Pocket solar system

ACTIVITY

In this activity students will:

- calculate to-scale distances between planets of our solar system
- create a physical model of our solar system
- appreciate the vast distances between planets
- consider scaling factors and measurement units

This activity is suitable for Year 2 and Year 6.

The follow-up questions are suitable for Year 2 students and extension questions for Year 6.

NOTE: Depending on the age of the students, the level of instruction may need to be adjusted. With those with developing reading skills, it may be beneficial for this to be a class activity with everyone doing each step together.

CURRICULUM LINKS

AUSTRALIAN CURRICULUM V 9

SCIENCE - Science Understanding

Year 2

- exploring representations of the solar system and identifying Earth and other planets
- creating a class model of the solar system and naming the sun and planets
- recognise Earth is a planet in the solar system and identify patterns in the changing position of the sun, moon, planets and stars in the sky

Year 6

describe the movement of Earth and other planets relative to the sun and model how Earth's tilt, rotation on its axis and revolution around the sun relate to cyclic observable phenomena, including variable day and night length (AC9S6U02)

- exploring simulations of the solar system such as a pocket solar system to appreciate the distances and relationships between the sun and planets

CURRICULUM LINKS

MATHEMATICS

Year 2

recognise and describe one-half as one of 2 equal parts of a whole and connect halves, quarters and eighths through repeated halving (AC9M2N03)

measure and compare objects based on length, capacity and mass using appropriate uniform informal units and smaller units for accuracy when necessary (AC9M2M01)

Year 6

convert between common metric units of length, mass and capacity; choose and use decimal representations of metric measurements relevant to the context of a problem (AC9M6M01)

BACKGROUND INFORMATION

Our Solar System is where we live. It contains the Sun, planets, moons, asteroids, comets and dust. It's the only solar system that we have been able to study in any close detail.

Until recently, it was believed that **all** solar systems would follow the same pattern as our own: i.e. terrestrial planets close to the star, and gas giants further out. As we study the skies with more specialised telescopes, such as the Kepler space telescope ('Kepler/K2', NASA website, https://science.nasa.gov/mission/kepler/), we find that the Universe is more diverse than this. Explore current exoplanets with NASA's online interactive ('Eyes on Exoplanets', NASA website, https://exoplanets.nasa.gov/eyes-on-exoplanets/#/).

The edge of our Solar System is not clearly agreed upon by scientists, mostly because it's not an important distinction to make. However, there are two generalised definitions that are used:

1. The Kuiper belt. It's a ring of about 100,000 small objects that are mostly made of ice that compose the last solid objects in our Solar System.

2. The heliosheath. This is the edge of the heliosphere. The heliosphere is the Sun's magnetic field.

Learn more on NASA's site: 'Where is the Edge of the Solar System?', NASA website, https://science.nasa.gov/resource/where-is-the-edge-of-the-solar-system/.

The Sun is in the middle of our Solar System, with eight planets travelling around it in giant circles. We used to say that there were nine planets, but in 2006 the International Astronomical Union created an official definition for the word 'planet'. This definition meant that Pluto could no longer be called a planet (but is still included in this activity).

BACKGROUND INFORMATION cont'd

The definition for a planet states that:

- the object must be in orbit around the Sun,
- the object must be round because its gravity pulled it into that shape, and
- it must have cleared the path of its own orbit around the Sun.

Pluto hasn't cleared its path, so it is now called a dwarf planet.

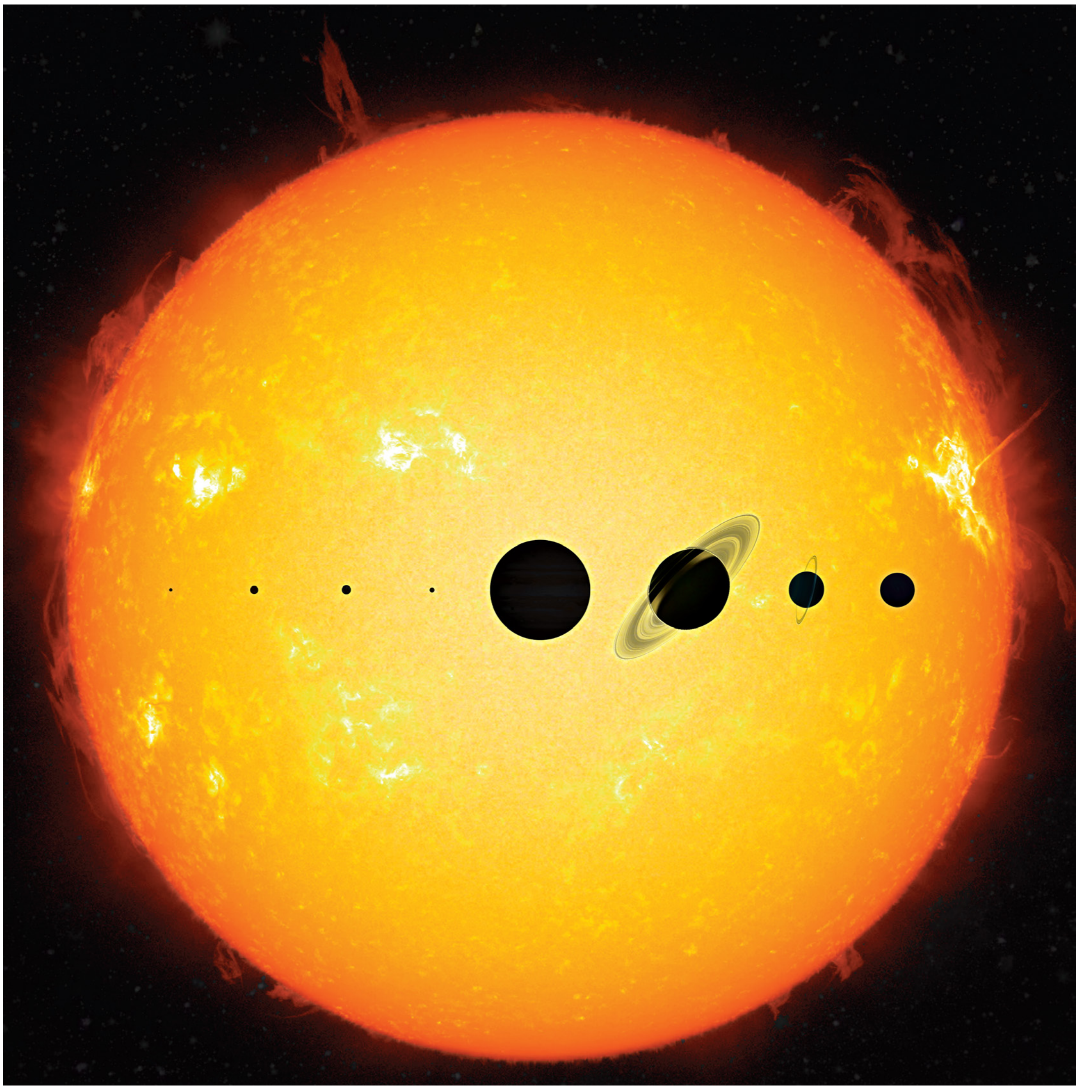
Planets are big, and yet tiny compared to the size of the Sun.

Object	Diameter (km)
Mercury	4,897
Venus	49,244
Earth	12,742
Mars	6,779
Asteroid belt	-
Jupiter	139,820
Saturn	116,460
Uranus	50,724
Neptune	49,244
Pluto	2,376

Also, the distances between the planets are huge.

Object	Distance from the Sun (km)
Mercury	60,000,000
Venus	105,000,000
Earth	150,000,000
Mars	225,000,000
Asteroid belt	420,000,000
Jupiter	780,000,000
Saturn	1,440,000,000
Uranus	2,880,000,000
Neptune	4,500,000,000
Pluto	5,925,000,000

BACKGROUND INFORMATION cont'd



This image compares the size of the Sun with each of the planets. Earth is the third one from the left.

FURTHER RESOURCES

'Modelling the Solar System in Your Backyard', ASTRO 3D Astro in the Home YouTube channel, https://youtu.be/I-XI1Osh8xs?si=21lcjEndYQv8J31w (7 min), 15 Aug 2020

'Solar System Size and Distance', Jet Propulsion Laboratory website, https://www.jpl.nasa.gov/edu/learn/video/solar-system-size-and-distance/

'Solar System Exploration', NASA website, https://science.nasa.gov/solar-system/

'NASA Space Place', NASA website, https://spaceplace.nasa.gov/menu/solar-system/

'Eyes on the solar system', NASA website with interactive app, https://eyes.nasa.gov/apps/solar-system/#/home

'Exoplanet exploration', NASA website to explore planets beyond our solar system, https://exoplanets.nasa.gov/alien-worlds/strange-new-worlds/

'How many solar systems are in our galaxy?', NASA Space Place, https://spaceplace.nasa.gov/other-solar-systems/en/

'Special: Solar System', ABC BTN episode, https://www.abc.net.au/btn/specials/solar-system-special/102554376 (18 min), 27 June 2023

All resources accessed 17/1/2024.

EQUIPMENT

Each student will need the following to complete this activity.

- A coloured print out of the Solar System and instructions
- A long strip of paper, as long as you can stretch your arms apart and about 5cm wide (cash register rolls work well).
- Scissors
- Glue stick or sticky tape
- A print out of the student workbook

SUGGESTED ANSWERS TO QUESTIONS

NOTE: This selection of questions has been prepared with a range of ages and abilities in mind. Choose which questions are most suitable to your students.

1. Sketch your solar system on another piece of paper, with the Sun on the left hand side and Pluto on the right hand side of the page. Uranus is in the middle, so it's at the half way point. Write the number for 'half' in the middle, and work out what fractions are needed for the other planet positions.

2. Is there gravity in space? Why do you think there is, or isn't? *Yes, gravity is everywhere. It's stronger nearer to large, dense objects and weaker in the spaces in between.*

3. What holds the planets in the Solar System? *The gravitational pull of the Sun. The Sun is huge, so its gravity is strong enough to reach even all the way to Pluto.*

4. Why don't the planets fly off? *In order for the planets to fly away, they would need a shove, or a force, to push them out of orbit. ('How do the planets stay in orbit around the sun?', Cool Cosmos website hosted by Caltech, https://coolcosmos.ipac.caltech.edu/ask/197-How-do-the-planets-stay-in-orbit-around-the-sun-)*

SUGGESTED ANSWERS TO QUESTIONS cont'd

5. What star is in the middle of our solar system? *The Sun*

6. Which planets can be seen without a telescope? *Venus, Mars, Jupiter, Saturn*

7. Why can't all of the planets be seen without a telescope? *Either they're too small or too far away, or in the case of Pluto, both.*

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

EXTENSION QUESTIONS

1. In reality, the distance between Pluto and the Sun is about 5.9 billion kilometres. The real diameter of Jupiter is about 140,000 km.

a) Write each of these numbers out with all of their zeros.

b) Using a calculator, work out how many Jupiters you would need to line up, side by side, to make a continuous line from the sun to Pluto. *About 42,000*

c) If you made Jupiter the correct size for your pocket solar system, how big would you make it? *Smaller than the eye could see. 1/42000th of the length of the paper.*

2. To make numbers a bit smaller and easier to manage, astronomers have invented a unit of length called an 'astronomical unit' (au). It's the distance between the Sun and the Earth.

Using a spreadsheet, calculate the distances of each of the planets from the Sun using astronomical units (au).

Object	Distance from the Sun (km)
Mercury	60,000,000
Venus	105,000,000
Earth	150,000,000
Mars	225,000,000
Asteroid belt	420,000,000
Jupiter	780,000,000
Saturn	1,440,000,000
Uranus	2,880,000,000
Neptune	4,500,000,000
Pluto	5,925,000,000

SUGGESTED ANSWERS TO QUESTIONS cont'd

If Earth's distance is equal to 1 au, then it was calculated like this:

$$\frac{150{,}000{,}000 \text{ km}}{150{,}000{,}000 \text{ km}} = 1$$

Therefore, each of the other planets' distances is calculated the same way, e.g. Mercury

$$\frac{60{,}000{,}000 \text{ km}}{150{,}000{,}000 \text{ km}} = 0.39$$

Object	Distance from the Sun (km)	Distance from the Sun (au)
Mercury	60,000,000	*0.4*
Venus	105,000,000	*0.7*
Earth	150,000,000	*1*
Mars	225,000,000	*1.5*
Asteroid belt	420,000,000	*2.8*
Jupiter	780,000,000	*5.2*
Saturn	1,440,000,000	*9.6*
Uranus	2,880,000,000	*19.2*
Neptune	4,500,000,000	*30*
Pluto	5,925,000,000	*39.5*