Does the Sun have Seasons?

Rich Task 1 Activity 2

Introduction:

The Sun is our nearest star and provides the conditions for life to exist on Earth. It's about halfway through its lifetime and acts as a nuclear reactor, giving us heat and light. It accounts for 99% of our solar systems' mass and one million Earth-sized planets could fit inside it. Within the Sun there are atoms of Hydrogen and Helium that are densely packed and collide violently with each other. The fusion of atoms that occurs in the Hydrogen core of the Sun generates light, which takes a hundred thousand years to escape the Sun's core and then travel for a further eight minutes to reach the Earth. Understanding the role the Sun plays in our lives is fundamental to understanding the Sun-Earth system (E & S LO 4).

This activity provides an opportunity for students to prompt investigation of how we can prove the Sun rotates and to connect the concept of rotation of the Earth and rotation of the Sun. This activity acts as the second stage of the ISLE process: investigating through experimentation. This activity scaffolds the next (Rich Task 1 Activity 3), which investigates the composition of the Sun.

Preparation Required: Printing

Downloadable Materials:

- Worksheet 1.2
- Images of the sunspots on solar surface
- Expected student responses
- Image of Sunspot tracking developments from 1644 to present day

Relevant Junior Cycle Learning Outcomes:

Students should be able to...

PW LO 3: Investigate patterns and relationships between physical observables.

E & S LO 1: Describe the relationships between various celestial objects including moons, asteroids, comets, planets, stars, solar systems, galaxies and space

E & S LO 4: Develop and use a model of the Earth-sun-moon system to describe predictable phenomena observable on Earth, including seasons, lunar phases, and eclipses of the sun and moon.

NOS LO 2: Recognise questions that are appropriate for scientific investigation, pose testable hypotheses, and evaluate and compare strategies for investigating hypotheses.

NOS LO 4: Produce and select data (qualitatively/quantitatively), critically analyse data to identify patterns and relationships, identify anomalous observations, draw and justify conclusions.

NOS LO 7: Organise and communicate their research and investigative findings in a variety of ways fit for purpose and audience, using relevant scientific terminology and representations.

Learning Intentions:

Students will be able to…

- Explain how seasons work on Earth
- Analyse the images and make observations
- Record their observations
- Communicate their ideas in a small group and whole-class setting
- Discuss their observations and infer conclusions
- Communicate why their findings are evidence for the rotation of the Sun

Prior Knowledge/Horizon Content Knowledge:

- Seasons on Earth
- Graphing
- Average
- Accuracy
- Making and recording observations
- Noticing patterns or anomalies in data
- Inferring conclusions from observations and discussion

Differentiation and Accessibility Suggestions:

This activity is accessible for all students but requires some prior knowledge.

The images can be printed and cut out for small groups to analyse as described in the task. The images may be laminated for repeated use. (*see downloadable materials*)

The images may also be shared with the students as a pdf (*see downloadable materials*) for viewing on a device in the classroom. This will make it easier for students to zoom in and out to identify different sunspots and this reduces the preparation time for the task. As an extension task, students can discuss the scientific development of tracking sunspots, by studying the image of hand-sketched sunspots and photographed sunspots (*see downloadable materials*).

If laminated, the sunspots could be given clear labels (A, B, C etc.) to help students notice the moving position of the sunspots across the Sun's surface.

The teacher could share the pdf as a presentation and facilitate class discussion of the images without the small group element. Labels could also be annotated directly onto the pdf of the images.

Activity Outline:

Activity Name	Investigating the rotation of the Sun
Alignment to ISLE investigation	Experimenting to investigate hypothesis
Rationale	To analyse data to investigate if there is any evidence of the Sun having seasons. To prompt investigation of how we can prove the Sun rotates. To connect the concept of rotation of the Earth and rotation of the Sun.
Activity Description	(*please see downloadable materials for the resources for this activity)* *(Q1. worksheet 1.2)* Students demonstrate, through acting, how the seasons work on Earth. *(Q2. worksheet 1.2)* Students are given images of sunspots on the surface of the Sun and must investigate the position of these sunspots. Students can fill a table of data about the location of the sunspots and the number of sunspots visible and reflect on how the presence of sunspots supports/opposes their hypothesis. In part c) students use solarmonitor.org to view current images of the sun and record the number of sunspots. *(Q3. worksheet 1.2)* Students consider how the sunspots indicate that the Sun rotates. Students are asked to plot the latitude and longitude coordinates of 3 sunspots and notice the movement as time passes. Students then use the data to calculate the approximate time it takes for the Sun to rotate once (rotation period). Students are also asked to reflect on the accuracy of their calculations compared to the actual value for the rotation period of the Sun (27 days).

	(Q4. worksheet 1.2) Students compare the rotation period of the Sun to the planets and some moons of our solar system. There is emphasis on the patterns that they notice in the data.
Link to other tasks	Scaffold for Rich Task 1 Activities 3 - 7
Link to current research in DIAS Dunsink Observatory	The Solar and Space Weather group at DIAS Dunsink consists of PhD students, postdocs and professors who study different aspects of the Sun and Space Weather. Through their research, scientists can get daily updates on the activity of the Sun (https://solarmonitor.org) and advise on precautions that can be taken to protect Ireland's power grid from potential solar storms. More information on specific projects can be found here: https://www.dias.ie/solarphysics
Related DIAS Dunsink Observatory Podcast	Podcast Description: An interview with Alberto Cañizares who studies energetic explosions on the Sun, at DIAS Dunsink Observatory. The podcast offers insight for students on the reason why the study of the Sun is important and how it is possible to move from one area of STEM to another, because of the versatility of STEM degrees. (engineering → physics) Podcast episode: Coming soon