Astronomy Lesson 4

Stars

Quiz Date:

Vocabulary

Compositions of Stars

* When you look at a white light through a glass prism, you see a rainbow.
* This rainbow of colors is called a spectrum.
* The spectrum contains the colors we recognize as red, orange, yellow, green, blue, indigo, and violet.
* A hot solid object, like the glowing wire inside a light bulb gives off a continuous spectrum—one that shows all of the colors.
* Astronomers use an instrument called a spectrograph to spread starlight out into its colors.
* Stars, however, don’t have continuous spectra.
* Because they are not solid objects, stars give off spectra that are different from those of light bulbs.

Making an I.D.

* Stars are made of various gases that are so dense, they act like a hot solid.
* For this reason, the surface of a star, or the part that we see, gives off a continuous spectrum.
* But the light we see passes through the star’s atmosphere which is made of somewhat cooler gases than the star itself is made of.
* A star therefore produces a spectrum with various lines in it.
* Emission lines are bright lines that are made when certain wavelengths of light are given off by hot gases.
* Only some colors in the spectrum show up, while all other colors that make up white light are missing.
* Emission lines are the fingerprints for the elements.

Classifying Stars

* In the 1800s, the first people to look at spectra found that different stars had different spectra.
* They started to collect the spectra of lots of stars and tried to classify them.
* At first, letters were assigned to each type of spectra.
* Stars with spectra that had very noticeable hydrogen patterns were classified as A type stars.
* Others were classified as B and so on.
* Later, when scientists finally understood why spectra are different they realized that the stars were classified in the wrong order.
* Stars are now classified by how hot they are.
* The main differences in the spectra of stars are related to the temperature of the stars.
* We see the temperature differences as colors.
* The original class O stars are blue—they are very hot.
* If you see a certain pattern of absorption lines in a star, you know that a certain element or molecule is in the star or at least in its atmosphere.
* But the absence of a pattern doesn’t mean the element isn’t there; the temperature might not be high enough or low enough for absorption lines to be produced.

How Bright Is That Star?

* Some stars are bright and some are faint.
* The brightest stars are called first magnitude stars and the faintest stars are sixth magnitude stars.
* Magnitude means size, or in this case brightness.
* A first magnitude star is 100 times bright than a sixth magnitude star.
* A smaller number means a brighter star.
* With telescopes we can see stars that are 29th magnitude.
* Very bright stars may have a negative number.

Apparent Magnitude

* Lights nearer to you look brighter than lights farther away.
* How bright a light looks is called apparent magnitude.

Absolute Magnitude

* Astronomers use a star’s apparent magnitude and its distance from Earth to calculate its absolute magnitude.
* Absolute magnitude is the actual brightness of a star.
* If all stars could be placed the same distance away, their absolute magnitudes would be the same as their apparent magnitudes and the brighter stars would look brighter.
* The sun, for example, has an absolute magnitude of 4.8—pretty ordinary for a star.
* However, because the sun is so close to Earth, its apparent magnitude is -26.8, making it the brightest object in the sky.

Distance to the Stars

* Because they are so far away, astronomers use light-years to give the distances to the stars.
* A light-year is the distance that light travels in one year.
* Because the speed of light is about 300,000 km/s, it travels almost 9.5 trillion kiometers in one year.
* Stars near Earth seem to move compared with more-distant stars as Earth revolves around the sun.
* This apparent shift in position is called parallax.
* While this shift can be seen only through telescopes, using parallax and simple trigonometry, astronomers can find the actual distance to stars that are close to Earth.
* Farther stars, however, are measured in more-complicated ways

Motion of Stars

* Earth rotates on its axis.
* As the Earth turns, different parts of its surface face the sun.
* This is why we have days and nights.
* The Earth also revolves around the sun.
* At different times of the year, you see different stars in the night sky.
* This is because the side of Earth that is away from the sun at night faces a different part of the universe.

Apparent Motion

* Because of our location on the Earth’s surface, the sun appears to rise in the east and set in tin the west.
* Stars also seem to rise and set.
* During the day, the atmosphere scatters light from the sun and cannot see the stars because the sky is too bright.

Actual Motion

* The rising and setting of the sun and stars is due to Earth’s rotation.
* But each star is also really moving in space.
* Because the stars are so distant, though, their motion is hard for us to measure.
* Most of the stars nearest the sun are traveling in the same direction as the sun.
* This is like driving on a highway while all the cars are going about the same speed and direction.
* It would be difficult to measure the speed of the cars in the lane next to you by just watching them.
* If you could watch stars over thousands of years, their movement would be obvious.

Life Cycle of Stars

* Stars are born, grow old, and eventually die.
* Stars exist for billions of years.
* They are born when clouds of gas and dust come together and become very hot and dense.
* As stars get older, they lose some of their material.
* Usually this is a gradual change, but sometimes it happens in a big explosion.
* Either way, when a star dies, much of its material returns to space.
* There some of it combines with more gas and dust to form new stars.

H-R Diagram

* An H-R diagram is a graph showing the relationship between a stars’s surface temperature and its absolute magnitude.
* The H-R diagram shows how stars are classified by temperature and brightness.
* It also is a good way to illustrate how stars change over time.
* In an H-R diagram, temperature is given along the bottom of the diagram.
* Absolute magnitude, or brightness, is given along the left side.
* Hot blue stars are located on the left and cool red stars are on the right.
* The brightest stars are a million times brighter than the sun.
* The faintest are 1/10,000 as bright as the sun.
* There is a band of stars going from the top left to the bottom right corner.
* This diagonal pattern of stars is called the main sequence.
* A star spends most of its lifetime as a main sequence star and then changes to one of the other types of stars.
* All stars begin as a ball of dust and gas in space.
* Gravity pulls the gas and dust together.
* The gas becomes hotter as it becomes more dense.
* When it is hot enough in the center, hydrogen turns into helium in a process called nuclear fusion, and lots of energy is given off.
* Most stars can be plotted on the main sequence.
* Small mass stars tend to be located at the lower right end of the main sequence; larger stars are found at the left end.
* As main sequence stars age, they move up and to the right on the H-R diagram to become giants or super giants.
* Such stars can then lose their atmospheres, leaving small cores behind, which end up in the lower left corner of the diagram as white dwarfs.

When Stars Get Old

* While stars may stay on the main sequence for a long time, they don’t stay there forever.
* Average stars, such as the sun, turn into red giants and then white dwarfs.
* More massive stars may leave the main sequence in a more spectacular fashion.

Supernovas

* Large blue stars use up their hydrogen much faster than stars like the sun.
* This means they make a lot more energy, which makes them very hot and therefore blue.
* Compared with other stars they don’t last long.
* At the end of its life, a blue star may explode in a tremendous flash of light called a supernova.
* A supernova is basically the death of a large star by explosion.
* A supernova explosion is so powerful it can be brighter than an entire galaxy.
* It may shine for several days after the initial explosion and then gradually dim.
* Heavy elements such as silver, gold, and lead are made during a supernova explosion and then scattered into space.

Neutron Stars and Pulsars

* What happens to a star that becomes a supernova?
* The leftover materials in a the center of a supernova are squeezed together to form a star of about two solar masses.
* But all the material is found in a sphere only about 20 km in diameter.
* The particles inside the star become neutrons, so this sat is called a neutron star.
* The squeezed material in a neutron star is so dense, a teaspoon of neutron star matter brought back to Earth would weigh a billion tons.
* If a neutron star is also spinning, it is called a pulsar.
* A pulsar sends out beams of radiation that also spin around very rapidly.
* These beams are much like the beams from a lighthouse.

Black Holes

* Sometimes the leftovers of a supernova are so massive that they collapse to form a black hole.
* A black hole is an object with more than three solar masses squeezed into a ball only 10 km across.
* A black hole is so small and massive and its gravity is so strong that not even light can escape.
* Black holes don’t gobble up stars.
* If a star is close by, some gas or dust from the star will spiral into the black hole, giving off x rays.
* It is by these x rays that astronomers can detect the existence of black holes.