ASTRONOMY 101A (Fall Semester 2002)

LUNAR PHASES, PART II

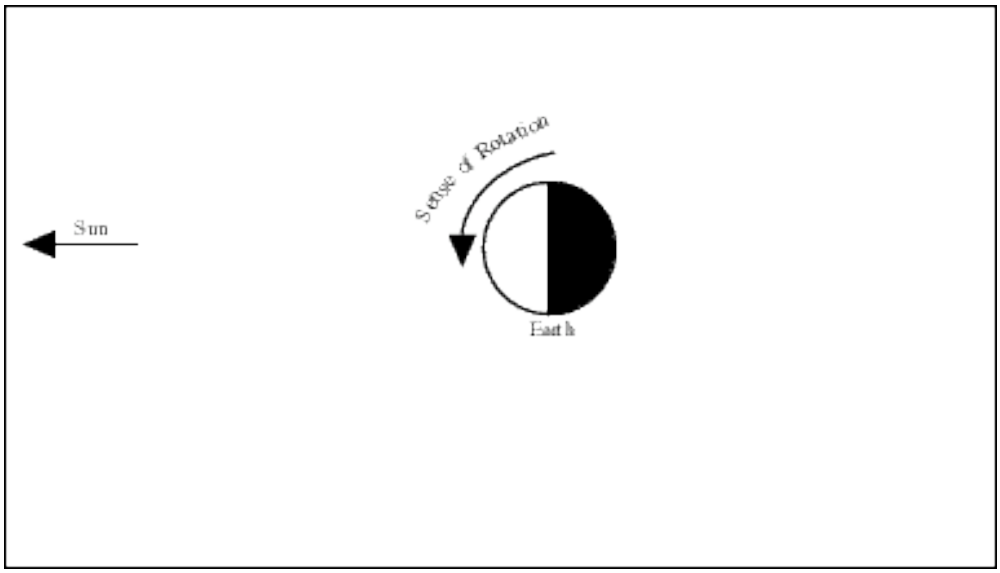
Objective: Your objective in this exercise is to develop a model for how the rising and setting times of the moon are related to the phases of the moon.

By the end of this exercise, you should be able to figure out and predict the times of moonrise, moonset, and transit (passage overhead) for different phases of the moon based on the model for the moon's orbit we used last week.

Procedure: Like last week, we will be using a Styrofoam ball and a light source to simulate the Moon and Sun, respectively. You, or someone in your group, should represent the Earth's position.

1) Modeling A Typical Day on Earth

For the moment, consider just the Earth and Sun in this model. As the Earth rotates (counterclockwise as **seen from above the North Pole**), you should see that someone on earth would see the Sun rise and set during one rotation of the earth (a period commonly referred to as a "day").

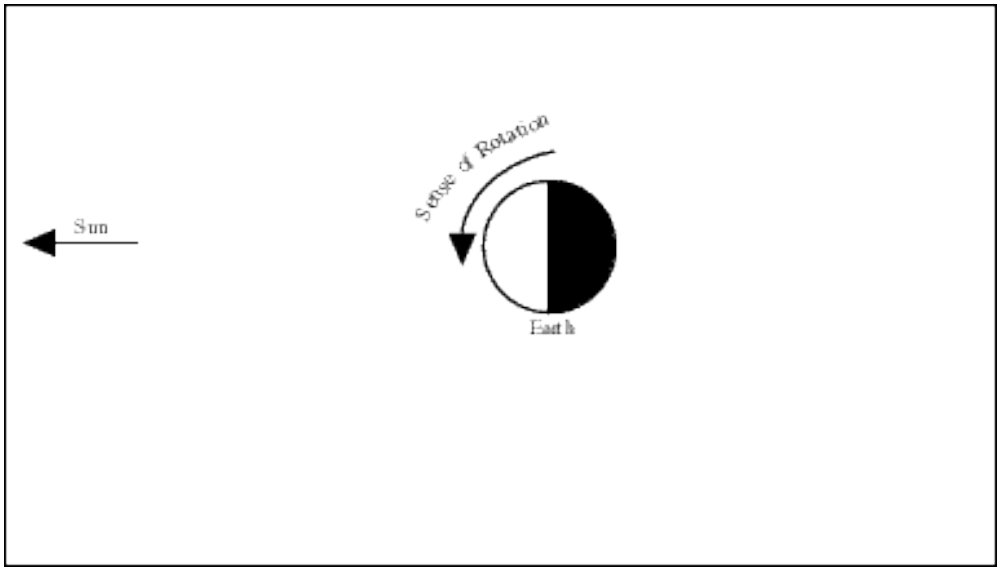


In the figure above, *label the points on the earth* (use arrows if necessary) where someone is currently experiencing the following:

- "sunrise."
- "sunset."
- "noon" (when the Sun appears directly overhead).
- "midnight" (when we are facing directly away from the Sun).

Explain your reasoning for how you the points you labeled in the diagram?

2) Which Direction is Which At Various Times of Day?



In the diagram above draw and label a "stick figure" representing a person at the location for which it is currently sunrise. Label two arrows indicating the directions of east and west for the person in the above diagram. Explain your reasoning carefully. How did you determine the direction of east? Of west?

Now add a "stick figure" representing a person at the location for which it is currently sunset. Label two arrows indicating the directions of east and west for the person in the above diagram. Explain your reasoning carefully. How did you determine the direction of east? Of west?

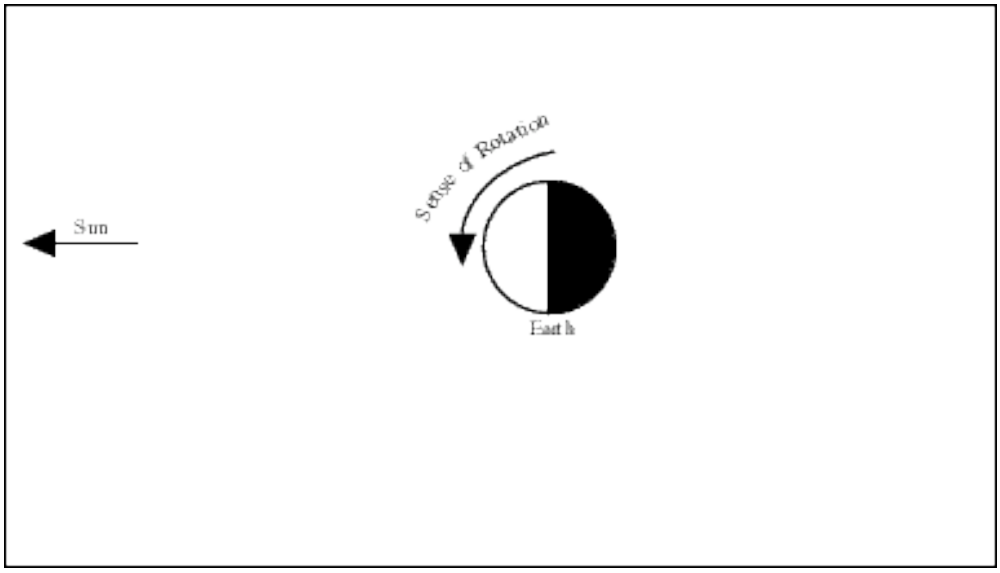
How do the directions for east and west at sunrise compare to the directions for east and west at sunset?

Now add a "stick figure" where it is currently noon, which direction is east, which direction is west? Can you state a general rule for which direction (clockwise or counterclockwise) is east and which direction (clockwise or counterclockwise) is west in the diagram above? Explain your reasoning.

3) Modeling the Rising and Setting Times of the Full Moon

Consider for a moment where your stick figures were for people at "sunrise," "noon," and "sunset." Those people were on the half of the earth where the Sun was visible. For any object reasonably far from the Earth's surface, there will be a half of the Earth where the object is visible and a half where the object is not visible. How do we determine which half? In general, it is the half of the earth closest to the object (it is not <u>because</u> it is the closest half, but rather because the object will be above the horizon for the closest half of the Earth). So for example, for the Sun the lit up half of the Earth is the half closest to the Sun and the half of the Earth where the Sun is currently above the horizon.

Now consider the moon. Remember from last week's exercise that we determined that the **full moon** occurs when the moon is directly on the opposite side of the earth as the Sun. *Add the full moon to the diagram below.*



Using the diagram above as a reference if necessary, answer the following questions:

When the full moon is "rising," what time is it? _____

If the full moon is "transiting" (passing overhead), what time is it? _____

When the full moon is "setting," what time is it? _____

Where in the sky (east or west) is the full moon at around 7 pm? _____

around 3 am? _____

It's midnight later the same day, what phase is the moon? _____
Explain your reasoning…

4) Modeling the Rising and Setting Times of Other Phases of the Moon

Remembering from last week's exercise where the moon is during it's other phases, answer the following questions. Feel free to use diagrams or the Styrofoam balls to help you visualize the situations described.

New Moon:

When the new moon is "rising," what time is it? _____

When the new moon is "transiting," what time is it? _____

When the new moon is "setting," what time is it? _____

Where in the sky is the new moon at around 9 pm? Explain your reasoning.

Quarter Moons:

When the 1st Quarter moon is "rising," what time is it? _____

When the 3rd Quarter moon is "transiting," what time is it? _____

The ____ Quarter moon sets at noon. (Fill in the blank) _____

Other Phases:

A Waxing Gibbous moon is "rising," about what time is it? _____

A Waning Crescent moon is overhead, about what time is it? _____

What lunar phase is highest overhead at 9 pm? (Fill in the blank) _____

Final Question: *It is noon and you notice the moon is setting in the west, what phase of the moon is it? Explain your reasoning.*

Your goal for when you leave today's exercise is to have a good sense of how to predict the rising, transiting, and setting times of the moon. A quiz is provided on the class website to so that you see if you can apply this model to solving some simple astronomical questions. If you have any questions, please ask the instructor.