

National Aeronautics and Space Administration



NASA Helio Club

Session 1

Activity 1: Modeling the Heliosphere

NASA Heliophysics Education Activation Team



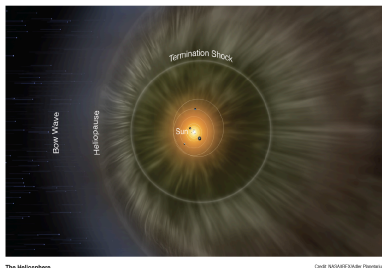
Explore: Modeling the Heliosphere

Overview of Activity 1 (25 Minutes)

This hands-on activity uses the kitchen sink to model the properties of the boundary of the **heliosphere** and takes learners through the scientific processes used in investigations: Making observations, using models, and communicating results.

Emphasize to learners that the image on the handout is not a picture NASA took, but rather was created from real data collected by NASA missions.

Scientists routinely use models to better understand phenomena. Colors can be added to these types of models to help us visualize what is going on.



Heliosphere Handout
Credit: NASA / IBEX

Materials

- Waterproof [Handout The Heliosphere Graphic PDF](#)

Instructions

- Direct learners** to the [Handout The Heliosphere Graphic PDF](#), which is the same image on **page 7** of the [NASA Helio Club Youth Guide](#).
- Provide Context:** The **heliosphere** has different parts, depending on how it interacts with the boundary of **interstellar space**. We know this from NASA missions like **Voyager** and **IBEX**, which have measured this boundary.
- Examine:** This image was created from a 3D model of the **heliosphere** using actual data collected by the **IBEX** mission. Colors are meant to enhance features and show structure. [[Slide 8](#)]

The **solar wind** is represented by the greenish, wavy lines coming out from the Sun.

The **heliopause** is the outermost boundary of the **heliosphere**. Beyond the **heliopause** is **interstellar space**.

The **termination shock** is the innermost boundary of the **heliosphere**, where the **solar wind** begins to interact with **interstellar space**. The **termination shock** is still inside the **heliosphere**.

The **heliosphere** creates a **bow wave** because the Sun is moving through **interstellar space**, as it orbits the center of the Milky Way galaxy. Just like how a bow wave is created as a boat moves through the water.

Encourage learners to record observations and draw diagrams, like real scientists and engineers do, in the [NASA Helio Club Youth Guide](#).

Educator Background

Information: In anticipation of questions on exactly what interstellar space is made of, you can tell learners that: *Interstellar space is the space between the stars in our Milky Way and contains a cold gas of mostly hydrogen atoms mixed together with a hot gas consisting of plasma.*

Take a few minutes to examine the **heliosphere** handout and make some observations.

- What do you notice about the boundary?
- What shape is it?

D. Model: We are going to use this waterproof image and the kitchen sink to model parts of the **heliosphere**.

Take learners through the directions. If you laminated the handout, instruct learners to skip the instructions for wrapping the handout in plastic wrap. Instruct learners to go to the sink and experiment. [[Slide 9](#)]

You can show learners the [Modeling the Heliosphere Video](#) to help them construct the model. [[Slide 10](#)]

C. Sharing Results:

- Record your results. Include drawings and diagrams and note any modifications you made in order to perfect the model, perhaps adjusting the water pressure or the position of the image, for example.
- How does this model help us learn about the properties (characteristics) of the **solar wind** and the **heliosphere** boundary?
- Why would a soap bubble not be an appropriate model for the **heliosphere**?

Allow time for learners to share their answers.

Activity 1 Major Concepts:

- ★ The **heliosphere** is the region of space influenced by the **solar wind**, and it extends far beyond Pluto. Very far! For perspective, Earth is 1 astronomical unit (AU) from the Sun. Pluto is, on average, approximately 40 AU from the Sun; the boundary of the heliosphere (the heliopause) is approximately 122 AU from the Sun. (1 AU is approximately 93,000,000 miles)
- ★ The **heliopause** is the outermost boundary of the heliosphere.
- ★ The **termination shock** is the innermost boundary of the heliosphere, where the **solar wind** begins to interact with **interstellar space**. The termination shock is still inside the heliosphere.
- ★ The flowing water on the image is a good model for the boundary of the heliosphere because the boundary ebbs and flows with solar activity.
- ★ The shape of the heliosphere is not round, however, because the Sun is traveling through space, orbiting around the center of the Milky Way galaxy, it creates a **bow wave** through interstellar space as it travels.
- ★ NASA missions are interested in studying this boundary because the Sun is the only star that we know of that hosts a planet with life. We can learn about other stars from studying our own star and its influence on space.

Featured NASA Missions: The [Interstellar Boundary Explorer \(IBEX\)](#) is an Earth-orbiting mission that has special telescopes that look out toward the edge of the solar system, mapping the boundary of our solar system. The twin [Voyager](#) spacecraft (Voyager 1 and Voyager 2) was launched from Earth in 1977. Voyager 1 reached the termination shock of the heliosphere in 2004 and crossed the heliopause in 2012. It was the first human-made object to enter interstellar space.

