Chapter 24

Stars, Galaxies & the Universe

Distance units

- **To talk about space we need to come up with distance units a little more appropriate than just miles. Otherwise it would be like measuring from here to New York in inches!**

- **AU** – astronomical unit – distance from the Earth to our Sun, about 93 million miles or 150 million kilometers- use this unit when talking about things in our solar system.

- **Light Year-** distance light would travel in one year- a distance measurement, not a time measurement!!- 5,900,000,000,000 miles (5.9×10^{12} miles). Use this unit when talking about distances between stars & galaxies.

How big are we talkin' about?

- Earth → Sun → Solar System → Galaxy → Universe

Earth: diameter 7,926 miles

Sun: diameter 870,000 miles Over 1 million Earths could fit inside the Sun

Sun is 93 million miles away = 1 AU (astronomical unit)

Solar System: 80 AU's in diameter

1 Light Year = 5,900,000,000,000 miles (5.9×10^{12} miles)

Closet star to the Sun = **Proxima Centauri** = 4.22 Light Years away

Milky Way Galaxy = 100,000 light years across
& 12,000 light years thick

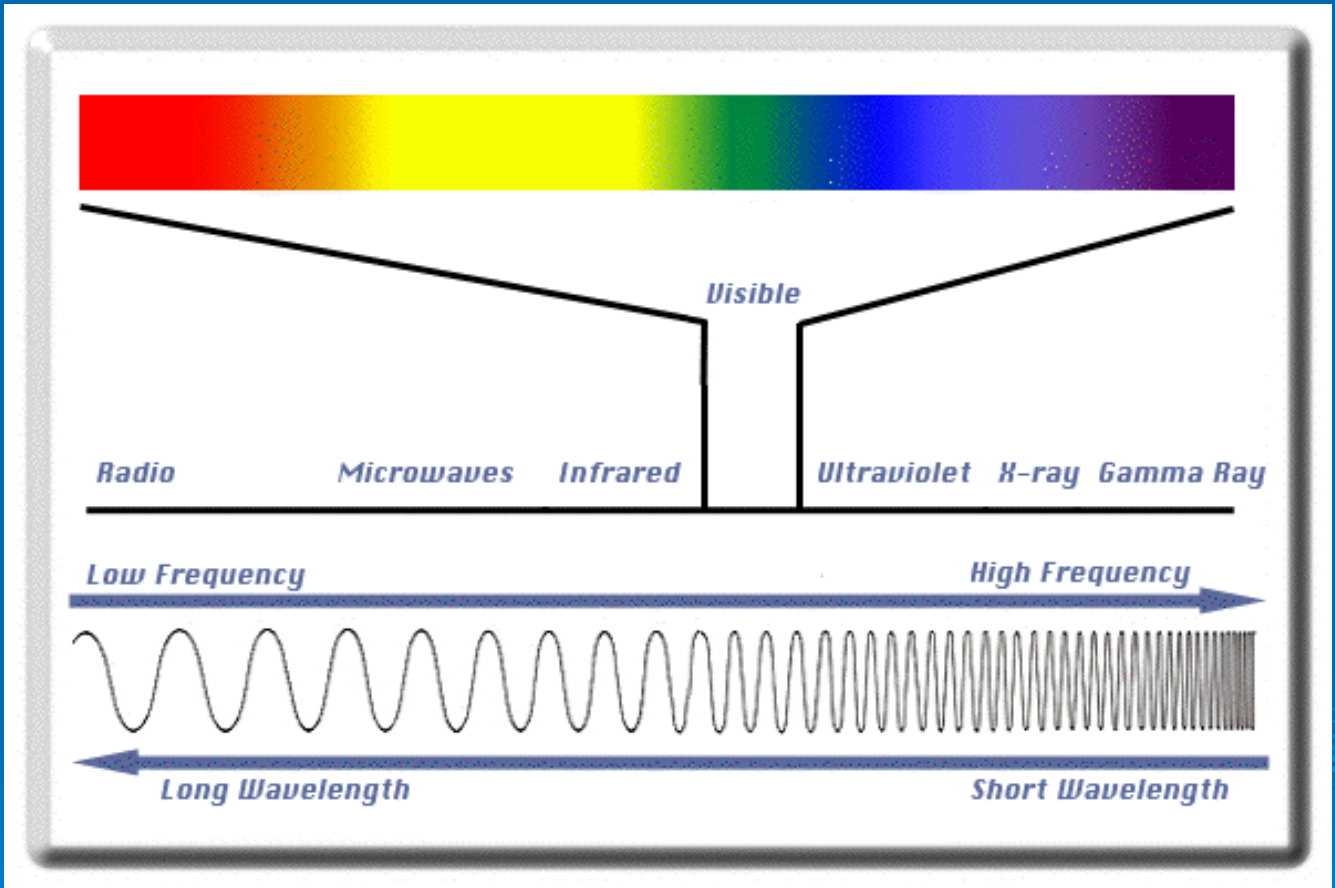
Nearest Galaxy to ours is **Andromeda =** 2 million light years away

Universe is estimated to be **156 billion light years** across

The Electromagnetic Spectrum

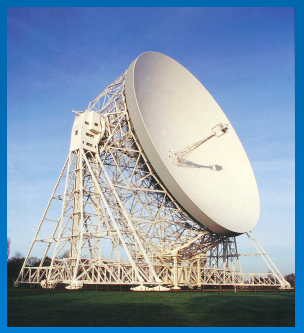
We observe stars by the EMR (electromagnetic radiation) they give off.

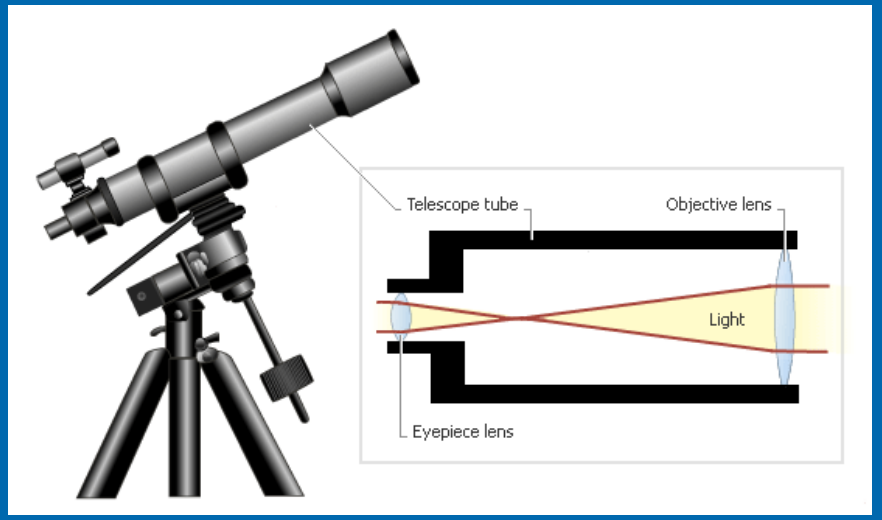
Most telescopes are “light” telescopes but telescopes that collect all different wavelengths in the spectrum are now used.

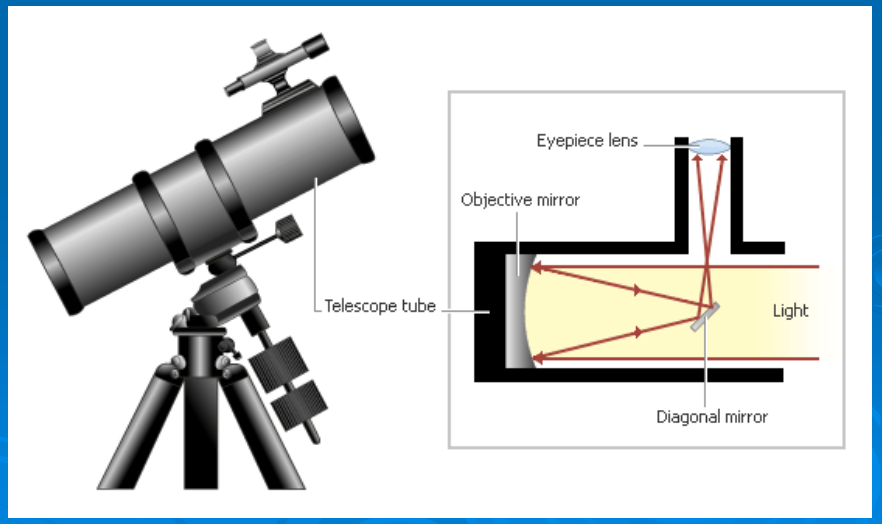


Telescopes

- Refracting Telescope: collects and focuses light using convex lenses
- Reflecting Telescope: uses a curved mirror to bounce the light onto a small area
- Radio Telescope: Uses a large parabolic dish to collect and focus radio waves

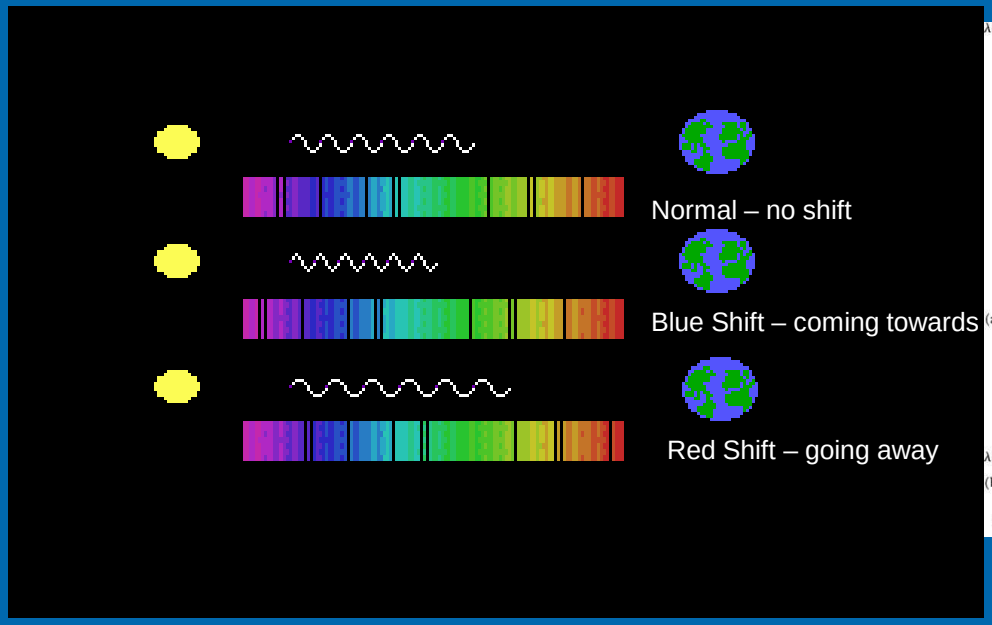


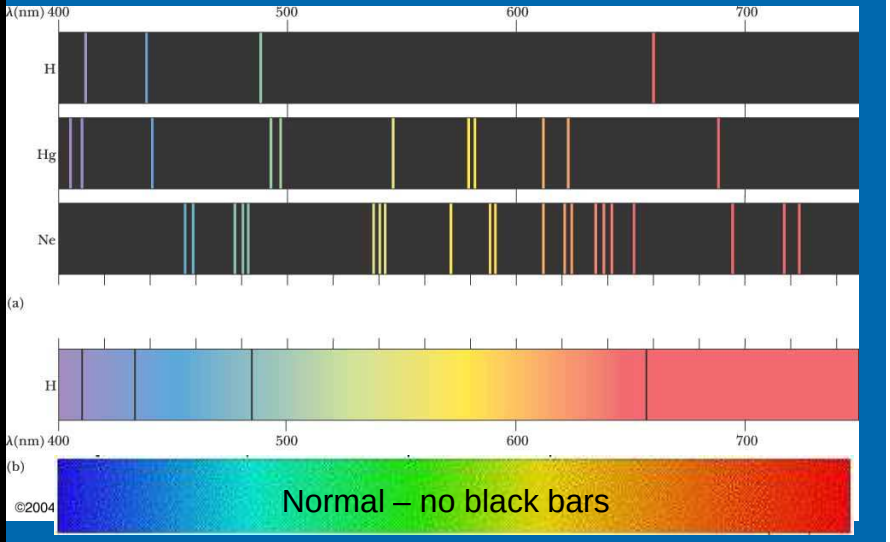




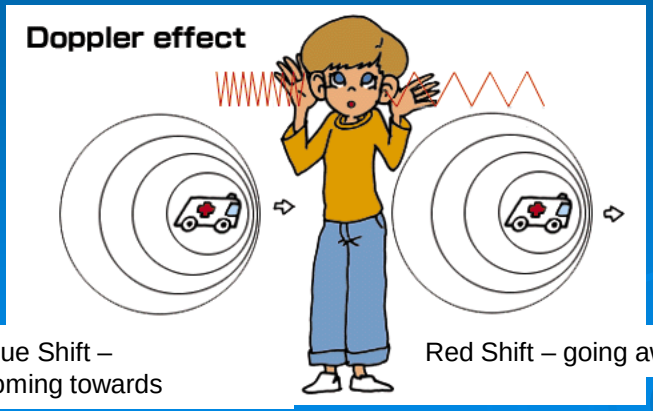
Spectrograph

Used to determine temperature & chemical make up of a star





Coming or Going?



Black bars indicate the wavelengths of light absorbed by that element being tested.

Each element has its own “fingerprint”.

Light from a star is passed through a prism/ spectrograph and the fingerprint observed is compared to known element fingerprints.

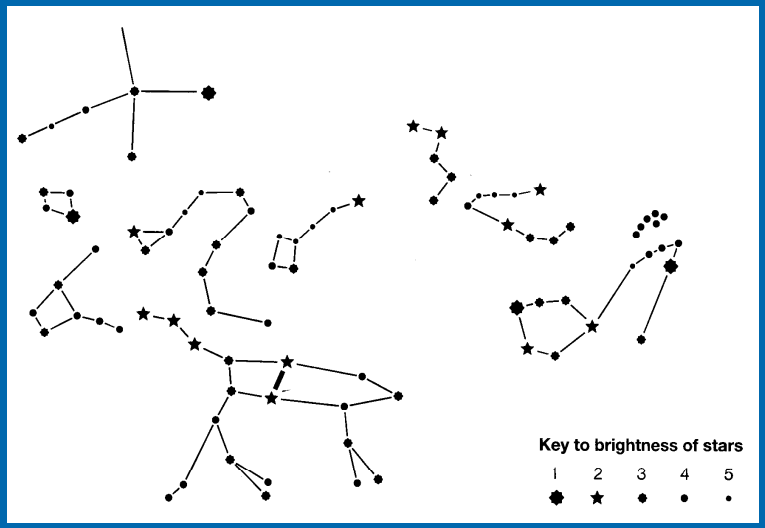
We now know what the star is made of

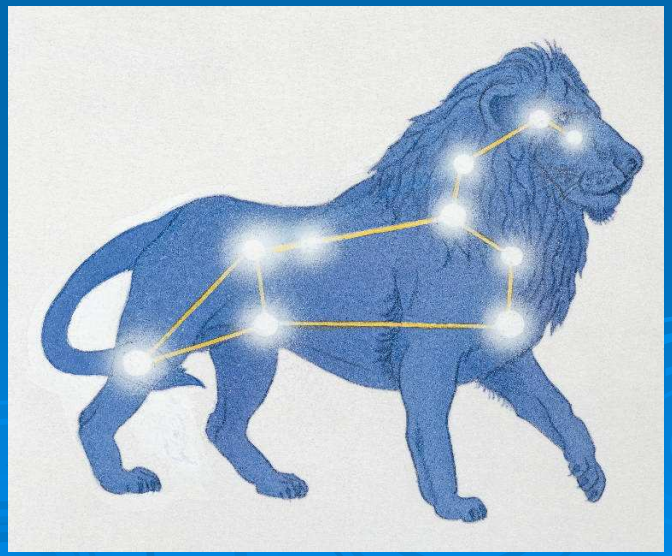
We next compare to see if there is a red or blue shift in the spectrum to see if the star is coming towards us or going away from us.

Star Characteristics

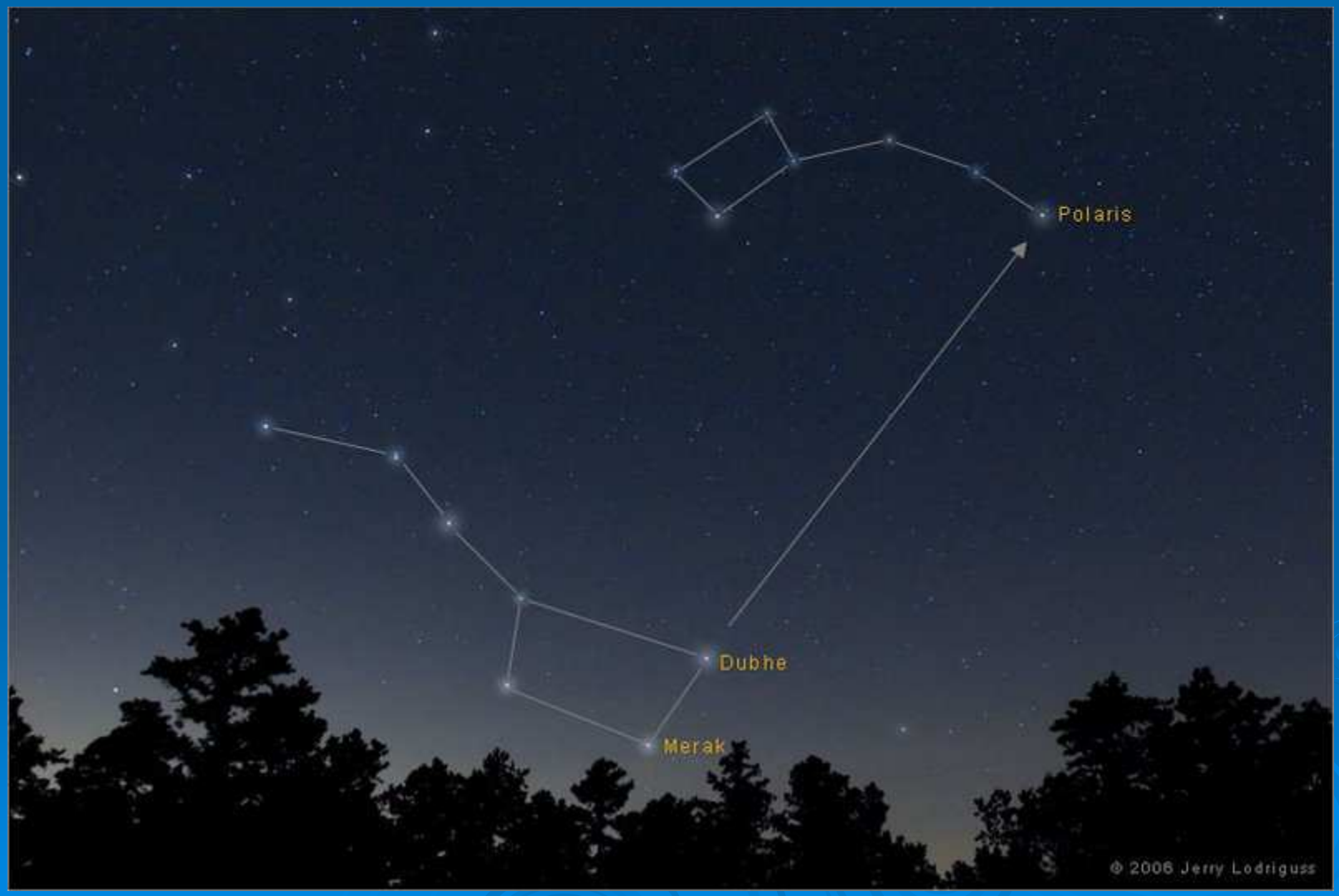
Constellation: a group or pattern of stars in the night sky that appeared as symbols or figures to ancient star gazers

77 Recognized Constellations





Polaris – The North Star



Classifying Stars

- 3 characteristics used to classify stars:
  - size, temperature and brightness

Size:

Neutron star – about 20 kilometers in diameter. 1 teaspoon weighs 1 billion tons!!

White dwarf- about the diameter of the Earth

Medium Size- about the size of our sun

Red Giant- several times the diameter of our Sun

Super Red Giant – can be the diameter of our entire solar system

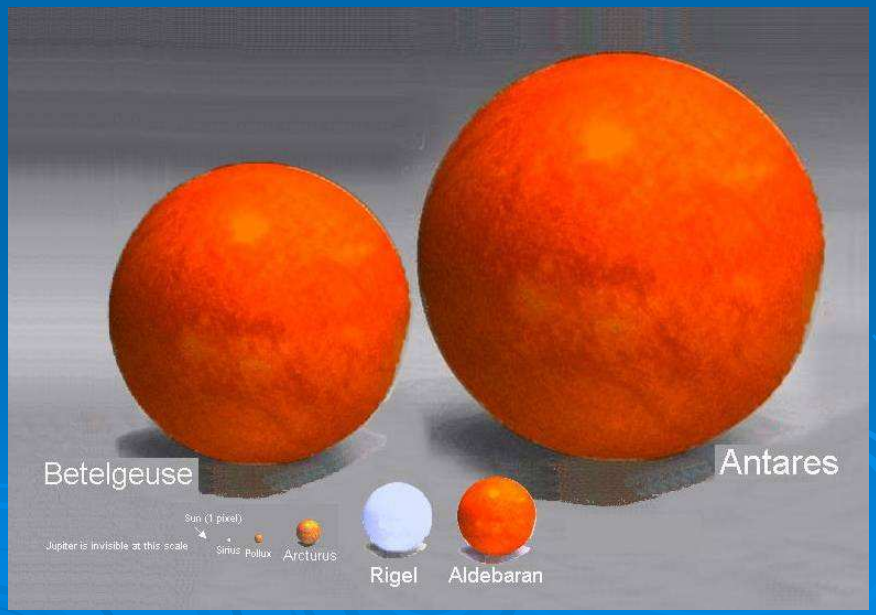
Surface Temp

Red - about 3,000 degrees Centigrade

Yellow- about 6,000 degrees Centigrade

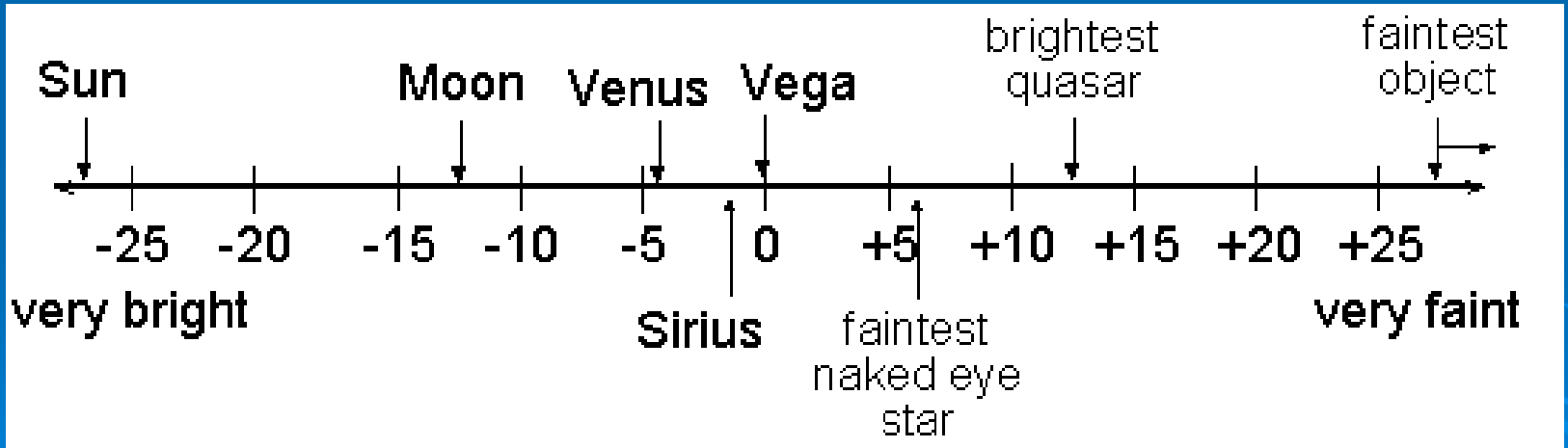
White – about 10,000 degrees Centigrade

Blue – about 50,000 degrees Centigrade



Star Brightness

- the amount of light given off by the star
  - **Apparent Magnitude** – the brightness as seen from the Earth. As the distance from the star increases, the apparent magnitude of that star would decrease.
  - **Absolute Magnitude** – the brightness the star would have if it were a standard distance from the Earth.



Apparent brightnesses of some objects in the magnitude system.

Hertzsprung – Russell Diagram

- a chart that compares Color, Surface Temperature and brightness of stars.

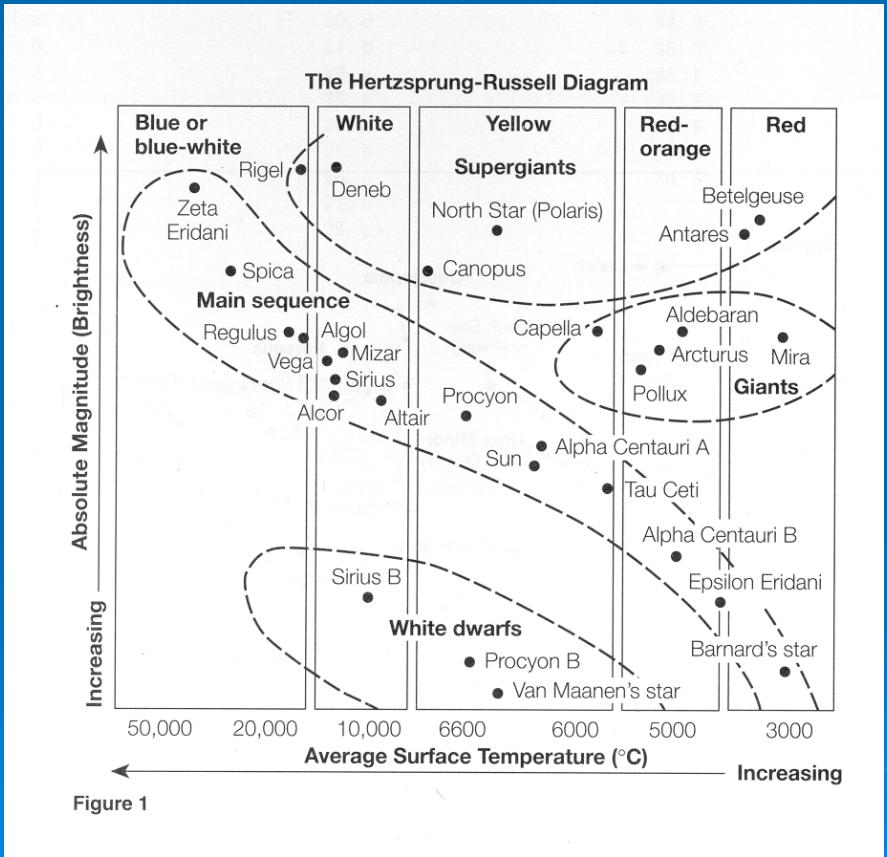
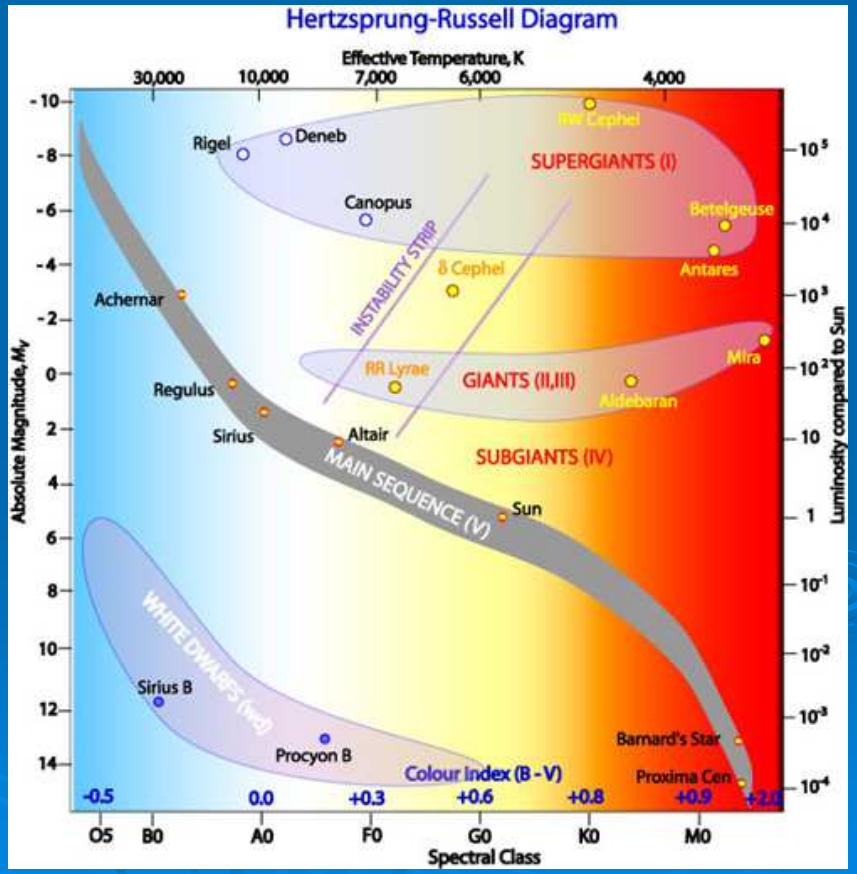
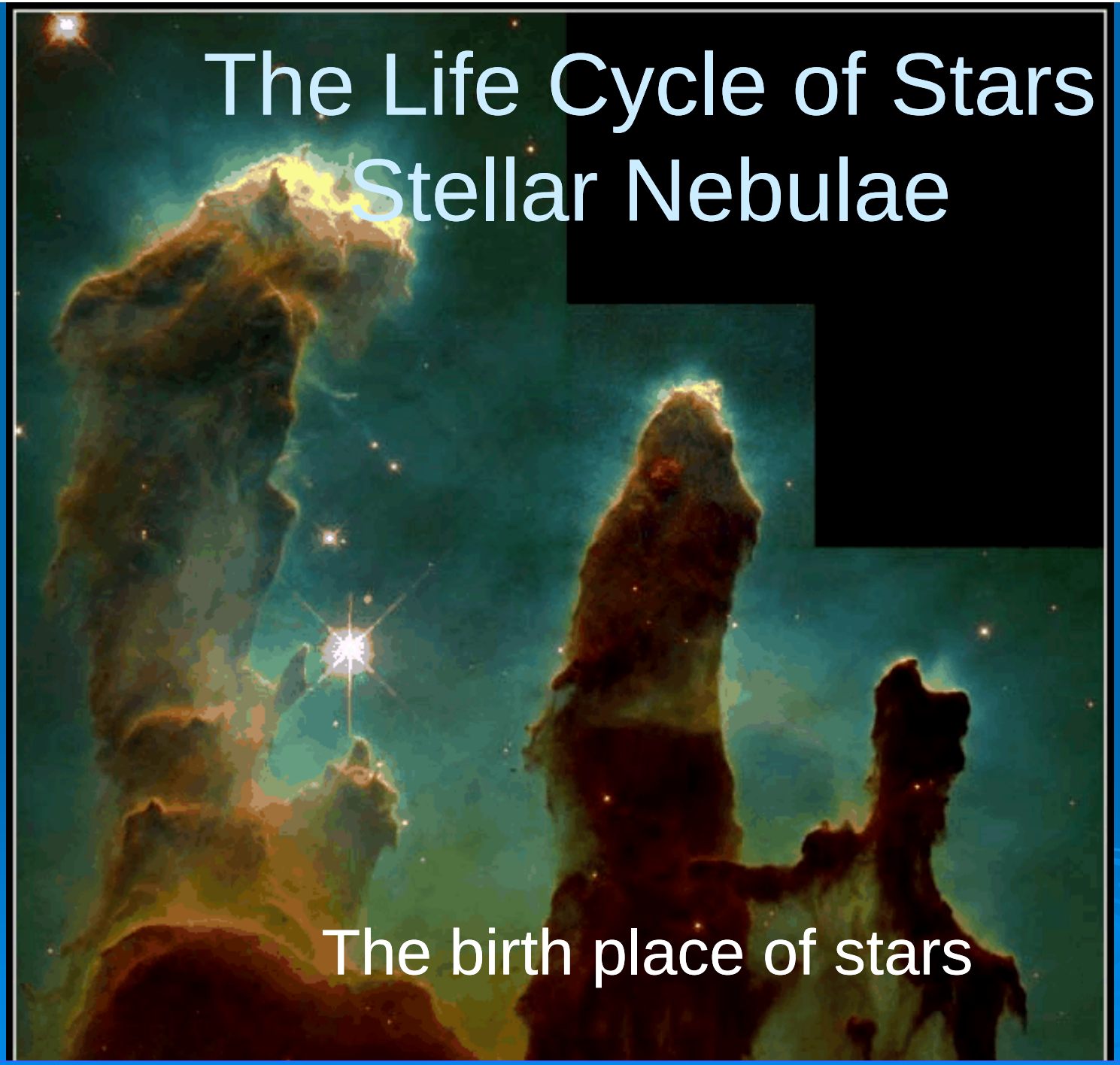


Figure 1



The Life Cycle of Stars
Stellar Nebulae

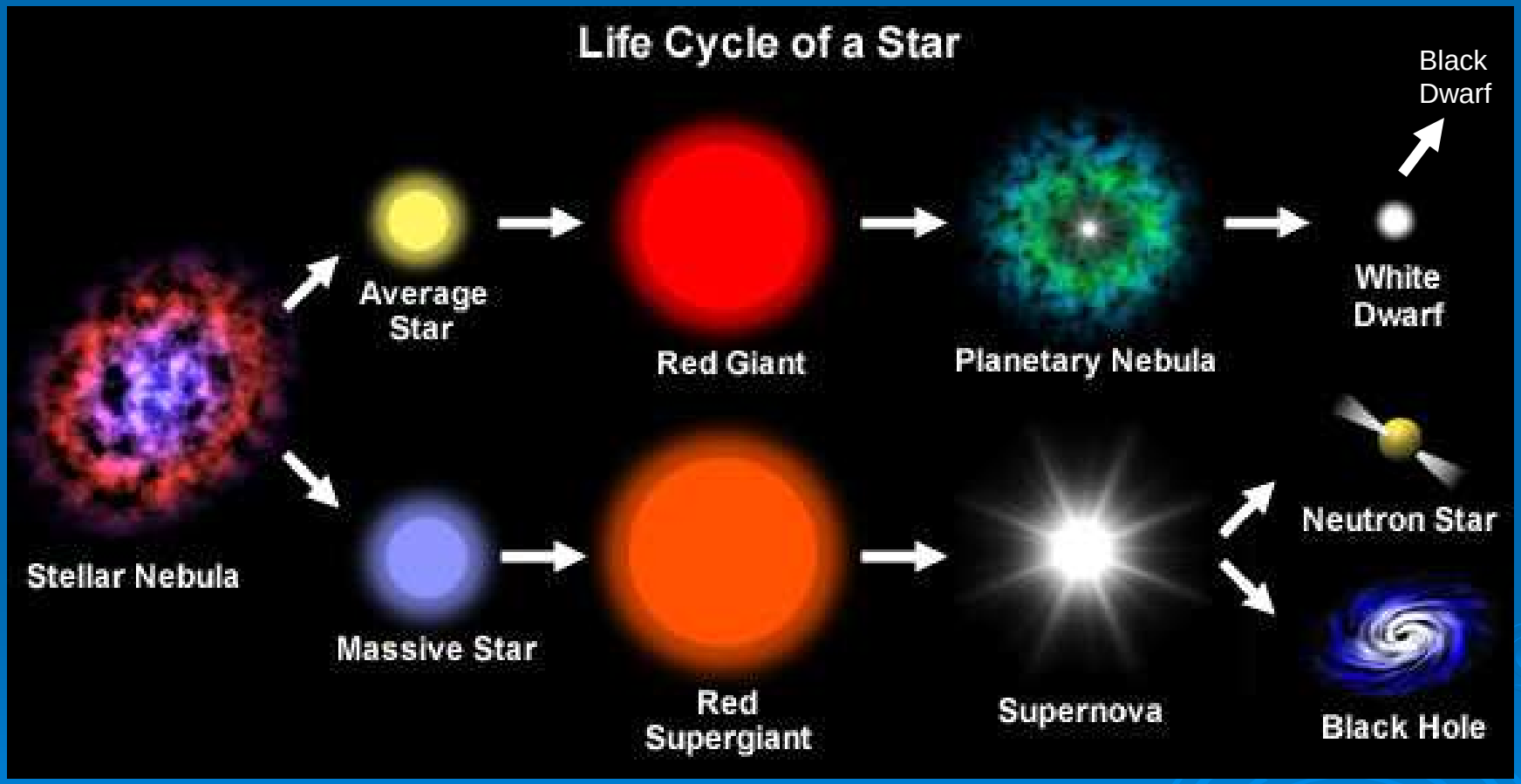


The birth place of stars

Star Life Cycle

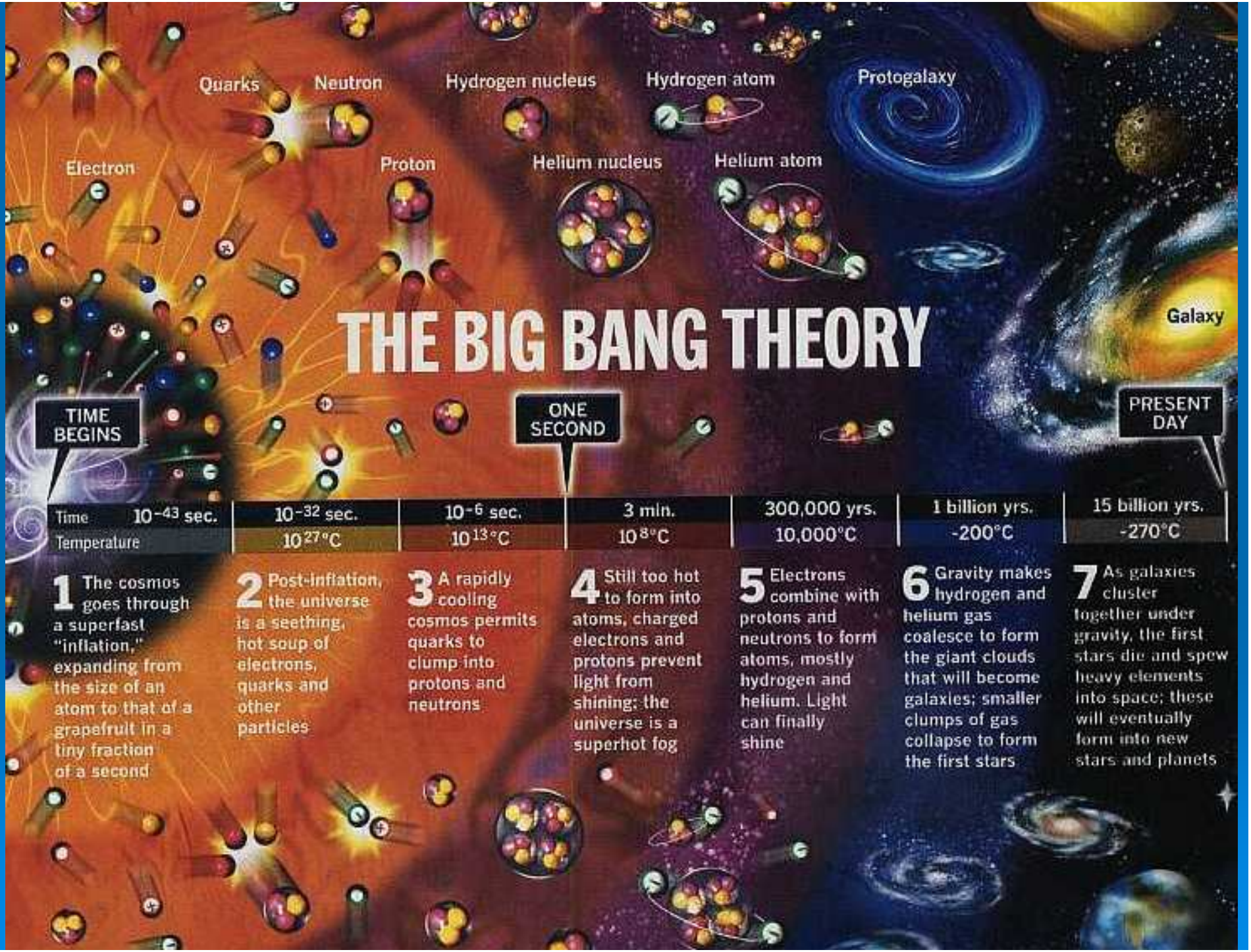
- **Nebula** – a huge gas cloud made up mainly of Hydrogen that collapse down on itself and compresses the gas down into a **Protostar**
- **Star is "born" when the protostar has contracting tight enough for Hydrogen to fuse into Helium, this releases the light and energy we normally associate with a "normal" star.**
- **How long a star lives depends on its initial mass – the more mass stars use their fuel faster than less massive stars!**
  - **Stars smaller than the Sun have lives up to 200 billion years**
  - **Medium Stars, like our Sun – have lives about 10 billion years**
  - **Massive Stars – have very "short" life spans – about 10 million years**

Star Life Cycle



Where did it all begin?

- We (as Christians) know!
  - Genesis 1:1 In the beginning **GOD** created the heavens and the earth.
- They (as evolutionists) say the
  - “Big Bang” Theory


Quarks
Neutron
Hydrogen nucleus
Hydrogen atom
Protogalaxy
Electron
Proton
Helium nucleus
Helium atom
Galaxy
THE BIG BANG THEORY
TIME BEGINS
ONE SECOND
PRESENT DAY
Time 10⁻⁴³ sec.
Temperature
10⁻³² sec.
10²⁷°C
10⁻⁶ sec.
10¹³°C
3 min.
10⁸°C
300,000 yrs.
10,000°C
1 billion yrs.
-200°C
15 billion yrs.
-270°C
1 The cosmos goes through a superfast "inflation," expanding from the size of an atom to that of a grapefruit in a tiny fraction of a second
2 Post-inflation, the universe is a seething, hot soup of electrons, quarks and other particles
3 A rapidly cooling cosmos permits quarks to clump into protons and neutrons
4 Still too hot to form into atoms, charged electrons and protons prevent light from shining; the universe is a superhot fog
5 Electrons combine with protons and neutrons to form atoms, mostly hydrogen and helium. Light can finally shine
6 Gravity makes hydrogen and helium gas coalesce to form the giant clouds that will become galaxies; smaller clumps of gas collapse to form the first stars
7 As galaxies cluster together under gravity, the first stars die and spew heavy elements into space; these will eventually form into new stars and planets

Big Bang Theory

- The Big Bang Theory says that the entire universe began 15 to 20 billion years ago.
- Scientist have viewed thousands of galaxies and can measure the fact that all galaxies are moving away from each other.
- If you could run the film “backwards”, it would appear that all of the galaxies come together at a single incredibly dense point.
- Scientist CANNOT Explain where this dense point came from. WE CAN:
  - **Gen 1:1** – In the beginning, God created the Heavens and the Earth

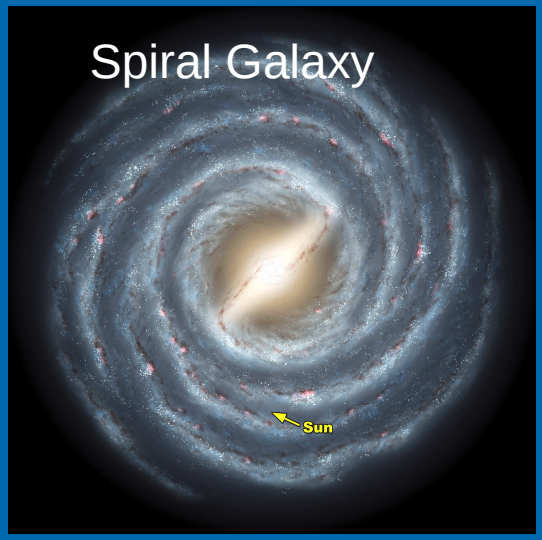
Celestial Bodies

100’s of billions of galaxies make up the known universe

Each speck is a galaxy – each galaxy contains 100’s of billions of stars!!

This picture takes up a very small piece of the sky, it covers about the size of your “pinky” finger nail held at arms length.

Spiral, Elliptical and Irregular

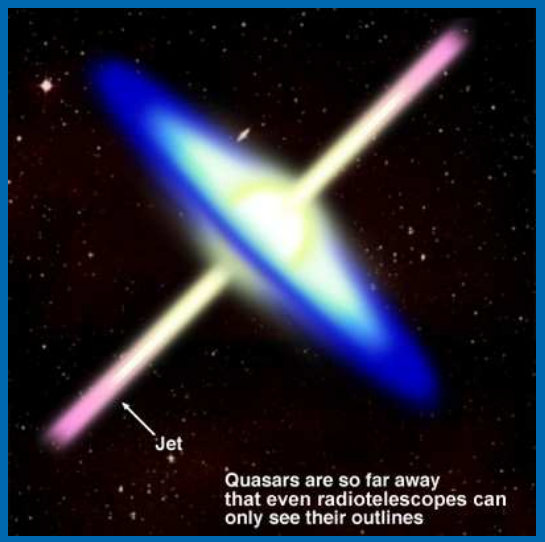


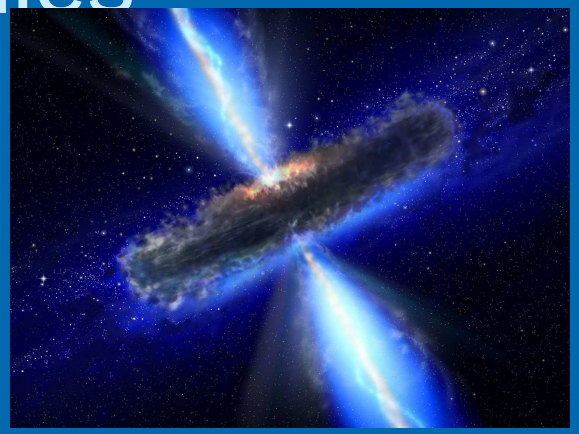
3 Basic Shapes - Spiral, Elliptical and Irregular

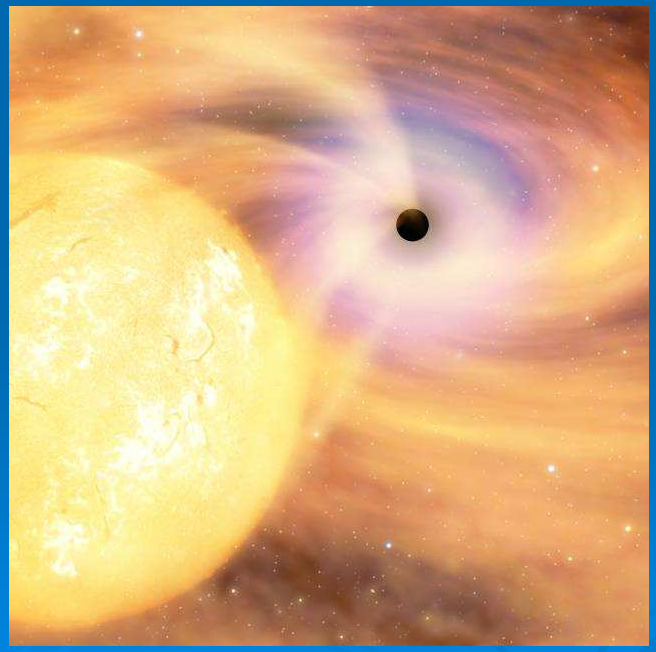
- Where is our Sun?

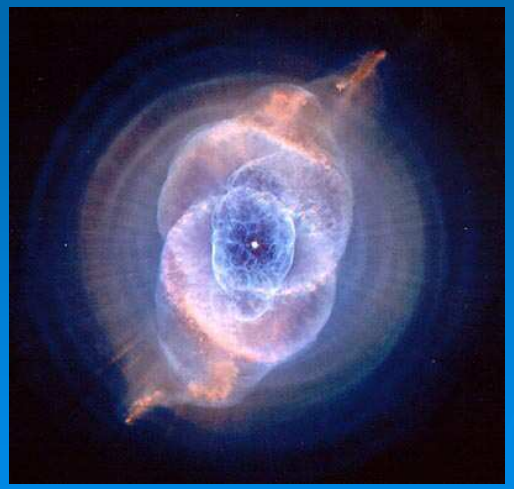
The Milky Way Galaxy

Other Celestial Bodies









That would be all there is for Chapter 24…..