The Scale of the Solar System

Introduction

In this exercise we are going to try to demonstrate how big the solar system actually is, and how far away the planets are from each other. This involves numbers far too big for most adults (let alone children) to grasp. To demonstrate the distances we will shrink the solar system down to a size that will fit in the classroom.

Background

The solar system contains lots of objects that move around (or orbit) the Sun. The Sun is a star just like all the other ones you can see in the sky. The planets are divided into two groups called the inner planets and the outer planets. The inner planets are made (mostly) of rock and are small. The outer planets (other than Pluto) are gas-giants since they are very big and made mostly of gas although they have a solid core (centre).

The Inner Planets

- The closest planet to the Sun is Mercury. It is small and has no moons.
- The next is Venus; it is very hot because of the 'greenhouse effect' where the Sun heats the carbon dioxide (CO_2) atmosphere to over 450C. This would melt lead and is almost twice as hot as the highest household oven setting (gas mark 9 is 240C).
- The next is called Earth and is where we live, it has one moon.
- The next planet is called Mars and is red. Mars has two small moons called Phobos and Diemos.

The Outer Planets

- The first is the biggest and called Jupiter. It weighs more than twice as much as all of the other planets added together. Jupiter is famous for its Great Red Spot. It has 63 moons, the four largest are called Io, Europa, Ganymede and Callisto.
- The next planet is Saturn. It is the second largest and is famous for its rings. The rings are made of grains of rock and dust. Saturn has 31 moons, the biggest of which is Titan.
- The next are Uranus and then Neptune. These are quite similar to each other. They both have rings but these are very faint compared to Saturn. Uranus has 27 moons and Neptune has 13.
- Finally and on its own is Pluto which is a rocky planet with a moon called Charon. Pluto is smaller than our Moon.

Exercise 1: Distance to the Planets

Let's try to use a 30cm ruler to work out where the inner planets are. We will do this by imagining the Sun to be at one end of the ruler at 0cm and Mars at the other end at 30cm.
This is about the length of an A4 sheet of paper (29.7cm).

On this scale,
zMercury is 7.6cm away from the Sun.
- Venus is 14.2cm, and
- Earth is at 19.7cm.

Class Discussion
Having shrunk the solar system down so that the distance between the Sun and Mars is 30cm, how far away do you think the next planet (Jupiter) will be? What about the last (Pluto)?

- The next planet is Jupiter. On the same scale, it is over a metre away from the Sun (actually 102.5cm).
- Saturn is nearly two metres away (188cm).
- Uranus is nearly four metres (378cm).
- Neptune is nearly six metres (592cm).
- Finally, Pluto is nearly eight metres away (778cm).

Class Discussion
The nearest star to our Sun is called Alpha Centauri. On the same scale, how far do they think it is away? It would actually lie 53km away. This is about the distance from Manchester to Liverpool. The children could think about this distance on a map of the UK.

Symbols and Mnemonics

Each of the major objects in the Solar System has a symbol:

These are (from left to right) The Sun, Mercury, Venus, Earth, The Moon, Mars, Jupiter, Saturn, Uranus, Neptune, & Pluto.

If you take the first letter of the planets (MVEMJSUNP) you can make a new sentence to help you remember the order, like these 'mnemonics'...

My Very Excellent Mother Just Sent Us New Pies.

Mr. Vincent Eats Many Juicy Strawberries Under Nice Plants.

Exercise 2: Size of the Planets

Using your 30cm ruler again; we are going to shrink the planets so that the biggest planet (Jupiter) has a diameter of 30cm.

Class Discussion
How big do you think Earth and the other planets will be on this scale?

The Outer Planets

- Saturn would have a diameter of 25cm.
- Uranus and Neptune are very similar in size with Uranus being 10cm and Neptune 9.8cm.
- We will ignore Pluto for a while.

The Inner Planets

- Earth is the biggest of these but is only 2.7cm across!
- Venus is nearly the same size at 2.6cm.
- Mars is only 1.5cm and Mercury only 1cm.

Finally Pluto is only **half a centimetre** across.

Class Discussion
On this scale how big do you think the Sun will be? It may be surprising that, using this scale, the diameter of the Sun is 3 metres!

Star Facts & Data

Some of the biggest stars are called Red Giants. One of the famous Red Giant stars is called Betelgeuse (often called Beetle Juice). This is the top left star in the constellation Orion. On this scale Betelgeuse is over a kilometre (1120 metres) in diameter!

The smallest stars are called Neutron Stars (they are the remnants of a supernova explosion). These stars are only about 20 kilometres across in real-life but are very, very heavy. On this scale they would be barely a pin prick (0.04mm).

	Distance from Sun (million km)	Diameter (km)
Sun	------	1391900
Mercury	58	4866
Venus	108	12106
Earth	150	12742
Mars	228	6760
Jupiter	778	139516
Saturn	1427	116438
Uranus	2870	46940
Neptune	4500	45432
Pluto	913	2274
Alpha Centauri	40396400	------
Betelgeuse	------	521962500