# Does the Sun have Seasons?

## Rich Task 1 Activity 4

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 asks students to model the formation of plasma in the Sun with a simple boiling water experiment and acting out particle collisions. This activity scaffolds the next (Rich Task 1 Activity 5), which explores the behaviour of plasma in a magnetic field.

Preparation Required:

- Printing
- Setting up hot plates and beakers of cold water for students to conduct an experiment (worksheet 1.4 A) OR Setting up a hot plate and beaker of cold water for teacher demonstration (worksheet 1.4 B)

Downloadable Materials:

- Worksheet 1.4 A
- Worksheet 1.4 B
- Expected Student Responses to Worksheet 1.4 A or B

Relevant Junior Cycle Learning Outcomes:

Students should be able to…

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

**CW LO 4:** Classify substances as elements, compounds, mixtures, metals, non-metals, solids, liquids, gases and solutions.

**NOS LO 2:** Design, plan and conduct investigations; explain how reliability, accuracy, precision, fairness, safety, ethics, and the selection of suitable equipment have been considered

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

**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 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…

- Model the behaviour of particles in the Sun and make observations.
- Describe the behaviour of particles in different states of matter through role play.
- Record their observations.
- Communicate their ideas in a small group and whole-class setting.
- Discuss their observations.
- Explain how atoms can become ionised and connect the movement of charged particles in the Sun to the flow of electricity (current)
- Recognise the role of scientist Cecilia Payne - Gaposchkin in the study of the Sun.
- Apply new information to an unfamiliar context. (understanding generation of plasma on the Sun).

Prior Knowledge/Horizon Content Knowledge:

- States of matter
- Structure of the atom
- Formation of Ions
- Making and recording observations
- Noticing patterns or anomalies in data

Differentiation and Accessibility Suggestions:

This activity requires some prior knowledge. Students can decide the depth of questioning and discussion in the class.

There are two versions of this worksheet, Worksheet 1.4 A is designed for the students to conduct the modelling of the behaviour of particles in the Sun experiment in pairs. Worksheet 1.4 B is designed for the teacher to demonstrate to the class.

The teacher could share the pdf as a presentation and facilitate class discussion without the small group element.

Students could research Cecilia Payne-Gaposchkin's contribution to solar physics and astronomy as an extension task or research project.

Activity Outline:

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| **Activity Name** | What is the Sun made of? |
| **Alignment to ISLE investigation** | Investigating the hypothesis |
| **Rationale** | Analysing data to aid investigation of whether or not the Sun has seasons. To address questions the students may have about what the Sun is made of and what the Sun ejects through solar eruptions (as seen on images in Rich Task 1 Activity 1) |
| **Activity Description** | (*please see downloadable materials for the resources for this activity)*<br><br>*(Q1. Worksheet 1.4 A or B)*<br>Using the worksheet (or teacher demonstration) students can model the behaviour of particles in the Sun.<br><br>**Teacher demo:** boil water in a clear Pyrex beaker on a hot plate. Ask students to describe the behaviour of the water as it boils (changing from no movement to some bubbling to larger bubbling and lots of movement). Prompt students to observe that the increase in temperature of the water as it boils causes an increase in motion (kinetic energy) of the water. This is what happens in the Sun since the temperature range is 6700℃ up to 5,000,000℃ - the atoms of Hydrogen and Helium are very energetic and collide |

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| | frequently. Students can work together as a class or in large groups to role-play the state of matter of the atoms in the experiment in Q1 a). This is to explore the increased number of collisions that occur at high temperatures vs lower temperatures.<br><br>*(Q2. Worksheet 1.4 A or B)*<br>Students can then explore how collisions can result in the damage and separation of something, and in the case of atoms, this means an electron can be lost in a collision.<br><br>(*Q3. worksheet 1.4 A or B*)<br>Students can recap on the formation of Ions to then apply this knowledge to Q4.<br><br>(*Q4. worksheet 1.4 A or B*)<br>Students reflect on how all the activities in the worksheet *(also worksheet 1.3)* have helped the students to build an argument for the composition on the Sun. |
| **Link to other activities** | Scaffold for Rich Task 1 Activities 5 - 7 and links back to Rich Task 1 Activity 1. |
| **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.<br><br>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.<br><br>More information on specific projects can be found here:<br>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 |

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| | move from one area of STEM to another, because of the versatility of STEM degrees. (engineering → physics)<br><br>Podcast episode:<br><br>Coming Soon! |