

Elementary Astronomy Laboratory

Lab Three: For Every Season: Tilt, Tilt, Tilt

Name:

Lab Time:

Date:

Questions From Slides

Which three observations are so tightly related that they are all the result of the same set of phenomena?

- Colder temperatures at poles
- Seasons
- Length of day versus night
- Magnetic fields
- Height of Sun at noon
- Average temperature of planet

Star the three major contributing factors for the existence of seasons. Underline three major contributing factors for determining average temperature for a planet.

Planet is round.

Planet has an elliptical orbit.

Planet's distance from its star.

Planet's axis of rotation is tilted from the ecliptic.

Planet's axis of rotation does not rotate in sync with the planets revolution around the sun.

Planet's amount of atmosphere determines level of insulation.

Planet has an internal heat source.

Planet has a magnetic field.

Using Celestial Globes

Set the celestial globe to model the heavens as viewed from Richmond, Virginia at 37.5° N latitude. The latitude tells us the angle between the equator and the given latitude from the center of the earth. Since the horizon is perpendicular to directly overhead, the northern most point of the horizon ring is set to $90^\circ - \text{latitude}$. In our case this is $90^\circ - 37.5^\circ = 52.5^\circ$. So aim the northern most point of the horizon ring at 52.5° declination. Then turn the earth so that Virginia is in the center of the ring.

Now rotate the little gold/yellow ball that represents the sun so that it is at the autumnal equinox (September 21st). Notice that the ball may not sit directly in front of the date marker, just ignore this discrepancy taking the date marker as the true location. Rotate the outer sphere and sun together so as to create noon on the summer solstice for Richmond, Virginia. Follow a declination line to obtain an approximate value for the angle of the sun above the southern most part (actually the break) of the horizon ring. Write down this value. Notice what portion of a total rotation it takes to get the sun to go from sunrise to sunset. Give an approximate percentage of one total rotation that the daylight hours of this day entails. Remember to use the date marker instead of the ball for better accuracy.

Repeat this process for December 21st, the winter solstice.

Repeat this process for March 21st, the vernal equinox.

Repeat this process for June 21st, the summer solstice.

Set the celestial globe to model the heavens as viewed from Barrow, Alaska (71.3° N latitude). The northern most point of the horizon ring points to what value of the declination? Now do all four dates for this location. Notice the rather odd behavior. This occurs for latitudes above 66.5° N. What is the difference between 90° and 66.5° ? What is the significance of this value? Because this odd event is seen for all latitudes above 66.5° N, the circle created by the 66.5° N line is given a special name. What is the name of this latitude **line**? (Use a google.com search if needed.)

Set the celestial globe to model the heavens as viewed from Sydney, Australia (34° S latitude). The northern most point of the horizon ring points to what value of the declination? Now do all four dates for this location. How would you relate the seasons here to the seasons in Virginia?

The Tropic of Cancer is the name given to the latitude line at 23.5° N. The Tropic of Capricorn is the name given to the latitude line at 23.5° S. What view of the Sun can only be had between these two latitudes twice a year and on these latitudes once a year?

Questions from using Celestial Globes

| Richmond, Virginia 37.5° N | Angular Height of Sun | Percentage of Rotation of Daylight |
|----------------------------|-----------------------|------------------------------------|
| Autumnal Equinox | | |
| Winter Solstice | | |
| Vernal Equinox | | |
| Summer Solstice | | |

The northern most point of the horizon ring points to what value of the declination for modeling Barrow, Alaska?

| Barrow, Alaska 71.3° N | Angular Height of Sun | Percentage of Rotation of Daylight |
|------------------------|-----------------------|------------------------------------|
| Autumnal Equinox | | |
| Winter Solstice | | |
| Vernal Equinox | | |
| Summer Solstice | | |

What is the difference between 90° and 66.5°?

What is the significance of this value?

What is the name given to the 66.5° N latitude line?

The northern most point of the horizon ring points to what value of the declination for modeling Sydney, Australia?

| Sydney, Australia 34° S | Angular Height of Sun | Percentage of Rotation of Daylight |
|-------------------------|-----------------------|------------------------------------|
| Autumnal Equinox | | |
| Winter Solstice | | |
| Vernal Equinox | | |
| Summer Solstice | | |

Describe the relationship of the seasons in Sydney, Australia to the seasons in Virginia?

What view of the Sun can only be had between the Tropic of Cancer and the Tropic of Capricorn twice a year and on these latitudes once a year?