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| **Chapter 26****Sun and Solar System** | Name: |
| Period: |
| **Objectives**:* What is the Sun’s structure and source of energy?

**Key Vocabulary**:* Fusion
* Photosphere
* Corona
* Solar wind
* Plasma
* Chromosphere
* Sunspot
* Aurora
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| **THE SUN’S ENERGY** | All stars, including our Sun, get their energy from **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**.**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** is the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** of the nuclei of **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** to **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** a **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**. Matter is converted into energy during fusion. A star has intense heat and pressure – so intense that atoms are torn apart into their component nuclei and electrons. As a result, elements such as hydrogen and helium exist as **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**.**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** is a **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** consisting of charged particles: Nuclei (or ions) that are positively charged and electrons that are negatively charged.The nuclei normally repel each other. Due to the speed at which they move, and the crowding and heat, **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**.\*\* |
| **THE SUN’S LAYERS** | Energy produced inside the Sun **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**. This is **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**.drawing the outer layers inward.Because the sun is made of gas, no sharp boundaries exist between its various layers. We can divide the sun into four parts: the **\_\_\_\_\_\_\_\_\_**; the visible surface, or **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**; and two atmospheric layers, the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** and **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**. |
| **THE CORE – SOLAR INTERIOR** | * Consists mostly of hydrogen and helium ions in a plasma state (more than 100 times as dense as water).
* Temperatures reach about 15,600,000° Celsius.
* This is **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**.\*\*
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| **RADIATIVE ZONE** | * Another layer of plasma.
* Temperature ranges from about 8,000,000° Celsius near the Core to about 2,000,000° Celsius near the Convection Zone.
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| **CONVECTIVE ZONE** | * Rising and falling currents of plasma carry energy to the Sun’s surface, where it is radiated out into space as sunlight.
* Temperatures reach about 1,500,000° Celsius.
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| **PHOTOSPHERE** | * The **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**.\*\*
* The tops of the rising currents from the Convection Zone form structures called granules.
* The temperature is “only” about 6,000° Celsius.
* Energy is radiated out here into space as sunlight.
* **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**.
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| **CHROMOSPHERE** | * The inner layer of the Sun’s atmosphere that extends thousands of kilometers above the Photosphere.
* The 20,000°Celsius temperature causes the hydrogen to emit light with a distinctive reddish color.
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| **CORONA** | * The Sun’s thin outer atmosphere.
* The Corona is a million times less bright than the Photosphere.
* The temperature ranges from 1,000,000° to 3,000,000° Celsius.
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| **SUN’S DISTANCE TO EARTH** | The average distance that the Earth is from the Sun is **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**.\*\* Astronomers have defined this distance as 1 AU. “AU” stands for Astronomical Unit. |
| **FEATURES OF THE SUN** | * \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
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| **SOLAR PROMINENCES** | * **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** are dense clouds of material **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** above the Sun’s surface by **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**. They can erupt off the Sun in just a few minutes or hours, extending thousands of kilometers into space before falling back to the Sun’s surface.
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| **SUNSPOTS** | * **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** are dark spots on the Photosphere. Some are barely visible, others are four times larger than Earth’s diameter.
* Small sunspots may be visible for a few hours, whereas larger ones may remain visible for a few months.
* **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** are actually very hot and bright. They look dark in pictures because the surrounding Photosphere is so much hotter and brighter.
* The magnetic field associated with a sunspot is about 1,000 times stronger than the magnetic field of the surrounding Photosphere.
* We can watch sunspots move from left to right across the Sun’s surface. This tells us that the **\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**.
* The Sun is not solid, so its **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** from place to place. The rate of rotation at the equator is a little over 25 days, while near the poles, the rate is about 34 days. (=faster at the equator than the at the poles).\*\*
* The number of visible sunspots varies from day to day. At times of peak solar activity, more than 100 sunspots can be seen. During periods of low solar activity, several days may pass where no sunspots are visible.
* The **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** averages about **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** from one period of peak activity to the next.
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| **SOLAR WIND AND MAGNETIC STORMS** | * The corona gives off a constant **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** .\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_called the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**.
* These particles travel in all directions at a speed of about 450 kilometers per second (reaching Earth in a few days).
* Earth’s magnetic field deflects most of the solar wind particles around the planet.
* **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**. (outbursts of light that rise up suddenly in areas of sunspot activity) are **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**.
* **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**. Without this field, Earth’s surface would be bombarded by particles that are very harmful to life.
* Some **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** (of the solar wind) do **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**. This causes **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**, which are displays of color and light appearing in the upper atmosphere.
* Auroras are also called the “northern lights” or the “southern lights”, and are common events in the regions near Earth’s magnetic poles.
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| SECTION 26.1 REVIEW1. How does a plasma differ from a gas?
2. Describe how the temperature of the sun changes as you move from the sun’s core out to the corona.
3. How does the solar wind affect Earth?
4. Use your knowledge about Earth’s magnetic field and solar winds to explain why auroras are not always visible from temperate regions.
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| **Objectives**:* Describe the early models of the movements of planets and stars.
* Explain Newton’s Law of Gravitation.

**Key Vocabulary**:* Geocentric
* Heliocentric
* Gravitation
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| **MOVEMENT OF PLANETS AND STARS** | For thousands of years, the predominant model of the universe stated that the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**.Such a model of the universe is called a **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** –\*\* meaning “**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**”.Ancient astronomers (as long as 6000 years ago) noticed that the stars appeared to move across the sky, but they did not move in relation to each other.To explain this, the astronomers envisioned the stars as holes in a solid celestial sphere that surrounded Earth. Beyond the sphere, they imagined a source of intense light that shone through the holes. They concluded that the stars moved around Earth as the sphere rotated.Lights that wandered across the sky were correctly identified as planets.Early astronomers noticed that most of the time the planets moved eastward in front of the background of constellations. Periodically, the planets stopped moving eastward and moved westward for a few weeks, then resumed their eastward paths.The **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** is called **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**. |
| **Ptolemy’s Geocentric Model** | * Real name was Claudius Ptolemaeus.
* **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**.
* His model assigned small circular orbits to the planets (epicycles). The center of each small orbit moved around Earth on a larger circular orbit (deferent).
* Even though observations didn’t always match his model, it was used by astronomers until the 16th century.
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| **Copernicus’s Heliocentric Model** | * Proposed the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** (or “\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_”) model of the universe.
* Suggested that Earth rotated and was a planet that revolved around the Sun just like the other planets.
* Retrograde motion was explained by planets moving at different speeds, and orbiting at different distances from the sun.
* The **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** is the basis for our modern understanding of the universe.
* The model is still not completely correct however, as Copernicus still has planets with circular orbits.
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| **Tycho, Kepler, and Planetary Motion** | * Tycho Brahe was an observational astronomer. He studied the stars without the aid of a telescope.
* **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**, planets, and other celestial objects. These were the most precise measurements taken before the invention of the telescope.
* Johannes **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** was a mathematician who worked for Tycho Brahe. After Brahe died, he analyzed Brahe’s data, which helped him **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**.
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| **KEPLER’S LAWS OF PLANETARY MOTION** | * Law #1: The **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** (not circular).
* The Sun is at one focus of the ellipse.
* Because the orbit is elliptical, a planet’s distance from the Sun will change throughout its orbit.
* Law #2: **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**.
* Known as the “**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**” law.
* While Kepler thought a planet would not have a constant speed while in orbit, he wasn’t able to explain why.
* Law #3: The square of the period (in years) for one revolution equals the cube of the mean distance from the Sun’s center.
* Known as the “**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**” law.
* The formula would let someone find the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (if the period was known), or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of a planet (if the distance was known).
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| **Isaac Newton and the Law of Gravitation** | * Newton’s contribution to modern science was enormous.
* He invented calculus, studied the composition of light, and established classical physics.
* He came up with three laws of motion and the **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**.\*\*
* Law #1: An object will move forever in a straight line at the same speed unless some external force changes its direction or speed.
* Law #2: The acceleration of an object multiplied by the mass of the object is equal to the net force acting on the object.
* Law #3: For every action, there is always an equal and opposite reaction.
* **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** is a force of attraction between any two objects with mass.
* The **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** (larger objects have a stronger force) and **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** (the closer the object, the stronger the attraction).
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| SECTION 26.2 REVIEW1. What is the main difference between geocentric and heliocentric models of the solar system?
2. How did Ptolemy account for retrograde motion in his model of the solar system?
3. Explain how Copernicus’s model contributed to modern understanding of the solar system.
4. Draw a diagram to demonstrate why Mars appears to travel westward across the sky most of the time and eastward
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