

Diyala University

Architecture Department

Architect and Environment

Ass. Teacher Firas Gh. Altamemi

4th stage

3rd lecture.

Sun Movement

Climate Analysis



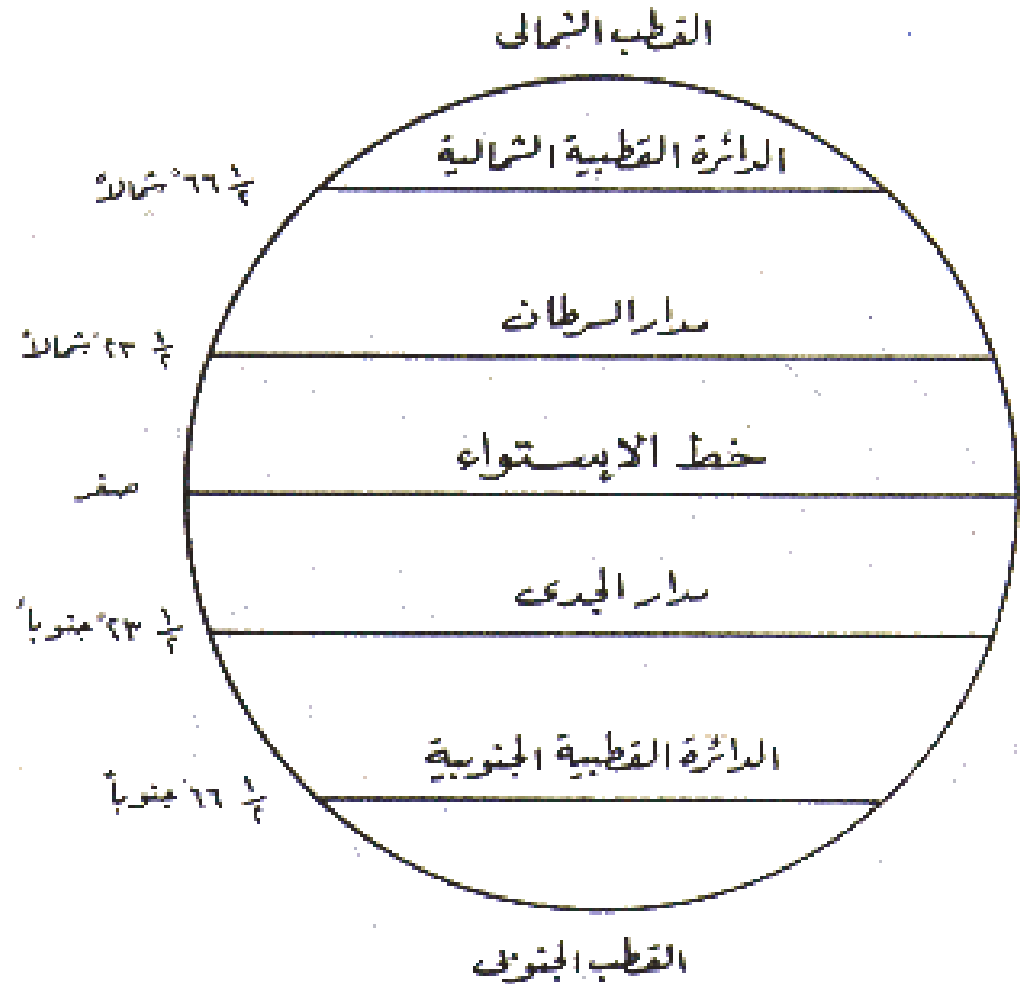
FACTORS AFFECTING CLIMATE

- (A) Solar radiation (Sun Movement)
- (B) Air temperature
- (C) Air humidity
- (D) Precipitation
- (E) Wind
- (F) Sky condition

North pole
Arctic circle
Tropic of Cancer

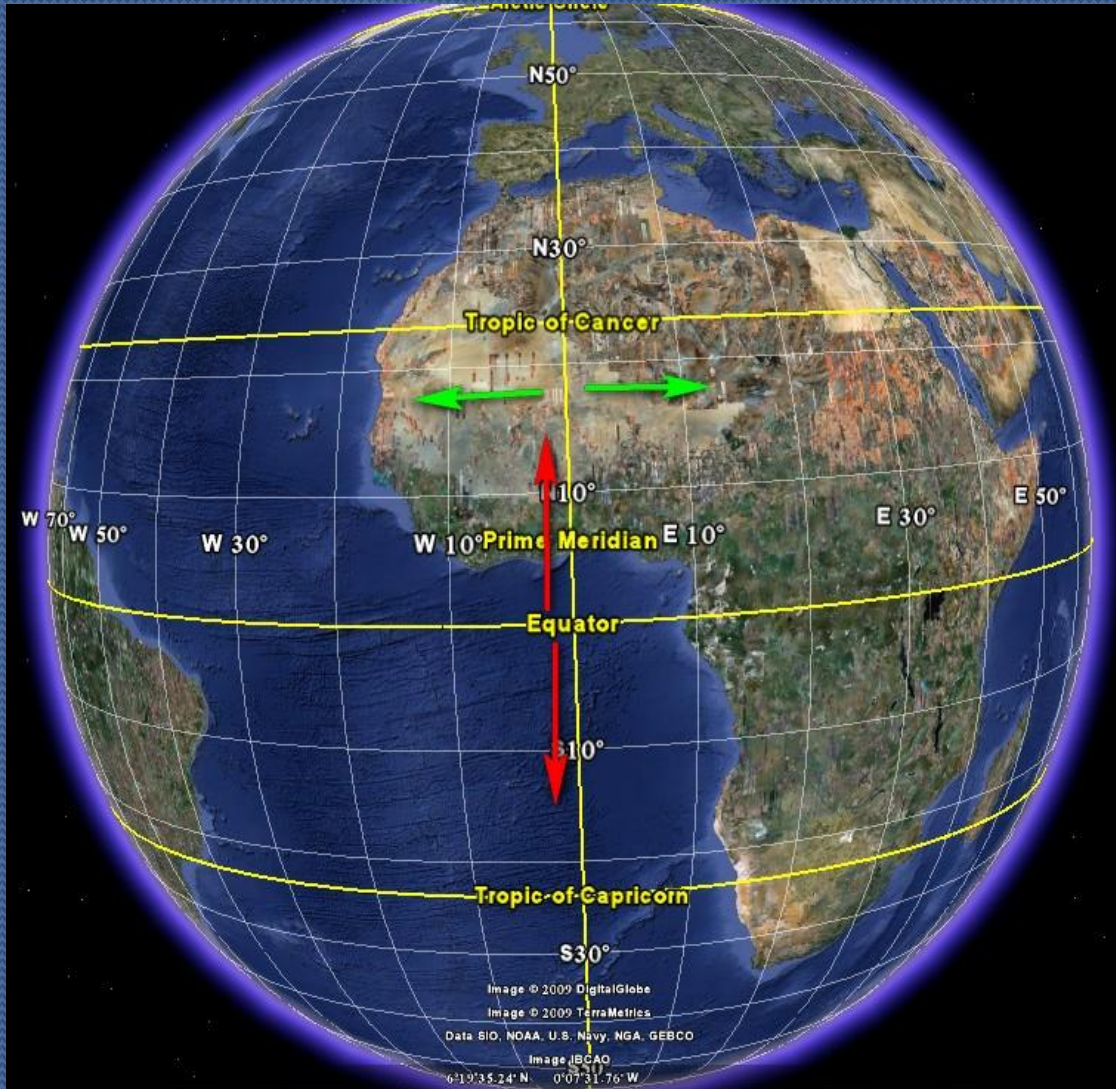
Equator

Tropic of Capricorn
Antarctic circle
South pole



Latitude	Position	Description
Equator	0	Hottest area, Sun perpendicular in Spring and Autumn
Tropic of Cancer	23.5° north	The sun perpendicular when there is summer in the northern hemisphere and winter in the southern.
Tropic of Capricorn	23.5° south	The sun perpendicular when there is summer in the southern hemisphere, and winter in the north
Arctic circle	66° north	It is the latitude in which there is a day in summer when the sun does not set (six months of the day). All the latitudinal circles above it are day for 6 months, and vice versa in the south 6 months are night.
Antarctic circle	66.5° south	It is the latitude in which there is a day in which the sun does not set for 6 months (summer in the south, winter in the north).
North pole	90° north	It is the farthest circle of latitude relative to the equator from the north, and it is the area that the sun never reaches because it is far from the equator.
South pole	90° south	It is the farthest circle of latitude relative to the equator from the south, and it is the area that the sun never reaches because it is far from the equator.

Regions



cold

From the Arctic Circle to the North Pole



Temperate

From the Tropic of Cancer to the Arctic Circle (Northern Temperate)



Hot tropical

It is one of the hottest regions



Temperate

From the Tropic of Capricorn to the Antarctic Circle (southern temperate)

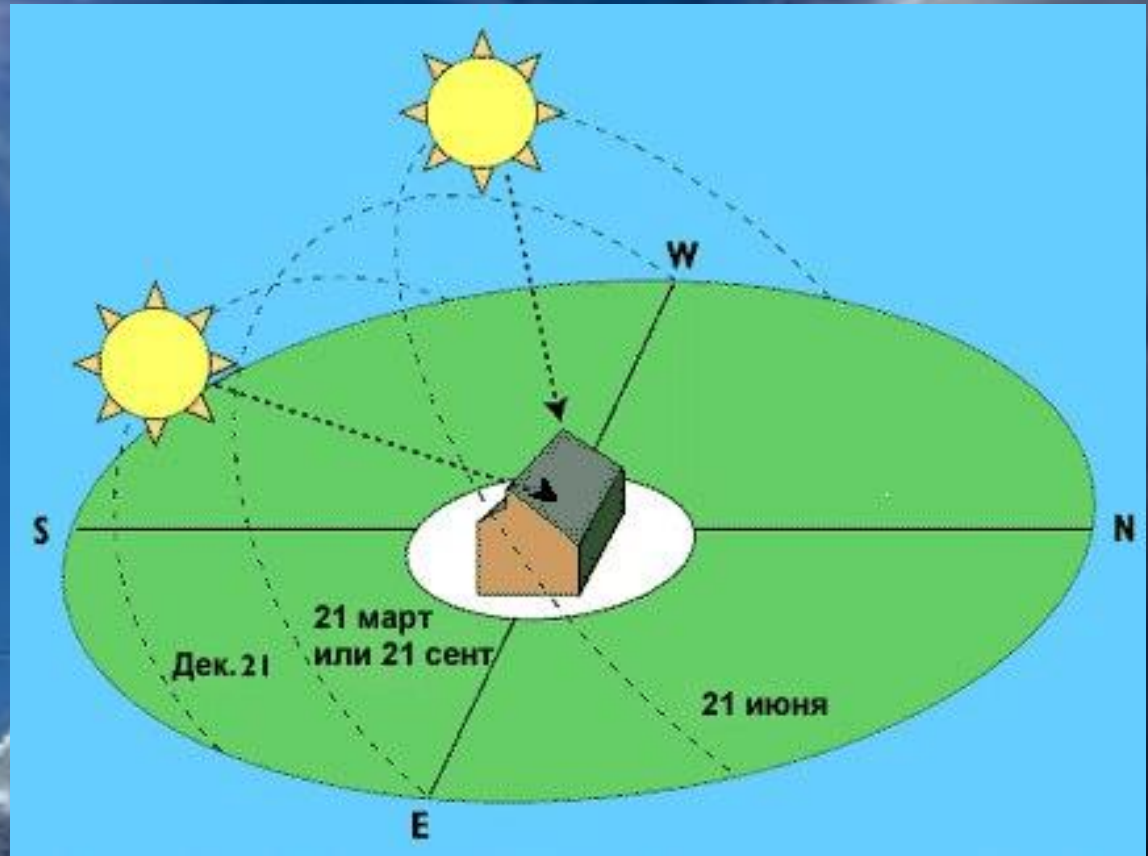
Cold

From the Antarctic Circle to South pole

Longitudes & Latitudes (GPS)

Longitudes	Latitudes
<ul style="list-style-type: none">• Locating places west or east of the Greenwich line.• Determining the time in different parts of the world.• It helps in drawing navigational maps.	<ul style="list-style-type: none">• Locating places south or north of the equator.• Know the weather conditions (regions)
360 line (79 Km) on Equator	180 circle (110Km)
W/E Greenwich	N/S Equator
GMT line (village of Greenwich, southeast of London in Britain.	Equator

Sun Movement

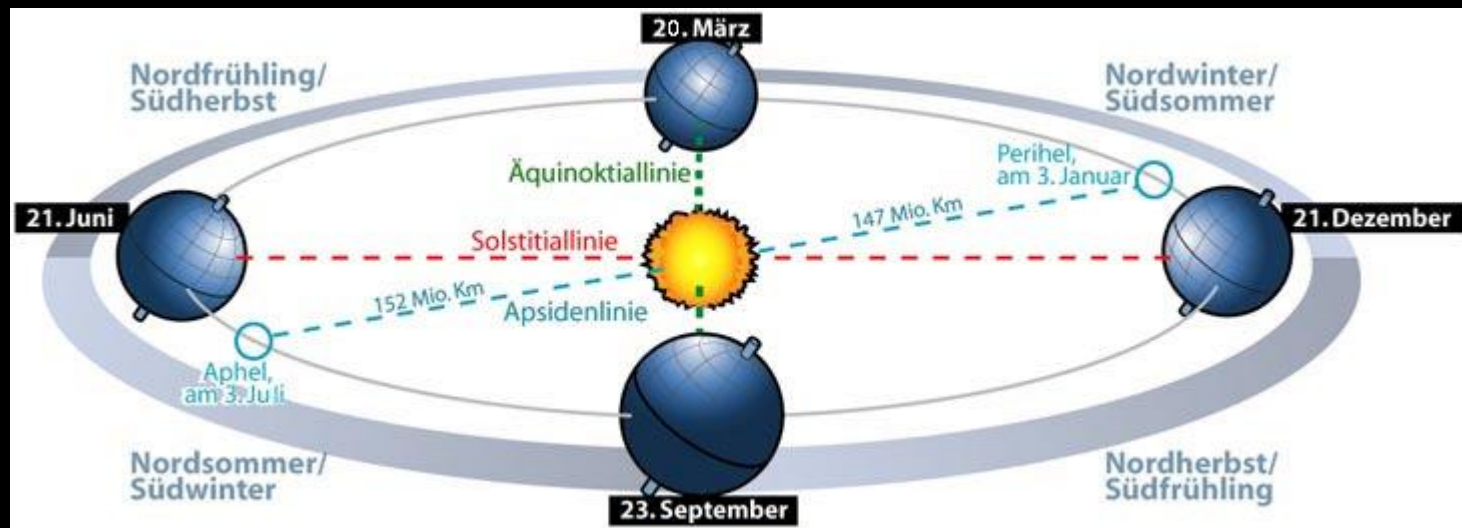




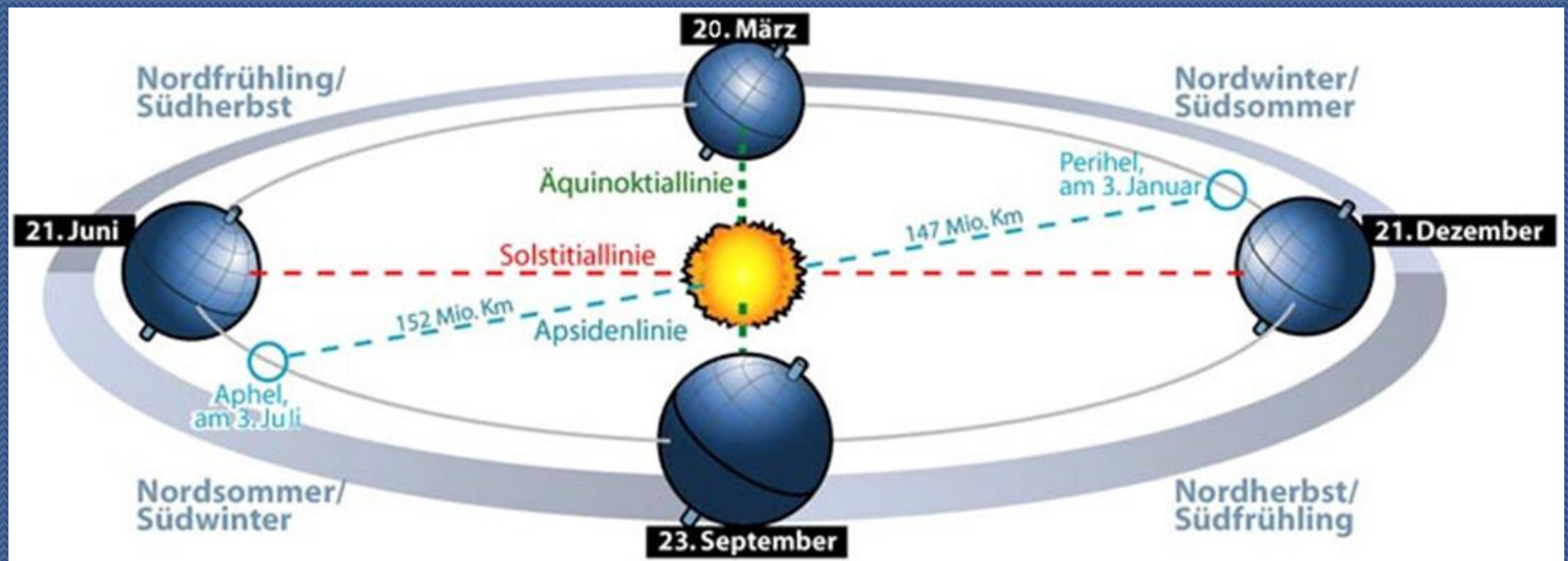
Daytime & Night (Sun movement)

Seasons (Earth movement)

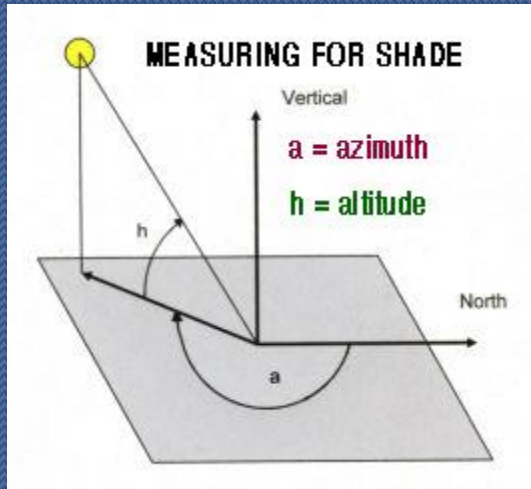
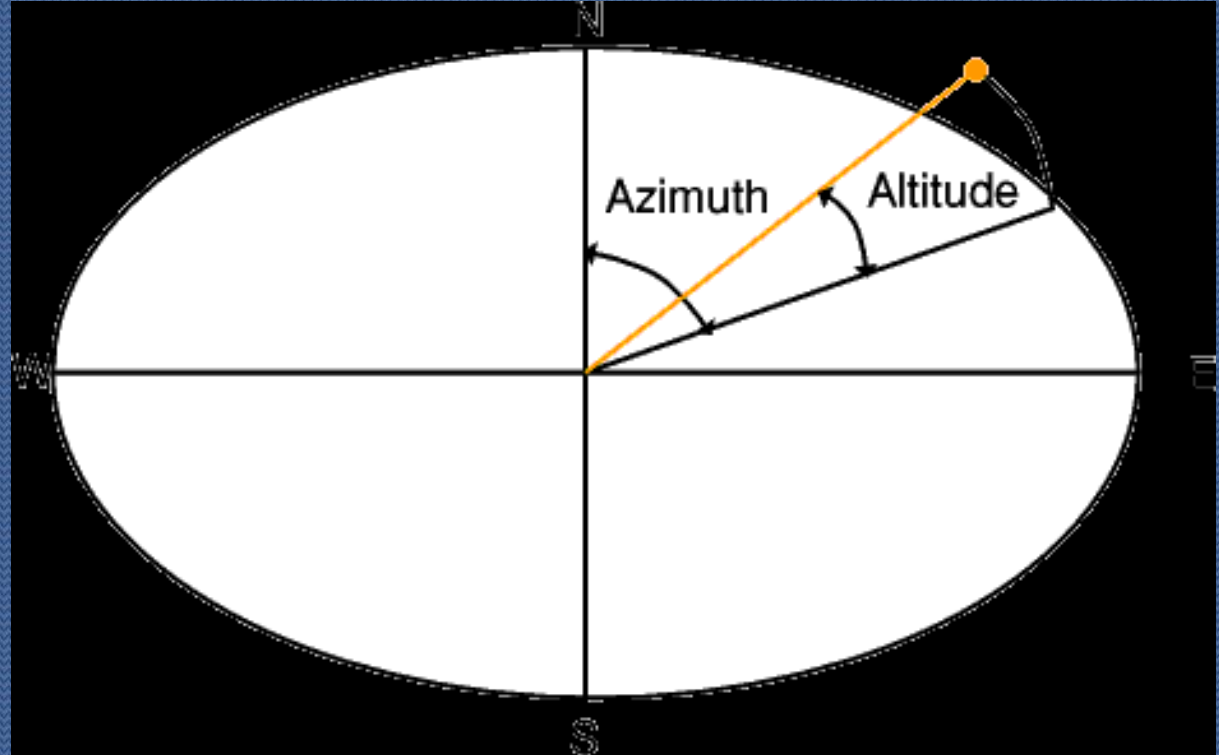
The direction of the Earth's rotation axis is fixed in space. The seasons of the year arise.



- Right: The sun is perpendicular to the Tropic of Capricorn (summer in the south, winter in the north).
- Left: the sun is perpendicular to the Tropic of Cancer (summer in the north, winter in the south).
- Middle: the equinoxes March 21 and September 23: the sun is perpendicular to the Equator.

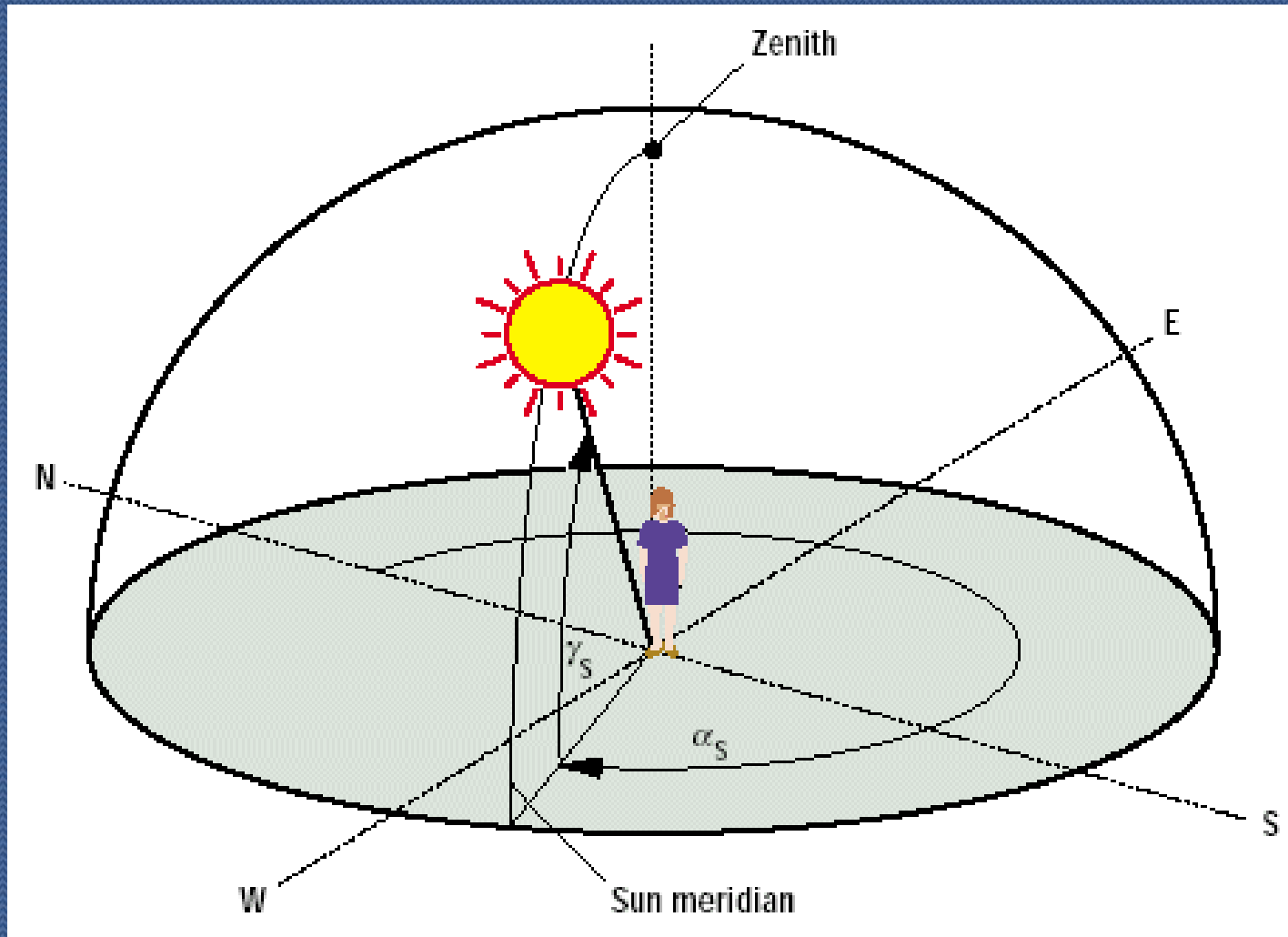


هو زاوية بين مستوي مرجعي ونقطة، غالباً ما يقاس بالدرجة. يستخدم السميت في Azimuth السميت بالإنجليزية: العديد من العلوم التطبيقية مثل الملاحة، الفلك وعلم المساحة، وفي سلاح المدفعية. كلمة سميت العربية هي أصل الكلمة الإنكليزية، وهي في الأساس تعني الطريق.



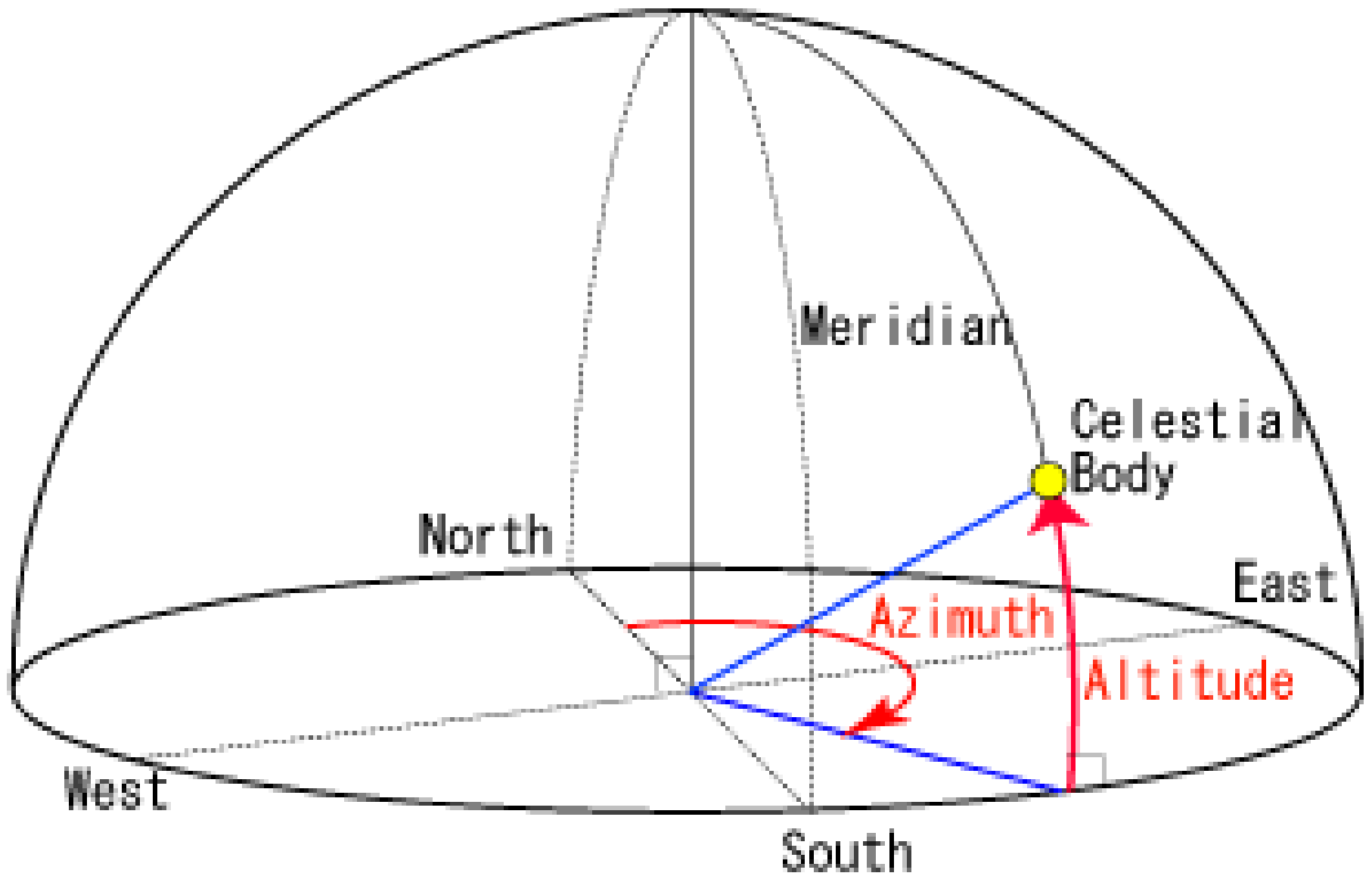
Azimuth: An azimuth is an angle between a reference plane and a point, often measured in degrees (clockwise). Azimuth is used in many applied sciences such as navigation, astronomy and surveying, and in artillery.

Altitude An angular elevation (up to 90°) above the horizon.



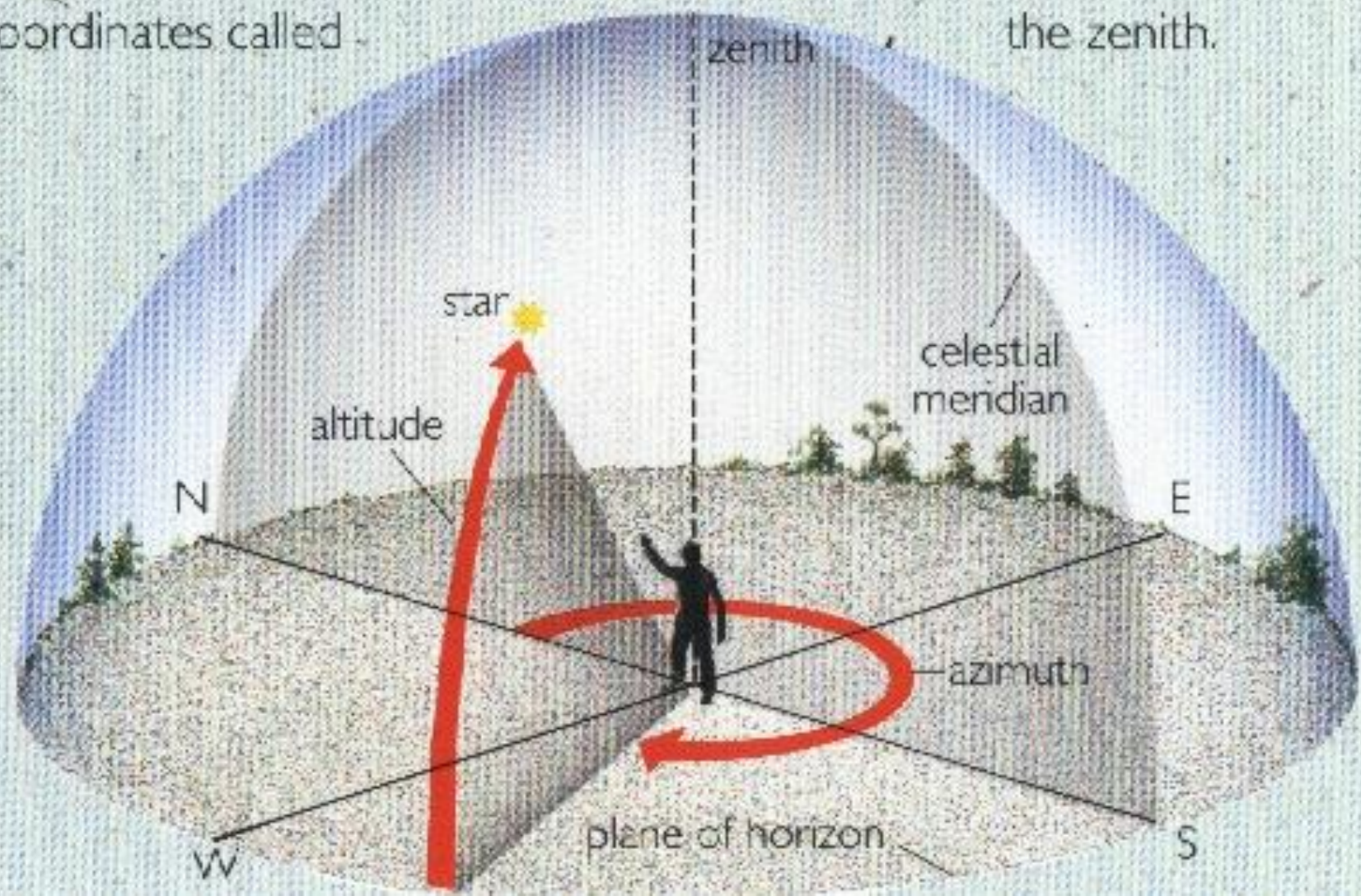
Definition of Altitude & Azimuth

Zenith; Apogee of sun
on meridian



coordinates called

the zenith.



star

altitude

N

celestial
meridian

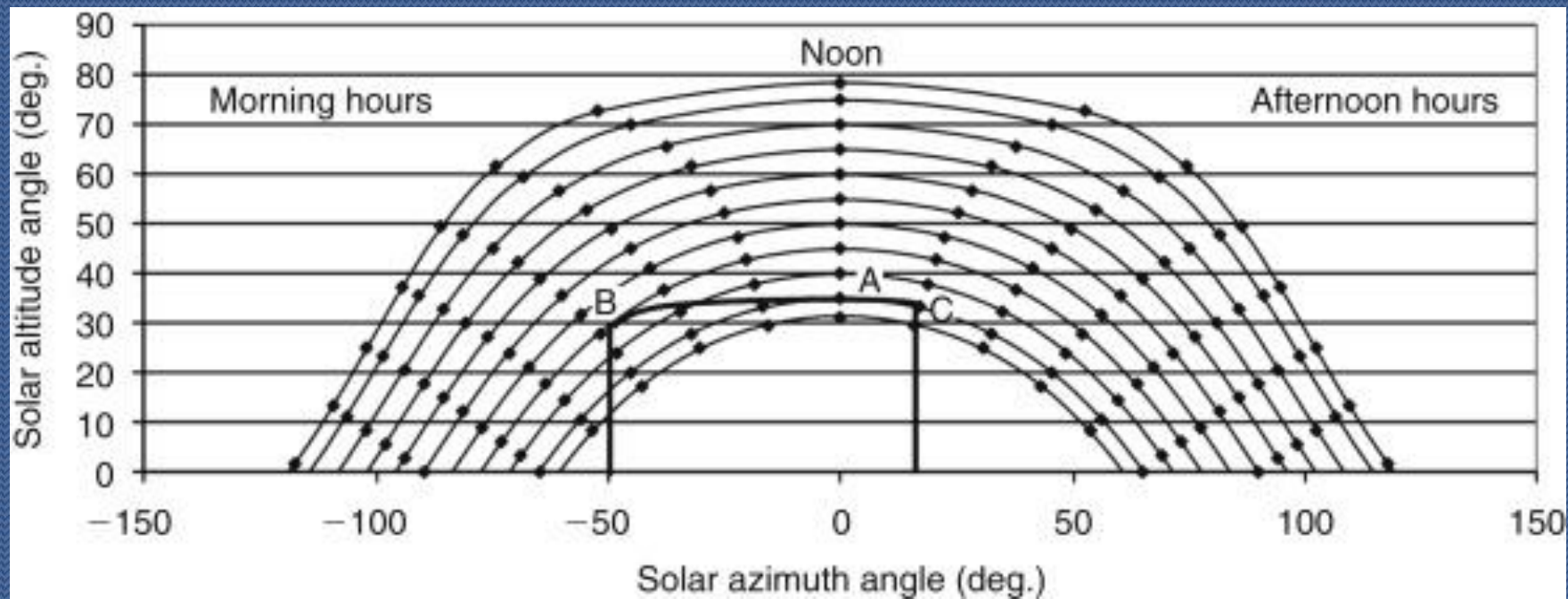
E

azimuth

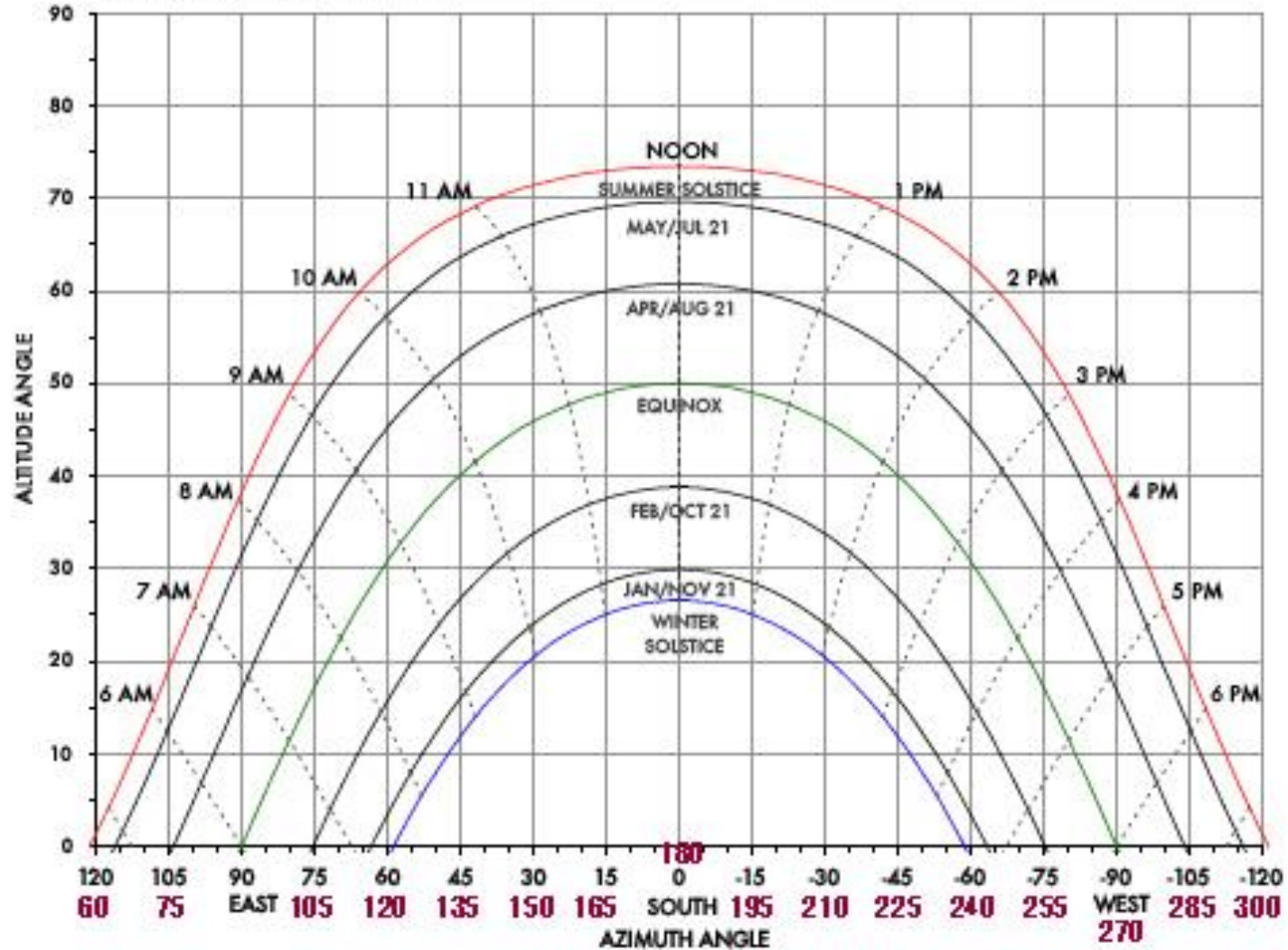
W

plane of horizon

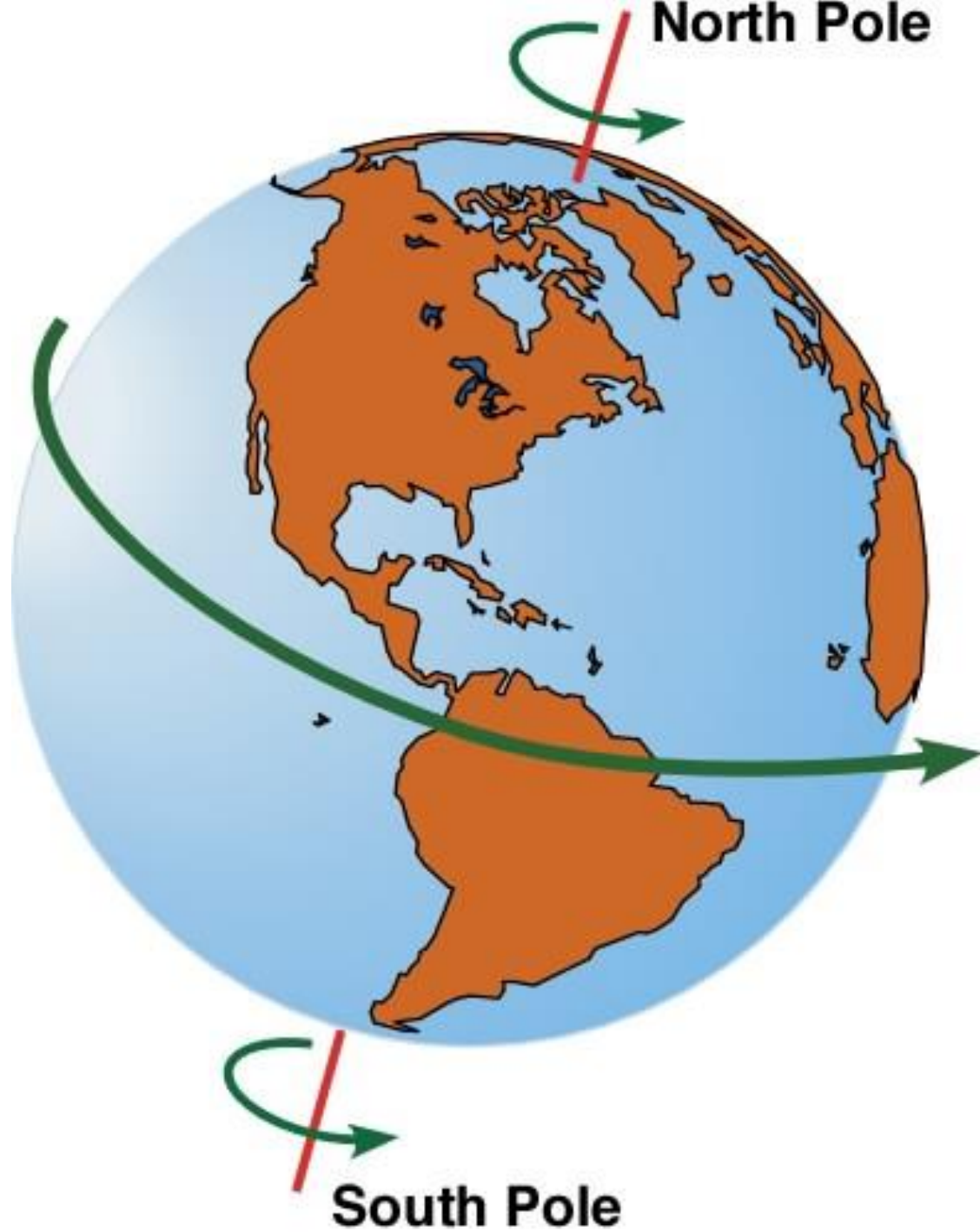
S

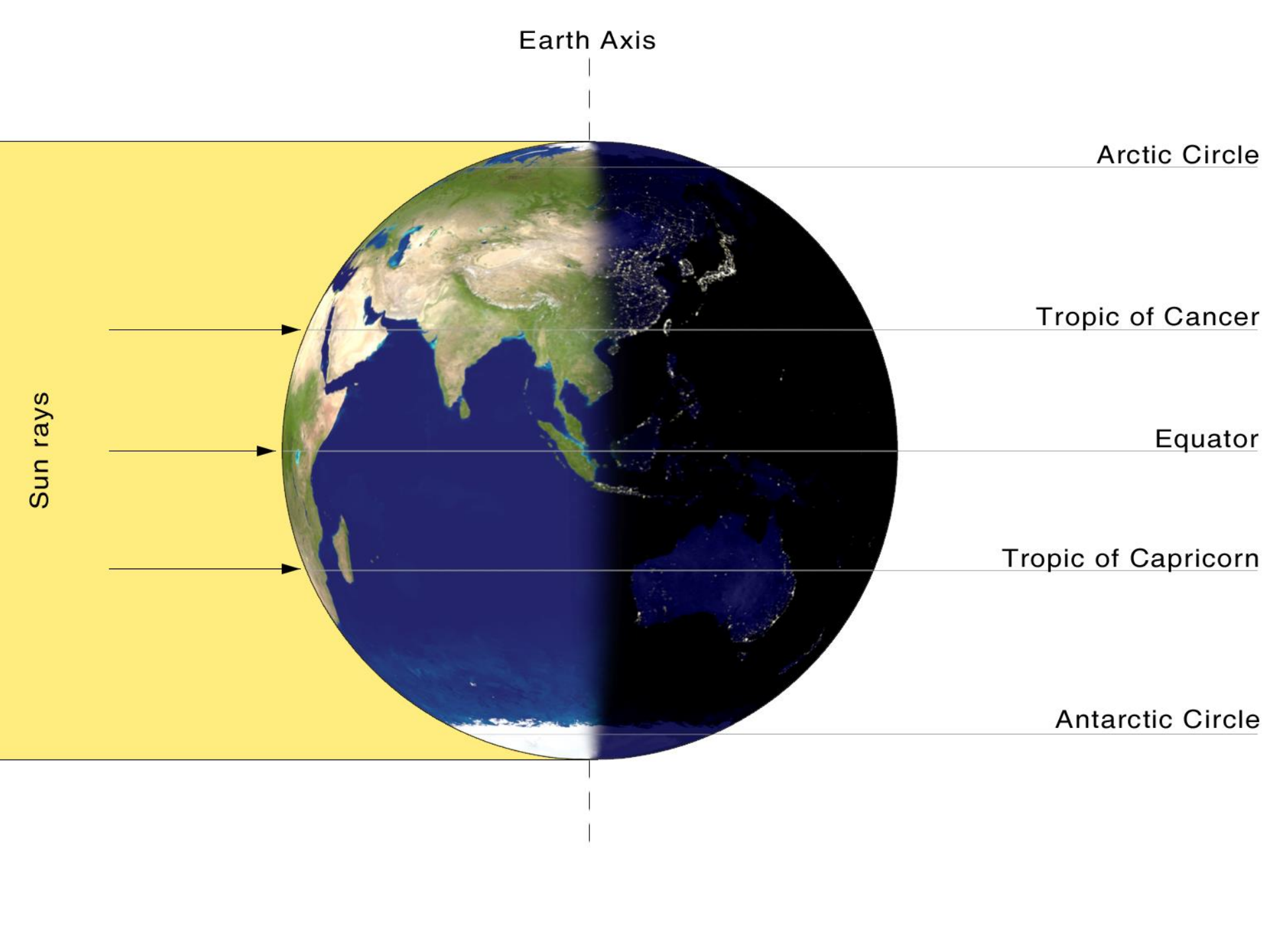


SUN PATH CHART FOR 40°N



23.5 degree





Earth Axis

Arctic Circle

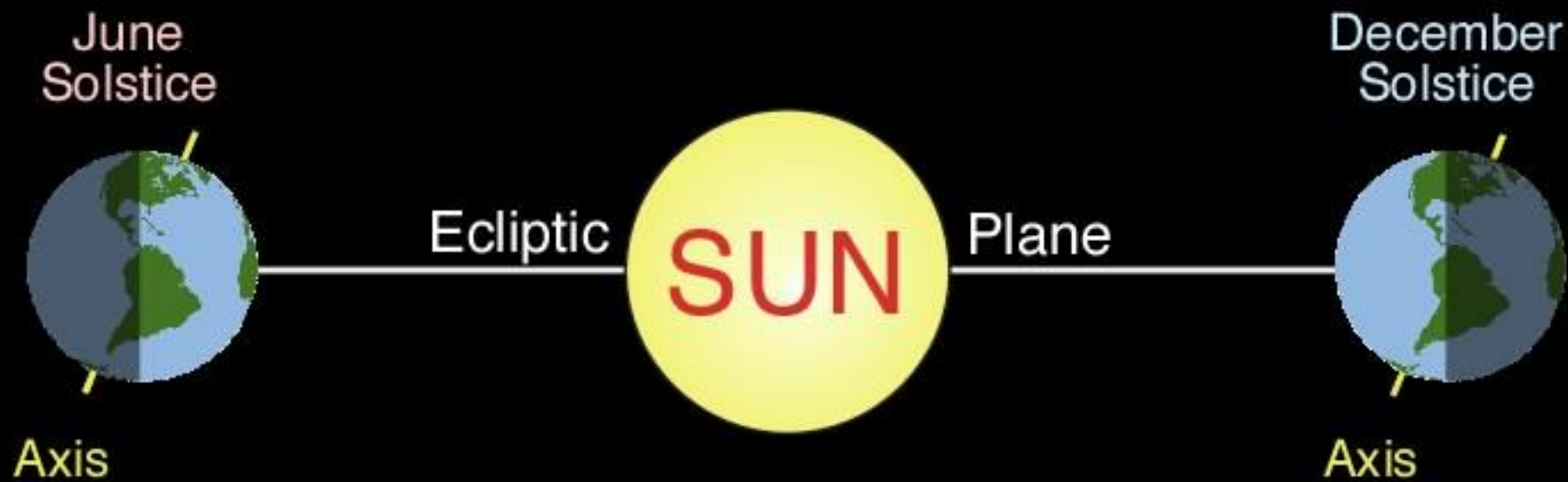
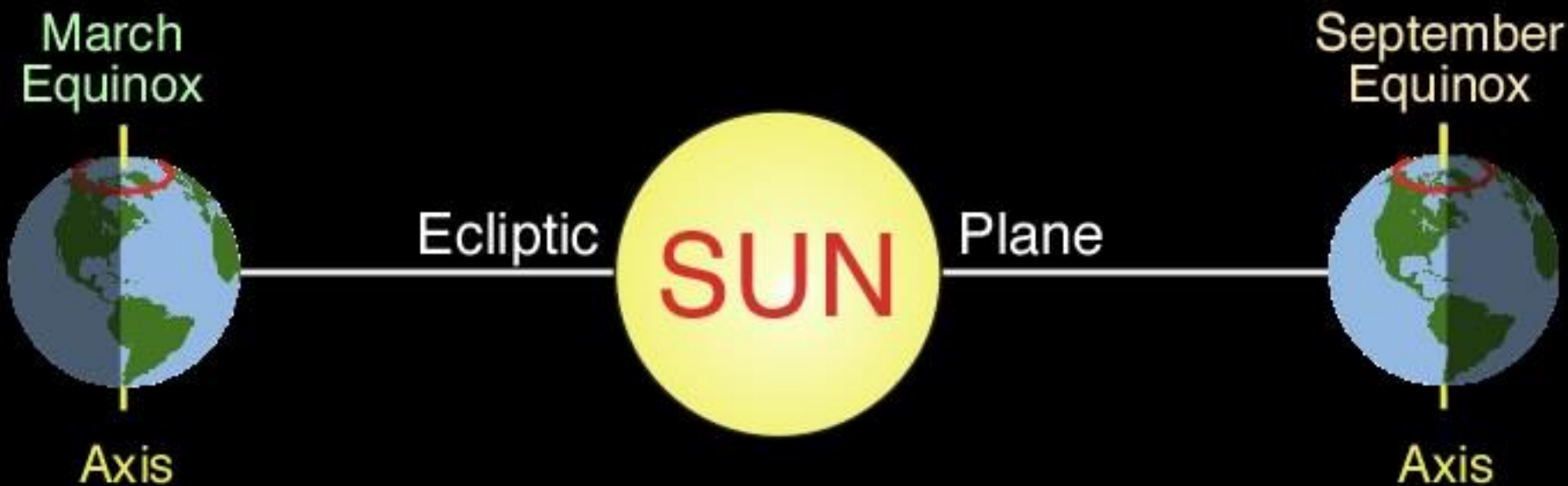
Tropic of Cancer

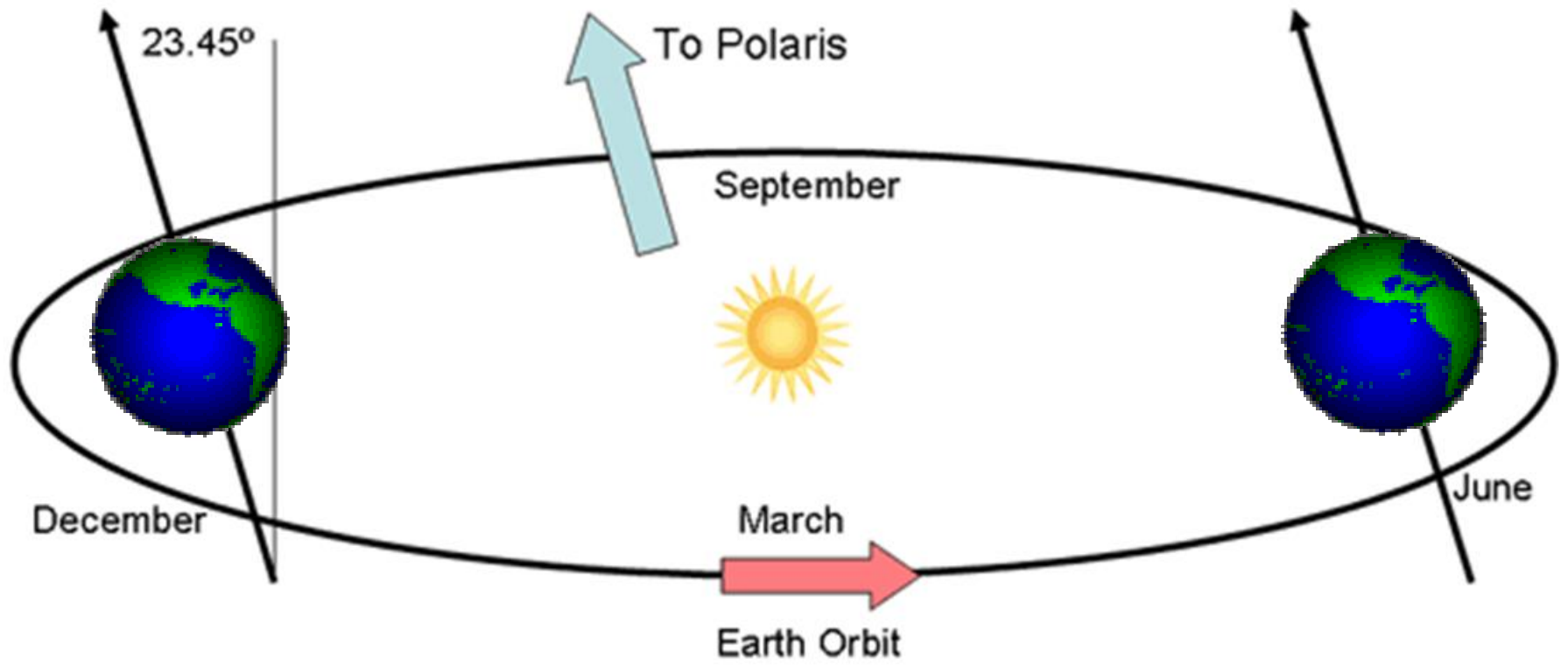
Equator

Tropic of Capricorn

Antarctic Circle

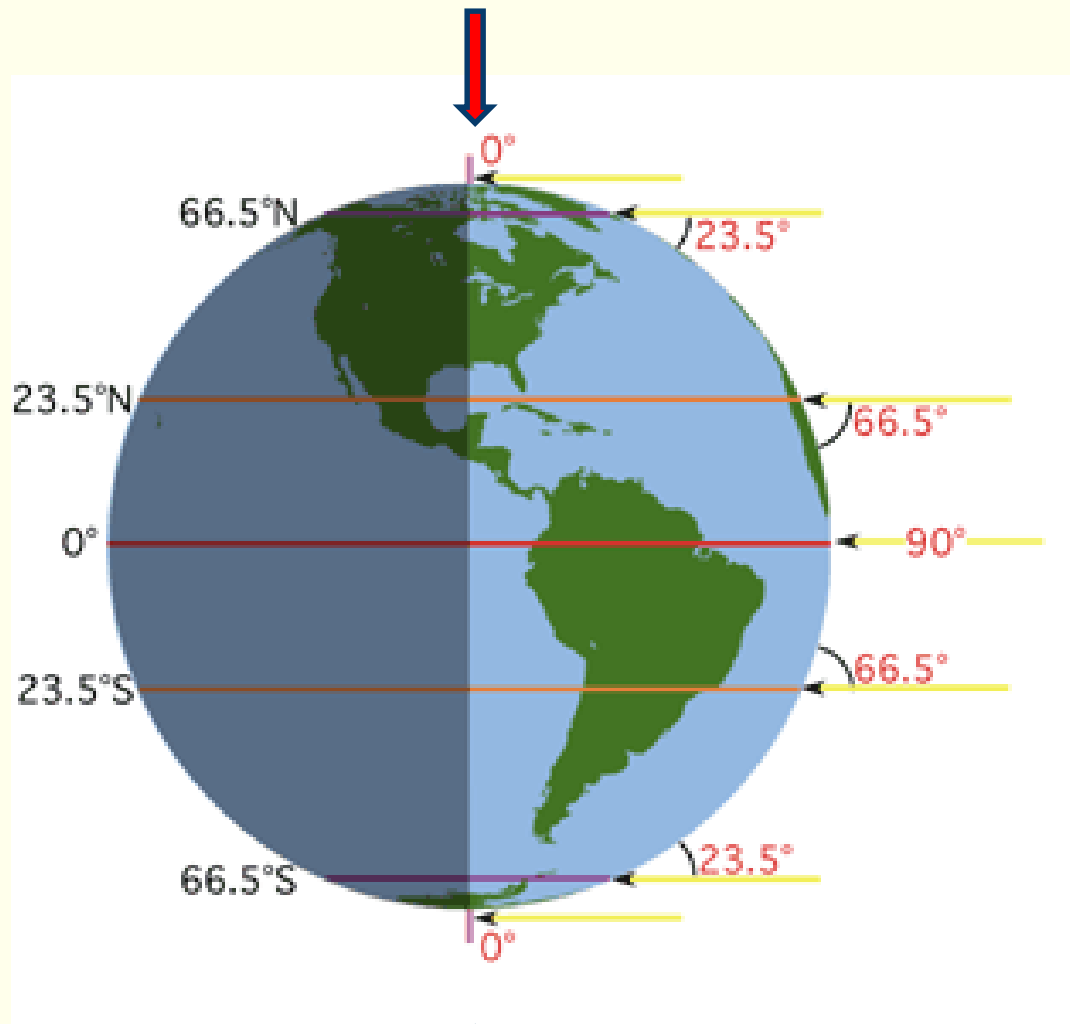
Sun rays



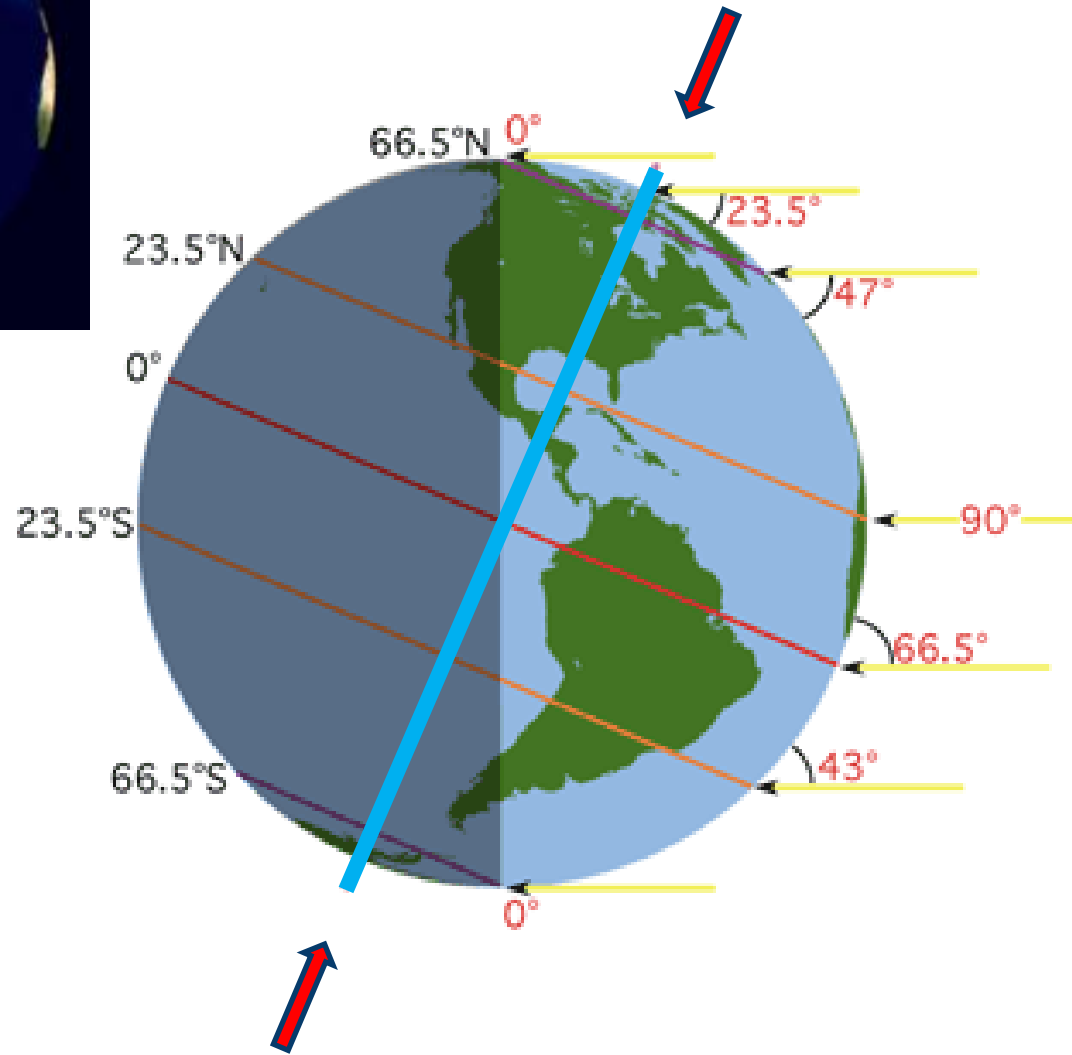






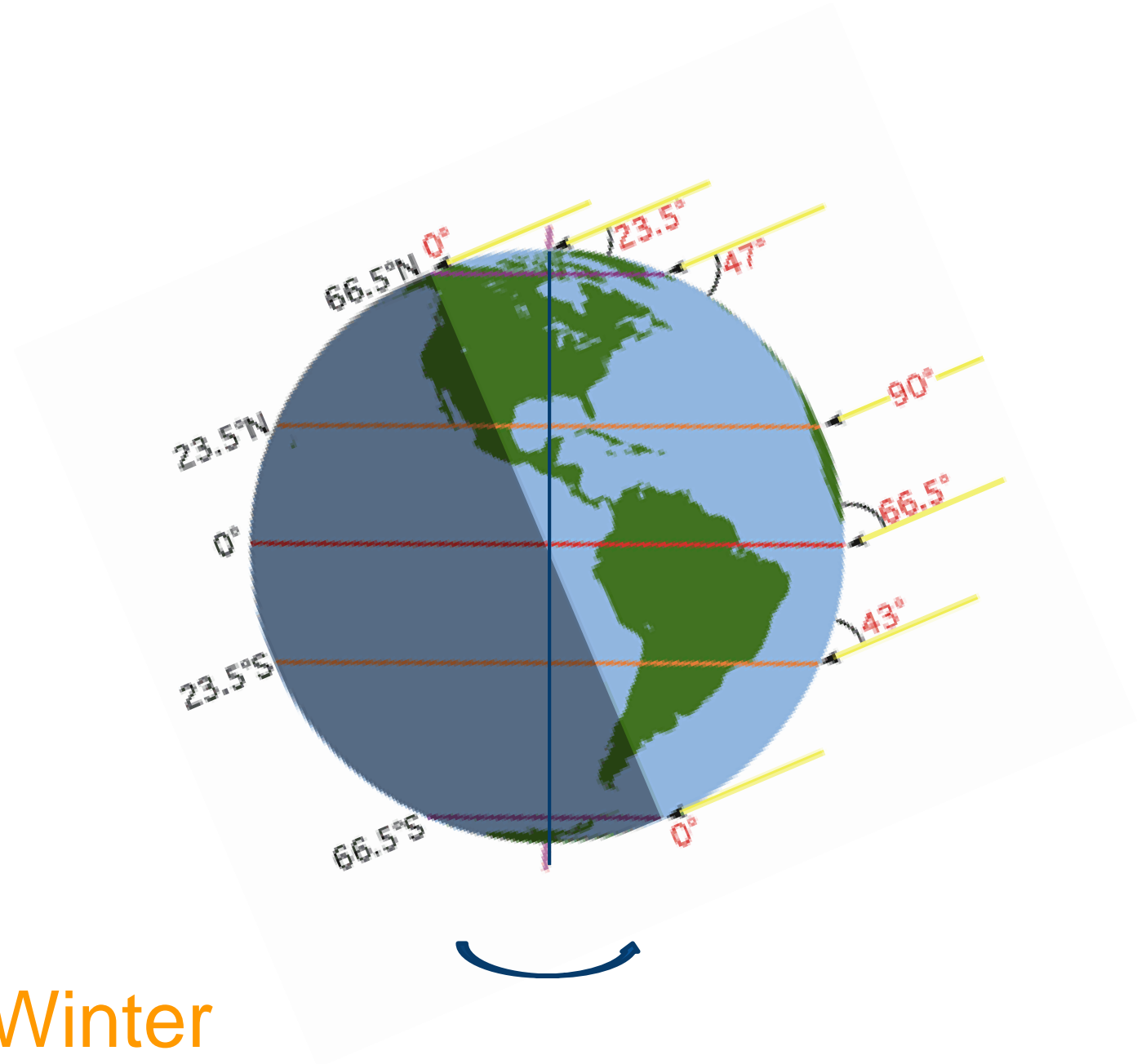


Autumn & Spring 

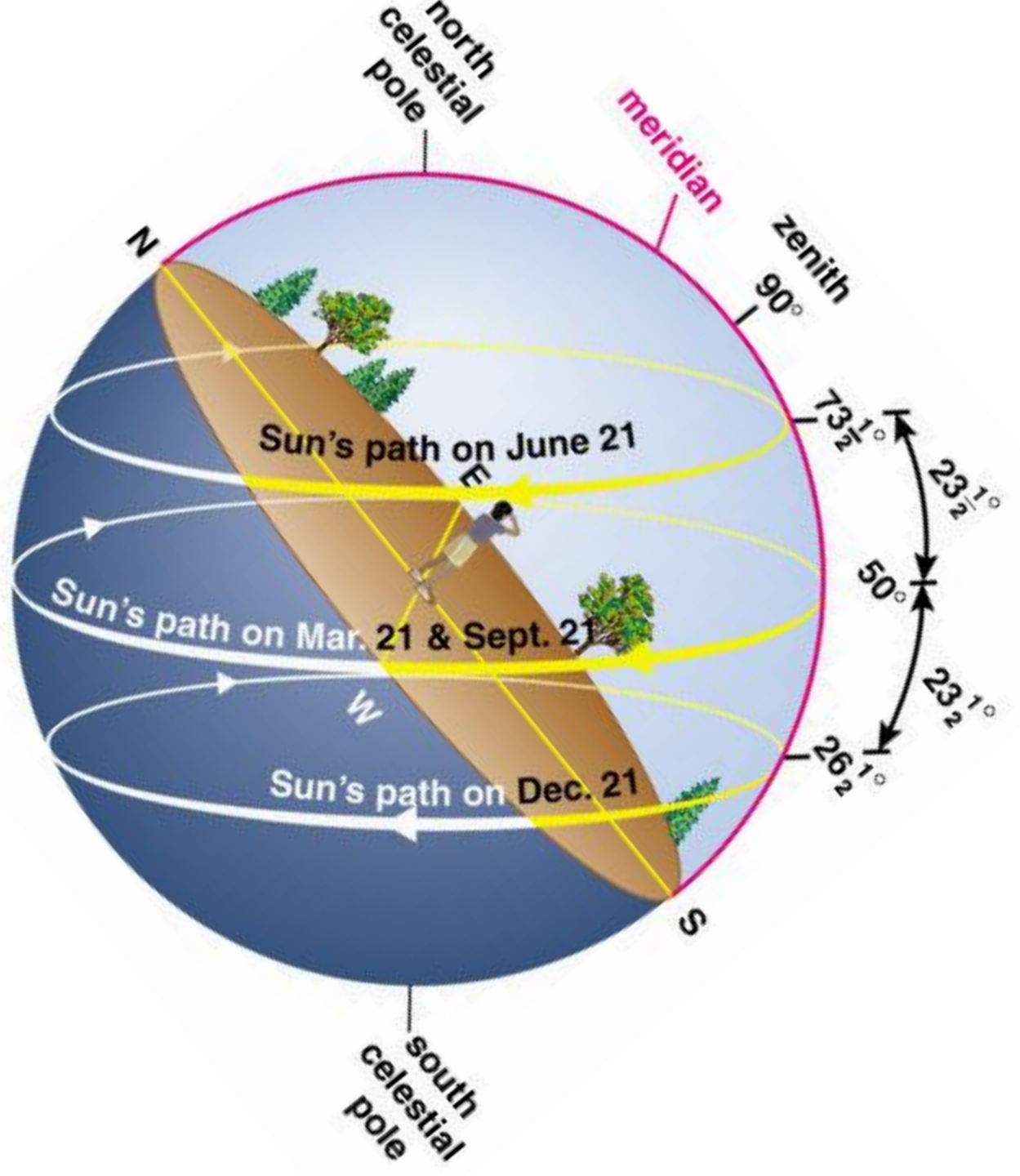


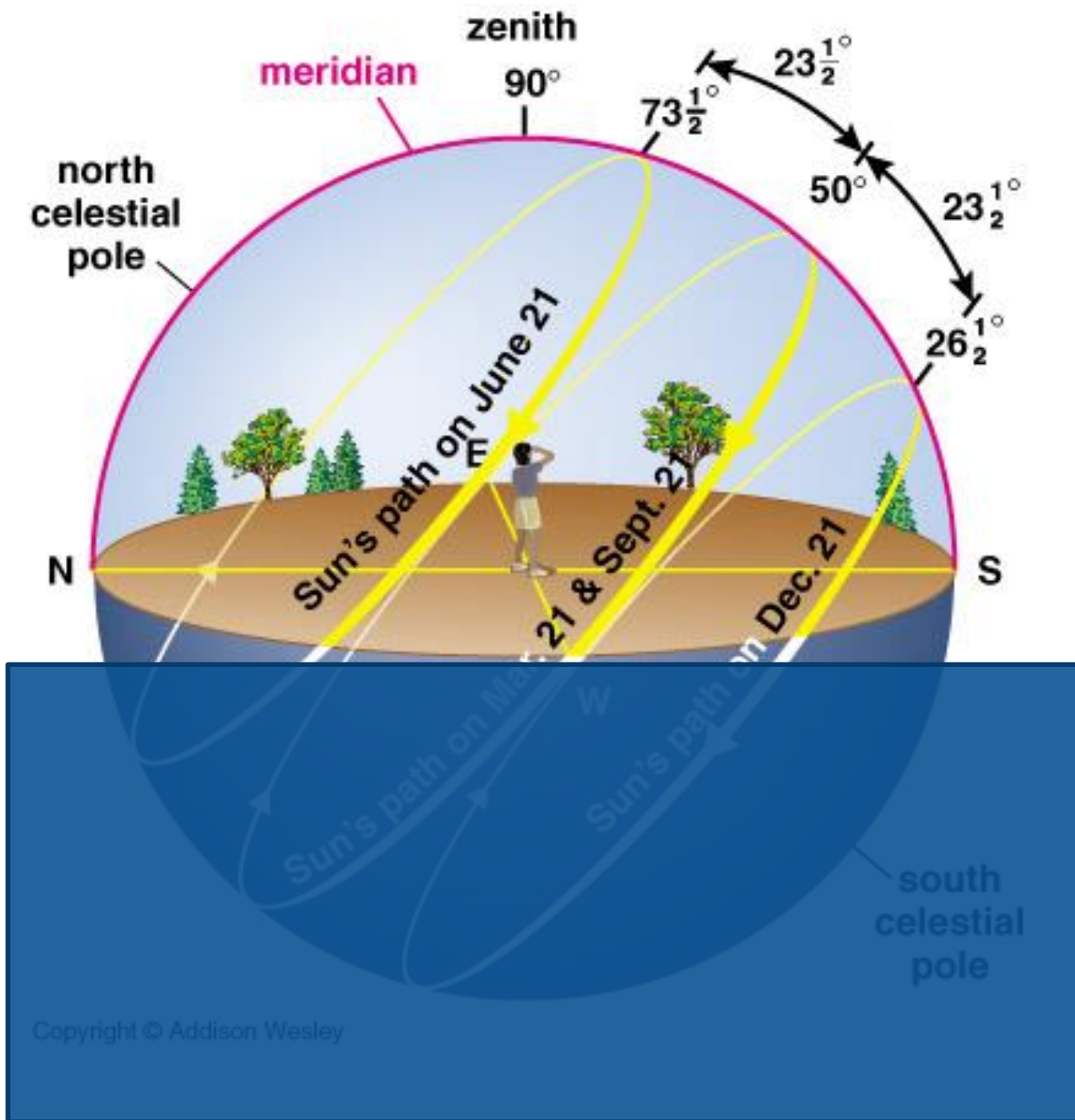
Summer

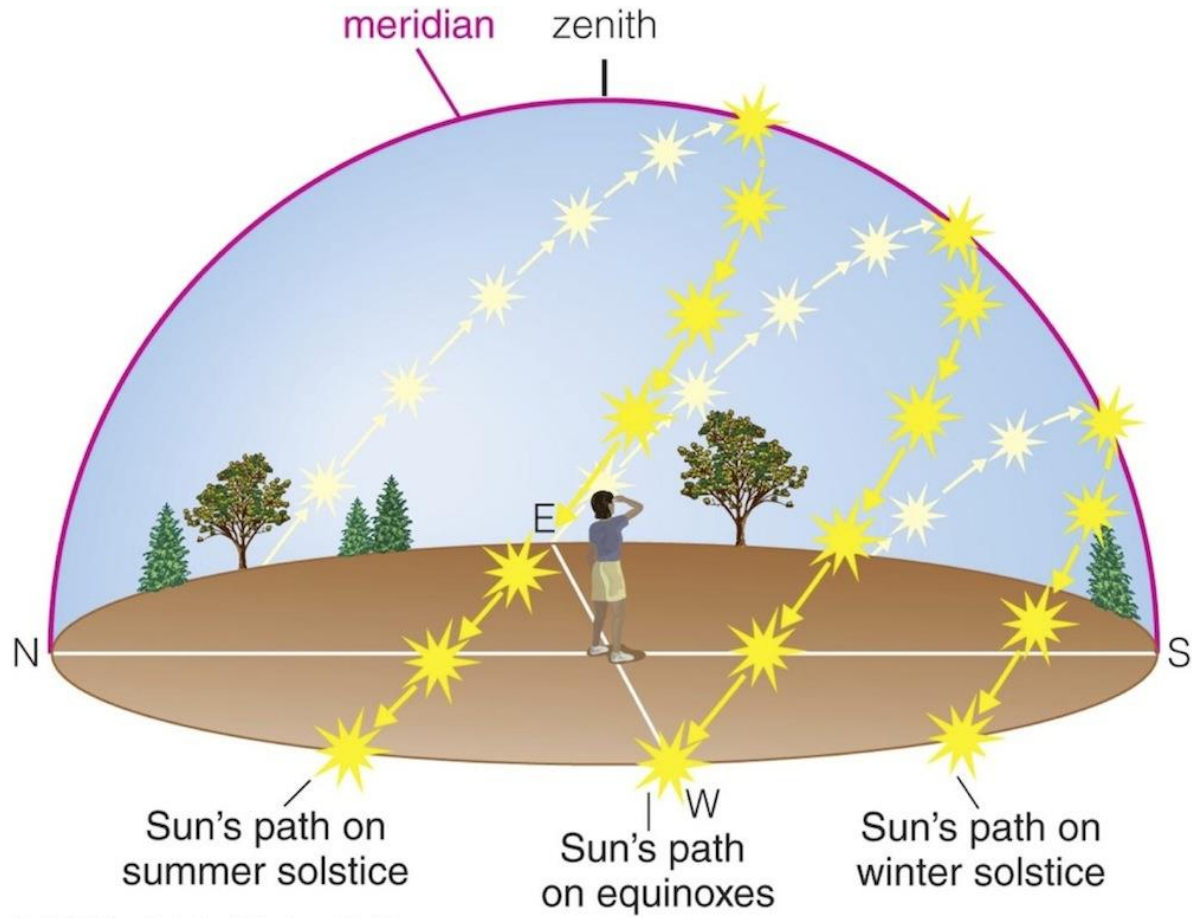
Winter



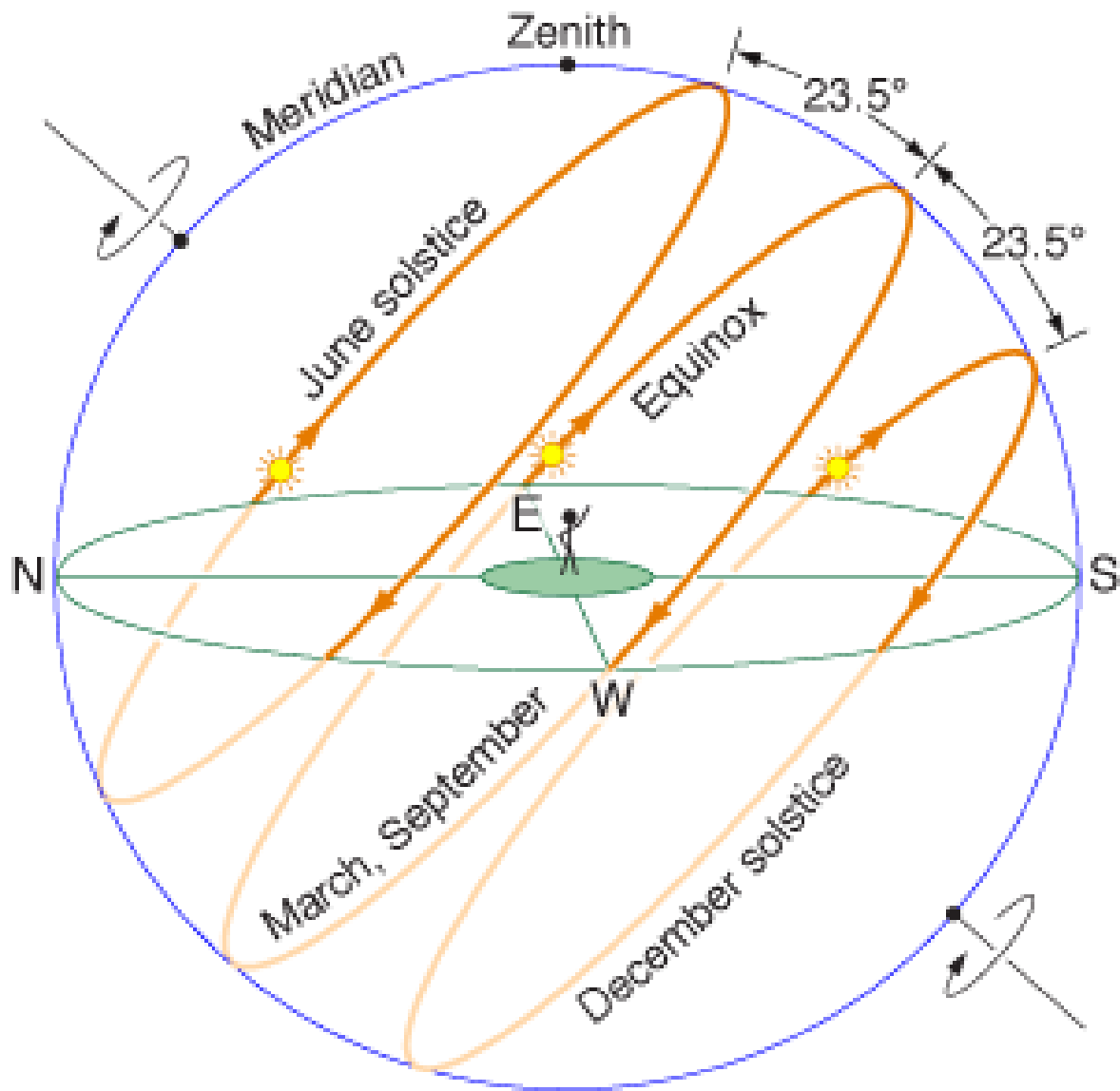
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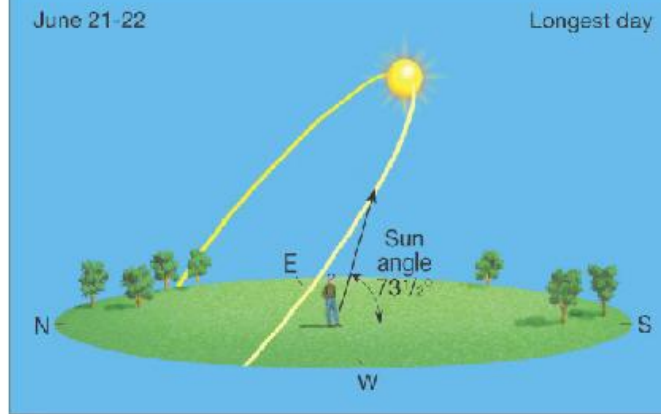




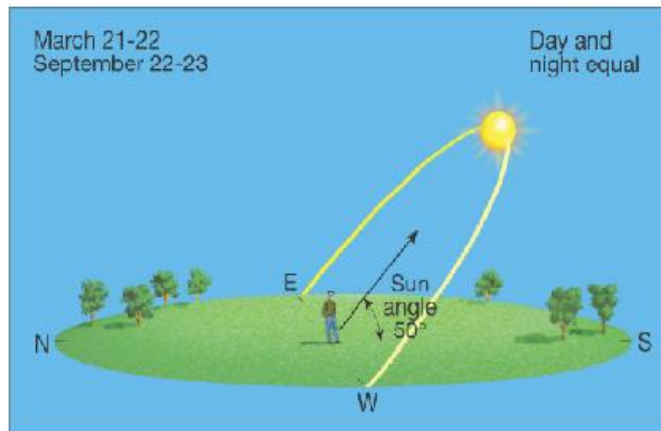


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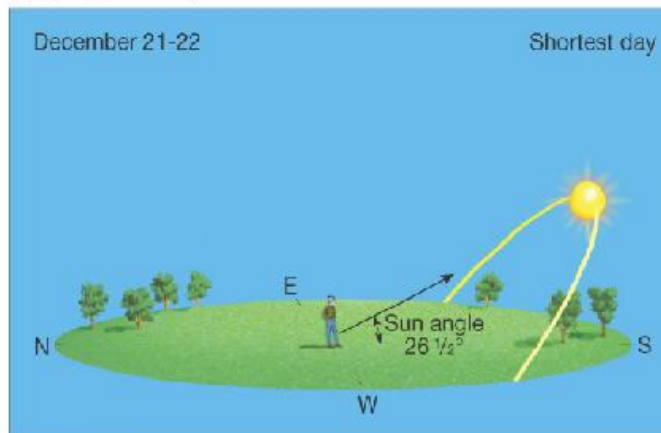




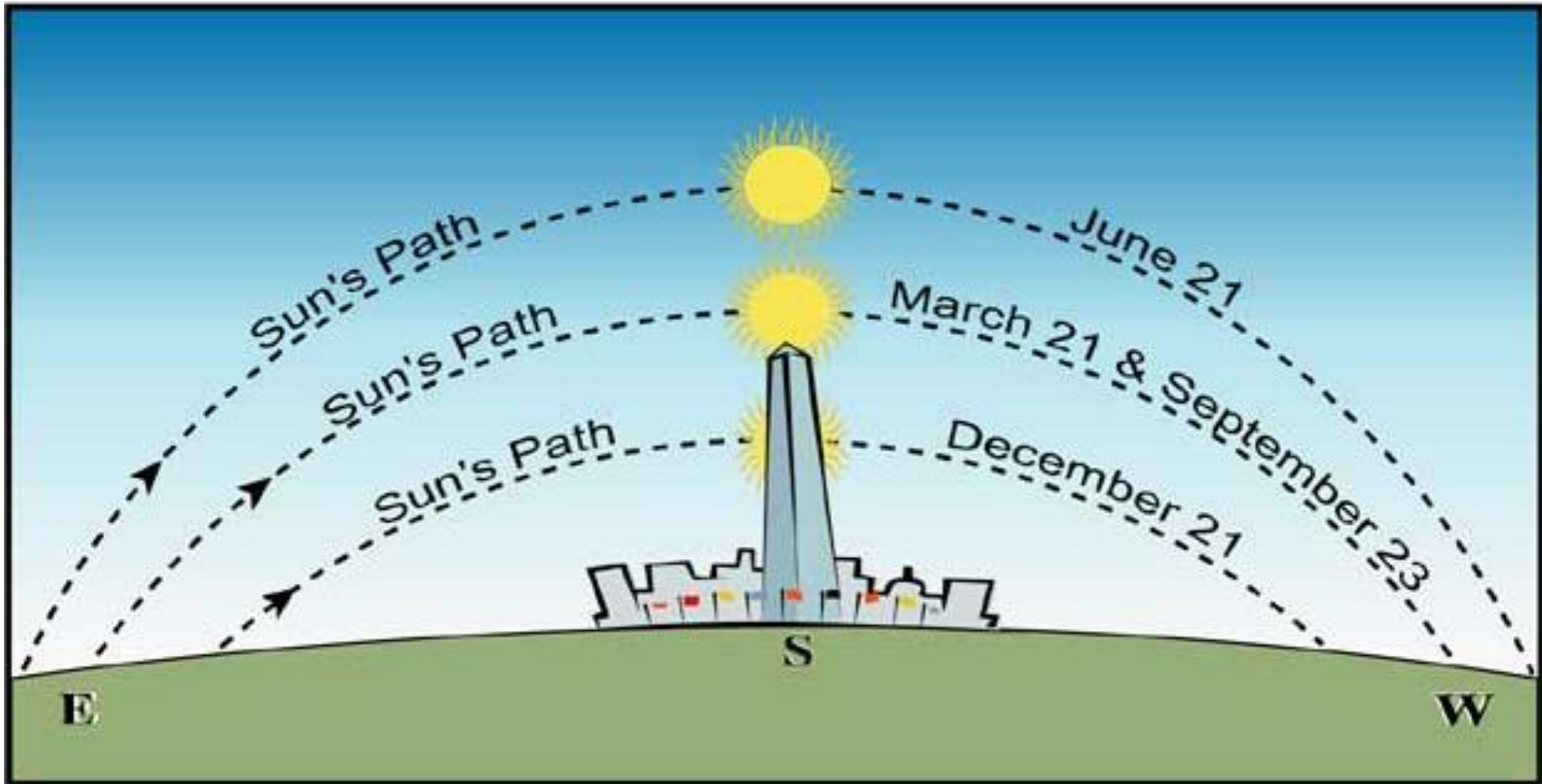
(a) Summer solstice



(b) Spring or fall equinox



(c) Winter solstice



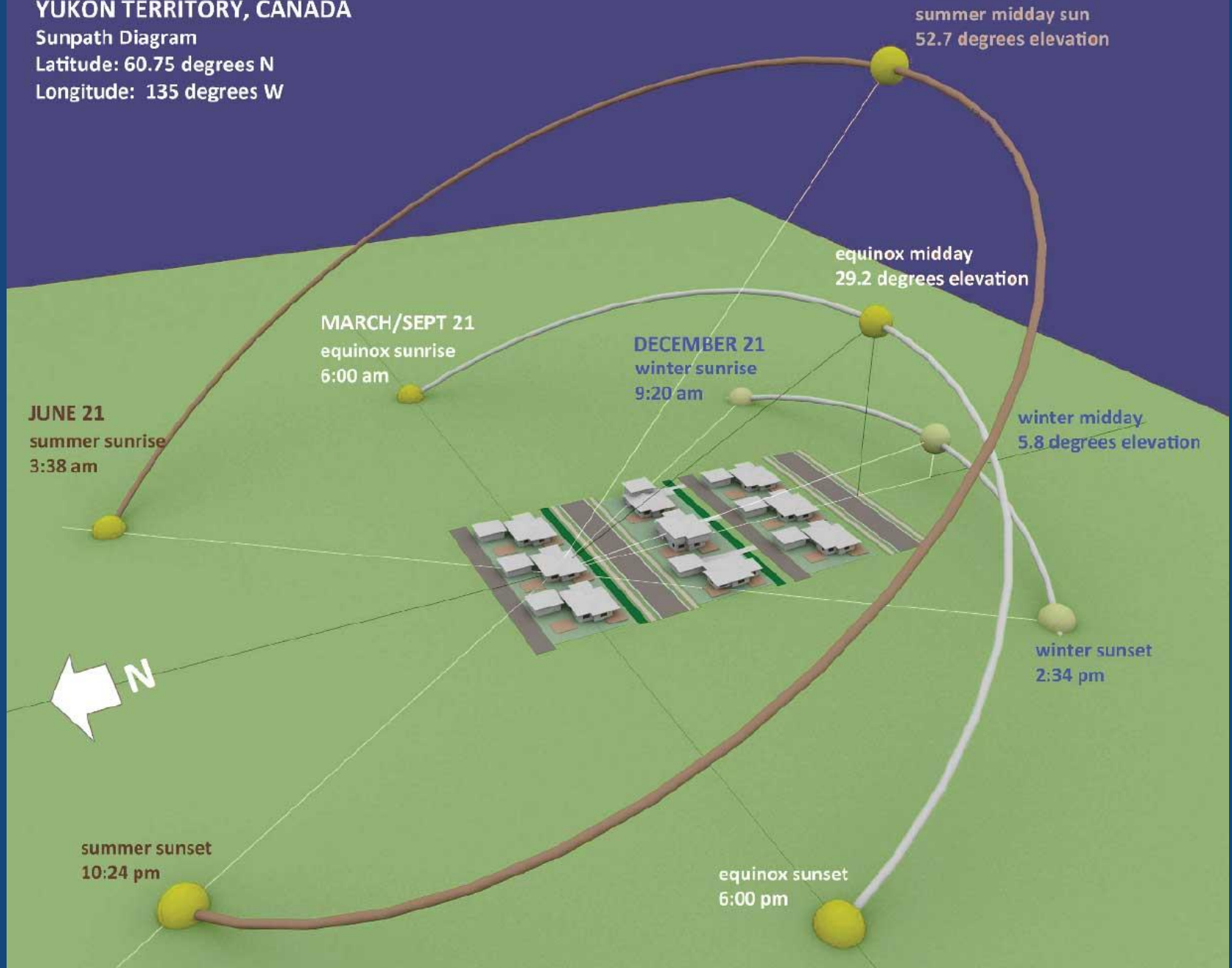
Not to Scale

YUKON TERRITORY, CANADA

Sunpath Diagram

Latitude: 60.75 degrees N

Longitude: 135 degrees W



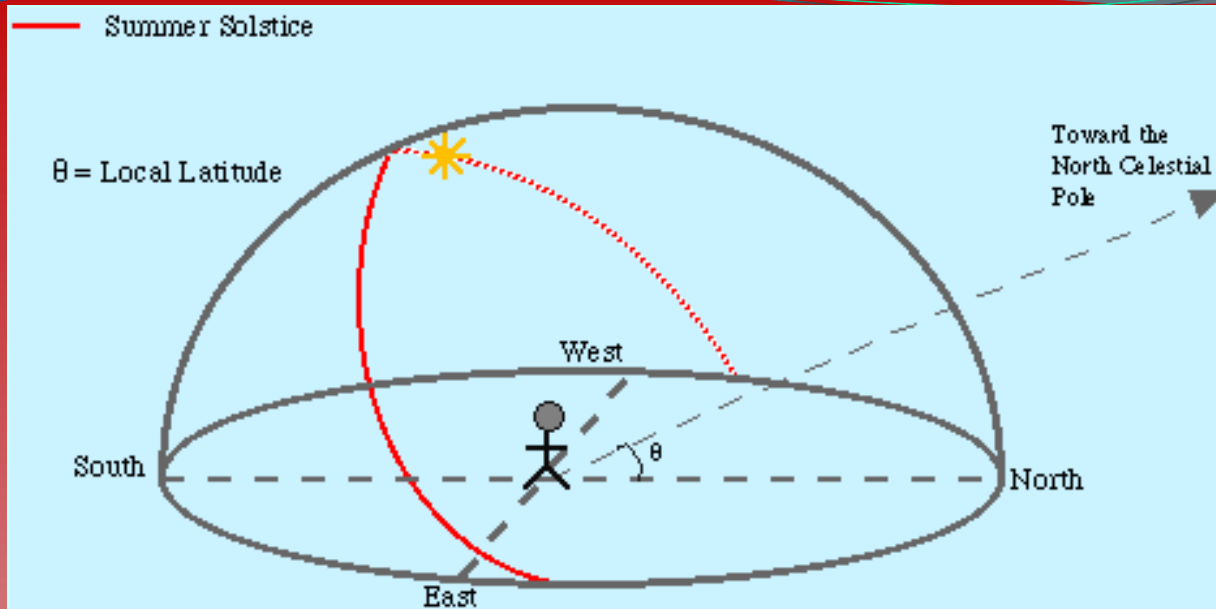


At the northern hemisphere's summer solstice (21 June), the sun's rays make an angle of $23^{\circ} 27'$ to the equatorial plane. The beam is approximately perpendicular to the Tropic of Cancer.

the day length reaches its maximum value on this date.

the solar altitude at noon is at its greatest value for the year.

The Sun in the sky during the Summer



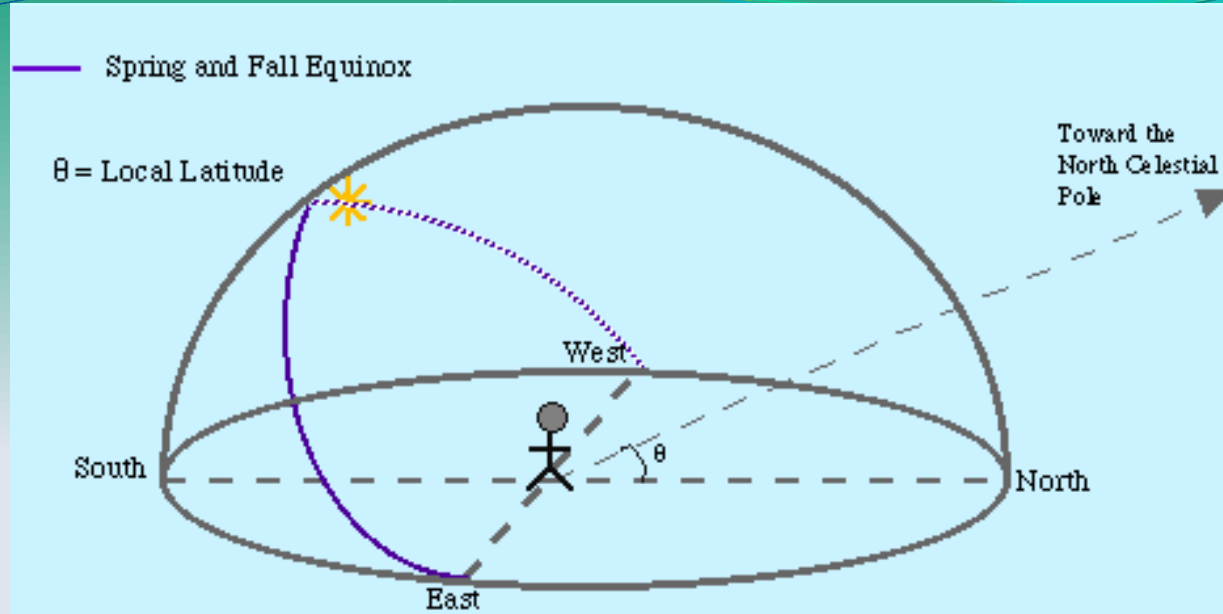
On the **Summer Solstice** the Sun is at its highest path through the sky and the day is the longest (**which occurs on June 21st**). Because the day is so long the Sun does not rise exactly in the east, but rises to the north of east and sets to the north of west allowing it to be in the sky for a longer period of time.

spring and autumn equinoxes

At the northern hemisphere spring and autumn equinoxes (21 March and 24 September), the sun's rays are perpendicular to the equator.

The day and night lengths are almost equal everywhere in the world.

The Sun in the sky during the Spring Equinox



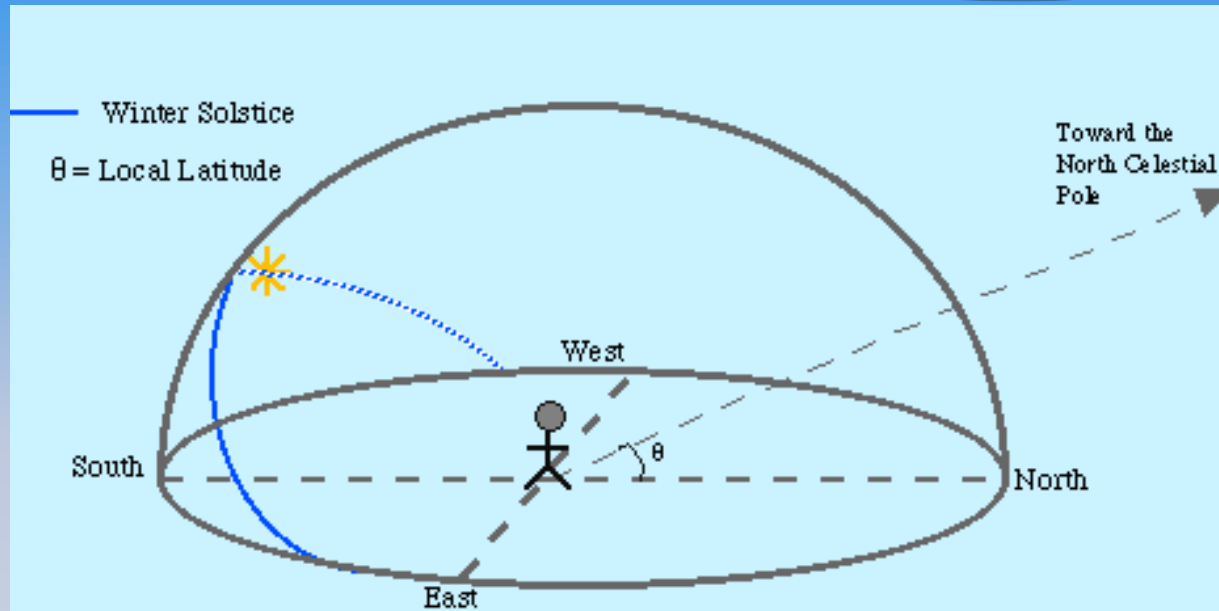
On the spring and autumn equinoxes (21 March and 24 September) the Sun rises exactly in the east travels through the sky for 12 hours and sets exactly in the west.

Winter

At winter solstice (21 December), the sun's rays make an angle of $-23^{\circ} 27'$ to the equatorial plane. The beam radiation is approximately perpendicular to the Tropic of Capricorn.

The days are at their shortest and the solar altitude at noon has its lowest values.

The Sun in the sky during the Winter



In the winter the days are short and the Sun is low in the sky. The winter solstice (which occurs on December 21st). This is the day when the Sun is the lowest in the southern sky.

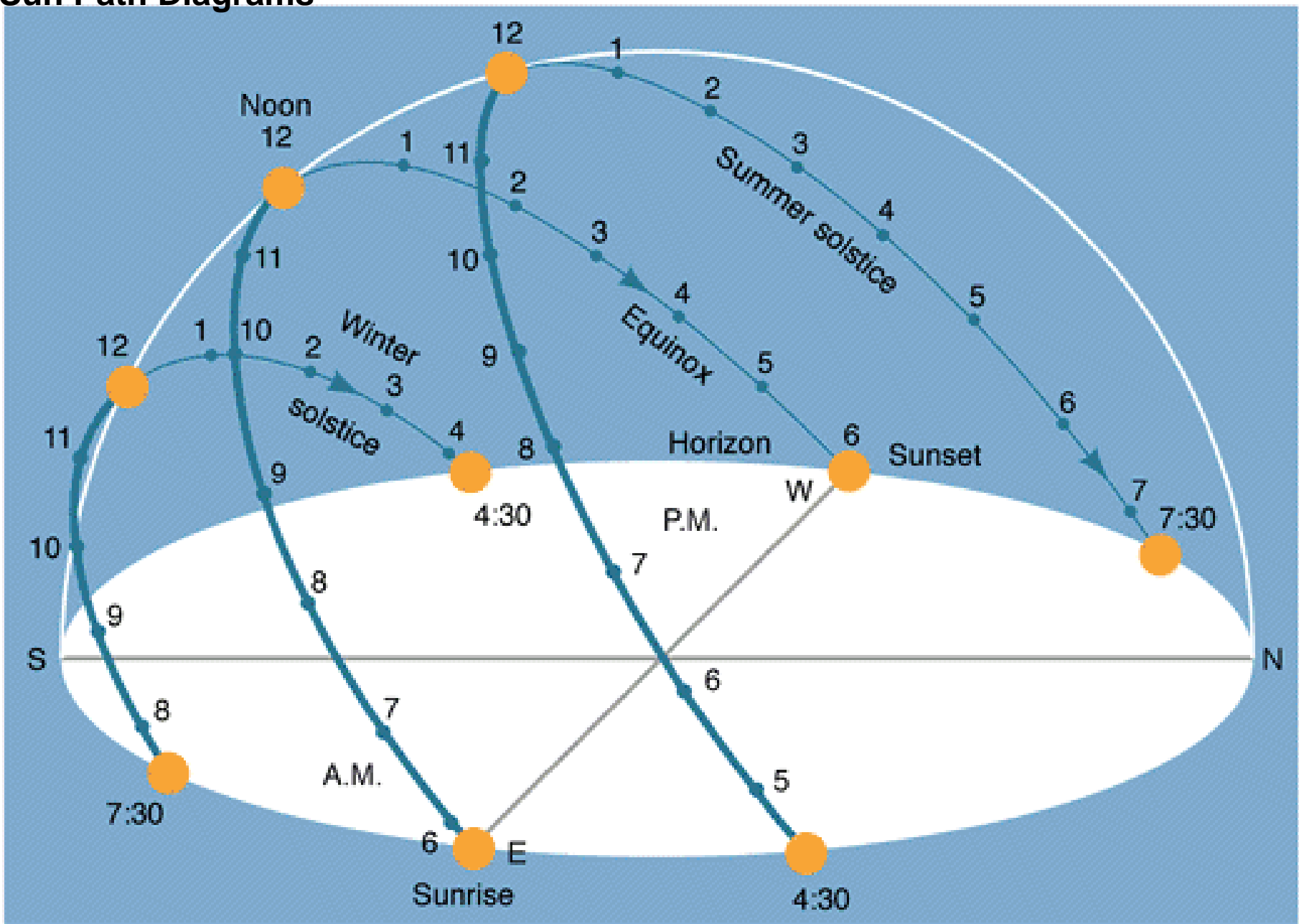
During the short winter days the Sun does not rise exactly in the east, but instead rises just south of east and it sets south of west.



Summer

Winter

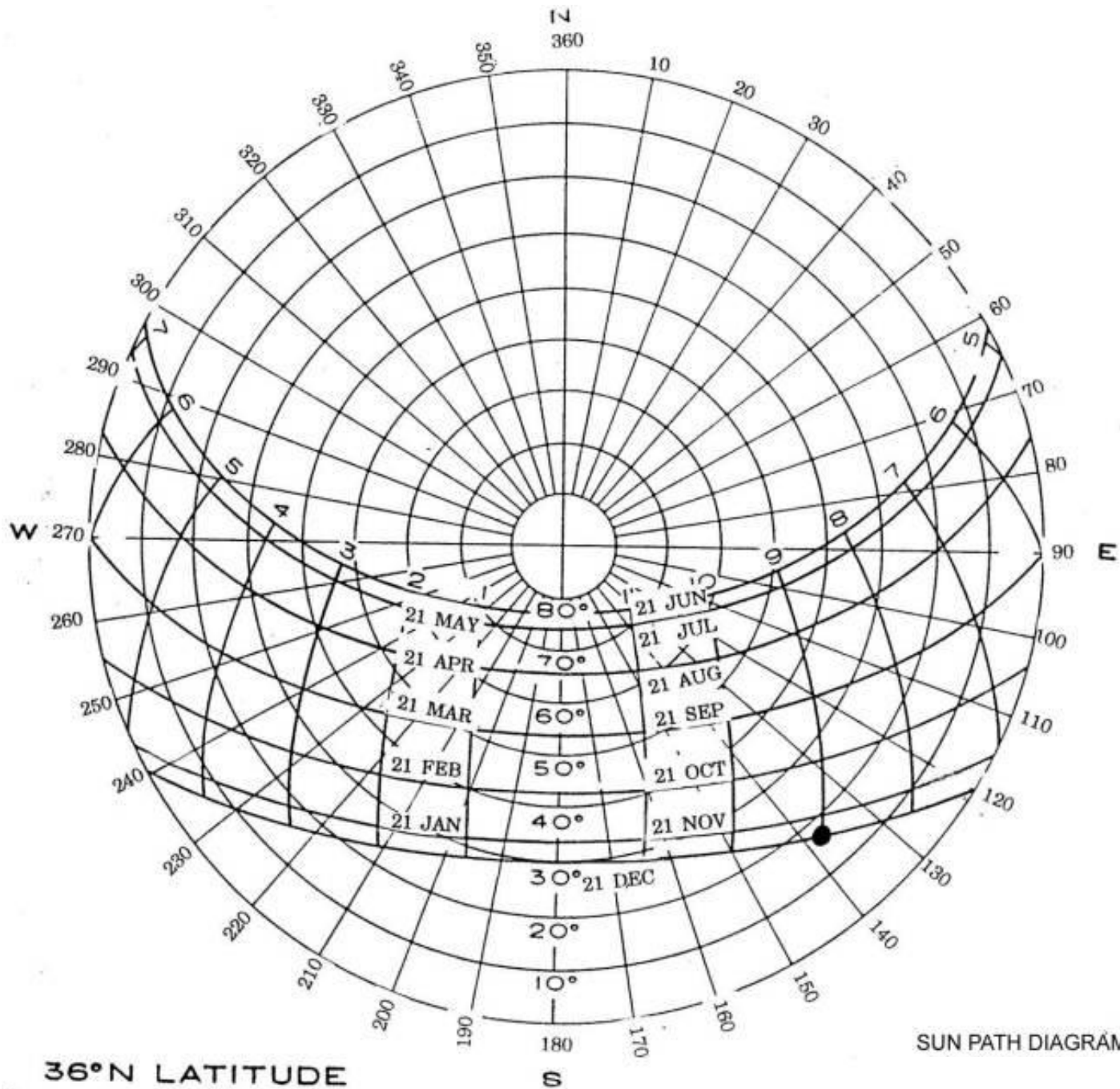
Sun Path Diagrams



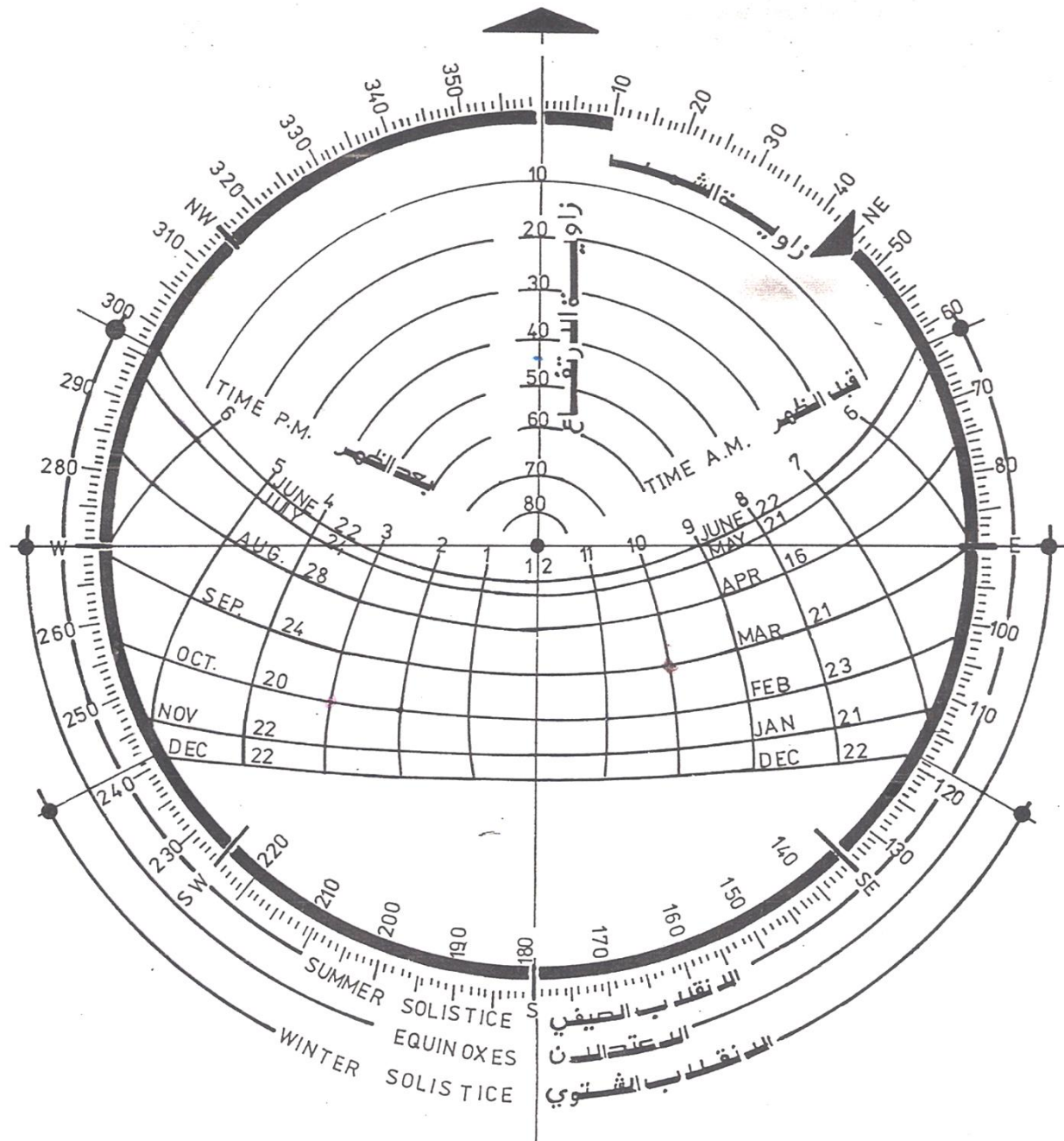
Sun Path Diagrams

There are several methods of projections to present the apparent movement of the sun on the sky hemisphere.

By using any of these projection methods, the apparent three-dimensional movement of the sun can be represented on a two dimensional chart which is called **SOLAR CHARTS** or **SUN PATH DIAGRAM**



SUN PATH DIAGRAM

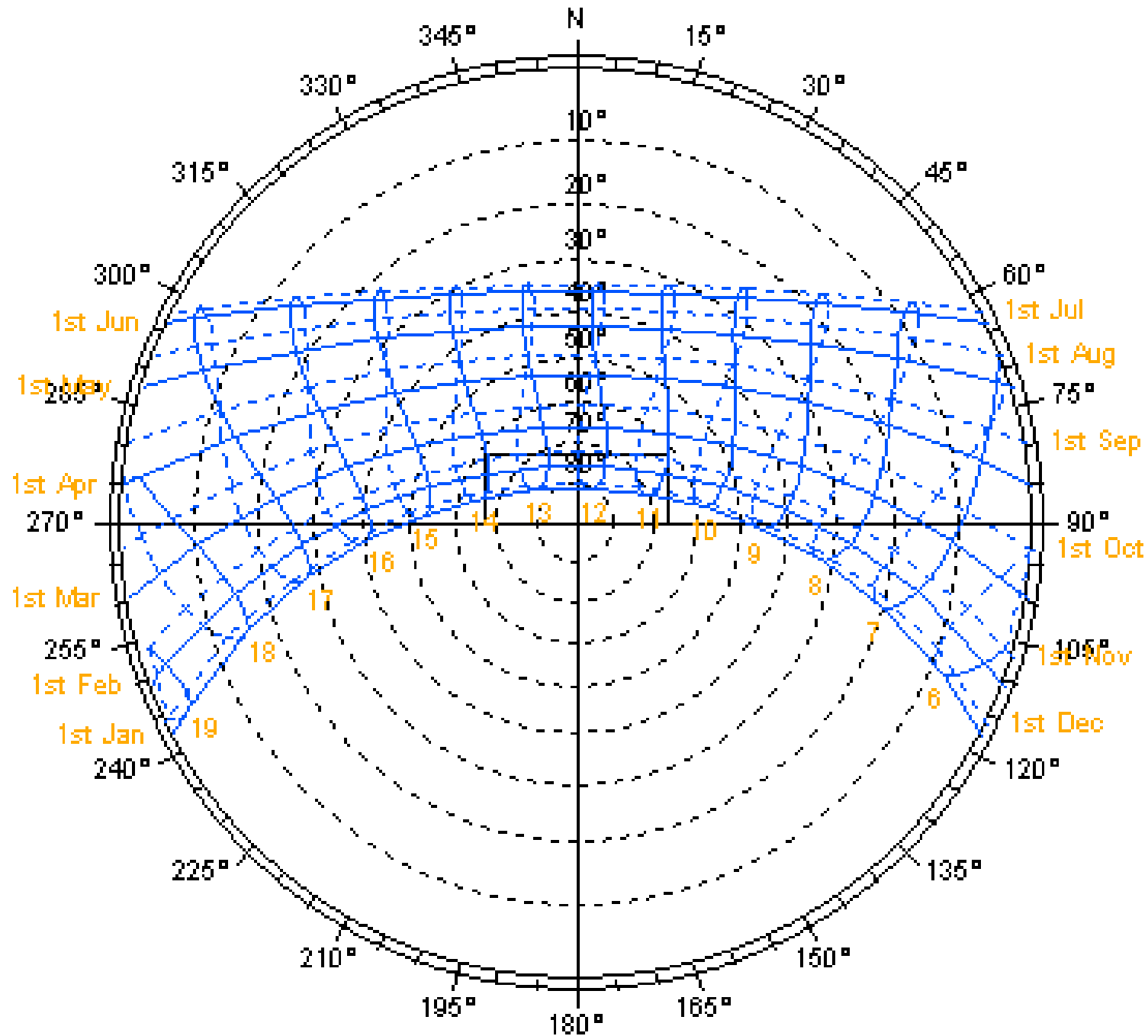


The solar altitude and azimuth over the year can be plotted on a solar chart. The **altitude** scale is shown on a series of concentric circles. The **azimuth** scale is set around the perimeter of the chart.

The azimuth angle is read by setting a straight edge from the center of the chart to the intersection of the required hour and date path lines and noting where it cuts the chart perimeter. Different charts are required for different latitudes.

In Baghdad, at a latitude of 33°N , the sun's path is 240° wide at the **summer solstice** and the maximum solar altitude is 83° .

At the **winter solstice**, the sun's path is 120° wide and the maximum solar altitude is 33° .



Make sure your diagram represents the right latitude...