/lunar\\_phases/PaperPlateMoonPhase.pdf](https://www.lpi.usra.edu/education/step2012/participant/lunar_phases/PaperPlateMoonPhase.pdf)

Be sure to have students continue completing their moon observations and tracking.

## The Moon

### Lesson Plan 4

Today is the day students will summarize their findings through data and predict future ones. The students will also review and discuss job opportunities with NASA.

Phase tracking and predictions. Complete the second page of the Moon Observation Journal with these questions: (from: <https://moon.nasa.gov/resources/12/moon-observation-journal/>)

- 1. Did the Moon look the same each day? If not, describe how it changed throughout the month.*
- 2. Did you see the Moon at the same time each day throughout the month? Was there a pattern to the time when you were able – or not able – to observe it? If so, describe the pattern.*
- 3. Did anything ever prevent you from being able to see the Moon? If so, what? Could you figure out what the Moon would have looked like if you could have seen it? If so, how?*
- 4. What do you think will happen to the Moon's shape in the sky during the next week?*
- 5. Look up information on the phases of the Moon. Indicate in your Moon Observation Log (on the back of this page) where you think the Moon most closely matched each of the following phases: Waxing Crescent, First Quarter, Waxing Gibbous, Full Moon, Waning Gibbous, Third Quarter, Waning Crescent, and New Moon.*
- 6. What questions do you have about the Moon? Look up information about the Moon that interests you and share what you learn with your friends and family.*

To apply a deeper understanding of data, you may have your students track in numbers and show on graphs, their answers to the questions above. I.e. how often they were able to see the moon vs not. How often was the moon more than half full (or waning, or waxing, etc). Compile results as a class or as individual work.

Have a discussion on jobs at NASA - <https://www.nasa.gov/specials/calliefirst/#graphic-novels> (there is an interactive model  $\frac{3}{4}$  of the way down the page, titled YOUR FUTURE AT NASA). Ask students to choose their favorite and either write down or verbalize why to the class. If time allows, sit down with each student and go over the next steps to help them achieve this goal! This could really turn into an entire lesson plan of its own. More resources and information here to help guide these conversations here: <https://www.nasa.gov/audience/forstudents/5-8/career/index.html>