Lesson Plan

NEUROHEADWAY

Neuroscience Into Education

Outer Planets

Lesson Three

Slide 1

Title Slide

Slide 2

Recap the order of the planets and their relative sizes (from Lesson 1)

Slide 3 - The Gas Giants & The Ice Giants

Introduce Jupiter, Saturn, Uranus and Neptune.

- These planets are huge, far bigger than Earth, and are completely inhospitable. The earth is shown to scale (Jupiter's diameter is 11 times larger than Earth's).
- Jupiter and Saturn are made mostly of hydrogen and helium gases, with hard inner cores. They are therefore called the gas giants.
- Planetary scientists use the word "ice" to mean compounds like water, ammonia and methane. At the temperatures in the outer planets (below -100^{o}C) these are in ice crystal form, rather than being in gas form.
- Uranus and Neptune are also mostly made of hydrogen and helium gas. But they have a little more of these "ices". Therefore to distinguish them, they are often refered to as the "ice" giants.
- Due to their enormous size, they have many interesting moons, some close to the size of Earth, that are potential hosts for life elsewhere in the solar system.

Slide 4 - Jupiter

- Stress how **huge** Jupiter is – twice as large as all of the other planets in the solar system combined.
- It has 79 catalogued moons, and we are still discovering them (10 discovered in 2017-2018). There are probably many more small bodies in orbit around the planet.
- One of Jupiter's moons, Europa, is one of the most promising potential habitats for life elsewhere in our solar system. It is believed to have a salt water ocean under its icy shell, which could be a host to some form of aquatic life.

Slide 5 - The Great Red Spot

- A huge storm that has been raging on Jupiter for almost 350 years
- The strongest hurricane ever recorded on Earth reached wind speeds of 200 mph. The Great Red Spot blows this away with speeds of 384 mph.
- However, it may not be around for much longer, it has been shrinking over the past 50-100 years. By 2040 it could have shrunk to a circular shaped could feature, similar to others we see on the surface. And therefore no longer deserving of the name "the great red spot".

Slide 6 - Saturn

- The second largest planet in the solar system. Saturn is known for its distinct rings, that are made of chunks of ice and rock varying in size from dust particles to objects the size of mountains.
- Saturn has at least 62 Moons. This number may go up to over 150 as more moons and 'moonlets' are classified. Some of these moons are bigger than planets. Titan is larger than Mercury for example.
- Like Jupiter, it also has a huge raging storm – right on its North pole, you can see this hexagonal shaped vortex.

Slide 7 - Saturn's Rings

- Saturn's rings are composed mainly of water ice, which is why they're so bright: they reflect The Sun's rays very well.
- *Bottom Right:* Computer generated image of what it would be like to stand on Saturn's rings.
- While Saturn's rings are the biggest and brightest, the other three giant planets (Jupiter, Neptune and Uranus) also have smaller rings that are hard to see. They are much dimmer than Saturn's rings but have been detected with large telescopes and by space craft.

Slide 8 - Activity

Lesson 3 Worksheet 1.pdf – find the 10 largest moons in the solar system in the word search grid. They are listed from biggest to smallest.

Extra activity for gifted and able students – a harder worksheet, with the largest 15 moons in the grid. The grid is 15 x 15 letters, rather than the 10 x 10 above.

Lesson 3 Worksheet1 G&T.pdf

Slide 8 - Uranus

- Uranus is tilted nearly 90 degrees on its axis, which you can see from its faint rings which orbit the planet vertically.
- This is most likely due to a collision with another planet-sized body early in its formation.
- It is one of the two "**Ice Giants"**. So called because it has a higher content of water, ammonia and methane than Jupiter or Saturn.
- Remember that those three substances (water, ammonia and methane) are common because they are made up simply of hydrogen, carbon, nitrogen and oxygen (which are 4 of the five most abundant elements in the Universe, the other being helium).
- It is still mostly hydrogen and helium, with about 2-3% in those ices. With a surface temperature of -200 ^{o}C, the water, ammonia and methane will be a mix of ice crystals and gas.
- The methane gives it the blue colour.

Slide 9 - Miranda

- Uranus's closest and smallest moon, Miranda has been carved up by a series of bizarre canyons.
- It has the highest cliff in the solar system, Verona Rupes, standing at 20km.

Slide 10 – Neptune

- The existence of Neptune was *predicted* by two mathematicians before it was physically observed.
- The mathematicians, in Cambridge and Paris, both calculated the planet's existence due to its gravitational effect on the orbit of its neighbour, Uranus.
- Luckily since the French Professor had an astronomer friend with a telescope who could confirm the planet's existence, he got all the credit. This lead to disputes between the two countries over who discovered it!
- Its surface is a thick soup of water, methane and ammonia.

Teachers Evaluation and Handouts

Outer Planets

Lesson Three Worksheet 1 – find the largest moons in the solar system

C N O T I R T E N N
W A Q Z Y F U O T A
N M L H Y R O B I T
U O W L O M W K T I
Q C R P I B J G A T
W E A E B S H T N R
R H E A B E T I I Q
K H Q F M O Y O A F
B N L B T Y O P N R
G A N Y M E D E R Q

This word search contains the names of the 10 largest moons in the solar system. They are in the table below, together with their host planet and their diameter in kilometres. Find them in the word search above and colour code them using a different colour to group together all the moons that belong to the same host planet.

Moon name	Host Planet	Diameter (kilometres)
Ganymede	Jupiter	5268
Titan	Saturn	5150
Callisto	Jupiter	4816
Io	Jupiter	3636
Moon	Earth	3474

Europa	Jupiter	3120
Triton	Neptune	2707
Titania	Uranus	1580
Rhea	Saturn	1528
Oberon	Uranus	1522