

Lesson Plan

NEUROHEADWAY

Neuroscience Into Education

The Solar System

Lesson Five

Asteroids, Comets and Meteors

Teachers' Notes

Slide 1: Title Slide

Slide 2: Introduction Asteroids, comets and meteors

The use of these three terms can be a little confusing, particular when also using the term meteorite. Here are the differences

- Asteroid – used for “big” chunks of rock orbiting the Sun.
- Meteoroid – a very “small” asteroid or little chunk of rock that is orbiting the Sun, but comes close to earth and enters the earth's atmosphere
- Meteor – the streak or flash of light that happens when a meteoroid burns up in the atmosphere. All meteors are caused by meteoroids, and these meteoroids can be the size of a pea ! Meteors are also called “shooting stars”
- Meteorite – if part of the meteoroid survives the burn up in the atmosphere and hits the ground, then that piece of rock is called a meteorite.
- Comet – similar to asteroids. They are ice and rock, but they are made up of a lot more ice than rock compared to asteroids

Of course, very big asteroids (and comets) could hit the earth. Meteors, meteoroids and meteorites are terms usually reserved for little pieces (less than a few 10s of metres, and usually much smaller)

We will learn about these different sizes and compositions in this lesson.

Slide 3: Asteroids

- Slide text should be easy to follow
- It's difficult to count the number of asteroids in the solar system. We are limited to finding only the bigger ones far away, the asteroid belt for example. Or the smallest when they happen to come close to the earth. We call the objects that come close to the earth “near earth objects” (or NEOs)
- That's why we say “billions” in this slide. The total number is not known. See Slide 6 for numbers in the asteroid belt.

Slide 4: Biggest Asteroids

- Recall that Ceres is now called a dwarf Planet. It lies in the asteroid belt and up to 2008, it was called an asteroid and it was the biggest of them all
- Now that Ceres is defined as a dwarf Planet, that leaves Vesta as the largest known asteroid in our solar system
- Here are Ceres, Vesta, the Moon and Earth all shown to scale.
- Highlight the fact that Vesta is very small, in comparison to the Moon even though is the biggest asteroid.

- The activity coming up with reinforce the size

Slide 5: The asteroid belt

- The image on the left is not to scale – it is just highlighting that the asteroid belt is located between Mars and Jupiter
- Most, but not all, asteroids in our solar system are in the asteroid belt. It is also often called the “main belt”.

Slide 6 and 7: Activity

Lesson5-Worksheet1-DrawVesta.pdf

This activity gets the pupils to think of the size of the largest asteroid Vesta, its dimensions and shape.

Give them the sheet, and ask them to draw the asteroid (keep the image and activity slide displayed for them) over the light outline map of the UK and Ireland. If they get the dimensions right they will see exactly how big Vesta is in comparison.

There is a check box table at the end – to get them to think carefully about an accurate representation, get then pupils to tick off the details that they have included in the drawing. This should prevent them just from drawing a blob and saying, finished!

Suggestion for Gifted and Talented students: if they do the Vesta drawing quickly. Get them to go and research what the second biggest asteroid is and do the same on this sheet. Draw it in comparison so that they have now two examples of the biggest. The answer is Pallas and the Wikipedia page is a good source of information.

https://en.wikipedia.org/wiki/2_Pallas

Slide 8: Comets

- The image on the right is Comet Lovejoy. So called because it was discovered by Australian amateur astronomer Terry Lovejoy.
- It was taken by astronaut Dan Burbank in 2011 when he was aboard the International Space Station
- Comets are similar to asteroids but they just have a lot more ice and less rock and metal. The ices are mostly water and carbon monoxide.
- We'll see the surface of a comet coming up in Slide 11.

Slide 9: Periodic and non-periodic comets

- Periodic comets have a regular orbit around the Sun, and can sometimes be seen from Earth.
- The most famous example is Halley's comet, which returns to Earth every 75 years. The last time we saw it was in 1986, which means it will come around once again in 2061.
- Non-Periodic comets are those that have either only passed through our solar system once, or may take over 200 Earth years to orbit the sun.

Slide 10 – Rosetta spacecraft and the Philae Lander

The European Space Agency launched what is probably the most famous mission to a comet or asteroid. In 2014, the Rosetta spacecraft reached the comet called “Comet 67P/Churyumov-Gerasimenko”.

The name is a bit of a mouthful, it is named after the two Ukrainian-Kazakh discoverers. Astronomers often just refer to it as “comet 67P”.

As well as taking close-up pictures of 67P, the spacecraft launched a lander called Philae to land on the surface. That was partly successful – it did land, and send back some pictures but the landing didn't go as smoothly as hoped and Philae was in an awkward place for both taking images and sending back data to earth.

Slide 11, 12 and 13 – Meteors, meteorites and impacts with the earth

The vast majority of meteoroids are tiny, pea sized pieces of rock that burn up in the atmosphere and are visible as meteors (or “shooting stars”).

At certain times of the year, the earth's orbit passes a region in space that is made up of left over bits of a comet that has broken up. This causes a higher rate of meteors or “meteor showers”. The most well known is the Geminid meteor shower of the 12th August each year.

Large meteorites have fallen to earth, and have been found all around the globe. They are easier to find in desert regions, rather than in areas of vegetation, for obvious reasons – easier to spot ! Meteorites range in size from a few centimetres up to the largest known which is 2.7m – see the image of the Hoba meteorite in this picture on slide 13.

Slide 14 – The weird object Oumumua

Pronounced “o -mua -mua” – which is the Hawaiian language name for “first distant messenger”. This was found by a Hawaiian telescope (called Pan-STARRS) in 2017, so it is a very recent addition to our understanding of the solar system.

Two things are very strange about this object. First, when it was tracked across the sky, astronomers were able to show that it could not be on an orbit around the sun and that it had come into our solar system from outside. It was moving so fast that the Sun's gravity could not trap it and left the solar system as quickly as it arrived.

Secondly, it has a very strange shape, very unlike the known asteroids in our solar system. It is shaped more like a long cigar. We know this, because it changed brightness rapidly, which means it was tumbling and reflecting different amounts of sunlight. This is an artist's impression of what it most likely looked like.

Scientists pointed many telescopes at it, as it passed through our solar system. Some serious scientists proposed that it could be an artificial alien body. There were no radio signals detected from the object.

Power point Example

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ASTERIODS, COMETS, AND METEORS

These three celestial objects are all similar, but with distinct differences.

- **Asteroids** are chunks of rock orbiting the sun
- **Comets** are made of ice and rock, and may or may not be in orbit around the sun
- **Meteors** are small things like pieces of asteroids, comets or other space debris that fall to earth. They usually burn up in the atmosphere
- Large asteroids and comets have hit the earth in the past - and very likely such a massive collision killed off the dinosaurs

ASTERIODS

- An asteroid is a small rocky body in orbit around the Sun.
- Most of them occupy the space between Mars and Jupiter.
- There are *billions* of asteroids floating around in our solar system. They are the leftover material of the planets and moons when they were forming in the early years of the solar system, 4.5 billion years ago.



NAS, Caltech, University of California, Max Planck Society, DLR

This is Vesta – the largest asteroid in our solar system. The image was taken by NASA's Dawn spacecraft in 2012

BIGGEST ASTEROIDS

- Ceres is classified as both a dwarf planet and an asteroid. It is the largest body in the asteroid belt, with the 2nd being Vesta.
- Here you can see the comparison in size. Ceres is even smaller than our moon, and Vesta slightly smaller than that.



THE ASTEROID BELT



- Most of the asteroids in our solar system are located in the asteroid belt between Mars and Jupiter. There are over 1 million asteroids bigger than about 1 km.
- The abundance of useful metals and water make asteroids an attractive target for mining operations in the future, when we begin to colonise outer space. Companies have already announced future plans for mining on asteroids, but the biggest challenge is developing affordable spaceflight technology.

ACTIVITY

- Draw Vesta on the worksheet with the outline of Great Britain and Ireland
- Try to get it roughly to scale to show you how big it is
- The three big craters near the top left are called the "snowman" because of their shape
- The "mountain" at the bottom of the asteroid is more than twice the height of Mount Everest!



ACTIVITY

- This is a "true color" photograph of Vesta.
- It was also taken by NASA's Dawn spacecraft
- It gives you an idea what the colour is really like
- Why do you think the Snowman is not visible in this image ?

