Chapter 12: Measuring the Rate of Solar Rotation

Student Worksheet

Objective:

Use NASA images of the sun to calculate the rate of rotation for the Sun.

Engage:

How would life on Earth change if we did not rotate on our axis each day? Would life still be possible? How would life on Earth change if we did not revolve around the Sun? Would life still be possible? Explain as many ideas as possible.

Introduction:

The Earth rotates on its axis once every 24 hours. The Sun rotates too, in the same direction as the Earth, but with a longer period of rotation. In this lab you will use data from the Solar and Heliospheric Observatory (SOHO) to monitor sunspots over a 12 day cycle to determine the rate of solar rotation.

Your Task:

Use the SOHO images to track a set of sunspots over the course of 12 days to measure the rate of the Sun's rotation.

Procedure:

NOTE: Your teacher will provide you with the following tools to help you complete this lab activity:

- Solar Rotation Data Table
- Transparent Solar Grid Overlay

1. Look at the first image from 12-30-2012. Choose three prominent sunspots to track in the images from each of the next 11 days. It is ok if the sunspot is not visible the entire 12 days. Choose sunspots from different latitudes.

2. In your Solar Rotation Data Table, fill out the column for the sunspot numbers of your chosen sunspots.

3. Use the Transparent Solar Grid Overlay to measure the latitude and longitude position for the sunspots on each day and record your results in the Solar Rotation Data Table.

4. To measure the Sun's rate of rotation, look at the sunspots you tracked one at a time. Calculate the change in longitude by subtracting the initial longitude from the final longitude. Divide the change in longitude by the number of days between the observations. Your units will be degrees per day. Complete Table 1 below.

   For example: If you observe a sunspot initially at -70 degrees longitude on day 1 and finally at 10 degrees longitude on day 6, the calculation would be:
   (-70 – 10)/ (6 – 1) = 80 degrees/5 days, or 16 degrees per day.

   Table 1 Measuring the Sun's Rate of Rotation

Sunspot number	**Change in longitude (initial longitude – final longitude)**	**Change in days (final day number - initial day number)**	**Rate (degrees per day)**

5. Find the Sun's rotation period—i.e., how many days it takes to make a rotation--by solving for how many days it would take a sunspot to rotate 360 degrees at the rate you found in part 4 above. Complete Table 2 below.

   For example: at 16 degrees per day it would take the Sun 360/16 days, or 22.5 days

to make a rotation. (This is not the true rotation rate of the Sun. It just serves as an example)

Table 2 Finding the Sun's Rotation Period

Sunspot number	Rate (degrees per day)	Period (days)

Conclusion:

1. Is the period of the Sun's rotation the same for each spot? If not, describe the differences.

2. How does the period of the Sun's rotation differ as the spots move away from the equator?

3. What is your estimate for an average period of rotation of the Sun?

4. What quality of the sun allows for different speeds of rotation?

Extend:

- Differential rotation is the term for the Sun's varying rotation speed. What are some effects of differential rotation? How does differential rotation tie into the 11-year solar cycle?

- Look at the directions of rotation and revolution for different objects in our solar system. Do they all tend to go the same direction? What does? What does not?

- Investigate solar telescopes like SOHO. What questions are they trying to answer?