Unit 4: (Orbits)

Unit Overview:
This unit will begin with an introduction to the sun, since this is the center of our solar system.

1 Students will research how the sun rotates

2 The class will investigate the beliefs of different scientists to determine if our solar system is heliocentric or geocentric

3 The students will examine the relationship between the speed and shape of the orbit.

Lesson 4:1: Here Comes the Sun: Days 32-33

Objective(s): Students will identify and describe the structures of the sun in order to compare the characteristics and properties of the sun to the characteristics and properties of the planets.

Skills attained:
Reading to be informed
Diagramming

Topics:

1 Parts of the sun
- Core
- Photosphere
- Chromosphere
- Corona

2 Nuclear fusion

Vocabulary:
Sun – star that is the center of our solar system and provides Earth with heat and light.
Sunspot – a dark area of gas on the sun that is cooler than surrounding gases.
Equator – A circle that divides a sphere or other surface into congruent parts. The equator is perpendicular to the axis of rotation.
Photosphere – The visible outer layer of a star, especially of the sun.
Chromosphere – An incandescent, transparent layer of gas, primarily hydrogen, several thousand miles in depth, lying above and surrounding the photosphere of a star, such as the sun, but distinctly separate from the corona.

Corona – A faintly colored luminous ring appearing to surround a celestial body visible through a haze or thin cloud, especially such a ring around the moon or sun, caused by diffraction of light from suspended matter in the intervening medium. Also called aureole.
Solar wind – A stream of high-speed, ionized particles ejected primarily from the sun's corona.
Auroras – A luminous atmospheric phenomenon appearing as streamers or bands of light sometimes visible in the night sky in northern or southern regions of the earth. It is thought to be caused by charged particles from the sun entering the earth's magnetic field and stimulating molecules in the atmosphere.
Nuclear fusion – a nuclear reaction in which nuclei combine to form more massive nuclei with the simultaneous release of energy

Procedure:

1 Each group of students will be given a 100g ball of clay. Students will construct a model of the solar system from the ball of clay. This is a prediction. Have students share their models with one another

2 The teacher will show his or her model to the class. The teacher's model should have over 99 grams of clay rolled into a ball to represent the sun. The small amount of clay left (less than one gram) would be used to construct all the other celestial bodies in the solar system (planets, moons, asteroids, etc.) Ask students how their models compared to the teacher's model. Accept all reasonable responses.

3 Have students predict how the sun provides light and heat for the earth and how the sun's composition is different from the planet's composition. Students will record their responses on **Activity 4:1: Here Comes the Sun**.

4 Students will read the directions for "How to Use a Reading Road Map." Have students locate the reading road map and go over the directions individually and as a class.

5 As the students read, they will complete the Reading Road Map: "Resource Sheets 1 and 2: Our Active Sun Road Map."

6 After students read, have them complete "Activity 4: After Reading" and Analysis questions. Have students discuss in small groups or with the class.

Materials list:
Print resources
Internet resources
Ball of clay (100g) for each group

Motivation:
Having students construct a model of the solar system from the clay.

Content Background:

Try to imagine the heat and light that would be produced by 300,000 candles squeezed into a single square inch of space. This is the amount of energy given off by every square inch of the sun's surface. The sun's surface is almost 12,000 times as great as that of the earth. Energy from the sun makes life on the earth possible. In this investigation you will identify and describe the structures of the sun in order to compare the characteristics and properties of the sun to the characteristics and properties of the planets.

The sun's atmosphere has three layers: the photosphere, the chromosphere, and the corona. Sunspots are areas of gas on the photosphere that are cooler than the gases around them. Sunspots appear dark, because cooler areas do not give off as much light. Many of the sunspots are as large as Earth.

The number of sunspots varies over a period of 10 to 11 years. This is called the sunspot cycle. Scientists believe the change in sunspots may cause changes in the Earth's atmosphere.

Suggested Teaching Strategies:

An effective way to approach this activity is by using the clay model and the Reading Road Map.

Lecture Support:

Class notes 4:1a and 4:1b.

Application:

Analysis Questions

Assessment:
Analysis questions

Wrap-up Activity:
Students can try to remake their models using the correct proportions

Homework:
Completion of Analysis questions if needed

Lesson 4:2: As the Sun Turns: Day 35 - 36

Objective(s): Students will be able to calculate and analyze the speed of sunspots in order to determine the speed at which our sun is spinning.

Skills attained:
Measuring
Calculating rotation speed
Utilizing a calculator

Topics:

1 Movement of sunspots

2 Speed of the sunspots, the sun and the rotation or the sun

Vocabulary:
Sun – star that is the center of our solar system and provides Earth with heat and light.
Sunspot – a dark area of gas on the sun that is cooler than surrounding gases.
Diameter – A straight line segment passing through the center of a figure.
Rotation – the spinning motion of the sun about its axis.
Rotation speed – rotation speed (R) = time (T) multiplied by diameter (D) divided by the 2nd distance (B) – the 1st distance (A). $R = T \times \frac{(D)}{B-A}$
Equator – A circle that divides a sphere or other surface into congruent parts. The equator is perpendicular to the axis of rotation.
Sun's axis – an imaginary line that passes through the sun's center about which the sun rotates.

Procedure:

1 What is a sunspot?

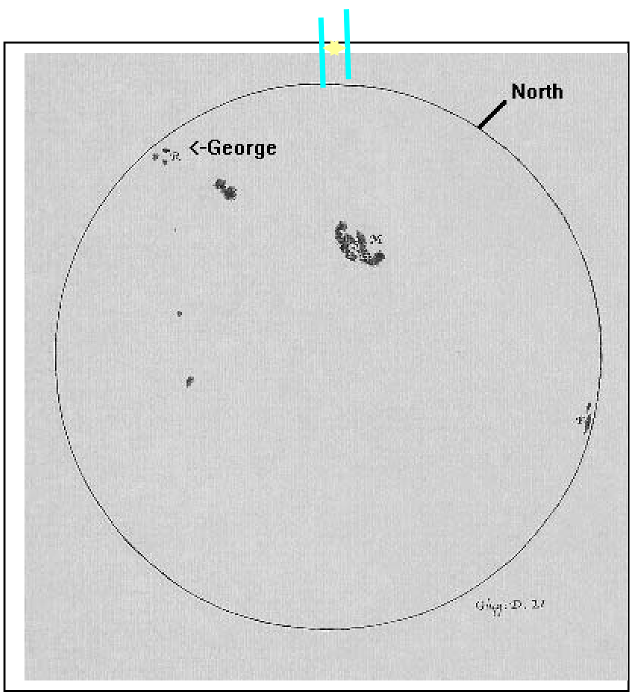
A) Post the question "what is a sunspot?" on the board or overhead.
B) Have students brainstorm possible responses as you place them on the board without evaluating their ideas.
C) Locate a number of images of sunspots for students to observe.
D) Discuss why sunspots are dark spots and not bright or any other color.

2 Students will predict and draw how they think sunspots will move in a 7-day period. Draw three circles on the board and have students draw their predictions with different colored chalk. Ask students how they came up with predictions. Have students raise one hand if they think sunspots move and raise two hands if they think sunspots don't move.

3 Have students brainstorm and record how you think scientist know the sun is spinning. Students should share their ideas with their small group.

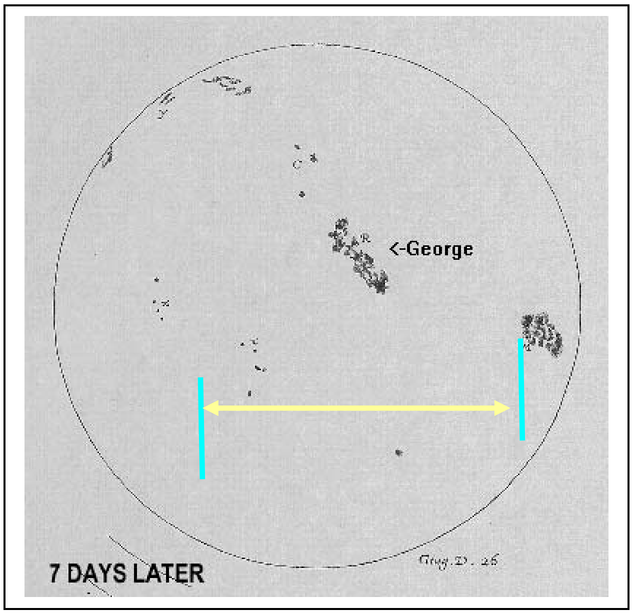
4 Students will measure the diameter of the sun in Diagram 1, "Sunspots." Be sure the students are using centimeters or millimeters. Record in Chart 1, "Movements of Sunspots."

5 Students will locate the sunspot named "George" in the first picture and measure from the left sides of the sun to the sunspot.



"Courtesy of SOHO/(instrument name) consortium. SOHO is a project of international cooperation between ESA and NASA."
http://solar-center.stanford.edu/spin-sun/estimate.html

Then have students measure from the left side of the sun to "George" on the second picture. Students will record both distances in Chart 1, "Movement of Sunspots."



"Courtesy of SOHO/(instrument name) consortium. SOHO is a project of international cooperation between ESA and NASA." http://solar-center.stanford.edu/spin-sun/estimate.html

6 Students will calculate the rotation speed of the sun using the formula:

$$R = T \times \left(\frac{D}{B-A} \right)$$

7 Students will complete procedures 3 through 5 for three more groups of sunspots. Sunspot images can be accessed at http://solar-center.stanford.edu/spin-sun/estimate.html.

8 Compare the student's data and results with one another and identify and explain any differences. (accuracy of measuring, quality of pictures, what part of the sunspots you measured)

9 Students will complete and discuss the analysis questions. Students will need to read Resource Sheet 1, "Solar rotation Reading," to answer the analysis questions. Have students read the questions first, and highlight or underline the answer as they read.

Materials list:

Print resources
Internet resources
Metric ruler
Sun spot pictures
Calculator

Motivation:
Having students predict and draw their predictions on the board will get them motivated, interested, and up and moving.

Description:

Have students predict and draw how they think sunspots move in a seven-day period. Share their predictions with the class and have some students draw their predictions on the board.

Students will the measure the distances to sunspots over a period of time, to determine the rotation speed of the sun. All of the data should be recorded on Chart 1, "Movement of Sunspots." Ask students if the sunspots near the equator or near the poles move faster. (Sunspots near the equator rotate faster than the sunspots near the poles.)

Have the students analyze their data from their chart to answer the result and analysis questions. Students must read Resource Sheet 1, "Solar Rotation," in order to answer the analysis questions.

Content Background:

The sun's atmosphere has three layers: the photosphere, the chromosphere, and the corona. Sunspots are areas of gas on the photosphere that are cooler than the gases around them. Sunspots appear dark, because cooler areas do not give off as much light. Many of the sunspots are as large as Earth.

The number of sunspots varies over a period of 10 to 11 years. This is called the sunspot cycle. Scientists believe the change in sunspots may cause changes in the Earth's atmosphere.

Suggested Teaching Strategies:

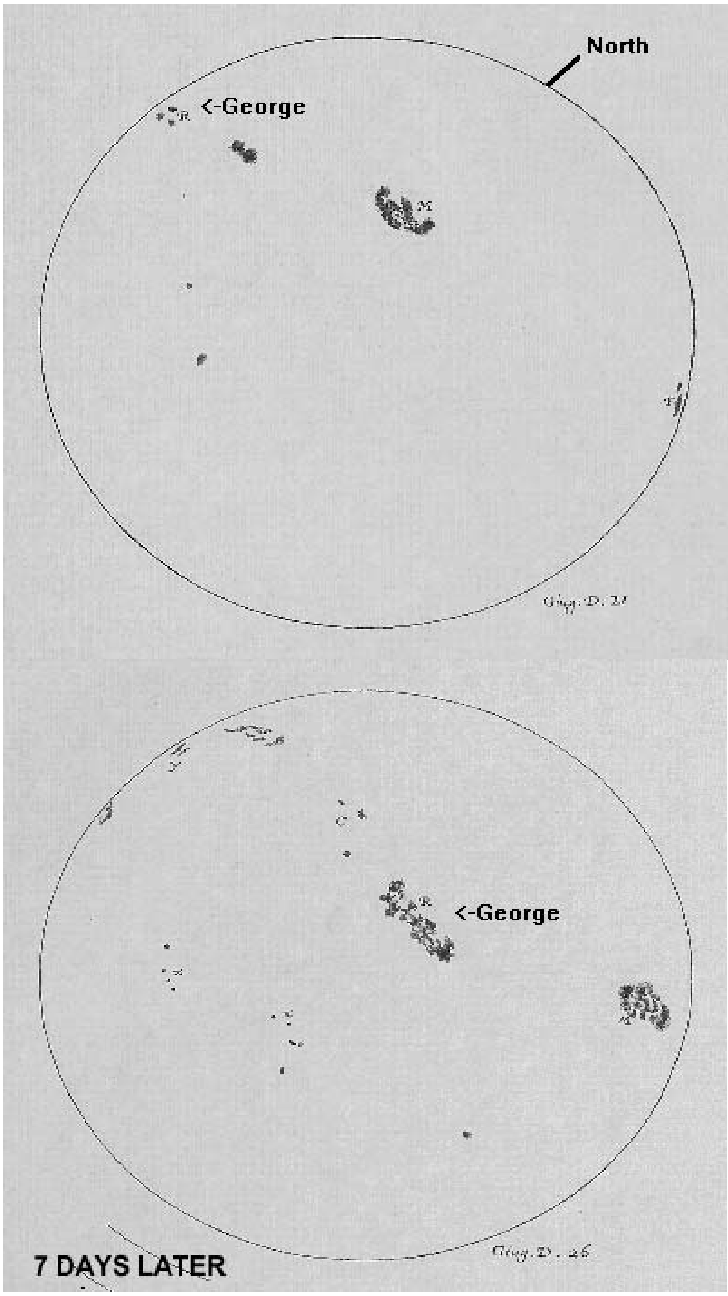
An effective way to approach this activity is by using Chart 1, "Movement of Sunspots," in **Activity 4:1: As the Sun Turns**. This will be helpful for students because it will organize their data and help them set up their formula for rotation speed.

Lecture Support:

Class notes 4:2

Information originally created by Deborah Scherrer, April 1997 located at http://solar-center.stanford.edu. How can you use your sunspot data to figure out how long it takes for the Sun to spin around once? To estimate the Sun's rotation rate, let's assume that the Sun is a flat disk, just like it appears on your copies or sketches. You can use a calculator for this exercise.

On your data sketches, pick a sunspot group that travels a long distance across the Sun's disk. A good choice would be a sunspot which starts out closest to the left limb (edge) of the Sun. Let's call this spot "George". You are going to figure out how long it took George to move across the Sun.

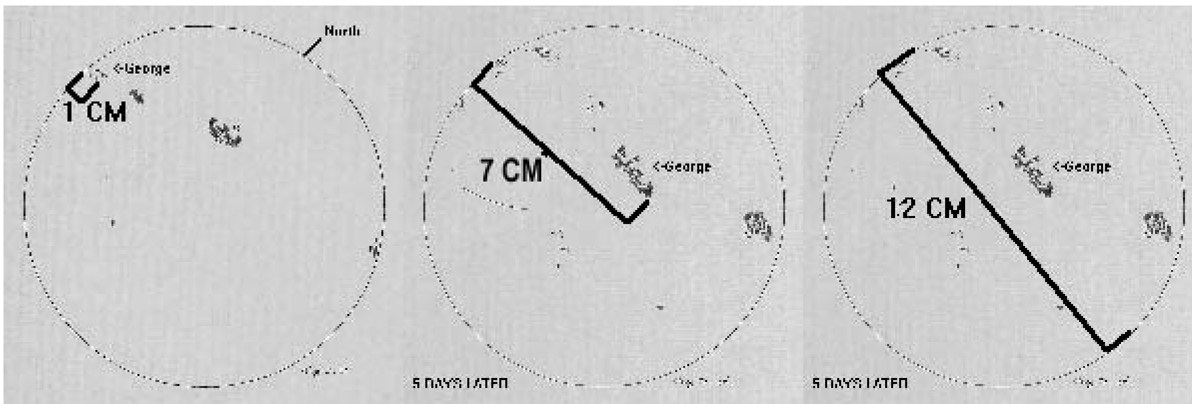


"Courtesy of SOHO/(instrument name) consortium. SOHO is a project of international cooperation between ESA and NASA."
http://solar-center.stanford.edu/spin-sun/estimate.html

Find your picture with George closest to the left limb of the Sun. With a (metric) ruler, measure how far away from the left edge of the Sun's disk George is.

Now, find the picture with George closest to the right limb of the Sun and measure it's distance. Make sure you again measure the distance starting from the left limb.

Now, measure the distance across the entire disk of the Sun (ignoring George and any of his friends). You will need to multiply this by 2 to include the backside of the Sun.



"Courtesy of SOHO/(instrument name) consortium. SOHO is a project of international cooperation between ESA and NASA."
http://solar-center.stanford.edu/spin-sun/estimate.html

Look again at your data sheets and find out what time your first sketch of George was taken. Find the time for your last sketch of George. How long did it take for George to travel from the first place to the last? (Subtract the last time from the first. In our example, it was 7 days.

Now, how far around the Sun did George go? In our example, George went 6 cm (7 cm - 1 cm) and the Sun was 24 cm around. So, in this example, it took George 7 days to get 1/4 of the way around the Sun, which means that George would need 4*7 = 28 days to go all the way around (assuming he could last that long).

If your numbers are more complicated than George's, then you can use your calculator to figure it out:
Sun's rotation time = George's-time * (Sun's-distance / George's-distance)
28 days = 7 days * (24 cm/6 cm)

If you picked a different spot or group, do you think your answer for the Sun's rotation rate would be the same? Try to find out by doing the calculation for groups at higher or lower latitudes (that is, groups that are closer or farther from the Sun's poles).

You have just estimated the solar rotation rate. Your data will be more accurate if you use the **Angular Velocity exercise**.

http://solar-center.stanford.edu/spin-sun/estimate.html

Application:

Students can complete the **Angular Velocity exercise** (http://solar-center.stanford.edu/spin-sun/angvel.html)

Assessment:
Analysis questions

Wrap-up Activity:
Watch an animation of the sun and sunspots rotating at http://science.nasa.gov/ssl/pad/solar/images/sunturn.gif

Homework:
Completion of Analysis questions if needed

Lesson 4:3: Myths of the Mystery of the Sun: Day 37 - 39

Objective(s): Students will read and discuss different folklores and myths about the sun in order to create our own folklore about the sun.

Skills attained:
Researching
Locating and understanding myths
Summarizing
Creative writing
Illustrating

Topics:

1 Myths and folklores about how and why the sun exists

Vocabulary:
Myth – popular belief or story that has become associated with a person, institution, or occurrence, especially one considered to illustrate a cultural ideal
Sun – the star that is the center of our solar system and gives Earth heat and light
Folklore - The traditional beliefs, myths, tales, and practices of a people, transmitted orally.