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Questions Galore!

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STUDY GUIDE: STARS

Facts You Should Know:

Stars are created in swirling masses of gas and dust particles called a **nebula**. A star is fueled by internal **nuclear energy**, in a process called **thermonuclear fusion**, and it stays together due to the forces of its own **gravitation**. The hotter a star's **core**, or center, the more reactions it produces. A star's gravity depends upon the **mass** of the materials inside its core. Most stars are composed primarily of **hydrogen**. The rest of a star's content is **helium**. In the core of a star, hydrogen **fuses** to form helium, thereby releasing nuclear energy. In **main sequence** stars, the greater a star's mass, the brighter its **luminosity** will be.

Stars vary greatly in mass, temperature, and luminosity.

Astronomers have categorized visible stars into six different **magnitudes**, depending upon their **apparent brightness**. Apparent magnitude refers to how bright a star appears when seen from the earth. The first magnitude is a **relative measurement** because it often depends on the star's distance from us. Closer stars often appear brighter than some of the farther stars, even though the farther stars are actually brighter.

Luminosity is the measure of the total amount of light a particular star emits. To measure luminosity, astronomers must measure the u-v rays that are emitted, but this is sometimes difficult because our atmosphere blocks these rays from visibility.

Astronomers use a star's light rays to calculate its **spectral type**, which indicates its approximate temperature. To do this, these use a **spectroscope**. Since the color of a star is correlated with its surface temperature, this measurement, which breaks the star's light into color bands, helps to determine the star's temperature. Astronomers classify stars according to their temperatures into seven spectral classes. In order from hottest to coldest, these spectral classes are **O, B, A, F, G, K, and M**. The hottest stars are placed in the O and B class and are blue. The next hottest are classified in the A class and are

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white. F and G are yellow. Those in the K class are orange, and the M class contains the red stars, which are the coolest of the stars.

A graph developed by Ejnar Hertzsprung and Henry Norris Russell, now known as the Hertzsprung-Russell diagram, plots the relation of absolute brightness to its spectral type. When the stars are plotted, most of the stars fall along a “main sequence” diagonal from the top left to the bottom right. This chart portrays surface temperatures horizontally and plots luminosity vertically so that the brightest stars fall at the top of the chart, and the hottest stars congregate on the left. The faintest stars are found at the bottom.

The sun is a star! In fact, it is the closest star to earth, only 150 million kilometers (93 million miles) away. This may seem like a long way, but it’s still 250,000 times closer to us than the next closest star, which is Proxima Centauri. The sun is 4.6 billion years old and its light only takes 8 minutes to reach earth, while the light of many other stars takes billions of years. **Red giants**, the biggest stars, are hundreds of times larger than the sun. **White dwarfs** are approximately the size of the earth.

The earliest astronomers thought stars were motionless and formed fixed patterns in the night sky that became known as **constellations**. Now we know that stars do move, but they do so very slowly. This factor is known as **proper motion**. The motion we see of stars across the night sky is called **apparent motion**, and it is actually a by-product of the earth’s rotation.

The universe contains countless **galaxies**, each composed of billions of stars that orbit around one central location. Galaxies are classified according to their shape. The three main types of galaxies are **elliptical, spiral, and irregular**. All the visible stars in relation to us are in the **Milky Way**, our galaxy, which contains the sun and our solar system of planets as well. The Milky Way is a spiral galaxy.

Star clusters can be **open** (also called **galactic**) or **globular**. There are fewer and more sparse stars found in an open cluster than globular one. Stars in an open cluster are usually about the same age. One of the more famous visible open clusters is the **Pleiades** (also known as the Seven Sisters) in Taurus, which contains approximately 500 stars. The brightest star in the Pleiades is Alcyone. One of the most well-known open clusters in the Southern Hemisphere is the Jewel Box, which contains stars of many colors.

Globular clusters are more common. They are symmetrical, spherical, and closely bound. They surround the galaxy in a “galactic halo.” They can contain millions of stars that are bunched together in a “glob.” In comparison, open clusters are shapeless and contain relatively few stars. There are approximately 120 known globular clusters in the Milky Way. Most are found near Scorpio and Sagittarius.

Phases of Stars

Stars go through several phases as they age. Once they are formed in a nebula from gas and dust, they continue to survive by burning hydrogen for billions of years. This phase is called the **main-sequence**.

When a star runs out of hydrogen, the star is out of balance and the core shrinks. However, the star itself expands, becoming a **red supergiant**. As the core shrinks, the internal pressure rises, making it hot enough to begin another nuclear reaction, at which point the core stops shrinking, and the atmosphere begins to consolidate.

When supergiants contract, they often form **neutron stars**: dense, compact stars that spin rapidly.

Extremely massive supergiants may repeat this process, condensing even further to become **black holes**, whose gravitational fields are strong enough to block light.

A **white dwarf** occurs when a small to middle-mass star uses up its fuel, and collapses. As it collapses, much of its atmosphere disburses into space as gas and dust from which new stars will be formed. After about a billion years, this type of star will lose its fuel and change into a **black dwarf**.

Unique Types of Stars

Binary stars are actually two stars that orbit each other, which means every so often one of the stars passes behind the other star and is hidden for a short time.

Variable stars alternate between brightness and dimness. Two important variable stars are Delta Cephei in the Northern Hemisphere and R Centaiuro in the Southern Hemisphere.

Flare stars are red dwarfs that suddenly release brief bursts of light.

Pulsars emit radio waves and magnetic fields and are created when neutron stars collapse.

Novas occur when a main-sequence star and a white dwarf star in a binary star system explode in the course of a day. Temporarily, this can make their system 300,000 times brighter than the sun. This brightness lasts for a few days or weeks, and then lessens gradually, leaving the stars about the same as they were before. In 1992, Nova Cygni, in the northern constellation Cygnus, became one of the brightest novas visible during this century.

A **supernova** occurs on rare occasions. It happens when a star explodes, giving off light, and typically destroying itself. The most notable recent supernova, because it was the first to be visible to us on earth in 300 years, was SN 1987 A, which erupted near the Milky Way in a galaxy known as the Magellanic Cloud.

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THE BRIGHTEST STARS IN THE SKY IN ORDER OF BRIGHTNESS:

1. Sirius
2. Canopus
3. Alpha Centauri
4. Arcturus
5. Vega

The next brightness stars are Capella, Rigel, Procyon, Archnar, and Betelgeuse. Vega is the brightest star in the Northern Hemisphere.

THE CLOSEST STARS TO EARTH, IN ORDER:

1. The Sun
2. Proxima Centauri/Alpha Cen C
3. Rigel Kentaurus/Alpha Cen A
4. Alpha Centauri B
5. Barnard's Star

THE CONSTELLATIONS:

Stars form patterns in the sky called constellations. The constellations in the northern sky that circle Polaris, the north star, are called the north circumpolar constellations. The five most popular north circumpolar constellations are Ursa Major, Ursa Minor, Draco, Cassiopea, and Cepheus.

Ursa Major is known as the Big Bear and contains the seven stars that compose the Big Dipper. The front stars of the Big Dipper are called the pointer stars because they point to Polaris, located at the end of the handle of the Little Dipper, which is found within Ursa Minor, the Little Bear. Draco is a dragon, and Cassiopea is a queen, whose shape resembles a wide "w" in the sky. Cepheus, the king of Ethiopia, also sits beside Cassiopea in the northern sky. This constellation appears as a simple picture of a house, and it is often upside-down in the sky. These north circumpolar constellations can be found at any time of the night.

THE ZODIAC CONSTELLATIONS:

The zodiac constellations are 12 constellations that appear to encircle the earth. A list of these constellations and pictures associated with each constellation are given below.

CONSTELLATION

1. Capricorn
2. Aquarius

PICTURE THAT IT FORMS

Goat
Water Bearer

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3. Pisces	Two Fish
4. Aries	Ram
5. Taurus	Bull
6. Gemini	The Twins
7. Cancer	Crab
8. Leo	Lion
9. Virgo	Virgin
10. Libra	Measuring Scales
11. Scorpio	Scorpion
12. Sagittarius	Archer

OTHER STAR CONSTELLATIONS:

<u>CONSTELLATION</u>	<u>PICTURE THAT IT FORMS</u>
1. Bootes	Herdsman
2. Corvus	Crow
3. Crater	Cup
4. Hydra	Sea serpent
5. Aquila	Eagle
6. Corona Australis	Southern Crown
7. Corona Borealis	Northern Crown
8. Cygnus	Swan
9. Hercules	Hercules
10. Lacerta	Lizard
11. Lupus	Wolf
12. Lyra	Lyre
13. Vulpecula	Fox
14. Andromeda	Princess of Ethiopia
15. Cetus	Sea Monster (Whale)
16. Delphinus	Porpoise or Dolphin
17. Equuleus	Little Horse
18. Pegasus	Winged Horse
19. Perseus	Perseus
20. Triangulum	Triangle
21. Auriga	Charioteer
22. Camelopardus	Giraffe
23. Canis Major	Large Dog
24. Canis Minor	Small Dog
25. Columba	Dove
26. Lepus	Hare
27. Orion	Hunter
28. Apus	Bird of Paradise
29. Crux	Southern Cross

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30. Musca	Fly
31. Pavo	Peacock
32. Reticulum	Net
33. Triangulum Australe	Southern Triangle
34. Tucana	Toucan
35. Volans	Flying Fish

SELECTED CONSTELLATIONS

BRIGHT STARS IN CONSTELLATION

Within a star constellation there is sometimes a star that shines brighter than the rest. You will be given the bright stars in the following constellations.

1. Bootes	Arcturus
2. Ursa Minor	Polaris
3. Leo	Regulus
4. Virgo	Spica
5. Cygnus	Deneb
6. Lyra	Vega
7. Aquila	Altair
8. Perseus	Algol
9. Auriga	Capella
10. Gemini	Castor and Pollux
11. Taurus	Aldebaran
12. Canis Major	Sirius
13. Canis Minor	Procyon
14. Orion	Rigel and Betelgeuse