Naked Eye Astronomy, Day 2: The Sun

1. Recap of last week
   (a) Please ask questions at ANY TIME.
   (b) Web page with resources for the course: `https://osp.berry.edu/SeniorScholars`.
   (c) The stars move collectively across the sky from east to west, completing a full cycle in 23 hours, 56 minutes.
   (d) Each star always rises/sets in the same spot and spends the same number of hours above the horizon each day. Some stars near Polaris never rise/set (circumpolar stars).
   (e) All of our star observations can be accounted for by assuming we are at the center of a giant rotating celestial sphere that carries the stars around once every 23 hours, 56 minutes. The axis of rotation passes through a point 35 degrees above our northern horizon, near the star Polaris.
   (f) Now we will turn our attention to the Sun.
2. Observing the Sun (in Stellarium)
   (a) Rising location/time
      i. Track Sun and advance time until sun is on eastern horizon. Note location.
      ii. Advance by one week and adjust time to get Sun on eastern horizon. Note time and location change.
      iii. Repeat until full cycle is observed.
      iv. Location: rises farthest south and latest in December, farthest north and earliest in June, due east at avg time in Sep and March.
   (b) Setting locations/time
      i. Track Sun and advance time until sun is on western horizon. Note location.
      ii. Advance by one week and adjust time to get Sun on western horizon. Note time and location change.
      iii. Repeat until full cycle is observed.
      iv. Location: sets farthest south and earliest in December, farthest north and latest in June, due west at avg time in Sep and March.
      v. Longest day - summer solstice, shortest day - winter solstice, 12 hours days on equinoxes.
   (c) Transit time for Sun
      i. Get Sun on meridian line.
      ii. Measure time between transits. (24 hours) Is that what you expected? How does it compare to the transit time for stars?
      iii. So the Sun moves relative to the stars. Which way? (east)
      iv. But we know Sun doesn't move ONLY eastward relative to the stars. It must also move north/south depending on the time of year in order to explain changes in rising/setting locations and times.
3. Using shadows to track the Sun

(a) It is hard to observe the Sun directly, but easy to track the motions of the sun using shadows.

(b) Show Gnomon simulation. Demonstrate shadow tracks for solstices, equinoxes. Discuss how elevation of Sun changes throughout the day, as shown by changing length of shadow.

(c) Summer: sun is up the most hours and gets highest in the sky. Winter: sun is up the fewest hours and stays lower in the sky. Spring/Fall: sun is up an average number of hours and reaches average altitude.

(d) Discuss definition of local noon (as opposed to noon on our clocks - difference will be discussed later).

(e) Show plot of local noon altitude versus day of year. Note both the median value and the max/min values. Discuss how this plot can be used to find the obliquity of 23.5 degrees. Note that local noon altitude on an equinox appears to be 90 degrees minus our latitude.

(f) These patterns in the motion of the Sun govern seasonal changes in temperature. (Note: it has nothing to do with how far away the Sun is. In fact, the Sun is closest to us in January!)

(g) Next time we will look at two different models to explain these patterns in the motion of the Sun.

4. Questions and conversation.