

# Discovering the Universe for Yourself



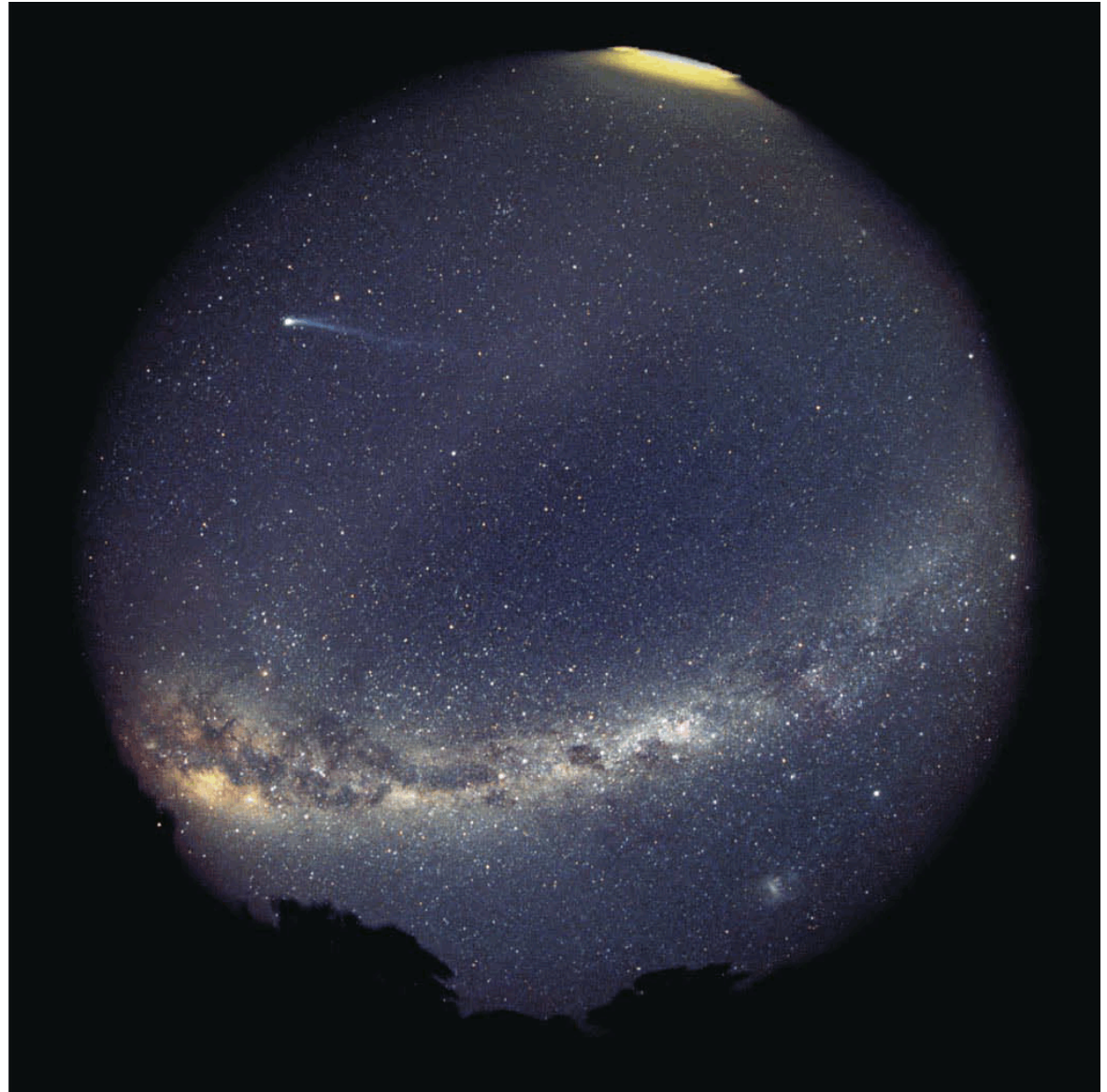
## 2.1 Patterns in the Night Sky

- Our goals for learning:
  - **What does the universe look like from Earth?**
  - **Why do stars rise and set?**
  - **Why do the constellations we see depend on latitude and time of year?**



# What does the universe look like from Earth?

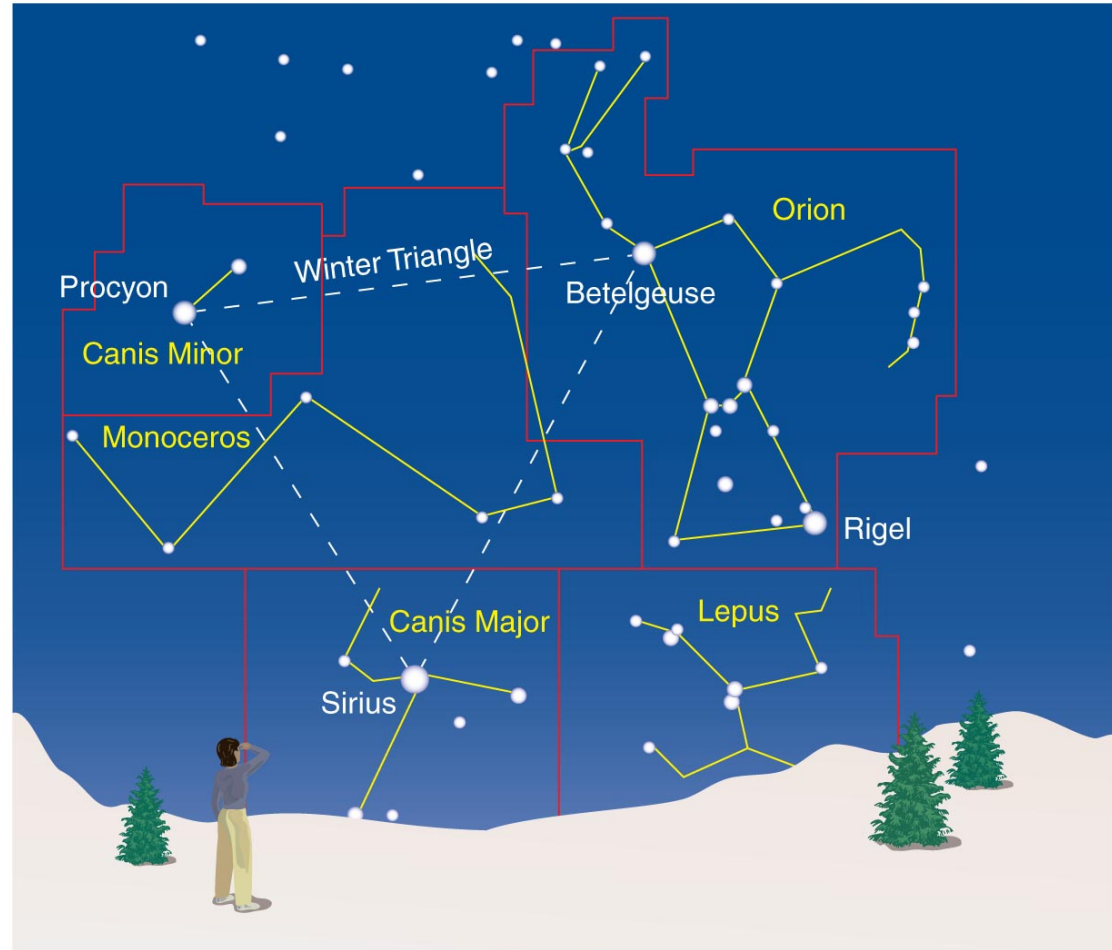
With the naked eye, we can see more than 2,000 stars as well as the Milky Way.



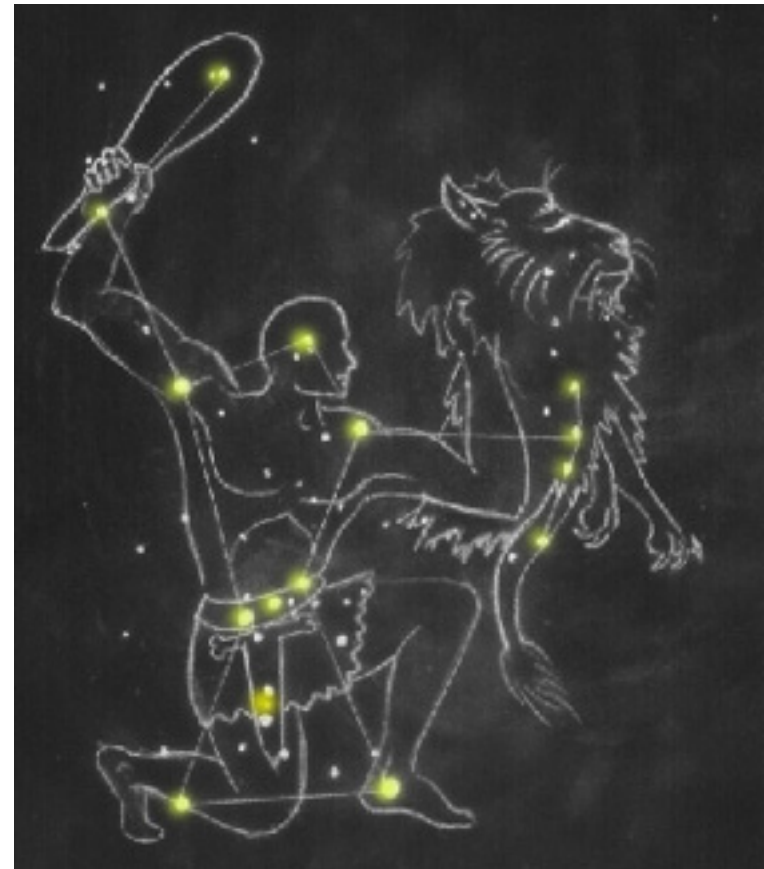
# Constellations

A constellation is a *region* of the sky.

Eighty-eight constellations fill the entire sky.

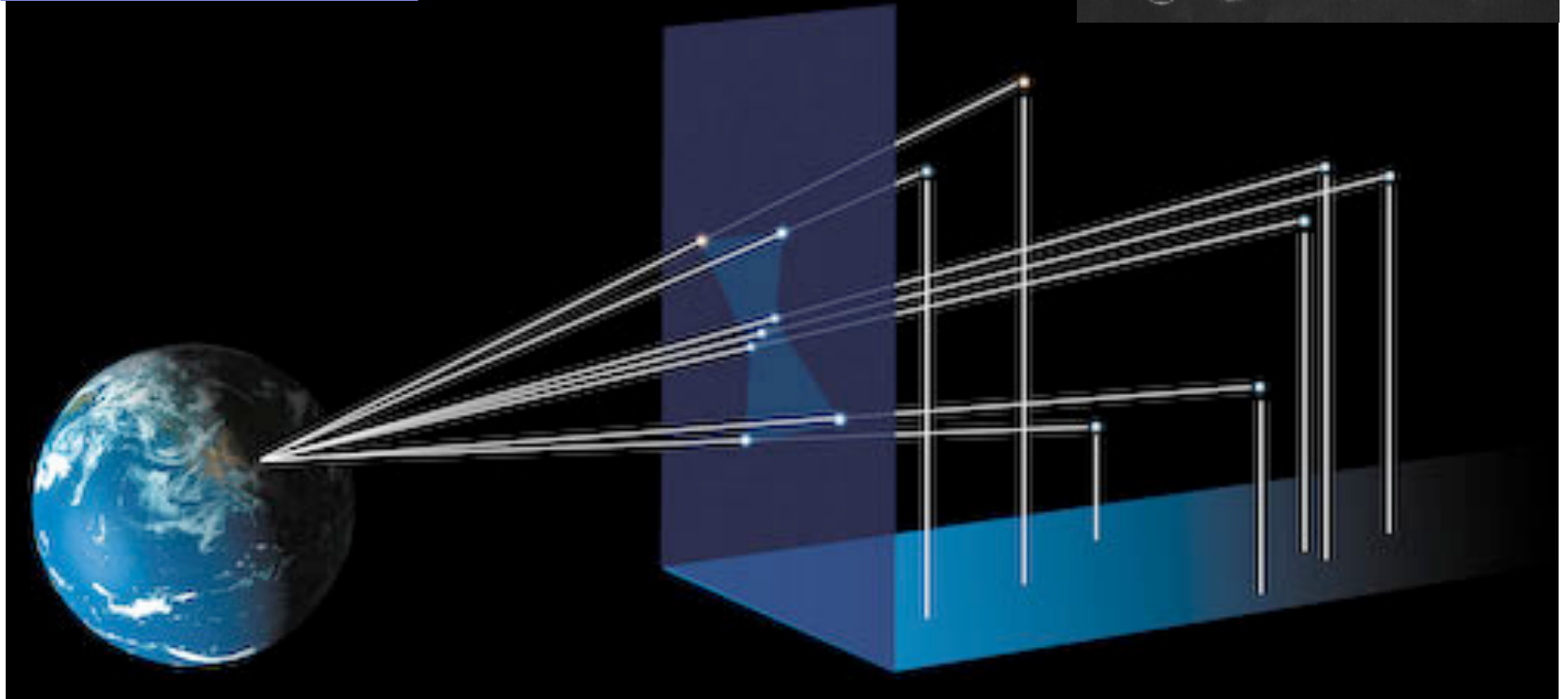
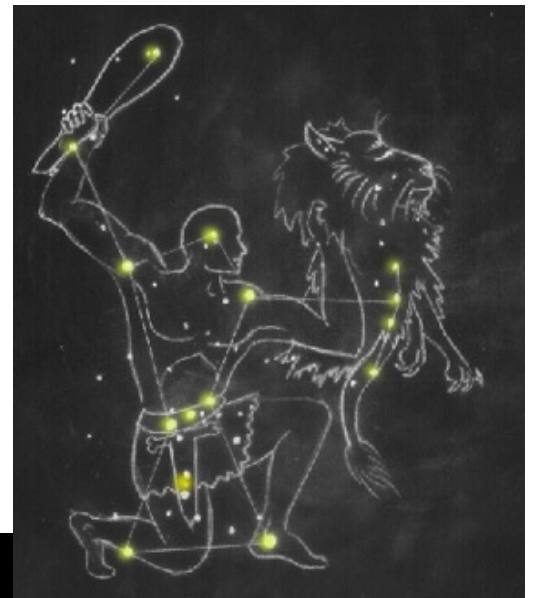


# Orion



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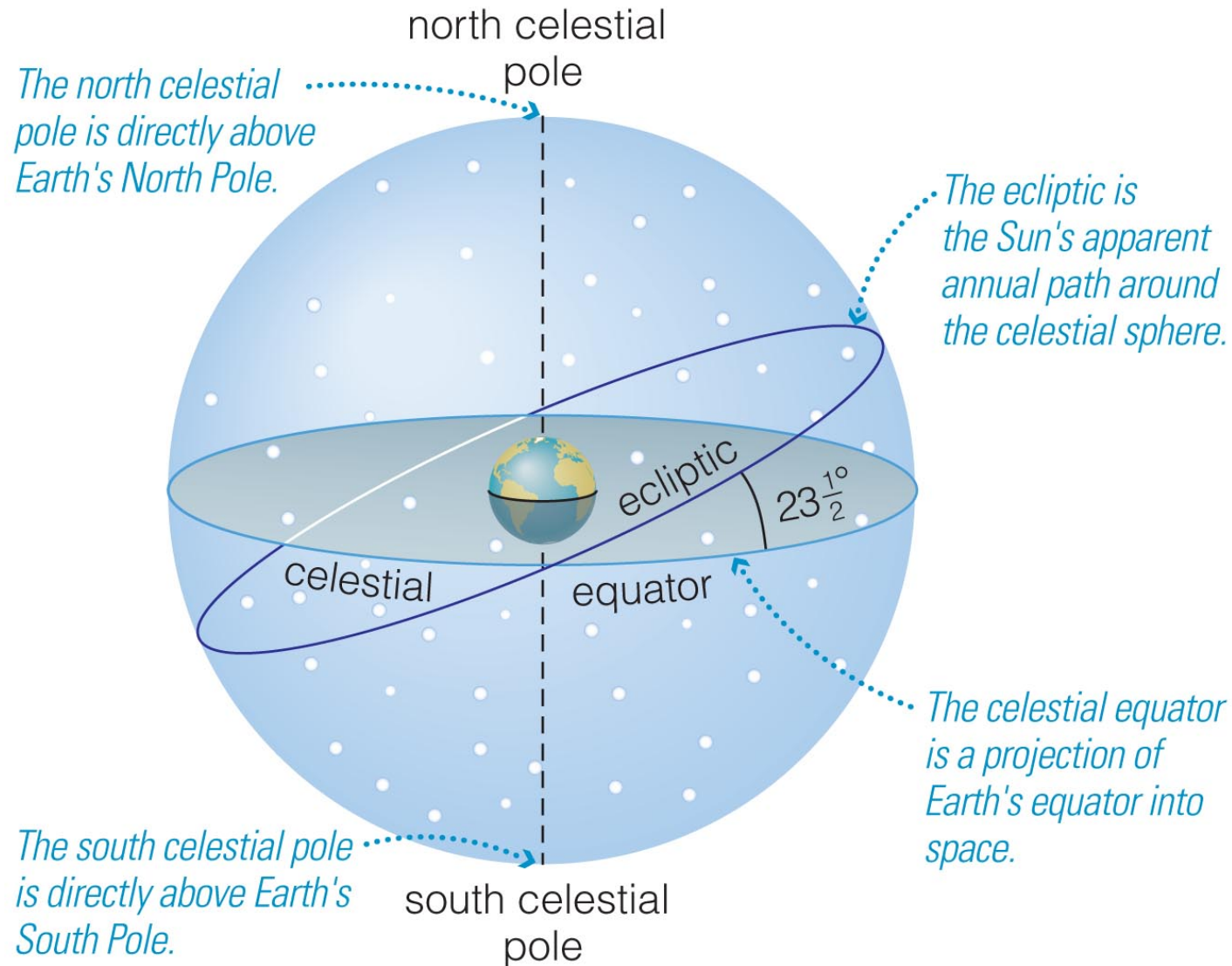
# The Celestial Sphere



Stars at different distances all appear to lie on the celestial sphere.

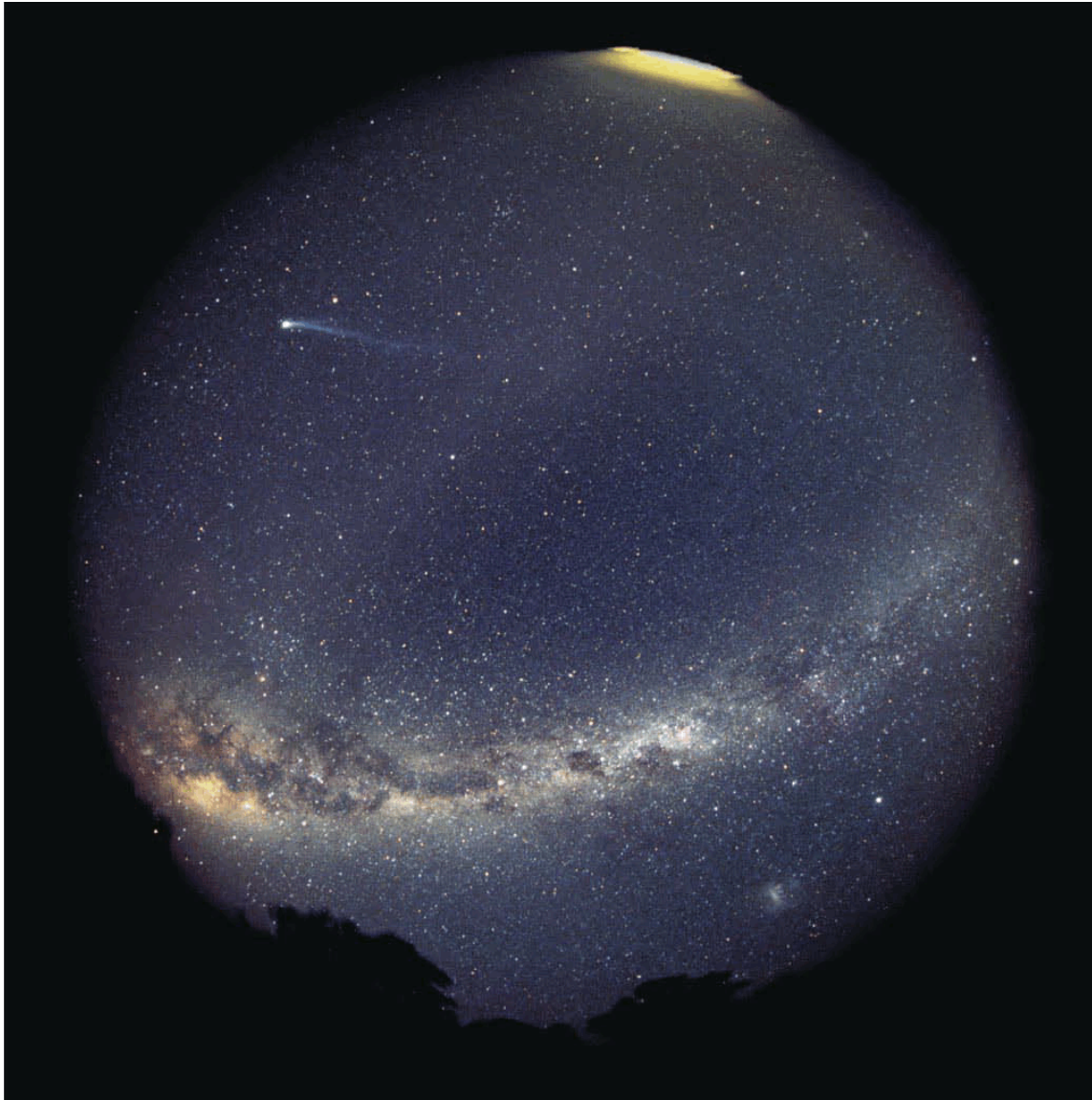
The 88 official constellations cover the celestial sphere.

# The Celestial Sphere





# The Milky Way

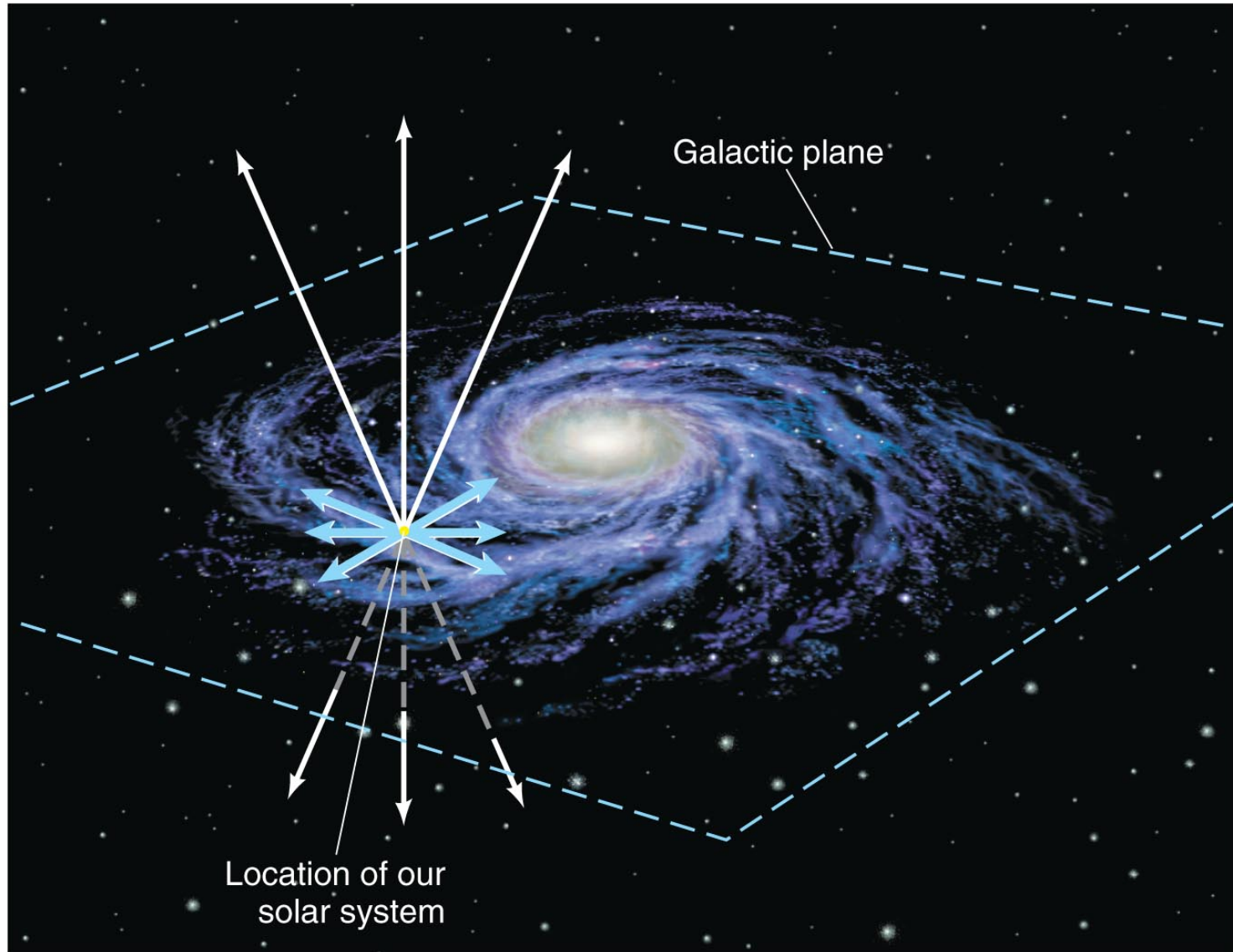


A band of light making a circle around the celestial sphere.

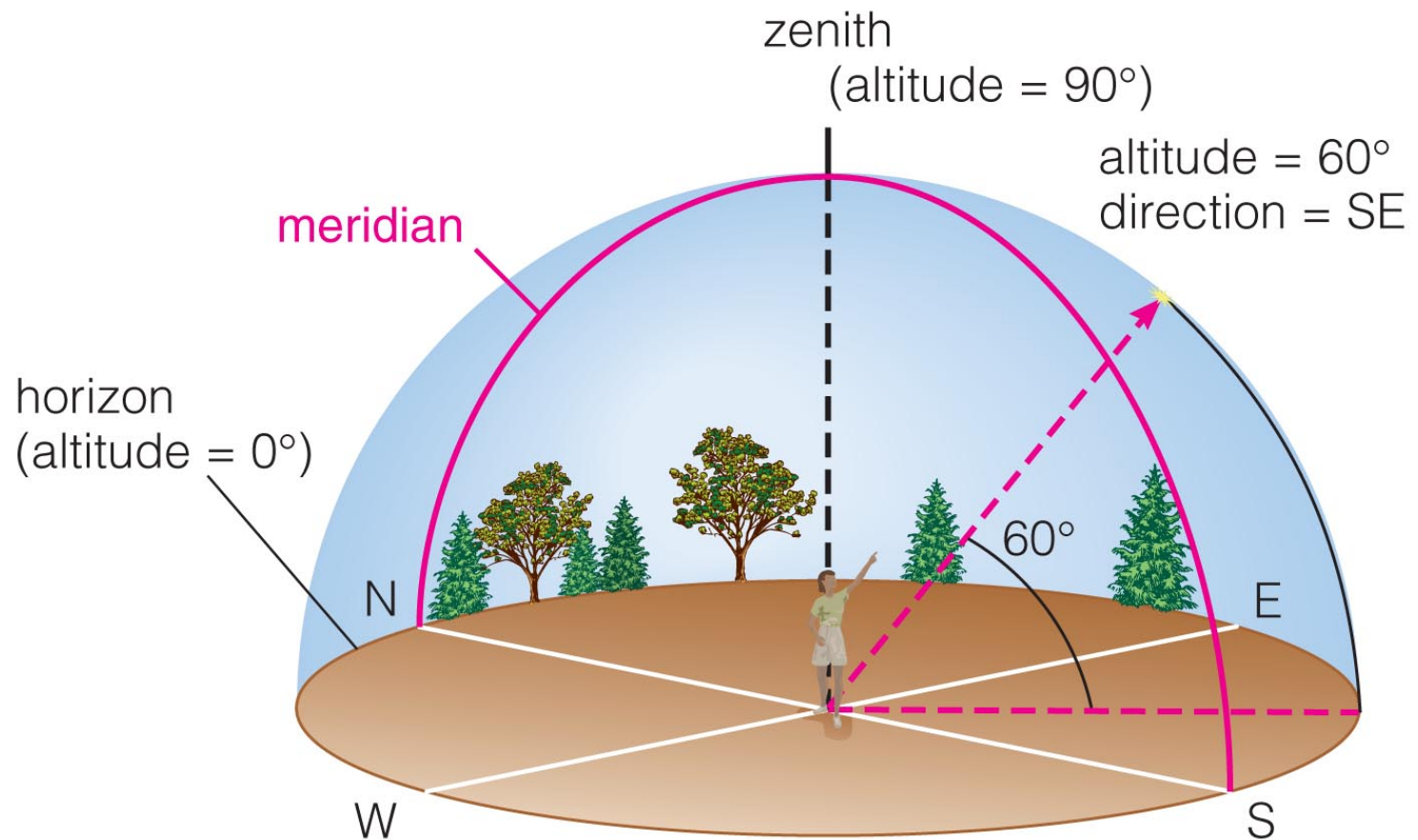
**What is it?**

Our view into the plane of our galaxy.

# The Milky Way



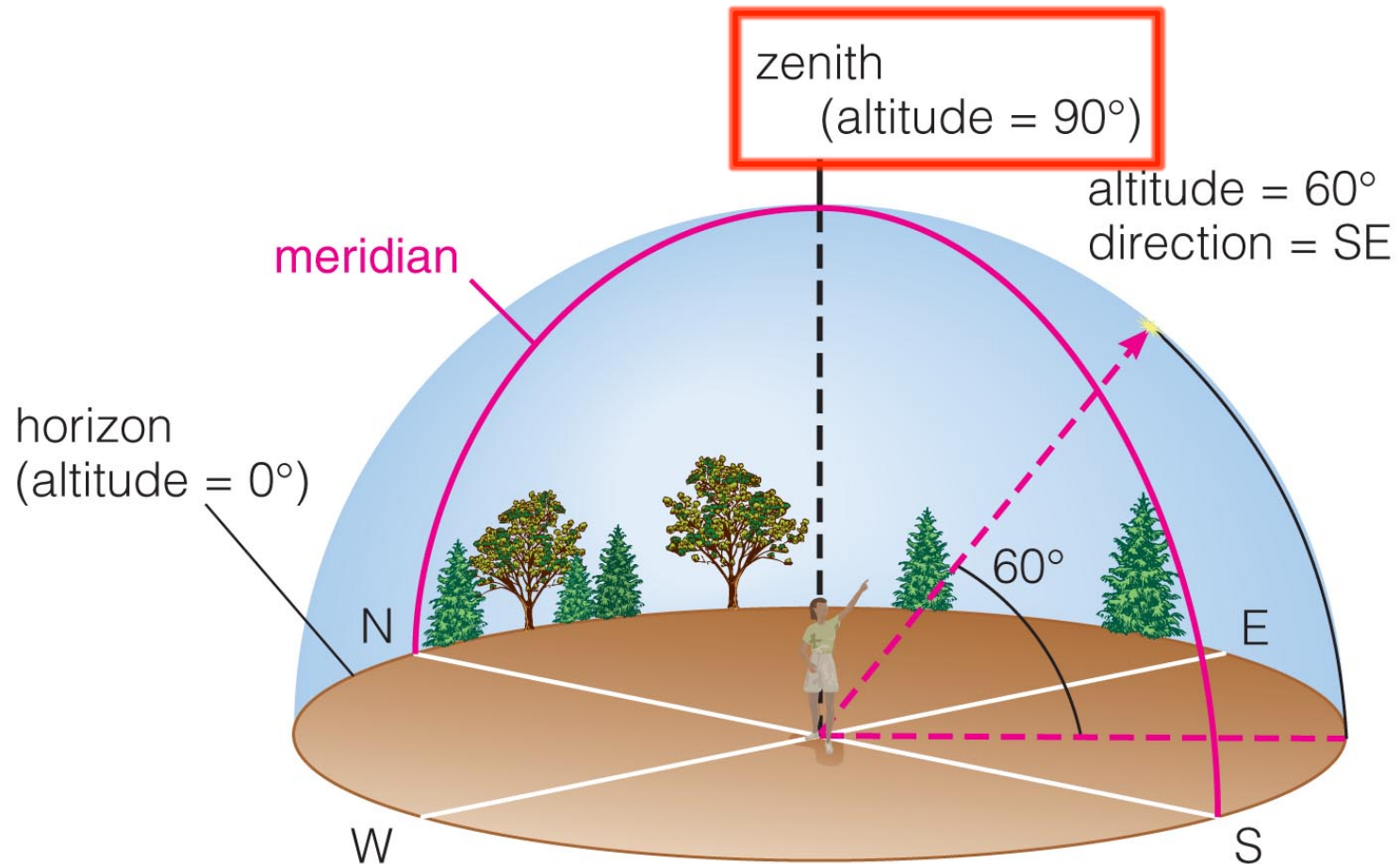
# The Local Sky





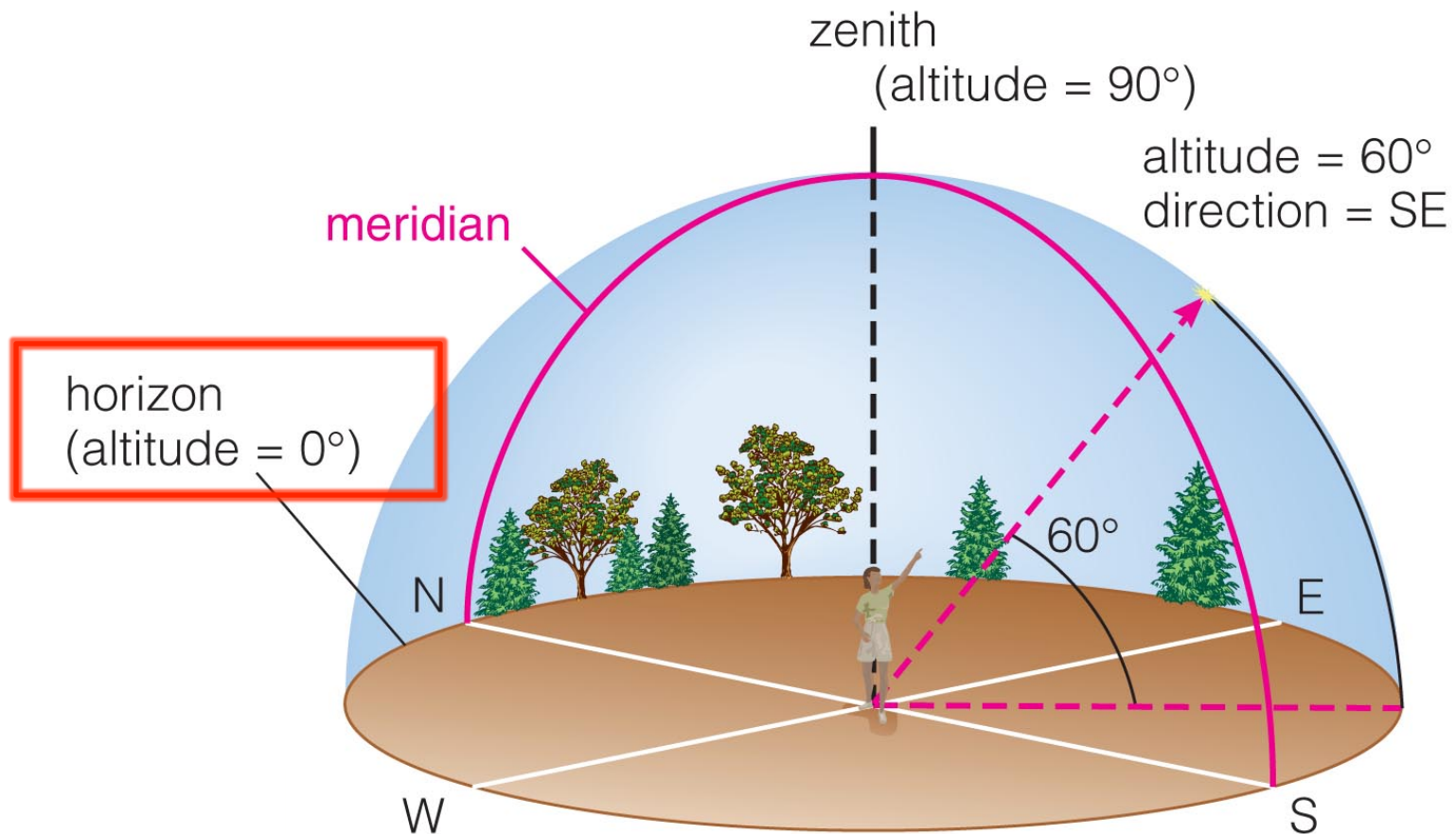
# The Local Sky

**Zenith:** The point directly overhead.



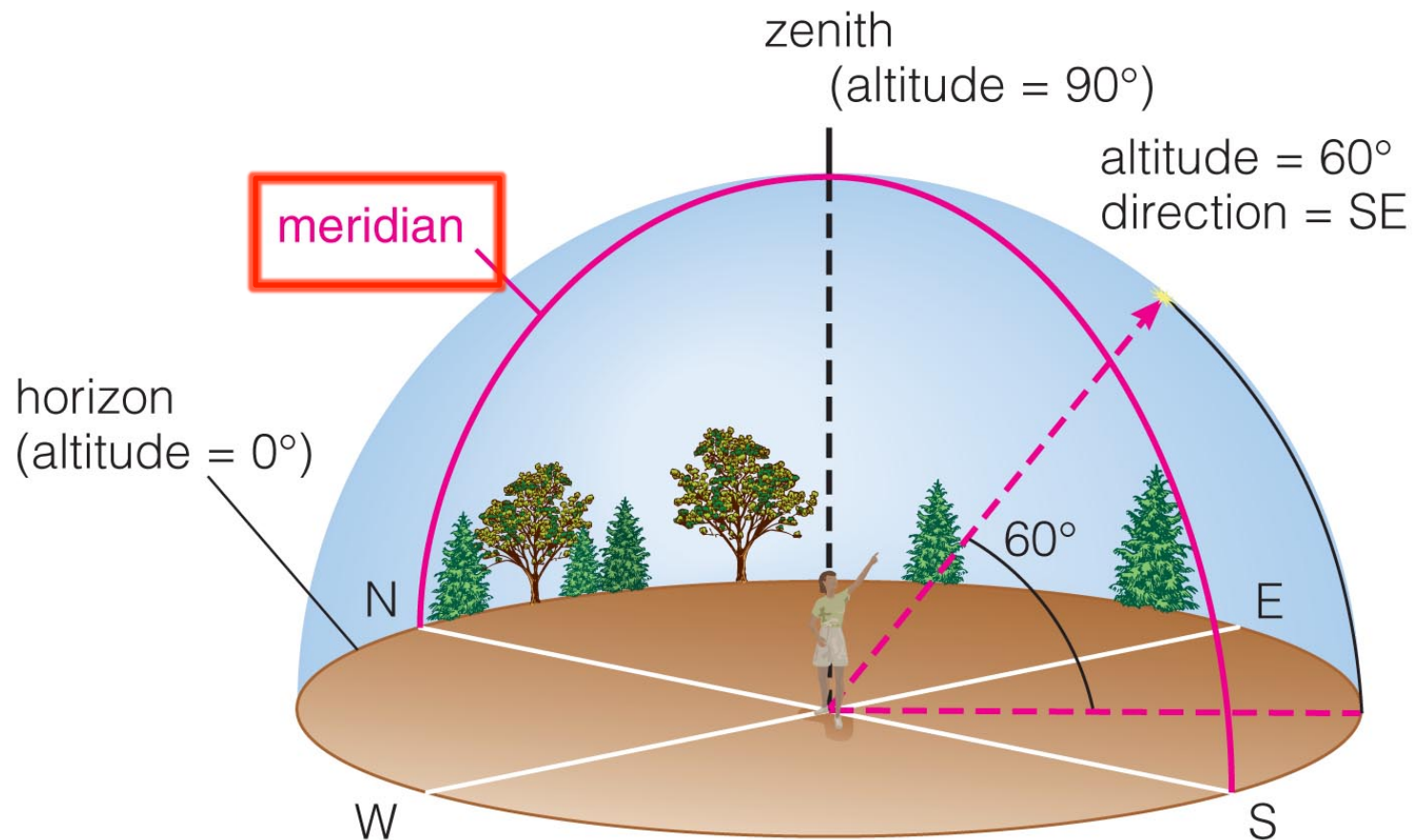
# The Local Sky

**Horizon:** Where the sky touches the ground.



# The Local Sky

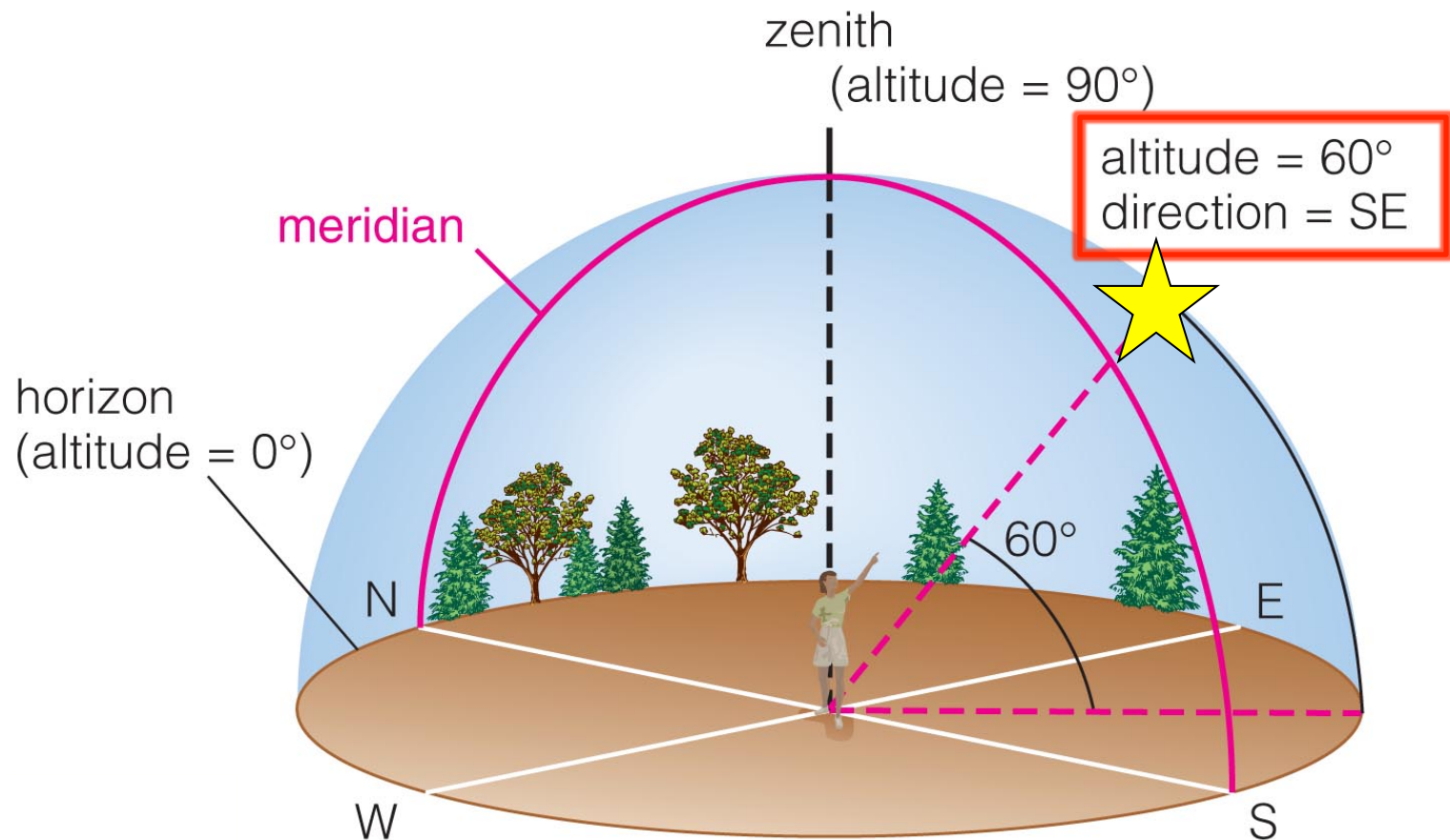
**Meridian:** A north-south line running through the zenith.



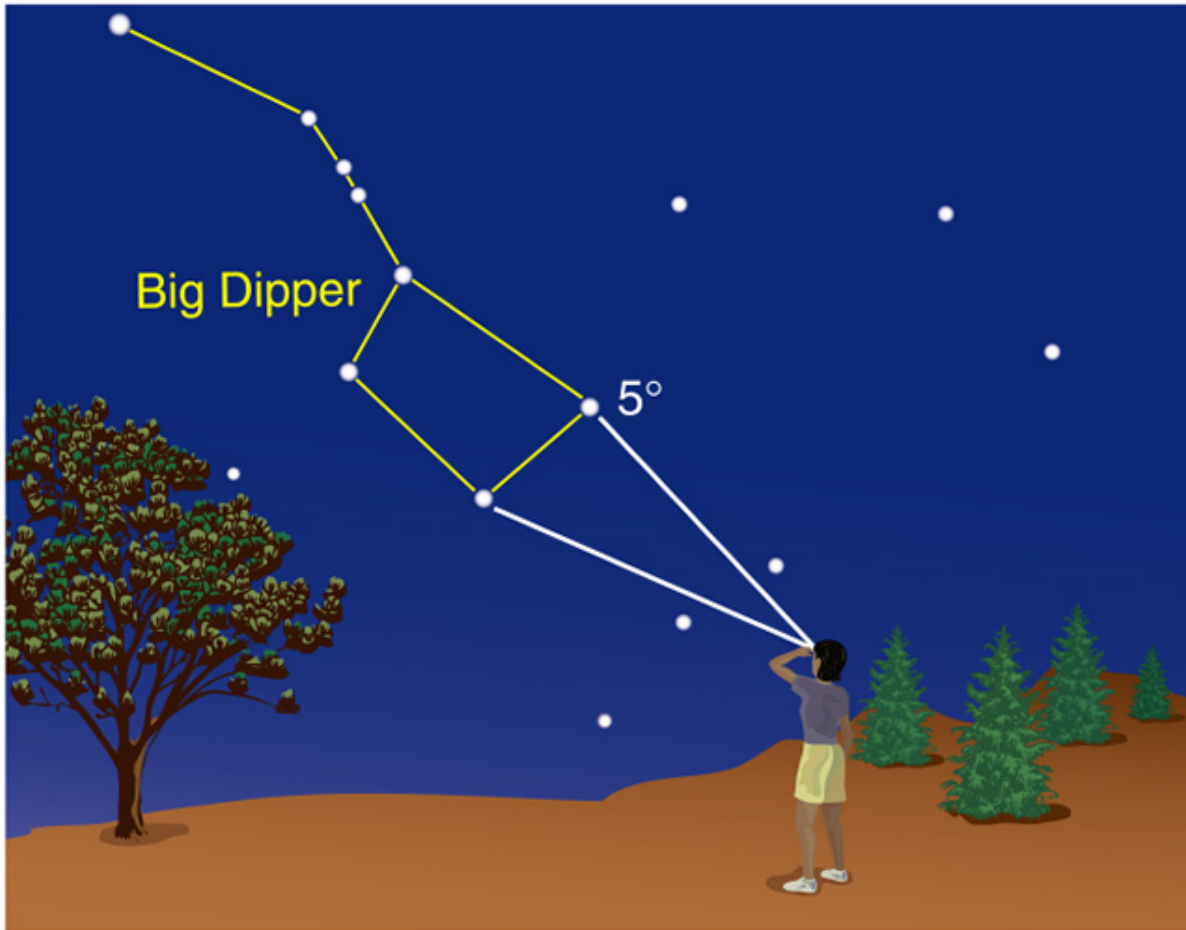


# The Local Sky

An object's **altitude** (above horizon) and **direction** (along horizon) specify its location in your local sky.

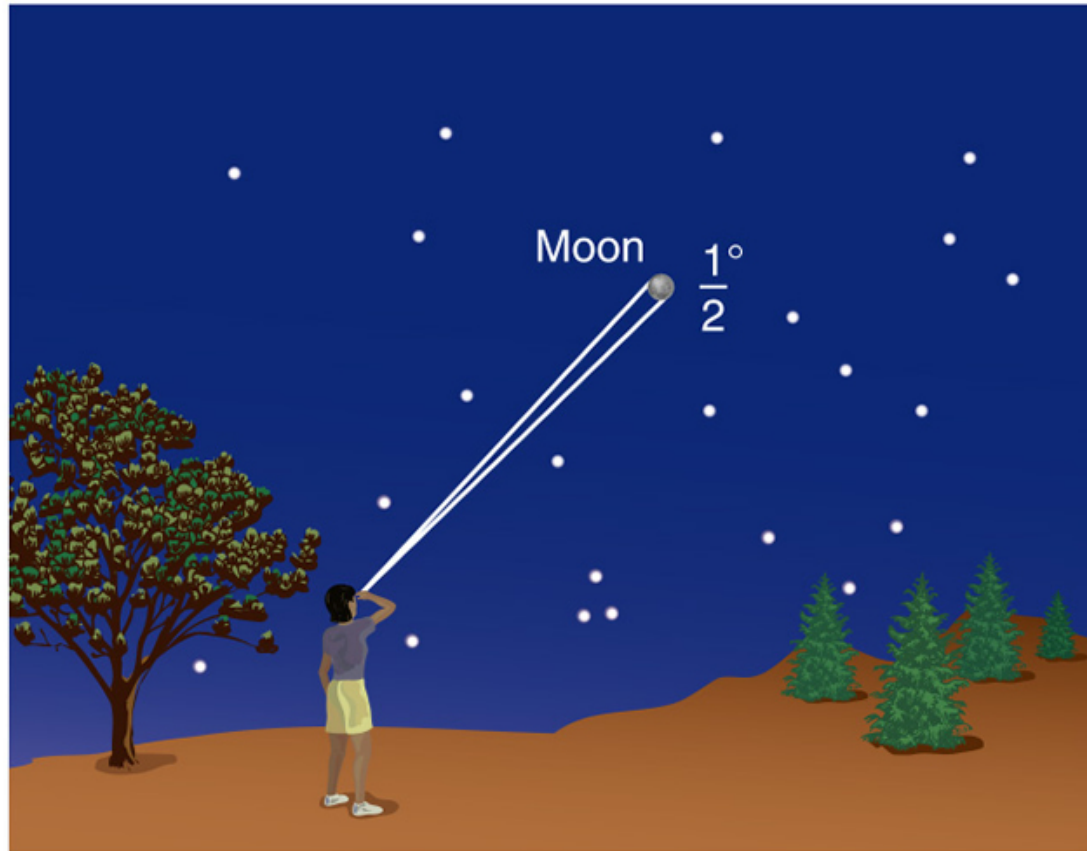


We measure the sky using *angles*.



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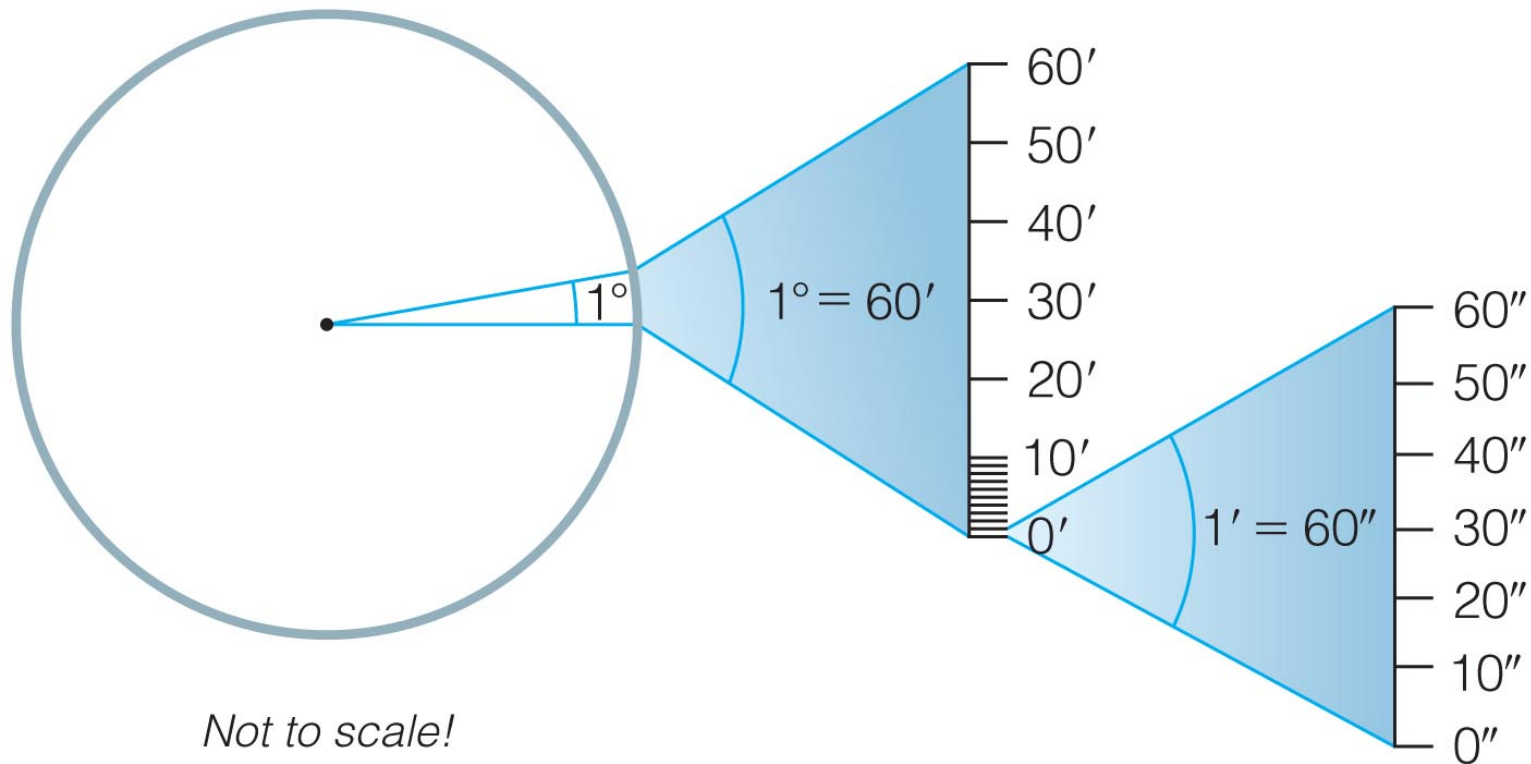
# We measure the sky using *angles*.



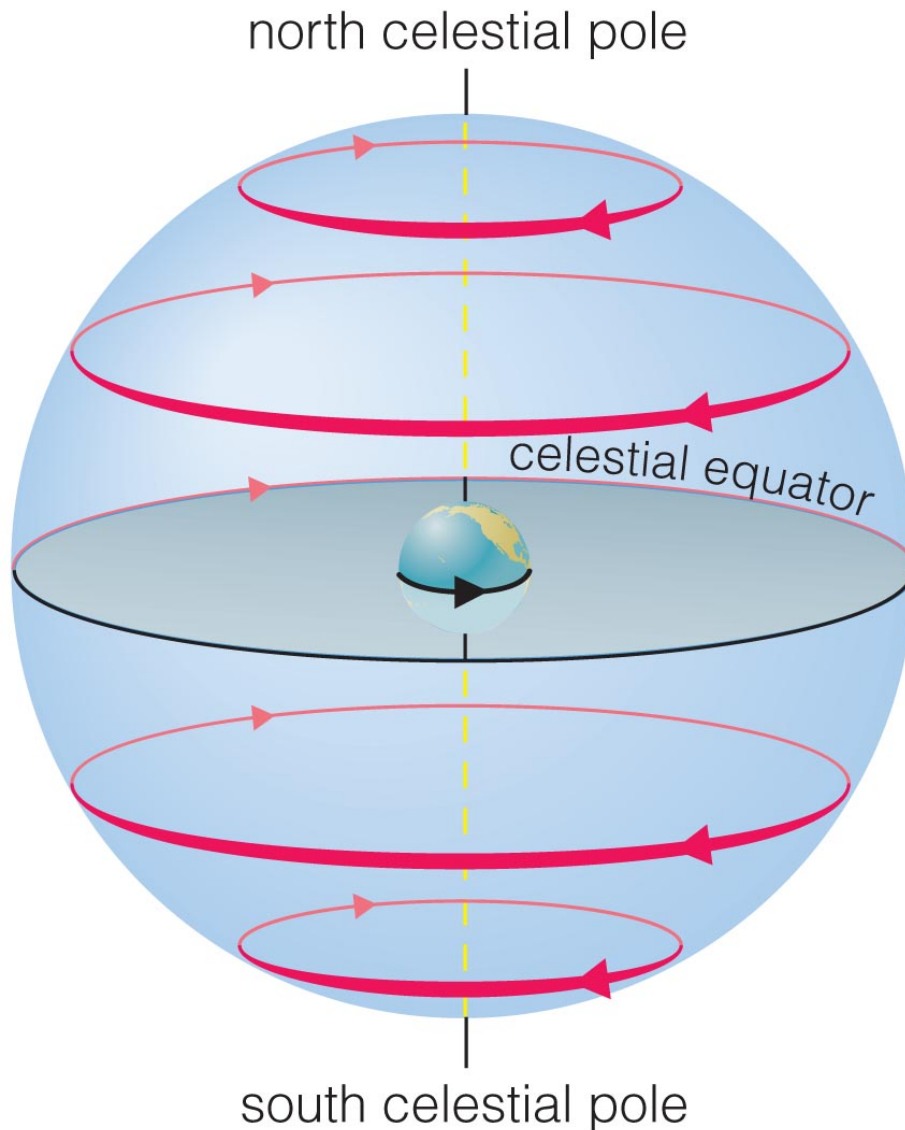
Stretch out your arm  
as shown here.

# Angular Measurements

- Full circle =  $360^\circ$
- $1^\circ = 60'$  (arcminutes)
- $1' = 60''$  (arcseconds)



# Why do stars rise and set?



Earth rotates from west to east, so stars appear to circle from east to west.

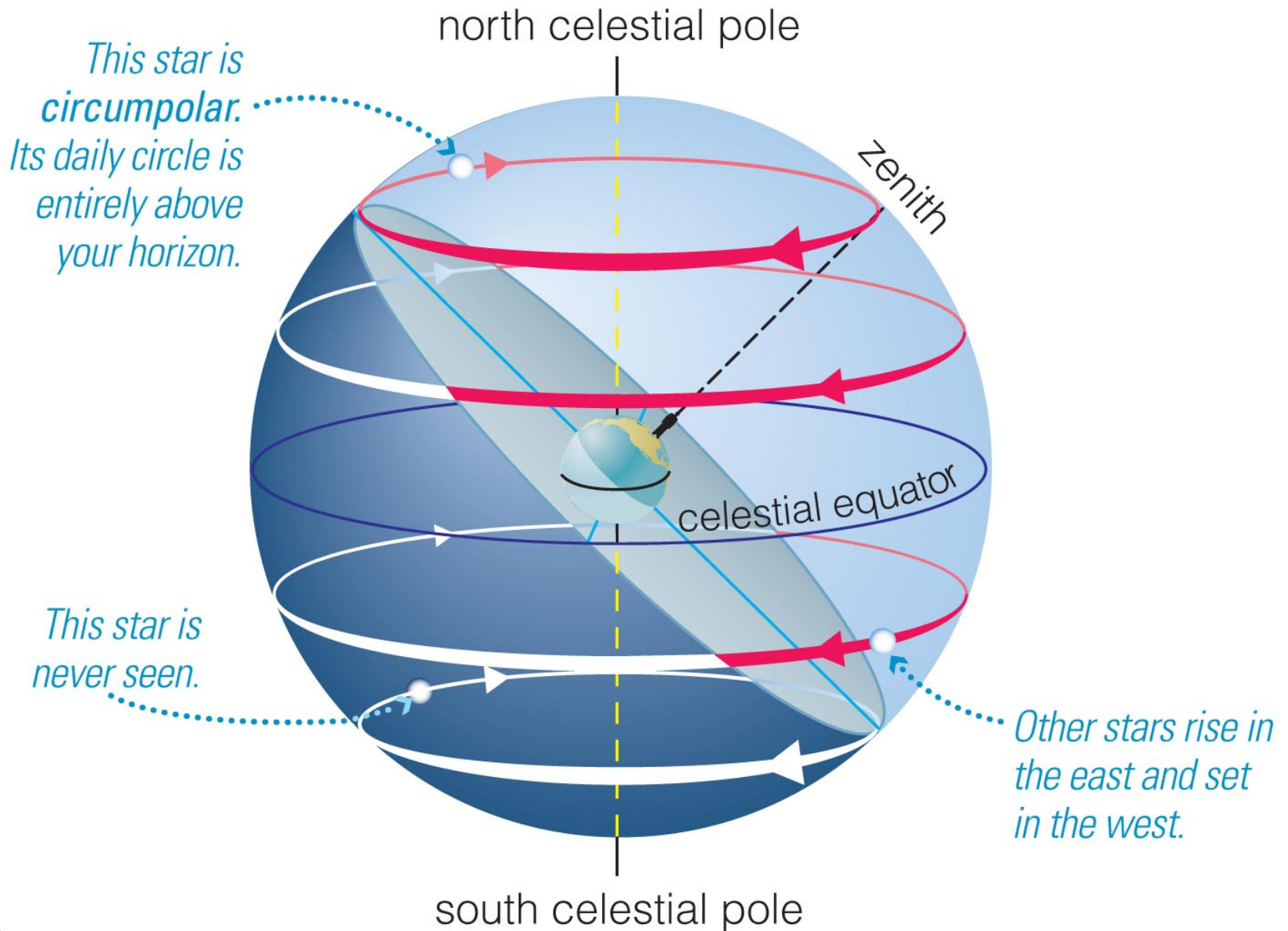


# Why do stars rise and set?



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# Our view from Earth:

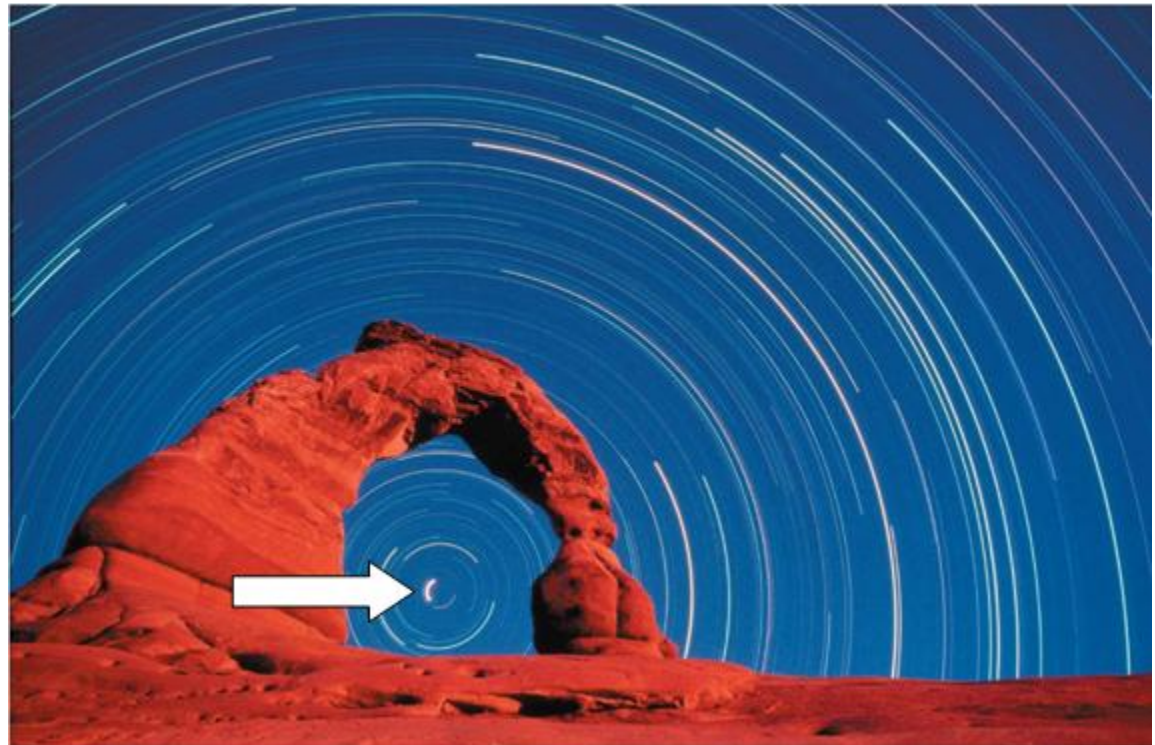




# Thought Question

What is the arrow pointing to in the photo below?

- A. the zenith
- B. the north celestial pole
- C. the celestial equator



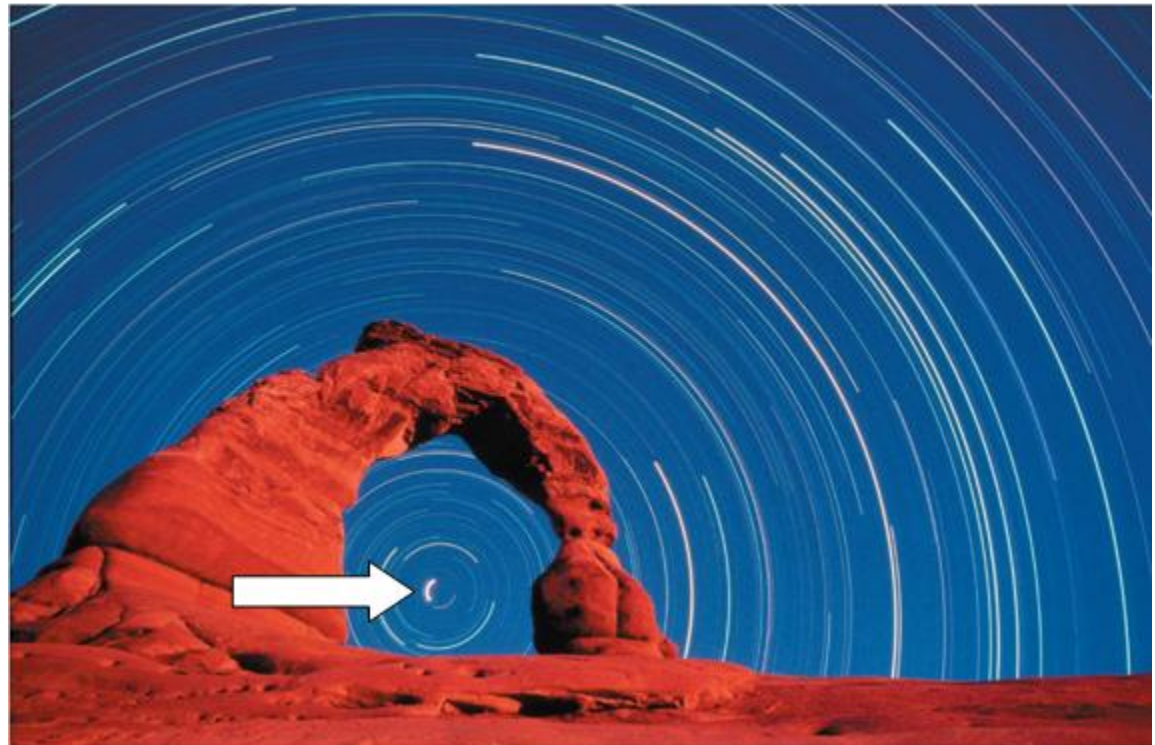
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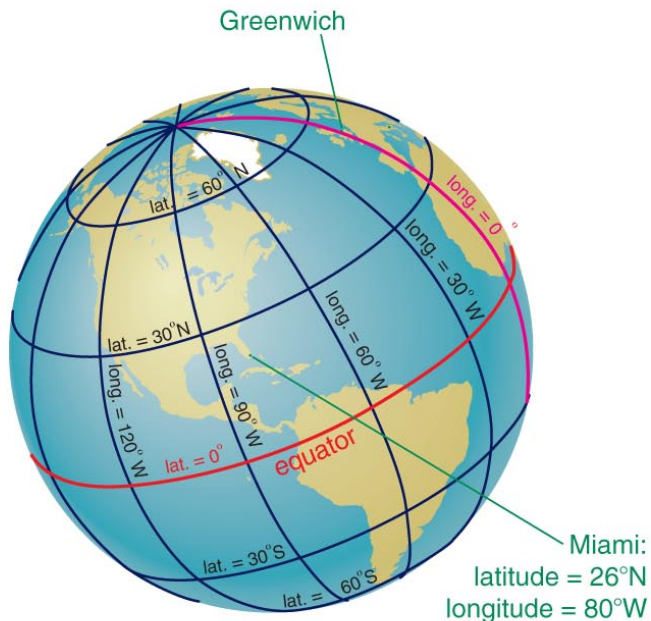


# Why do the constellations we see depend on latitude and time of year?

- They depend on latitude because your position on Earth determines which constellations remain below the horizon.
- They depend on time of year because Earth's orbit changes the apparent location of the Sun among the stars.

# Review: Coordinates on the Earth

- **Latitude:** position north or south of equator
- **Longitude:** position east or west of prime meridian (runs through Greenwich, England)

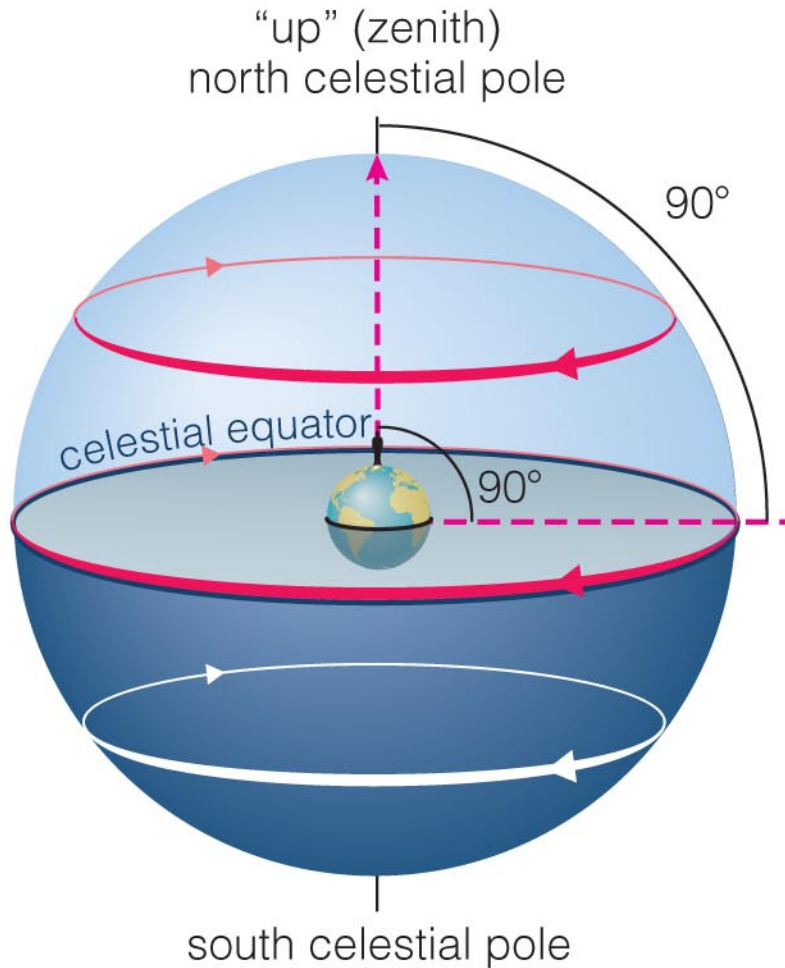


**a** We can locate any place on Earth's surface by its latitude and longitude.

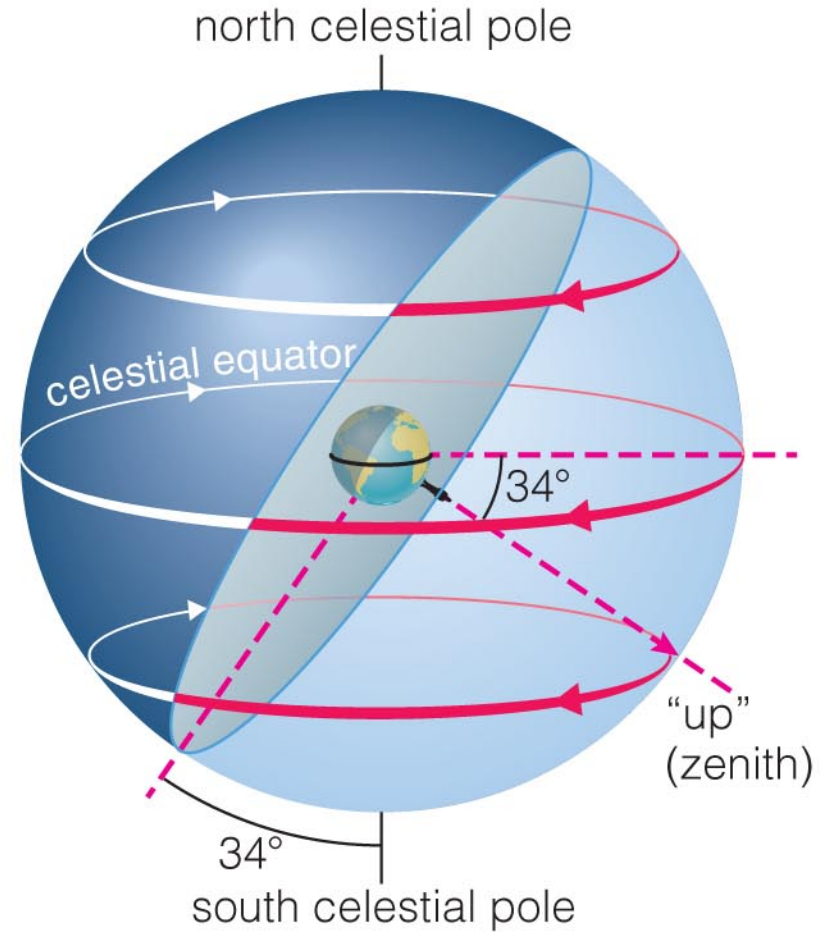


**b** The entrance to the Old Royal Greenwich Observatory, near London. The line emerging from the door marks the prime meridian.

# The sky varies with latitude but not with longitude.

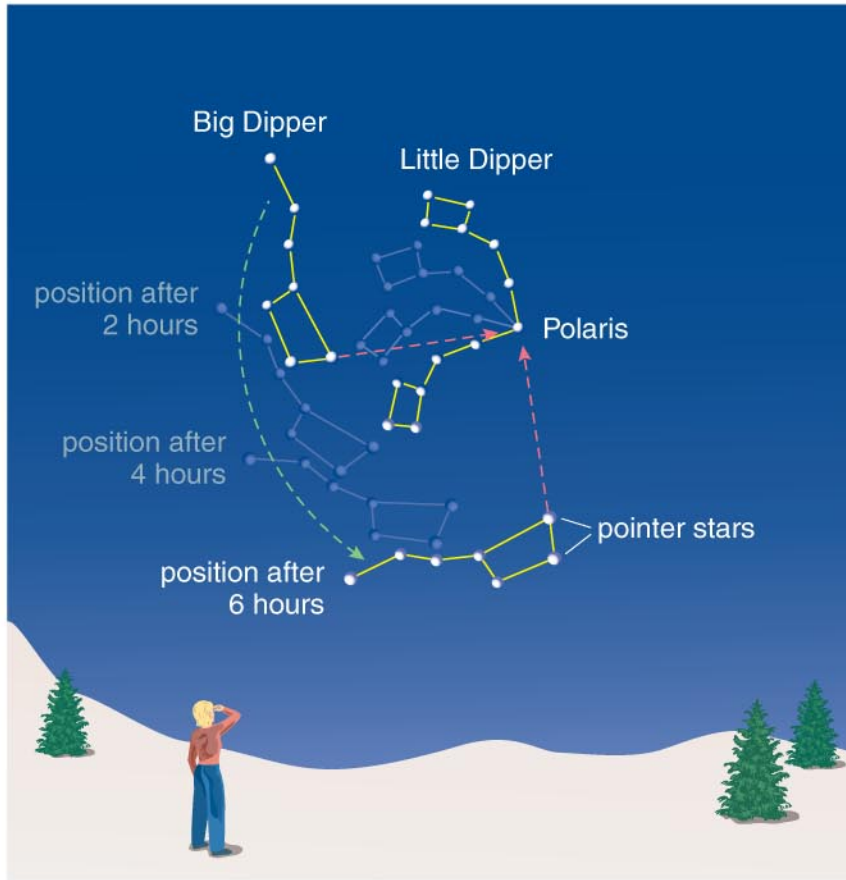


**a** The local sky at the North Pole (latitude  $90^\circ\text{N}$ ).



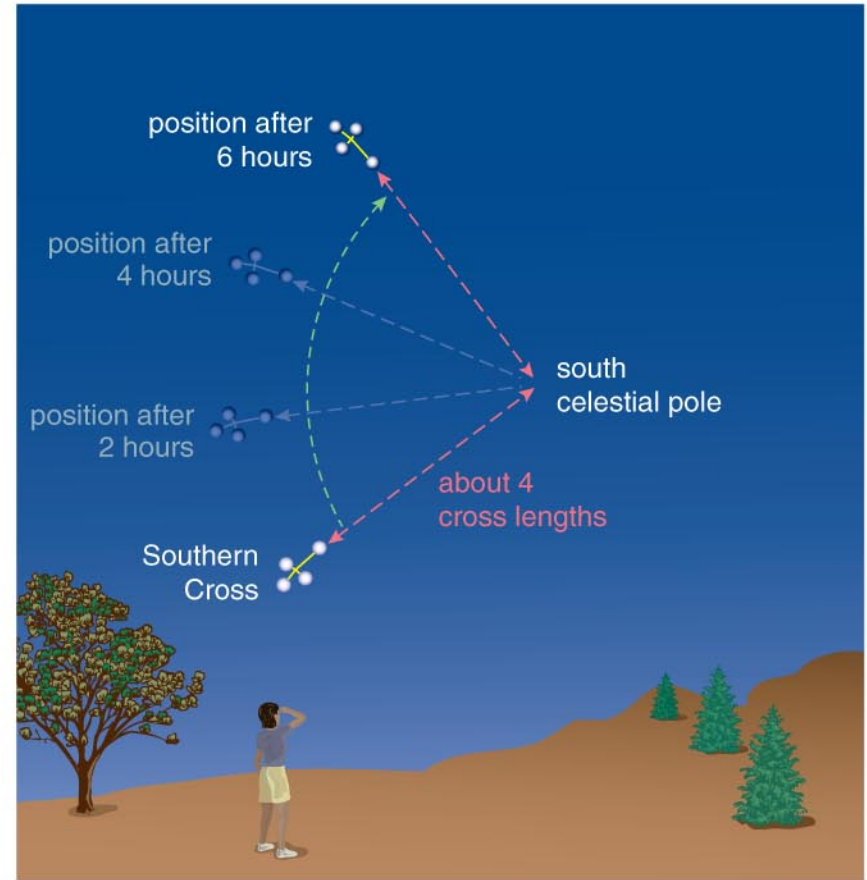
**b** The local sky at latitude  $34^\circ\text{S}$ .

# Altitude of the celestial pole = your latitude



looking northward in the Northern Hemisphere

**a** The pointer stars of the Big Dipper point to the North Star, Polaris, which lies within  $1^\circ$  of the north celestial pole. The sky appears to turn *counterclockwise* around the north celestial pole.



looking southward in the Southern Hemisphere

**b** The Southern Cross points to the south celestial pole, which is not marked by any bright star. The sky appears to turn *clockwise* around the south celestial pole.

**Interactive Figure**



# Thought Question

The North Star (Polaris) is  $50^\circ$  above your horizon, due north. Where are you?

- A. You are on the equator.
- B. You are at the North Pole.
- C. You are at latitude  $50^\circ\text{N}$ .
- D. You are at longitude  $50^\circ\text{E}$ .
- E. You are at latitude  $50^\circ\text{N}$  and longitude  $50^\circ\text{E}$ .

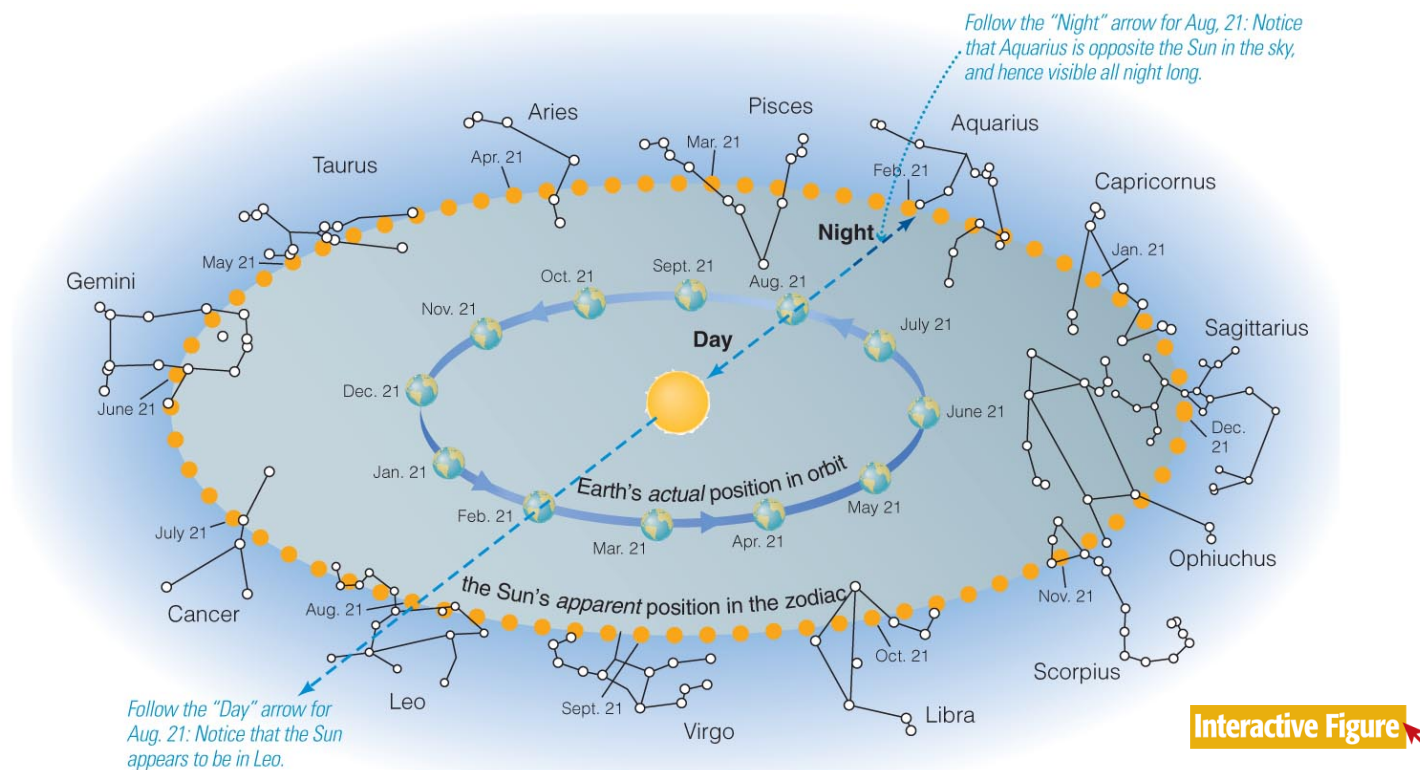
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# The sky varies as Earth orbits the Sun

- As the Earth orbits the Sun, the Sun appears to move eastward along the ecliptic.
- At midnight, the stars on our meridian are opposite the Sun in the sky.



# What have we learned?

- **What does the universe look like from Earth?**
  - We can see over 2000 stars and the Milky Way with our naked eyes, and each position on the sky belongs to one of 88 constellations.
  - We can specify the position of an object in the local sky by its **altitude** above the horizon and its **direction** along the horizon.
- **Why do stars rise and set?**
  - Because of Earth's rotation.



# What have we learned?

- **Why do the constellations we see depend on latitude and time of year?**
  - Your location determines which constellations are hidden by Earth.
  - The time of year determines the location of the Sun on the celestial sphere.