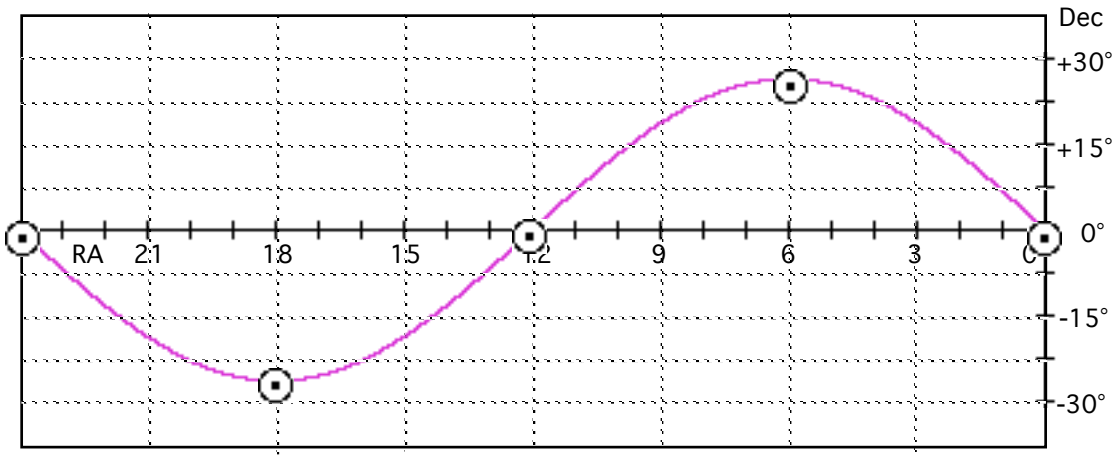
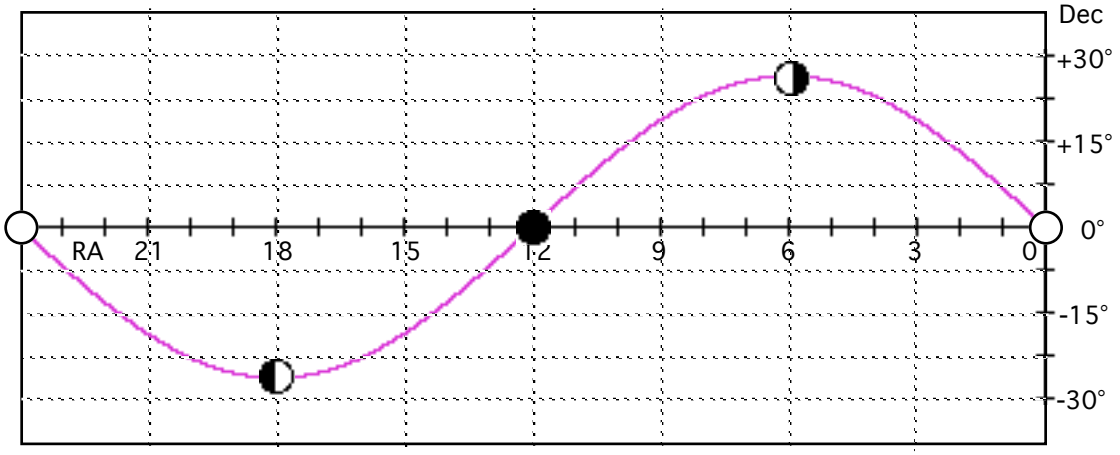
Seasonal Variations of Moon Phases

Over the course of a year, the Sun travels all the way around the ecliptic. Its positions at the equinoxes and the solstices are indicated on this equatorial chart:

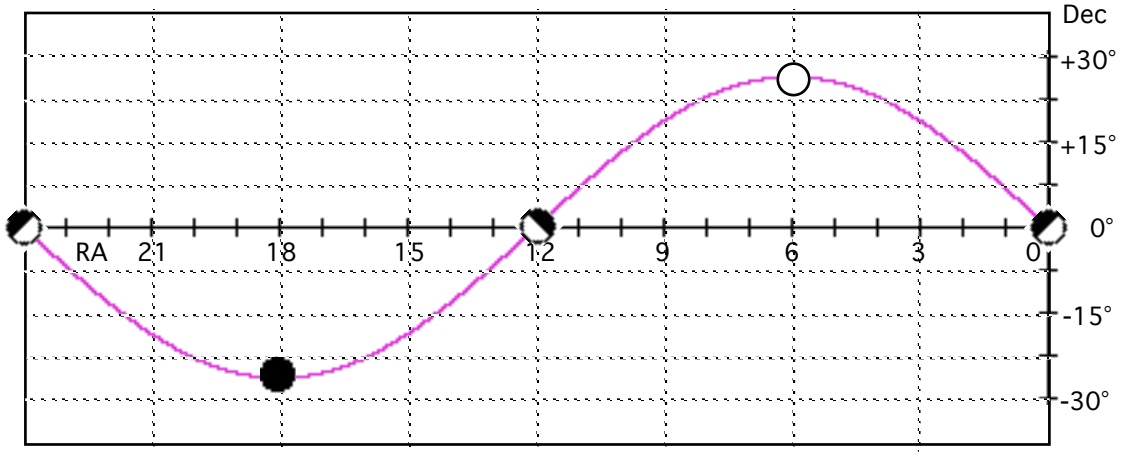


As the Moon orbits, it also travels around the celestial sphere, remaining within 5° of the ecliptic. (This 5° difference will be ignored here.) During each month, the different moon phases appear at positions which shift gradually from month to month as the new moon follows the Sun around the ecliptic. The following diagram shows the positions of the four principal moon phases when the Sun is at the autumnal equinox around September 22-23:

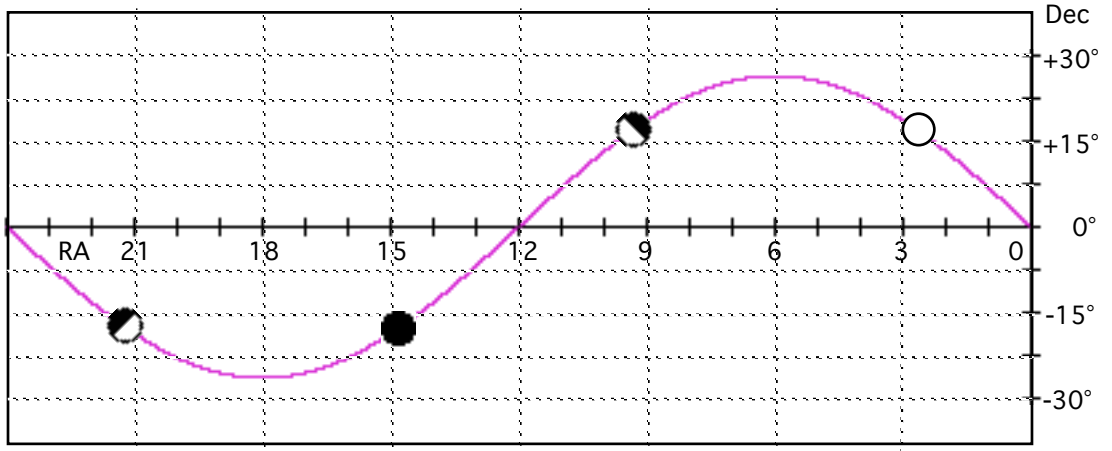


Around the time of the autumnal equinox, the last quarter moon rides highest on the ecliptic, rising north of east, setting north of west, and remaining above the horizon for about 16 hours (as seen from Minnesota). In the same month, the first quarter moon rides lowest on the ecliptic, rising south of east, setting south of west, and spending only about 8 hours above the horizon. The new moon and full moon both rise due east, set due west, and spend about 12 hours above the horizon.

Three months later, near the winter solstice (December 21-22), the moon phases will appear as shown in the next diagram. This time the full moon will ride highest on the ecliptic, the new moon will ride lowest, and the quarter moons will be on the celestial equator, rising due east and setting due west. Note the tilt of the quarter moons as they turn their illuminated faces toward the Sun, located at the new moon position.



Midway between the autumnal equinox and the winter solstice (around Halloween) the moon phases would be positioned as shown below:



In a similar fashion, the locations of the various moon phases along the ecliptic can be easily deduced for any time of the year. The new moon lines up with the Sun, and the full moon is 180° away along the ecliptic. The first quarter moon is 90° east of the Sun and the last quarter moon is 90° west of the Sun.