**Stars, Galaxies and the Universe:**

**Unit 4: Astronomy**

**Mini-Unit:** The Universe

**Goal 3: The student will demonstrate the ability to identify and describe the properties, natural forces, and theories of formation and operation of the solar system and universe.**

Objectives – The student will be able to:

* Describe the life cycle of stars (nebulae, protostar, red giants, white dwarfs, neutron stars, pulsars, supernovas, black holes), and the role of gravity in their stellar evolution.
* Explain the relationship between absolute magnitude and surface temperature of stars using the Hertzsprung-Russell Diagram
* Use bright and dark line spectra to determine the movement and elemental compositions of stars
* Describe the structure and evolution of galaxies using their visible characteristics
* Explain how the Doppler effect supports the concept of an expanding universe and the Big Bang Theory

**Textbook:** Unit 8, Chapter 30, pg. 774

Characteristics of Stars:



Star: ball of gases that gives off a tremendous amount of electromagnetic energy created by nuclear fusion within the star

Analyzing Starlight:

1. The composition of a star can be determined by the color of light it emits
2. Spectrograph – devices which separate light into different colors or wavelengths called a spectrum
3. By analyzing where dark lines cross the colors, one can determine the composition and temperature of the star

The Elemental Composition of Stars:

 The color and bands on a spectrum tell your what elements make up a star; mostly hydrogen with the second most being helium



The Temperature of Stars:

 The color of a star tells you how hot the star is

The Size and Masses of Stars:

1. Can range in size from the size of Earth to a 1,000 times the diameter of the sun
2. Stars can have more mass and be smaller than our Sun, they can also have less mass and be larger than our Sun

Stellar Motion:

1. Apparent Motion: motion of the stars by using our eyes, caused by the movement of the Earth
2. Actual Motion: can be the rotation of the star on its axis, revolution around another star, or moving towards/away from our solar system
3. Doppler Effect: An observed change in the frequency of a wave when the source or observer is moving
4. A star moving towards the Earth will be shifted towards the blue end of the spectrum, while stars moving away from Earth will show a shift towards red

Expanding Universe Theory: It was proposed that since the Big Bang was an explosion in all directions, then the Universe should be expanding. The findings of the Doppler Effect, most notably the abundance of galaxies showing a red shift, supports this finding.

Stellar Evolution:



Hertzsprung-Russell Diagram (H-R Diagram): A graph that shows the relationship between the brightness of a star and its surface temperature.

* Used to describe the life cycle of stars
* Main Sequence: The location on the H-R diagram where most stars lie; it goes from hot and bright to cold and dim

Nebula: A large cloud of gas and dust where stars are born when an outside force brings particles together which in turn exert gravity on each other, pulling other objects in

Protostars: Dense regions of gas in the nebula that begin to spin and flatten as heat energy builds turning the gas into plasma; as temperatures increase fusion begins thus making it a star

Main Sequence Stages: As long as fusion continues, the star remains on the main sequence, the larger the star the faster it burns out

Red Giants: As medium size stars cool they expand and begin glow red (10 or more times larger than the sun)

Planetary Nebula: As fusion ends, the outer gases drift away forming clouds of gas

White Dwarfs: As medium size star cools, matter collapse inward creating a hot, extremely dense core of matter (about the size of Earth)

Red Supergiant: As a massive star cools, it expands and begins to glow red

Novas and Supernovas:

 Explosions of stars due to the inward collapse of matter (Novas – Red Giants, Supernovas – Super Red Giants)

Neutron Star: A star that has collapsed under gravity to the point that the electrons and protons have smashed together to form neutrons.

Black Hole: An object so massive and dense that not even light can escape it



Galaxies:

Galaxy: A collection of stars, dust, and gas bound together by gravity; major building block of the universe

Types of Galaxies:

1. Sprial – most common; nucleus of bright stars with spiraling flattened arms emanating from it
2. Elliptical – stretched out football shaped; bright in the center, no arms
3. Irregular – have no particular shape with a low total mass but an abundance of gas and dust



The Big Bang Theory:

Big Bang Theory: The theory that all matter and energy in the universe was compressed into a an extremely small volume that 13 to 15 billion years ago exploded and began to expand in all directions

Evidence of:

1. Red Shifts of Galaxies – Edwin Hubble discovered that many galaxies had a red shift in their spectra, with those furthest away having the greatest shift; meaning that not only was the universe was expanding, but it was accelerating
2. Cosmic Background Radiation – Radiation uniformly detected from every direction in space; remnant of the Big Bang