
Ancient Astronomy

# Poll everywhere



When poll is active respond at **PollEv.com/nikhilpatten355**

Send **nikhilpatten355** to **22333**

# Poll everywhere



results

# Unit conversion problems



- Optional practice problems available here:

http://physics.uwyo.edu/~nikhil/Courses/ASTR1050/lecture_notes/week_01/Friday/practice_problems.pdf

- Feel free to ask for additional problems in the future.
- Office hours are 12–1 pm, everyday.

# Equinox



- Equinox - from Latin *aequus nox* or “equal night”.
- Occurs two times per year, one in the spring (vernal) and in the fall (autumnal).
- Equal parts day and night.
- Sun rises directly East, sets directly West.

The Sun rising directly eastward, as seen by Angkor Wat, Cambodia.

# Solstice



- Solstice - from Latin *sol sistere* or “the Sun to stand still”.
- The Sun reaches its northern or southern maximum
- Occurs two times per year, one in the winter and one in the summer.
- Longest or shortest days of sunlight.

The Sun rising directly through the stones at Stonehenge on the Winter Solstice

# The movement of the Sun throughout the year

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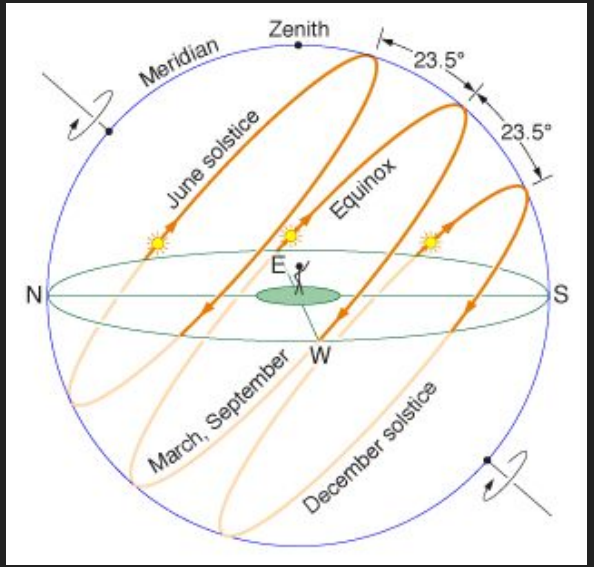
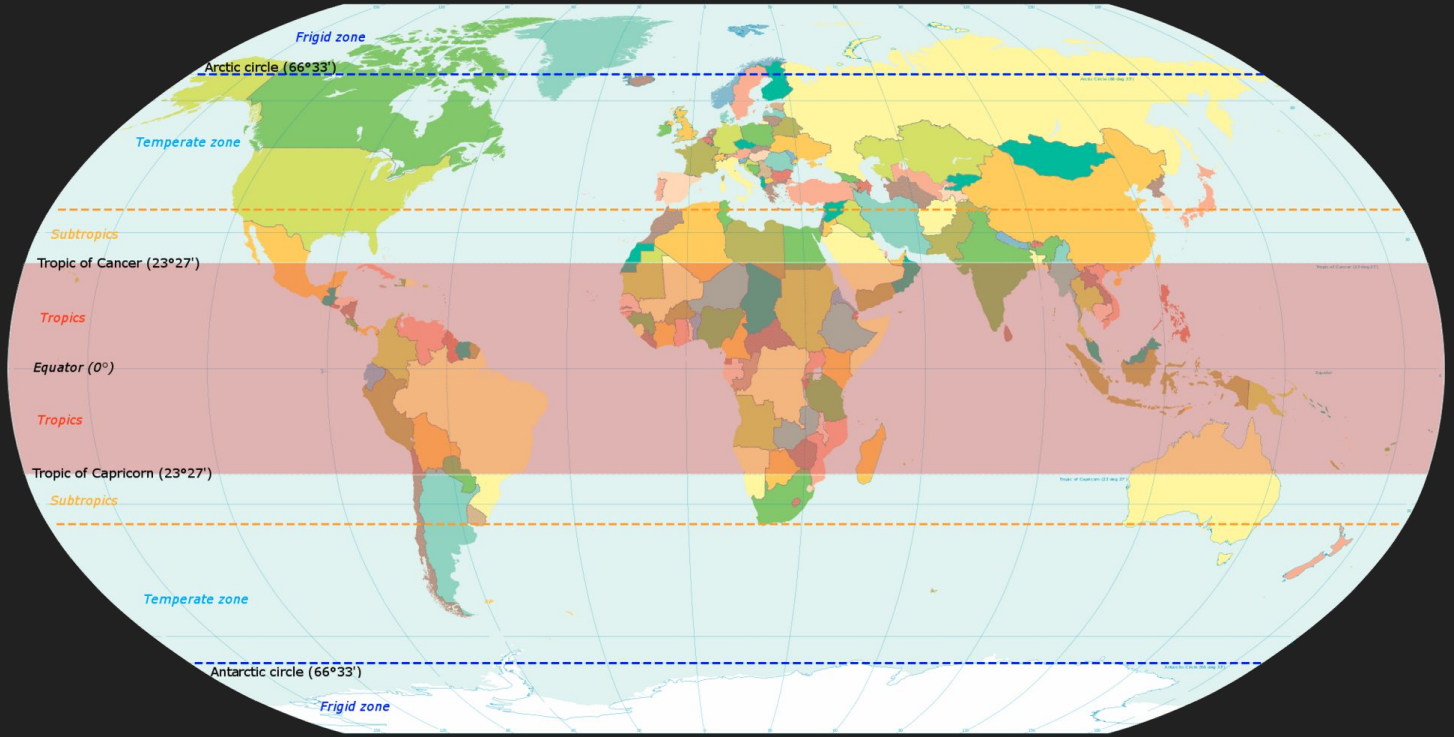
- The Sun moves North and South throughout the year.
  - Due to the Earth's axial tilt.
- The Sun can appear directly overhead for a range of latitudes North or South of the equator.
- Tropics, from Latin *tropē*, or "turn around."
  - The northernmost/southernmost constellations the Sun reaches.




The Sun's path in different parts of the year.

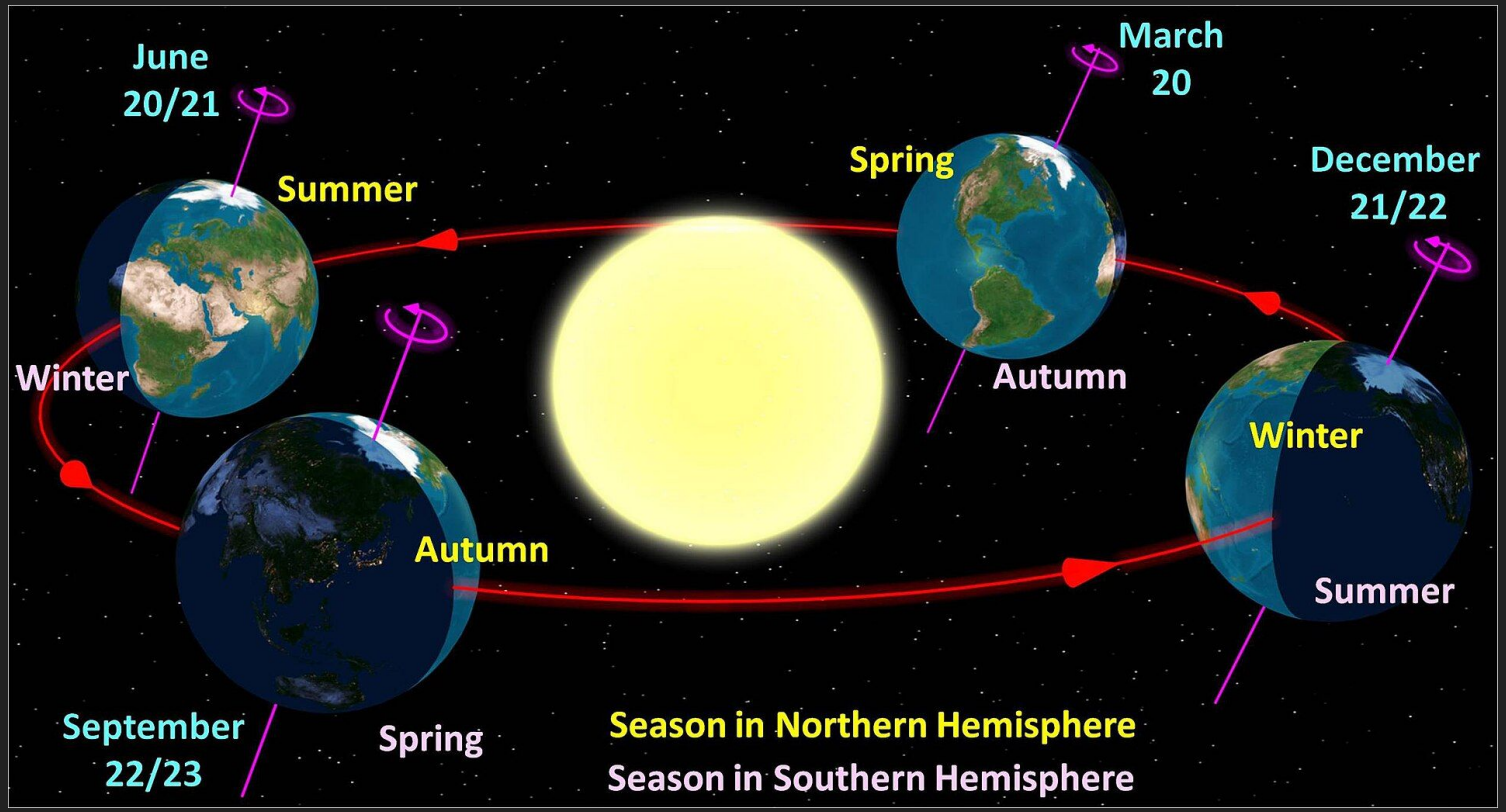
# Tropics




Frigid zone
Arctic circle (66°33')
Temperate zone
Subtropics
Tropic of Cancer (23°27')
Tropics
Equator (0°)
Tropics
Tropic of Capricorn (23°27')
Subtropics
Temperate zone
Antarctic circle (66°33')
Frigid zone

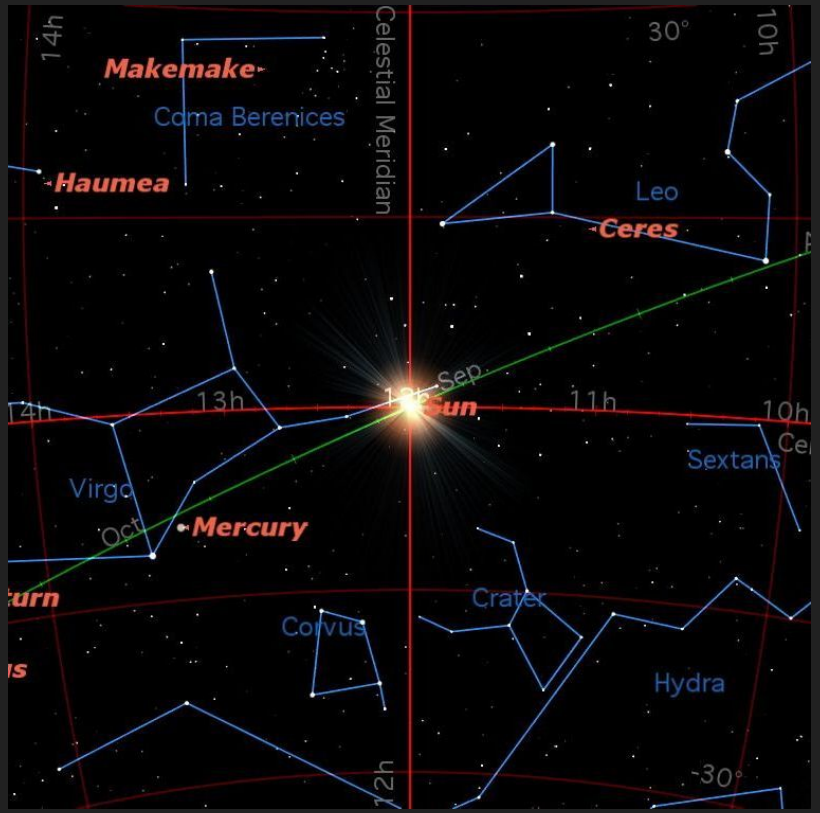
# Solar year




June
20/21
Summer
March
20
Spring
December
21/22
Winter
Autumn
Winter
Autumn
Summer
September
22/23
Spring
Season in Northern Hemisphere
Season in Southern Hemisphere

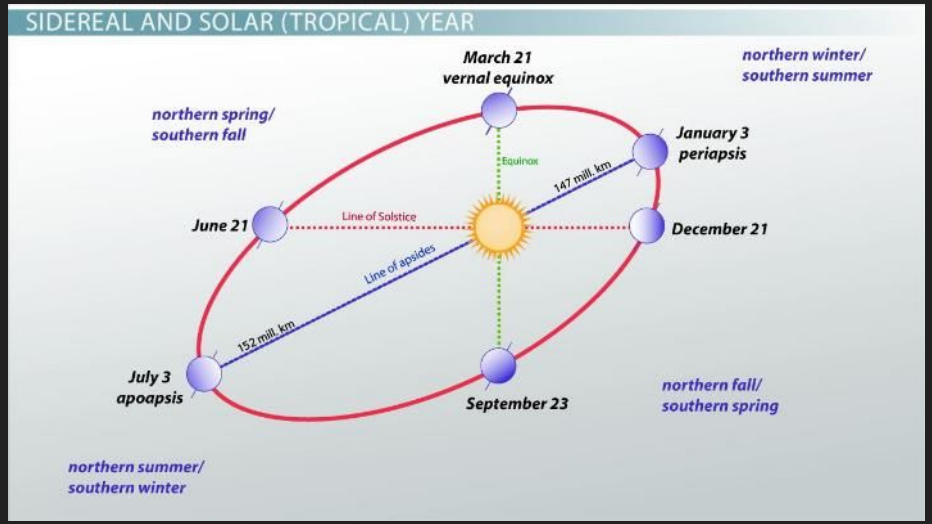
# Solar year

- “Tropical” year
- Time it takes the Sun to return to the same part of the sky.
  - E.g. Autumnal equinox to autumnal equinox, tropic to tropic
- 365.242190402 days



# Sidereal year

- Time it takes the Earth to make one complete orbit around the Sun.
- 365.256363004 days
- Sidereal year is 20 minutes and 24.5 seconds longer than a solar year.




Exaggerated depiction of the Earth's orbit around the Sun

# Question



- Why is the sidereal year different than the tropical year?

# Question



- Why is the sidereal year different than the tropical year?

The difference is caused by the Earth's axial precession.

# Axial precession



- What is axial precession?
- Spinning top demonstration

http://physics.uwyo.edu/~nikhil/Courses/ASTR1050/files/precession_spinning_top.mp4

# Axial precession

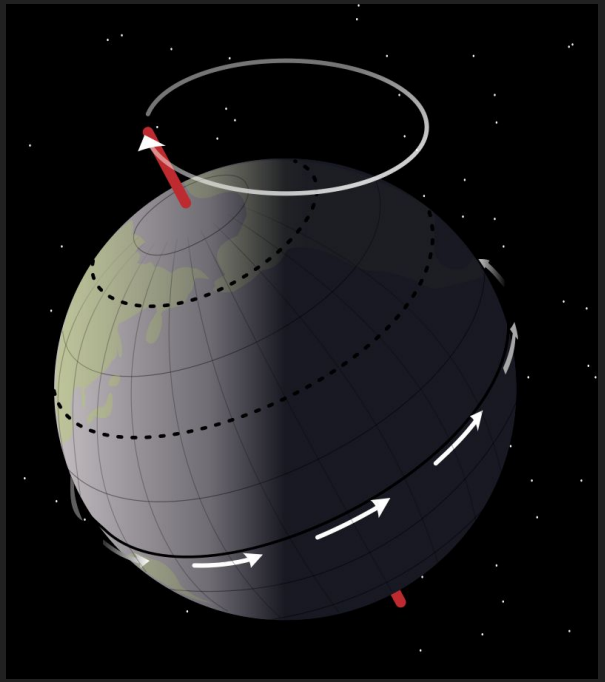


- Discovered by Hipparchus of Antioch.
  - Studied the precise location of stars in the sky.
  - Spica had moved 2° in a two hundred years.
- Axial precession causes the Earth's poles to change where they point in the sky.

# Axial precession

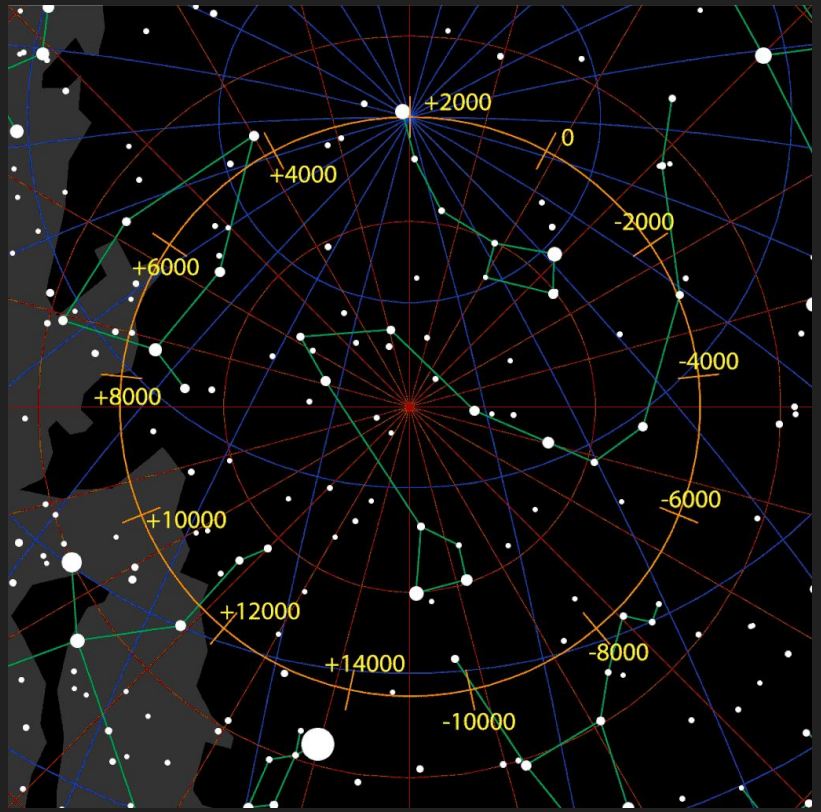


- North and South star change over the millenia.
- Earth’s axial precession has a period of 26,000 years.



# North pole




+2000
0
+4000
-2000
+6000
-4000
+8000
-6000
+10000
+12000
-8000
+14000
-10000

# South pole

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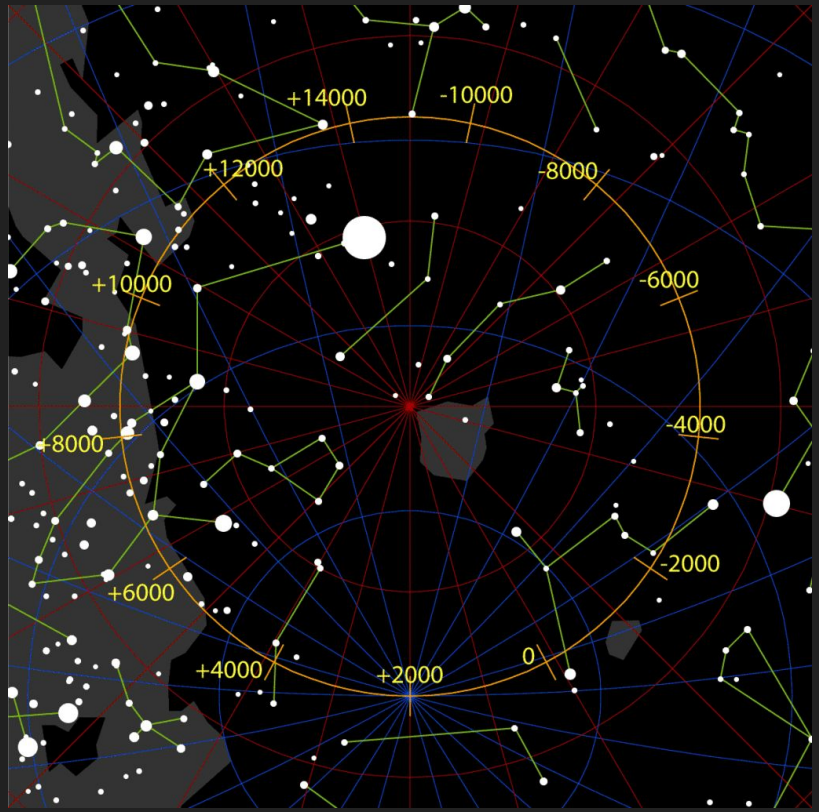

# Sidereal year vs. tropical year



- Sidereal year- 365.256363004 days. Astronomical significance, used in Astronomy.
- Tropical, or solar, year- 365.242190402 days. Correlates with seasons, most noticeable to us on Earth, used for everything else.
- 365.242190402 days is the magic number.

# Calendars — Lunisolar calendar



- Developed independently by the Mesopotamia, Indian subcontinent, China, Americas, to name a few.
- The solar year was roughly 12 lunar cycles.
- 12 lunar cycles x 29.5306 days per lunar cycle = 354.3672 days in a lunar year.
- Tropical year was 365.242190402 days long.
- Years are off by 10.875 days, or 0.36826 lunar months.
- Add 7 “leap months” every 19 lunar years.
- 12 +7/19 lunar months = 365.246894 days, close!
    - 1 less day every 212 lunisolar years.

# Calendars — Julian calendar



- Old Roman Calendar divided 355 days into 12 months with a 22–23 day leap month (similar to lunisolar calendar with leap months).
- Leap month was not standardized.
  - Corrupt leaders added spurious leap months to extend their rule.
- Revamped by Julius Caeser.
- 365 days split over 12 months.
  - Leap year with extra day every four years.
- 365 +¼ = 365.25 days per Julian year.
- 365.242190402 days in tropical year.
  - 1 less day every 128 years.
- Easier calibration than lunisolar calendar.

# Calendars — Gregorian calendar

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- Very similar to Julian calendar.
- 97 leap years (366 day years) every 400 (365 day) years.
- 1 Gregorian year = 365 +97/400 days = 365.2425 days/ Gregorian years
- 365.242190402 days in tropical year.
- 1 extra day every 3229.995 Gregorian years!
- Standard calendar used by majority of the world.
- Used by the majority of the world, some accepting it as late as 2016.

# Astrology vs. Astronomy



- Astronomy developed from the need to develop a calendar.
- Ancient cultures also designated the wandering stars as Gods and attributed certain characteristics to them.

# Astrology vs. Astronomy



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## MARS

### Mars: The Planet of Passion

Mars is the action planet of the zodiac. The 'Red Planet,' after all, should be pretty fiery, and Mars does not disappoint. Energy, passion, drive and determination are all right up Mars's alley. This planet commands you (and yes, Mars does rule the military) to stand up, be noticed and get things done — sitting on the sidelines belongs somewhere else in the heavens. Simply put, Mars speaks to the power and confident expression of the individual.

# Astrology vs. Astronomy

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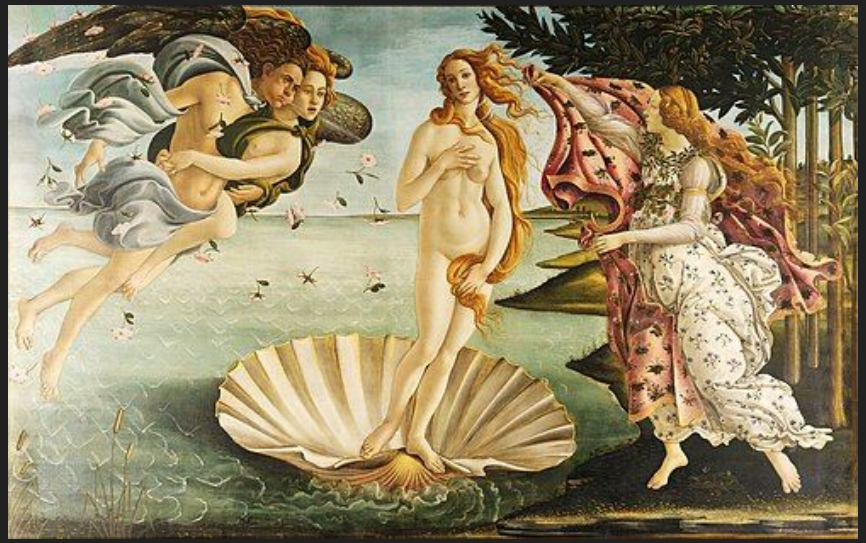
## VENUS

### Venus: The Planet of Love and Money

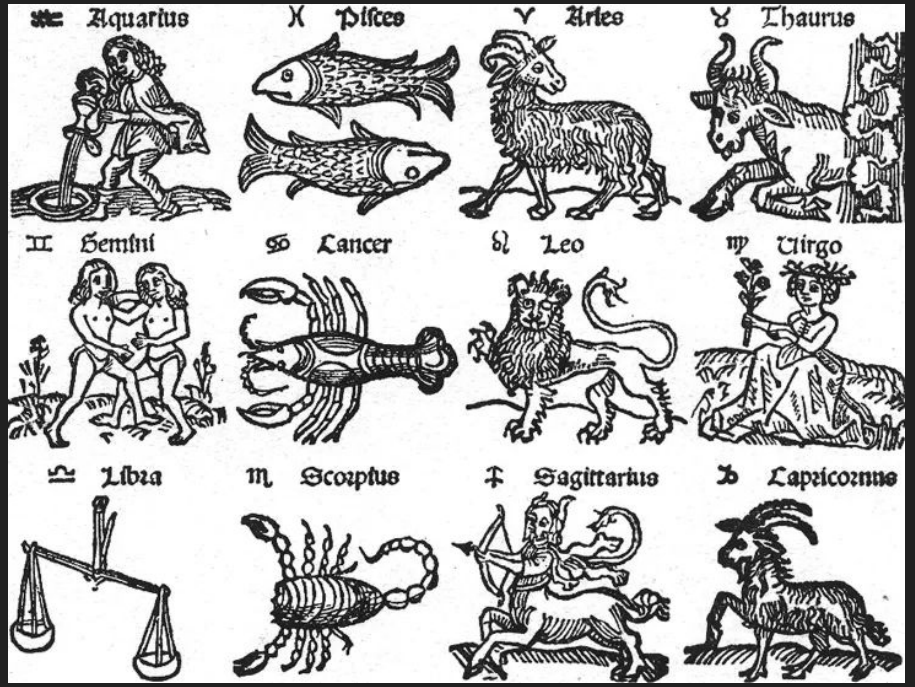
Venus is all about pleasure, especially pleasure shared with someone else. This planet concerns itself with love, romance and harmony in our emotional attachments, marriages, friendships and other unions (like business partnerships). Venus is content to spread happiness and tenderness, all the while teaching us how to love and appreciate others and the things that we possess.



# Astrology vs. Astronomy



- Astrology was developed about 2,500 years ago by the Babylonians
- Greeks believed the positions of the planets, Sun, and Moon at birth shaped personalities
- Horoscope, from Greek *hora skopos*, time keeper.
- Split the paths the Sun, Moon, and planets travel in (i.e. the ecliptic) into 12 areas called signs.



# Astrology vs. Astronomy



# Astrology vs. Astronomy



- Stars have shifted since development of astrology because of precession!
- Some ancient astrologers knew about precession and worked it into their systems.

# Astrology vs. Astronomy

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## What constellation was the Sun in on your birthday?

These dates are correct for people alive today, but as the Earth wobbles, the dates will continue to change, as they always have.

| Constellation | Dates |
|---|---|
| Aries | April 19 – May 14 |
| Taurus | May 15 – June 20 |
| Gemini | June 21 – July 20 |
| Cancer | July 21 – August 10 |
| Leo | August 11 – September 16 |
| Virgo | September 17 – October 31 |
| Libra | November 1 – November 24 |
| Scorpio* | November 25 – December 17 |
| Sagittarius | December 18 – January 19 |
| Capricorn | January 20 – February 16 |
| Aquarius | February 17 – March 11 |
| Pisces | March 12 – April 18 |

**Scorpio is combined here with the constellation, Ophiuchus, through which the Sun passes between November 30 and December 17. (It is not part of the Zodiac, however.)*

# Announcements



- First homework is assigned (10 questions), due Friday.
- First lab next week, meet in planetarium.

# Next time



- The birth of modern Astronomy