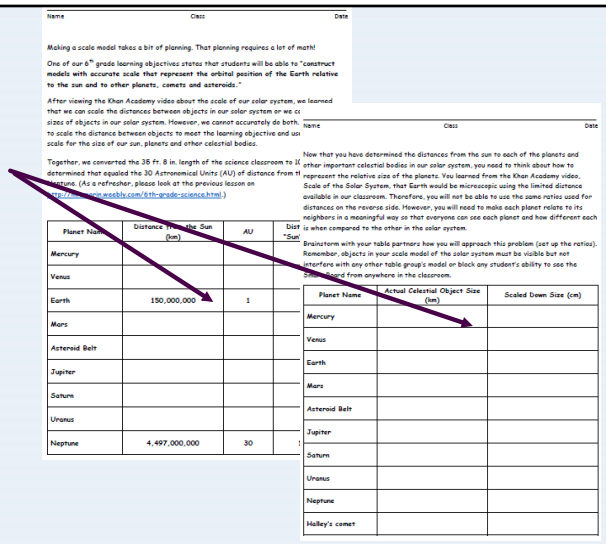
Plan for the day:

1) LATE: Turn in completed Scaling the Solar System handout if you have not already done so.

2) FINISH reading pages 74 - 85 addressing ALL questions (1-16). ANNOTATE as you read. You have ONLY the first of your two science periods to complete (1st 3rd, and 7th).

3) Show me what you have completed for a PROCESS grade.

4) Go over the answers.



Name Class Date

Making a scale model takes a bit of planning. That planning requires a lot of math!

One of our 6th grade learning objectives states that students will be able to "construct models with accurate scale that represent the orbital position of the Earth relative to the sun and to other planets, comets and asteroids."

After viewing the Khan Academy video about the scale of our solar system, we learned that we can scale the distances between objects in our solar system or we c sizes of objects in our solar system. However, we cannot accurately do both. to scale the distance between objects to meet the learning objective and us scale for the size of our sun, planets and other celestial bodies.

Together, we converted the 35 ft. 8 in. length of the science classroom to 1 determined that equaled the 30 Astronomical Units (AU) of distance from t Neptune. (As a refresher, please look at the previous lesson on http://

Planet Nam	Distance from the Sun (km)	AU	Dist "Sun
Mercury			
Venus			
Earth	150,000,000	1	
Mars			
Asteroid Belt			
Jupiter			
Saturn			
Uranus			
Neptune	4,497,000,000	30	

Name Class Date

Now that you have determined the distances from the sun to each of the planets and other important celestial bodies in our solar system, you need to think about how to represent the relative size of the planets. You learned from the Khan Academy video, Scale of the Solar System, that Earth would be microscopic using the limited distance available in our classroom. Therefore, you will not be able to use the same ratios used for distances on the reverse side. However, you will need to make each planet relate to its neighbors in a meaningful way so that everyone can see each planet and how different each is when compared to the other in the solar system.

Brainstorm with your table partners how you will approach this problem (set up the ratios). Remember, objects in your scale model of the solar system must be viable but not interfere with any other table group's model or block any student's ability to see the [illegible] board from anywhere in the classroom.

Planet Name	Actual Celestial Object Size (km)	Scaled Down Size (cm)
Mercury		
Venus		
Earth		
Mars		
Asteroid Belt		
Jupiter		
Saturn		
Uranus		
Neptune		
Halley's comet		

Disciplinary Core Ideas

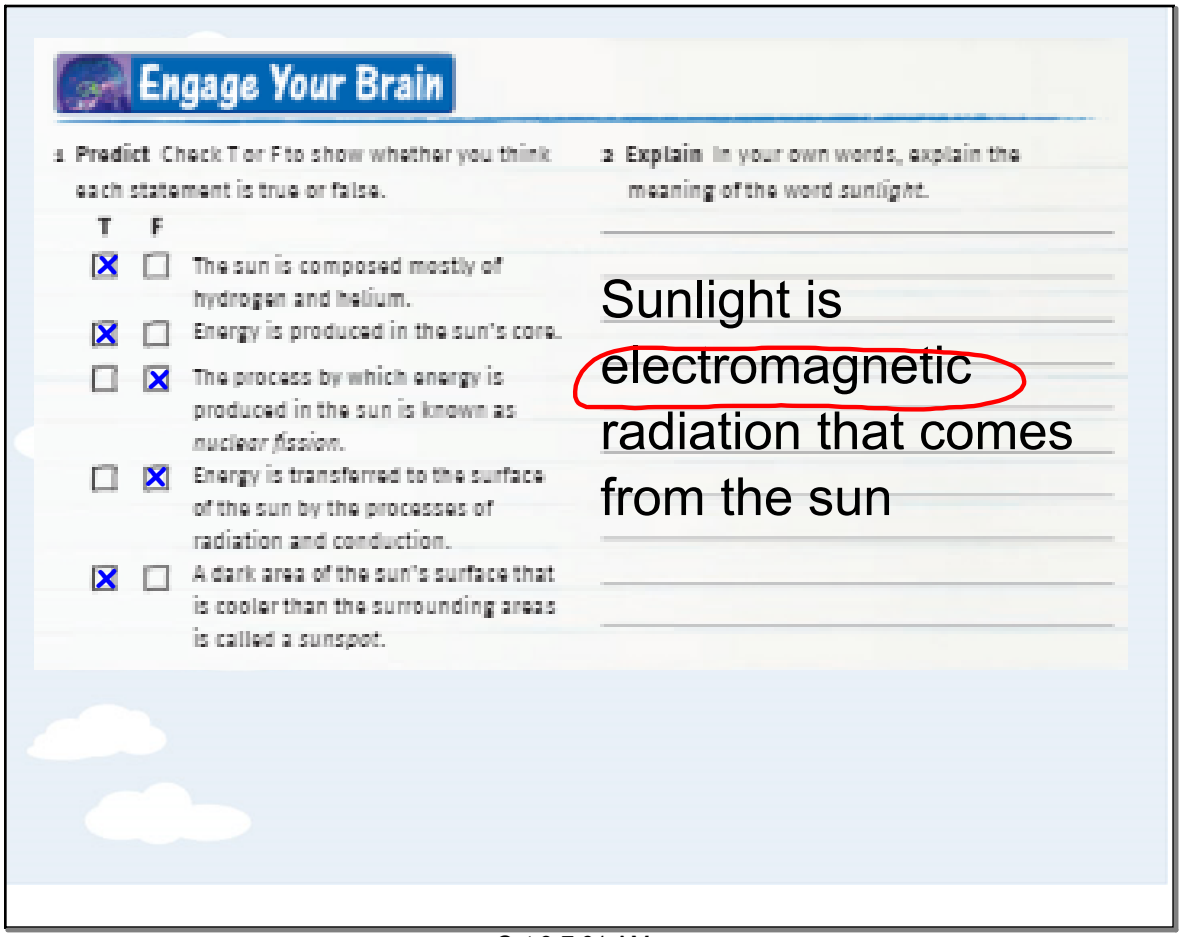
ESS1.A: The Universe and Its Stars

- *Earth and its solar system are part of the Milky Way galaxy, which is one of many galaxies in the universe.*

ESS1.B: Earth and the Solar System

- *The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them.*
- *The solar system appears to have formed from a disk of dust and gas, drawn together by gravity.*

Sep 25-6:22 AM



Engage Your Brain

1 **Predict** Check T or F to show whether you think each statement is true or false.

T	F	
X		The sun is composed mostly of hydrogen and helium.
X		Energy is produced in the sun's core.
	X	The process by which energy is produced in the sun is known as nuclear fission.
	X	Energy is transferred to the surface of the sun by the processes of radiation and conduction.
X		A dark area of the sun's surface that is cooler than the surrounding areas is called a sunspot.

2 **Explain** In your own words, explain the meaning of the word *sunlight*.

Sunlight is electromagnetic radiation that comes from the sun

Oct 3-7:01 AM

Active Reading

I used different shades of GREEN to circle in the reading.

3 **Synthesize** You can often define an unknown word if you know the meaning of its word parts. Use the word parts and sentence below to make an educated guess about the meaning of the word *photosphere*.

Word Part	Meaning
photo-	light
-sphere	ball

Example sentence
Energy is transferred to the sun's photosphere by convection cells.

Vocabulary Terms

- nuclear fusion
- sunspot
- solar flare
- prominence

4 **Apply** This list contains the key terms you'll learn in this section. As you read, circle the definition of each term.

photosphere:
Variations on: Layer of the sun (a sphere) from which light escapes into space.

Sep 25-6:22 AM

What do we know about the sun?

Active Reading

5 **Identify** As you read the text, underline different discoveries that scientists have made about the sun.

Since early in human history, people have marveled at the sun. Civilizations have referred to the sun by different names. Gods and goddesses who represented the sun were worshipped in different cultures. In addition, early astronomical observatories were established to track the sun's motion across the sky.

By the mid-19th century, astronomers had discovered that the sun was actually a hot ball of gas that is composed mostly of the elements hydrogen and helium. Scientists now know that the sun was born about 4.6 billion years ago. Every second, 4 million tons of solar matter is converted into energy. Of the light emitted from the sun, 41% is visible light, another 9% is ultraviolet light, and 50% is infrared radiation. And, perhaps most important of all, without the sun, there would be no life on Earth.

Sun Statistics	
Avg. dist. from Earth	149.6 million km
Diameter	1,390,000 km
Average density	1.41 g/cm³
Period of rotation	25 days (equator); 35 days (poles)
Avg. surface temp.	5,527 °C
Core temp.	15,000,000 °C
Composition	74% hydrogen, 25% helium, 1% other elements

Do the Math You Try It

6 **Calculate** The diameter of Earth is 12,756 km. How many times greater is the sun's diameter than the diameter of Earth?

$\frac{1,390,000}{12,756} = \sim 109$

Oct 3-7:01 AM

What is the structure of the sun?

The composition of the sun and Earth are different. However, the two bodies are similar in structure. Both are spheres. And both have a layered atmosphere and an interior composed of layers.

In the middle of the sun is the core. This is where energy is produced. From the core, energy is transported to the sun's surface through the radiative zone and the convective zone.

The sun's atmosphere has three layers—the photosphere, the chromosphere, and the corona. The sun's surface is the photosphere. Energy escapes the sun from this layer. The chromosphere is the middle layer of the sun's atmosphere. The temperature of the chromosphere rises with distance from the photosphere. The sun's outer atmosphere is the corona. The corona extends millions of kilometers into space.

7 **Analyze** Why is the structure of the sun different from the structure of Earth?

Sample answer: The sun is a star made up of hot gases. The temperature is so hot, nuclear reactions occur. Energy produced in in the core is transferred outward through the radiative zone and convective zone to the sun's surface, the photosphere.

Oct 3-7:01 AM

Think Outside the Book

8 **Discussion** Einstein's equation $E = mc^2$ is probably the most famous equation in the world. With your classmates, discuss the kinds of technologies that rely on the conversion of matter to energy.

In your every day life:

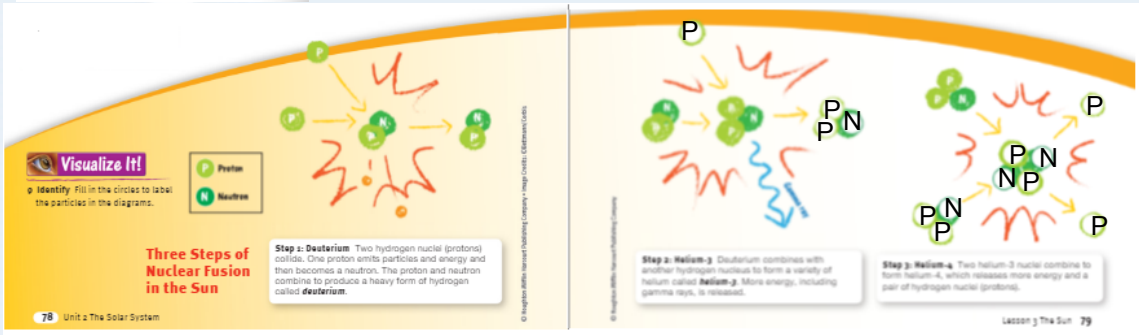
batteries solar panels

In the production of electricity:

nuclear power plants

In the military, for defense:

nuclear weapons



Sep 14-7:04 AM

By the Fusion of Hydrogen into Helium

The most common elements in the sun are hydrogen and helium. Under the crushing force of gravity, these gases are compressed and heated in the sun's core, where temperatures reach 15,000,000 °C. In the sun's core, hydrogen nuclei sometimes fuse to form a helium nucleus. This process takes three steps to complete. This three-step process is illustrated below.

Most of the time, when protons are on a collision course with other protons, their positive charges instantly repel them. The protons do not collide. But sometimes one proton will encounter another proton and, at that exact moment, turn into a neutron and eject an electron. This collision forms a nucleus that contains one proton and one neutron. This nucleus is an isotope of hydrogen called *deuterium*. The deuterium nucleus collides with another proton and forms a variety of helium called *helium-3*. Then, two helium-3 nuclei collide and form a helium-4 nucleus that has two protons and two neutrons. The remaining two protons are released back into the sun's core.

The entire chain of fusion reactions requires six hydrogen nuclei and results in one helium nucleus and two hydrogen nuclei. There are approximately 10^{38} collisions between hydrogen nuclei taking place in the sun's core every second, which keeps the sun shining.

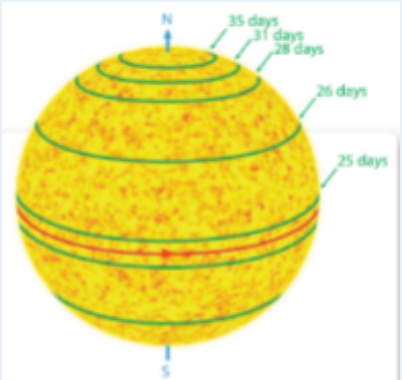
Active Reading

10 **Identify** As you read the text, underline the steps in the nuclear fusion process in the sun.

Sep 14-7:04 AM

11 **Compare** How is energy transferred from the sun's core to the sun's surface in the radiative zone and in the convective zone?

Radiative zone	Convective zone
energy transferred by electromagnetic waves;	energy transferred by movement of matter;
electromagnetic waves don't travel directly through the radiative zone but are absorbed and re-emitted	energy transferred to sun's surface by convection cells;
	hot gases rise to the surface, cool then sink back to the CZ.



The sun's period of rotation varies with latitude.

12 **Define** In your own words, define the term *differential rotation*.

Rotation of a non-solid body; different periods of rotation occur at different latitudes.

Sep 14-7:04 AM

What is solar activity?

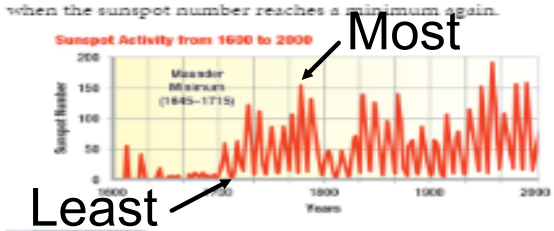
Solar activity refers to variations in the appearance or energy output of the sun. Solar activity includes dark areas that occur on the sun's surface known as *sunspots*. Solar activity also includes sudden explosive events on the sun's surface, which are called *solar flares*. Prominences are another form of solar activity. *Prominences* are vast loops of gases that extend into the sun's outer atmosphere.

Sunspots

Dark areas that form on the surface of the sun are called **sunspots**. They are about 1,500 °C cooler than the areas that surround them. Sunspots are places where hot, convecting gases are prevented from reaching the sun's surface.

Sunspots can appear for periods of a few hours or a few months. Some sunspots are only a few hundred kilometers across. Others have widths that are 10 to 15 times the diameter of Earth.

Sunspot activity occurs on average in 11-year cycles. When a cycle begins, the number of sunspots is at a minimum. The number of sunspots then increases until it reaches a maximum. The number then begins to decrease. A new sunspot cycle begins when the sunspot number reaches a minimum again.



Most

Least

Do the Math **You Try It**

13 **Analyze** The sunspot range is the difference between the maximum number of sunspots and the minimum number of sunspots for a certain period of time. To find this range, subtract the minimum number of sunspots from the maximum number of sunspots. What is the range of sunspot activity between 1700 and 1800?

Least: 0; Most: 150 to 160 So, 0-150 or 0-160

Sep 14-7:04 AM

Solar Flares

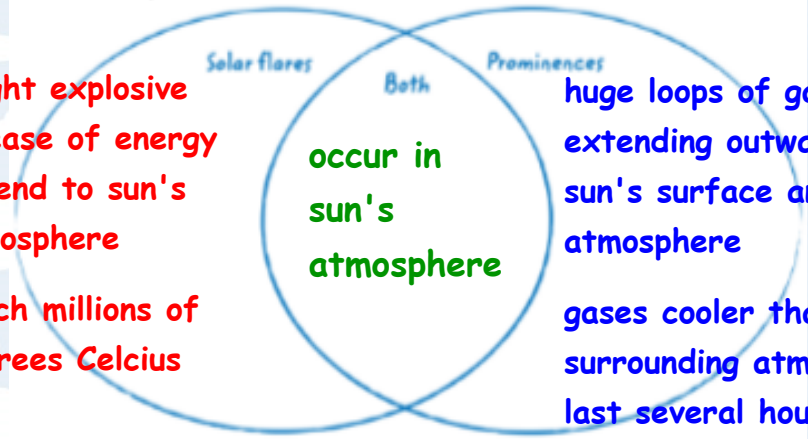
Solar flares appear as very bright spots on the sun's photosphere. A **solar flare** is an explosive release of energy that can extend outward as far as the sun's outer atmosphere. During a solar flare, enormous numbers of high-energy particles are ejected at near the speed of light. Radiation is released across the entire electromagnetic spectrum, from radio waves to x-rays and gamma rays. Temperatures within solar flares reach millions of degrees Celsius.

Prominences

Huge loops of relatively cool gas that extend outward from the photosphere thousands of kilometers into the outer atmosphere are called **prominences**. Several objects the size of Earth could fit inside a loop of a prominence. The gases in prominences are cooler than the surrounding atmosphere.

Prominences generally last from several hours to a day. However, some prominences can last for as long as several months.

14 **Compare** Use the Venn diagram below to compare solar flares and prominences.



bright explosive release of energy extend to sun's atmosphere

reach millions of degrees Celcius

occur in sun's atmosphere

huge loops of gas extending outward to sun's surface and outer atmosphere

gases cooler than surrounding atmosphere

last several hours to day

Sep 14-7:04 AM

Properties of the Sun

The sun is composed of layers.

15 Identify the six layers of the sun, beginning with the innermost layer.

core, radiative zone, convective zone, photosphere, chromosphere, corona

Energy is transferred from the sun's core to the photosphere.

16 By what process is the sun's energy transported in layer A? radiation

By what process is the sun's energy transported in layer B? convection

Sep 14-7:04 AM

Lesson Review

Vocabulary

Fill in the blank with the term that best completes the following sentences.

1 The process by which two or more low-mass atomic nuclei fuse to form another, heavier nucleus is called nuclear fusion.

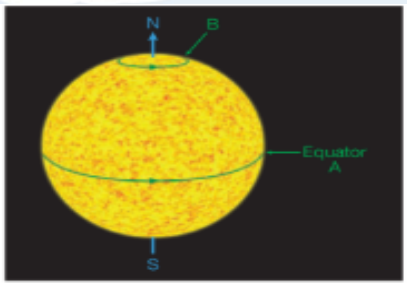
2 A sunspot is a dark area on the surface of the sun that is cooler than the surrounding areas.

3 A prominence is a loop of relatively cool gas that extends above the photosphere.

Key Concepts

In the following table, write the name of the correct layer next to the definition.

Definition	Layer
4 **Identify** What is the layer of the sun from which energy escapes into space?	photosphere
5 **Identify** What is the layer of the sun in which energy is produced?	core
6 **Identify** What is the layer of the sun through which energy is transferred away from the core by radiation?	radiative zone



9 **Determine** How many days does it take for the sun to spin once on its axis at location A? How many days does it take for the sun to spin once on its axis at location B?

A: 25 days; B: 35 days

7 **Identify** What is the composition of the sun?

74% hydrogen; 25% helium; 1% other elements

8 **Explain** What is the sunspot cycle?

Sunspot cylcle is about 11 years. In that cycle, sunspots go from the minimum to maximum and back to minimum.

Sep 14-7:04 AM

10 **Compare** How is the rotation of the sun different from the rotation of Earth?

The sun has different rotation periods at different latitudes.

11 **Explain** In your own words, explain how energy is transported from the core to the surface of the sun by radiation and by convection.

Radiation: energy transferred through the radiative zone as electromagnetic waves. Electromagnetic waves do not travel directly through the RZ, but are absorbed and re-emitted by particles until they reach the top of the RZ.

Convection: energy transported to the sun's surface, cools, sinks back into the CZ.

Sep 14-7:04 AM

Attachments

- Scale of Earth and Sun.mp4
- Scale of Solar System.mp4