

Lesson Plan

NEUROHEADWAY

Neuroscience Into Education

The Solar System

Lesson Four

The Dwarf Planets

Teachers' Notes

Slide 1: Title Slides

Slide 2: Introduction to the dwarf planets

This is a very new area of astronomy and one that is still very active – by the time you give this lesson, we may even have found more dwarf planets. These strange little worlds, and this should catch the imagination of the pupils.

- Pluto used to be counted as the 9th planet from the sun until the discovery of Eris, a body almost the same size as it, prompted scientists to decide whether they would have to list it as a new planet, or create a subcategory of planets titled **Dwarf Planets**.
- All Dwarf Planets but **Ceres** reside in the **Kuiper Belt**, a region of ice and rock at the edge of the solar system. You can also call these **Trans-Neptunian Objects**.
- There may be as many as 200 dwarf planets beyond the orbit of Neptune waiting to be discovered, but it may take a long time, as we have to search very large areas of the sky for very small, far away objects. The activity will show the pupils how we find these planets – we simply look for faint things that move from night to night.

Note – the “images” of the planets are illustrations (not real photographs), but they are to scale. Eris is the largest of the dwarf planets, even larger than Pluto. Highlight Haumea, it is oval shaped like a rugby ball.

Slide 3: Definition of a Dwarf Planet

- A dwarf planet is a celestial body too small to be considered a planet, but too large to fit into one of the smaller categories, such as asteroids.
- A full-classed planet must have cleared its orbit of other debris. For example, think of the earth – there are no asteroids, moons or other large lumps of rock in the same orbit. Earth (and the other planets) have effectively cleared their path of these by hoovering up all the small pieces when they formed.
- Dwarf planets do not have enough gravitational force to either join the intruding objects to themselves, or kick them out of the way.
- On the other hand, a dwarf planet also needs to be big enough so that when they formed they had enough mass (gravitational force) to pull themselves into a roughly round shape. Asteroids are often lumpy potato

shapes (we will see in the next lesson), dwarf planets are not, and they are round. But note the shape of Haumea – oval but smooth.

Slide 4: Where are these Dwarf Planet's?

- There is a region of the outer solar system called the “Kuiper Belt” (pronounced “Koi – per”; named for Gerard Kuiper) . This is full of asteroids – it is like the asteroid belt between Mars and Jupiter but much bigger. It is 20 times wider and about 100 times more massive in total. There are about 100 asteroids known in the Kuiper Belt, but astronomers estimate that there are more than 100,000 asteroids in there which are bigger than 100 km. The diagram on the left shows roughly where the Kuiper Belt is.
- To give a scale – the orbits of Jupiter and Neptune are shown.
- The dwarf planets Pluto, Haumea, Makemake and Eris are all in the Kuiper Belt. They are larger than asteroids of course (that's why they are called dwarf planets!). Basically they are the biggest things in the Kuiper Belt.
- The diagram on the right shows the orbits of the dwarf planets, also compared to Jupiter and Neptune.
- You can see they are not exactly circular (they are what we call ellipses or elliptical orbits). They are all beyond Neptune. Pluto's elliptical orbit sometimes brings it a little closer to the Sun than Neptune but it is mostly further.
- As the Dwarf Planets are far away, and small – they are difficult to find. In the next activity, you are going to find one!

Power point Example

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DWARF PLANETS

Remember Pluto? It used to be counted as the 9th planet from the sun until the discovery of Eris, a body almost the same size as it, prompted scientists to decide whether they would have to list it as a new planet, or create a subcategory of planets called **Dwarf Planets**.

All Dwarf Planets apart from **Ceres** reside in the **Kuiper Belt**, a region of ice and rock at the edge of the solar system.

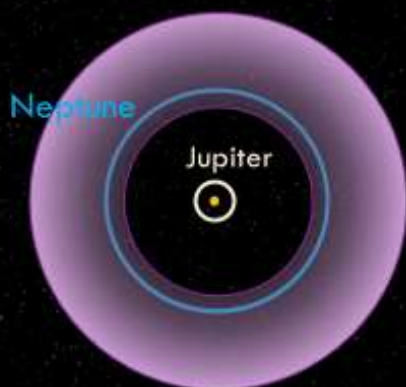


There may be as many as 200 more dwarf planets beyond the orbit of Neptune, waiting to be discovered.

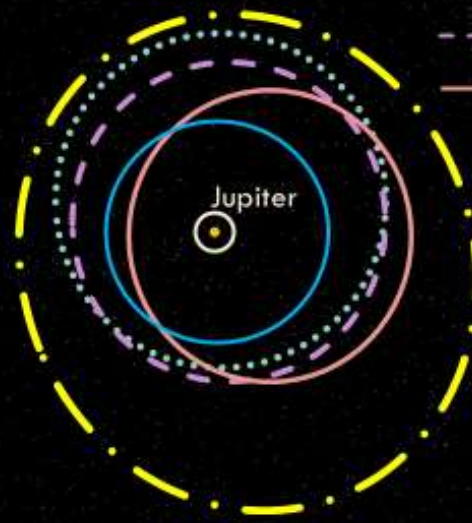
WHAT IS THE DEFINITION OF A DWARF PLANET?

- A dwarf planet is a celestial body too small to be considered a planet, but too large to be an asteroid.
- Another difference between planets and dwarf planets – a planet must have cleared its orbit of other debris. Dwarf planets do not have enough gravitational force to either join the intruding objects to themselves, or kick them out of the way.
- On the other hand dwarf planets must be large enough to have formed in (roughly) round shape – they can't be lumpy potatoes like most asteroids !
- They are all (apart from Ceres) very far from the Sun - let's take a look at their orbits

ORBITS OF THE DWARF PLANETS



Kuiper Belt : more than
100,000 asteroids (bigger
than 100 km in size)



— · — · — Eris
······ Makemake
- - - - Haumea
———— Pluto

ACTIVITY – FIND A DWARF PLANET

- Try and find a dwarf planet in some real images from a telescope in Hawaii
- This telescope surveys the sky every night and searches for moving objects (which are planets and asteroids) and anything that flashes or changes brightness.



Here's an image from
telescopes of the European
Southern Observatory of a
patch of sky.

It is covered in stars – how
would you go about finding a
planet in all this confusion?

Let's find out.

Image credit : ESO, Digitized Sky Survey 2. Acknowledgement: Davide De Martin

PLUTO

- The most famous dwarf planet. Pluto was discovered in 1930 and named by Venetia Burney, an 11 year old girl from Oxford. She received £5 as a reward.
- Pluto was demoted from planet to dwarf planet status in 2006, following the discovery of Eris.



PHOTO: NASA

HAUMEA

- Haumea is a strange, oval shaped dwarf planet on the outskirts of the solar system. Its odd shape is thought to be the result of a violent collision with other **trans-Neptunian objects** (objects beyond the orbit of Neptune), coupled with its extremely fast rotation. A day lasts only four hours.
- Haumea even has a ring, like Saturn and Uranus.



Image: Stephanie Hoover



Credit: IAA-CSIC/UHJ