Lunar Phase Times Worksheet
to follow the astronomy demonstration video at
https://www.youtube.com/watch?v=nU4Yh_VvC1M

Review of Lunar Phase Concepts: Please complete the following specified annotations to the graphic on lunar phases. In many questions an example (the waning crescent) has been completed for you.

1) Note Earth at the center of the diagram.
    a. The perspective has you looking down from the North Celestial Pole. Add the label "NP" to the north pole on Earth.
    b. The perspective has you looking down from the North Celestial Pole. Add the label "NP" to the north pole on Earth.
    c. Add a small curvy arrow just outside Earth showing the direction of Earth's rotation.
    d. Sunlight also dictates time zones on Earth. Add small labels for the times at the center of times zones for 12pm, 3pm, 6pm, 9pm, 12am, 6am, and 9 am.

2) Note that the moon is shown for 8 evenly spaced locations in its orbit.
    a. Add a second curvy arrow on the moon's orbit illustrating the direction of the moon's revolution.
    b. Shade the portions of the moon in shadow for the 7 other phases. Picture a line from the sun to the center of the moon and draw in the bisector through the center of the moon perpendicular to it. This divides the moon into an illuminated half and a shaded half.
    c. Label the phase for the 7 other phases.
    d. Sketch in the appearance of the moon in the boxes provided for the 3 other "corner" phases. Picture a line from Earth to the center of the moon and then draw in its perpendicular bisector. This divides the moon into a portion an observer on Earth can see and a portion they can't see.

3) The meridian time is when a particular phase of the moon is highest in the sky. Note that the times you labeled on Earth give the meridian time for the phase above that location. Note that that meridian time for waning crescent is 9 am.
    a. The meridian time for first quarter is _____.
    b. The meridian time for waning gibbous is _____.

4) If we assume that the moon is above the horizon for 12 hours (which is close to true), then a particular phase rises 6 hours before the meridian time and sets 6 hours after. Note that for the waning crescent the rising time is 3 am and the setting time is 3 pm.
    a. The rising time for the first quarter is _____.
    b. The setting time for the first quarter is _____.
    c. The rising time for the waning gibbous is _____.
    d. The setting time for the waning gibbous is _____.

5) Note that the lunar period depends upon how you measure it The sidereal period (27.3 days) is the time for the moon to orbit and come back to the same place (it depends only upon the moon's revolution around Earth). The synodic period (29.5 days) is the time between successive alignments with the sun and the cycle of lunar phases (it depends upon the moon's revolution around Earth and Earth's revolution around the sun).

So one typically assumes that the new moon is at 0 days and uses a value of 28 days, which is close to correct and puts the new, full, and quarter phases 1 week apart. So the waning crescent occurs around day 25 of the cycle of phases.

    a. The first quarter moon occurs in the cycle of phases at day _____.

    b. The waning gibbous moon occurs in the cycle of phases at day _____.

6) **Video Activity**: Let repeat the major focus of the video: what phases of the moon are visible in the sky over a month's time at 1:30 pm?

You should identify the location on Earth corresponding to that time, draw in a time stick figure at that location, and draw in the tangent plane. (If you wish to take into account that Earth is drawn much larger than its correct size relative to the moon's orbit, you are encouraged to do so, but it won't affect your answer to this question.)

    a. What phases of the moon are visible at 1:30 pm? _____

_____

_____

    b. What phases of the moon are never visible at 1:30 pm? _____

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_____

7) **Application**: A common misconception seen when astronomy education researchers interview students regarding the phases of the moon is that some students say "the moon cannot be seen during the daytime".

Why do you think this is? Use your result from the previous question about the phases visible at 1:30 pm to help you formulate an argument explaining why some students (and many members of the general population) believe this. Make sure that your argument includes thinking about ease with which certain phases can be seen and the general viewing situation.

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_____

_____

_____

_____

_____

Sunlight

B
D
A
C
Waning Crescent