STAR PROPERTIES

Contelations

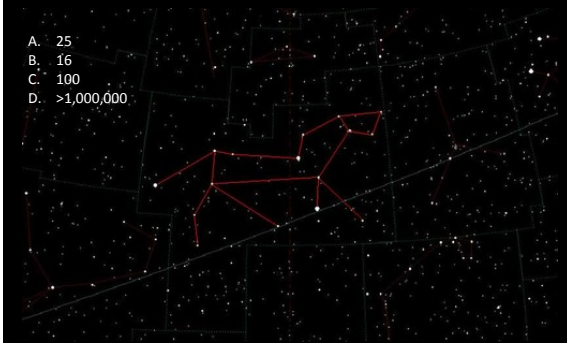
- Ursa Minor (Little Dipper)
- Ursa Major (Big Dipper)
- Cassieopa
- Cepheus
- Draco
- Orion
- Bootes
- Capella
- Castor & Pollux (Gemini)
- Corona Borealis
- Saggitarius
- Hercules
- Fomahault (Pieces)
- Andromeda and Pegasus
- Lyra
- Cygnus
- Aquila
- Summer Triangle
- Delphinus
- Scorpius
- Canis Minor
- Canis Major
- Leo

How Many Stars in Orion?

A. 25
B. 8
C. 100
D. >1,000,000

How Many Stars in Leo?

A. 25
B. 16
C. 100
D. >1,000,000

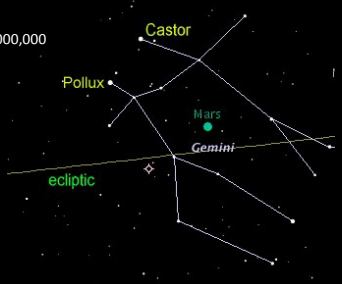


How Many Stars in Ursa Major?

A. 50
B. 21
C. 100
D. >1,000,000

How Many Stars in Gemini?

A. 15
B. 21
C. 100
D. >1,000,000

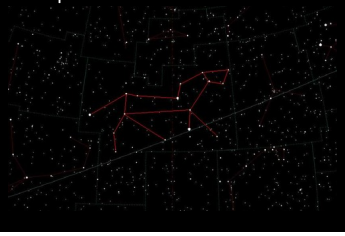


Answers

- Orion >1,000,000
- Leo > 1,000,000
- Ursa Major >1,000,000
- Gemini >1,000,000

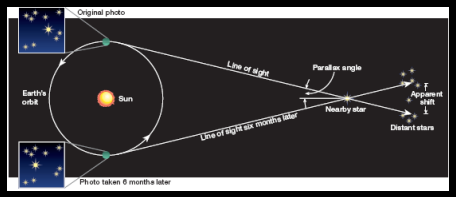
Properties of Stars

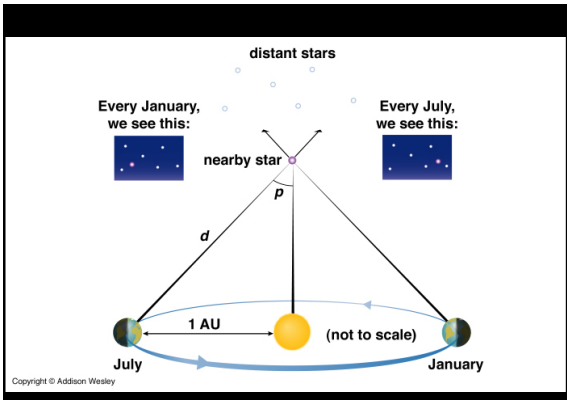
- Constellation – 88 total
  - More stars in constellation than found in pattern
  - Millions upon millions of stars in each



Properties of Stars - Distance

- Parallax – basic way to measure distance
  - Stars positions appear to shift based on season
  - Smallest angle shift = farther away
  - Largest angle shift = closest





Properties of Stars - Distance

- Measured in light-years – distance light travels in one year (9.5×10^{12} or 9.5 trillion kilometers)

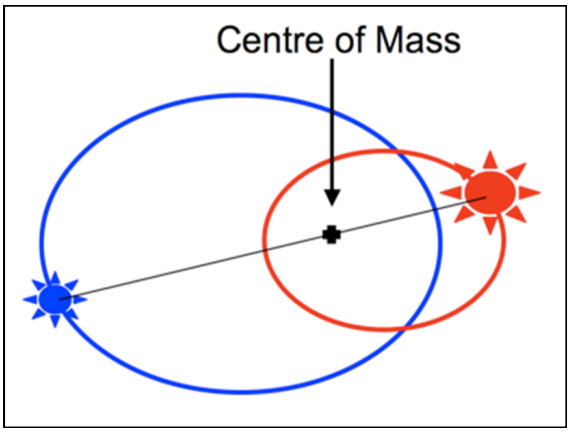
LIGHT-YEAR MEASURES **DISTANCE**

NOT TIME

- Astronomical unit (AU) – 1 AU is the distance between the Sun and Earth
- Our closest star (other than the sun) is 4.3 light-years away.

Properties of Stars - Mass

- Binary Stars - pairs of stars pulled together by each other's gravity
  - Gravity pull determined by mass
  - The bigger the mass the greater the pull
  - Difference in center of masses allows calculations of both star masses
  - About 85% of the single points of light we observe in the night sky are actually two or more stars orbiting together. (in the Milky Way)



Types of Binary Systems

A ***Binary System*** is a star system where two stars orbit a common center of mass. Analyzing binary systems is useful for determining stellar masses. About half of all stars are part of a binary system.

There are four types of binary systems:

- **Visual Binary** – This is a binary system where the two stars can be resolved visually with any sort of optical device. These systems typically have very large orbits about the center of mass.
- **Spectroscopic Binary** – This is a binary system where the stars are detected by closely analyzing the light and determining there are actually two stellar spectrums present instead of one. The period the orbiting stars is determined by using the Doppler effect for the spectral absorption lines of the stars.
- **Eclipsing Binary** – This is a binary system where the plane of the orbiting stars is edge-on from the Earth's point of view. This results in the stars eclipsing each other and a plot of brightness of light from the system versus time (called a "light curve") displays periodic changes.
- **Astrometric Binary** – This is a binary system where one star appears to "wobble" in space as it moves about the center of mass with no visible companion.

Which Flame?

Properties of Stars - Temperature

- A star's color tells us about its temperature!
  - Blue = very hot (30,000 K)
  - Yellow = medium (5,000 K)
  - Red = cool (2,000 K)
    - Blue
    - White
    - Yellow
    - Orange
    - Red

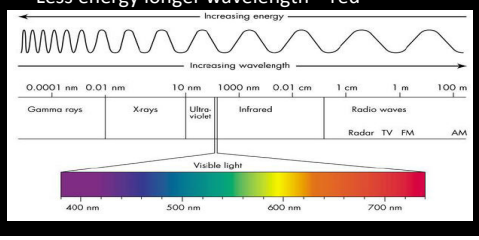
Hottest ↓ Coolest

K = Kelvin, a type of temperature.

K = °C +273

Properties of Stars – Temperature cont.

- Different colors based on energy emitted
  - More energy shorter wavelength = blue
  - Less energy longer wavelength = red



Properties of Stars - Brightness

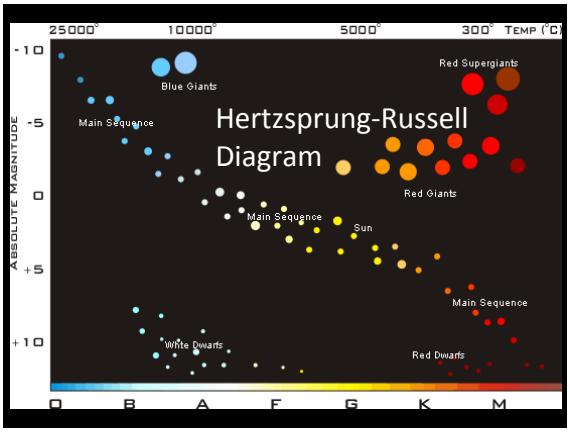
- **Apparent Magnitude**: brightness of a star as it looks from Earth
  - Depends on how big it is, how hot it is, and how far away it is.
- **Absolute Magnitude**: how bright a star actually is from 32.6 light years away
  - Based on distance away – abs. mag. Sun = 5
  - less than 5 brighter than Sun
  - Greater than 5 dimmer than Sun
- **Negative numbers mean that the star is very bright!!!**

Properties of Stars – Brightness cont.

- Luminosity is the measure of the energy output from the surface of a star per second.
- This is based on the star's apparent magnitude and how far away it is.
- Sun = 3.85×10^{26} Watts = 3.85×10^{24} W 100 W lightbulbs!
- No stellar property varies by so much!
  - From .0001 to more than a million times the Sun's

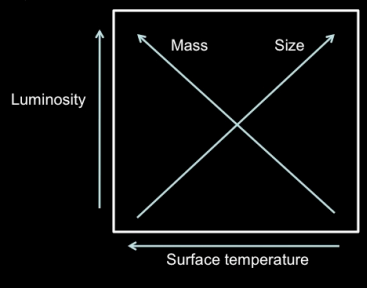
Check for Understanding:

- If I compare the brightness of two stars from where I am standing on Earth, am I using **apparent** or **absolute** magnitude?
- What color of star is the hottest?
- What are common units of distance when talking about astronomy?

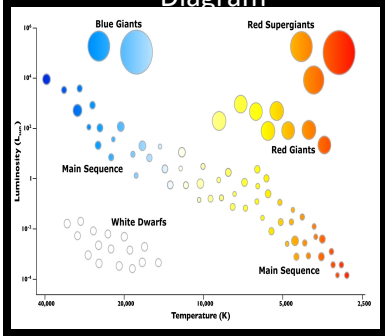


HR Diagram

Since its original inception, the HR diagram is now understood to display additional correlations between stellar mass and size:



Hertzsprung-Russell Diagram



Hottest Stars:
On the left side

Brightest Stars:
At the top

Biggest stars?
Giants and Supergiants

Smallest stars?
White dwarfs

Stars fluctuate in brightness – Variable Stars

- Pulsate in brightness because of the expansion and contraction of their outer layers
- Cepheid stars – get brighter and fainter in a regular pattern
  - Comparable to a street lamp
  - Longer periods – larger absolute magnitude
  - Distance can be measured by comparing the absolute magnitude and the apparent magnitude.
- Nova – sudden brightening of a star (white dwarf)
  - Small amount of mass lost during surge
  - Due to energy transfer in binary stars from bigger to smaller star

Nebulae

- Clouds of dust and gas
  - Mostly hydrogen
  - Absorb UV light
  - Reflected nebulae – reflect light from near star
  - Dark nebulae
  - not very dense, but more mass than sun

Recap

- 1. What are some properties of stars we discussed? Explain each.
- 2. Why do astronomers use parallax? Describe the process.
- 3. Compare and contrast apparent and absolute magnitude.
- 4. What does an HR Diagram tell astronomers? What are the axes labeled?