

Passports: Adventures in Learning
A Traveler's Guide through the Solar System
The Sun - Our Nearest Star
Curriculum Guide grades 3-6

Objectives:

Language Arts

- Write a poem about the Sun.
- Organize and apply factual information.

Science

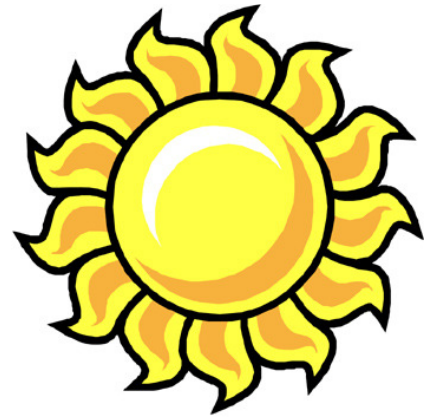
- Understand that the sun is an enormous ball of hot gas.
- Understand that the Sun is far away from the Earth and much larger than the Earth.
- Understand that the Sun Provides light and warmth and is necessary for plants and animals to live.
- Understand that the Sun is our nearest star.
- Define astronomy as the science that involves space and all the bodies in it.
- Describe the physical properties of the Sun.
- Build a sundial and observe changes in shadows over the course of one or more days. Students identify patterns in the shadows and discuss how shadows may be used to tell time.

Social Studies

- Apply geographic knowledge of the countries of the world.
- Understand the different cultural beliefs of the sun cycle and to create their own story of the sun's movements.

Mathematics

- Apply appropriate techniques, tools, and formulas to determine measurements.
- Understand measurable attributes of objects and the units, systems and processes of measurements.



Vocabulary:

Astronomy – the study of the universe

Galaxy – A large group of stars and other matter found throughout the universe

Astronomical Unit – the average distance from the Sun to the Earth. It is the shortest way of measuring distances within the solar system (149,597,870 km)

Light Year – the distance a ray of light travels through space in one year – 5,880 billion miles or 9,460 billion kilometers. Distances in space are measured in light years.

Corona – the atmosphere around the sun. This layer can only be seen during an eclipse.

Sunspots – A dark area on the Sun's surface that is cooler than the area around it. Sunspots are caused by magnetic storms on the Sun.

Solar System – the Sun and all of the planets, satellites, asteroids, meteors, and comets that are subject to its gravitational pull

Solar Wind – Streams of gas particles flowing out from the Sun

Milky Way – the spiral galaxy to which Earth and its solar system belong

Star – a large ball of gas that creates and emits its own radiation

Core - the center layer of the Sun. This is where all the sun's heat and light is made.

Radiative Zone – the heat and light move from the core into this layer

Convection Zone – the layer where gases move like boiling water. This moves the gases from the inner parts of the Sun to the outer part of the Sun that we see.

Photosphere – The part of the Sun that we see. This layer gives off heat and light from the Sun.

Chromosphere – The lower level of the solar atmosphere between the photosphere and the corona. This layer shoots out hot gases.

Activity 1

Before participating in the The Sun – Our Nearest Star, engage students in the following activity: Using the KWL Chart, have the students complete the sections “What I Know” and “What I want to Know” about the Sun.

Activity 2

Students will complete the KWL Chart section “What I learned” after participating in the The Sun – Our Nearest Star.

Activity 3 -Making a Sundial

Materials:

- 1 9-inch white paper plate per student
- One skewer stick or thin straw (gnomon)
- Regular and colored pencils
- Rulers
- Tape
- Protractor
- Scissors
- Watch or clock
- Work sheet to record observations



Procedure for Building the Sundials

1. Explain to students that they will build sundials and collect data based on their observations.
2. Modeling the steps to building the sundial will make it easier for young students to complete the task. Distribute plates, straws, pencils, rulers, scissors and tape to students.
3. Ask students to find the center of the paper plate and mark it with a dot.
4. With a pencil, draw two lines that are perpendicular to each other. Draw one line horizontally so it passes through the dot; draw the second line vertically so it passes through the dot.
5. Stick the gnomon through the dot so that 10 cm of the gnomon is sticking straight out of the paper plate. Use a protractor to make sure that the gnomon is perpendicular to the plate.
6. Use tape to keep the gnomon standing straight and make sure that exactly 10 cm is sticking out of the plate.

Discuss the following questions with students. A demonstration with a pencil and a flashlight could help facilitate discussion.

- What causes a shadow? *Answer: An object blocking the path of light.*
- What does your shadow look like shortly after the Sun comes up? *Answer: Shadows are the longest shortly after the Sun comes up and right before it goes down.*
- What happens to the length of your shadow as noon approaches? *Answer: Your shadow gets shorter.*

- At what time of day is your shadow the shortest? *Answer: Your shadow is the shortest around noon, when the Sun's position is directly overhead.*
- What happens to the length of your shadow as evening approaches? *Answer: Your shadow gets longer*
- Why does your shadow change throughout the day? *Answer: The Sun's position in the sky changes, causing shadows to be at different lengths and angles.*
- Compare your shadow shortly after sunrise to your shadow shortly before sunset. *Answer: Your shadow shortly after sunrise and shortly before sunset is close to the same length but is on different sides of your body.*
- Can you predict a shadow's movement? *Answer: Yes, because we can predict the position of the Sun.*
- How does a shadow give us information about the time of day? *Answer: Shadows that are made as a result of the Sun tells us the Sun's position in the sky. Changes in the position of the Sun help us measure the time of day.*

Procedure for Collecting Data with the Sundial

Day 1:

1. In the morning distribute pencils, rulers, chalk and sundials to students.
2. Ask students to place their sundials in a sunny spot on the playground. Mark the playground with chalk at the 4 registration points on the edge of their sundials. Remember to make one of the chalk marks longer so the sundials can be correctly repositioned.
3. Have students carefully trace the straw's shadow with a pencil. Ask them to darken in the shadow with the pencil and write the time at the tip of the shadow.
4. Ask students to note where the Sun is in the sky. Warn them NOT to look directly at it.
5. After tracing ask students measure the shadow length and fill in their data sheets.
6. Students will take more measurements every half hour until the end of the day. Next to each shadow length, label the time of day that it was marked. Accuracy is very important.

Day Two:

1. Using a protractor, have the students measure the angle between the horizontal line through the center of the paper. Record these angles on the Sun Shadow Data Sheet.
2. Have the students measure and record the length of each shadow on the Sun Shadow Data Sheet.



Post-Activity Discussion Questions:

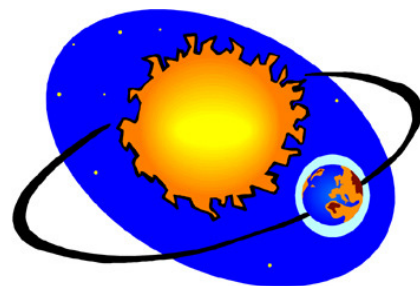
Students use their Sun Shadow Data Sheets during this discussion.

- How do shadow lengths change? *Answer: Early in the day they are longer, and as they approach true north, they get shorter and then longer again.*
- How do the positions and angles of the shadows change? In which direction do they move? *Answer: The shadows move clockwise in a horseshoe or U- shape.*
- What do the changing positions and angles tell you about how the position of the Sun changes throughout the day? Does the Sun's position in the sky change in a clockwise or counterclockwise direction? Draw a picture to explain your answer. *Answer: The Sun's position changes in a counterclockwise direction.*
- When are the shadows the shortest? When are they the longest? Draw a picture explaining your answer. *Answer: The shadows are the shortest when the Sun's position is straight overhead and longer during the morning and evening hours.*
- How do you think the curve would change if you used a different sized gnomon to cast the shadow? *Answer: The curve would be in the same shape, but the length of the shadows would be different in proportion to the difference in size.*
- Will the curve be the same throughout the year? *Answer: The shape of the curve would be the same, but the positions and lengths of shadows will be different due to the tilt of the Earth.*
- What causes the changes in shadows, the moving of Earth or the moving of the Sun? Draw a picture to explain your answer. *Answer: The Sun's position does not change. The spinning and tilt of the Earth cause a change in shadow lengths and angles.*

Activity 3 - Parts of the Sun

Materials:

1. White, blue, yellow and red clay
2. Paper plates
3. Toothpicks
4. Paper
5. Scissors



Procedure:

1. Distribute the Student Sheets. Read over the descriptions of the sun's layers orally (corona, core, radiative zone, convection zone, photosphere, chromosphere).
2. Distribute the clay. Show students how to mix the clay to get other colors. Direct students to start with a marble sized ball of white clay to which will represent the core. From there, they may mix their clays and use them to form the other layers of the sun.
3. After students have completed their models, carefully cut away a wedge so that the inner layers show. Do not cut through the cores; leave them intact.

4. Have students use the paper to make labels for each of the layers. Have them attach the strips to the toothpicks and place them in the correct layers

Post Activity Discussion: Discuss the parts of the sun and what each part does and have the students complete “Layers of the Sun” diagram. Answers: 1. core 2. radiative zone 3. convection zone 4. photosphere 5. Chromosphere 6. Corona

Cross-Curricular Connections

Have the students name the sun in different languages around the world.

Tell the students that the same sun travels across your sky each day shines down on people all around the world. Find the names of the Sun in the following languages and find the corresponding country on a world map: See this URL <http://www.mreclipse.com/Special/SElanguage.html>

<u>Country</u>	<u>Answer</u>
Arabic	Shams
Chinese	Taiyang
Danish	Sol
Dutch	Zon
French	Soleil
German	Sonne
Greek	Helios
Italian	Sole
Japanese	Taiyo
Lakota	Anetu wi
Navajo	Sha
Russian	Soince
Spanish	Sol
Turkish	Gunes

English – Write your own poem or song about the Sun.

Critical Thinking Skills:

What information did you learn about the Sun that surprised you the most? Explain why.

Websites:

<http://kids.msfc.nasa.gov>
<http://www.thursdaysclassroom.com>
<http://amazing-space.stsci.edu>
<http://www.kidsastronomy.com>
<http://spacelink.nasa.gov>
<http://sunearth.ssl.berkeley.edu>
<http://education.gsfc.nasa.gov>
<http://www.kideclipse.com>

Book Resources:

Bourgeois, P. *The Sun*. Stunning Images and illustrations illuminate activities, experiments, and stories about the Sun. This resource encourages learning about solar power, sunsets, shadows, and other cultures’ historical ideas about the Sun. ISBN 1-55074-158-6 (Bound); ISBN 1-55074-330-9 (paperback)

Branley, F. (1989). ***Sunshine Makes the Season***. Answers to questions about the length of days and the seasons become clear as you demonstrate the tilt of the Earth and its movement around the Sun using a pencil, an orange, and a flashlight. ISBN 0-690-04481-X

Vogt, G. (2000). ***The Sun***. Learn about the composition, atmosphere, and origin of the Sun, Beautiful color images of sunspots, solar flares, solar eclipses, and telescopes enrich the text. ISBN 1-562-94600-5 (bound); ISBN 0-7613-0160-7 (paperback)

National Mathematics Standards:

Number and Operations – Understand numbers, ways of representing number, relationships among numbers, and number systems

Algebra – Use mathematical models to represent and understand quantitative relationships.

Measurement – Use visualization, spatial reasoning, and geometric modeling to solve problems.

National Science Standards:

Earth and Space Science – Earth in the solar system.

Science and Technology – Abilities of technical design

History and Nature of Science – Science as a human endeavor

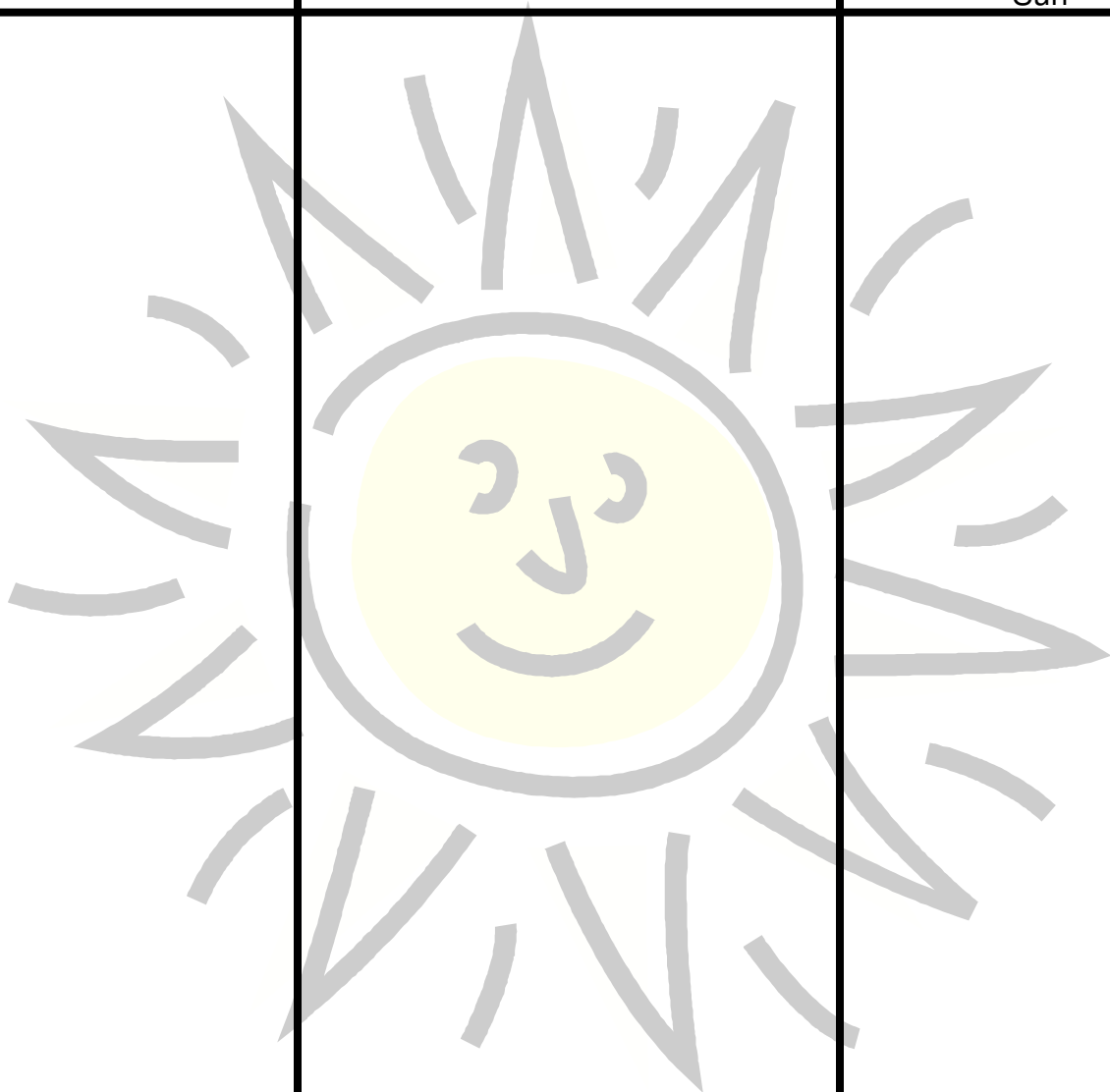
Nature of Science – Science process skills

KWL Chart

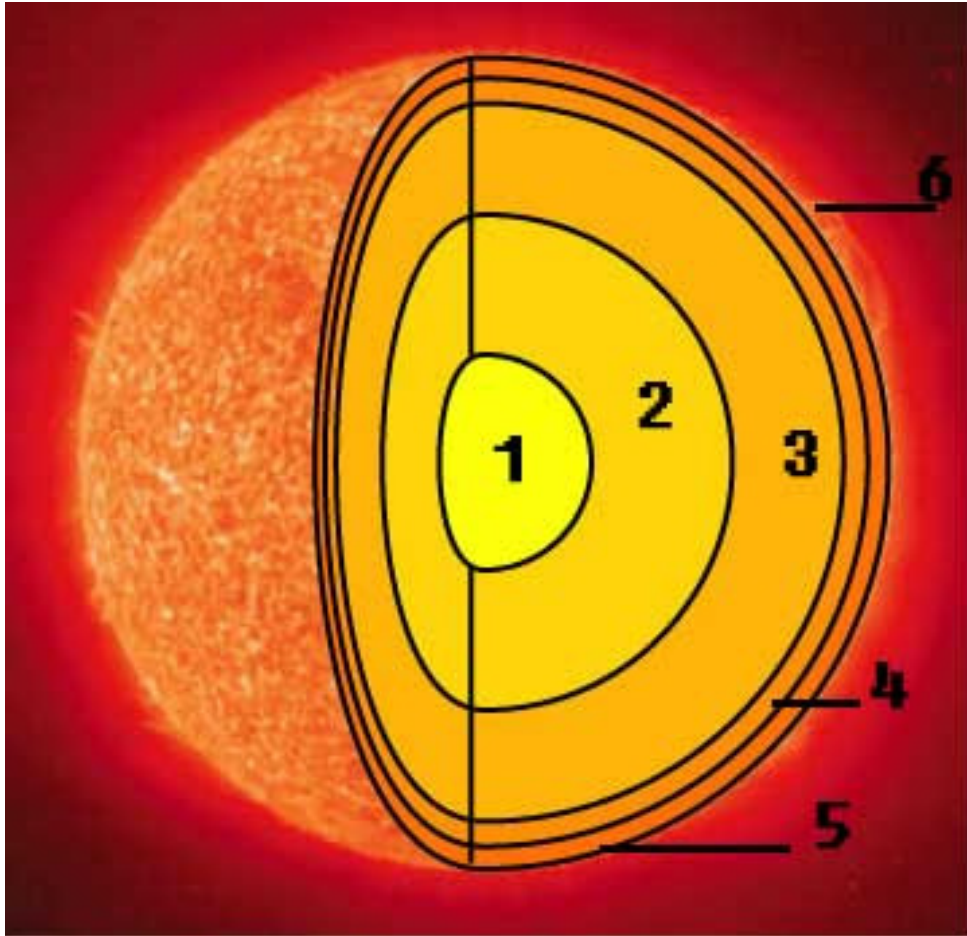
What I know about the Sun

What I want to know about
the Sun

What I learned about the
Sun



Layers of the Sun



1. _____ is where the Sun's heat and light are made.
2. _____ is where the heat moves from the core.
3. _____ is where the gases from the inner parts of the Sun to the outer part of the Sun that we see.
4. _____ is the part of the Sun that we see.
5. _____ is the part of the Sun that shoots out gases.
6. _____ is the atmosphere around the sun.

Sun Shadow Data Sheet

Time															
Angle from baseline (degrees)															
Length of Shadow															

Discussion Questions:

1. How do shadow lengths change?
2. How do the positions and angles of the shadows change? In which direction do they move?
3. What do the changing positions and angles tell you about how the position of the Sun changes throughout the day? Does the Sun's position in the sky change in a clockwise or counterclockwise direction? Draw a picture to explain your answer.
4. When are the shadows the shortest? When are they the longest? Draw a picture explaining your answer.
5. How do you think the curve would change if you used a different sized gnomon to cast the shadow?
6. Will the curve be the same throughout the year?
7. What causes the changes in shadows, the moving of Earth or the moving of the Sun? Draw a picture to explain your answer.