National Aeronautics and Space Administration

NASA Helio Club

Session 1

Heliophysics 101

NASA Heliophysics Education Activation Team

Youth Guide Page 5

Materials Needed for this Session

Basics
- ❑ Writing tools (pens or pencils)
- ❑ Art supplies (markers or crayons)
- ❑ (1) pair of scissors
- ❑ (1) roll of tape

Prior Knowledge/Evaluate
- ❑ (1) Handout_KWL_Session 1

Engage
- ❑ (1) Handout_The Sun's Energy Graphic PDF
  or find the digital version here NASA Space Place: Where does the Sun's energy come from?

Explore: Activity 1
- ❑ (1) Handout_The Heliosphere Graphic PDF (needs to be printed in color on cardstock, laminated)

Explain: Activity 2
- ❑ (1) 5" x 7" index card

Extend: Activity 3
- ❑ (1) measuring tape
- ❑ (1) Handout_Sun-Earth Day Model PDF

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Scientist and engineers record everything!

Grab a notebook or use the extra paper provided in the Helio Club Youth Guide to record observations, collect data, and organize ideas.

Session 1: Notes

What do you already know about the Sun ?

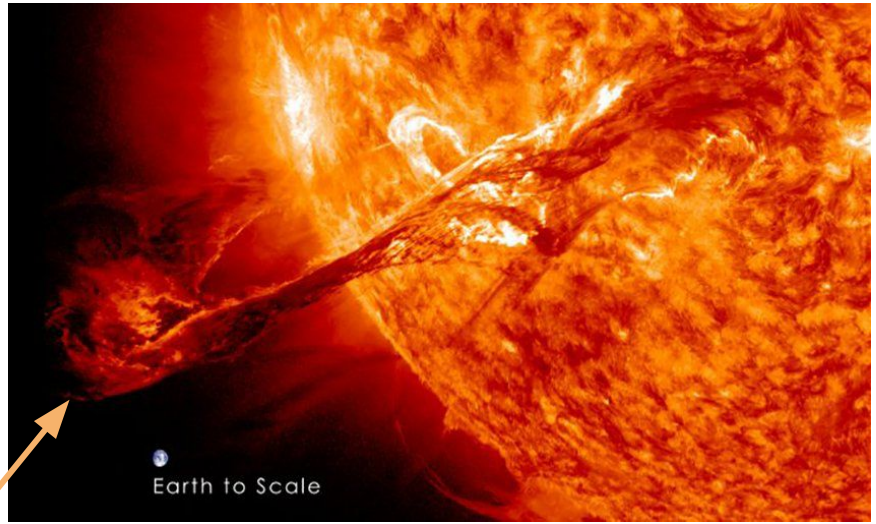
Session 1: KWL		
K - what do we already know?	**W- what do we wonder about?**	**L- what did we learn?**
What do we already know about the Sun? What is it? What is it made of?	**Record questions you have about the Sun in this column.**	**Record what you learned about the Sun in this column.**

What is Heliophysics?

Heliophysics is the study of the Sun and its influence on the Solar System.

There are a lot of very interesting heliophysics topics that NASA studies.

For example: a Coronal Mass Ejection



A 2012 coronal mass ejection (CME) from the sun. Earth is placed into the image to give a sense of the size of the CME, but our planet is, of course, nowhere near the Sun. *Credit: NASA/ Goddard Media Studios*

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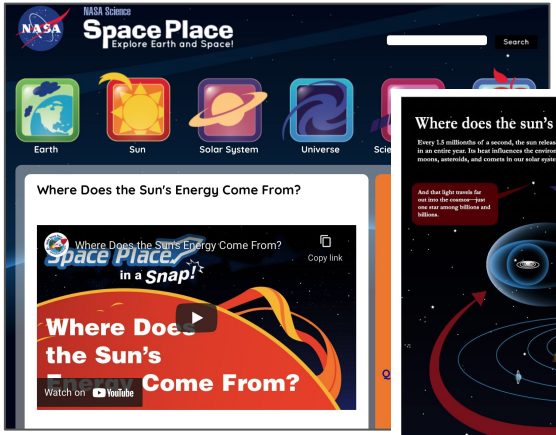
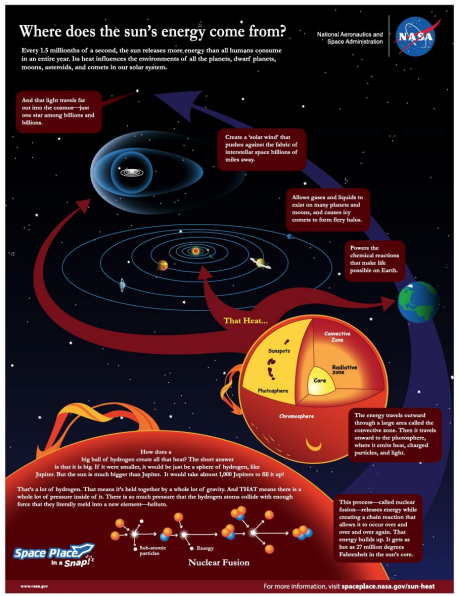
Video

Where does the Sun's energy come from?





Focus Questions:

- ★ What is the Sun?
- ★ Why isn't it a planet, like Mars or Venus, for example?
- ★ How big is the Sun?
- ★ How does it make energy?

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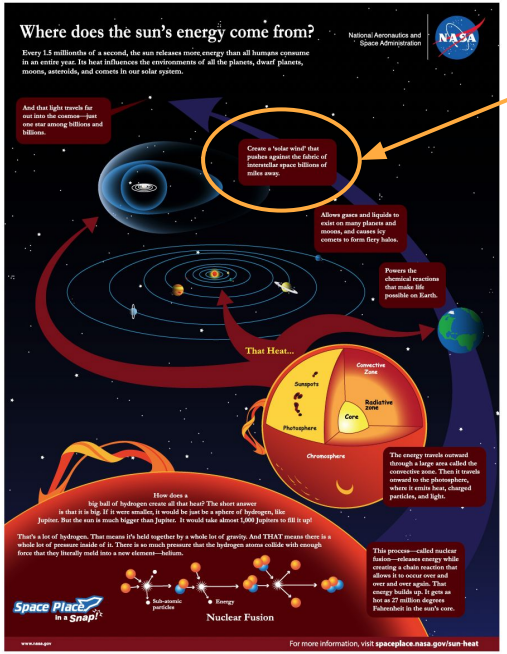
Asking Questions

*Have you heard of **solar wind**?*

*What about **interstellar space**?*



Create a 'solar wind' that pushes against the fabric of interstellar space billions of miles away.

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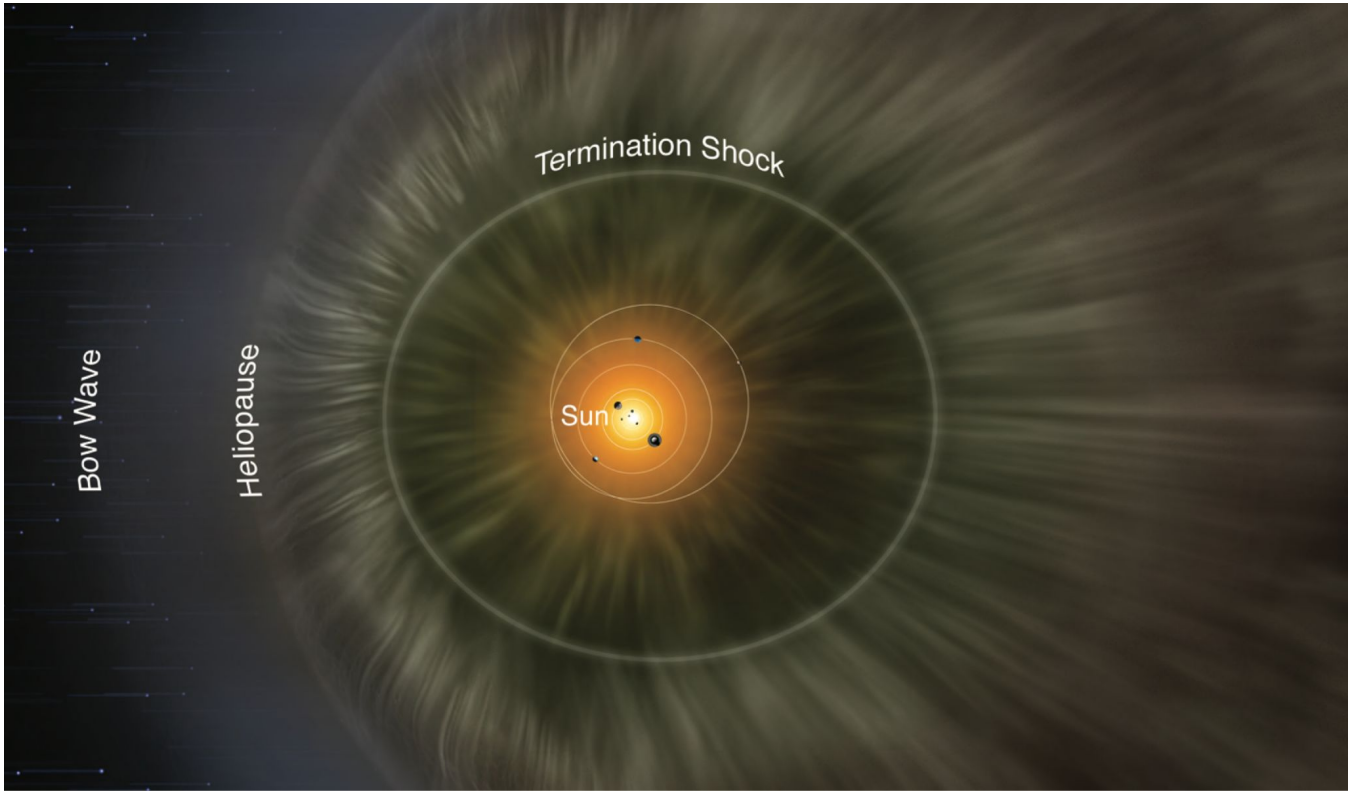
Modeling the Heliosphere



Key terms:

Solar Wind

Interstellar Space

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Modeling the Heliosphere

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For you to try: Model the heliosphere using your kitchen sink

Materials

- Picture of the heliosphere (front of this lithograph)
- A sheet of cardboard*
- Clear plastic wrap*
- A sink with running water

* This activity works better if you place the picture of the heliosphere under a sheet of plexiglass or laminate it instead of wrapping it in plastic wrap.

Place the picture of the heliosphere on top of the cardboard. Carefully wrap the plastic wrap around the picture and cardboard, like wrapping a present. Try not to have any wrinkles or bubbles. Make sure the entire picture is covered so no water can get in.

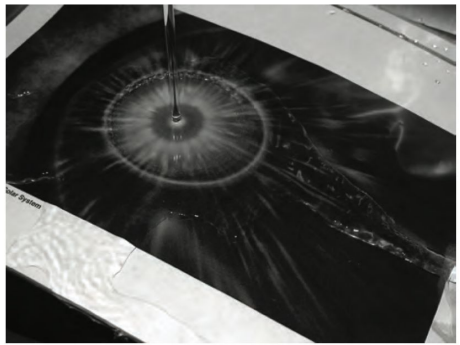
Turn on the faucet and adjust the stream of water so that it is about the thickness of a pencil.

Place the plastic wrapped picture of the heliosphere under the stream of water. Move the picture so that the water hits at the location of the Sun. Tip the image so that the water flows toward the right side of the picture.

Watch the stream of water flow quickly away from where it hits the paper. This represents the solar wind streaming away from the Sun.

Look for the round edge where the water slows down and looks bumpy. This represents the termination shock.

Adjust the position of the picture up and down, or the amount of water coming out of the faucet, so that the water model matches up with the diagram of the solar wind and the termination shock on the picture.



Credit: NASA/IBEX/Adler Planetarium

Directions:

Skip the first step if your handout is already waterproof.

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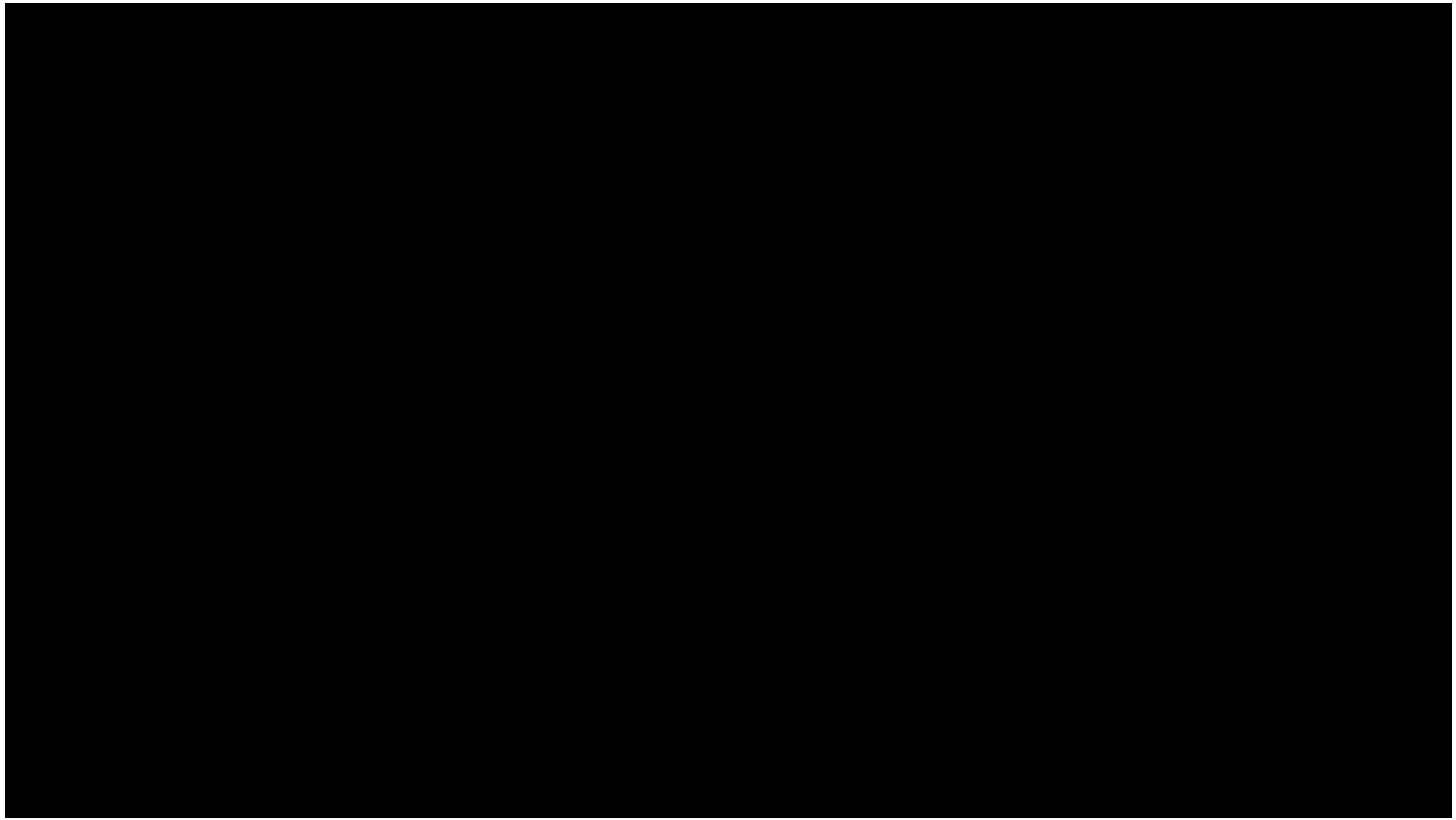
Heliosphere in the Sink

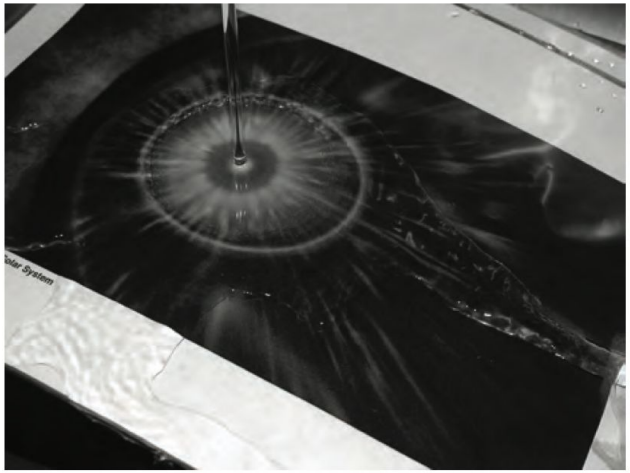


Modeling the Heliosphere

Results:

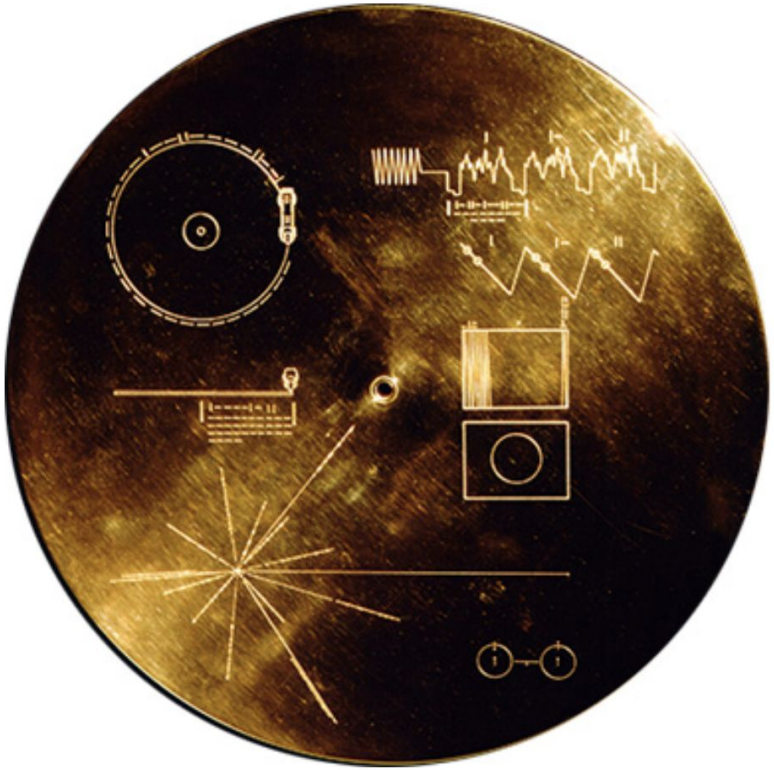
Record your results. Include drawings and diagrams and note any modifications you made in order to perfect the model, perhaps adjusting the water pressure or the position of the image, for example.

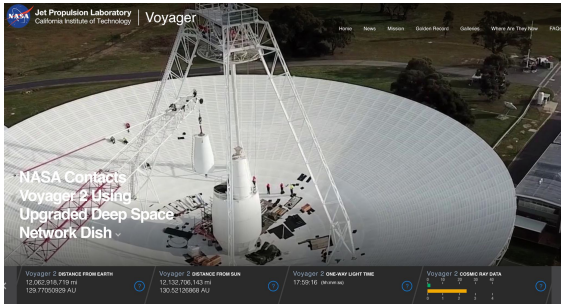
- How does this model help us learn about the properties (characteristics) of the **solar wind** and the **heliosphere** boundary?
- Why would a soap bubble not be an appropriate model for the **heliosphere**?



Credit: NASA/IBEX/Adler Planetarium

The Golden Record





[Voyager Mission]

Postcards in Space

Greetings! [message] ***Sincerely,*** ***The Earthlings***	***PLACE STAMP HERE*** **What information is included in an address?**

Postcards in Space

Greetings! [message] ***Sincerely,*** ***The Earthlings***	***PLACE STAMP HERE*** **Name**

Postcards in Space

Greetings! [message] ***Sincerely,*** ***The Earthlings***	***PLACE STAMP HERE*** **Name** **Street**

Postcards in Space

Greetings! [message] ***Sincerely,*** ***The Earthlings***	***PLACE STAMP HERE*** **Name** **Street** **City**

Postcards in Space

Greetings! [message] ***Sincerely,*** ***The Earthlings***	***PLACE STAMP HERE*** **Name** **Street** **City** **State + ZIP code**

Postcards in Space

Greetings! [message] ***Sincerely,*** ***The Earthlings***	***PLACE STAMP HERE*** **Name** **Street** **City** **State + ZIP code** **Country**

Postcards in Space

Greetings! [message] ***Sincerely,*** ***The Earthlings***	***PLACE STAMP HERE*** **What information would that address need to include if your new friends came from outside of our heliosphere?** **What about from outside of our galaxy?**

Postcards in Space

Greetings! [Leave blank for now] ***Sincerely,*** ***The Earthlings***	***PLACE STAMP HERE*** **Name** **Street** **City** **State + ZIP code** **Country** **Planet**

Postcards in Space

Greetings! [message] ***Sincerely,*** ***The Earthlings***	***PLACE STAMP HERE*** **Name** **Street** **City** **State + ZIP code** **Country** **Planet** **Planetary System**

Postcards in Space

Greetings! [Message] ***Sincerely,*** ***The Earthlings***	***PLACE STAMP HERE*** **Name** **Street** **City** **State + ZIP code** **Country** **Planet** **Planetary System** **Heliosphere Boundary**

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Postcards in Space

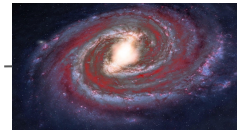
Greetings! [Message] ***Sincerely,*** ***The Earthlings***	***PLACE STAMP HERE*** **Name** **Street** **City** **State + zip code** **Country** **Planet** **Planetary System** **Heliosphere Boundary** **Galaxy**

Welcome Extraterrestrials!

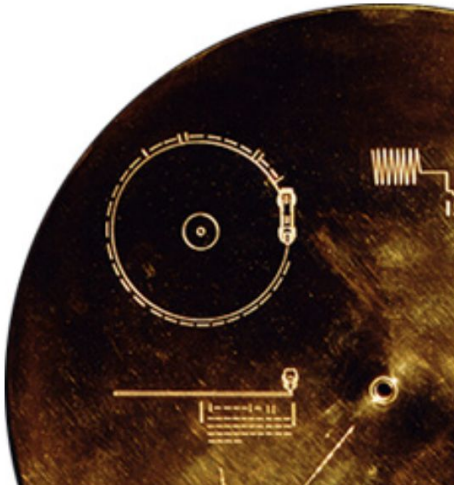
Back of Postcard

Greetings! ***Welcome to Earth!*** ***Earth is a really cool place because…*** ***Sincerely,*** ***The Earthlings***	***PLACE*** ***STAMP HERE*** ***Learner Name:*** _____ ***House #, Street:*** _____ ***City, State, ZIP Code:*** _____ ***Country:*** _____ ***Planet:*** _____ ***Planetary System:*** _____ ***Solar System Boundary:*** _____ ***Galaxy:*** _____

Front of Postcard



Draw a map from outside the Milky Way Galaxy to Earth.



Sun-Earth Scale Model

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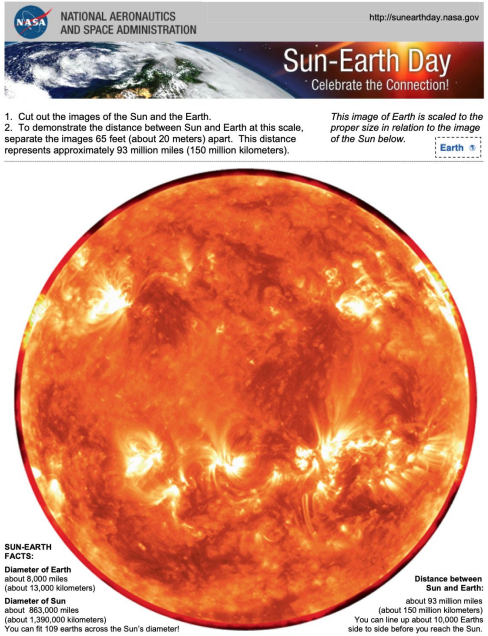
1. Tear out **page 9** of the NASA Helio Youth Guide, or use the [Handout Sun-Earth Day Model PDF].

2. Cut out the Sun and the Earth.

3. To demonstrate the distance between Sun and Earth at this scale, separate the images 65 feet (about 20 meters) apart. This distance represents approximately 93 million miles (150 million kilometers).



Sun-Earth Scale Model

Observations:

- What is a scale model?
- Why do both size and distance matter when making a model to scale?
- Was the model of the heliosphere in the sink a scale model? Why or why not?
- Do both scale and not-to-scale models serve a purpose? Explain.
- Was there anything that surprised you about the sizes and distance between the Sun and Earth?

What did you learn about the Sun?

Session 1: KWL		
K - what do we already know?	**W- what do we wonder about?**	**L- what did we learn?**
What do we already know about the Sun? What is it? What is it made of?	**Record questions you have about the Sun in this column.**	**Record what you learned about the Sun in this column.**

Session 1 Major Concepts

- ★ The Sun is a star and is the largest object in the Solar System; 1.3 million Earths can fit into the Sun.
- ★ The Sun is just one of billions of stars in the Milky Way Galaxy; there are billions of galaxies in the universe.
- ★ The Sun is so big and has so much gravity and pressure, it can create energy. The Sun makes energy in its core through the **nuclear fusion** of hydrogen into helium. **Nuclear fusion** releases a lot of energy.
- ★ The Sun is made of a super-heated, ionized gas called **plasma**.
- ★ The Sun releases heat, light, and charged particles. These charged particles make up the **solar wind**.
- ★ **Solar wind** is created by the intense super-heated **plasma** of the Sun, which flows outward in all directions, pushing against the material that is in between the stars, creating a sort of bubble that surrounds our Solar System. We call this bubble the **heliosphere**.
- ★ The **heliosphere** is the region of space influenced by the **solar wind,** and it extends far beyond Pluto.
- ★ The space between stars is called **interstellar space**. This kind of space turns out to be a little different from the space inside the boundary of the Sun's influence.