Hands-on

STAR★net

Tested & Approved STEM Activities

Jump To Jupiter

Activity Guide

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Science-Technology Activities & Resources For Libraries

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Jump To Jupiter

The Jump to Jupiter course begins at a grapefruit-sized "Sun," Participants jump (or pace out) the distances to Mercury, Venus, Earth, Mars, Jupiter, and more, visiting a marker for each planet. Many parking lots are large enough to hold the markers out to "Jupiter." -- Credit: Enid Costley, Library of Virginia

Overview

Participants jump through a course from the grapefruit-sized "Sun," past poppy-seed-sized "Earth," and on to marble-sized "Jupiter" — and beyond! By counting the jumps needed to reach each object, children experience first-hand the vast scale of our solar system.

Activity Time

45-60 minutes.

Intended Audience

Families or other mixed-age groups, including children as young as 5 years old with assistance from an older child, teen, or adult
School-aged children ages 8-9
Tweens up to about age 13
Teens and adults with modifications

Type of Program

☑ **Facilitated hands-on experience**

☐ Station, presented in combination with related activities

☑ **Passive program (if instructions are provided at the start of the course)**

☐ Demonstration by facilitator

What's The Point?

- **The solar system is a family of eight planets, an asteroid belt, several dwarf planets, and numerous small bodies such as comets in orbit around the Sun.**
- **The four inner terrestrial planets are small compared to the four outer gas giants.**
- **The distance between planetary orbits is large compared to their sizes.**
- **Models can be used to answer questions about the solar system.**

Materials

Facility needs:

- ☐ A large area, such as a long hallway, a sidewalk that extends for several blocks, or a football field (see Preparation section for setup options)

For each group of 20 to 30 participants:

- ☐ A variety of memorable objects used to represent the Sun and planets, including:
  - ☐ 1 (4 inch) grapefruit or pomegranate
  - ☐ 1 (1 centimeter) wooden bead
  - ☐ 1 pony bead
  - ☐ 2 peppercorns
  - ☐ 2 table salt or sugar crystals
  - ☐ 2 sea salt crystals
  - ☐ 1 pinch of fine sand
  - ☐ Optional: 1 pinch of pollen, milled flour or corn, or gelatin
- ☐ 1 set of solar system object markers created (preferably in color) from:
  - ☐ 1 set of Our Solar System lithographs (NASA educational product number LS-2013-07-003-HQ)
    https://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Our_Solar_System_Lithograph_Set.html

    AND/OR
  - ☐ Optional: Posters created by the participants

    AND
  - ☐ 12 (3′) stakes **OR** ☐ 12 traffic cones **OR** ☐ 12 sign stands

For each child:

- ☐ 1 "Jump to Jupiter" poem (below)
- ☐ 1 pencil or pen

For the facilitator:

- ☐ Measuring wheel

  OR
- ☐ 1 meter- or yard-stick
- ☐ Mallet or heavy object (for placing stakes in the ground)
- ☐ Tape
- ☐ Examples of the objects used in the solar system scale model course:
  - ☐ 1 (approximately 4-inch-wide) grapefruit or pomegranate
  - ☐ 1 (approximately 3/8-inch-wide) wooden bead
  - ☐ 1 pony bead
  - ☐ 1 peppercorn
  - ☐ 1 table salt or sugar crystal
  - ☐ 1 sea salt crystal
  - ☐ 1 pinch of fine sand
  - ☐ Optional: 1 pinch of pollen, milled flour or corn, or gelatin

Supporting Resources

Consider setting up a digital device (such as a computer or tablet), speakers, and access to the Internet to display websites or multimedia before or after the activity.

Books:

Becker, Helaine, and Brendan Mullan. Everything Space. Washington, D.C.: National Geographic Children's Books, 2015. (ISBN-13: 978-1426320743)

McMahon, Peter, and Josh Holinaty. The Space Adventurer's Guide: Your Passport to the Coolest Things to See and Do in the Universe, 2018. Toronto, ON: Kids Can Press Ltd. (ISBN 9781771380324)

Mosco, Rosemary and Jon Chad. Solar system: Our Place in Space, 2018. New York: First Second. (ISBN 9781626721418)

Farndon, John. The Awesome Book of Planets and Their Moons, 2014. Franklin, TN: Flowerpot Press. (Hardcover ISBN 978-1-4867-0342-5)

Couper, Heather, Robert Dinwiddie, John Farndon, Nigel Henbest, David W. Hughes, Giles Sparrow, Carole Stott, and Colin Stuart, 2014. The Planets. New York, NY: DK Publishing. (ISBN-13: 978-1465424648)

Enrich this activity by providing sources of information about the Sun, planets, dwarf planets, and asteroids in the form of signs, lithographs, books, and/or websites. -- Credit: Lunar and Planetary Institute

Video Clip:

How big is the solar system? This video shows relative sizes of the planets and how far they really are from the Sun: https://www.youtube.com/watch?v=MK5E_7hOi-k

Games, apps, and simulations:

NASA's Eyes on the Solar System: learn about our home planet, our solar system, the universe beyond, and the spacecraft exploring them with this downloadable application: http://eyes.jpl.nasa.gov

A Stunning Scale Model of Our Solar System, Drawn in the Desert. On a dry lakebed in Nevada, a group constructed a model by drawing circles in the desert around a 1.5 meter Sun and a marble-sized Earth. Video: http://www.theatlantic.com/video/index/417309/our-place-in-the-universe/

Lunar and Planetary Institute Augmented Reality App: Download the Lunar and Planetary Institute's augmented reality (AR) space science experience on your mobile device. Then, launch the app and point your camera at poster -- either printed on paper or enlarged on a computer screen. https://www.lpi.usra.edu/AR/

Images:

NASA Solar System Exploration
http://solarsystem.nasa.gov

Planetary PhotoJournal (NASA/JPL)
http://photojournal.jpl.nasa.gov

Preparation

Advanced Planning Tips:

- **If possible, incorporate additional science, technology, engineering, art, and mathematics (STEAM) activities into the event. See the STAR_Net resources listed at www.starnetlibraries.org for ideas.**
- **Prepare and distribute publicity materials for programs based on this event.**
- **Pull supporting resources out of circulation to feature during the program.**
- **View the how-to video of this activity at www.youtube.com/starnetlibraries.**

- Refer to Table 1 (below) for a list of memorable objects used to represent the Sun and planets, along with their diameters, distances from the "Sun," and the approximate number of jumps between the objects at a scale of 1 inch:350000 kilometers.

A football field, for example, would contain the entire model out to the orbit of Pluto if the course doubles back on itself six times. You may be able to modify the course to fit inside by using only the inner planets. The activity works best if the first five planets from the Sun, from Mercury to Jupiter, are included to illustrate the scale of our solar system. If you must omit some of the solar system objects, provide a wall or other area to display information about them.

- Set up a solar system course in an outside area or in a long hallway. The course does not have to be in a straight line! The course may fold back on itself. (Uranus is half way between the Sun and Pluto, so have the participants turn back at the Uranus marker.) It is helpful to have the grapefruit "Sun" visible at the beginning of the course so that participants may look back at it (at least from the "Earth" marker). Mark each object's position with a stake, traffic cone, or sign stand.

Alternatively, use the following resources to create your own larger or smaller course. A larger course will make the planet representatives larger and easier to see. A smaller course may fit in tighter location, or even indoors, but the Pluto, Mercury, and Mars representatives quickly become too tiny to see with the naked eye as the course is scaled down.

- Use the Exploratorium museum's online calculator (http://www.exploratorium.edu/ronh/solar_system/) to automatically determine the scaled sizes of the planets and distances from the Sun, relative to the size of the Sun you provide.
- Partner with community institutions to create a solar system model for your neighborhood! Place a giant-pumpkin-sized "Sun" at a central location and place the "planets" at area landmarks.

Preparation (continued)

Participants can visit the "planets" in person, or they can use digital or physical maps to visualize their locations. See the NASA programming guide, Solar System in My Neighborhood (https://www.lpi.usra.edu/education/explore/solar_system/activities/familyOfPlanets/solarSystem/), for tips. Or, use just a few of these food items to create a larger scale model of the Earth (grape), Moon (peppercorn), and Sun (pumpkin) in the NASA programming guide, Earth's Bright Neighbor (https://www.lpi.usra.edu/education/explore/marvelMoon/activities/whatIf/brightNeighbor/).

- Earth as a Peppercorn (http://www.noao.edu/education/peppercorn/pcmain.html) is a large-scale outdoor model of the solar system; "Pluto" is more than half a mile away from the "Sun."
- Give participants a choice of a variety of balls to use to create an even larger scale model of the Earth and Moon: How Big and How Far is the Moon (http://www.lpi.usra.edu/education/space_days/activities/moon/documents/Moon_How_Big_and_Far.pdf)

- Attach the "Our Solar System" lithographs for each solar system object to the appropriate stake, traffic cone, or sign stand.

Alternatively, invite the participants create their own course! Provide children ages seven and up with access to high-quality sources of solar system information and blank poster boards, paper, and craft materials. Have them create the markers that will be used in the course. Make sure they include accurate facts on each poster, and encourage creative representations of the planets and the information.

Have tweens and teens determine the scaled sizes of the solar system objects, as well as their relative distance from the Sun. Identify the solar system objects' actual sizes and distances from the Sun in current print and online resources. The Jump to Jupiter model uses a scale of 1 inch: 350,000 km. Earth as a Peppercorn (http://www.noao.edu/education/peppercorn/pcmain.html) uses 1 inch: 100,000 miles.) The following conversion factors may be helpful:

1 yard = 36 inches
1 meter = 39.37 inches
1 mile = 5,280 feet
1 inch = 2.54 centimeters
1 kilometer = 0.62 miles

- Optional: The distances may be quite large, so you may want to have an adult present at each marker in the course. Additional adults and teens also can guide the children with questions and information and keep them moving to other markers.

- Become familiar with information about the objects that are in view, as well as current and future missions to explore them using the "Our Solar System" lithographs and reputable websites.

Preparation (continued)

	Memorable Representative	Scaled Diameter	Scaled Average Distance from Sun	Number of Jumps Between Objects
Sun	Grapefruit or pomegranate	4" (10 cm)	-	-
Mercury	Table salt or sugar crystal	1/100" (0.4 mm)	14' (4 meters)	4
Venus	Sea salt crystal	3/100" (1 mm)	26' (8 meters)	4
Earth	Sea salt crystal	4/100" (1 mm)	35' (11 meters)	3
Mars	Table salt or sugar crystal	2/100" (0.5 mm)	54' (16 meters)	6
Asteroids (e.g. Ceres)	Pollen, milled flour or corn, or gelatin	3/1000" (70 micrometers)	98' (30 meters)	13
Jupiter	Wooden bead	1/3" (1 cm)	184' (56 meters)	26
Saturn	Pony bead	1/3" (8 mm)	337' (103 meters)	47
Uranus	Peppercorn	1/10" (4 mm)	677' (206 meters)	104
Neptune	Peppercorn	1/10" (4 mm)	1,061' (323 meters)	117
Pluto	Fine sand	7/1000" (170 micrometers)	1,393' (425 meters)	101
Alpha Centauri star system	Grapefruit	-	1,800 miles (3,000 kilometers)	Roughly the distance between Washington, D.C. and Mexico City

Activity

1. Share ideas and knowledge.

- Introduce yourself. Help the participants learn each other's names (if they don't already).
- Frame the activity with the main message: Space is full of…SPACE!

Pronunciation Guide
Ceres [seer-eez] - http://dictionary.reference.com/browse/ceres
Uranus [YOU'RE a nuss] - http://www.planetary.org/blogs/emily-lakdawalla/2009/1806.html
Haumea [hah-oo-may-ah] - http://starchild.gsfc.nasa.gov/docs/StarChild/solar_system_level2/haumea.html
Makemake [MAH-keh MAH-keh] - http://www.iau.org/news/pressreleases/detail/iau0806/
Eris [ee'-ris] - http://www.iau.org/news/pressreleases/detail/iau0605/

Activity (continued)

- Explain that the participants will use a scale model to explore the distances between solar system objects. Use open-ended questions and invite the participants to talk with you and each other about their prior experiences with scale models.

Direct the conversation toward the idea that a scale model has smaller parts but parts that are relatively the same size and distance to each other. Encourage children to consider how scale models like toy cars and play kitchen furniture allow us to play in ways that are impractical (or unsafe) with "real" cars or kitchen appliances. Encourage teens and adults to consider how models are used in architectural, engineering, and science professions. They might be familiar with the use of computer-based climate models to test questions relating to Earth's past, present, and future global climate. Or, they might mention that full-scale models are used in industrial design.

- Invite the participants to offer questions to the group about planets, the dwarf planets Ceres and Pluto, and asteroids in our solar system. As the participants name the different objects, ask them to choose the best representative — based on size — from the beads, salt crystals, etc. that were used to construct the solar system course.

As much as possible, encourage the participants to offer information and questions. This model can be used to answer questions such as:

- How do the planets compare in size?
- How does big does the Sun appear to be from Earth? From Jupiter?
- How does the distance between the Sun and Pluto compare to the distance between the Sun and the next closest star system (Alpha Centauri)?
- Which destination is closer for a spacecraft: Venus or Mars?
- Are some planets closer together than others?
- Could an accurate model of the solar system fit on my bookshelf at home?

2. Guide the participants as they explore the solar system scale model to answer their questions.

Leave the "Sun" at the beginning of the course for their reference.

a. Provide the meter- or yard-stick for the children to practice jumping that length.

b. Offer the "Jump to Jupiter" poem and pencils or pens. Ask the children to count the total number of (one-meter) jumps from the Sun it takes to get to each marker. Explain that the poem has a place for them to enter each distance.

c. Suggest that the participants find information about each solar system object by reading the signs.

Participants use one-meter jumps — or very large steps — to measure the distances between markers. -- Credit: Lunar and Planetary Institute

Facilitators (adults or teens) standing at each marker can engage participants with questions such as:

- How many jumps did it take to arrive at this planet (or asteroid belt or Pluto)?
- How big does the grapefruit "Sun" look from here? Imagine what the real Sun would look like in the sky of this planet/dwarf planet!
- What do you think is happening to the temperature as you travel further away from the Sun?
- At the last marker of the course, compare the immense scale of our solar system to the even larger distances to other stars. At this scale, Alpha Centauri A would be slightly larger than a grapefruit and about 1,800 miles (3,000 kilometers) away — roughly the distance between Washington, D.C. and Mexico City!

3. Have the participants describe what they discovered by exploring the model.

Each person will have counted slightly different numbers of jumps between each marker. (Those who used careful, consistent 1-meter-long jumps will more closely match the actual measurements of the model.) Focus the conversation on the relative distances that everyone measured.

Using this model, the participants can answer any number of their own questions, such as:

- The inner terrestrial planets — Earth, Mercury, Mars, and Venus — are relatively close together. Venus is Earth's closest neighbor (after the Moon). The giant planets (Jupiter, Saturn, Uranus, and Neptune) get farther and farther apart.
- From each marker, the grapefruit "Sun" will look just like it does in the sky of that object. From "Earth," the real Sun appears to take up half a degree (or arc) in the sky. The grapefruit "Sun" appears to be the same size; it can be covered with a pinkie finger held at arm's length.

4. Remind the participants that the model isn't perfect.

In space, the planets are in motion as they orbit the Sun. Only rarely do four or more planets "line up." Have them imagine the circles that each planet would trace! Or, if desired, invite a few participants to carry a selection of planet models in large circles around the "Sun" to demonstrate their orbits.

5. Conclude.

Draw on the participants' discoveries to summarize the experience, and wrap up with the main message: Space is full of…SPACE! The planets are small compared to the Sun, and they are spread far, far apart. There is an enormous distance between the Sun and even the closest stars.

Correlation to the Next Generation Science Standards

Disciplinary Core Ideas

ESS1.B: Earth and the Solar System

- The solar system consists of the sun and a collection of objects, including planets, their moons, and asteroids that are held in orbit around the sun by its gravitational pull on them.

Science and Engineering Practices

Developing and Using Models

- Develop and/or use a model to represent amounts, relationships, relative scales (bigger, smaller), and/or pat terns in the natural and designed world(s).
- Identify limitations of models.

Analyzing and Interpreting Data

- Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and de signed world(s) in order to answer scientific questions and solve problems.

Using Mathematics and Computational Thinking

- Use counting and numbers to identify and describe patterns in the natural and designed world(s).

Crosscutting Concepts

Patterns

- Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.

Scale, Proportion, and Quantity

- Natural objects exist from the very small to the immensely large.
- Students observe time, space, and energy phenomena at various scales using models to study systems that are too large or too small. They understand phenomena observed at one scale may not be observable at another scale.

The Nature of Science

Scientific Investigations Use a Variety of Methods

- Science investigations use a variety of methods and tools to make measurements and observations.

Brief Facilitation Guide

Download the full activity guide at www.starnetlibraries.org

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- Explain that the participants will use a scale model to explore the distances between solar system objects. Use open-ended questions and invite the participants to talk with you and each other about their prior experiences with scale models.
- Invite the participants to offer questions to the group about planets, the dwarf planets Ceres and Pluto, and asteroids in our solar system. As the participants name the different objects, ask them to choose the best representative — based on size — from the beads, salt crystals, etc. that were used to construct the solar system course.

2. Guide the participants as they explore the solar system scale model to answer their questions. Leave the "Sun" at the beginning of the course for their reference.

a. Provide the meter- or yard-stick for the children to practice jumping that length.

b. Offer the "Jump to Jupiter" poem and pencils or pens. Ask the children to count the total number of (one-meter) jumps from the Sun it takes to get to each marker. Explain that the poem has a place for them to enter each distance.

c. Suggest that the participants find information about each solar system object by reading the signs.

3. Have the participants describe what they discovered by exploring the model.

4. Remind the participants that the model isn't perfect.

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Jump To Jupiter

Hands-on STAR net

My Poem:

Poem	
I'm the one star in this special place. You'll find me in the center. Just guess my name to start this game, Then you may surely enter......	Star's Name: ___________
I orbit fast, but s l o w l y turn, With a 1,400-hour day! I'm the first. My name is _________________________,	# Jumps: ___________
Because my ghastly atmosphere is mainly CO_2, It's like a scorching greenhouse of 900 degrees. It's true! My name is _________________________, I'm yellow and the hottest, And all I can say is, "Whew!"	# Jumps: ___________
I'm glad I'm home to boys and girls, Even though I do seem "blue", I'm planet _________________________. and a little larger than Venus (that's your clue!).	# Jumps: ___________
I'm reddish-rust, with rocks and dust And a 24-hour day. I'm _________________________ and I am close in size To Mercury, I'd say!	# Jumps: ___________
I'm a band that's full of rocks and dust That travel in between the inner and outer solar system's planetary scene. And because I'm a band of asteroids, I felt, I should be called the _________________________.	# Jumps: ___________

Jump To Jupiter

My Poem:

I'm full of gas, with colorful stripes, # Jumps:
And a really enormous girth.
I am mighty ________________________ and ____________
I'm over ten times as wide as Earth!

I'm yellow and my ammonia haze # Jumps:
covers each and every thing.
I'm ________________________ and my beauty's ____________
found within my icy rings!

Methane gas colors my atmosphere blue. # Jumps:
My axis is tilted so I spin on my side.
I'm ________________________! Next to Saturn, I'm small, ____________
Compared to neighbor Neptune, I'm a little wide.

It takes me over sixty thousand days # Jumps:
to go one whole year through!
I'm the last giant planet. I'm ________________________, ____________
and just a little darker blue.

With comets and other dwarf planets # Jumps:
I orbit in an oval path
Count the miles to get to ________________________, ____________
It will take a lot of math!

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