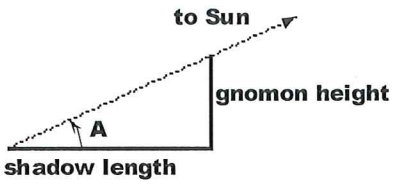
INST 2403

The Sun's Shadow and Position



How shadow length and gnomon height determine the altitude A of the Sun

To study the motion of the sun in the sky, we need to measure its **position** accurately. However, the sun is too bright the aim a telescope at it and then measure the orientation of the telescope. In fact, you shouldn't even look directly into the sun with a naked eye!

What to do? There is a simple way to circumvent the problem: Use a stick called a **gnomon** and measure the length of the stick above ground, and the length of the shadow the sun casts. The ratio of the two is the tangent of the altitude angle, see figure. Use the two meter/yardsticks you are given and perform this measurement of the position of the sun.

1. Write down the height H of the gnomon. H= 1m

2. Measure the length L of the shadow keeping the gnomon is perpendicular to the ground.
   L = 1.2 m (as an example)
3. Estimate the direction of the shadow (called the azimuth angle), e.g. Northeast.
   Northwest, so sun is in the southeast → before noon.
4. If H=L then A=45 degrees. Use this to estimate the altitude of the sun crudely.
   H is smaller than L, so angle is (a little) smaller than 45°.
5. From what you know (latitude of Westerville, season we're in, time of the day) does this make sense? Why or why not?
   Yes, sun is low before noon. In Westerville sun at highest (June 21) is 73°5.
6. Predict how the position of the sun (altitude and azimuth) will be different (if at all):
   a. In one hour higher (towards noon) ← when we measured
   b. Same time tomorrow a little lower (August → December sun gets lower)
   c. Same time in a month even lower (September is fall)
   d. Same time in a year same. Pattern repeats after 1 year.
7. When (if ever) is there no shadow cast by the sun in Westerville?
   Never. Sun is overhead only in the tropics (closer than 23½° to Earth's equator)
8. When (if ever) is the shadow cast by the sun in Westerville infinitely long?
   At sunset & sunrise shadows are very, very long.