Voyage: A Journey Through Our Solar System

Grades K-12

Voyage!

On a visit to the National Mall in Washington, DC, one can see monuments of a nation—Memorials to Lincoln, Jefferson, and WWII, the Vietnam Veterans Memorial Wall, and Washington Monument. Standing among them is *Voyage*—a one to 10-billion scale model of our Solar System—spanning 2,000 feet from the National Air and Space Museum to the Smithsonian Castle. *Voyage* provides visitors a powerful understanding of what we know about Earth's place in space and celebrates our ability to know it. It reveals the true nature of humanity's existence—six billion souls occupying a tiny, fragile, beautiful world in a vast space.

Voyage is an exhibition that speaks to all humanity. The National Center for Earth and Space Science Education is therefore making replicas of *Voyage* available for permanent installation in communities worldwide (http://voyagesolarsystem.org.)

This activity allows you to create your own *Voyage* scale model Solar System, and bring the *Voyage* experience into your backyard, a nearby park, or your school playground.

Voyage is a program of the National Center for Earth and Space Science Education (http://ncesse.org.) The exhibition on the National Mall was developed by Challenger Center for Space Science Education, the Smithsonian Institution, and NASA.

Voyage!

Voyage: A Journey Through Our Solar System is a 1-to-10-billion scale model of the Solar System that was permanently installed on the National Mall in Washington, DC in October 2001 by Challenger Center for Space Science Education, the Smithsonian Institution, and NASA. Stretching 600 meters (650 yards) from the National Air and Space Museum to the Smithsonian Castle, Voyage illustrates that Earth is but one small body within a vast system of worlds bound to the Sun.

Voyage was designed for replication and installation at sites around the planet. The project also includes the development of educational materials to enhance the experiences for visitors to *Voyage*, as well as bring the experience to those without access to an exhibition.

Voyage consists of 13 units, including one each for the eight planets, the Sun, Pluto (as an example of dwarf planets), asteroids and comets, and two anchor units. Each unit displays the appropriate scaled planet and its moons, stunning color imagery, and lively informative text that vividly describes each world. Each unit also includes statistics about the planet, comparisons to Earth, directional signage, and a list of robotic explorations.

On the *Voyage* scale, the Sun is about the size of a large grapefruit; Earth is 15 meters (50 feet) away, and smaller than the head of a pin. The entire orbit of the Moon fits comfortably in the palm of your hand. Pluto, a dwarf planet in the outer parts of the planetary realm of the Solar System, is 600 meters (approximately 2000 feet or 6.5 football fields) away from the Sun. The nearest star to the Sun, Proxima Centauri, would be the size of a cherry in coastal California.

The following activity provides directions to create your own scale model Solar System, and allows you to bring *Voyage* into your own backyard or school yard to explore on your own!

For more information visit *Voyage* Online at www.voyagesolarsystem.org.

Voyage! Build a Scale Model Solar System

You will create a scale model of the Solar System that is one 10-billionth its actual size to investigate the relative sizes of the Sun and planets, and the distances between them.

Materials

- Meter stick
- Masking tape
- Solar System Questions and Fun Facts
- Model Distances Chart
- Scissors
- 10 poster boards
- 10 items to fasten the Sun and planets to the ground (e.g., sticks, tomato stakes, etc.)

Directions

1. Cut out the model Sun and model planet cards and tape each of them to a separate piece of poster board.

2. Use masking tape to attach a stick or stake to each piece of poster board, or fold your poster board in half to create tent cards.

3. Use a thick marker and write the name of the planet (or Sun) on the appropriate piece of poster board. Use big letters so that the name of the planet or Sun can be seen from a distance. When finished, you will have 10 poster boards con-taining your model planets and Sun.

4. Find an area outside to walk 600 meters (0.4 miles) in a straight line if you want to pace out the entire Solar System. You only need half this distance if you pace from the Sun to Uranus, which is half-way to Pluto.

5. Before going outside, familiarize yourself with the "pace" as the "ruler" for this model Solar System. Define a pace as two steps, one with each foot. Put a few parallel strips of masking tape on the floor, one meter apart, and walk back and forth, to get used to the size of a meter pace. For taller people, you might want to define a pace as one step.

Construction Tip

The stakes attached to the model Sun and model planets can be a variety of household items. For example, you may use tomato stakes, dowels, chop-sticks, shish kabob skewers, etc. The idea is that the model Sun and model planets will be visible from any point along the path in your model. If you are creating your scale model on pavement, or if the ground is very hard, you can create tent cards out of poster board or put the stakes inside the center of construction cones. Be creative!

6. Go outside to walk the length of the model Solar System. Take along the Model Distances Chart, as well as the Solar System Questions and Fun Facts page to refer to while you are walking the model, which will allow you to take a 'tour' of the Solar System.

7. Place your model Sun by pushing the attached stake into the ground. Read the Solar System Questions and Fun Facts that pertain to the Sun.

8. Use the Model Distances Chart to find the number of paces to Mercury. Pace out the distance to where the model Mercury should be and push the attached stake into the ground. Read the Solar System Questions and Fun Facts that pertain to Mercury.

9. Repeat step 8 for the remaining planets. You will likely be shocked at the number of paces to each planet once you move beyond Mars.

10. Many model Solar Systems you have seen show the planets' sizes on one scale, and the distances between them on another, making the planets appear much closer together than they really are. Now that you have constructed your own scale model Solar System with the planets and the distances represented on the same scale, you can realize the difficulty in representing the Solar System accurately in a book or encyclopedia. Were you surprised by the vastness of the Solar System? Once you have traveled beyond Pluto, you can look back at the tiny place we call Earth, and truly appreciate our home for the first time.

Construction Tip

If you do not have space (or time) to model all of the planets, you might continue with the model until you reach Uranus. At this point, you are only halfway to Pluto! Read the Solar System Questions and Fun Facts for the rest of the Solar System from Uranus.

Extensions

Observe Earth's orbit around the Sun by connecting a piece of string to the model Sun and stretching it to the model Earth. Keep the string taut and travel in a circle around the Sun. (Note: The Earth's orbit is actually elliptical in shape, but on this scale it appears so close to a circle that this is a good representation of it.) It takes the Earth one year to travel around the Sun at the average speed of 107,200 km/h (66,600 mi/h), on this scale the model Earth will travel at 1 cm/h!

Chart of Paces Between Model Planets								
Sun to Mercury	Mercury to Venus	Venus to Earth	Earth to Mars	Mars to Jupiter	Jupiter to Saturn	Saturn to Uranus	Uranus to Neptune	Neptune to Pluto
6 paces	5 paces	4 paces	8 paces	55 paces	65 paces	144 paces	163 paces	142 paces

Chart of Total Distances (Meters) from Model Sun to Each Model Planet								
Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune	Pluto (dwarf planet)
6 meters	11 meters	15 meters	23 meters	78 meters	143 meters	287 meters	450 meters	592 meters

Solar System Questions and Fun Facts

The **Sun** is a star. Why does it look so big and bright compared to the other stars? *Because it is much closer than the other stars, not because it is bigger—it is only an average sized star.*

Did the position of **Mercury** surprise you?

Mercury orbits the Sun faster than any other planet (once every 88 days).

For many years, people called **Venus** Earth's "sister planet." Why do you think they did this? *Because Venus is about the same size as Earth. We have known this since 1761.*

Venus is the second brightest object in the night sky; only the Moon is brighter.

How long does it take the **Earth** to go around the Sun once? *One year.*

How many **Earths** do you think would fit inside the Sun? *One million.*

If you wanted to gift-wrap the **Moon**, you would need a piece of wrapping paper the size of Africa.

The total area of **Mars's** surface is about the same as all the dry land on Earth.

Why does **Mars** appear red? *Mars' surface contains iron oxide, also known as rust, which gives it its red color.*

Between which planets is the **asteroid** belt? *Mars and Jupiter.*

If you wanted to tie a ribbon around Ceres, the largest **asteroid**, you would need a ribbon long enough to go from northern Maine to southern Florida.

Jupiter is the first of the Jovian planets. How do their compositions differ from those of the inner, or terrestrial planets? *The terrestrial planets have a solid, rocky surface. The Jovian planets do not have a solid surface that we can see; they are gas giants.*

Jupiter has a giant storm in its atmosphere, called the Great Red Spot, which could swallow almost three Earths.

More than 1,000 Earths could fit inside **Jupiter**, but over 900 Jupiters could fit inside the Sun.

Saturn is the least dense of all of the planets. It is the only planet with a density less than that of water—that means that if there were a bathtub big enough to hold Saturn, it would float.

Traveling from the Sun, once you get to **Uranus**, you are only half-way to Pluto.

Uranus is the only planet that rotates on its side, instead of upright.

Like Earth, **Neptune** has four seasons each year. However, one Neptunian year equals 165 Earth years. How long does each season last? *Each season lasts approximately 41 Earth years.*

It takes **Pluto** 248 Earth years to go around the Sun once. Pluto has not had enough time to go around the Sun once since the Declaration of Independence was signed in 1776.

Pluto's orbit is the most elliptical among the worlds included in the *Voyage* model—sometimes it actually is closer to the Sun than Neptune.

Pluto's orbit is by no means at the edge of the Solar System. The Oort Cloud, home of the comets, extends almost half-way to the nearest star.

General Solar System Questions

How do the distances to the Sun compare for the inner (Mercury through Mars) versus the outer (Jupiter through Pluto) planets? *All the inner planets are relatively close to the Sun while the outer planets are far from the Sun and from one another.*

How do the sizes of the inner and outer planets compare? *Inner planets are generally much smaller than the outer planets. (The inner planets are also all rocky and are called terrestrial planets. The outer planets are gaseous giants, and are called Jovian planets. Pluto is the exception to this rule among the outer planets.)*

Which of the planets have rings? *All of the Jovian planets (outer gas giants) have rings (Jupiter, Saturn, Uranus, and Neptune), although Saturn has by far the most extensive system.*

How fast do you think a spacecraft would travel on this model? *In this model, a spacecraft might move an average of 3 cm (1 inch) every 5 hours.*

If we placed the model Sun in Washington, D.C., how far away would you have to put the model of the next star, Proxima Centauri? *Over 4,000 km (2,500 miles) away, on the coast of California. Proxima Centauri on this scale would be the size of a cherry. Depending on where you are setting up your model Solar System, you might be able to identify something familiar to the students that is 4,000 km away.*

Internet Resources

Are you interested in learning more about the Solar System and its worlds? Use these online resources for further information.

Astronomy for Kids
: www.frontiernet.net/~kidpower/astronomy.html

Kids Astronomy
: www.kidsastronomy.com/solar_system.htm

NASA Kids' Club
: www.nasa.gov/audience/forkids/kidsclub/flash/

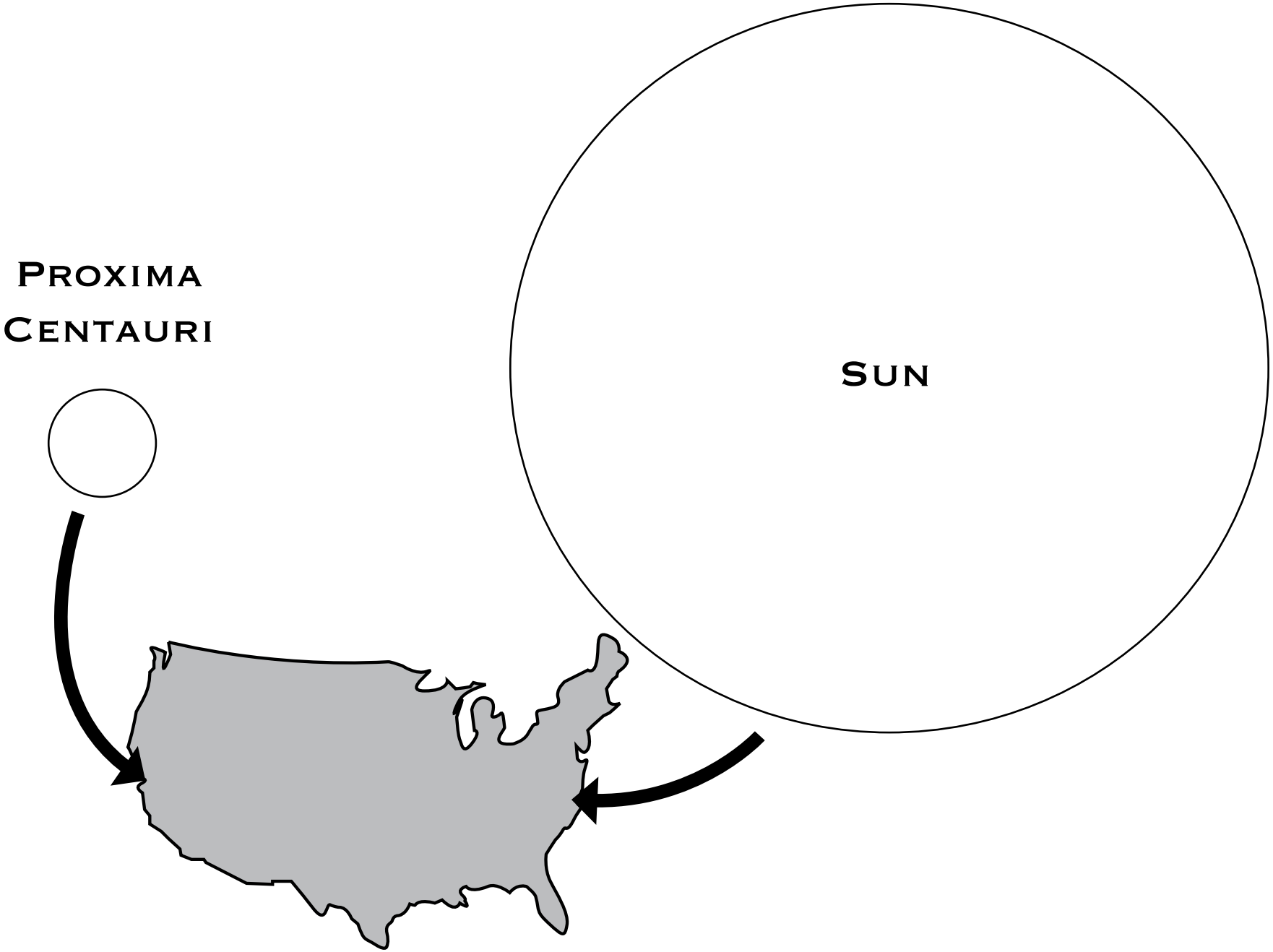
NASA's Planetary Photojournal
: photojournal.jpl.nasa.gov

NASA's Solar System Exploration Homepage
: solarsystem.nasa.gov

The Nine Planets
: www.nineplanets.org

Star Child
: starchild.gsfc.nasa.gov/docs/StarChild/solar_system_level2/solar_system.html

Voyage: A Journey Through Our Solar System
: www.voyagesolarsystem.org



On this scale, the model Proxima Centauri (the closest star to the Sun) would be located 4,000 kilometers from the model Sun. This is approximately the distance between Washington, DC and San Francisco, CA.

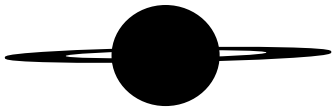
Mercury

Venus

Moon

Earth

Mars



Jupiter

Io

Europa

Ganymede

Callisto

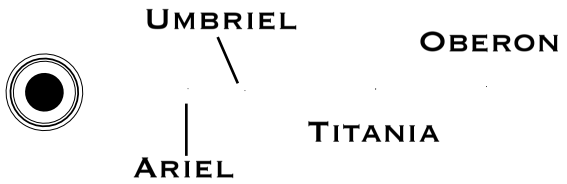
Saturn

Dione

Thethys

Rhea

Titan



Uranus

Neptune

Pluto