

# Announcements

## ★ Homework 1 posted on Compass

Ordinarily due by classtime next Friday Jan 27,  
but HW1 available on Compass until Jan 30

can submit answers for score more than once:  
persistence pays off!

## ★ Register those iClickers! link on course site

## ★ Readings for Week 2 posted

## ★ Last Time: Introduction

## ★ Today: The Night Sky

- ▶ Constellations
- ▶ Celestial Sphere
- ▶ Phases of the Moon



# The Night Sky

Friday, January 20, 2012

# A Sky Full of Stars



S

Earth, Urbana, 221m

FOV 64.3°

82.8 FPS

2010-02-20 20:43:58

Friday, January 20, 2012

# A Sky Full of Stars



Friday, January 20, 2012

# Constellations

Since ancient times

- ▶ groups of stars that appear to form patterns in the sky
- ▶ Devised by ancient people to help recognize the stars

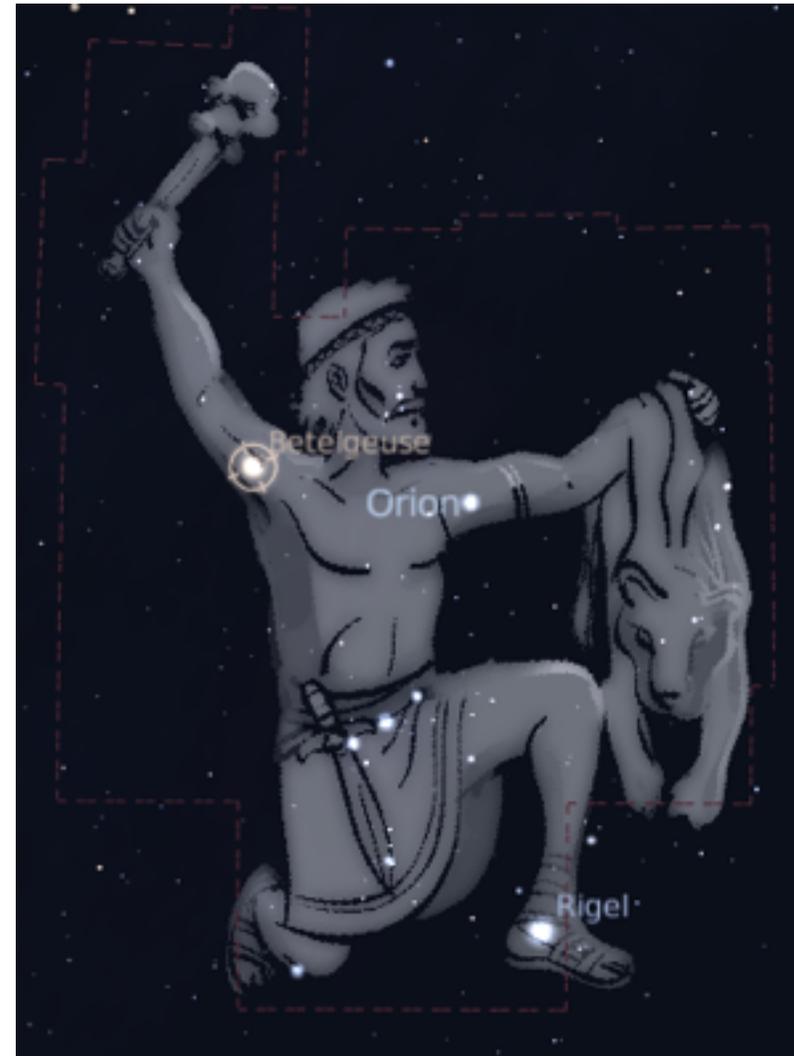


**Orion, the Hunter**

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**Orion, the Hunter**

# Constellations can vary greatly between cultures



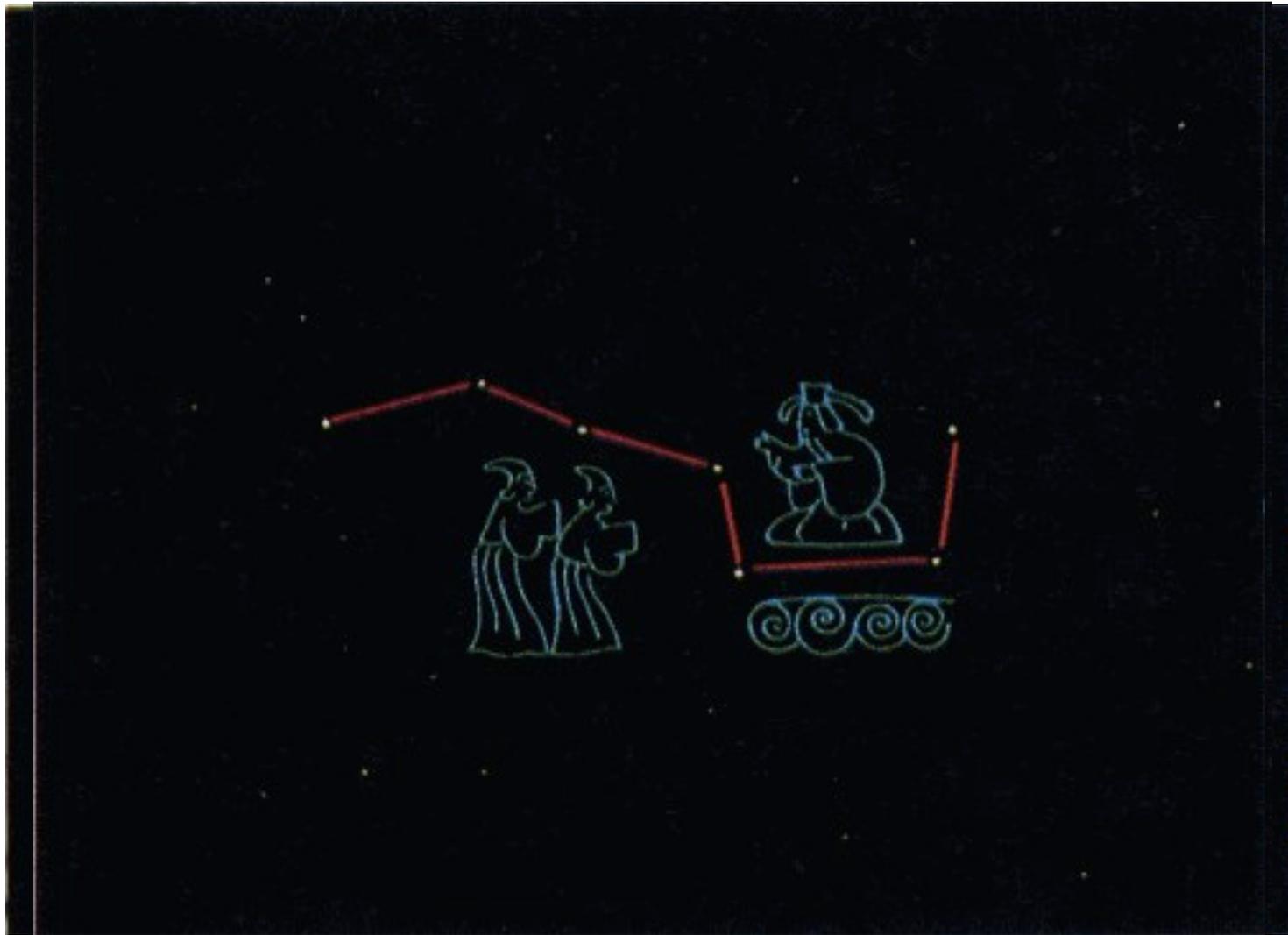
Tail of a bear (Ancient Greeks and Native Americans)

# Constellations can vary greatly between cultures



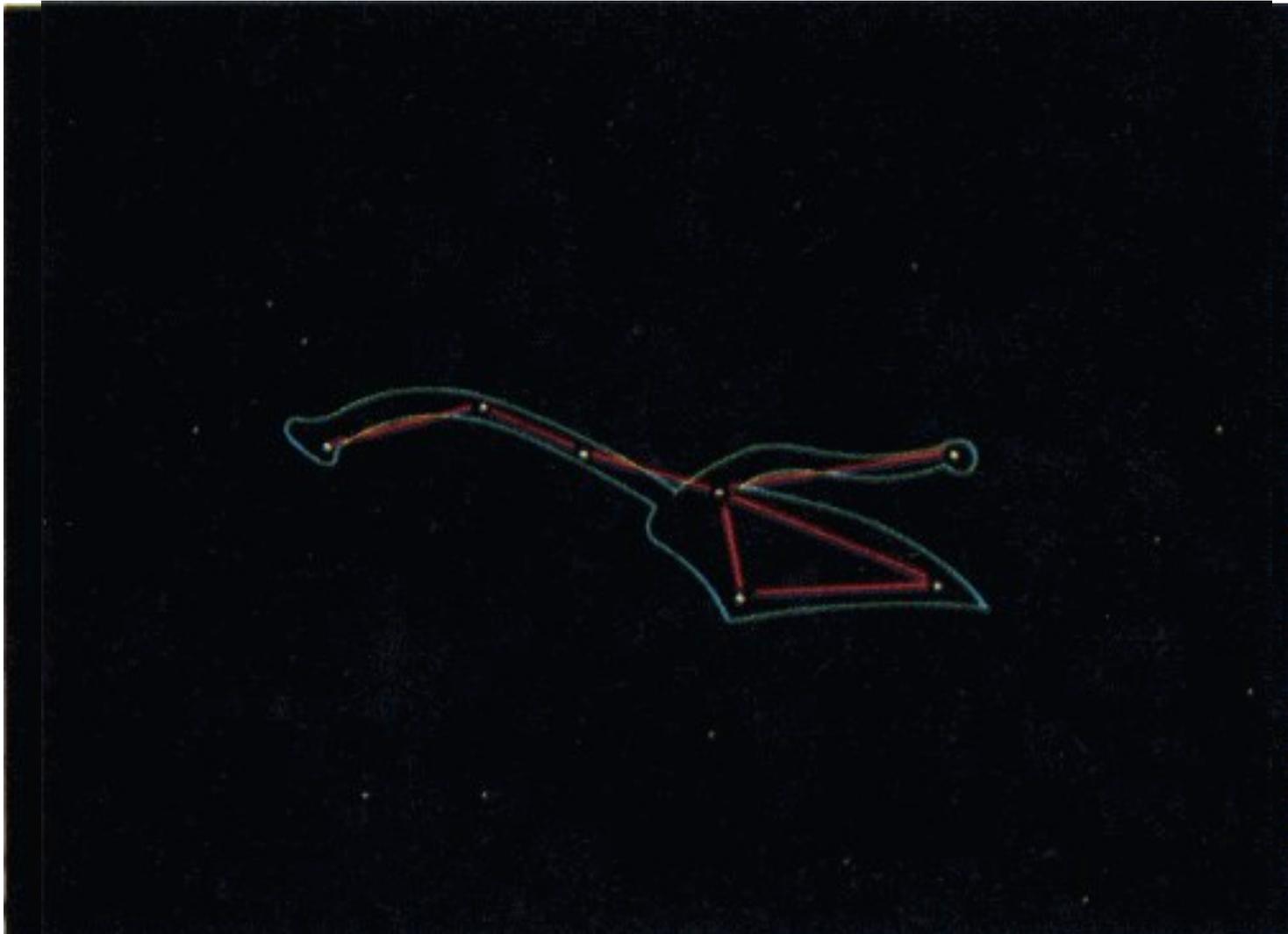
Bull, man, hippopotamus, crocodile (Ancient Egypt)

# Constellations can vary greatly between cultures



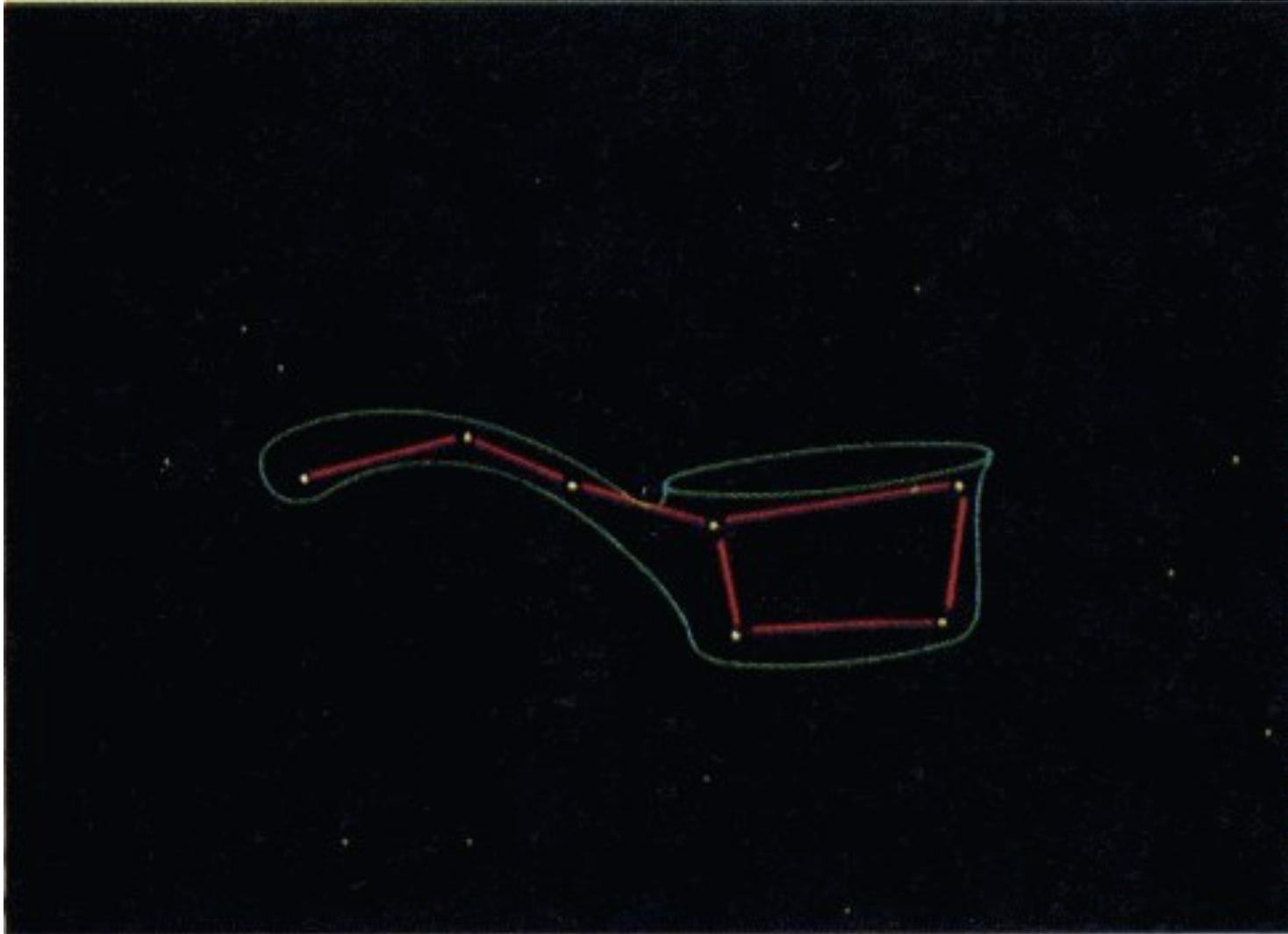
Celestial Bureaucrat (China)

# Constellations can vary greatly between cultures



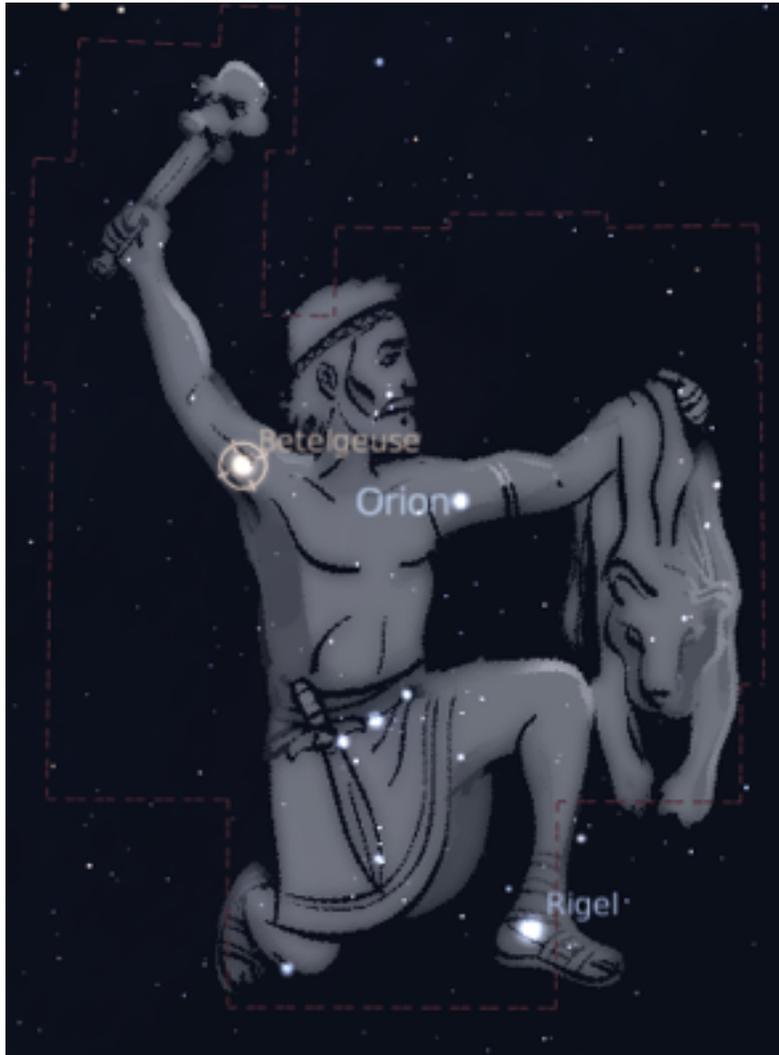
Plow (England)

# Constellations can vary greatly between cultures



Big Dipper (Modern North America)

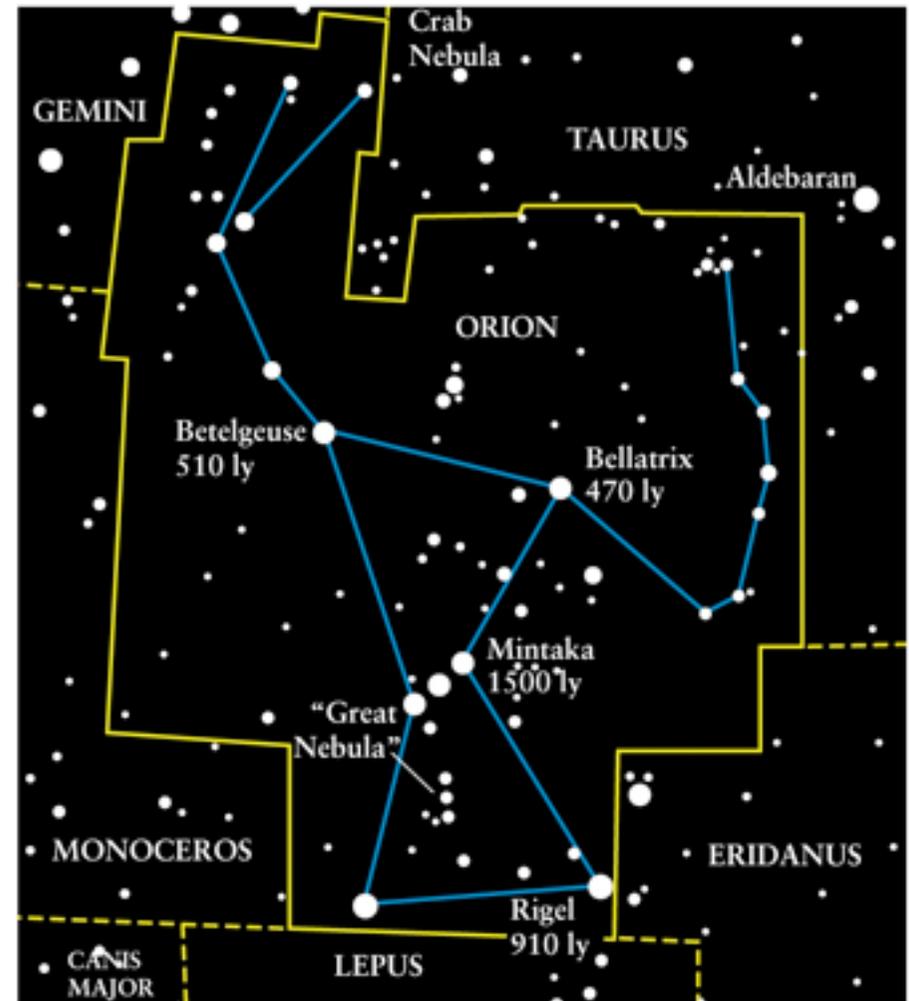
# Orion the Quarterback?



# Constellations Today

For modern astronomers:

- ▶ constellations are **regions** of the sky
- ▶ completely cover the sky like states on a US map
- ▶ not just stars in “connect the dots”
- ▶ every star lies in exactly one constellation

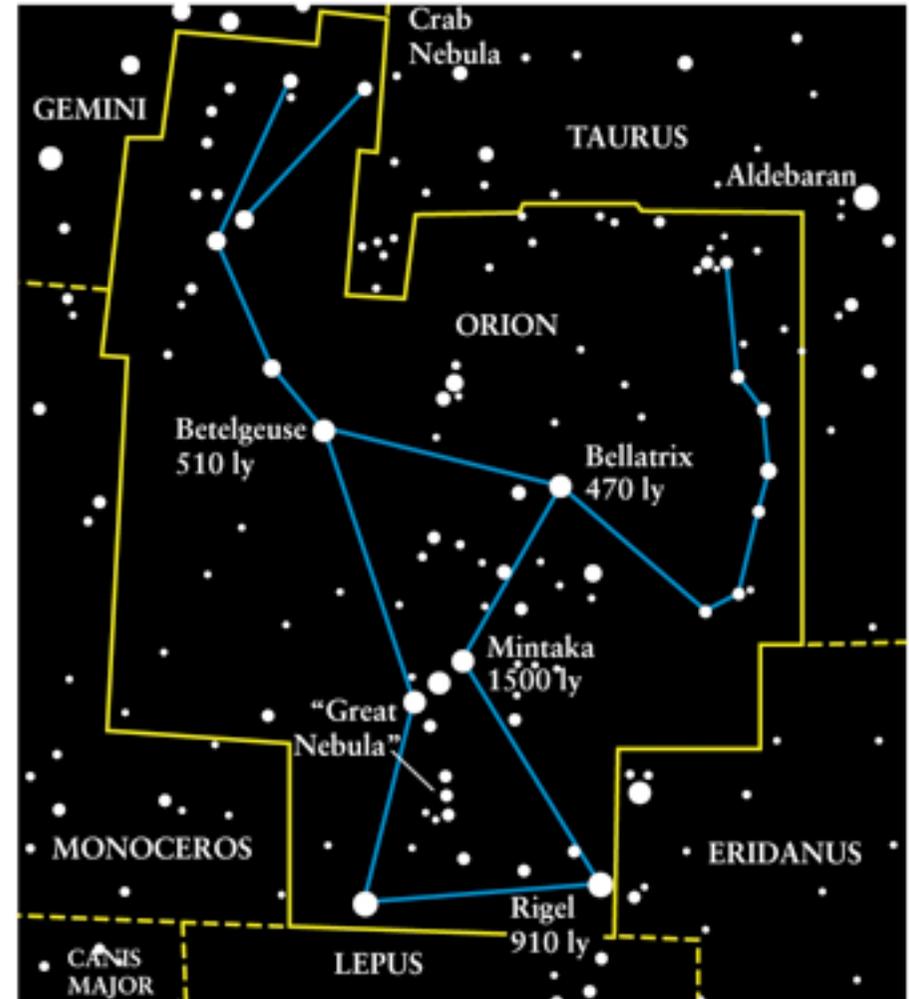


b

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b

Questions so far?

# Cosmic Roadkill

Crucial fact of astronomical life:

- ▶ **distances** to stars (and Sun, Moon, planets) hard to measure
- ▶ distances not obvious to naked eye

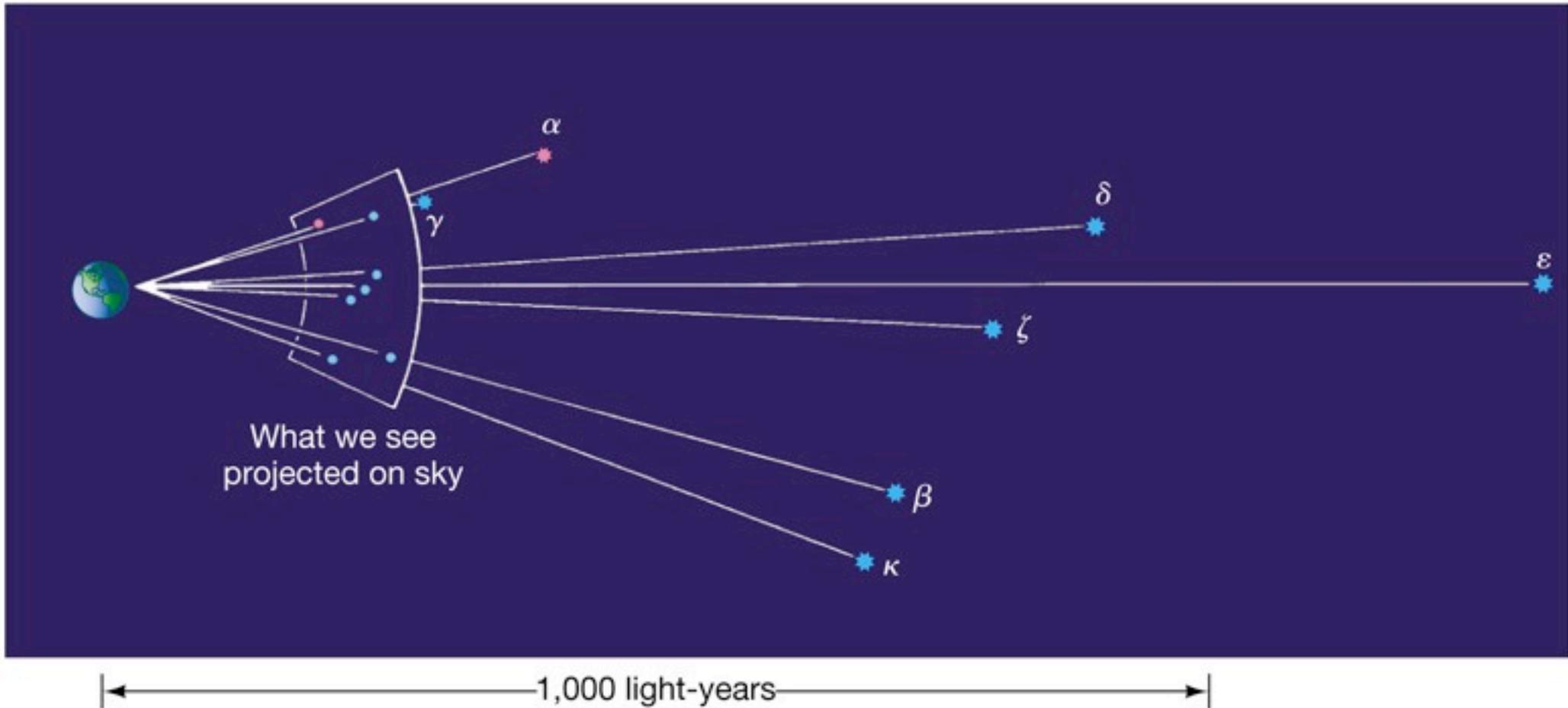
The sky shows **no “depth”**

- ▶ in reality, stars spread over a 3-dimensional volume in space
- ▶ but eye can't tell distance, so stars appear “flattened” onto 2-dimensional sky

Always must keep in mind difference:

- ▶ what you observe: 2D sky, versus
- ▶ what's really going on: 3D space

# Stars that appear close in the sky may not actually be close in space



**The only thing the stars in Orion have in common is that they lie in approximately the same direction from Earth.**

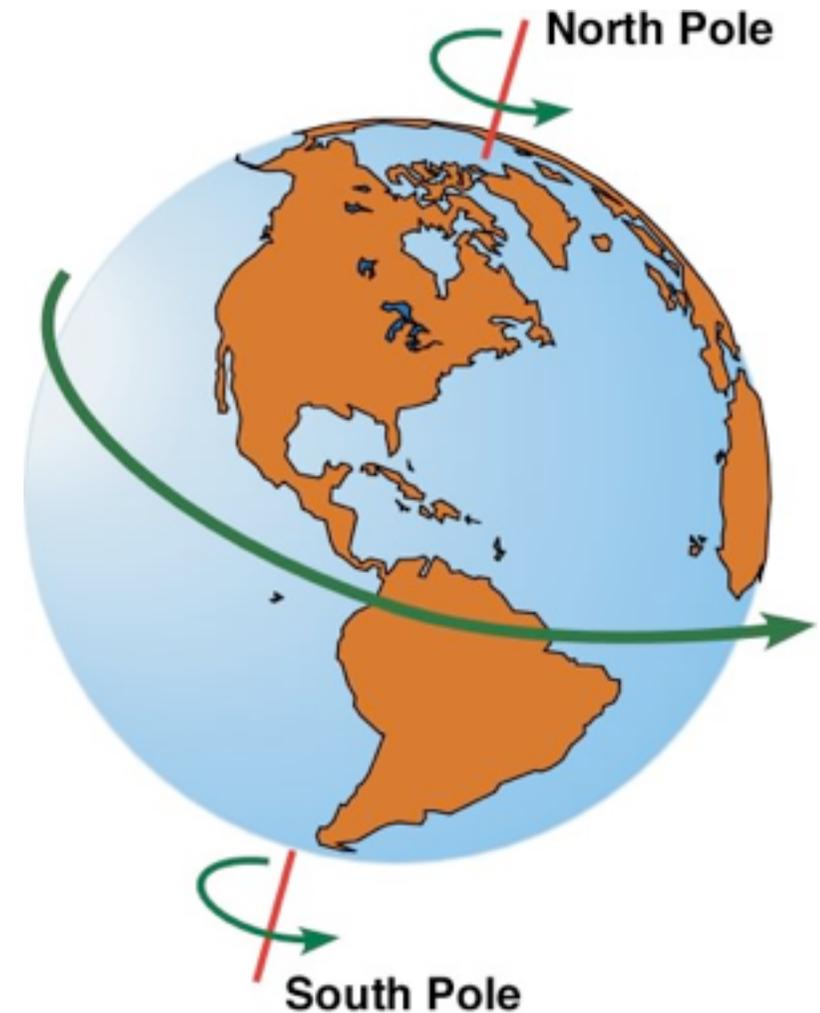
# The View from the Merry-Go-Round

We observe stars while riding on a spinning planet

- ▶ Earth spin about axis once daily

So stars appear to move in the sky as do Sun, Moon, planets

- ▶ rise in the east
- ▶ set in the west
- ▶ period = time for one cycle in sky = 1 day



# iClicker Poll: Star Trails

Imagine you could see paths (“trails”) of all stars as each moves across the night sky

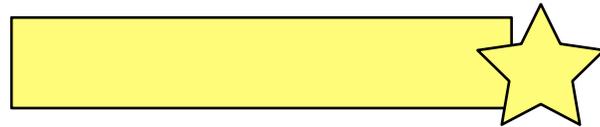


**What pattern would you see?**

- A. arcs of circles**
- B. arcs of ovals**
- C. parallel line segments**
- D. none of the above**

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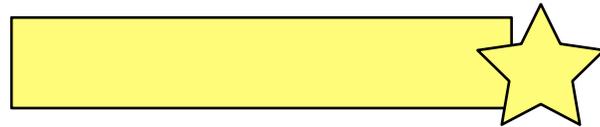


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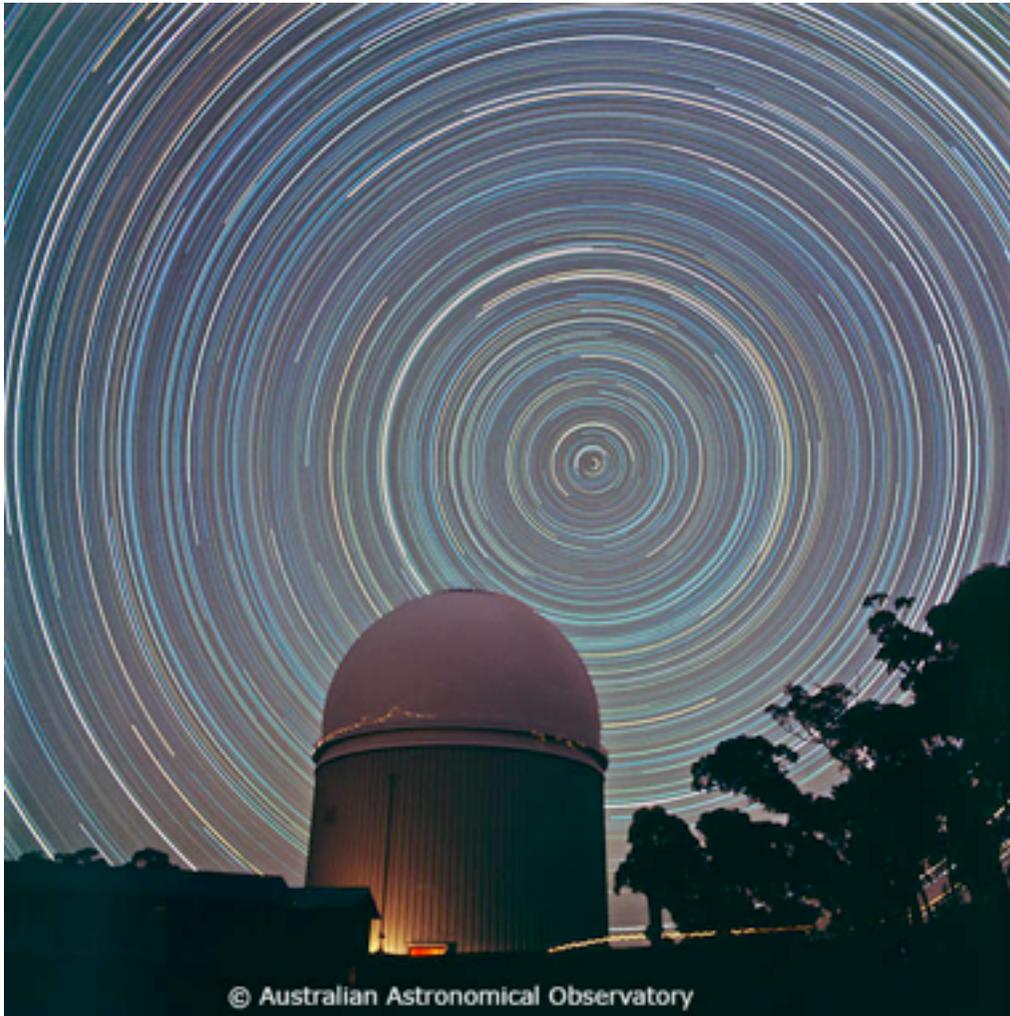


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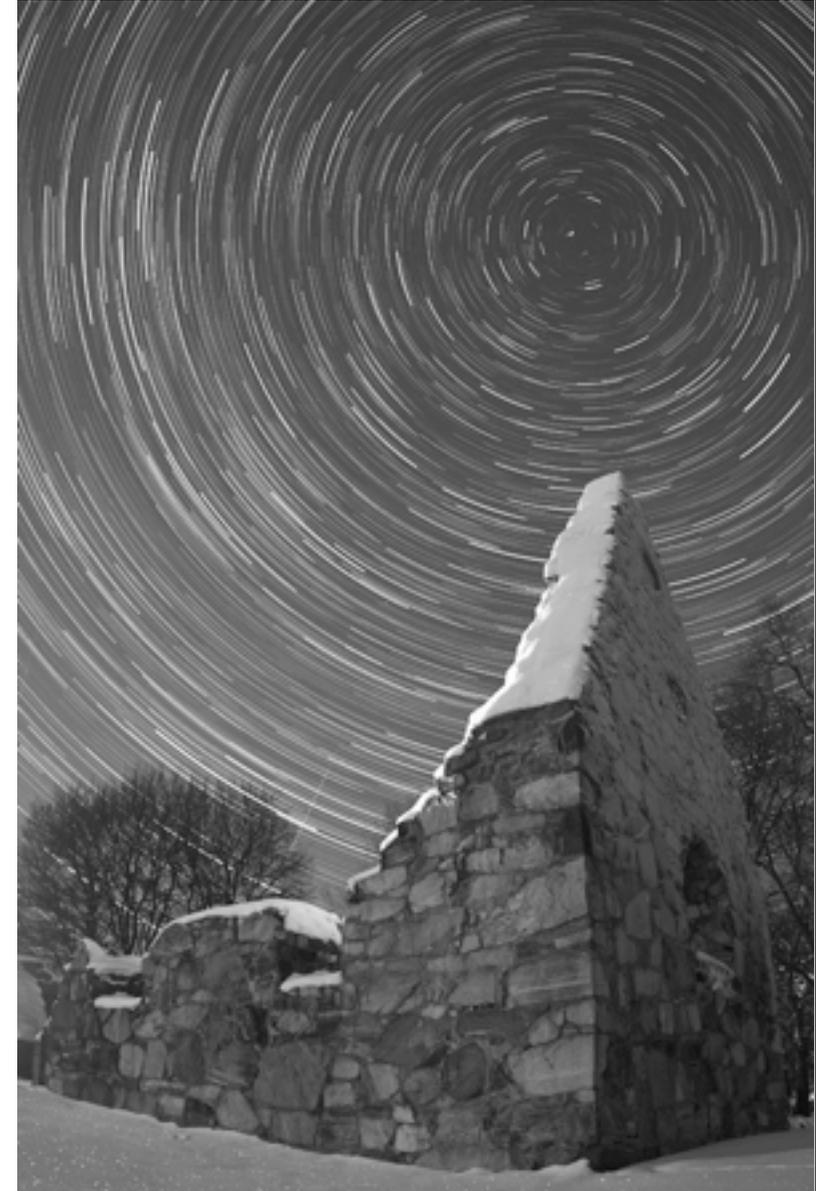
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How could we do this experiment?

# Star Trails

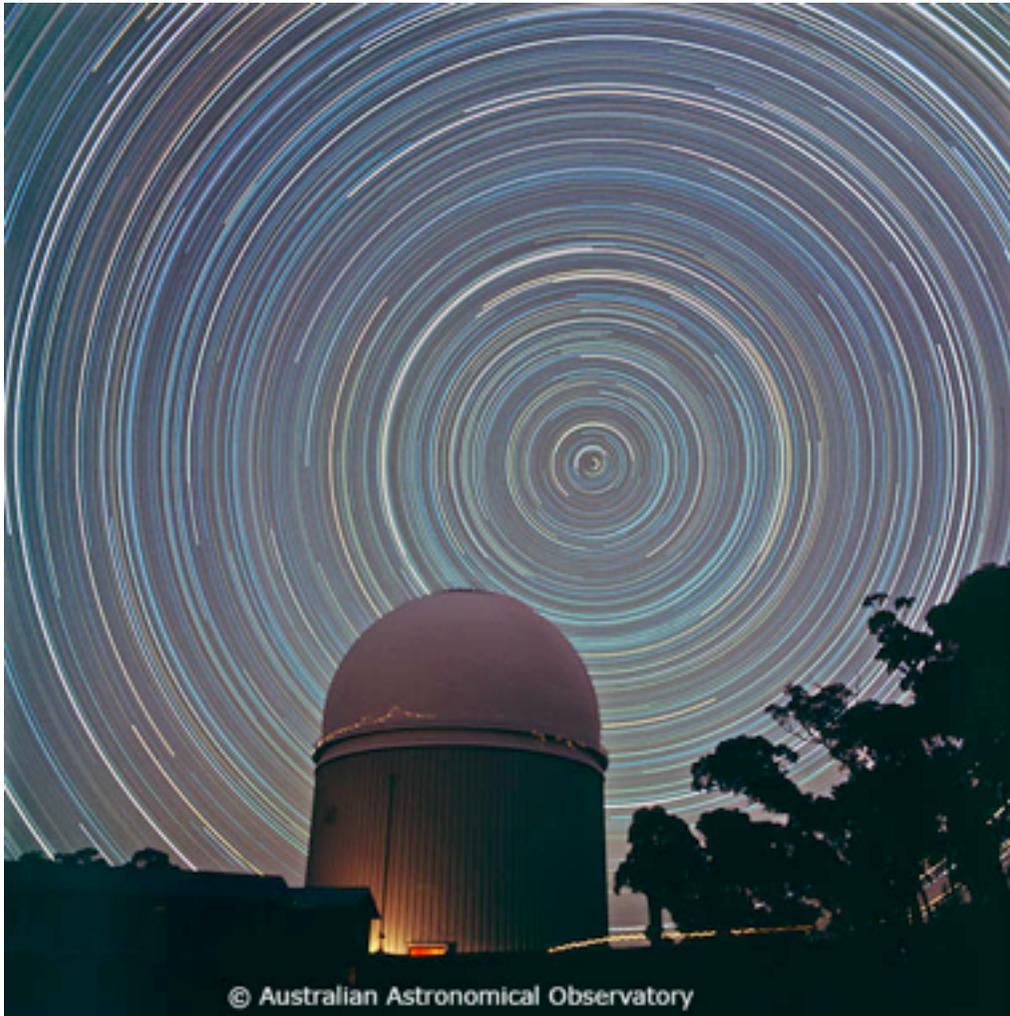


star trails as seen in  
Southern Hemisphere (Australia)



star trails as seen in  
Northern Hemisphere

# Star Trails



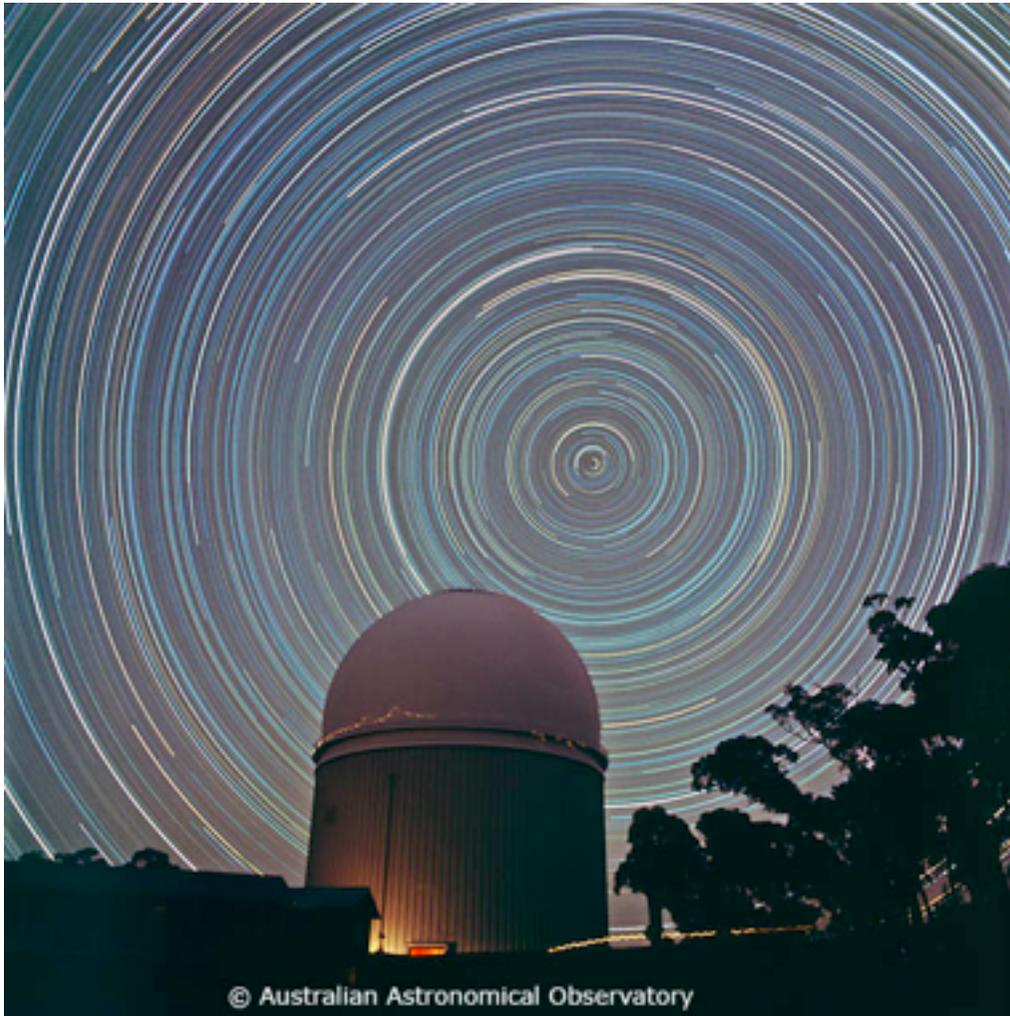
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Polaris = North Star



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# Star Trails



star trails as seen in  
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Polaris = North Star  
Are these apt names?

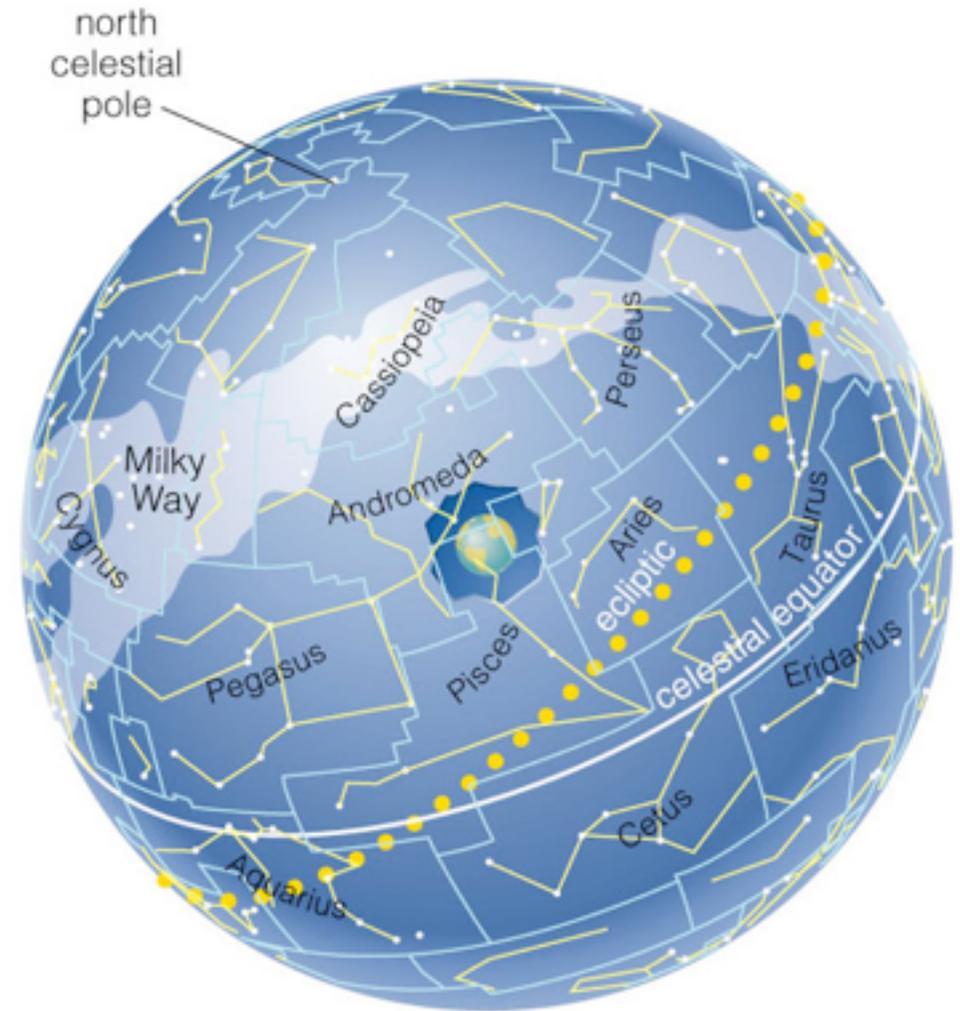


star trails as seen in  
Northern Hemisphere

# The constellations appear to fill a great celestial sphere

Stars seem to be on the inside of a sphere around the Earth

A useful model for describing the sky  
In reality, stars are scattered through space at different distances



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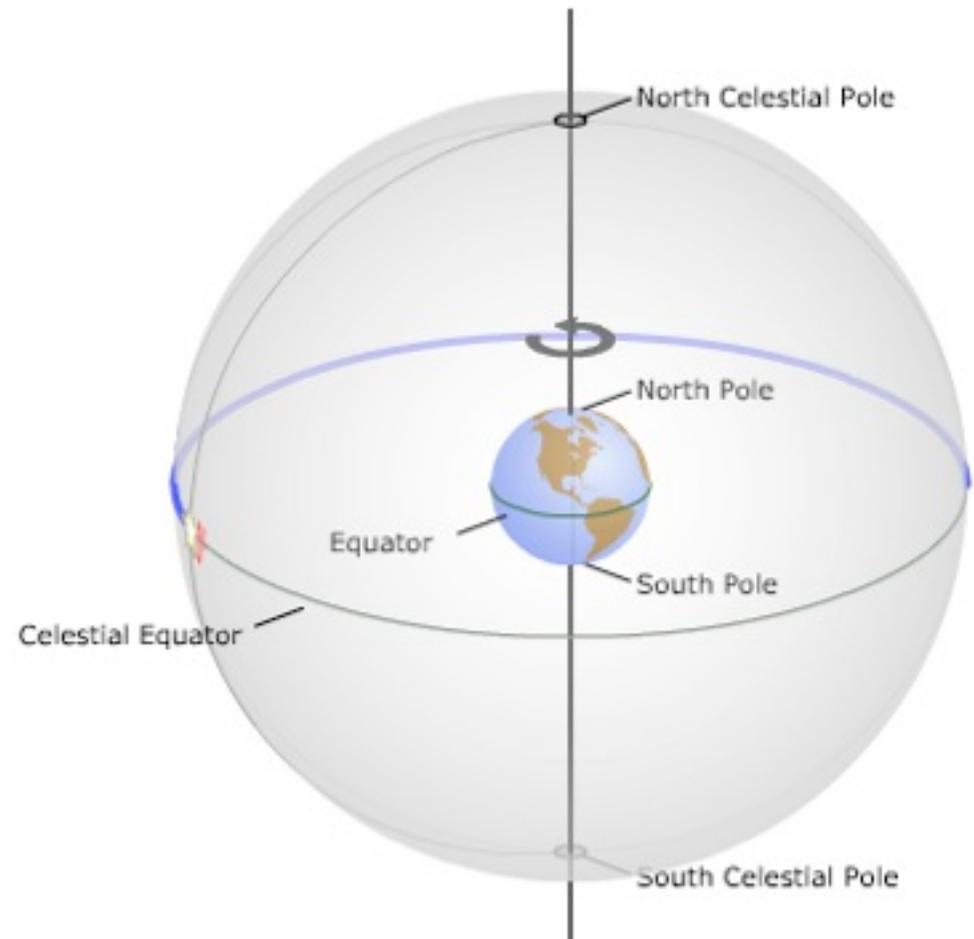
# Celestial poles and equator

## Celestial poles

- ▶ Projections of the Earth's north & south poles onto the celestial sphere

## Celestial equator

- ▶ Projection of the Earth's equator onto the celestial sphere



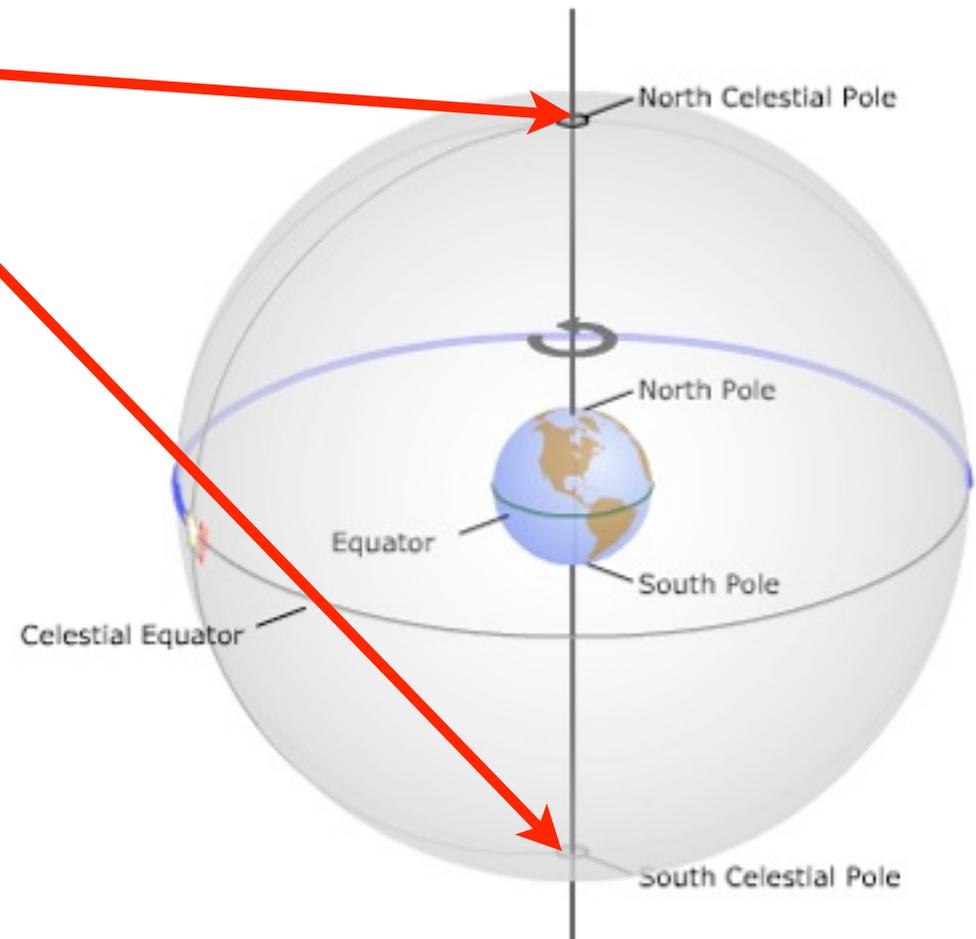
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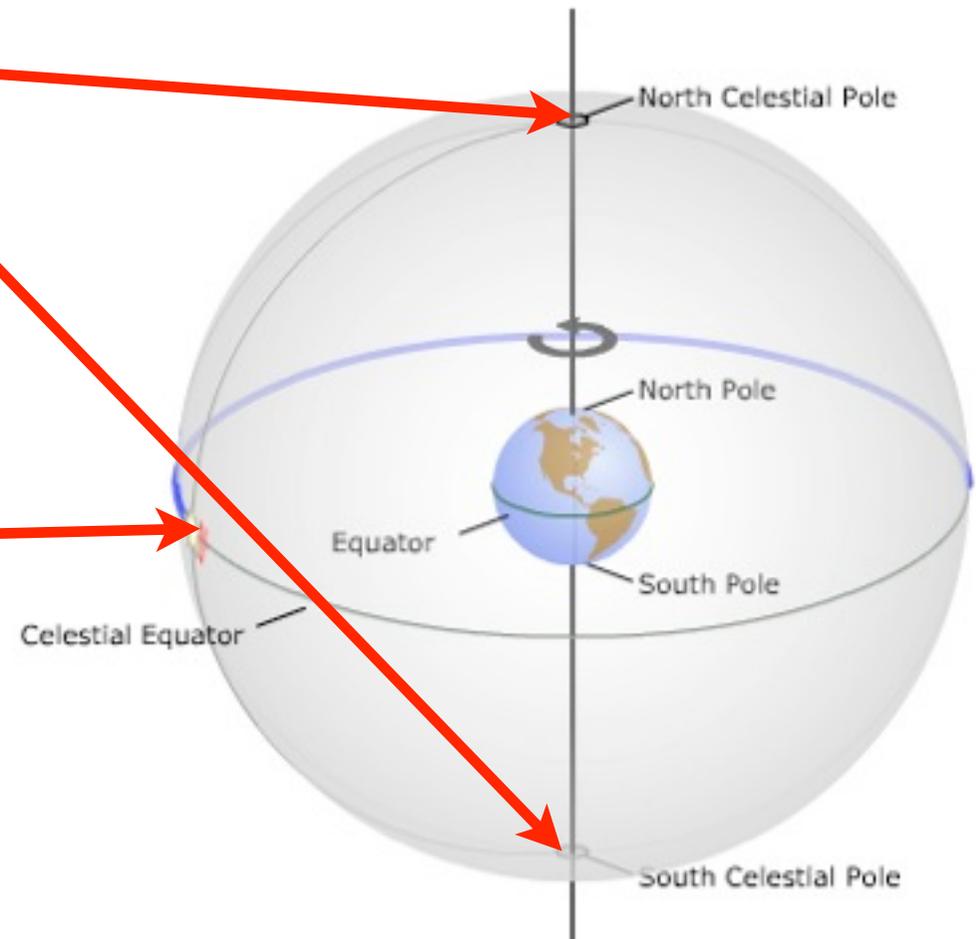
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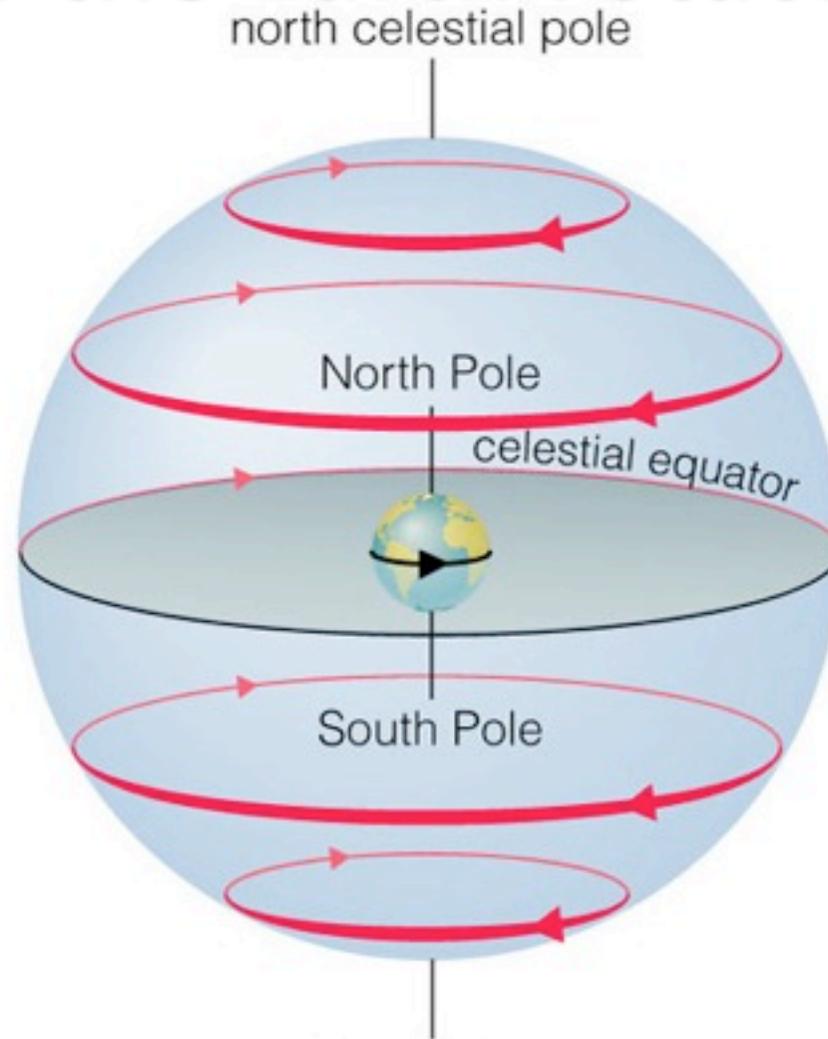
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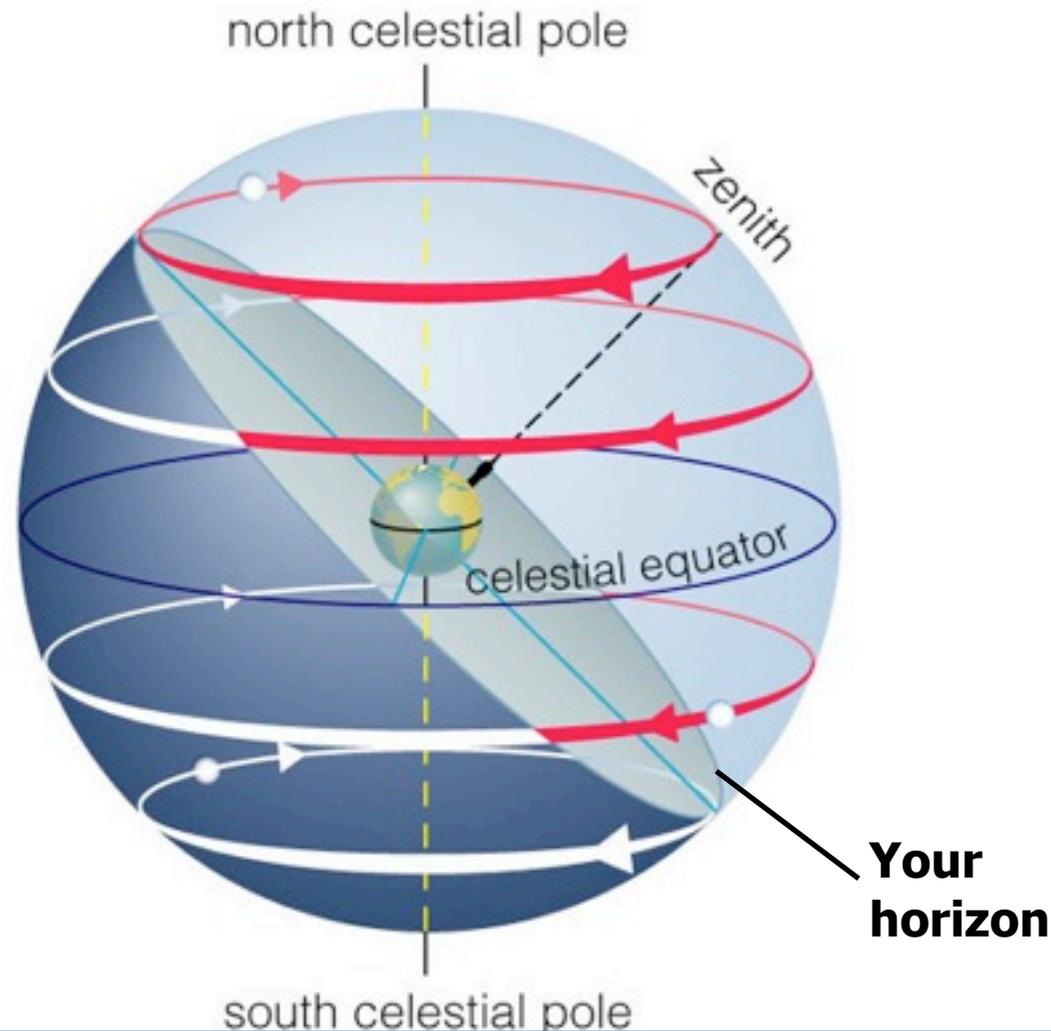


# How does the sky appear to move as the Earth rotates?



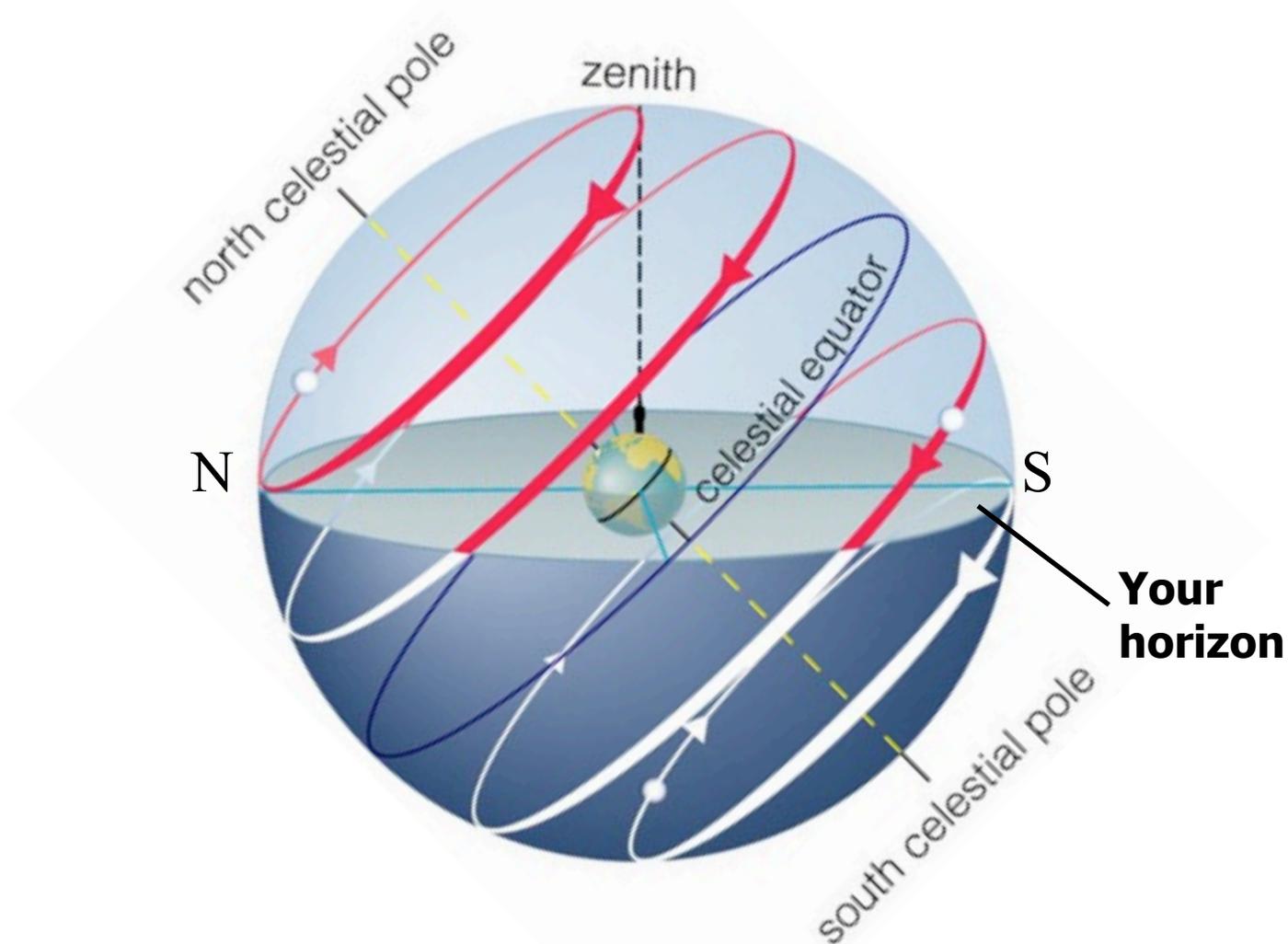
**Earth rotates west to east on its axis, so stars appear to circle from east to west about the celestial poles**

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# Polaris, the North Star

Polaris is a star that appears very close to the North Celestial Pole

The whole sky appears to turn around it

If you find Polaris, you know which north is!

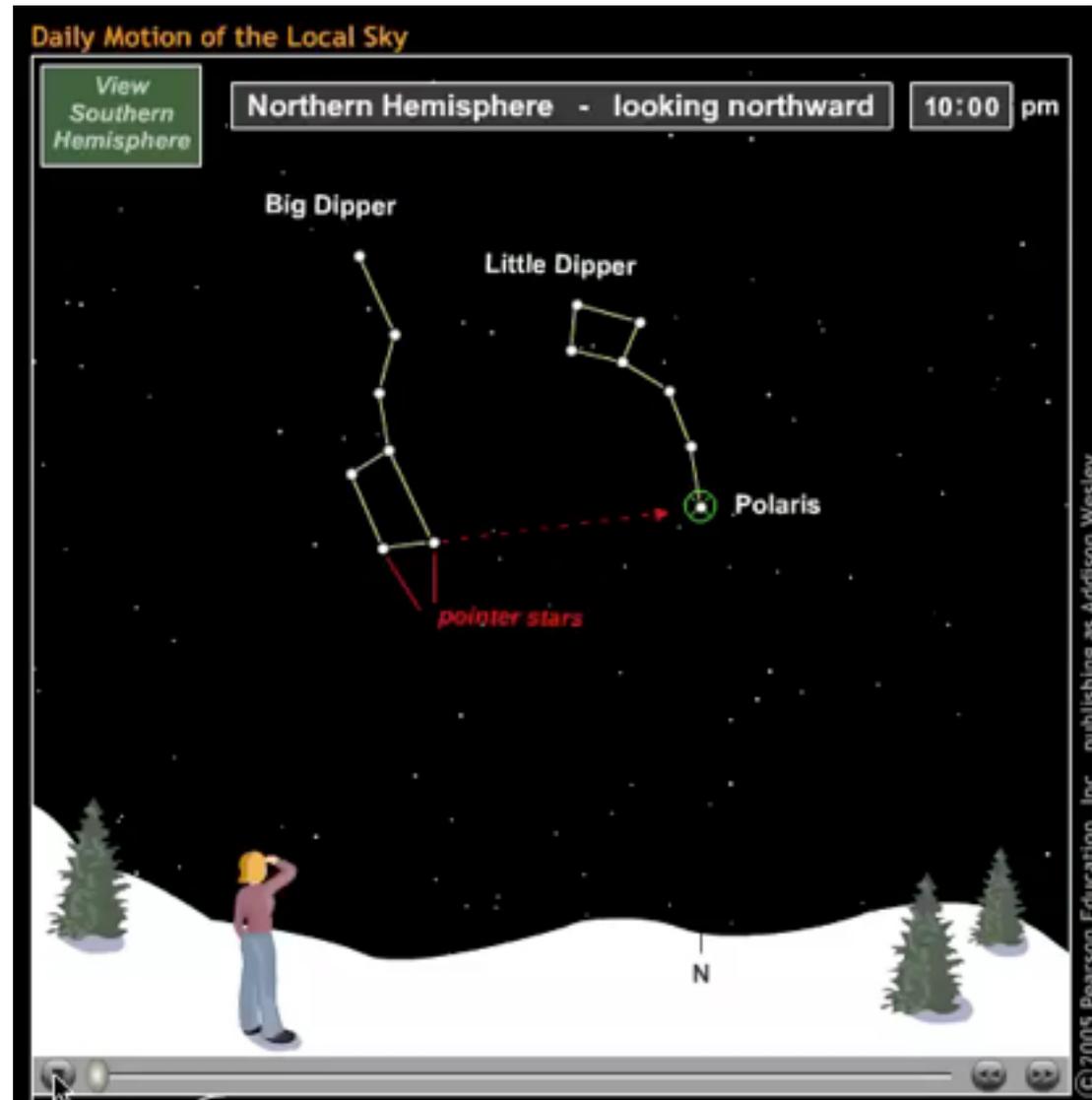


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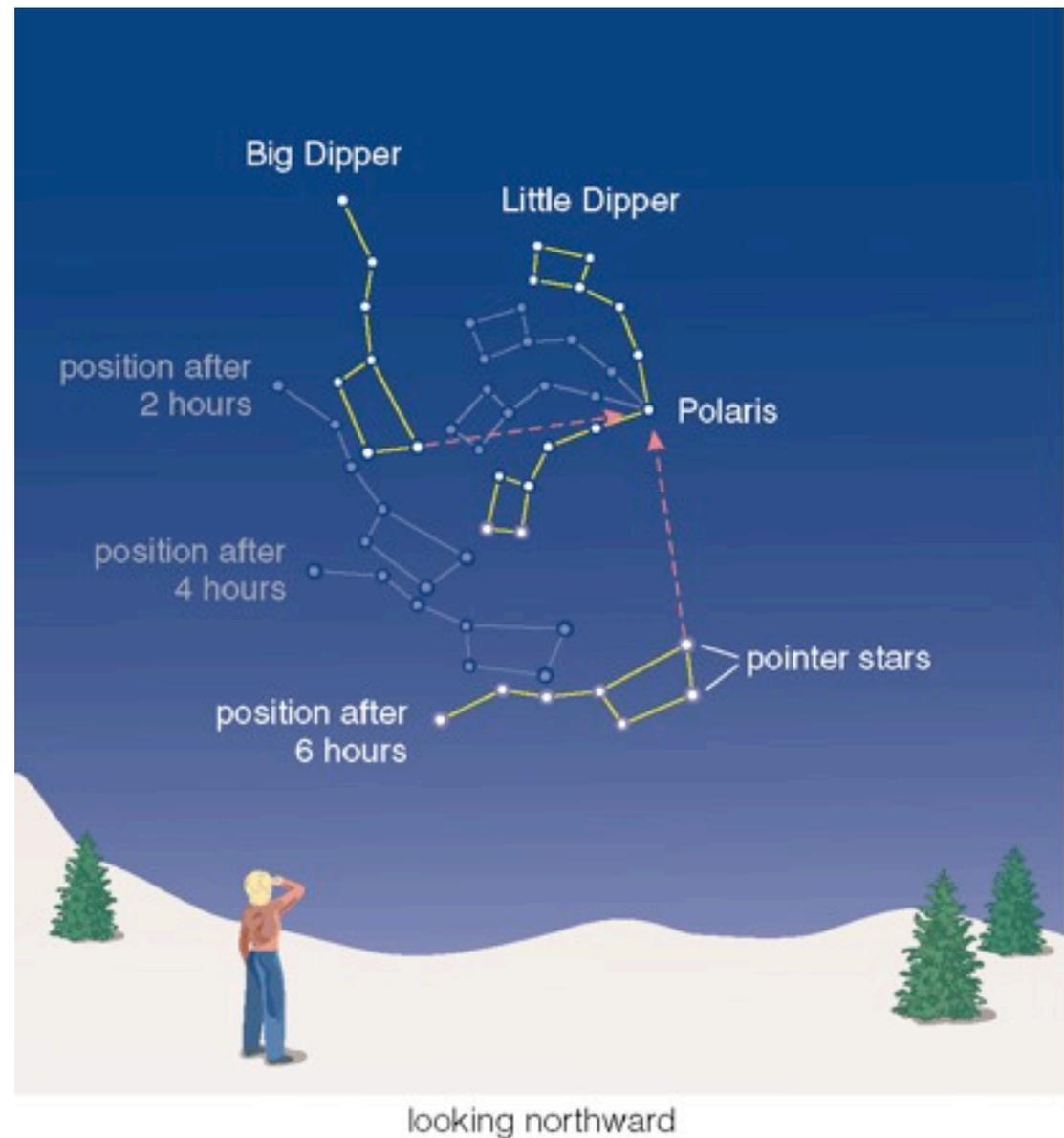


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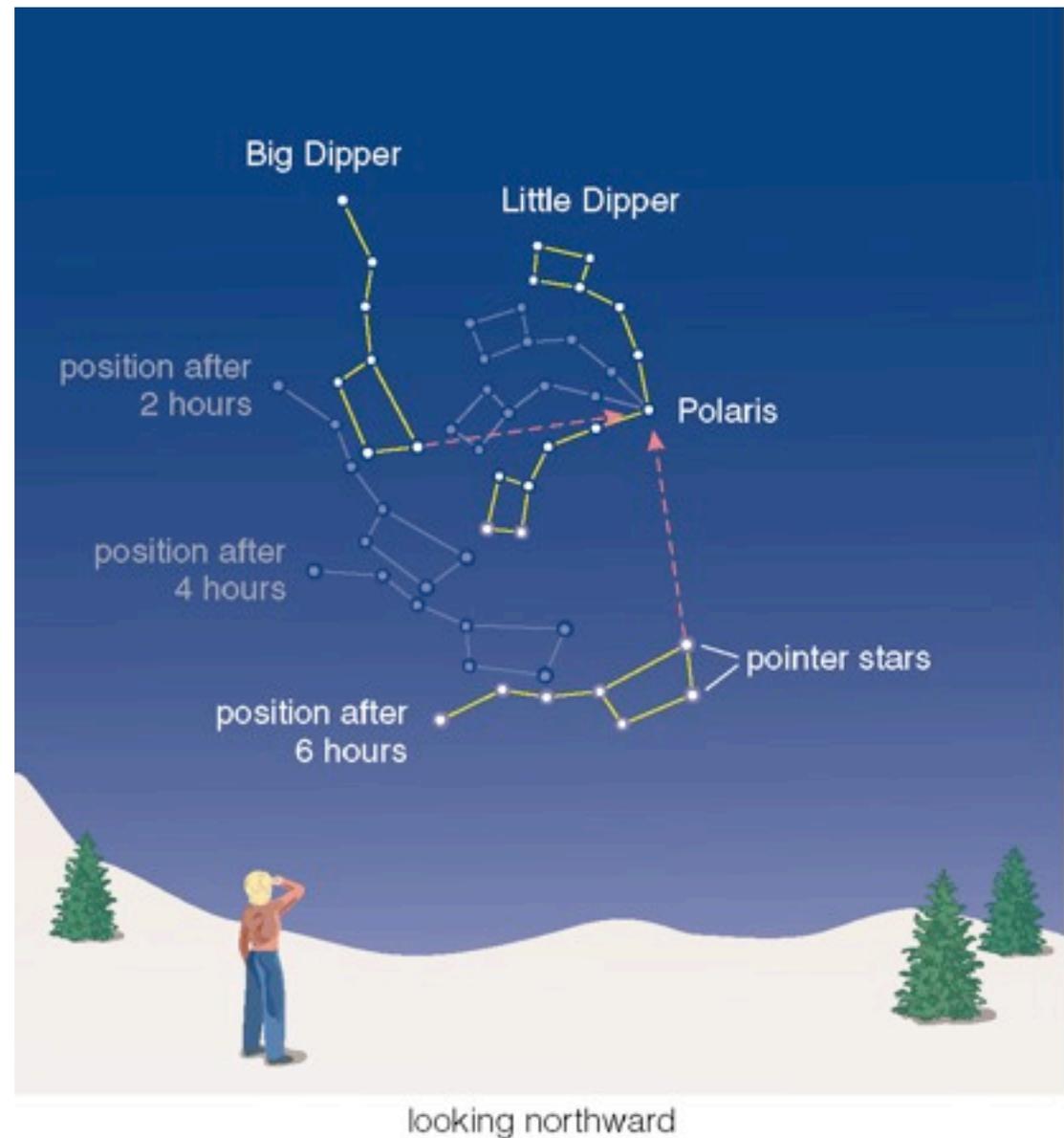
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**Follow the drinking gourd**

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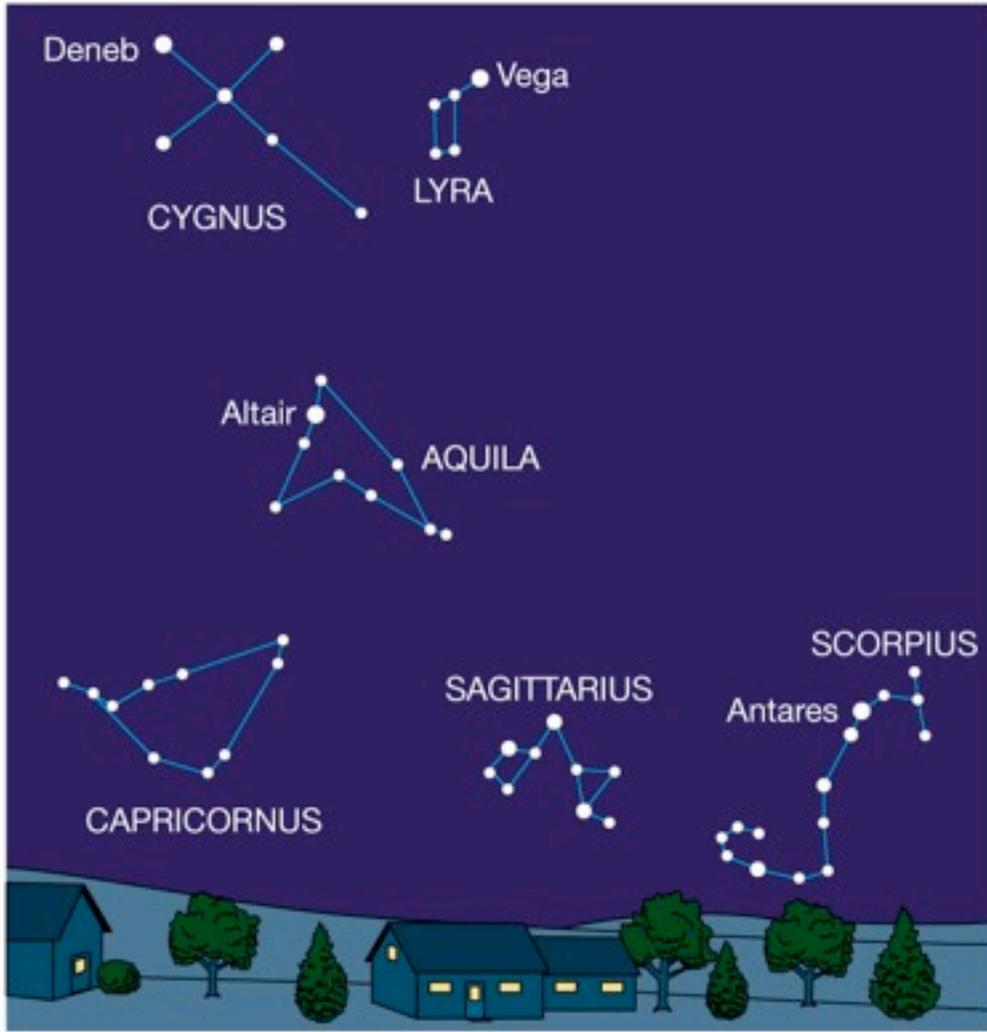
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# Why don't we see the same constellations throughout the year?

Summer

Winter



(a) Southern horizon, Summer

(b) Southern horizon, Winter

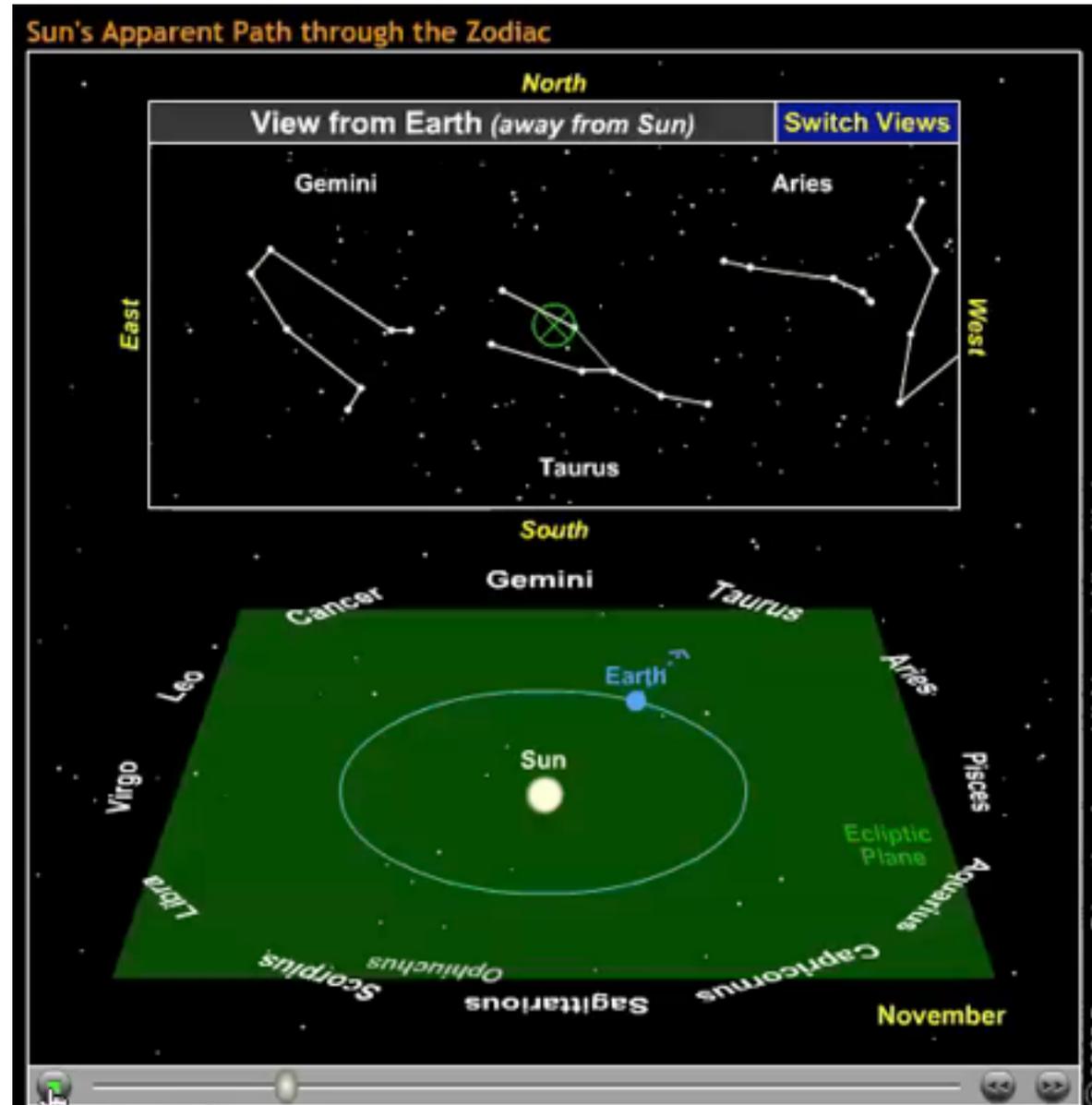
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# Earth's orbit around the Sun causes a "seasonal migration" of

Stars in the direction away from the Sun are visible at night

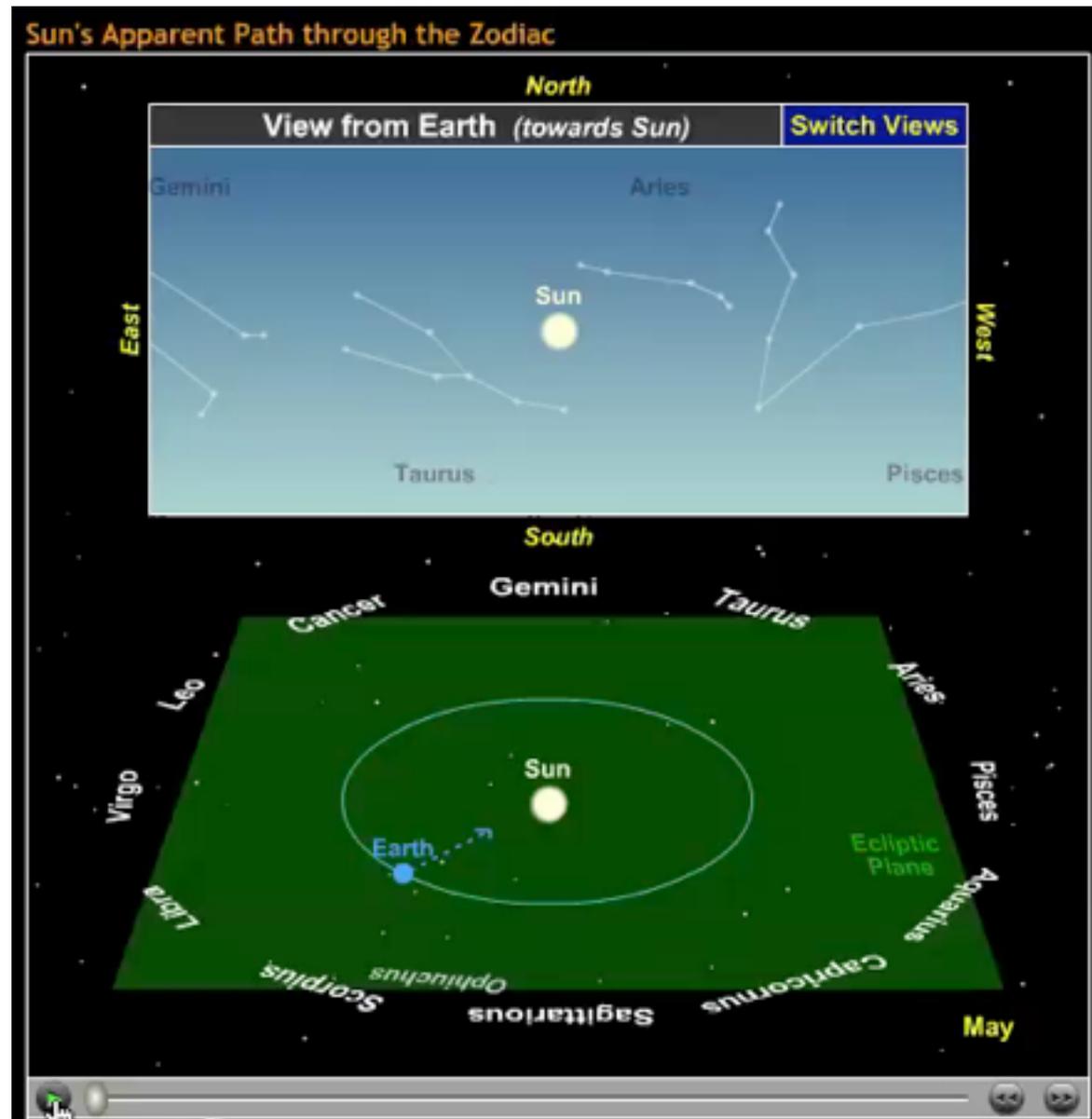
In May, Scorpius is visible at night

In November, Taurus is visible at night



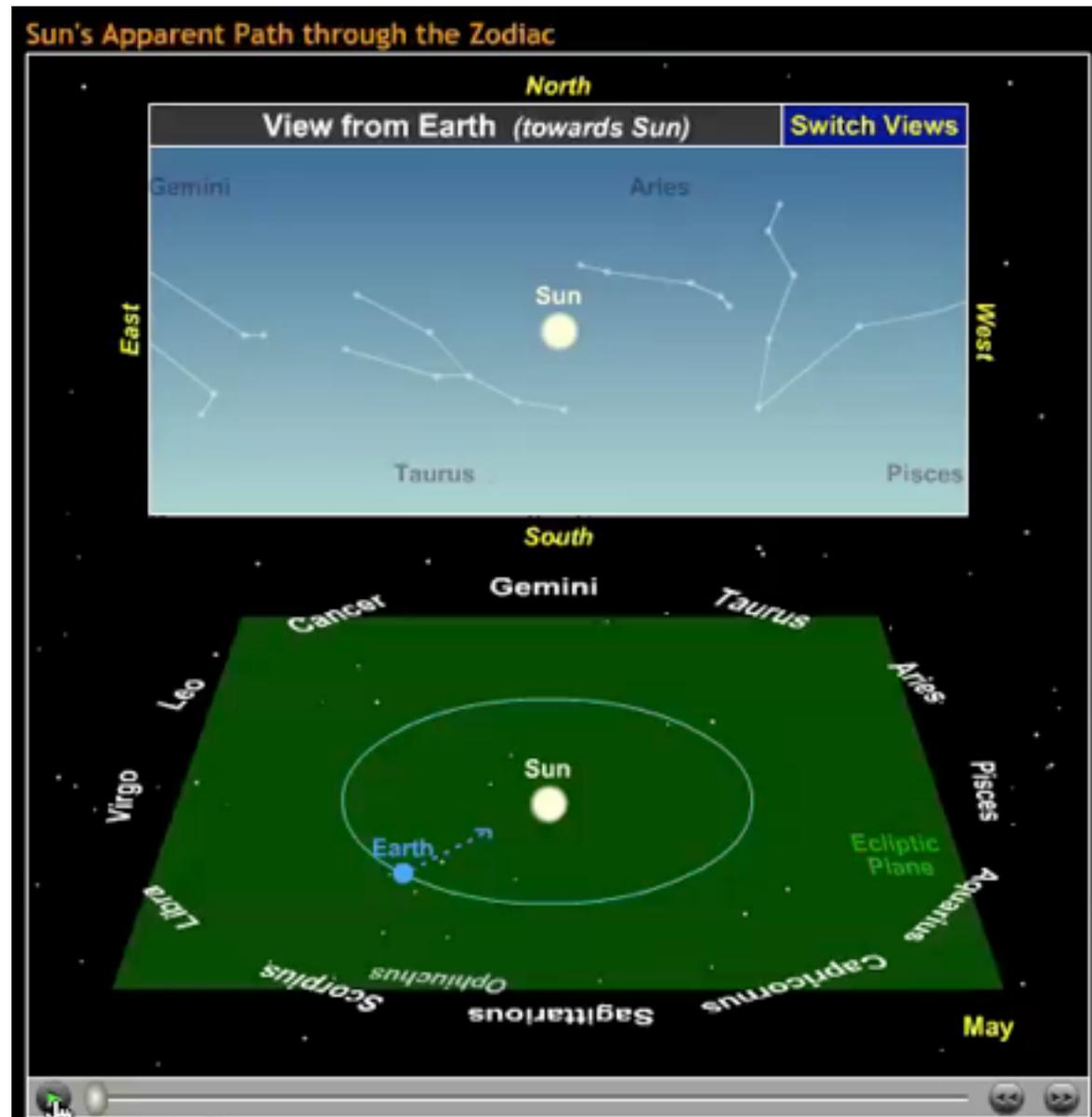
# The Sun's Apparent Path through the Zodiac

If we could see the stars during the day, the Sun would appear to move relative to the stars. One full circuit in one year traces out a path through the Zodiac.



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Questions?

# Constantly Changing Moon



Over the course of about a month, we see the moon go through a series of *phases*

# Names of the Phases



new (Moon not seen)



waxing crescent



first quarter



waxing gibbous



full



waning gibbous



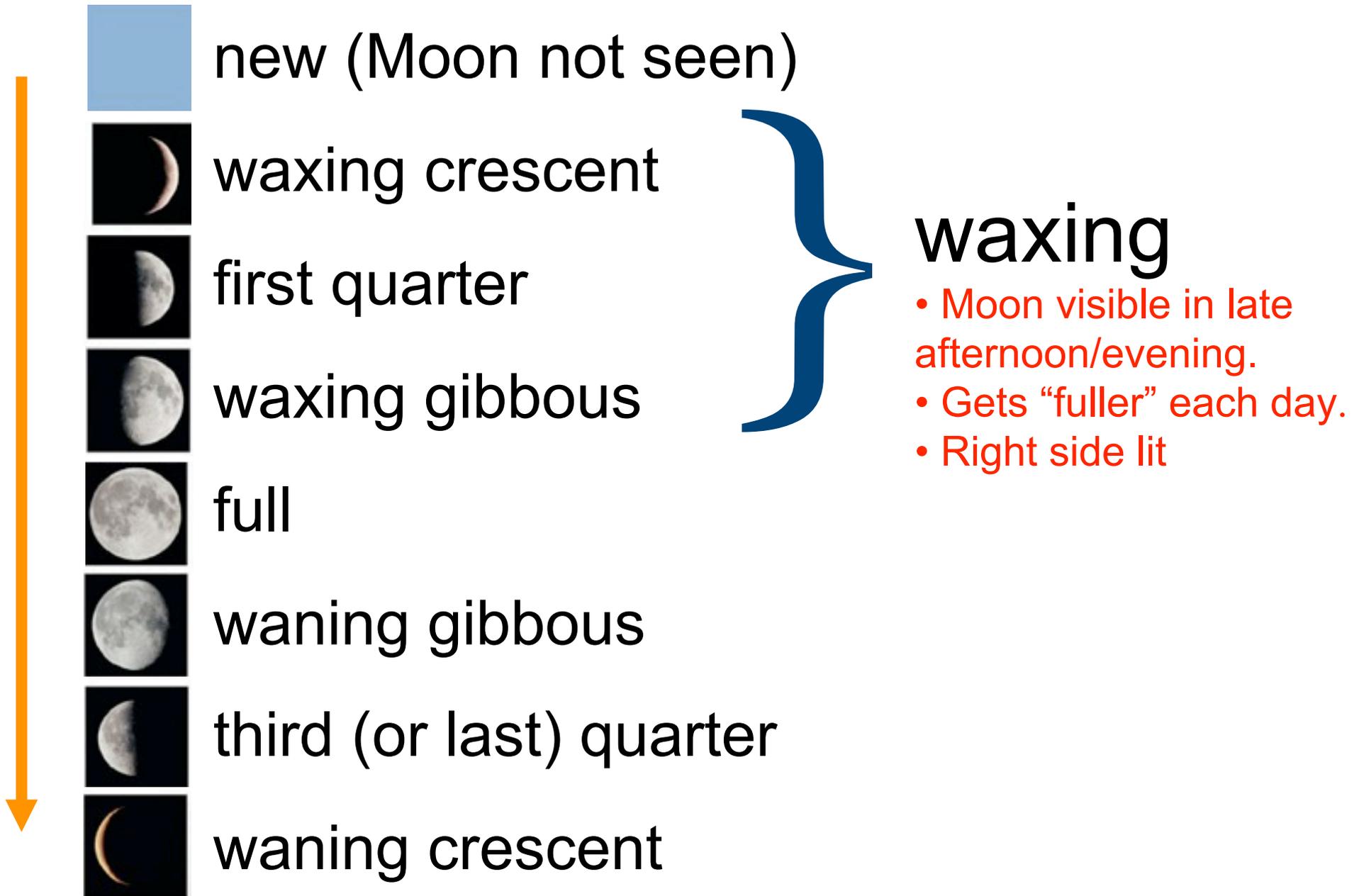
third (or last) quarter



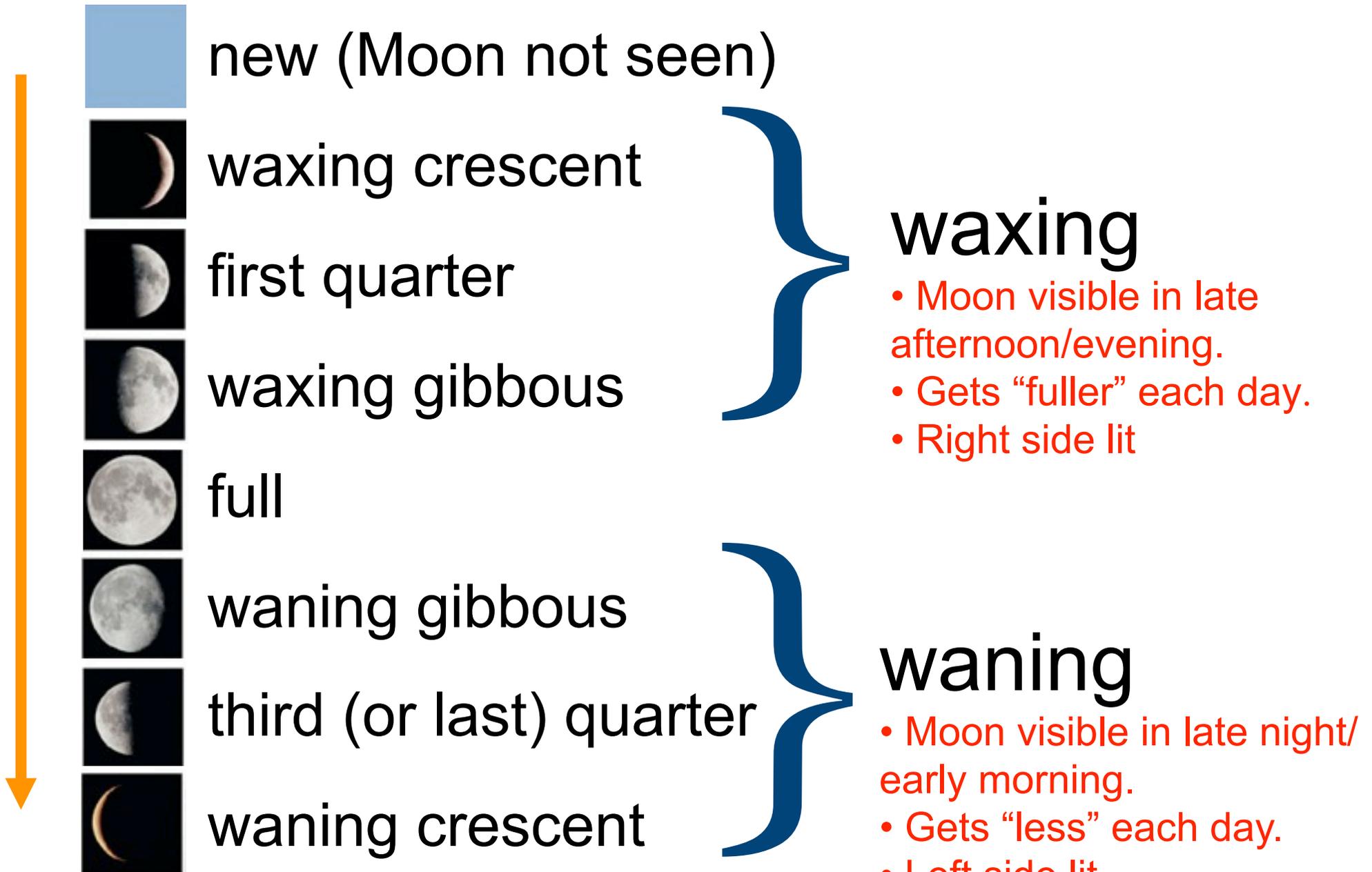
waning crescent



# Names of the Phases



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# Are the Moon's phases caused by Earth's shadow?

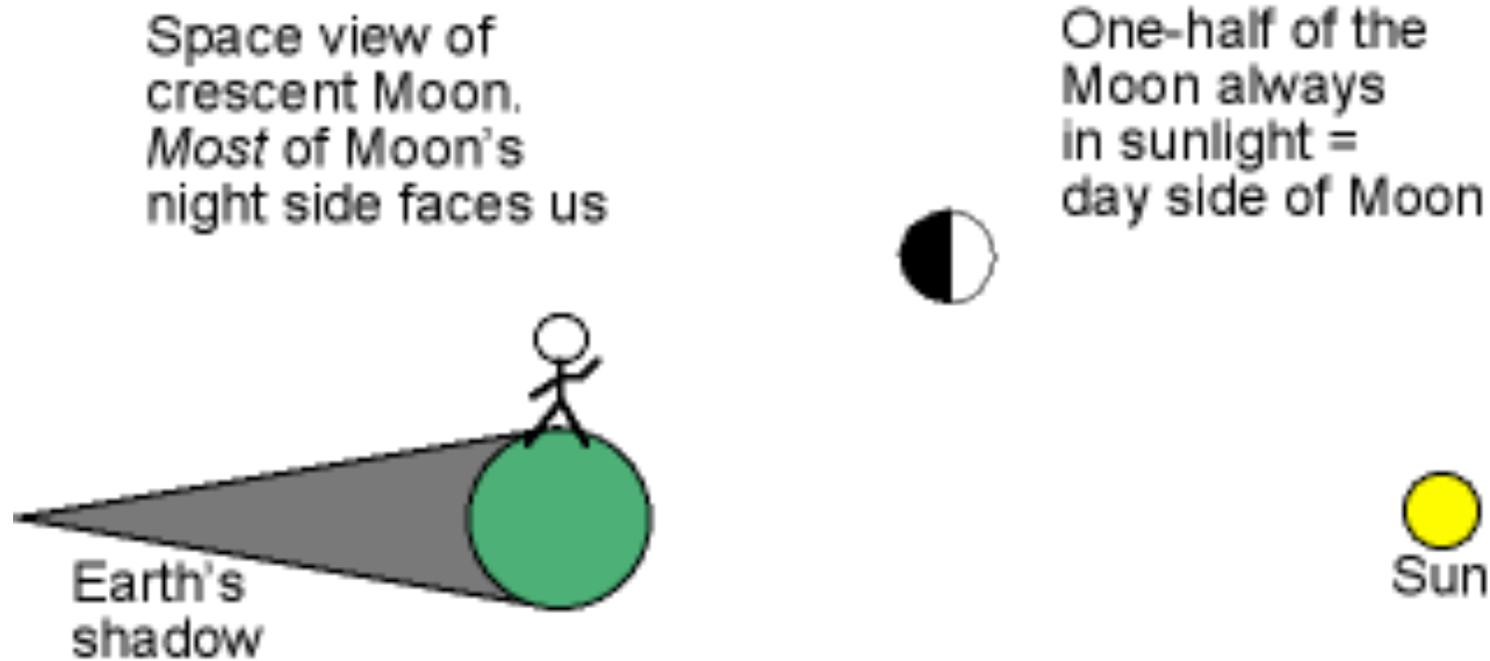
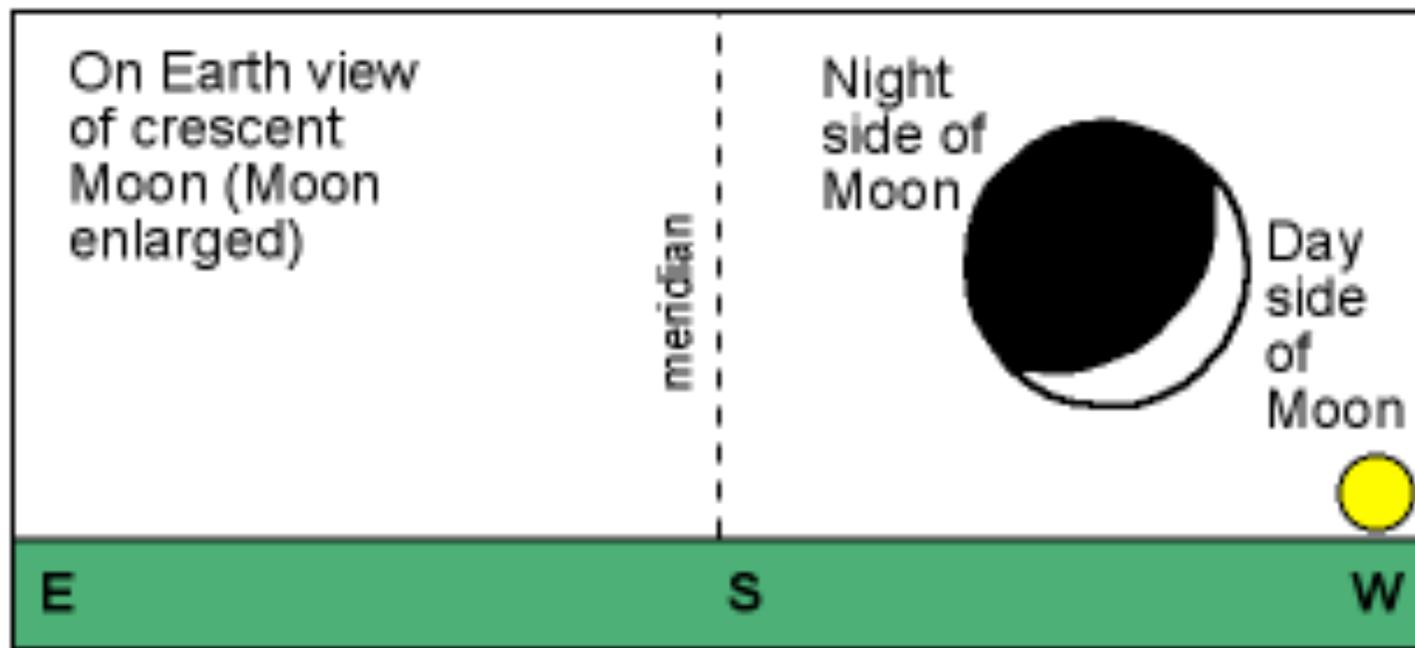


**If so, then a crescent moon (as at left) would occur when the Moon was *opposite* the Sun in the sky**

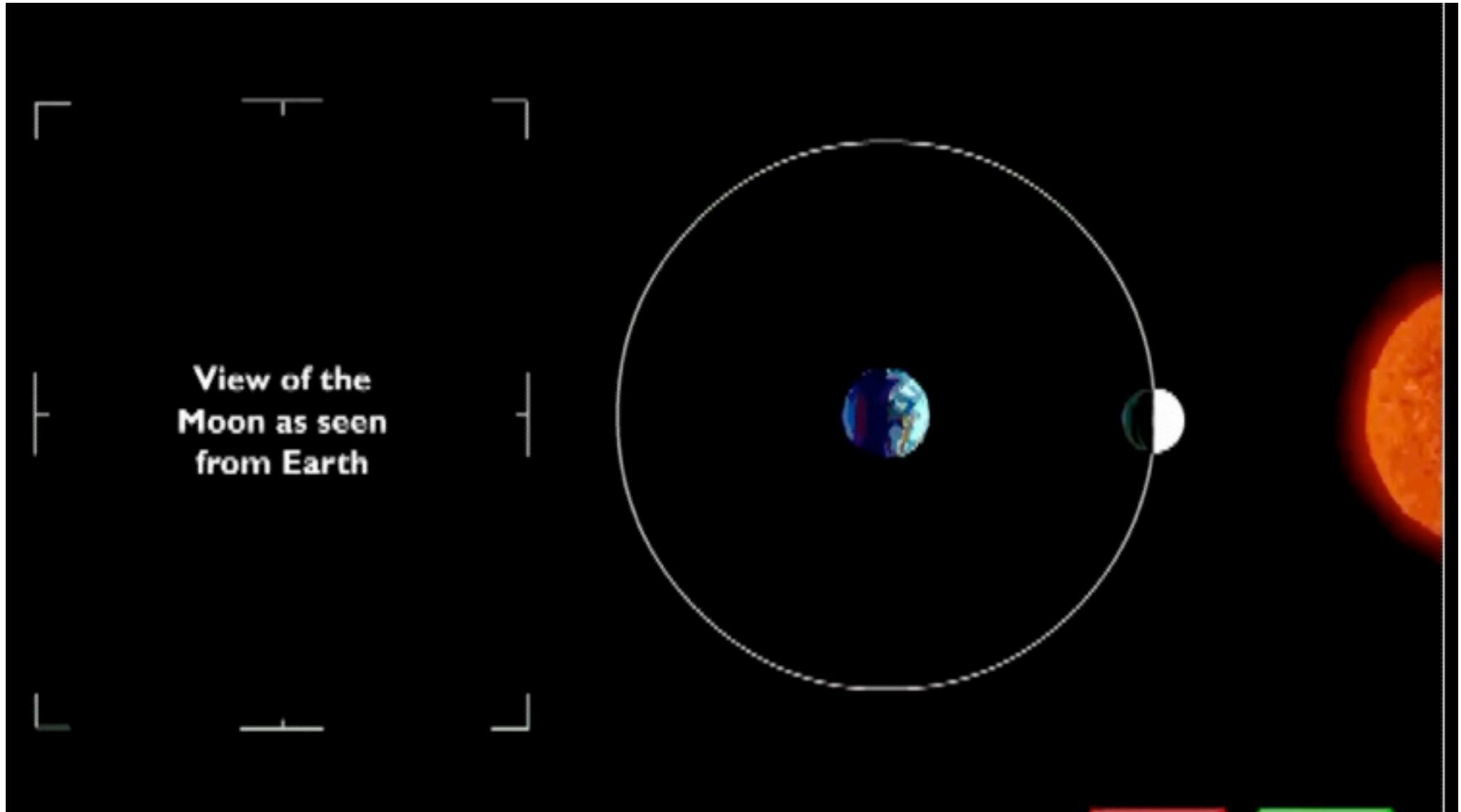
# A crescent moon is in the WEST at sunset



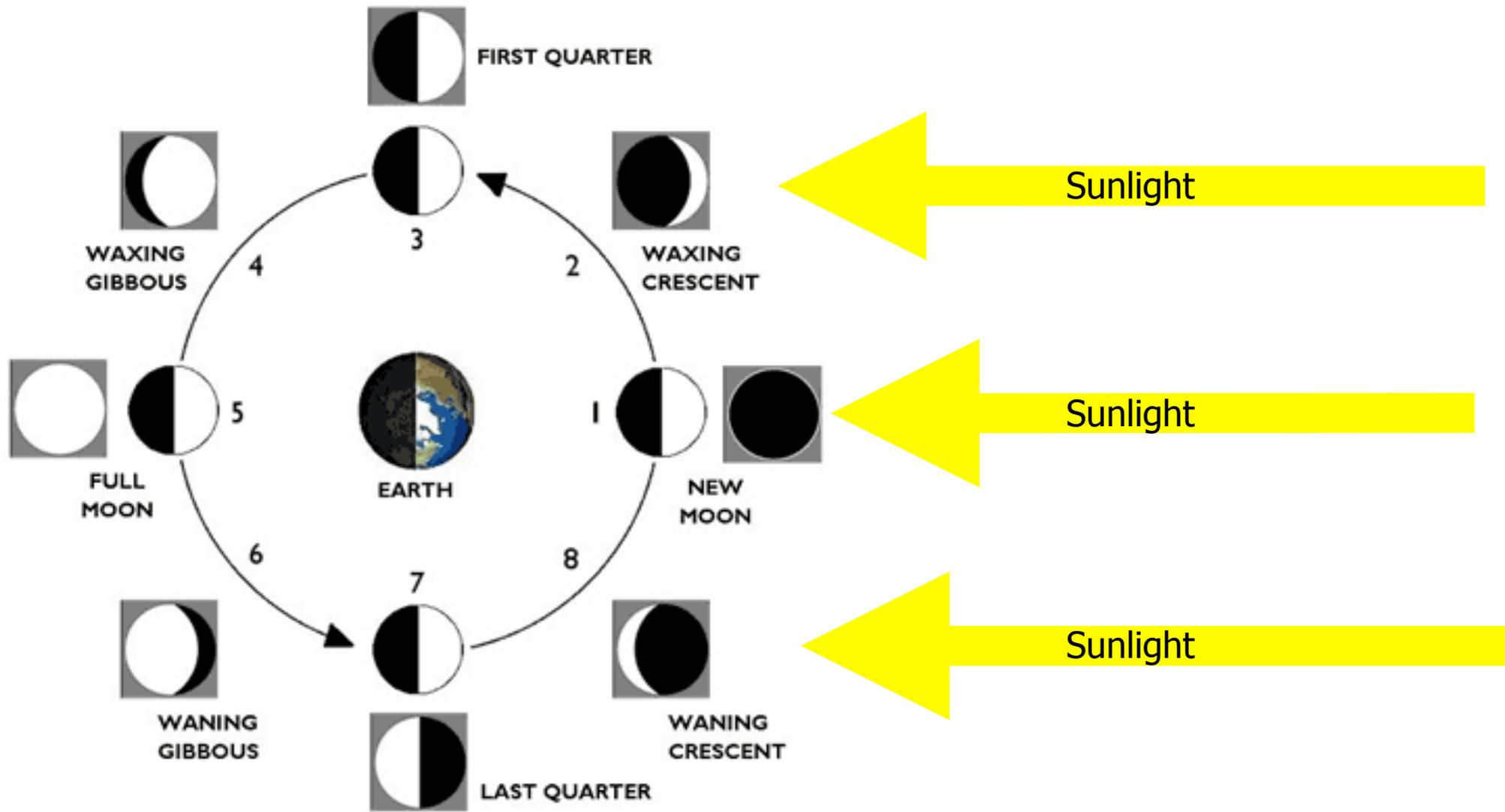
**A crescent moon is in the same direction as the setting Sun!**



**Lunar phases are caused by the relative positioning of the Earth, Moon, and Sun**

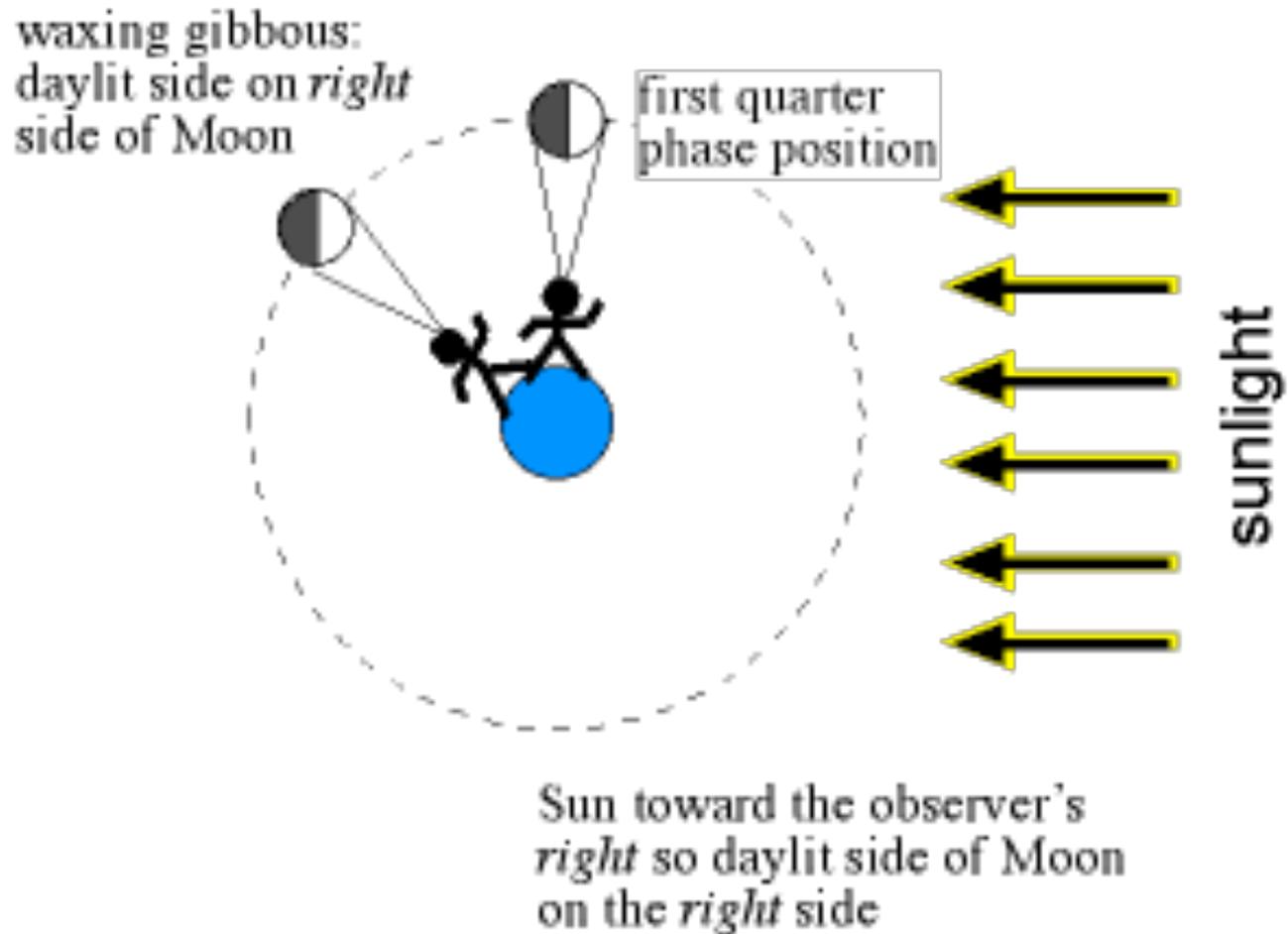


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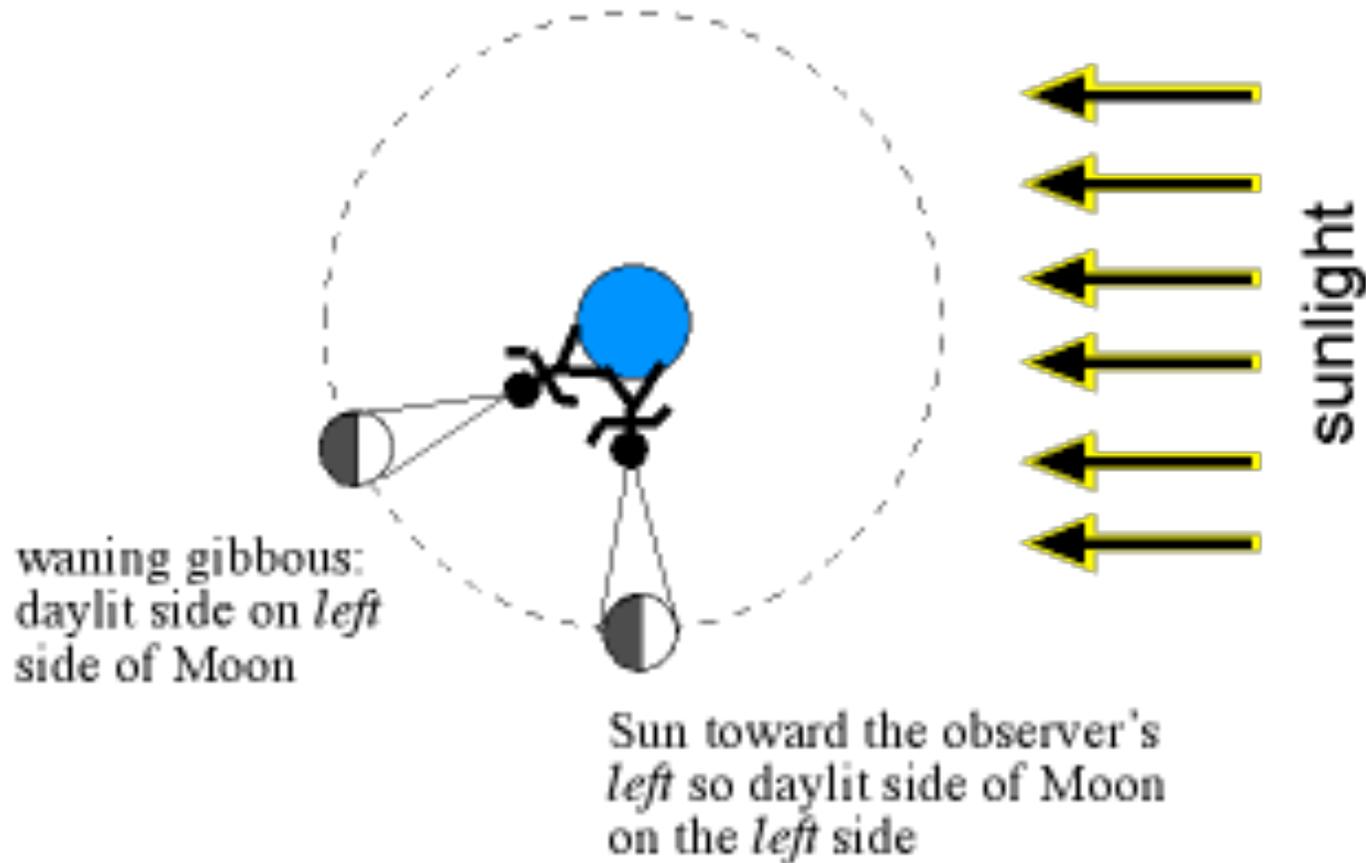
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# Waxing Phases



**Waxing phases have the daylit side on the *right***

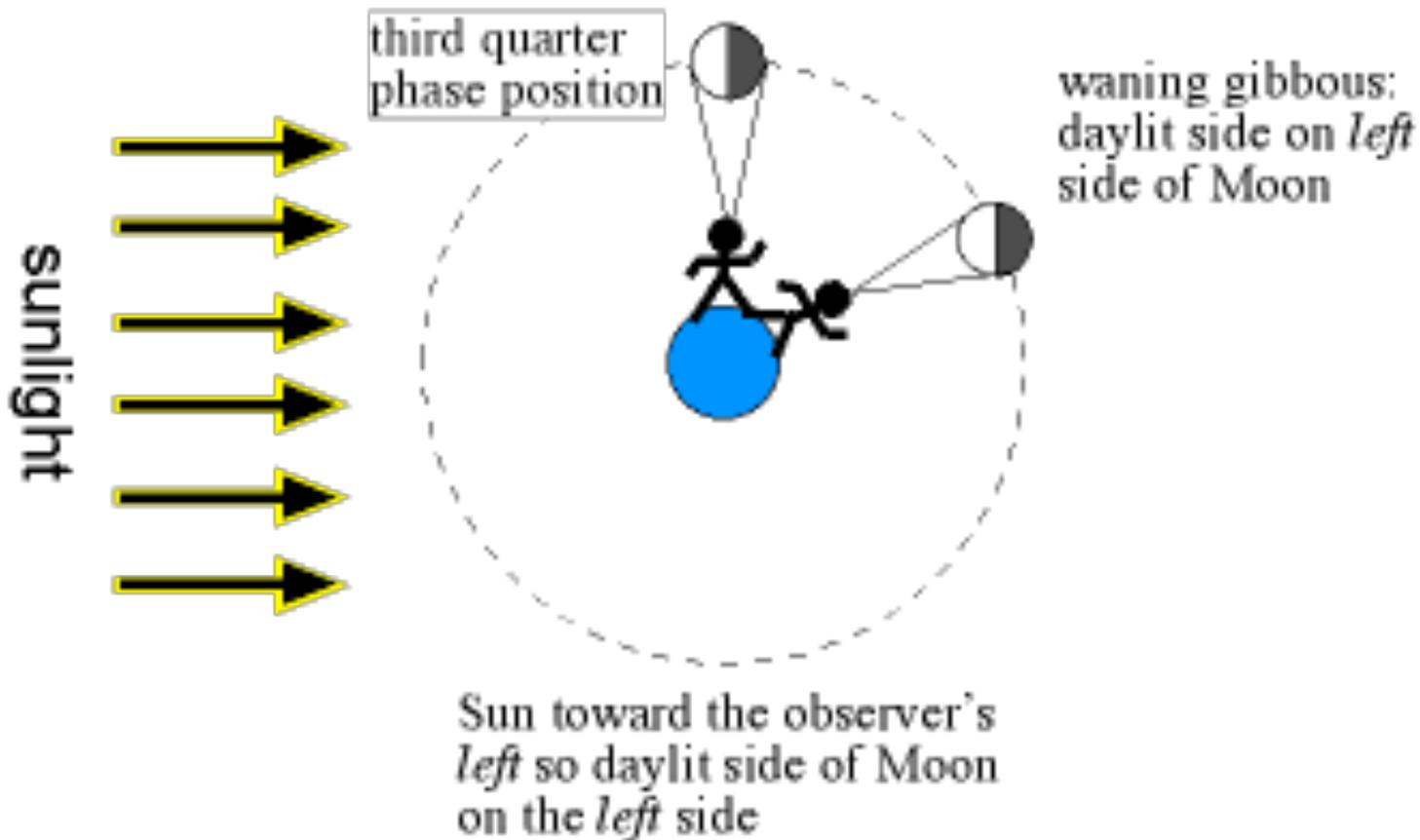
# Waning Phases



**Waning phases have the daylit side on the *left***

# Waning Phases

Rotate picture so observer is not upside down:



**Waning phases have the daylit side on the *left***

# iClicker question

Moon shown in eight positions in its orbit.

Which letter position corresponds to a waxing crescent moon?

