

Space

Brief #1: Astronomy



When you look up into the night sky you can see lots of different things. There is the moon, stars, and planets. There are millions and millions of objects in space. From Earth, we can only see a tiny portion of what is in the universe.

For thousands of years—long before computers, cars, telescopes, and rockets—people gazed up into the sky and wondered about what they saw. They noticed that there were some events that happened over and over again. These events were predictable. For example, ancient people noticed that the moon had phases. Sometimes

it was full; at other times, only a sliver of it was visible.

People also noticed that the sun rose and set every day. Ancient people created calendars based on these predictable events. The calendars helped them to decide when to plant and harvest their crops.

Vocabulary

1. solar eclipse
2. lunar eclipse
3. Stonehenge
4. El Castillo
5. sextant
6. radio telescope

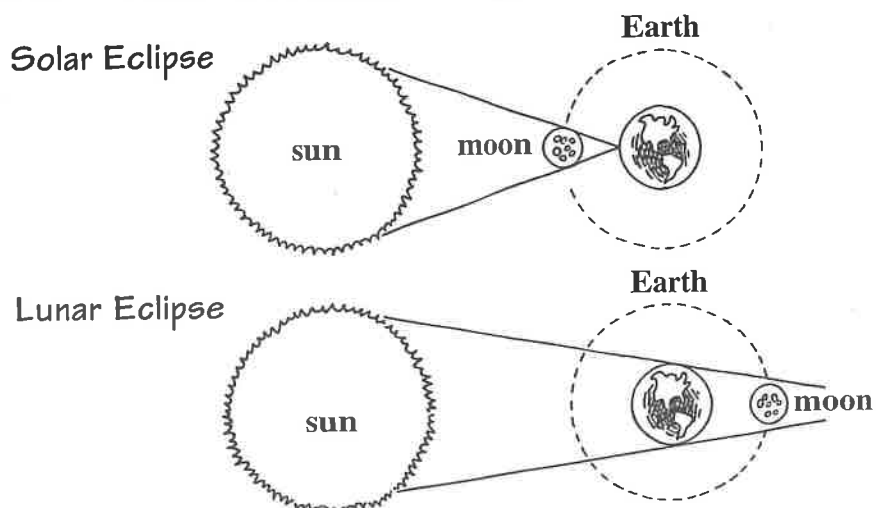


Eclipses

Eclipses were events that ancient people noticed taking place in the sky. There are two types of eclipse: a solar eclipse and a lunar eclipse.

A solar eclipse is when the moon blocks the sun's light to the Earth. When a solar eclipse happens during daytime hours, the Earth goes dark as if it is nighttime.

A lunar eclipse is when the Earth casts a shadow on the moon. During a lunar eclipse, a person standing on the Earth could see the Earth's shadow moving across the face of the moon. Lunar and solar eclipses don't happen very often. In ancient times, people thought these events foretold of something bad happening.



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Brief #1: Astronomy (cont.)



Ancient Astronomy

People who lived centuries ago did not have telescopes or other kinds of modern technology to study the sky the way that modern people do. But that did not stop them from observing the sky. We know that ancient people observed the stars by the buildings that they constructed.

Stonehenge is an ancient structure of stones located in the southeast of England. It is an outdoor place of worship that was built by people about 5,000 years ago. Scientists know that there is a part of Stonehenge that aligns with the sunrise of the summer solstice. The summer solstice marks the beginning of the summer season in the northern hemisphere. It is the day with the most hours of daylight.

The ancient Maya people, who once lived in Mexico, built a pyramid known as El Castillo. This step pyramid has four sides with steps that lead to the top. The pyramid has 365 steps altogether. That is the same number of days in the year. When the sun rises and sets during the spring and autumn equinox, it casts a shadow that looks like a snake on part of the pyramid. As the Earth moves around the sun, the shadow of the snake appears to be slithering down the side of the pyramid!

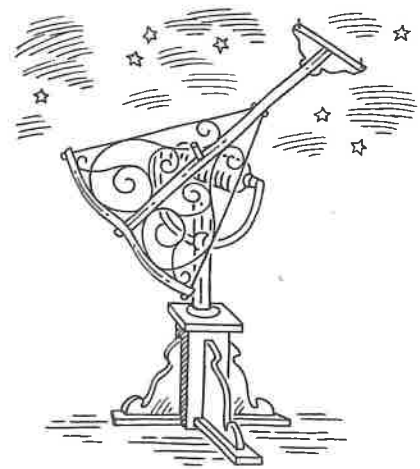


The Tools of Astronomy

People began to invent tools to help them get a better look at the sky centuries ago. Since that time, people have been improving upon these special instruments. It's important to remember that something like the Hubble Space Telescope is the result of hundreds and hundreds of years of human experimentation and invention.

The telescope was invented in the early part of the 17th century. The great Italian scientist Galileo was the first person to use one for observing the sky. It was through this early version of the telescope that he observed that the moon had craters and mountains and that Jupiter had moons.

Another important invention was a navigational tool called the sextant. This instrument was invented during the Renaissance, a cultural movement that took place during the 14th–17th centuries. **The sextant was a very important tool in navigation because it allowed people to find the angle of stars that appeared above the horizon.** This helped sailors determine their location and the route they needed to take.



sextant

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Brief #1: Astronomy (cont.)



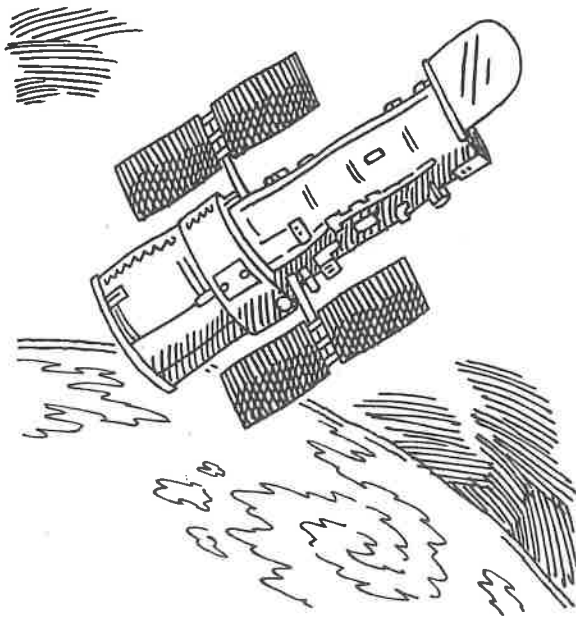
The Tools of Astronomy (cont.)

Today the tools of astronomy are much more complex than what people used long ago. An example is the Hubble Space Telescope, which is in orbit around the Earth. It was launched into space in 1990.

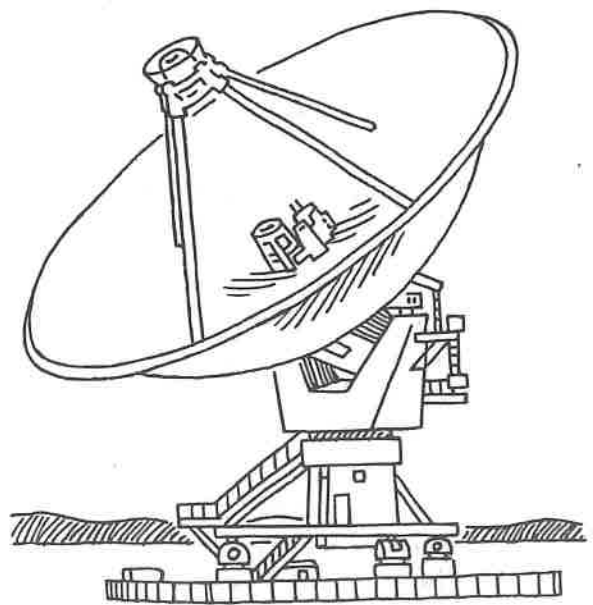
There are many large and complex telescopes that are located on Earth. But there are advantages to having a telescope like the Hubble out in space. For one thing, it is always dark in space. It is much easier to see stars and other objects in the sky when it is dark.

Another advantage is that a telescope in space doesn't have to penetrate the Earth's atmosphere or all of the pollution that exists in our atmosphere. A space telescope can get a clear picture of what things are really like. The Hubble Telescope has taken many amazing photographs of the universe, and scientists have learned a lot from these pictures about the way in which the universe operates.

Telescopes like the Hubble use large mirrors to gather and concentrate light. But not all telescopes work that way. **Radio telescopes look somewhat like large bowls. They gather information from space in the form of radio waves.** There are many large radio telescopes in the United States. The Very Large Array, located in New Mexico, is a series of 27 radio dishes.



Hubble Space Telescope



radio telescope

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Brief #2: The Sun

Focus

The sun is one of billions of stars in the universe.

When you look up into the sky on a clear day, what is the brightest thing that you can see? The sun, of course! But did you know that the sun is actually just one of billions and billions of stars in the universe?

Earth's sun is a giant ball of hot gas. Most of this gas is helium and hydrogen. The sun has no solid surface, so even if it weren't so incredibly hot—about 5,000°C (9,032°F)—you could not stand on it.

Vocabulary

1. photosphere
2. chromosphere
3. corona
4. core
5. nuclei
6. prominences
7. sunspots
8. solar flares

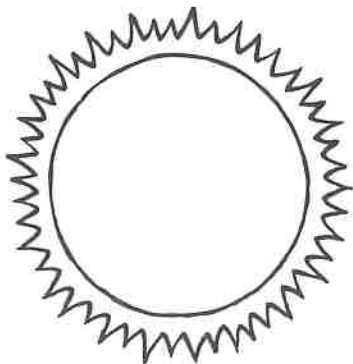


The Parts of the Sun

Scientists know from observing the sun through very special telescopes that it has different parts. **The part of the sun that we see from Earth is called the photosphere.** This is the part of the sun that gives off the light energy. **The layer of the sun just above the photosphere is called the chromosphere.** And the outermost layer of the sun is the **corona.** **The innermost part of the sun is called the core.** (See the diagram on page 72.) Between the core and the photosphere are two areas called the radioactive zone and the convective zone.



What Makes the Sun Shine?



It is in the sun's core where the energy is produced that creates all of the heat and light that is generated from the sun. The light energy of the sun is a product of a powerful reaction between hydrogen nuclei.

In the sun's core, the nuclei of the hydrogen collide and fuse together with each other. This collision forms a new nucleus and creates a new element called helium. This fusion process releases enormous amounts of energy. It is this energy that creates a shining sun.

The sun is 93 million miles from Earth. The light that shines from the sun takes about eight minutes to reach us.

Fast Fact

The sun is between 4 and 5 billion years old!

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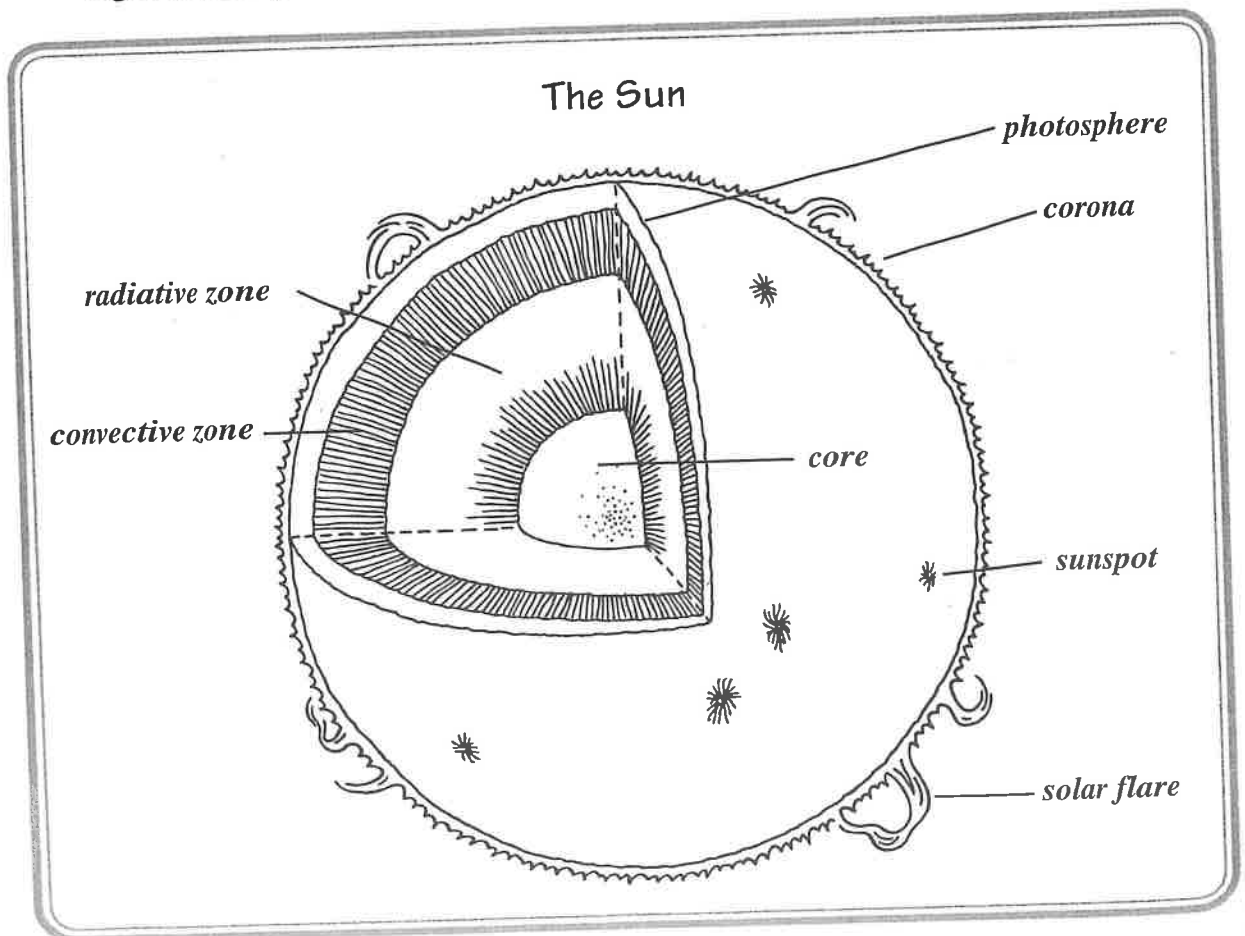
Brief #2: The Sun (cont.)



Other Solar Events

The core of the sun is not the only place where there's lots of action:

- ✓ **Prominences look like huge plumes that blast upward from the sun's chromosphere into its corona.** They are not clouds at all but massive and sudden explosions of gas that leap out from the sun.
- ✓ **Sunspots are areas of the sun's photosphere where we can see strong magnetic activity.** Remember Galileo? He was the first person to notice that sometimes the sun appeared to have tiny dark spots on it. He also observed that these spots changed and moved across the face of the sun. Their magnetic activity makes these sunspots a bit cooler than other parts of the sun, so they appear darker. To us, these spots appear to be very small, but in reality they can be as large as the Earth!
- ✓ **Solar flares are giant explosions that can happen in the sun's chromosphere, photosphere, or corona.** When these explosions occur, they throw out large amounts of protons, electrons, and electromagnetic waves. These solar flares can be millions of degrees in temperature and can disrupt electronic communication on Earth.



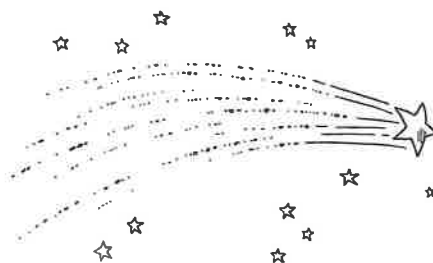
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Brief #3: Stars



Stars are giant balls of hot gas. Stars in the universe are classified or grouped according to certain characteristics. Stars are classified by the following characteristics:

- ✓ color
- ✓ brightness
- ✓ temperature



Vocabulary

1. star
2. nebula
3. supernova
4. neutron star
5. black hole
6. light-year



The Color of Stars

The billions of stars in the universe come in different colors.

The color of a star is determined by how hot it is. You know that our sun looks yellow. In fact, our sun is called a yellow star.

Yellow stars are about 5,000–6,000° (9,032–10,832°F). Red stars are the coolest stars. They are less than 3,500°C (6,832°F). The hottest stars in the universe are blue stars. Some of them can have temperatures over 25,000°C (45,032°F).



The Birth and Death of Stars

Stars live very long lives. Our sun is over 4 billion years old. But even though stars exist for long periods of time, eventually they die.

Out in deep space, there is lots of gas and dust. **Huge areas of this cosmic gas and dust are called nebula.** Nebulas are often nicknamed “star nurseries” because it is inside of them where stars are born.

The force of gravity causes the particles of dust and gas in the nebula to combine. During this process, the temperature inside of the nebula rises. The rise in temperature starts a chemical reaction. This reaction causes hydrogen to change into helium. When this occurs, tremendous amounts of energy are released and stars are created.

Once a star is formed, hydrogen will be used to power the star. The chemical process that created the star is the same process that is responsible for fueling it through its lifetime. But eventually, the star will use up all of its hydrogen fuel. After the star burns up all of its hydrogen, it begins to expand and cool off.

With its hydrogen supply gone, the star will begin to use helium as a source of fuel. But there is a limited amount of helium in the star, too. Once the helium is consumed, the star will contract. Because stars are made of gas, the remaining layers will float off into space.

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Brief #3: Stars (cont.)



The Birth and Death of Stars (cont.)

When the core of a star runs out of fuel, it begins to shrink and shrink until it can't get any smaller. **This causes a gigantic stellar explosion called a supernova.** During a supernova, stars can become billions of times brighter than they were during their lifetimes. All of the matter and energy that was part of the star is hurtled out through space. After these explosions, the stars become neutron stars. **A neutron star is what is left after a supernova explosion.** Although neutron stars are not that big, they are very dense. In fact, they are the densest objects in the known universe. A piece of neutron star the size of a sugar cube can weigh 100 million tons!

There are stars in the universe that are so enormous that when they die they leave a black hole. **A black hole is an area in space that has such a strong gravitational force that nothing, not even light, can escape from it.** A black hole is what is left when the largest stars in the universe die.



The Distance to Stars

The universe is full of millions and millions of stars. When you look up into the night sky you can only see a tiny fraction of these stars. Other than our sun, all of the stars that you can see (and all of the stars that you can't see) are very, very far away from the Earth. Every star but the sun is so far from us that its distance is measured in light-years. **A light-year is the distance light travels in one year, about 10 trillion kilometers.** For example, if a star is one light-year from Earth, that means that the light we see currently shining from it actually left the star one year ago.

Earth's Closest Stars

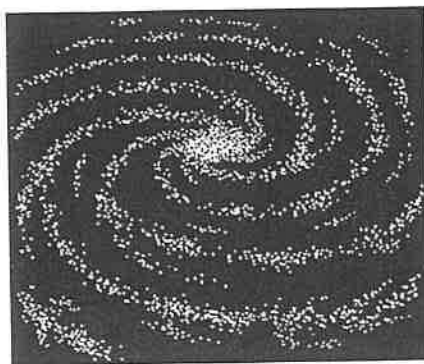
Star Name	Approximate Distance
Proxima Centauri	4.25 light-years
Barnard's Star	6 light-years
Wolf 359	8 light-years
Lalande 21185	8 light-years
Sirius	8.6 light-years

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Brief #4: Galaxies and Constellations



The universe is bigger than anyone can possibly imagine. No one knows for sure how large it is or all of the objects that are within it. Still, much is known about the universe.



Vocabulary

1. galaxy
2. Milky Way
3. constellations



Galaxies

One thing that we know for sure is that the universe is full of galaxies. **A galaxy is a huge group of stars, gas, and dust that is held together by gravitational forces.**

The galaxy in which our solar system—including the Earth and sun—is located is called the Milky Way.

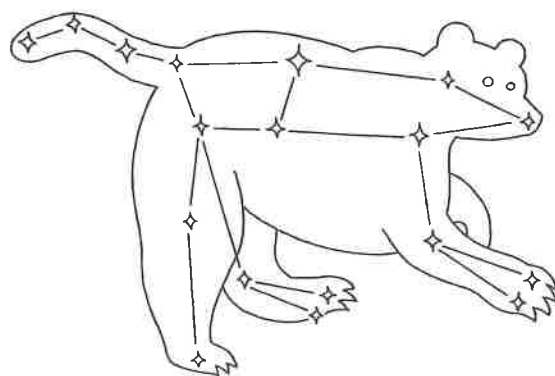
Galaxies come in different shapes and sizes. There are elliptical galaxies, which are oval-shaped; spiral galaxies, which are bulged in the center and have long, wispy arms that spiral out from the bulge; and irregular galaxies, which have no definite shape. The Milky Way is a spiral galaxy.

Even though the universe is filled with billions of galaxies—which are, in turn, filled with billions of stars—from Earth, these cosmic giants look like a single point of light. That's because they are at great distances from the Earth. The closet spiral galaxy to our Milky Way is called Andromeda. It is about 2.5 million light-years away.



Constellations

Constellations are groups of stars in the night sky that appear to form a pattern or make a picture. People have been gazing at these constellations for thousands of years. In fact, many of the constellations that are so familiar to us were originally named by people who lived thousands of years ago. Some of the most well-known constellations are the Greater Dog, Orion, and Ursa Major. The Big Dipper is a part of Ursa Major.



Space

Sentence-Completion Assessment

Name: _____ Date: _____

Directions: Read each statement. Fill in the word or words that best complete the sentence.

1. A _____ eclipse is when the moon blocks the sun's light to the Earth.
2. A _____ is when the Earth casts a shadow on the moon.
3. _____ is an ancient place of worship located in England.
4. Part of Stonehenge aligns with the sunrise of the summer _____.
5. El Castillo was built by the _____.
6. El Castillo has _____ steps.
7. The _____ was a tool that allowed people to find the angle of the stars above the horizon.
8. The sun is made mostly of _____ and _____.
9. The _____ is the outermost layer of the sun.
10. In the sun's core, hydrogen nuclei _____ together to form helium.
11. The sun is _____ million miles from Earth.
12. An area of strong magnetic activity that can be seen on the sun's photosphere is called a _____.



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Sentence-Completion Assessment (cont.)

13. Stars are classified by temperature, brightness, and _____.
14. The color of a star is determined by its _____.
15. The hottest stars in the universe are the color _____.
16. A star is formed in a _____.
17. The force of _____ causes particles of dust and gas in the nebula to combine.
18. Stars use helium and _____ as fuel.
19. A massive stellar explosion is called a _____.
20. After a massive star dies, it becomes a _____ hole.
21. A light-year is equal to about _____ kilometers.
22. It takes _____ minutes for the sun's light to reach the Earth.
23. Irregular, elliptical, and _____ are types of galaxies.
24. The galaxy in which you live is called the _____.
25. A _____ is a pattern of stars in the sky.



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True-False Assessment

Name: _____ Date: _____

Directions: Read each statement carefully. If the statement is true, put a **T** on the line provided. If the statement is false, put an **F** on the line provided.

- _____ 1. A solar eclipse is when the moon blocks the sun's light to the Earth.
- _____ 2. A lunar eclipse is when the Earth casts a shadow on the moon.
- _____ 3. Stonehenge is located in Mexico.
- _____ 4. A part of Stonehenge aligns with the sunrise of the summer solstice.
- _____ 5. El Castillo was built by the Aztecs.
- _____ 6. During the spring equinox, a shadow in the form of a serpent is cast on part of El Castillo.
- _____ 7. The sextant helped people find the angle of the moon and the sun.
- _____ 8. El Castillo has 150 steps.
- _____ 9. The sun is made mostly of hydrogen and helium.
- _____ 10. The outermost layer of the sun is called the photosphere.
- _____ 11. Hydrogen and nitrogen fuse together in the core of the sun.
- _____ 12. The sun is 93 trillion miles from Earth.



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True-False Assessment (cont.)

- _____ 13. A sunspot is an area of strong magnetic activity that can be seen on the photosphere.
- _____ 14. Stars are classified by color, brightness, and temperature.
- _____ 15. The hottest stars are yellow.
- _____ 16. The coolest stars are blue.
- _____ 17. A star is formed in a nebula.
- _____ 18. Stars use liquid ore as fuel.
- _____ 19. When stars run out of helium, they begin to contract.
- _____ 20. Neutrons and black holes were once stars.
- _____ 21. Supernovas create galaxies.
- _____ 22. One light-year is 10 million kilometers.
- _____ 23. Galaxies can be spiral or elliptical.
- _____ 24. Our galaxy is called Ursa Minor.
- _____ 25. A pattern of stars is called a constellation.

