**Galaxies and the Universe**

**\_Nebula**\_\_\_\_\_: Large cloud of gas and dust which can form stars and galaxies.

\_**Solar Nebula Theory**: Stars and planets formed through condensing of the solar nebula.

**Galaxy**\_: Large group of stars, gas, and dust that constitute the universe. By a large group, we mean hundreds of billions.

Most galaxies have a \_**black hole** at their center.

The \_**Milky Way**\_\_ is our galaxy. It is a great disk made of stars orbiting a central point in the disk.

Scientists have used **radio waves**\_ and **infrared radiation** to determine the shape of the Milky Way.

The Milky Way has a galactic center (called the nucleus) that is surrounded by a \_**nuclear bulge**\_\_ which sticks out of the galactic disk. Surrounding this disk is a set of \_**spiral arms**\_\_.

Three types of galaxies (based on their shape)

1. **\_spiral** \_\_\_\_ : Flattened into a disk with spiral arms.
2. \_**elliptical**\_\_\_: Three dimensional and look more like a football
3. \_**irregular\_**\_: Does not have a distinct shape.

**The Sun**

The sun is the largest object in our **\_solar system**.

* Its **mass** controls the motions of the planets. It contains more than 99.8% of the total mass of the Solar System.
* All energy for our solar comes from the \_\_\_**sun\_**\_\_\_\_.
* The sun is presently made of **70%**\_ hydrogen, **28%**\_ helium , and \_**2%**\_\_ everything else (metals).
* The sun is a **\_plasma**\_\_\_\_\_\_\_: electrically charged particles. Considered the fourth state of matter.

**Inside the Sun**

* **Core**
  + Because of the **high**\_ temperature (10,000,000 kelvin – *metric unit*), the interior of the Sun is gaseous throughout.
  + It is the \_**densest\_**\_\_\_\_\_\_ part of the sun.
  + At this high temperature many of the gases are completely ionized, meaning that the gas has been energized to the point that some of the electrons break free from, but travel with, their nucleus.
  + The sun’s energy comes from nuclear \_\_**fusion\_**\_\_\_\_\_\_ of hydrogen to helium.
* **Radiative zone**
  + Energy is transferred from particle to particle by \_\_**radiation\_**\_\_\_\_\_\_\_\_\_.
* **Convection zone**
  + In this zone, moving volumes of gas carry the energy the rest of the way to the sun’s surface through \_**convection\_**\_\_\_\_\_\_\_\_\_\_\_.

**Sun’s Atmosphere**

**Photosphere**

* It is the \_**lowest\_**\_\_\_ layer, but most **\_\_visible\_\_\_\_\_\_**layer.
* It is \_**400 km** in thickness and the temperature is \_**5800\_** Kelvin.
* It is the most visible layer (even though it’s the lowest layer) because most of the light emitted from the Sun comes from this layer.

**Features on the Photosphere**

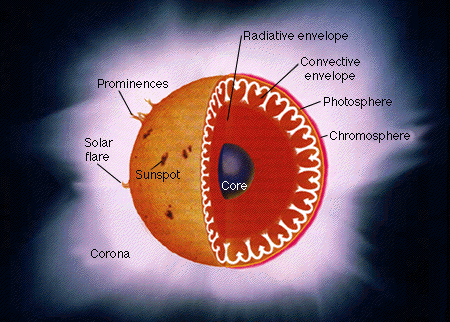
* **\_Sun\_ \_spots** : Cooler areas on the surface (6,200 F compared to Suns surface of 10,000 F) of the photosphere that appear darker than the surrounding areas on the Sun.
  + Dark and small, but brighter than Full Moon and big as Earth.
  + Associated with \_\_**magnetic fields**\_\_: one set of spots is positive, other is negative.
  + \_**solar\_\_\_\_ \_activity \_\_\_ \_cycle**\_\_\_\_\_: A period of 22.4 years in which the number of sunspots on the Sun changes regularly and the Sun’s magnetic field reverses.
  + \_**Galileo\_\_\_\_** was the first to observe sunspots. He saw that they moved across the Sun which also showed that the sun was rotating.
* \_**solar\_\_ \_\_flare**\_\_\_: A sudden eruption of intense high-energy radiation from the sun’s surface.
* \_**prominence**\_\_\_\_\_\_\_\_: Arc of gas ejected from the photosphere.
* \_**coronal \_\_\_holes**\_\_\_\_: Areas of low density in the gas of the corona from which particles escape.

**Chromosphere**

* It is \_**2500km\_**\_\_\_\_\_ in thickness and approximately \_\_**30,000**\_ Kelvin.
* Without special filters, this layer is visible only during a \_\_**solar\_\_\_\_\_\_\_** **\_\_eclipse\_\_\_\_.**

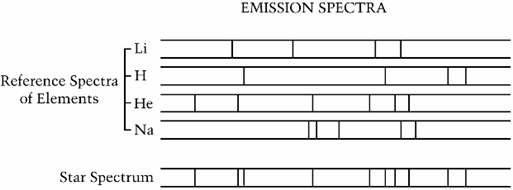
**Corona**

* Top layer of the Sun’s atmosphere. It extends several million kilometers from the top of the chromosphere. It has a temperature range of **1 million**\_\_\_\_ to **2 million**\_\_ Kelvin.
* The \_**density\_\_\_\_** of the gas in the corona is so low that it can only be seen during a total solar eclipse.
  + Gas flows outward from this layer at high speeds and forms the \_**solar\_\_\_\_wind**\_\_It is made up of charged particles, or **\_ions**\_\_\_, which flow outward through the entire solar system.
  + Creates Auroras or Northern and Southern Lights. Electrons from solar wind are captured by the Earth’s magnetic field which interacts with atoms in our atmosphere. Oxygen and nitrogen make red and green; nitrogen can also make violet. Northern lights = Aurora Borealis, Southern = Aurora Australis.



**Measuring the Stars**

* Stars can be smaller than or up to 2000x larger than the Earth.
* Stars contain different \_**densities\_**\_\_\_\_.
* Color of a star depends on \_\_\_**temperature\_**\_\_\_\_\_\_\_ and elements.
* Stars form by the \_**contraction**\_\_\_\_ of a large sphere of gases which causes the nuclear fusion of \_**lighter\_**\_\_\_\_\_\_ elements into \_\_**heavier\_\_\_\_** elements.



* Astronomers study the composition of stars by measuring their \_**Spectra\_**\_\_\_, light spread out in a rainbow band. The spectroscope (which measures the spectra) is fitted into a telescope. When light from the star passes through, it breaks into its component colors. Which two elements in the above star? **Hydrogen and helium**. The dark lines are caused by **elements\_** in the star’s atmosphere.
* Light passes through the elements and is absorbed, causing black lines.
* Each element absorbs certain wavelengths, producing a unique pattern of dark lines which are used to identify elements in the star’s atmosphere.
* Most stars (90% of them) that you see are **\_\_Main\_\_\_ \_Sequence**\_\_\_\_\_ Stars.

**Constellations**

* \_**Constellations**\_ are groups of stars named after animals, mythological characters, or everyday objects.
* Different constellations appear as Earth revolves around the sun.
* \_**Polaris\_**\_\_\_\_\_\_\_\_\_\_\_ (North Star), is the center of the constellation circle, positioned directly over the North Pole. Located at the end of the Little Dipper in the constellation Ursa Minor.
* \_\_\_**circumpolar \_stars**\_\_ are constellations that appear year round. As Earth rotates, many constellations circle around Polaris.

**Stars Continued**

* \_**Binary\_\_ \_stars**\_ are two stars that are gravitationally bound together and orbit a common center of mass. The bright star \_**Sirius**\_\_\_\_\_\_ is an example.
* Astronomers use two units of measure for long distances.
  + \_**Astronomical\_\_ \_Unit**\_\_\_\_\_: The distance between Earth and the Sun. 1 AU = 93,000,000 miles.
  + \_**Light\_ \_\_year**\_\_: The distance it takes to travel one year. 9.5 trillion kilometers.
* **\_Parallax**\_\_: the apparent shift in a stars position by the motion of the observer. The motion of the observer is the change in position of Earth as it orbits the sun.

**Brightness of Stars**

* \_\_**absolute**\_\_ magnitude – The measure of the amount light a star gives off (How bright the star really is)
* \_\_**apparent**\_\_\_\_\_\_ magnitude – A measure of the amount of light received on Earth (How bright it looks because it is closer).
* \_**\_Luminosity**\_\_\_\_\_\_\_ – Energy output from the surface of a star per second; measured in watts.