Into Our Skies: Space in Schools

Classroom Activity: Making an orrery.

National Curriculum Learning Outcome: To describe the movement of the Earth, and other planets, relative to the Sun in the Solar System.

Focus of this activity: Pupils will make an orrery and demonstrate their understanding of the scale of the Solar System and how the planets orbit the Sun relative to each other. This can be done in groups or as a class with each table contributing one planet.

Resources required: 4 x sheets of black sugar paper (75cm x 51cm each), 1 x cardboard box e.g., cereal boxes, 1 cocktail stick or kebab skewer, pencil/chalk, 0.5m of string, drawing pin, blu tack/play doh, name labels, planet images (optional)

Starter: Use the dance session on orbits to recap with pupils what an orbit is – the time for a planet to make one complete circle around the Sun. Do they remember the order of the different planets?

Teaching Questions:

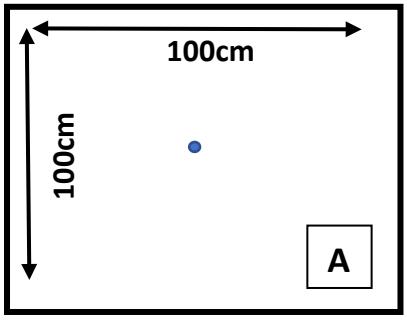
- Can they recall the order of the planets in the Solar System?
- Recap what a year is on Earth and discuss the idea that a year on another planet might be shorter or longer than on Earth.
- How are the planets spaced out in the Solar System? Are they evenly spaced or bunched up?
- How long does each planet take to orbit the Sun?

Student Activity:

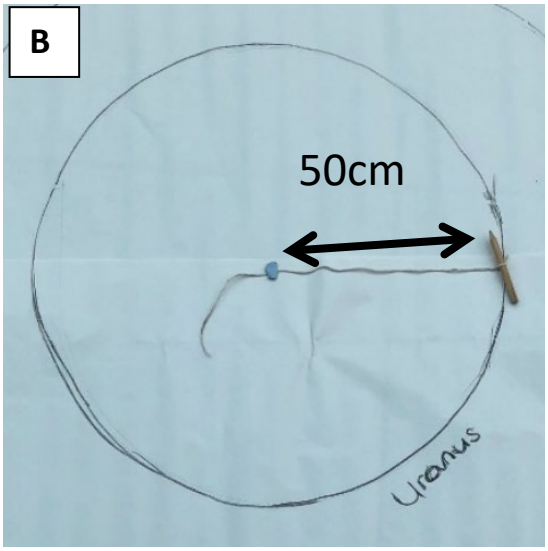
Part A: Drawing the orbits.

(Note: To make this practical possible we will not include the orbit of Neptune on our orrery. The distances for the scale are listed in Table 1 so you can add Neptune if you wish.)

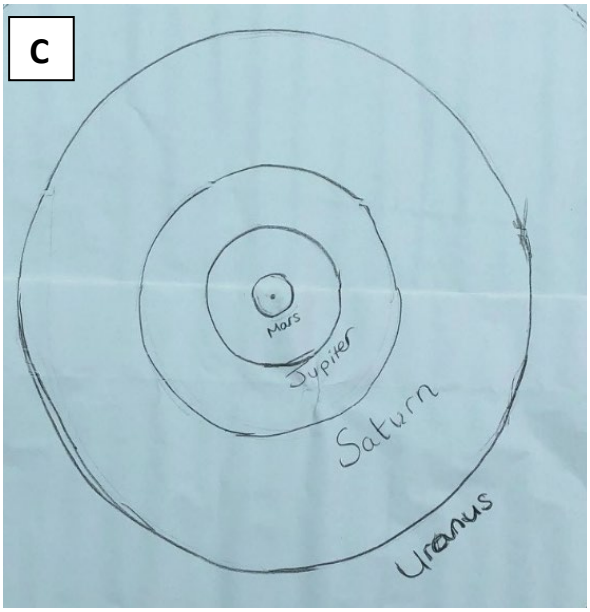
- Stick the sheets of A3 or sugar paper together to make a rough square (100cm by 100cm) and mark the centre of the paper **(see diagram A).**



- Tie one end of the string around the pencil/chalk and measure 50cm on the string.
- Secure the other end of the string to the centre of the paper using the blu tack and draw a circle on the paper **(see diagram B).** This represents the orbit of Uranus.

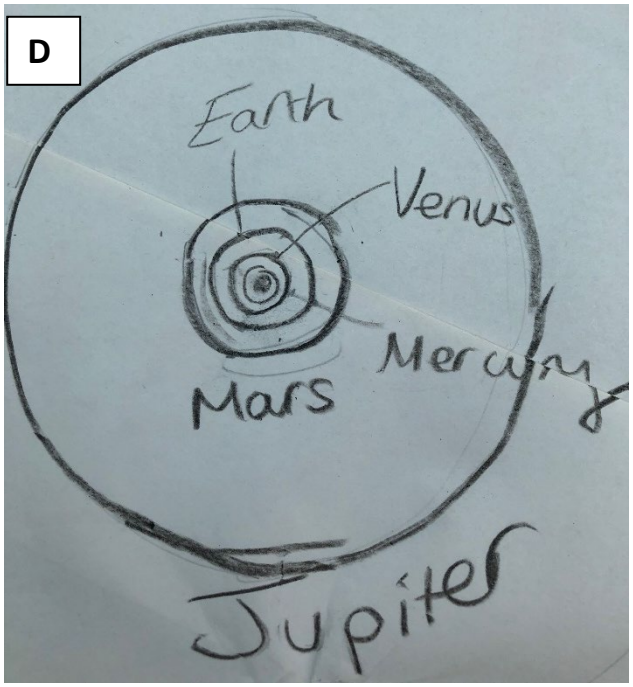


- Shorten your string to 25cm and drawn another circle inside the first one. This represents the orbit of Saturn.
- Shorten your string again to measure 13.5cm. This is the orbit of Jupiter.
- Shorten your string again to measure 3.9cm. This is the orbit of Mars around the Sun. (You should end up with something that looks like **diagram C.)**



- Don't forget in between Jupiter and Mars is the asteroid belt!

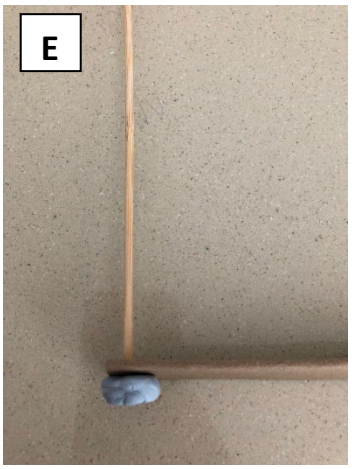
- Shorten your string again to measure 2.5cm, draw another circle inside the orbit of Mars. This is the orbit of Earth.
- It is hard to use the string now so use a ruler and measure 1.8cm from the centre of the circles on each side and join the dots with a circle by hand. This is the orbit of Venus.
- Do the same again, measuring just 1cm from the centre. This is the orbit of Mercury, the closet planet to the Sun. (You should end up with something that looks like **diagram D**.)



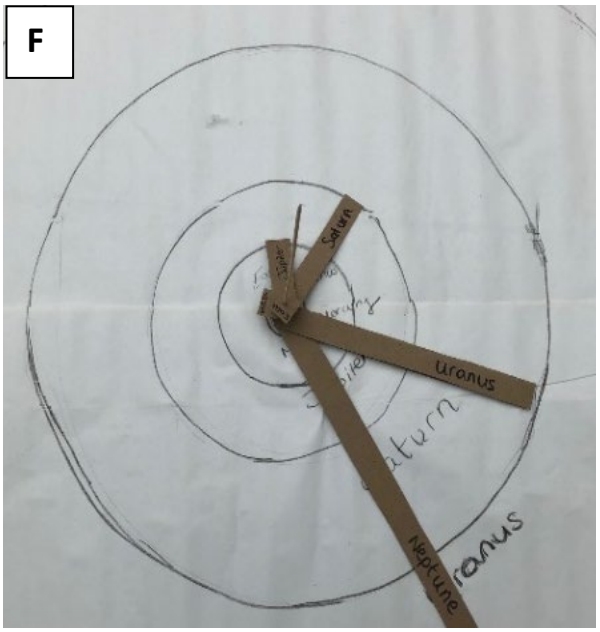
Part B: Labelling the planets.

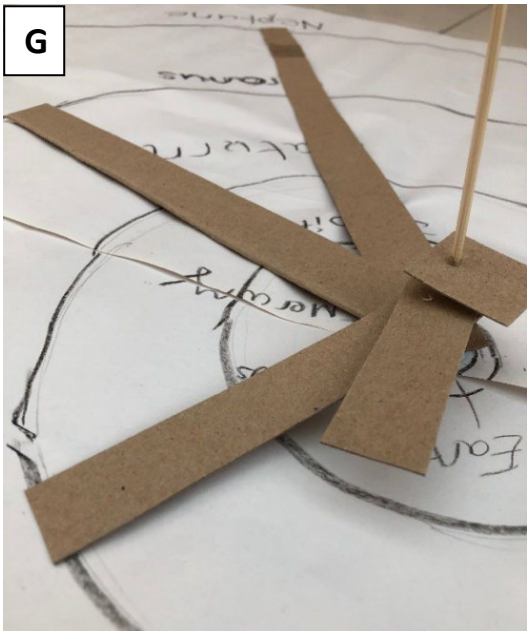
(Note: For this the cardboard needs to be slightly longer than the radius of the orbit to allow for placing onto the cocktail stick)

- Cut the cardboard (e.g., cereal box) into a strip 51cm long and 3cm wide, (you may want to do two and stick them together to add strength)
- Pierce the cardboard at one end with the cocktail stick (you may need your teacher to help here) and place the blu tack underneath to keep the cocktail stick in place (**see diagram E**). This is the orbit of Uranus.



- Cut another piece of cardboard 26cm long and 3cm wide, pierce at one end and add over the top of the cocktail stick – this is the orbit of Saturn, add it to your orrery. Repeat with cardboard 14.5cm in length. This is the orbit of Jupiter, add it to your orrery. (Your orrery should look a bit like **diagrams F and G**)





- Repeat with cardboard 4.5cm in length. This is the orbit of Mars.
- Repeat with cardboard 3.5cm in length. This is the orbit of Earth.
- Repeat with cardboard of 3cm in length. This is the orbit of Venus.
- Repeat with cardboard of 2cm in length. This is the orbit of Mercury.

(You might find the last ones a bit difficult so ask an adult for help if needed)

- On each piece of cardboard stick the planet name label (provided on page 8) or images (page 9)

Part C: Using your model.

- You should be able to move each planet in orbit around the centre (Sun).
- Use the model to show how quickly the planets orbit relative to each other. Table 2 gives the length of orbit for each planet.

Example:

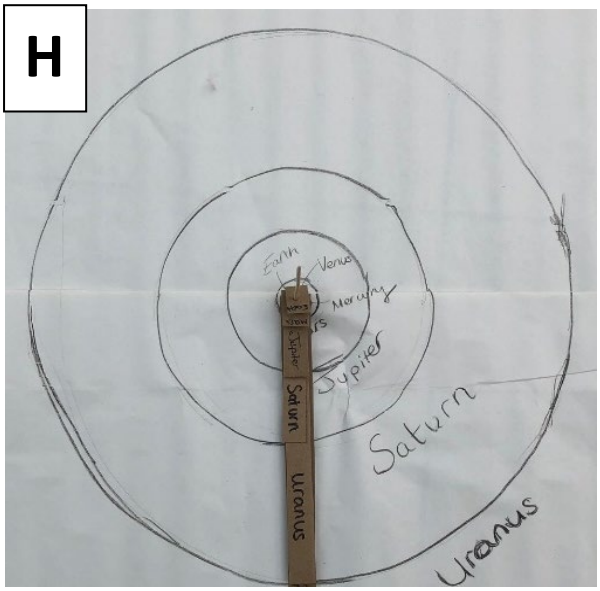
Jupiter takes 12 years to complete one orbit, Uranus takes 84 years to complete one orbit.

So, 84/12 = 7, therefore for every 1 orbit Uranus makes, Jupiter makes 7 orbits.

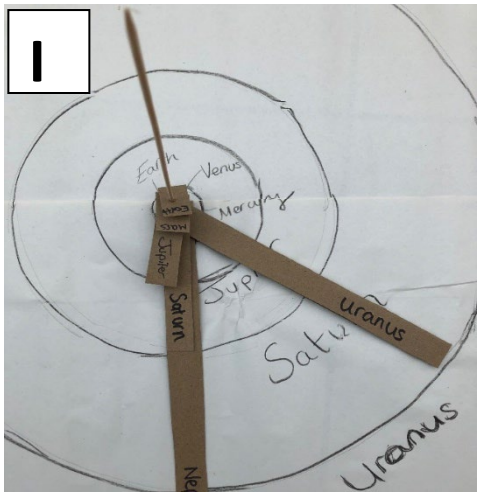
Or for every orbit Jupiter makes, Uranus has made 1/7th of an orbit.

Can pupils demonstrate this on their model? Start with all the planets aligned (**see diagram H**)

H

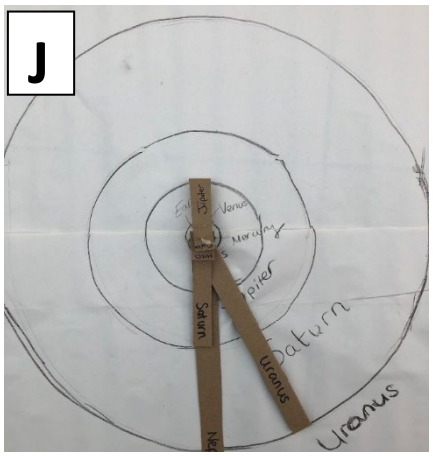


After 12 years, Jupiter is about to complete one orbit, 360 degrees. Uranus has moved about 1/7th of an orbit (1/7th x 360 = 51 degrees) (**see diagram I**)



What about after 6 years? Jupiter has done half an orbit, Uranus has moved only a bit of it's orbit. So if Jupiter has moved half an orbit or 180 degrees, Uranus has moved around (180/7) 25 degrees. (Teachers may wish to use this example as an extension to the Mathematics/Geometry topic discussing degrees in a circle)

(51/2 = 25 degrees - **see diagram J**)



Extension:

You have looked at how the planets are spaced out in the Solar System, but how big are each of the planets in the Solar System? How many Jupiter's could you fit across the Sun? How many Earths could you fit across Jupiter?

Additional Links:

Scale of the Solar System using a string: https://www.wesharethesamemoon.org/?p=1919

Scale of the planets using fruit:
https://www.stem.org.uk/resources/elibrary/resource/31649/fruit-solar-system

Table 1: Orbit Scale: Table of the length of a year on each planet.

(Here the scale is 1 Astronomical Unit = 1.4cm but you can change this if you decide to use a different paper size. 1 Astronomical Unit is 150 million km.)

Planet	Orbit Diameter (AU)	Scale radius (cm)
Mercury	0.4	1
Venus	0.7	1.8
Earth	1	2.6
Mars	1.5	4
Jupiter	5.2	13.5
Saturn	9.5	25
Uranus	19.2	50
Neptune*	30.1	78

*Note we have not included Neptune in order to be able to look at the inner planets, but you can add it if your paper is large enough.

Table 2: Orbit Length: Table of the length of a year on each planet

Planet	Orbit Length (Earth years)
Mercury	0.24 years
Venus	0.6 years
Earth	1 year
Mars	1.9 years
Jupiter	12 years
Saturn	29 years
Uranus	84 years
Neptune	165 years

Name Labels:

Use these name labels to mark where each planet would be on your orrery.

Alternatively, you could use the images of planets on the next page (from https://education.nationalgeographic.org/resource/planet-sizes/) which gives you the size of the planets relative to each other.

Mercury

Earth

Venus

Mars

Saturn

Jupiter

Uranus

Sun

Neptune