PROFESSOR SMARTT'S GUIDE TO THE UNIVERSE

Presented by smartt science

Photo: NASA/Wikimedia commons

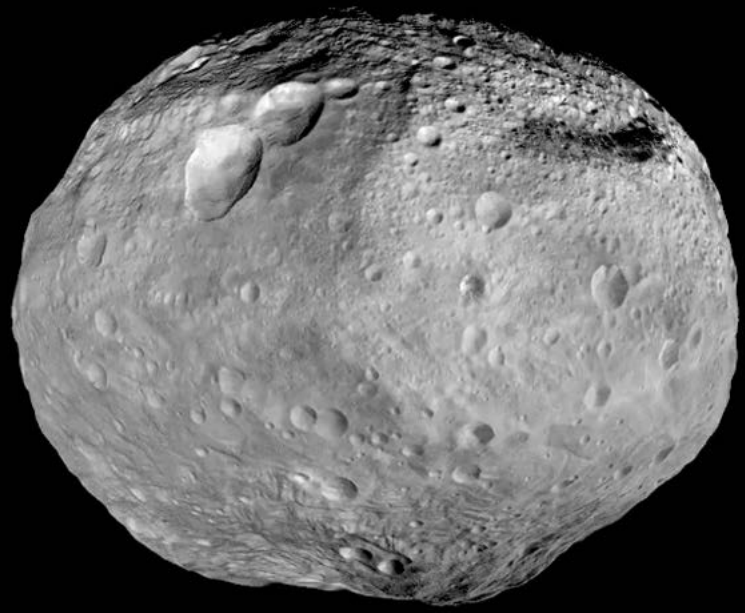
ASTEROIDS, COMETS AND METEORS

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 it is very likely that such a massive collision killed off the dinosaurs.

ASTEROIDS

- 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

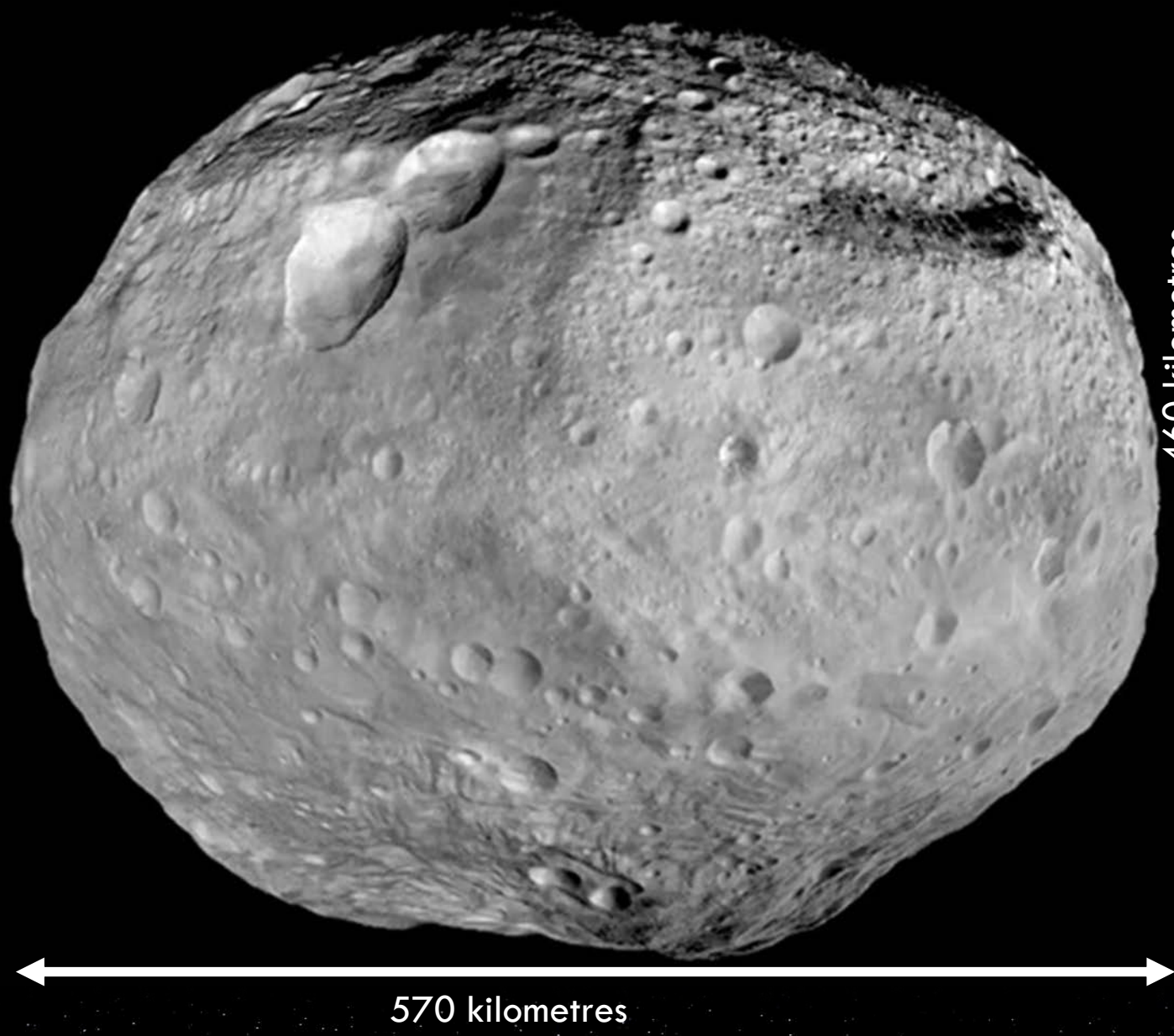
- Ceres is classified as both a dwarf planet and an asteroid. It is the largest body in the asteroid belt, with the second largest being Vesta.
- Here you can see the comparison in size. Ceres is even smaller than our Moon and Vesta is slightly smaller than Ceres.

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 1km across.
- The abundance of useful metals and water make asteroids an attractive target for mining operations in the future, when we will 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!



Draw the asteroid Vesta to scale compared with the size of Great Britain and Ireland.

The distance from the very north of Scotland (John O'Groats) to the southernmost tip of England (Land's End) is 968 kilometres. These two places are marked with dots.

Make sure you get all these details in and tick the box when you complete each task.

The correct size compared to the map of the Great Britain and Ireland		The correct shape	
The Snowman		All other big craters	
The Big Mountain		Colour – what colour do you think it might be?	

ACTIVITY

- This is a “true colour” 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?

COMETS

- Comets are similar to asteroids. They too are rocky but they have much more ice.
- A good description of them is a “dirty iceball” or “icey dirtball”.
- They also have elliptical (oval-shaped) orbits.
- Whenever they are closer to the Sun, the ice on the surface begins to fizzle and evaporate creating a long tail.
- A comet will lose mass over its lifetime. If it orbits the Sun too many times, or gets too close, it will all melt away.

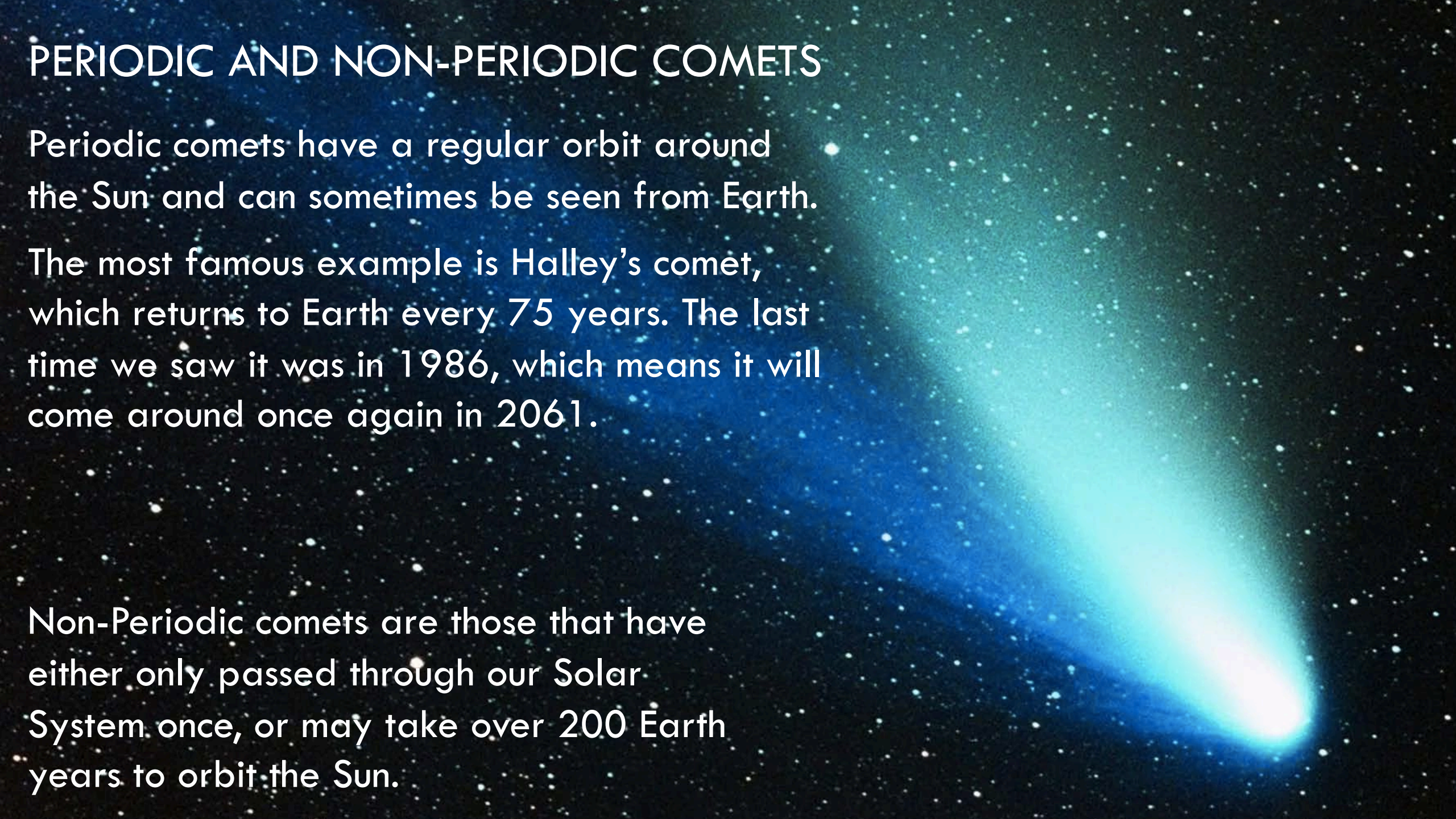
NASA/Dan Burbank

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.

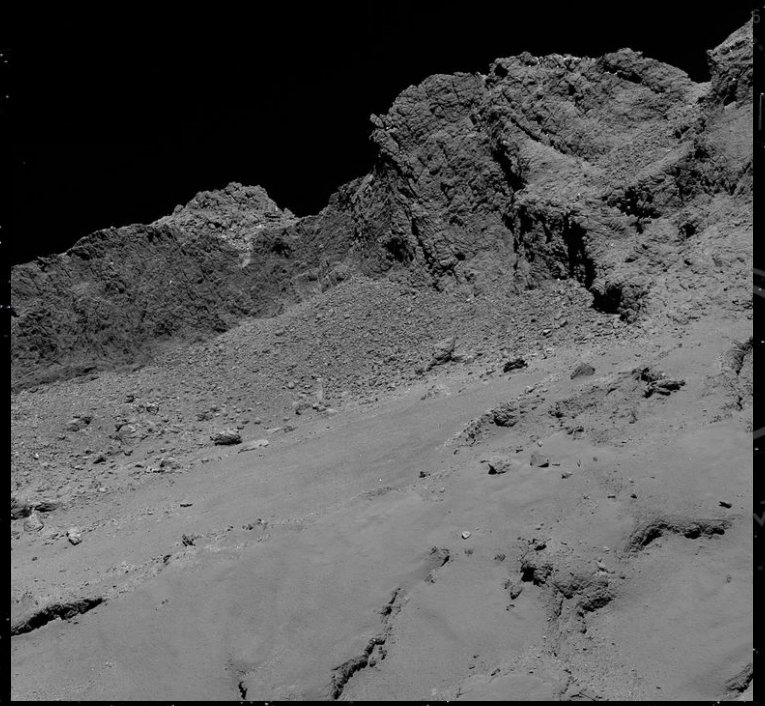


THE ROSETTA SPACECRAFT AND THE PHILAE LANDER

In 2014, after flying past Mars and two asteroids, the unmanned **Rosetta spacecraft** reached its destination: *Comet 67P/Churyumov–Gerasimenko*. It locked into the comet's orbit and jettisoned its lander **Philae**, with the intention of it reaching the surface. Unfortunately, Philae crash landed on the comet, leaving it in the wrong location and orientation: it was tipped over on its side! Philae was still able to capture some amazing images of the surface of the comet. Rosetta was able to take pictures of the entire comet.

LEFT: An image of Comet 67P taken by the Rosetta spacecraft, superimposed onto a picture of Los Angeles, to show the scale.

RIGHT: The surface of Comet 67P, taken by the lopsided Philae lander.



ESA

METEORS

- Meteors are small bits of rock that fall to Earth.
- These can range in size from grains of sand (also called **space dust**), to boulder-sized rocks, however most of them burn up as they enter the atmosphere.

Jeffrey Sullivan

- They start to glow as they burn up in the atmosphere, which causes a long streak of light known as a **Meteor** or **Shooting Star**.
- Meteor showers are caused when the Earth passes the remains of a comet. This cloud of dust is the leftovers of an old broken up comet.

METEOR IMPACT

When a meteor hits the ground, we then call it a meteorite. The largest discovered meteorite is the **Hoba Meteorite** in Namibia. It weighs 60 tonnes and is thought to have fallen to Earth 80,000 years ago.

Alamy

Also, it is believed that an asteroid 15 kilometres across hit the Earth 66 million years ago. This triggered a huge climate shift causing the extinction of the dinosaurs.

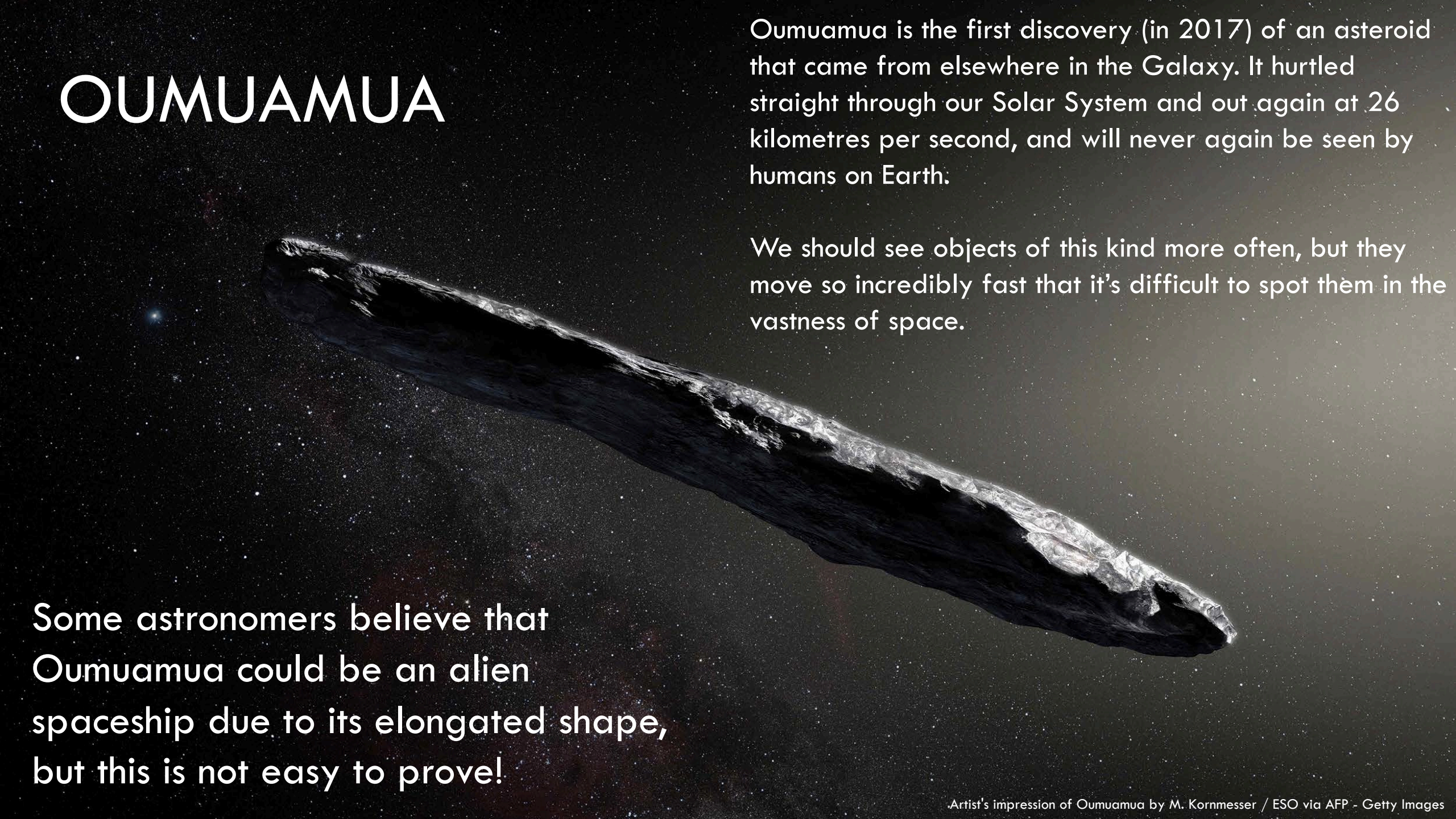
BARRINGER CRATER IN ARIZONA, USA

- This is the best preserved example of an impact crater on the Earth's surface.
- This meteor crater is 170 metres deep.
- The meteor that caused this is estimated to have been about 50 metres across, much bigger than the Hoba meteorite.
- Fragments of this 50 metre asteroid have been found, but it was smashed to pieces in the impact.
- It is estimated that this occurred 50,000 years ago.

OUMUAMUA

Oumuamua is the first discovery (in 2017) of an asteroid that came from elsewhere in the Galaxy. It hurtled straight through our Solar System and out again at 26 kilometres per second, and will never again be seen by humans on Earth.

We should see objects of this kind more often, but they move so incredibly fast that it's difficult to spot them in the vastness of space.



Some astronomers believe that Oumuamua could be an alien spaceship due to its elongated shape, but this is not easy to prove!

Artist's impression of Oumuamua by M. Kornmesser / ESO via AFP - Getty Images

Asteroids, Comets and Meteors

1. *Which dwarf planet is also considered an asteroid?*
    a. Ceres
    b. Haumea
    c. Eris

2. *Between which two planets is the asteroid belt located?*
    a. Venus & Earth
    b. Earth & Mars
    c. Mars & Jupiter

3. *Halley's comet is a…*
    a. Periodic comet
    b. Non-periodic comet

4. *Why don't we spot more objects like Omuamua passing through our Solar System?*

    _____

5. *How big is the meteor crater in Arizona?*
    a. 12 metres
    b. 120 metres
    c. 1.2 kilometres

6. *Which of these solar objects leave long tails of evaporating ice?*
    a. Asteroids
    b. Comets
    c. Meteors

7. *Rank these celestial bodies 1 to 3, with 1 being the largest and 3 being the smallest.*
    a. Ceres
    b. Vesta
    c. Our Moon

8. *What major event 66 million years ago was triggered by an asteroid impact?*

    _____

Score: / 8

BONUS ACTIVITY

As a class, come up with some questions about the Solar System and tweet them to Professor Smartt.

@smarttscience

Answer - Draw the asteroid Vesta to scale compared with the size of Great Britain and Ireland.

The distance from the very north of Scotland (John O'Groats) to the southernmost tip of England (Land's End) is 968 kilometres. These two places are marked with dots.

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   They are too fast

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   a. Ceres 2
   b. Vesta 3
   c. Our Moon 1

What major event 66 million years ago was triggered by an asteroid impact?

The extinction of the dinosaurs

Score: / 8