

Astronomy 122

TR 1300-1350

112 Chemistry Annex



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Office Hours:

W 11:00 a.m – noon or
by appointment

This Class (Lecture 3):

The Glorious Dance

Next Class:

Brief overview of our
Solar System

Homework #1 due Sunday night:
2 parts: MC and short

Music: *Space Oddity* – David Bowie

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Outline



- Motions of the Sky
- Seasons

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The Data



- Look up at the night sky.
- What are the **Data**?
 - Where does the day, the month, and the year come from?
 - What are the motions of the Earth, Moon, and Sun?



<http://www.ex-astris-scientia.org/gallery/stmagazine/data-queen-kiss.jpg>
<http://atropos.as.arizona.edu/aiz/teaching/a250/lecture1.html>



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Question



- Living on the Earth, we experience three different astronomical time-scales that we have whole heartedly adopted.
- Try to explain/talk about the
 - Daily motion of the sky
 - Monthly motion of the sky
 - Yearly motion of the sky

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And iClicker



The daily motions, e.g. rising and setting of the Sun, are caused by

- a) The Sky orbiting the Earth.
- b) The Sun orbiting the Earth.
- c) The Earth orbiting the Sun.
- d) The Earth rotating.
- e) The Sky rotating.

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The monthly motions, e.g. the phases of the Moon, are caused by

- a) The Moon orbiting the Earth.
- b) The Sun orbiting the Earth.
- c) The Earth orbiting the Sun.
- d) The Earth rotating.
- e) The Sky rotating.

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The yearly motions, e.g. different constellations in the night sky, are caused by

- a) The Sky orbiting the Earth.
- b) The Sun orbiting the Earth.
- c) The Earth orbiting the Sun.
- d) The Earth rotating.
- e) The Sky rotating.

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A Day

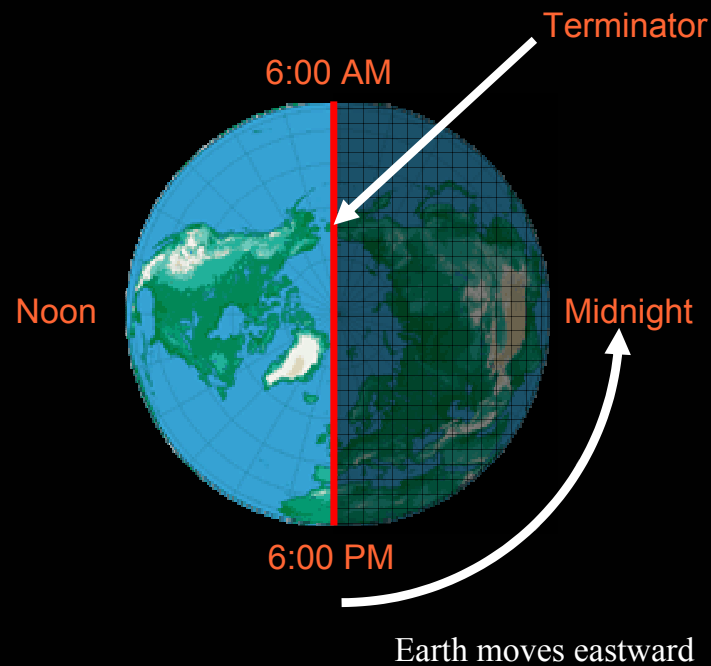


- What causes a day to be 24 hours?
- The Earth is rotating around its axis.

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Note: not to scale



Point of View



- So the Earth is rotating, and that gives the illusion that the Sun rises and sets.
 - This is not obvious.
- Also the Earth's rotation makes the stars, Moon, and planets seem to rise and set each night.
- Are there any objects that do not seem to rise and set?

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Polaris, the Pole Star, the North Star



- Polaris does not rise or set.
(in the northern hemisphere)
- If you stood on the North Pole and looked straight up (also called the North Celestial Pole), you would see Polaris.
- If you find Polaris, you know North.
- Is it the brightest star in the Sky?



NO!

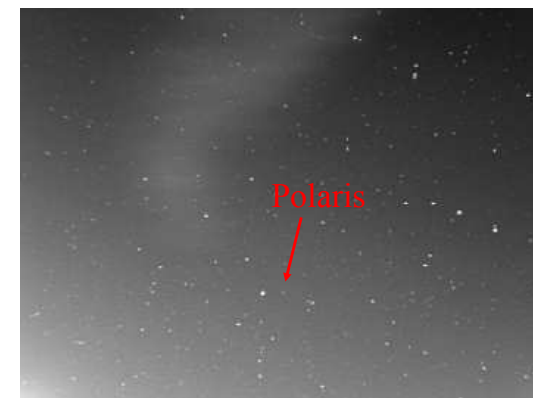
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Question



If we took a time-lapse photo of the starry night sky toward Polaris, what would it look like? Hint: The Earth is rotating (eastward).



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Daily Paths

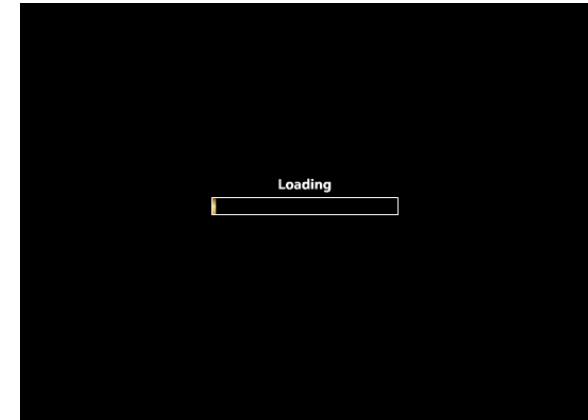


- Earth's rotation creates daily (diurnal) motion of the stars, Sun, Moon, & planets
- Earth spins eastward, so stars appear to move westward – **daily paths**

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The Earth is Rotating



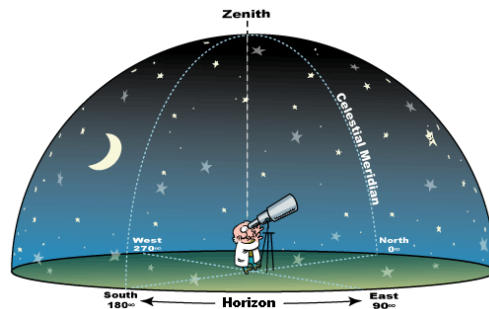
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Your View of the Sky



- **Zenith** – point directly overhead
- **Horizon** – marks the intersection of Earth and sky
- **Meridian** – from North to South through the zenith



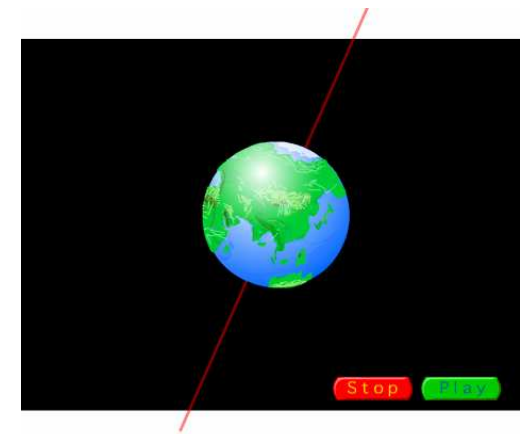
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Celestial Poles and Equator



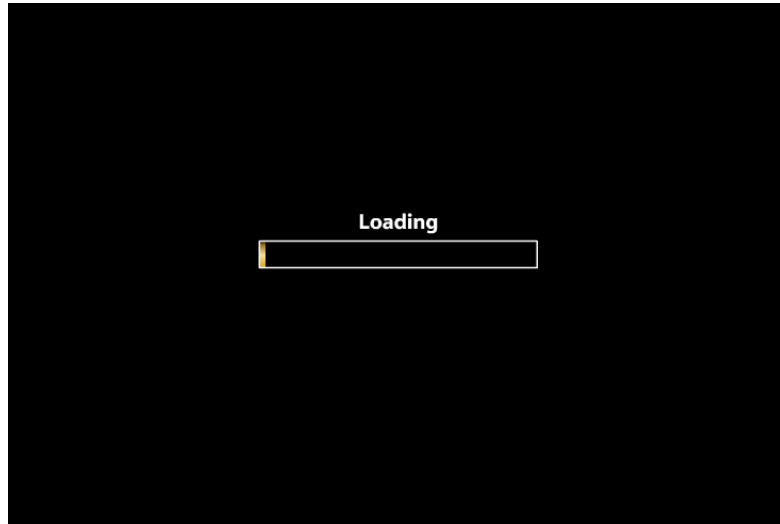
- **Celestial poles** – extensions of the Earth's axis onto the celestial sphere
- **Celestial equator** – project the Earth's equator onto the celestial sphere



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Stars motion depend on your Latitude!



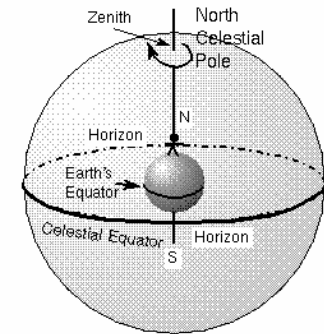
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Changes with Latitude



- The positions of the celestial poles and celestial equator on the sky depend on your latitude (GPS anyone?)
- Note: The celestial equator always crosses the horizon at due east and due west



Latitude = 90° N (at North Pole)
altitude of NCP = 90°

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At the North Pole



- Polaris is directly overhead
- The sky appears to spin around it
- Stars don't rise or set (circumpolar), they just go around
- All stars are circumpolar at the pole!



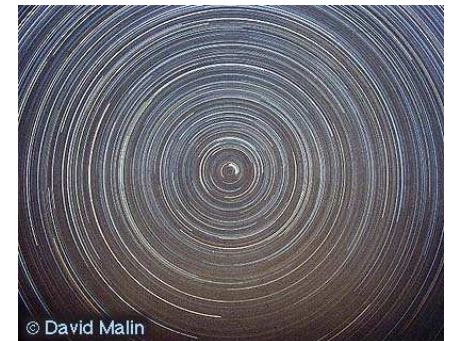
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Circumpolar Stars



- The sky appears to spin around Polaris.
- Earth's rotation is counter clockwise, if you were to look down on the North Pole
- Most stars' daily paths rise in the east and set in the west
- But, some are so close to Polaris, they can't reach the horizon!
- Called *circumpolar stars*



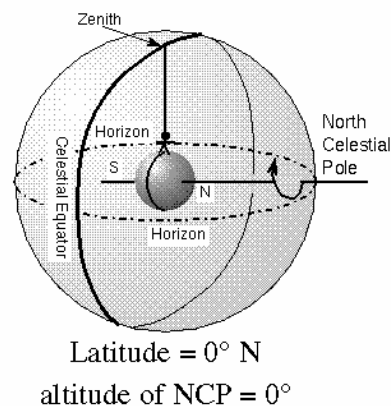
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Changes with Latitude



- The positions of the celestial poles and celestial equator on the sky depend on your latitude (GPS anyone?)
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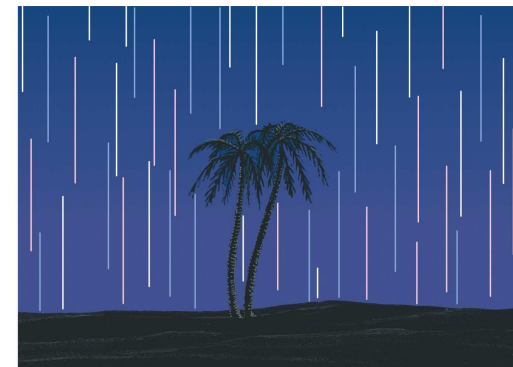
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At the Equator



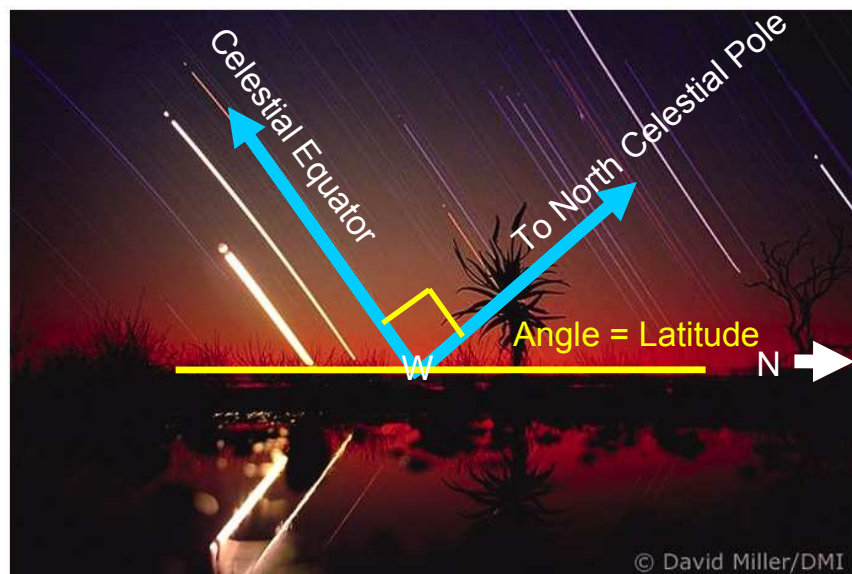
- Polaris is right on the horizon
- Stars rise straight up from the eastern horizon and set straight down on the western horizon
- No stars are circumpolar at the equator!



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Motions in the Sky



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Question



You observe a star rising directly to the East from Urbana. When this star reaches its highest position above the horizon, where will it be?

- High in the northern sky
- High in the eastern sky
- High in the southern sky
- High in the western sky
- Directly overhead

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South of the Equator



- South of the equator, you can't see Polaris
- You do see the South Celestial Pole
- But nothing is there.



<http://antwrp.gsfc.nasa.gov/apod/ap040911.html>

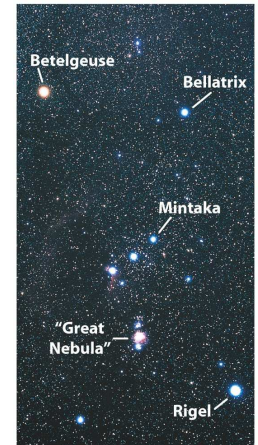
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Earth's Orbit



- The Earth's rotation explains the motions of the stars over a day, but why does the sky change over many nights? (i.e. Why can you see Orion only from Dec-March?)



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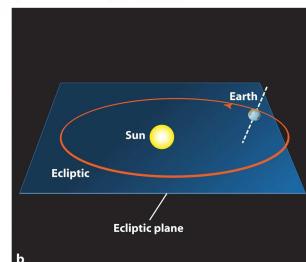
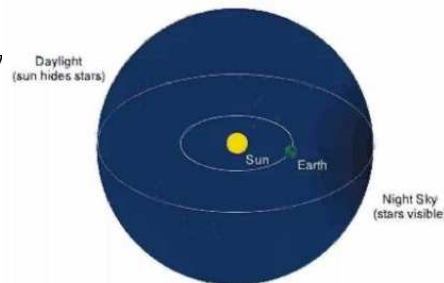
Free Trip Around the Sun



- The Earth orbits the Sun every 365 days
- The plane of the Earth's orbit is called the **ecliptic**

"Living on Earth may be expensive, but it includes an annual free trip around the sun."

-Asleigh Brilliant



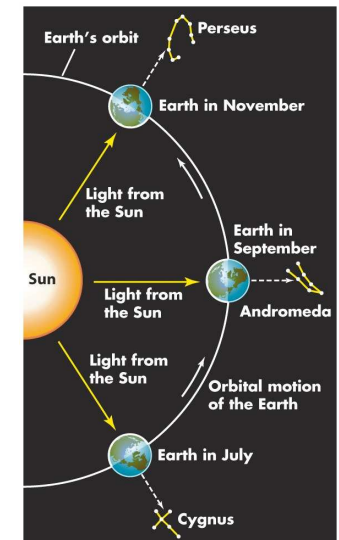
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Orbiting for Fun



- The Earth moves around the Sun.
- And the stars are far away.
- This makes the stars appear to move slightly every day.
- A star will rise about 4 mins early every day or about 2 hours earlier every month.



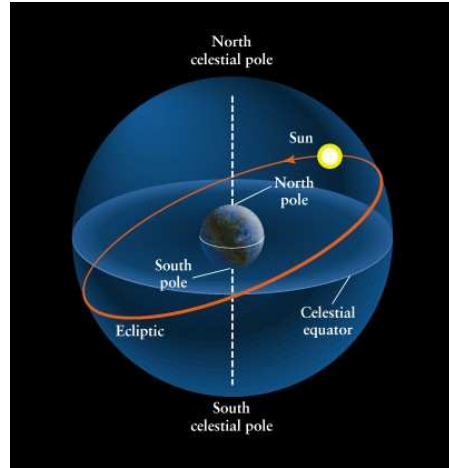
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The Ecliptic on the Celestial Sphere



- Similarly, from our point of view, the Sun moves a little each day with respect to the stars.
- This path (the ecliptic) can also be drawn on the celestial sphere
- Note, the ecliptic and the celestial equator are not the same circles
- What would cause that?



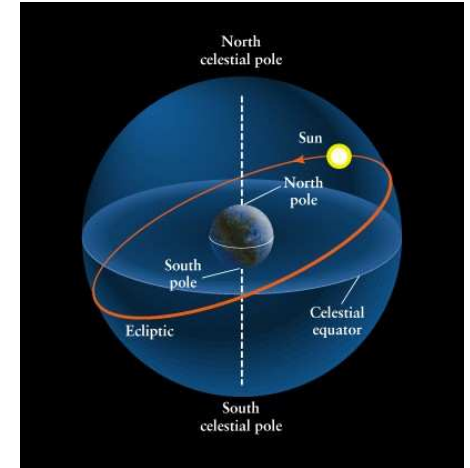
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The Ecliptic on the Celestial Sphere



- You're tilted.
- You're whole freakin' world is tilted.
- The Earth's axis is tilted to the ecliptic plane by 23.5°



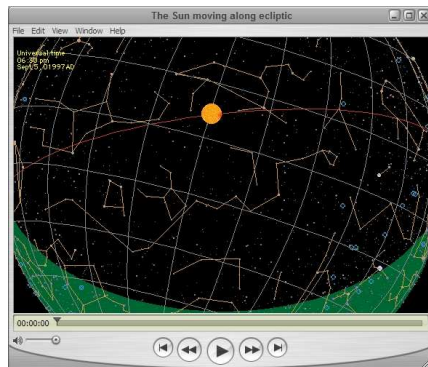
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The Sun Moves in the Sky



http://planck.phys.uwosh.edu/mike/exercises/anim/ecliptic_movie.mov



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