Creating Science – The Planets

How big, and how far, would the planets be if YOU were the sun? ***#CreatingScienceThePlanets***

Suggested Outcomes

(NOTE: This is by no means an exhaustive list of possible outcomes, neither is it intended that ONLY these outcomes can or should be met. Science is a deeply interrelated activity, and you may find cross curriculum links you can and should use.)

Science understanding

- Earth and space sciences 5 - The Earth is part of a system of planets orbiting around a star (the sun) (ACSSU078)
- Earth and space sciences 1 - Observable changes occur in the sky and landscape (ACSSU019)

Science inquiry skills

- Communicating 5: Communicate ideas, explanations and processes using scientific representations in a variety of ways, including multi-modal texts (ACSIS093)
- Processing and analysing data and information 2: Use a range of methods to sort information, including drawings and provided tables and through discussion, compare observations with predictions (ACSIS040) – i.e., Using modelling is an effective way to understand science concepts.

Science as a human endeavour

- Scientific knowledge has changed peoples' understanding of the world and is refined as new evidence becomes available (ACSHE119)

Cross curricular outcomes

Visual arts: Years 5 and 6 Content:

- Develop and apply techniques and processes when making their artworks (ACAVAM115)
- Plan the display of artworks to enhance their meaning for an audience (ACAVAM116)

Science vocabulary words

Tier 3 (Everyday words) – planet, space.

Warning

- Students may be invited to model the planets on a large field, please manage appropriately.

Preparation

In order to prepare for this lesson and the activity in the book Creating Science, you'll need;

- Create some planet templates using the handout at Creating Science "If You Were the Sun", or even better, build them using orbs - you can use play dough, wrapped up foil, balloons, or similar. If you're going to help students make their own planets sure to bring something that students can take their planets home in, if you like.
- Tape measure or a rolling meter ruler to make sure your planets are the right distances apart. You'll need at least 5 kilometres to get all the planets, so we usually stop at Mars, 228 meters away.

Suggestions for other year levels

As always, more material is presented here than can be used by the average class during the average lesson time. However, since the students' questions can and should guide student learning, more material is presented for your convenience. Remember, it is not uncommon for students to only remember those points which answered their personal questions.

Younger:

This activity is fairly well suited to this age group, but please scaffold activities appropriately.

Middle:

Pacing out the planets' distances across the oval might be fun, but the entire solar system at this scale is 24 kilometres, so please act accordingly. An alternate option could be to go through the first three planets and then describe landmarks to help children imagine the distance, or plot them out on Google maps.

Teen:

Mark out the Solar System in your suburb. Why not apply to the local council to have a scale sculpture of the solar system permanently set up in your town.

Learning Intent (student friendly)

'We are learning to' (WALT) – build a scale model of the solar system.

Success criteria

'What I'm looking for' (WILF) – an effective model of the solar system and an explanation of what it means.

Student learning goals

Help students make a self-monitored learning goal for this lesson, such as;

- Find out how big the planets really are compared with each other.
- Find out how far away the planets are compared with each other.

Evidence of learning

How will you know when the learning goal is achieved? What EVIDENCE do you have that your students have met or exceeded the learning expectations?

⇨ When students have constructed a scale model of the solar system, and can explain it.

Ideas for monitoring

Make sure students understand the nature of a model – that it is not a *real* representation, but a *symbolic* one.

Discuss with students how they will present their model, and help them to do so.

Engage

Give the students some diversely sized balls and pieces of play dough.

Ask: So how big is the sun? If the sun was as big as you (about 140cm tall) how big would the world be? Can you demonstrate with the balls and play dough? What are everyone's thoughts?

Explore

Using your pre-prepared planets, show the students the actual comparative size of the earth if the sun was as big as they are.

Activity: help students to build a model solar system of relative sizes (but not distances – even at this scale, if our sun was at the Queen Street Mall in Brisbane, Pluto is at Ekbin park, or out past the Brisbane hospital.) At this scale the closest star visible from earth, Alpha and Beta Centauri, are so far away you'd need a student standing on Earth, and the other student on Venus (at its closest point) to represent just how far away they are. It's really, really far. Stars have to be really, *really* bright in order for us to see them at all![1]

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[1] In fact, the closest star to our sun, Proxima Centauri, is so dim we cannot see it with our eyes alone. This means that MOST of the stars we can see are BRIGHTER than our sun – [I cant comment but WHAT does this mean->]some, but a LOT.

Explain

Space is made up of… mostly empty space. The amount of nothing out there is almost inconceivable!

Because there is so much *nothing* in space, there is nothing to stop the planets from moving. This means that they keep moving forever, until something stops them.

Then what keeps the planets moving *around* the sun? Gravity! But since the planets are moving so fast, they never actually fall into the sun, but end up going around instead.[2]

Incidentally, if the sun became a black hole, its gravity wouldn't increase. So Earth would keep revolving around a very cold, dark, black hole – potentially forever[3].

- ⇨ Build a scale model of the planets using the activity below, or from our book Creating Science, 'if you were the sun' online – but not to scale, since while Mercury is about 58 meters away, the heliopause (the official end of the solar system by most estimates) is still 24 kilometres away – Space is BIG!!

Elaborate

Nature of science: Why is Pluto no longer a planet?

Activity: After researching a little about the planets, see if you can classify them. How would you arrange the planets? In groups according to size? Colour? Interesting features?

For a long time, there were 9 planets: 4 rocky inner planets, 4 gas planets, and 1 'dirty snowball' called Pluto. But scientists realised that, if the maths was correct, there could be literally hundreds of 'dirty snowballs' out beyond Neptune.

Then… they found one…

It was called UB313 2003 at the time, and waited for an official name. In the meantime the debate started, do we have 10 planets in the system? What if there were more of dirty snowballs? Did we really want 50+ planets in the solar system, which is what would happen if we kept finding them? Sure enough, two weeks later, two more dirty snowballs were found. It was happening… 12 planets, would there be more?

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[2] See the pages on "CreatingScienceGravity" or "CreatingScienceHovercraft" (inertia) for deeper explanations of these concepts.

[3] There is one way all planets lose energy going around the sun – gravity waves. The changes in speed due to gravity waves is "leading to a decay in the orbit by about 1×10^−15 meters per day or roughly the diameter of a proton. At this rate, it would take the Earth approximately 10 trillion times (1×10^13) … the current age of the universe to spiral onto the Sun." We expect the sun to die long before this happens, so no time soon! (Taken 2 dec 2016 from https://www.quora.com/How-does-the-earth-orbit-the-sun-without-losing-energy)

Scientists decided it was time to sit down and decide what the name 'planet' officially meant. In the end, they decided:

1. A planet has to go around a sun, not another planet.[4]
2. A planet must be big enough to be round (so comets are not planets).[5]
3. A planet has to dominate its orbit around the sun, so it's not sharing it (like Ceres in the asteroid belt is).

And this meant that all the dirty snowballs, many of which aren't round and none of which dominate their own orbit, were no longer classified as planets. Now, they are classified as 'dwarf planets'. And the dwarf planet UB313 2003 was called Eris, after the Greek goddess of arguments.

Explain: Remember, Pluto is still there, it hasn't disappeared. Only its *classification* has changed, and in real life science classification schemes change all the time when new discoveries or ideas challenge the old way we used to look at things. Scientific classifications, including those used to organise medicines or explain evolutionary processes, are allowed to change as new knowledge comes to light. And they change all the time!

Activity: try developing some of your own classification schemes, and see how those schemes compare to the official scientific ones:

- Living vs non-living
- Organic vs non-organic
- Kinds of humans
- Forms of life on earth
- Classification of rocks
- Personality types

The lists go on and on.

Extension - Sun

Ask: Think about the sun in the sky: How big do you think it really is?

Answer: the sun is actually a million times bigger (in volume) than the earth. IT IS MASSIVE!!![6] Lucky it's very far away, or we'd all be burnt up in its heat. If you were as big as the planet Earth (a ball about 1.4 meters tall), the sun would be approximately 152 meters across – about as big as an Aussie rules football field. Now imagine that field is not flat, but round like a big, burning, blasting ball. The world is big, but the sun is a whole lot bigger!

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[4] The moon Titan, of Saturn, is bigger than the planet Mercury, for instance.
[5] Generally, over 400 kilometres in diameter.
[6] The **Sun** is about 1,391,000 kilometers across. This is about 109 times the diameter of **Earth**. The **Sun** weighs about 333,000 times as much as **Earth**. It is so large that about 1,300,000 planet Earths can fit inside of it. – taken 2 dec 2016 from http://coolcosmos.ipac.caltech.edu/ask/5-How-large-is-the-Sun-compared-to-Earth-

Evaluate

- ⇨ Review with students what they felt they learnt from this lesson. Did they have any questions at the start that they feel were answered?

Success criteria

- ⇨ Review the Learning Intentions of this lesson with students. Was it met?

At the end of each class, review the learning objective and see how we did. Ask:

- ⇨ Did you achieve your learning goal?
- ⇨ What did You learn?
- ⇨ What worked to help you achieve it?
- ⇨ What might you do better next time?
- ⇨ (If needed) where can you go for extra help or information?

Assessment

Prior learning:

Engage in a quick KWL (What do you Know, what do you Want to know, and what have you learnt) about the planets. Ask students if they think they know how big the planets are, or how far away they are, in relation to each other.

Formative

Be sure to watch out for the following common alternative conceptions:

Make sure students understand the nature of a model – that it is not a *real* representation, but a *symbolic* one.

Discuss with students how they will present their model, and help them to do so.

Summative

Have students display their solar system models and explain the relative sizes.

Have students prepare a report on their favourite planet, or, as a learning group, research one or more interesting facts about each planet or dwarf planet (especially Eris).

So what?

Learning about planets is fun!

Imagining the distances is mind boggling, but help us to appreaciate how BIG space is, and just how much SPACE there is in space – entire galaxies can collide and merge, yet hardly anything will bump into anything else!

Creating science

Science understanding

As students made and compared their own solar systems, they learnt that;

- Earth and space sciences 5 - The Earth is part of a system of planets orbiting around a star (the sun) (ACSSU078)
- Earth and space sciences 1 - Observable changes occur in the sky and landscape (ACSSU019)

Science inquiry skills

As students used modelling to learn about the solar system, and to present that learning, they;

- Communicating 5: Communicate ideas, explanations and processes using scientific representations in a variety of ways, including multi-modal texts (ACSIS093)
- Processing and analysing data and information 2: Use a range of methods to sort information, including drawings and provided tables and through discussion, compare observations with predictions (ACSIS040) – i.e., Using modelling is an effective way to understand science concepts.

Science as a human endeavour

We're always learning new things about space and the solar system. For instance, Pluto is no longer classed as a planet! Why?;

- Scientific knowledge has changed peoples' understanding of the world and is refined as new evidence becomes available (ACSHE119)

Cross curricular outcomes

As students artistically coloured and presented their model solar systems, they were;

Visual arts: Years 5 and 6 Content:

- Develop and apply techniques and processes when making their artworks (ACAVAM115)
- Plan the display of artworks to enhance their meaning for an audience (ACAVAM116)

Tips from the masters

Scientists of all ages can benefit from templates to help them make their relative planets.

try making the gas giants using balloons – you can even papier mache' them afterwards!