

Physical Science
Lecture Notes
Chapter 23 and 24

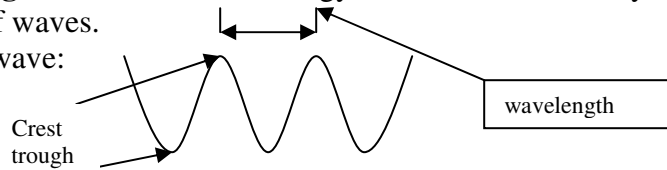
I. Chapter 24: Stars, Galaxies and the Universe

A. Tools of Modern Astronomy

1. **ElectroMagnetic Radiation**

a. **Electromagnetic Radiation** is energy that can travel directly through space in the form of waves.

b. Parts of a wave:



c. EMR spectrum includes (in order from longest wavelength to shortest wavelength) radio waves, infrared, visible light, ultraviolet, X-rays and gamma rays.

d. Visible light waves in order from longest wavelength to shortest wavelength: Red, Orange, Yellow, Green, Blue and Violet

2. Telescopes: collect and focus EMR

a. Visible Light Telescopes

- i. Refracting Telescope: collects and focuses light using convex lenses
- ii. Reflecting Telescope: uses a curved mirror to bounce the light onto a small area

b. Radio Telescope: Uses a large parabolic dish to collect and focus radio waves

3. **Spectrographs**: break light into its visible components

a. Astronomers use spectrographs to determine temperatures and chemical composition of the stars they are looking at.

B. Characteristics of Stars

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

a. Big Dipper, Orion, Gemini, Little Dipper, etc.

2. Distance units

a. **AU** – astronomical unit – distance from the Earth to our Sun, about 93 million miles or 150 million kilometers

b. **Light Year**- distance light would travel in one year- a distance measurement, not a time measurement!!- 9.5 million million kilometers!

3. Classifying stars: three characteristics used to classify stars: size, temperature and brightness

a. Size:

- i. **Neutron star** – about 20 kilometers in diameter
- ii. **White dwarf**- about the diameter of the Earth
- iii. **Medium Size**- about the size of our sun
- iv. **Red Giant**- several times the diameter of our Sun
- v. **Super Red Giant** – can be the diameter of our entire solar system

b. Surface Temperature: revealed by the star's color

- i. Red - about 3,000 degrees Centigrade
- ii. Yellow- about 6,000 degrees Centigrade
- iii. White – about 10,000 degrees Centigrade
- iv. Blue – about 50,000 degrees Centigrade

- c. **Brightness:** the amount of light given off by the star
 - i. **Apparent Magnitude** – the brightness as seen from the Earth. As the distance from the star increases, the apparent magnitude of that star would decrease.
 - ii. **Absolute Magnitude** – the brightness the star would have if it were a standard distance from the Earth.
- 4. **Hertzsprung – Russell Diagram:** a chart that compares Color, Surface Temperature and brightness of stars.
 - a. **Main Sequence** – that group of stars that increase in brightness as their surface temperatures increase.

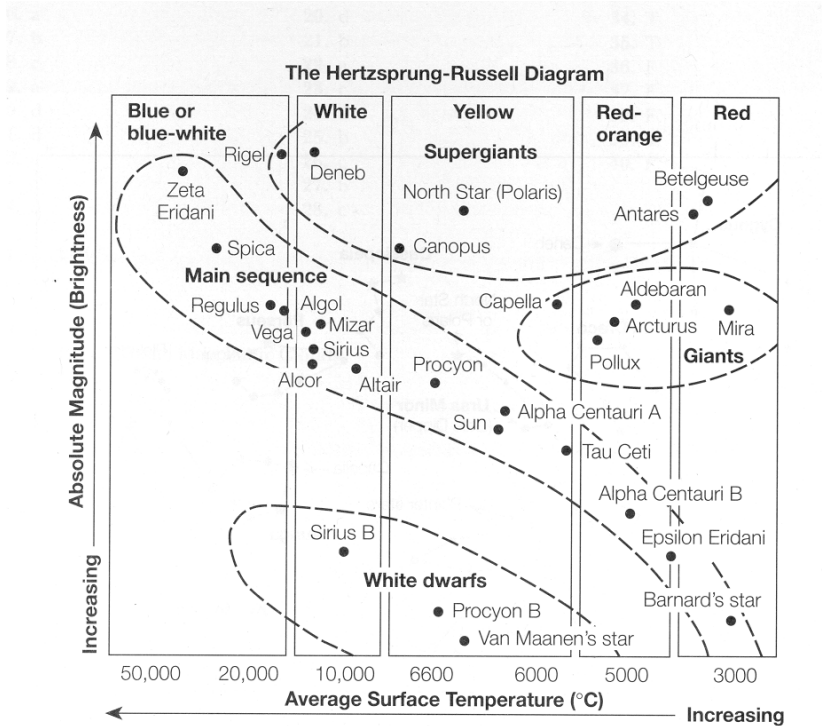
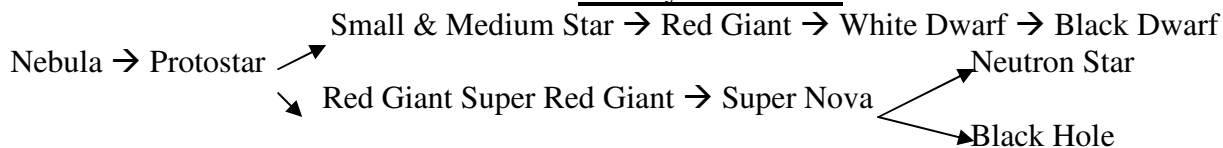


Figure 1

C. Lives of Stars

- 1. Birth of a Star:
 - a. **Nebula** – a huge gas cloud made up mainly of Hydrogen that collapse down on itself and compresses the gas down into a **Protostar**
 - b. 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.
- 2. Life of a Star
 - a. How long a star lives depends on its initial mass – the more mass stars use their fuel faster than less massive stars!
 - i. Stars smaller than the Sun have lives up to 200 billion years
 - ii. Medium Stars, like our Sun – have lives about 10 billion years
 - iii. Massive Stars – have very “short” life spans – about 10 million years
- 3. Death of Stars
 - a. As the fuel burns out, all stars will become Red Giants or Super Red Giants
 - b. After the Red Giant stage a star will become a white dwarf, neutron star or a black hole.

Life Cycle of a Star



D. History of the Universe

1. Galaxy – is a group of 100's of Billions of stars
 - a. Three main shapes
 - i. Spiral, Elliptical and irregular
 - b. 100's of billions of galaxies make up the known universe
2. **Big Bang Theory**
 - a. The Big Bang Theory says that the entire universe began 15 to 20 billion years ago.
 - b. Scientist have viewed thousands of galaxies and can measure the fact that all galaxies are moving away from each other.
 - c. If you could run the film “backwards”, it would appear that all of the galaxies come together at a single incredibly dense point.
 - d. Scientist **CANNOT** Explain where this dense point came from. WE CAN:
 - i. **Gen 1:1** – In the beginning, God created the Heavens and the Earth

II. Chapter 23: The Solar System

A. Observing the Solar System

1. Greeks watched the stars move across the sky and noticed five “stars” that wandered around and did not follow the paths of the normal stars. They called them Wander Stars “planets”.
2. “**Wandering Stars**” were: Mercury, Venus, Mars, Jupiter and Saturn
3. Greek Astronomer **Ptolemy** (pronounced “tall-oh-me) believed: Geocentric - Earth centered Solar system
4. **Copernicus**: Polish Astronomer believed: Heliocentric – Sun centered Solar System
5. **Galileo**: confirms Copernicus belief
 - a. He used telescope to see 4 moons revolving around Jupiter and that Venus went through phases just like our moon
 - i. These things couldn't happen if we were Geocentric, only if we were heliocentric
6. **Brahe**, an astronomer, made very precise measurements of the location of the planets for over twenty years.
7. **Kepler**, a mathematician, used Brahe numbers and determined that the orbits of the planets were elliptical not perfect circles.
8. **Newton** – determines that planets stay in orbit because of Inertia and Gravity
 - a. **Inertia** – an object at rest stays at rest, an object in motion stays in a straight line motion, until acted on by an outside force.
 - b. **Gravity** – the attraction of two objects. The strength of gravity depends on the masses each object possess.

B. The Sun

1. The Sun's Interior

- a. **Core** – Fusion takes place here, reaches temps of 15,000,000 degrees Centigrade. Most of the mass of the sun is found here.
- b. **Radiation Zone** – energy transferred from core out of the interior of the sun, reaches temperatures of 100,000 degrees Centigrade
- c. **Convection Zone** – Convection Currents boil as the energy from the interior is transferred to the surface of the sun. temperatures drop to 6,000 degrees Centigrade

2. The Sun's Atmosphere

- a. **Photosphere** - the surface of the sun, also known as the first atmospheric layer. It is what we see when we look at the sun
- b. **Chromosphere** – the middle layer of the sun atmosphere, seen as a reddish glow at the beginning and end of a solar eclipse
- c. **Corona** – the “white halo” is the outer layer of the sun's atmosphere, seen during total eclipses or w/ special filters on telescopes.
- d. See “Need to Know Handout for additional info!!– high energy streams of electrically charged particles “blown” away from the sun in all directions
 - i. Can cause problems with earth satellites, communications etc.
 - ii. Produce the **Aurora borealis** – Northern lights
 - iii. Produce the **Aurora australis** – Southern Lights

3. Features of the Sun

- a. **Sunspots**: areas on the sun surface that are cooler gases and cause dark spots, usually found in pairs,
 - i. Dark inner portion of sunspot is the **umbra**, lighter colored outer portion of the sun spot is the **penumbra**
 - ii. The number of sunspots found on the surface of the sun run in 11 year cycles.
- b. **Prominence**: a massive loop of plasma lifting off the surface of the sun
- c. **Solar Flare**: extremely strong prominences where the loop breaks away from one of its arms and “sprays” into space.

C. The Inner Planets: See “Need to Know Handout for additional info!!

1. **Mercury, Venus, Earth, Mars, Asteroid Belt**

D. The Outer Planets: See “Need to Know Handout for additional info!!

1. Jupiter, Saturn, Uranus, Neptune and Pluto

E. Comets, Asteroids and Meteors

1. **Comets**

- a. Chunks of ice and dust that orbit the sun in extremely long narrow orbits
- b. Parts include Nucleus, Coma and the tail

2. **Asteroids** see handout

3. **Meteors**

- a. **Meteoroid**: rock/ice in space, usually from comets or asteroids
- b. **Meteor**: rock/ice that enters Earth's atmosphere, producing “shooting stars”
- c. **Meteorite**: rock that makes it through the atmosphere and lands onto the Earth's surface.

Physical Science Need to Knows

Planets

Mercury-Venus-Earth-Mars-Asteroids-Jupiter-Saturn-Uranus-Neptune-Pluto

I. The Inner Planets-The Terrestrial Planets: Mercury, Venus, Earth and Mars

Mercury: Closest to the sun, about the size of our moon, fastest revolution, daytime temp 427 C & night temp -170 C

Venus: Earth's "twin" and one of the hottest surfaces, thickest atmosphere of terrestrial Planets, very slow rotation (243 Earth days) & retrograde rotation, Called the "Morning & the Evening Star"

Earth: Intelligent life, liquid water

Mars: The "Red" planet, live TV from the surface, largest volcano in solar system: *Olympus Mons*

Asteroid Belt: In orbit where a planet should be, range in size from 1000 km (1/3 the size of our moon) to dust size

II. The Outer Planets-Pluto & The Gas Giants: Jupiter, Saturn, Uranus, & Neptune

Jupiter: Largest of the Jovian Giants, large Red Dot is a massive storm, we viewed breakup of comet crash onto its surface.

Saturn: Rings are horizontal, fastest rotation causes poles to be flatten and equator to bulge, least dense- it would float in water

Uranus: Super heated ocean of water 8,000 km thick, Blue planet w/ atmosphere featureless & 11,000 km thick. Axis is tilted almost 90 degrees.

Neptune: Its orbit was used to calculate the position and existence of Pluto, 5 vertical rings, Blue planet w/ atmosphere with visible changing clouds. Its largest moon is Triton which has retrograde revolution.

Pluto: Last known planet discovered in 1930, only terrestrial planet in outer planets, "Twin" planets w/ large moon Charon. It has officially been declassified and is no longer a "planet".

Artificial Satellites

Mariner 2 – 1962, first probe of Venus

Mariner 4 - 1965, first probe of Mars

Mariner 7- 1969, explored Mars, sent back aerial photos of surface

Mariner 9 – 1971, Explored Mars, sent back photos of two Martian moons

Mariner 10- 1974, three passes of Mercury

Viking 1 – 1975 – first spacecraft to land on Mars

Viking 2 – 1975 , landed on and explored Mars

Pioneer 10- 1983, First man-made object to leave our solar system, explore outer planets

Pioneer 11 – explored outer planets

Voyager 1- explored outer planets

Voyager 2 – explored outer planets

Magellan – orbit around Venus

Pathfinder-1997- Landed on Mars, released microwave-sized remote controlled rover called "Sojourner"