



# Partial Solar Eclipse with setting Sun (Texas) from 2012

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# Observing the Sky

Topics: Constellations and the origins of astronomy.  
Celestial Sphere. Rotation of the Celestial Sphere. Precession.  
How do we know the Earth is SPINNING on its axis?

## Learning Goals

- *Recognize prominent constellations*
- *Describe rotation of celestial sphere*
- *List evidence for and consequences of Earth's precession*
- *Describe how Foucault pendulum reveals rotation of the Earth*

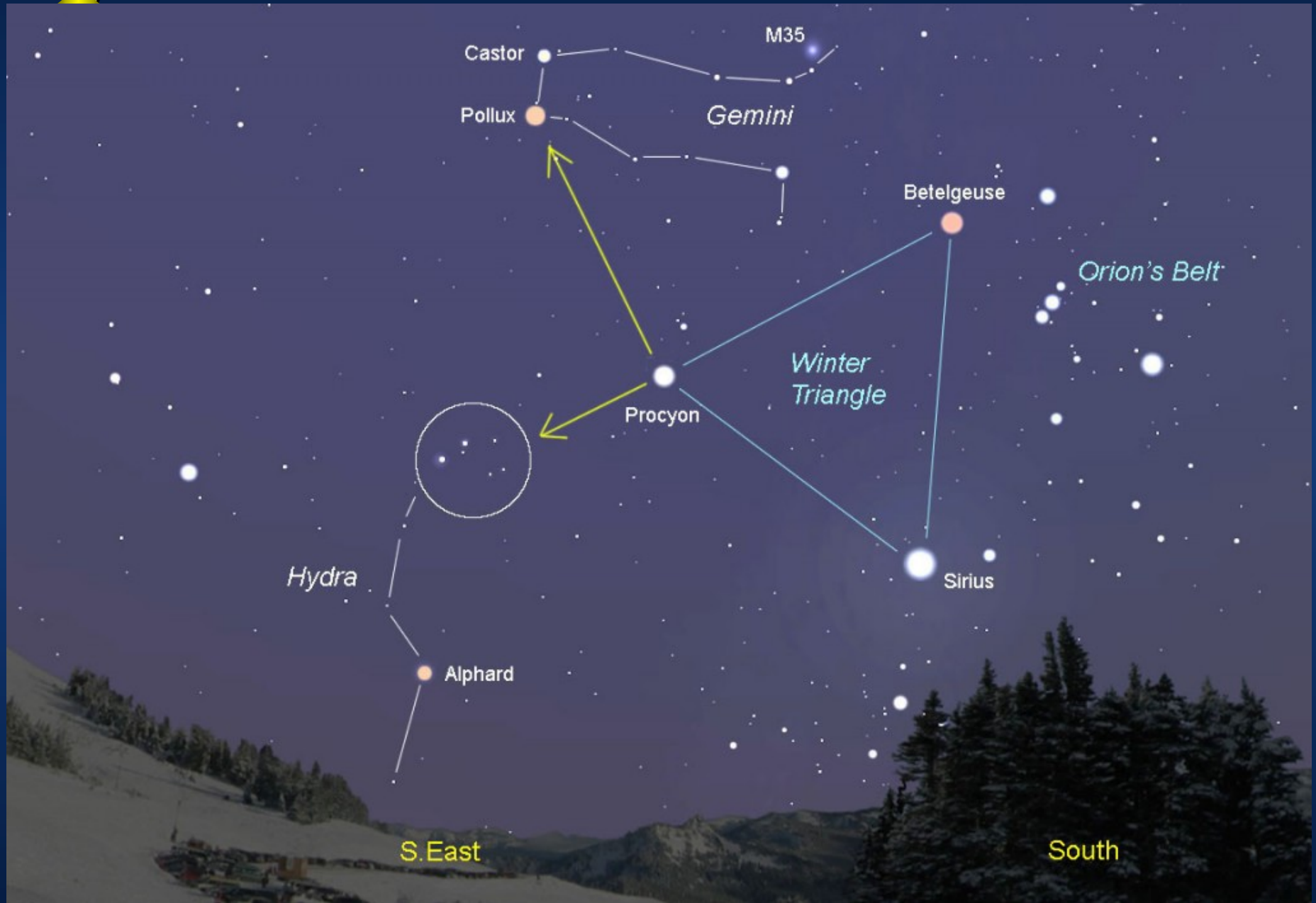


# CELESTIAL SPHERE



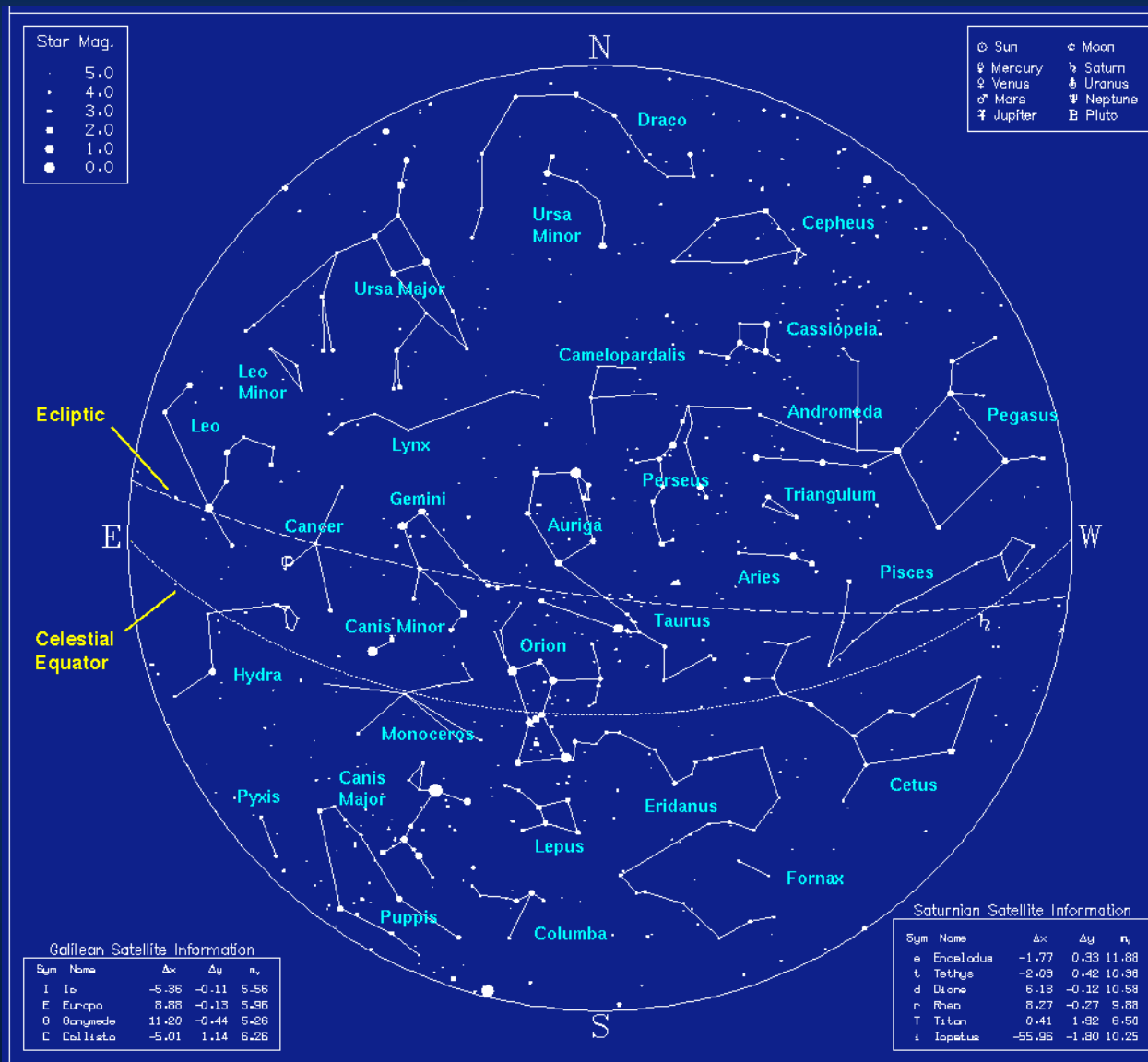


# Winter Constellations



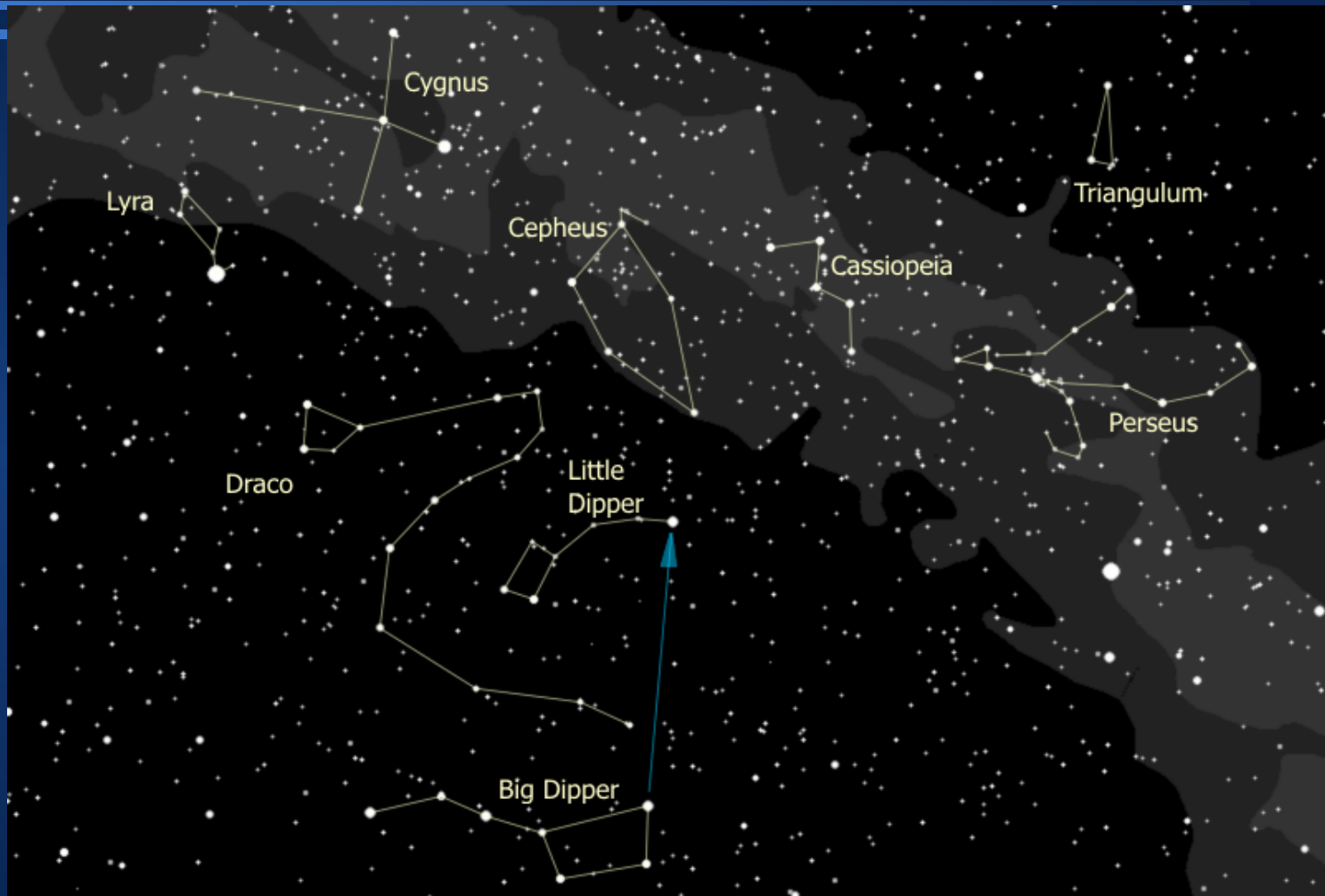


# Constellations and the Celestial Sphere



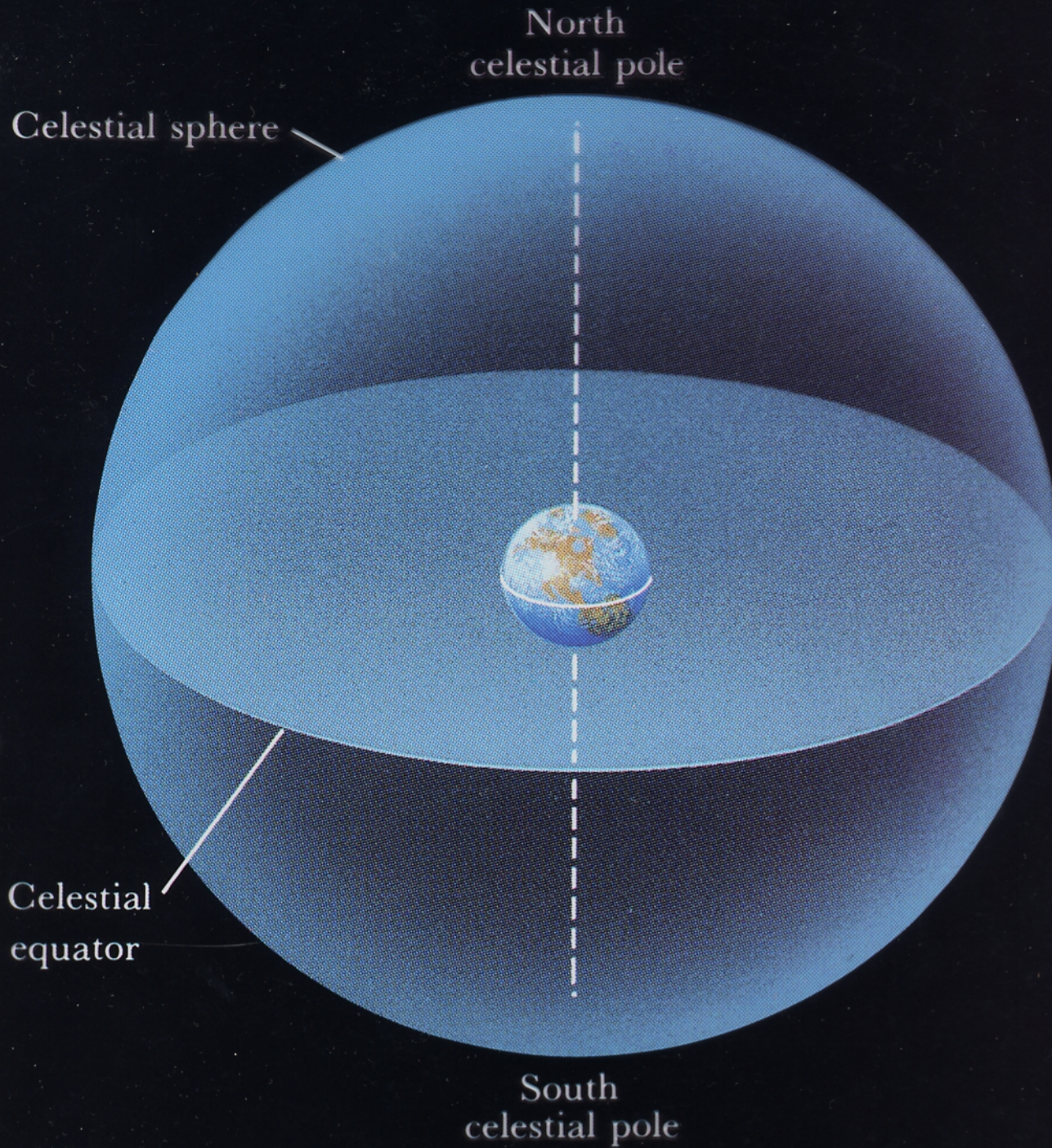


# Constellations

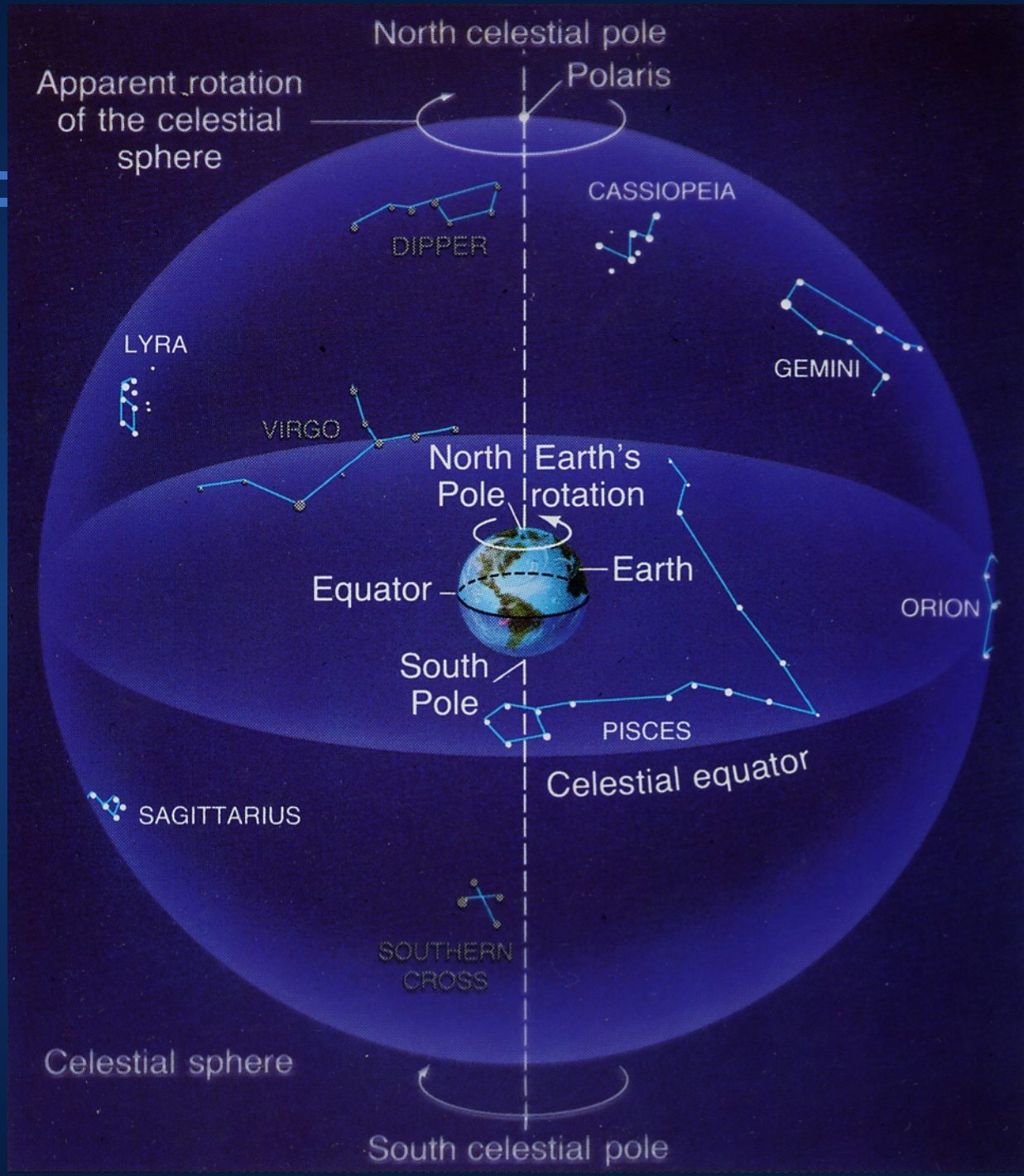


**Fall constellations**  
**Constellations used early on for navigation**









Interactive Figure





# Question

**Why is there a star almost directly above the North Pole of the Earth?**

- A) to tell us where north is located**
- B) vortices caused by a spinning Earth align it with a nearby star**
- C) the interaction of Polaris with the Earth's magnetic field forces the north magnetic pole to point at Polaris**
- D) it is just coincidence**
- E) Polaris and the Earth are gravitationally bound with Polaris' orbit going over the Earth's pole**



# The Spinning Earth

How do we know that the Earth is spinning  
on its axis?



# EARTH SPINS on its AXIS



- *Evidence of Earth's Spin*

- Daily rotation of Celestial Sphere

For how long was the camera open in this exposure?

What can you say about Polaris from this image?



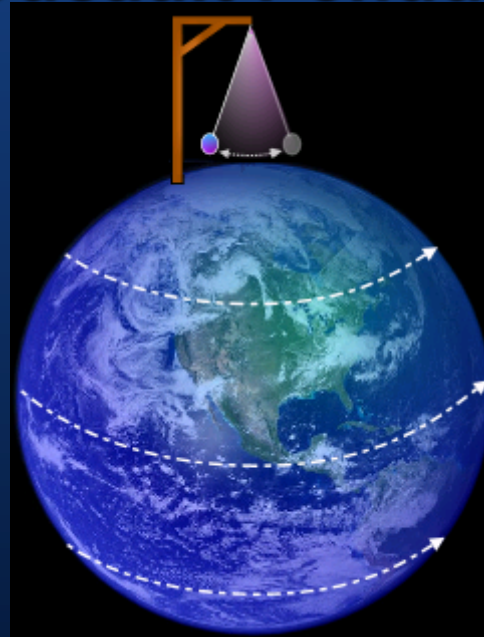
# EARTH SPINS on its AXIS



- *Evidence of Earth's Spin*

- Daily rotation of Celestial Sphere

- Foucault Pendulum

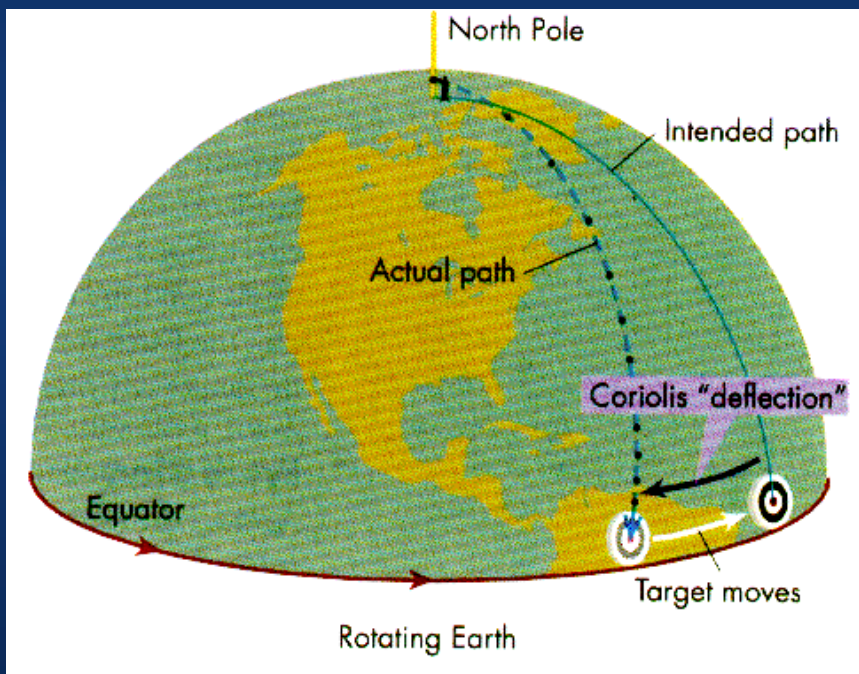


Experiment first done in 1851  
in Paris

Plane rotates **CLOCKWISE** at about  
11 degrees per hour– took 32.7 hours



# EARTH SPINS on its AXIS

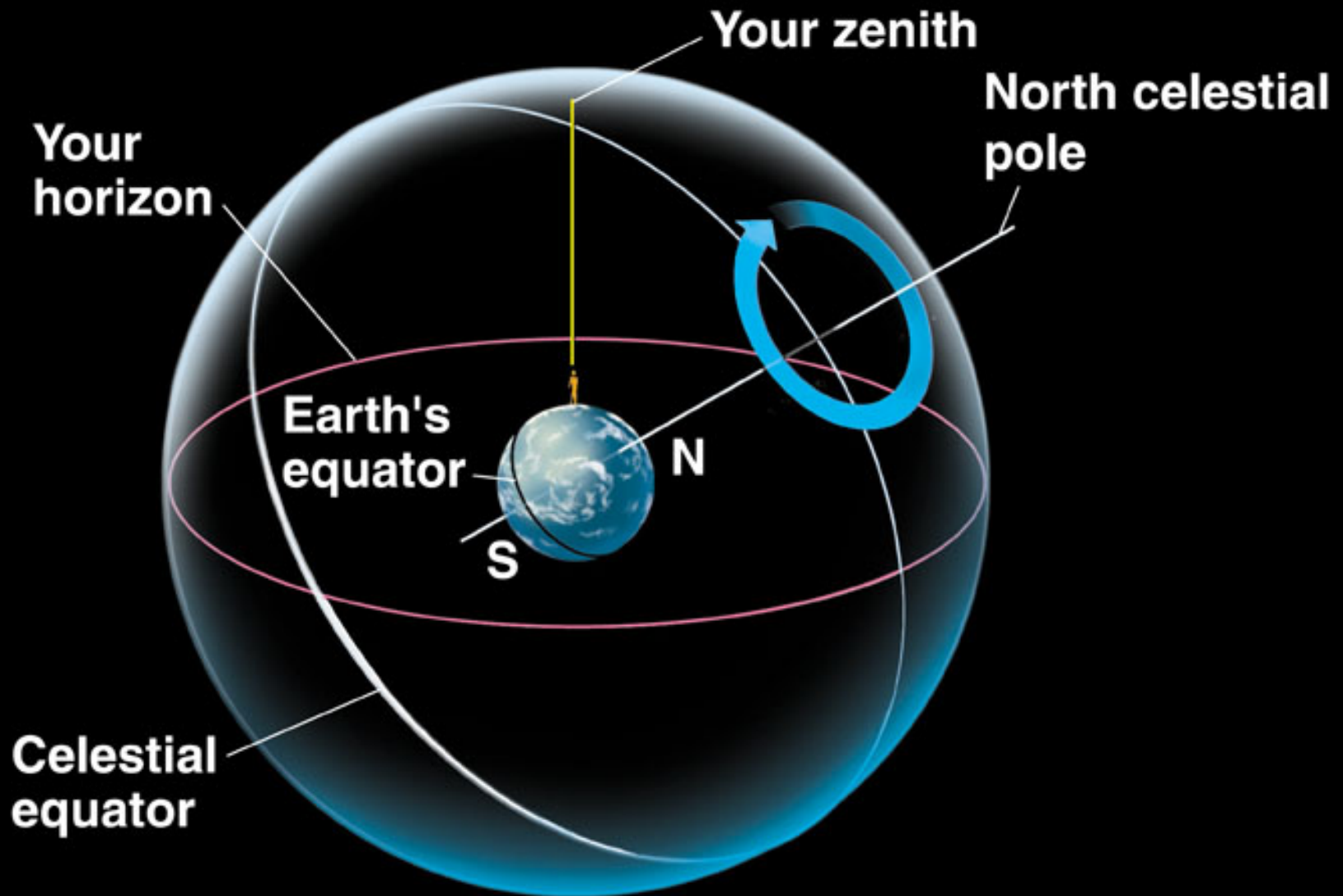


## ● *Evidence of Earth's Spin*

- Daily rotation of Celestial Sphere
- Foucault Pendulum
- Long Range Projectiles

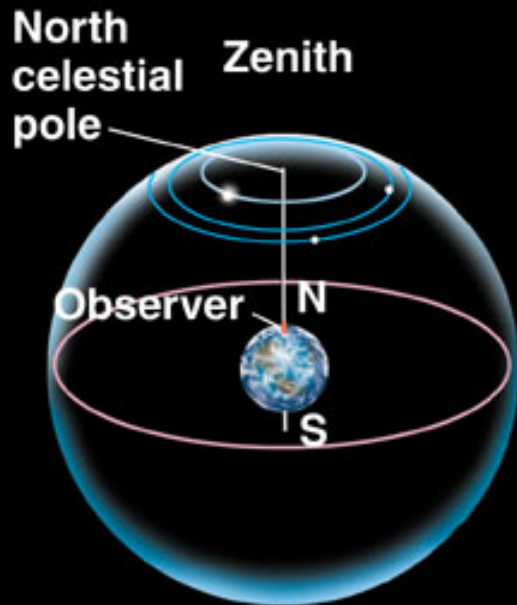


# APPARENT SKY ROTATION

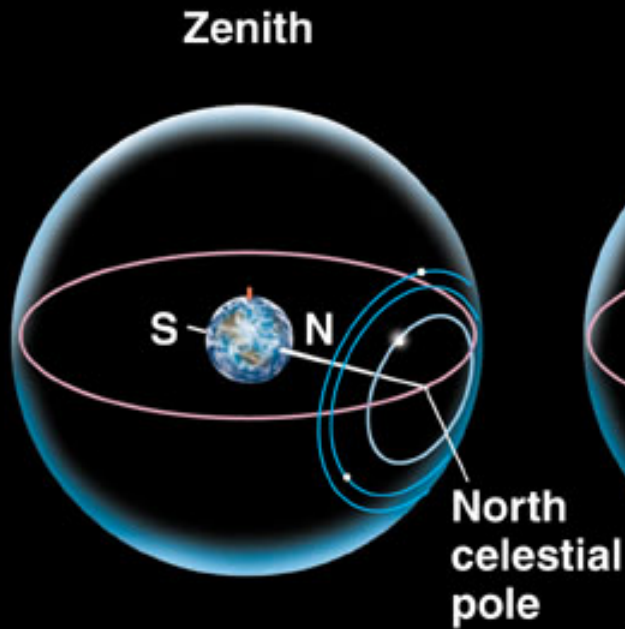




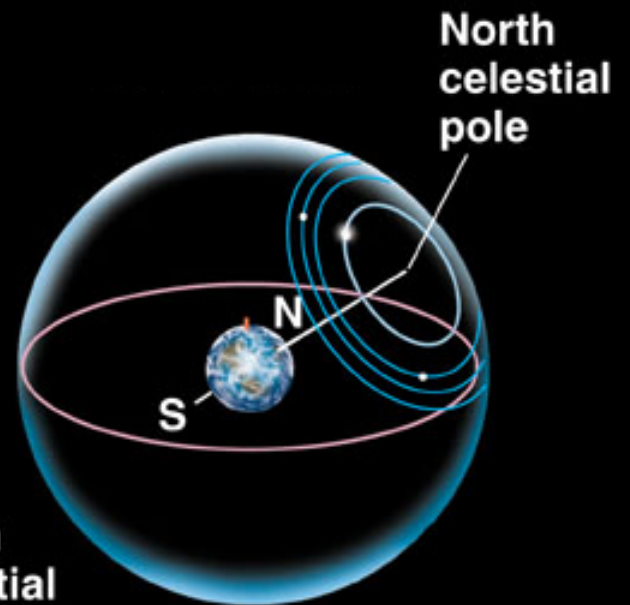
# STAR CIRCLES



At North Pole



At Equator



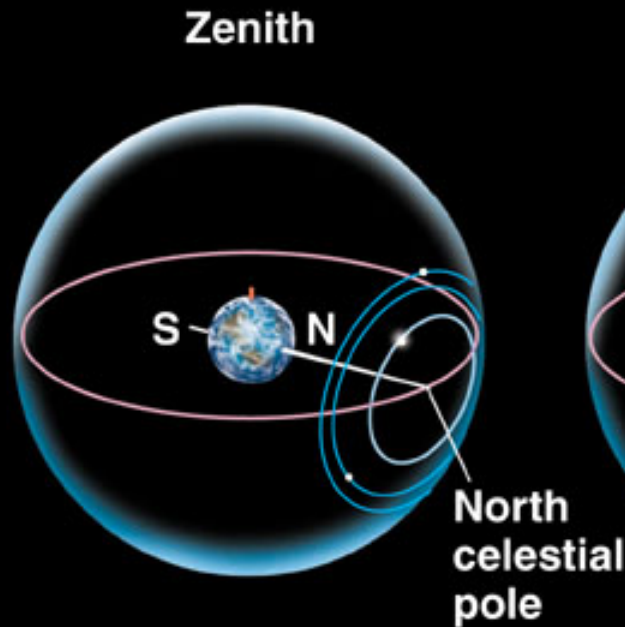
At intermediate latitude



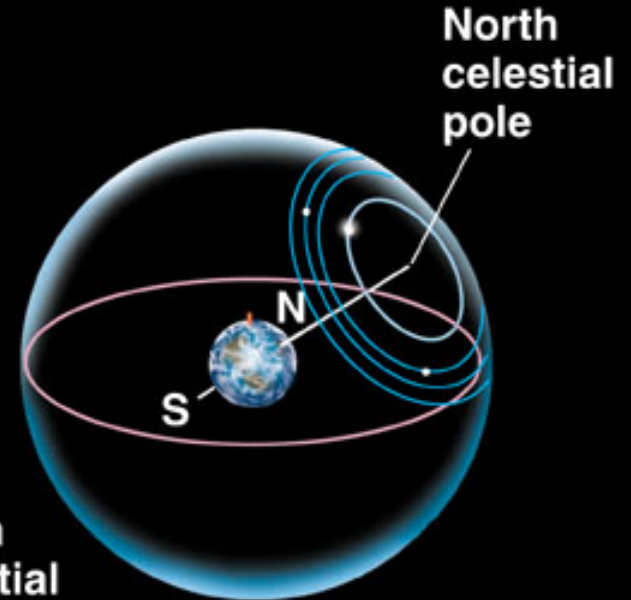
# STAR CIRCLES



At North Pole



At Equator



At intermediate latitude

How would you find your latitude out at sea?





# STAR CIRCLES

North  
celestial  
pole

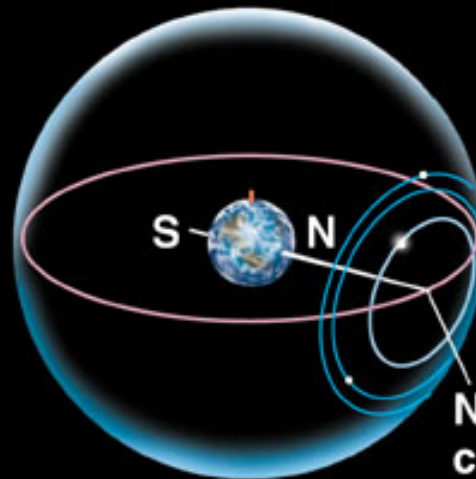
Zenith

Observer



At North Pole

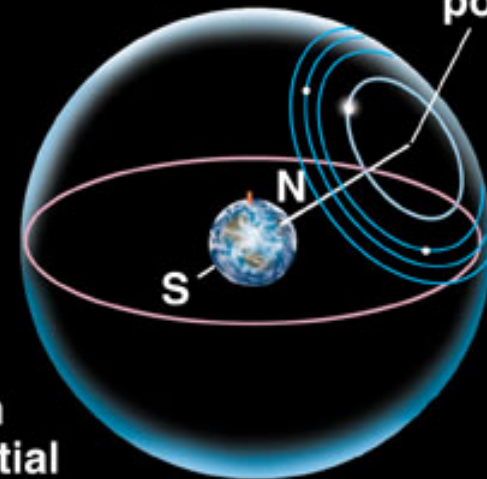
Zenith



At Equator

Altitude of pole  
= latitude of  
the observer

North  
celestial  
pole



At intermediate latitude



# STAR TRAILS NEAR THE POLE







# EQUATORIAL STAR TRAILS





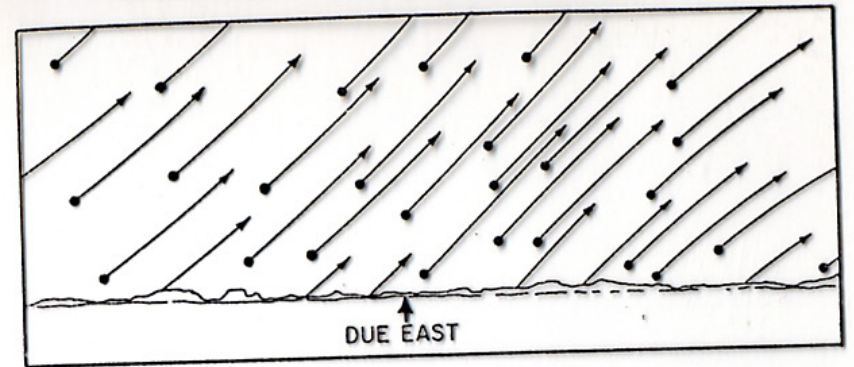
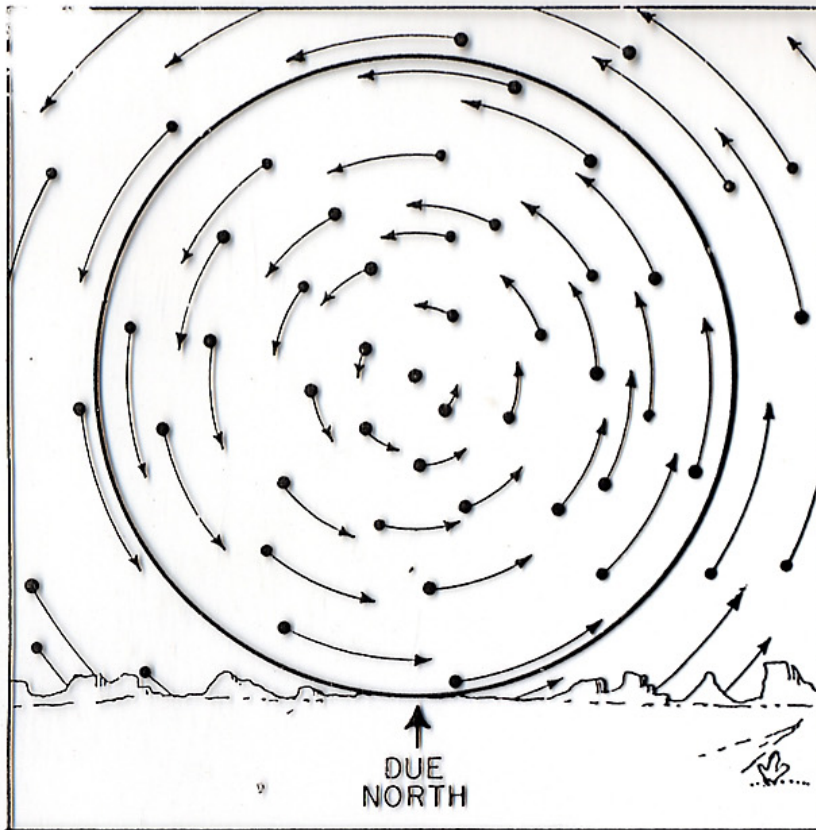
# INTERMEDIATE LATITUDE STAR TRAILS



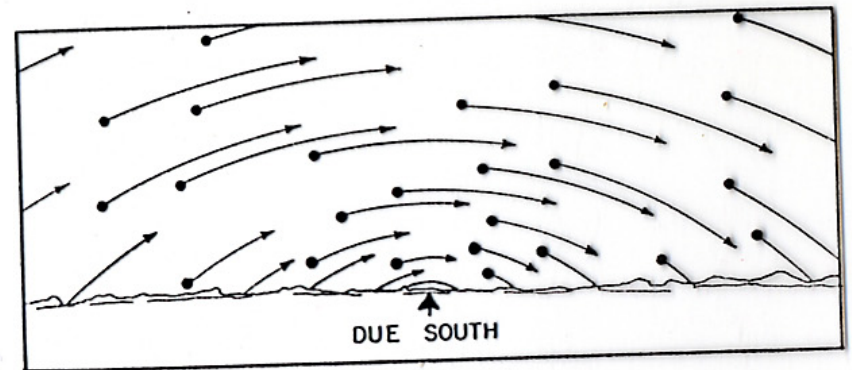




# STAR TRAILS



(a)



(b)

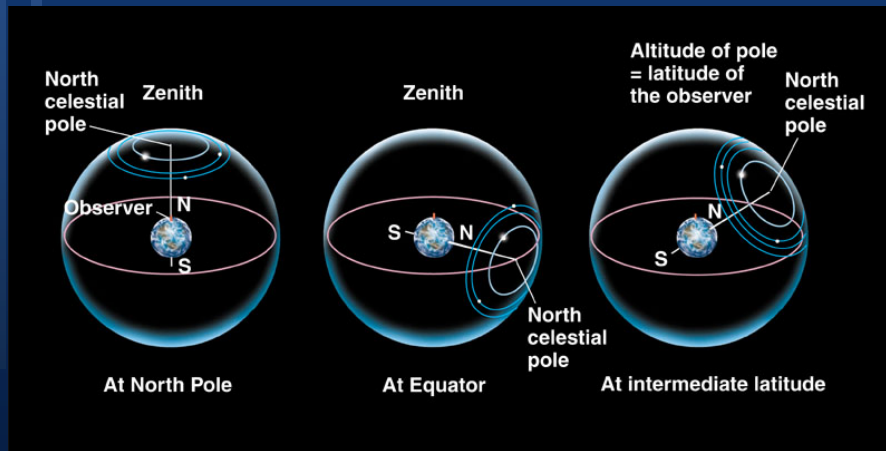
Circumpolar stars are those that never set – inside circle



# QUESTION

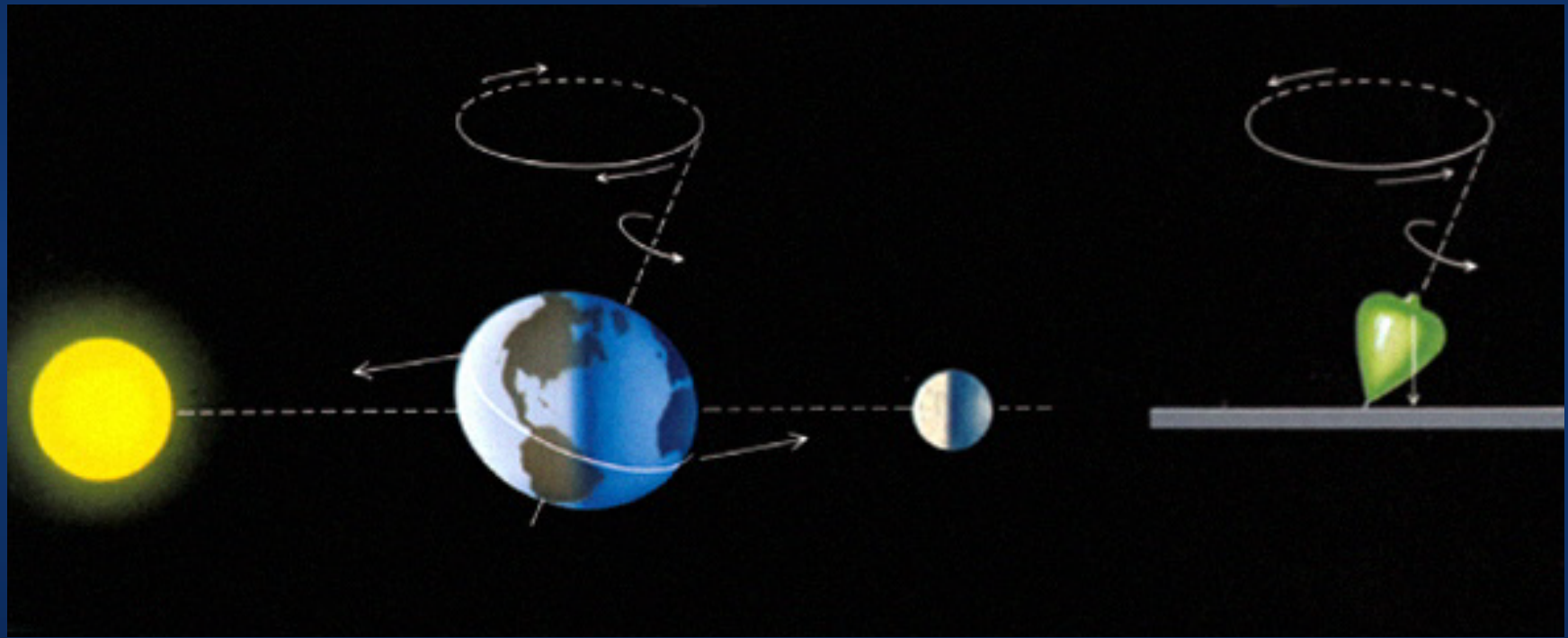
To see the greatest number of stars possible during a year, an astronomical observatory in the northern hemisphere should be located at latitude

- A) 90 degrees north
- B) 45 degrees north
- C) As near as possible to 0 degrees
- D) you will see the same number of stars from any latitude





# EARTH'S PRECESSION







CYGNUS

Deneb

AD 8000

CASSIOPEIA

LYRA

Vega

CEPHEUS

AD 15,000

DRACO

Polaris

Path of north  
celestial pole

URSA  
MINOR

AD 1

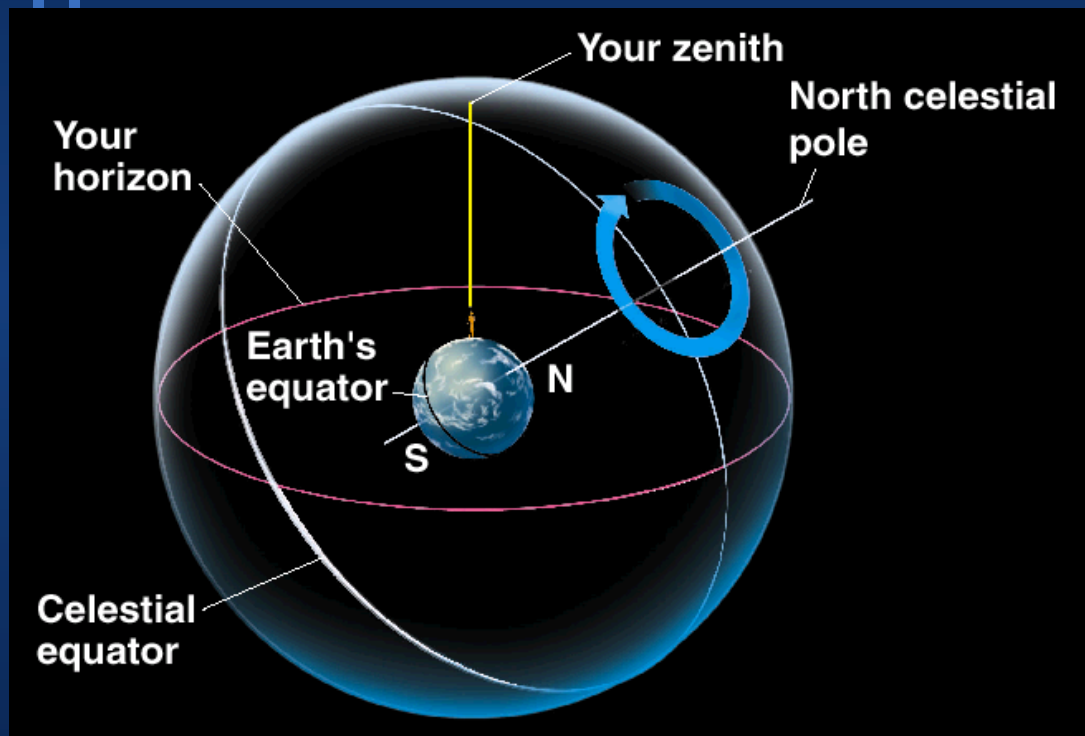
Thuban

5000 BC

CORONA  
BOREALIS

URSA MAJOR

# Rotation of the Earth



- Daily rotation of sky proves that Earth spins and is a unit of time = 1 day – this is a **natural** unit of time.
- Other natural units? Unnatural?