2 - Plotting the Daily Motion of the Sun

Purpose: To investigate the Sun's apparent daily motion across the sky.

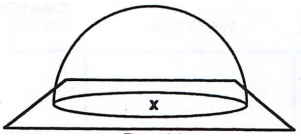
Materials:

plastic hemisphere
hemisphere base: hemisphere base sheet, cardboard, tape, binder clips
dry-erase pen (do not use permanent marker)
smartphone with compass app or magnetic compass
piece of chalk

Instructions:
At the end of the class, you should have answered Q1–Q6 on a separate piece of paper with your and your partners' names. You should also have a clear understanding of how to proceed outside of class, as a group, in order to answer Q7–Q11. Before the next lab, you will also need to work independently on the Field Work component.
Due: in one week, at start of class.

Preparation

1. Place the hemisphere base flat on your desk and the square rim of the plastic hemisphere flat on the hemisphere base/compass (provided).



2. Imagine that the sky is the inside surface of the dome created by the hemisphere. As an observer, you would be standing at the center of the circle where the lines intersect.

3. Using the dry-erase pen, label with the letter "N" the ridge on the dome that is closest to the arrowhead labeled "North" on the base. Looking down on the dome and going clock-wise from north, mark the other three ridges with "E", "S", and "W."

Pre-lab Questions—What Do You Think?:

As a team, discuss the answers to questions Q1–Q6. Each person must record the answers on a separate sheet of paper with all partners' names. Where appropriate, you will mark your answers on the dome, which should also have your names on it.

Q1) Predict the positions of the Sun for today at sunrise, sunset, and noon, using the dry-erase pen. Please do not use a permanent marker. Mark the dome with the letter *r* to show the position of the Sun at sunrise, the letter *n* to indicate its position at noon, and the letter *s* to indicate its position at sunset.

Q2) Connect these points on the dome with a curved line to show how you think the Sun will move across the sky today. Sketch your hemisphere on your separate sheets of paper.

Q3) As specifically as possible, state what direction the Sun rose this morning.

Q4) As specifically as possible, predict what direction the Sun will set this evening.

Q5) As specifically as possible, describe where in the sky the Sun was at noon.

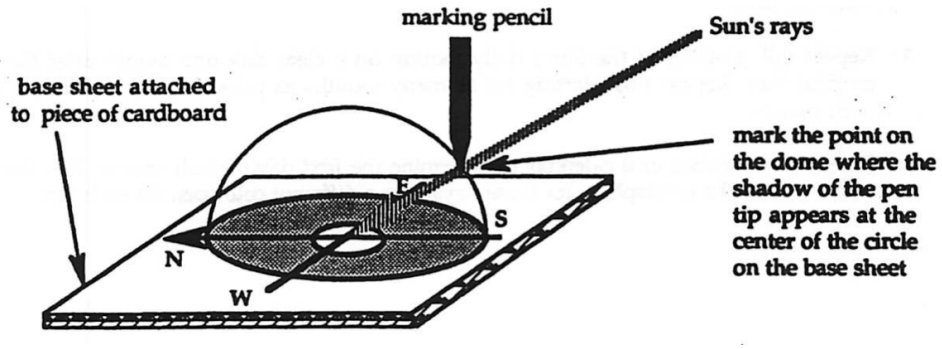
Q6) Predict how many hours of daylight there will be today.

Observations (outside of class):

1. Before taking the dome home assemble the dome/base: attach the dome to the base. Make sure to align the circular base of the dome with the circle on the base. Attach only one edge. This will allow you to draw on the inside and look through the dome from the inside. Use a binder clip to secure the other side for transport and measurements.

2. Place the dome on a flat horizontal surface in direct sunlight. With the aid of a compass, turn the dome so the ridge marked N points north. Be careful not to place your compass near iron or steel objects since these metals will attract your compass needle and produce an inaccurate reading. Once the dome is set in place, draw an outline around the base with chalk in case the dome is accidentally moved. Always return the dome to this position for the measurements of the Sun's positions.

3. Plot the Sun's position in the following way:
   a) Carefully move the tip of the dry erase pen close to the dome, but do not let it touch.
   b) Move the pen around until the shadow cast by its tip falls directly on the center of the base sheet where the lines intersect.
   c) Touch the tip of the pen to the dome and make a dot. The dot's shadow should fall directly on the intersection of the lines on the base.
   d) Repeat steps (a)–(c) as often as you can so you can have a good set of data that describes the motion of the Sun across the sky. At a minimum, make five measurements hours at least one hour apart and not at the same time of day. Ideally, take data from sunrise to sunset in intervals of one hour.
   e) <u>On the inside of the dome</u>, draw a line connecting the points. Label the line with the date and time range. Extrapolate to sunrise and sunset if not measured directly.



Discussion Questions:

After collecting data for a week, regroup to analyze your data and answer the following, which include a list of words to define (see your ASTR110 textbook or the internet, etc):

Q7) On your separate piece of paper, discuss *how* the points and line you drew for question Q1 compare with the points and line plotted from your actual observations of the sun (about 100 words). Include a discussion of what this means (the likely *why*).

Q8) From what direction did the Sun rise? Be as specific as possible.

Q9) Where in the sky was the Sun at noon? Be as specific as possible.

Q10) In which direction did the Sun set? Be as specific as possible.

Q11) Define the following terms (in context of astronomical observing) verbally and visually (i.e., in a figure):

a. Horizon
b. Zenith
c. Azimuth
d. Altitude
e. Meridian
f. Local Sky