

Lesson Plan

NEUROHEADWAY

Neuroscience Into Education

The Solar System

Lesson One

Overview of the solar system + introduction to the Sun

Teachers' Notes

Slide 1

Title Slide

Slide 2-5

Explain to the pupils that this is quick overview and we will come back to all these points in much more detail in the coming lessons.

NOTE: in all the images on slides 4 to 6, the relative size of the planets are to scale. So for example on slide 4, this is the real relative size of the four rocky planets to each other.

Explain the four main components that make up the solar system:

1. The Sun, a huge burning ball of gas that the entire solar system revolves around. This provides heat, light, and is the reason for life on Earth today.
2. The Rocky Planets – Mercury, Venus, Earth and Mars. They are composed of rock and ice. They are the most similar to Earth, however Mercury and Venus are scorching hot. Mars is the only planet that humankind *could* conceivably visit in our lifetime. But it is by no means certain that humans will do this before 2050.
3. The Gas Giants and the Ice Giants – Jupiter, Saturn, Uranus and Neptune. Jupiter and Saturn are massive planets are made up mostly of hydrogen and helium gas (so they are called Gas giants). Uranus and Neptune are mostly methane and ammonia gas, but scientists use the word "ice" for these two gases (hence we call them "ice giants" – we'll come back to this point). Humans couldn't walk on the surface. There is very little chance they could harbour life but due to their immense size, they have many moons. Some of these moons are potential habitats for life elsewhere in the solar system (*Jupiter's Europa and Saturn's Titan for example*).
4. The Dwarf Planets. These are relatively new discoveries, and haven't been taught much in most schools, but they are a very interesting subject and there are lots of facts about them coming up in the lessons. Explain that Pluto used to be officially called a planet but was demoted to dwarf planet when other bodies around the same size as it were discovered. Most dwarf planets exist beyond Neptune, in the *Kuiper Belt* (pronounced ky-per), but there is one, Ceres, that sits between Mars and Jupiter.

Slide 6: Solar system mnemonics

1. See if the pupils already know some mnemonics to remember the order of the planets in the solar system. Teach one, or both, of the mnemonics that are on the slide or even your own if you already have one that you prefer to use.
2. Make a point that Pluto is not included anymore, and tell a story of some angry astronomers who made their own mnemonics in protest of Pluto's demotion:
 - **My Very Easy Memory Jingle Seems Useful Naming Planets**
 - **My Very Easy Memory Jingle Seems Useless Now**

Slide 7: Activity

Worksheet "Lesson 1 Worksheet1a"

Basic activity: fill in the names, and colour the planets.

Bonus activity: make up your own solar system mnemonic.

Extra activity for capable pupils: find out how many moons each of the planets have and draw the right number (little dots or coloured circles) around each planet (they could do internet search). We're still finding little moons around the gas and ice giants, but the current count is

Planet	Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune
Number of moons	0	0	1	2	79	62	27	14

Very strangely, the little dwarf planets have moons! We'll come back to this.

Extra activity for gifted and talented pupils: "Lesson 1 worksheet G&T pupils". The first page is designed so that you can hand it out straight to the pupils, and you can instruct them to do either option on the sheet. The second page is a table to help you guide them if they have questions (but don't give them that information yet, make them work it out first).

Slide 8: The Sun

- The Sun is a burning ball of hydrogen and helium, about 15 million °C at its core.
- It makes up 99.86% of the mass of our solar system, with most of the remaining 0.14% made up by the two gas giants Jupiter and Saturn. *(Explain that mass is a measure of the amount of matter inside an object. Kind of like weight except the weight of an object is affected by how much gravity is being exerted on it).*
- You could fit 1.3 million Earths inside the Sun.
- Just as we rotate around the Sun, the Sun orbits the centre of our own galaxy which is called **The Milky Way**.

Slide 9

Explain that the Sun, despite its enormous size, is really only an average-sized star. The image shows the sun compared to relatively common large star (Arcturus, a red giant)

Slide 10: Solar Flares and "The Carrington Event"

- Solar flares are huge bursts of magnetic energy from the sun, that occur during **magnetic storms on the Sun.**
- Solar flares can affect Earth's magnetic field because particles from the flare reach the Earth's atmosphere.
- The largest solar flare that was felt on Earth was in 1859. Known as the **Carrington Event**, this geomagnetic storm produced Auroras¹ around the world. Those over the Rocky Mountains in the U.S. were so bright that the glow woke gold miners, who began preparing breakfast because they thought it was morning.
- Telegraph systems failed. Some operators received electric shocks and others told of how they could still send and receive messages despite being disconnected from their power supplies.

Slide 11

Hand out "Lesson 1 Worksheet 1b".

Answer the multiple choice questions. Answers in "Lesson 1 Worksheet1b Answers.pdf"

Extra activity for gifted and talented pupils: continue with "Lesson 1 worksheet G&T students", since that will take much longer than the time for Worksheet 1a above.

Power point Example

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MAKEUP OF THE SOLAR SYSTEM

Our solar system is made up of:

- The Sun
- 4 rocky planets (including the Earth)
- 4 gas and ice giants
- At least 5 known dwarf planets, though there could be as many as 200

ROCKY PLANETS

The four innermost planets of our solar system are made up of ice and rock.
Our planet, Earth, is the largest of them.



NASA/Lunar and Planetary Institute

THE GAS GIANTS AND THE ICE GIANTS

Jupiter and Saturn are the Gas Giants mostly made of hydrogen and helium gas with a rocky or metallic core.



NASA/Juno and Planetary Institute

Uranus and Neptune are also made of gas with a rocky core. They are called the Ice Giants as the gas is mostly very cold methane and ammonia

DWARF PLANETS

There are lots of small celestial bodies in our solar system, too small to be classified as planets.

These are called **Dwarf Planets**.

We'll learn a lot more about these strange objects in future lessons.



ERIS

PLUTO

HAUMEA

MAKEMAKE

CERES

Teachers Evaluation and Handouts

The Solar System

Lesson One

Lesson 1 – Extra Advanced activity for gifted and talented students

Here are the sizes of the planets. These values are the radius of each of the planets in kilometres (all rounded to 2 significant figures)

- Jupiter 70,000 km
- Saturn 58,000 km
- Urans 26,000 km
- Neptune 25,000 km
- Earth 6400 km
- Venus 6000 km
- Mars 3400 km
- Mercury 2400 km

Option 1

Make a drawing of each of the planets to scale to show their difference sizes. You can paint, colour and bring the planets to life to make a wall display.

For example, start with an A3 sheet of paper and make a circular Jupiter with a diameter of 28 cm (or radius 14 cm). You can do this with a drawing pin, a pencil and string with length of the radius of the circle.

Now work out what the relative size of the planets of the other planets are compared with Jupiter. Draw them on this sheet or make them from other sheets of paper (you'll need to work out what paper size you need) and compare their sizes.

Aim to make a montage for wall display.

Hint and tip – if Jupiter has a diameter of 28cm, then relatively speaking, Mercury will be tiny! But how big exactly is down to you to work out.

Option 2

Instead of making a drawing/painting of the planets, identify objects that have the correct relative size to make a model solar system.

Examples could be to combine balls (core-exercise ball, beach ball, basketball, tennis balls, ping pong balls) with fruit (oranges, mandarins, grapes, blueberries) or anything else you can find that is (roughly) spherical. Start with the biggest spherical object you can lay your hands on and work down. You

might want to identify the things first and make a list with what you think their sizes are, then collect them from around the School (or home for next day) and see how close you can get.

Teacher's notes

Here are the sizes they should be aiming at if they make Jupiter on an A3 sheet with 14cm radius

Planet	Actual size (radius)	Relative radius in cm (if Jupiter is set at a radius of 14 cm to fit on an A3 sheet)
Jupiter	70,000 km	14.0
Saturn	58,000 km	11.6
Uranus	26,000 km	5.2
Neptune	25,000 km	5.0
Earth	6400 km	1.3
Venus	6000 km	1.2
Mars	3400 km	0.7
Mercury	2400 km	0.5

And if you just want the relative sizes, where Jupiter is 100% then here you go

Planet	Actual size (radius)	Relative size (Jupiter = 100%)
Jupiter	70,000 km	100%
Saturn	58,000 km	83%
Uranus	26,000 km	37%
Neptune	25,000 km	36%
Earth	6400 km	9%
Venus	6000 km	8.6%
Mars	3400 km	5%
Mercury	2400 km	3%