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SPACE WEEK
Our Planet • Our Space • Our Time

Classroom Resource Booklet

Our Solar System

Discover Primary Science and Maths
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BACKGROUND INFORMATION

Why the Solar System?

The Solar System is a broad topic that can inspire children and stoke their imaginations on many different levels. As a theme it also provides an opportunity to teach across many areas of the primary school curriculum; as well as science, history, geography, mathematics, english comprehension, visual arts and drama, even P.E. can be brought into lessons based on this theme. Here, the objective is to understand the scale of the Solar System by modelling the size of all the Planets, plus the distance of each from the Sun.

Background Information for Teachers:

Useful facts about the Earth and Moon:

- Earth diameter: 12,742 km
- Moon diameter: 3,474 km
- Earth circumference: 40,075 km
- Moon circumference: 10,921 km
- Distance from Earth to Moon (average): 385,000 km
  (this is an average, as it varies because of the Moon's elliptical orbit)
- How many Earths away is the Moon? Just under 10 (circumference) or just over 30 (diameter)

Interesting Moon facts:

- Why the Moon orbits the Earth and how long it takes
  http://www.k12reader.com/reading-comprehension/Gr3_Wk20_Why_Does_the_Moon_Orbit_Earth.pdf

- How measurements of Moon's size and distance from the Earth were made
  (as well as the masses of the Earth and Sun)
  http://www.astronomyforbeginners.com/astronomy/howknow.php

Information about scales, distances and the Planets:

- Find out about formation of the Solar System here:
  http://www.schoolsobservatory.org.uk/astro/solsys/formation

- Use this slider to illustrate the Scale of the Universe (including Planets)
  http://htwins.net/scale/

- Video about Planet orbits here
  https://www.youtube.com/watch?v=aGVXyCrpUn8

- Rocky Planets versus gaseous Planets
  https://www.youtube.com/watch?v=DvhI891zGqU / https://www.youtube.com/watch?v=WoPtsnIcSv8

- Download Stellarium for free: a realistic sky view from your computer
  http://www.stellarium.org

- http://www.esa.int/esaKIDSen/SEMF8WVLWFE_OurUniverse_0.html

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DPSM/ESERO Framework for Inquiry

THEME	Overall theme	
CURRICULUM	Strand:	
	Strand Unit:	
	Curriculum Objectives:	
	Skills Development:	

ENGAGE

THE TRIGGER	WONDERING	EXPLORING

INVESTIGATE

STARTER QUESTION	PREDICTING	CONDUCTING THE INVESTIGATION	SHARING: INTERPRETING THE DATA / RESULTS

TAKE THE NEXT STEP

APPLYING LEARNING	MAKING CONNECTIONS	THOUGHTFUL ACTIONS

REFLECTION	

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DPSM/ESERO Framework for Inquiry

THEME	Overall theme	
CURRICULUM	Strand:	Use the DPSM Planning Guide to identify the strand/strand units and the appropriate curriculum/learning objectives that your pupils should achieve.
	Strand Unit:	
	Curriculum Objectives:	
	Skills Development:	

ENGAGE

THE TRIGGER	WONDERING	EXPLORING
• Relating the new experience to the children. • Using objects (e.g. torch for simple circuits, sycamore seeds for spinners etc.). • Play with toys, objects (e.g. magnets). • Use DVD clips, digital images of the scientific phenomenon. • Story. • The mystery box. • A mystery demonstration.	• Discuss everyday experiences. • Concept mapping. • Concept cartoons. • Think and draw. • Question and answer session. • Free writing. • Brainstorming. • Manipulation of materials. • Newspaper article (fictional/actual). • The science talk ball.	• The Invitation to learn. • New experience presented to the children. • The children discuss this and try to provide explanation. • Teacher identifies children's 'alternative ideas'. • Children's questions about the exploration provides them with opportunities to explore the phenomenon.

INVESTIGATE

STARTER QUESTION	PREDICTING	CONDUCTING THE INVESTIGATION	SHARING: INTERPRETING THE DATA / RESULTS
• Starter question for investigation. Teacher or children pose the question/ scenario/present the problem to be investigated.	• Children record predictions and provide reasons for their predictions.	• In groups the children design, plan and conduct inquiry. • Collect and organise data.	• Children interpret and discuss their results. • Present their findings: Propose explanations and solutions based on the data. • Drawing conclusions.

TAKE THE NEXT STEP

APPLYING LEARNING	MAKING CONNECTIONS	THOUGHTFUL ACTIONS

- Discuss implications of their findings e.g. bigger spinner falls more slowly than smaller one. Therefore if I was to jump out of a plane I would choose a bigger parachute as it would fall more slowly.
- Debating.
- Making connections.
- Apply their knowledge to a new learning situation.
- Consider how to extend their new understanding and skills - further exploration, address new questions.

REFLECTION	
	• Did I meet my learning objectives? • Are the children moving on with their science skills? • Are there cross curriculum opportunities here? • What questions worked very well? • What questions didn't work well? • Ask the children would they change anything or do anything differently.

DPSM/ESERO Framework for Inquiry

THEME	Solar System: Senior classes (3rd-6th)	
CURRICULUM	Strand:	Natural Environments (Geography). Numbers, shape and space (Maths).
	Strand Unit:	Planet Earth in space (the Earth, Moon and Solar System specifically for 5th/6th class); 2-D shapes, 3-D shapes, fractions.
	Curriculum Objectives:	Recognise that the Earth, its Moon, the Sun, other Planets and their satellites are separate bodies and are parts of the Solar System. Identify the properties of the circle, identify and examine 3-D shapes, draw the nets of simple 3-D shapes and construct the shapes (spheres).
	Skills Development:	Questioning, observing, predicting, estimating and measuring, analysing, recording and communicating.

ENGAGE

THE TRIGGER	WONDERING	EXPLORING
• Trigger interest by discussing huge objects in space that they may have seen, e.g. the Moon. These activities will give them models of space objects that are on a more workable scale. • Introduce your class to the names and features of all the planets in the Solar System using this European Space Agency resource (teachers guide and images associated): http://www.esa.int/Education/Teach_with_Rosetta/Our_Solar_System_Journey_to_other_celestial_objects_Teach_with_space_PR01 • You could show this fun video to introduce the planets and the differences between them. http://www.sciencekids.co.nz/videos/space/solarsystemsong.html	Questioning: When do you see the Moon, stars, planets – at night or in the day, or both? Do you know the difference between them all? Which ones move? Does the Earth move too? What is the furthest away thing that you've ever seen? Is it on Earth, or out in space? How far away actually is it? What can we see out in space? What are the Planets like compared with Earth? What sizes are they compared with Earth? All these questions help you to get a sense of the children's ideas or mental model of the Solar System.	Ask them to draw a picture of the Solar System, including everything they can think of. They can do this in groups and discuss among themselves what should be left in/out. You can ask what they think the sizes of the planets, Sun and Moon are and to think about the distances between these objects, before they draw anything (or leave this discussion until the body of the activity). Afterwards, as a class, discuss the objects they have included in their drawings.

INVESTIGATION 1: A SCALE MODEL OF THE EARTH AND MOON

STARTER QUESTION	PREDICTING	CONDUCTING THE INVESTIGATION	SHARING: INTERPRETING THE DATA / RESULTS
• How big is the Moon compared to the Earth? • How far away from Earth is the Moon?	• Asking children to predict how big the Moon is compared to Earth, and how far away they think it is.	• Students are shown items to represent the Earth and the Moon on a smaller scale, and guided through activities that model their sizes and distance from each other.	• For the two methods used to measure the Moon and Earth, students can compare the results: did they arrive at the same point using circumference versus diameter to measure the Moon's relative distance from the Earth? If not, they could discuss potential ways that errors might have been made when they did the investigations • Ask if they were surprised by the Moon's size and distance from Earth.

DPSM/ESERO Framework for Inquiry

INVESTIGATION 2: SIZES OF THE PLANETS IN THE SOLAR SYSTEM

STARTER QUESTION	PREDICTING	CONDUCTING THE INVESTIGATION	SHARING: INTERPRETING THE DATA / RESULTS
• How big is Mars/Jupiter/Saturn? • Which Planets can we see? E.g. Jupiter. It looks very small compared to the Moon – but how big is it really?	• Asking children to predict how big each of the Planets is compared to Earth.	• Students are shown items (fruit) to represent all 8 planets on a smaller scale and guided through figuring out which ones are which.	• Discuss the correct sizes as a class. Ask: were the students surprised by any of the sizes? Did they already know (from their drawings) which order the planets should be in?

INVESTIGATION 3: DISTANCES BETWEEN PLANETS IN THE SOLAR SYSTEM

STARTER QUESTION	PREDICTING	CONDUCTING THE INVESTIGATION	SHARING: INTERPRETING THE DATA / RESULTS
• Now that we know the sizes of all the planets in the Solar System, here's a new question: where are they in space? How far away are they? Are they always in the same place or do they move?	• Asking children to predict how far away each of the planets are from the Sun. Are their guesses on the scale of millions of kilometres? Some of them may have drawn the planets all spaced out evenly – ask whether the planets are really like that.	• Students work through two activities guided by the teacher, to illustrate the scale of distances between the planets, and also to demonstrate the (roughly) circular orbits of the planets around the Sun.	• Discuss the relationship between distance of a planet from the Sun, and the number of times it orbits the Sun in a given time period. Were the class surprised at how many times Mercury orbited the Sun within 100 steps compared with Neptune?

TAKE THE NEXT STEP

APPLYING LEARNING	MAKING CONNECTIONS	THOUGHTFUL ACTIONS

- Applying Learning: Talk about how we could use the information about the size and distance of the Moon in real life. For example, when the Moon landing missions were being planned, astronauts needed to know how far away the Moon was in order to know how long it would take to get there, and therefore how much fuel was needed. Also for landing on the Moon, it's important to know how big it was. If it was only the size of a house, the spaceship would have needed to be very small! The size and distance of the planets are also relevant for planning space missions to these planets.
- Making Connections: These activities can also link to more investigations on the Moon, such as the ESERO activity for understanding Moon phases and eclipses; http://esero.ie/wp-content/uploads/2015/01/62_Lunar-eclipse-and-phases-of-the-Moon.pdf and this activity on How the Moon affects tides on Earth http://www.ducksters.com/science/earth_science/ocean_tides.php .
- Thoughtful actions: Looking out for the Moon and Jupiter every night for a month, recording their observed positions on a chart in the classroom (teach children about North/South/East/West for this); great for showing that the Moon's position changes much more than Jupiter's from our Earth perspective.

A finished product from this lesson (investigations 1-3) could be a collage done by the students of the whole Solar System, illustrating all the concepts they've learned.

REFLECTION

- Did I meet my learning objectives?
- Are the children moving on with their science/maths skills?
- Can the children describe how to measure distance correctly?
- What went well, what would I change?

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INVESTIGATION 1: A SCALE MODEL OF THE EARTH AND MOON

Skills:

Working scientifically: questioning, observing, predicting, estimating and measuring.

Class level:

3rd-6th classes.

Content Strands:

- Geography: Natural Environments.
  Strand Unit: Planet Earth in space (the Earth, Moon and Solar System specifically for 5th/6th class)
- Maths: Numbers.
  Strand Unit: Fractions.
- Shape and space:
  Strand Unit: 2-D shapes, 3-D shapes.

Materials/Equipment:

- For the main activity: Globe of the Earth (solid or inflatable), balloons, string. For the alternative activities: basketball, tennis ball, metre stick.
- You also need to be in a space large enough to move around and measure distances – a classroom with some of the tables moved out of the way, or a gym/ sports hall.

Background Information:

- The video of the Solar System described in the framework (under Engage/Exploring) should be enough background knowledge; this lesson will probe deeper and bring them to an understanding of some scales of size and distances within the Solar System, using modelling.

Preparation:

- Gather the materials. Identify a suitable space for measuring distance of Earth to Moon (about 10 metres ideally). Pre-inflate several balloons to the size of the Moon in the activity (see 'activity' below).

Setting the scene:

- Get started by asking some general questions about the Moon – find out what the children know about it. You could show some pictures too to trigger interest and imagination, for example:

An image of the Moon taken by the Blackrock Castle Observatory TARA telescope.

This NASA image "Earthrise" was taken of the Earth from the Moon, in 1968.

- Chat a bit about who took this photo and when (it was from the Apollo 8 mission, information here http://www.nasa.gov/feature/astronaut-photography-from-space-helped-discover-the-earth). Ask how the photo makes them feel! Awed? Sad? Excited? Lonely? Happy to be on Earth?

Trigger questions:

- Ask some questions to gauge their understanding: How big do you think the Moon is? Find out what they think about the size of the Moon compared to the Earth. Ask them do they think the Moon is close to us or far away? How close? Some children may think the Moon is closer to us than it is, others much further away than it is.

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INVESTIGATION 1: A SCALE MODEL OF THE EARTH AND MOON

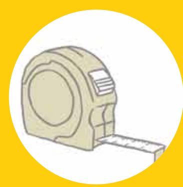
Activity:

What you will need:

Globe

String

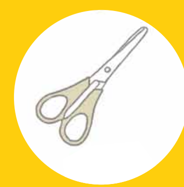
Balloons



Measuring Tape

A Notebook

Pencil



Scissors

- Show the students the globe and ask "how big is the Moon compared to Earth?"
- Explain that the Moon is 1/4 of the Earth's size, this is true for either circumference or diameter, (cross-curricular link with Maths: fractions).
- Using a long piece of string, measure the circumference (explaining this term) of the globe, then cut the piece to that size. Then, divide the string in 4 quarters (using mathematical skills; fold it in half, then in half again). That 1/4 is the size of the circumference of the Moon, on the scale we are using.
- Take a balloon and inflate it so that its circumference fits into that 1/4 string circled.
- Explain relative sizes, giving perhaps the example of comparing a doll's house with miniature doll people to your house and your family, then using the globe as the Earth relative to the balloon as the Moon.
- Take out some more pre-blown up balloons and hand out to groups of pupils, hold up the Earth and ask them to place the balloons where they think the Moon should be in a scale model.
- This should result in a few different guesses. You can leave the guess Moons in their places and then explain that you are going to show them how to measure where the Moon should be.
- Now it's time to adjust the distance of the Moon correctly. There are two ways to do this. Again using the circumference of the Earth as a reference point, you can explain that the Moon is 9.5 Earths away, i.e. that 9.5 Earth circumferences would fit side by side in the distance between the Earth and Moon.
- This is easier to visually demonstrate than to verbally explain, so take another length of string and wrap it around the Earth (globe). Cut it to size and ask the students to measure out together (or you can demonstrate it yourself) how far away the Moon (balloon) should go.
- **A second way** to measure this is by marking the globe on one end (e.g. at the North Pole) and roll the globe in a straight line along the floor til it has passed the North Pole mark 9.5 times.
- You could divide students into two groups and get them to try both ways and compare their outcomes.
- If students have not learned about circumferences yet, they can still conduct this investigation without referring to the circumference, using the string or the globe to measure out the distance of 9.5 Earths.

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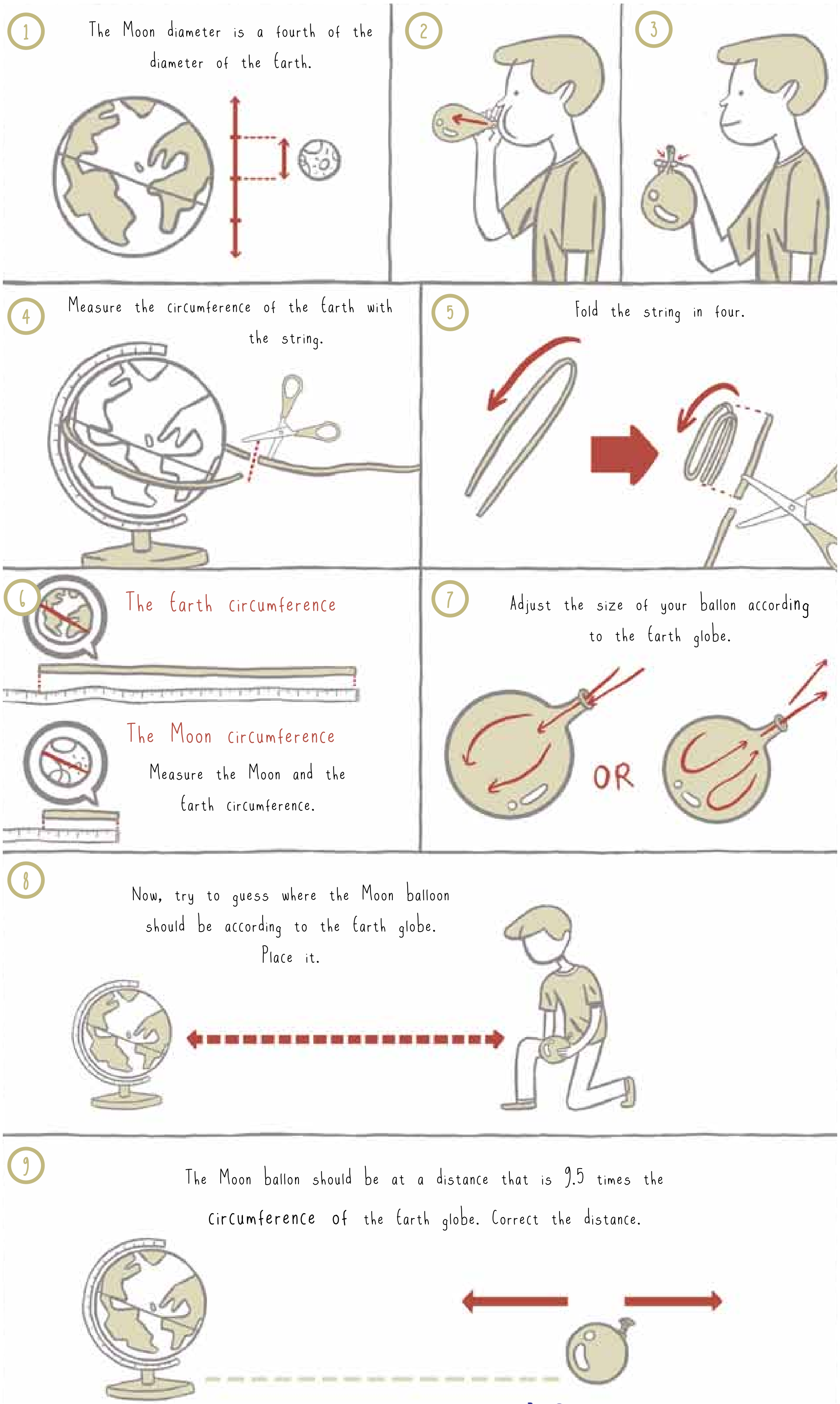
INVESTIGATION 1: A SCALE MODEL OF THE EARTH AND MOON



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INVESTIGATION 1: A SCALE MODEL OF THE EARTH AND MOON

Activity:

- Instead of showing the distance by circumference, you can also do it by diameter (depending on prior learning of the students). Students can do this one themselves – in the school sports hall perhaps, in groups, with individual basketballs (representing Earth) and tennis balls (representing the Moon).
- Ask them how they would measure 30 Earths away and see what methods they come up with. A method that can be used is to get them to mark a point on the floor where the Earth will be, then measure 30 Earths away using the basketball's diameter. In pairs they can use a vertically-held sheet of paper, or metre stick, to measure where the ball stops and where it should next be moved to. They should then repeat this until they've moved the ball along 30 times.
- Then they can leave the tennis ball (Moon) 30 Earths away and return the basketball (Earth) to its original position. This is a good way to compare and contrast circumference and diameter as ways of measuring. If students have not learned about diameter yet, they can still conduct this investigation without referring to diameter, using the ball itself as a way to measure out the distance of 30 balls (Earths).

Review:

Ask them if were they surprised at the distance? What about the size?
They might ask why the Moon looks so big to us.
This is a nice way to lead into the next section, about distances between the planets in the Solar System.

Assessment:

- Ask students to recall how many Earths could fit in the distance between the Earth and the Moon (distinguishing between circumference and diameter if this was included)
- Ask students to draw a picture of the Earth and Moon, with the correct relative size and distance (they would need to draw the Earth, then measure its diameter and draw the Moon with a diameter 1/4 of that).

Follow-up activities:

What about the Sun?

You could ask how big they think the Sun is compared to the Moon and Earth.
Tell them (26 metres diameter; like a big house size), plus how far away it would be from their basketball (2.8 kilometres! You could map an area of 2.8 km on Google Maps, overlaid onto a particular place near your school that the children would recognise, so that they can relate the distance to something familiar)

If you want to follow up with how we can figure out the size of the Moon, try this ESERO activity:
http://esero.ie/wp-content/uploads/2015/01/42_The-size-of-the-moon.pdf

INVESTIGATION 2: SIZES OF THE PLANETS IN THE SOLAR SYSTEM

Skills:

Working scientifically: questioning, predicting and analysing.

Class level:

3rd-6th classes.

Content Strands:

- Geography: Natural Environments.
  Strand Unit: Planet Earth in space (the Earth, Moon and Solar System specifically for 5th/6th class).
- Maths: Numbers.
  Strand Unit: Fractions.

Materials/Equipment:

- Fruit: 1 watermelon, 1 large grapefruit, 1 large apple, 1 lime, 2 cherry tomatoes, 1 blueberry, and 1 large peppercorn.
- If having the children work in groups, multiply the items as necessary to match the desired number of groups.

Background Information:

Here is a table for reference, with all planet volumes relative to Earth's:

Mercury	0.56
Venus	0.87
Earth	1
Mars	0.15
Jupiter	1,300
Saturn	760
Uranus	63
Neptune	58

Preparation:

- Gather the materials. Make labels for all 8 planets (these can be laminated if you like).

Setting the scene:

- Refer back to their drawings of the Solar System from before Investigation 1 and discuss the different sizes that may have come up, probe what their understanding is and where it came from (pictures they've seen, books read or TV shows watched, discussions with parents, etc).
- Tell them that scientists have come up with ways to measure the size and weight of the Earth and the other planets. This could be a good way to bring in a discussion of size versus mass or weight: are heavier things always bigger? Say that we're going to use fruit to make a model of the Solar System that is based on the real sizes. The concept of relative size that they learned about in Investigation 1 (Earth and Moon) can be reinforced here.

Cross-curricular links:

- Maths:
  Activity uses mathematical skills i.e. discussing biggest versus second/third biggest etc.

Trigger questions:

- Ask the students what sizes they think the other Planets are compared with Earth. Some of them may have the idea that the Earth is the biggest planet, others may not have thought about it.
- Ask if they know what the biggest and smallest planets are. Pluto may come up in conversation, at which point you can mention that it has been re-classified as a dwarf planet since 2006, partly due to its small size.

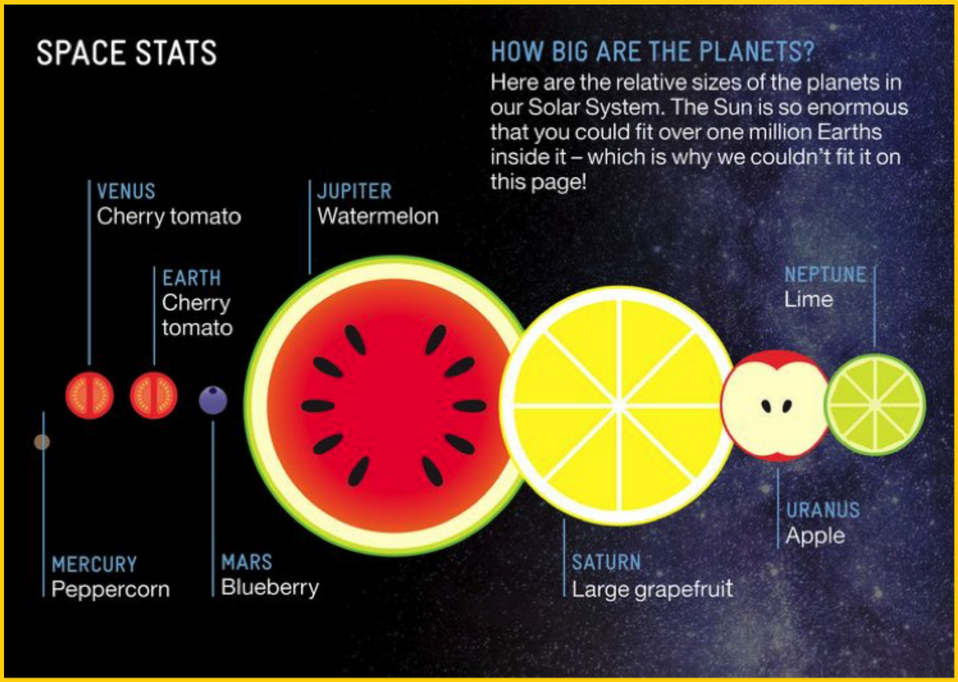
INVESTIGATION 2:
SIZES OF THE PLANETS IN THE SOLAR SYSTEM

Activity:

This activity can be done as a class (or in groups). It's based on a Royal Greenwich Observatory resource – see here to register for a free account to use their resources: https://www.stem.org.uk/user/register?destination=node/31649

- Start by checking as a recap from previous videos or discussions (or by looking at their Solar System drawings) that students know how many planets there are and ask for names around the class.
- Show the students all of the fruits available and ask for guesses as to which ones represent which planets. It should be an educated guess, so ask for reasoning when they give guesses.
- Tell them there are two different categories of planets in our Solar System: the four rocky or terrestrial Planets and the four gas giants. All the items we will be using today will be solid – is this accurate for all the planets in our Solar System? The answer is no. The gas giants are mostly made of gases, so are not solid.

Place all the items on a table. You can have labels for each planet laid out on the table, but don't match the fruits to the labels, have the students figure out where each should go!



From slideshare.com - Fruit Solar System.

Here are the items matched to their respective planets (from closest to farthest from the Sun):

Peppercorn: **Mercury**

Cherry tomatoes: **Venus and Earth**

Blueberry: **Mars**

Watermelon: **Jupiter**

Large grapefruit: **Saturn**

Apple: **Uranus**

Lime: **Neptune**

1) Ask students to decide which four objects should be gas giants and which four should be the terrestrial planets.
2) Students can either do their own research to find out the sizes of the planets or a series of hints can be given.

Continued on the next page...

INVESTIGATION 2: SIZES OF THE PLANETS IN THE SOLAR SYSTEM

Hints:

- Mercury is the smallest planet in the Solar System and the closest planet to the Sun.
- Jupiter is the biggest planet in the Solar System.
- Saturn is the second biggest planet in the Solar System.
- There are two pairs of similar sized Planets out of these four: Uranus, Earth, Venus and Neptune. Can you work out which pairs belong together and match them to the right items?
- One item should remain for Mars.
- Go around to the various groups (if this is being done in several groups) and listen to their discussions and reasoning as to which fruits correspond to which planets.

3) Discuss the correct sizes as a class. Were the students surprised by any of the sizes?

Assessment:

- See if students can recall the order of the planets based on distance from the Sun.
- See if they can come up with a memorable mnemonic to help them and ask them to share their mnemonics with the class (this is also good from an English language comprehension perspective). Two examples are: My Very Educated Mother Just Served Us Nachos; and My Very Easy Method Just Speeds Up Naming.

Here's a YouTube song that might be a catchy way to remember too.
https://www.youtube.com/watch?v=3b2twHNy9L8

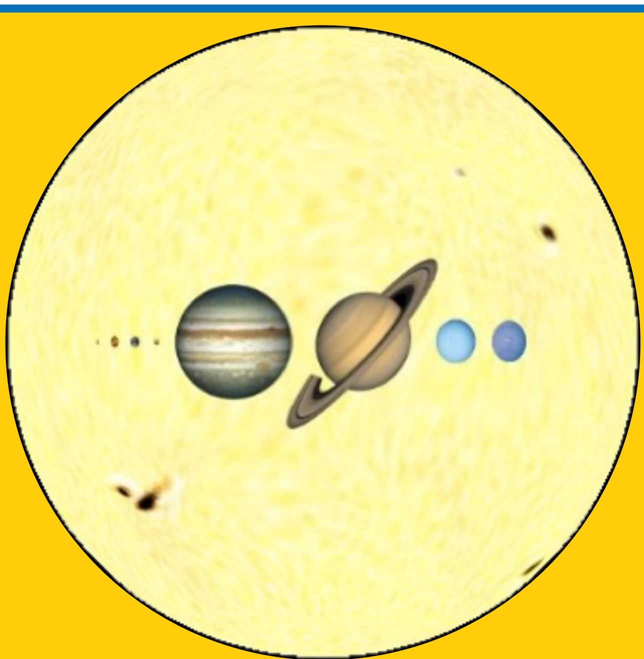
Follow-up activities:

You can discuss the role of the Sun in this model:

Ask them how big the Sun would be on the scale of the model made today.

Answer: for this fruit model, the Sun is the size of1.3 million Earths (or cherry tomatoes!).

An older class (5th-6th) could do this Play-Doh Solar System activity from the International Centre for Radio Astronomy Research, which involves using mathematical skills to divide Play-Doh into quantities to represent all the planets to scale:
http://www.icrar.org/__data/assets/pdf_file/0003/2499123/Scale-of-the-Solar-System.pdf



Scale of the Sun compared to planets – from Science on a Sphere
http://sos.noaa.gov/Datasets/dataset.php?id=211

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INVESTIGATION 3:
DISTANCES BETWEEN PLANETS IN THE SOLAR SYSTEM

Skills:
Working scientifically: questioning, estimating and measuring

Class level:
3rd-6th classes

Content Strands:
- Geography: Natural Environments. Strand Unit: Planet Earth in space (the Earth, Moon and Solar System specifically for 5th/6th class).
- Maths: Numbers. Strand Unit: Fractions.

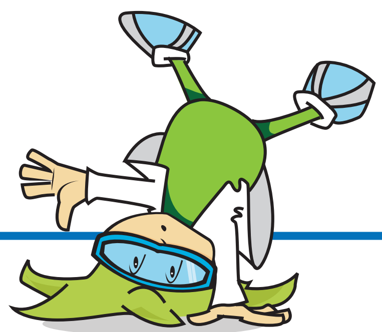
Materials/Equipment:
- **Pocket Solar System:** Enough pieces of till roll (adding machine paper) for a length of about 1.5 m for each person and a pencil. Stickers depicting the planets could be used for younger children who don't have advanced writing skills.
- **Large-scale Solar System:** Enough space to walk about 100 steps away from a central point, flags/laminated signs with planet names, masking tape/field chalk or paint.

Preparation:
- For the second activity (large-scale Solar System, create flags or signs with the 8 planet names on them, or simply laminated sheets for each one.
- If you have access to a gym or sports field for the second activity (large-scale Solar System) mark out circles for the orbits of each planet in advance using masking tape or field paint.

Safety:
- Caution about paper cuts when folding paper.

Setting the scene:
- Ask the children have they ever seen a planet in real life.
- Which planets can we see with our own eyes? Which ones need a telescope so that we can see them? (Answer: we can see all of them except Neptune. Uranus is hard to see but can be seen if you have sharp eyes).
- How far away do the children think each planet is? This will get them thinking about distances in the Solar System.
- If you use the fruit from the previous activity as a model, ask them how far apart all the fruits should be. Children may hold the misconception that all the planets are evenly spaced.

Cross-curricular links:
- **Maths:** Fractions: halves, quarters, eighths etc (pocket Solar System); counting steps (large-scale Solar System).
- **Physical education (P.E.):** The large-scale Solar System activity includes moving, jumping, running and travelling around in wide circles for planetary orbits (when done in a large space such as football field or school hall).



INVESTIGATION 3:
DISTANCES BETWEEN PLANETS IN THE SOLAR SYSTEM

Background information:

- This table shows the order of the worlds of the Solar System going out from the Sun and their average distances.
- *AU stands for "astronomical unit" and is defined as the average distance between the Sun and the Earth (about 150 million kilometres).
- **The International Astronomical Union (IAU), the organization in charge of naming celestial objects, classified these objects as "dwarf planets" in 2006.

Object	Average distance in AU *	Nearly the distance in AU	Number of steps out from the centre (Sun)
Mercury	0.4	0.3	1
Venus	0.7	0.6	2
Earth	1	0.9	3
Mars	1.5	1.25	4
Ceres ** (in the Asteroid Belt)	2.6	2.5	7
Jupiter	5.2	5	13
Saturn	9.2	10	25
Uranus	19	20	50
Neptune	30	30	78
Pluto ** (representing the Kuiper Belt)	40	40	100

Pocket Solar System:

We are going to make a model of the Solar System, with each planet at roughly the right distance from the Sun. To make this easier to do, we have rounded some of the distances of the planets up or down a little bit to "nearly the distance."

Give each student a piece of till roll or toilet roll as tall as or taller than them, and a pen or pencil. At least 1.5 m is a good length. Give them the following instructions:

- Write Sun at one end and Pluto at the other.
- Fold the paper in half, bringing the Pluto end to the Sun end and crease.
- Look at the table and see that the Planet that is half way between Pluto and the Sun is Uranus. Write Uranus on the crease.
- Fold the paper back in half and fold again into quarters. Neptune is half way between Pluto and Uranus; Saturn is halfway between the Sun and Uranus. Unfold and write those planets on the creases.
- All the other planets are in the quarter of the Solar System between the Sun and Saturn. Fold just the Sun end over to meet Saturn. Jupiter is halfway to Saturn. Write Jupiter on the crease.
- Fold the Sun end over to Jupiter. The asteroids are halfway to Jupiter. Write Ceres or asteroids on the crease.
- Fold the Sun end over to Ceres/asteroids. Mars is halfway to the asteroids. Write Mars on the crease.
- The final folds are done differently. Fold the Sun end to Mars and crease. Keep the paper folded and fold in half again. This will make three creases between Sun and Mars. Unfold and write the three inner planets on the creases, Mercury closest to the Sun, then Venus, then our home Earth.

You've made yourself a Solar System that is the size of you, but can be folded up and put in your pocket!

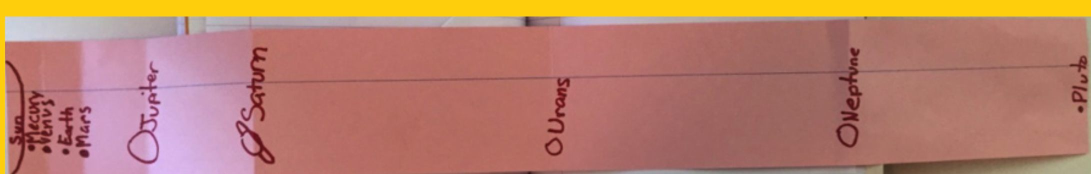


Image: www.betterlesson.com

(Activity adapted from Pocket Solar System from the Astronomy Society of the Pacific and from NASA's Pocket Solar System)

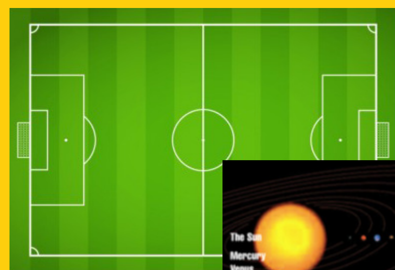
SPACE WEEK
Our Planet • Our Space • Our Time

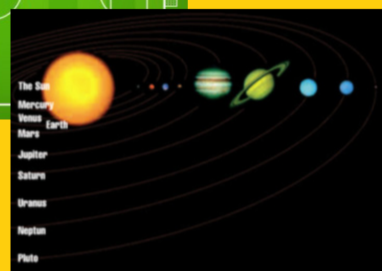
INVESTIGATION 3:
DISTANCES BETWEEN PLANETS IN THE SOLAR SYSTEM

Large-scale Solar System:

Let's get moving while learning about space!

In a field outside or in the school gym, we will plot the distance of each planet away from the Sun (in the centre), followed by an'orbit walk' around. We can add to the 8 planets discussed in Investigation 2, the asteroids and Pluto (see table on previous page).





- Teacher stays in the middle and represents the Sun.
- Divide the children into 10 even groups. Each group represents a planet (or asteroid belt/dwarf planet).
- The scale you will use is 58 million kilometres for each step.
- Pick a group to mark the place of Pluto. Have them walk together, in a straight line, away from the centre and count out 100 even steps.
- Get the next group to mark Neptune and walk in the same path away from the centre, counting out 78 steps.
- Follow the table above (in particular the steps column) to mark the rest of the planets, until all groups are in place in a straight line.
- If another teacher can somehow position themselves above the group, high up/far enough away to take a photo of all the groups in line, it would be a great image to show the children afterwards.

Follow-on activities for orbiting and extra movement
(for this one, we will focus only on the 8 true planets, leaving out the asteroids and Pluto):

- Again, you need a large open space with room for 100 steps in any direction around the centre point (Sun). Orbits of the planets can be pre-mapped out by teacher, or this can be part of the activity if time permits.
- Designate a central spot for the Sun and prepare the playing area by marking out 8 circles going around the Sun, representing the orbits of the planets. In the previous activity students will have gotten an idea of how far out (relatively) each planet is from the Sun.
- Place the prepared flags/signs with each planet's name on the appropriate orbits (these don't need to be in a straight line, they can be staggered).

1) Planet Relay!

- Divide students into teams of 4 or 5. Explain that, as a class, you will come up with a 'movement' unique to each planet (or you can come up with these yourself in advance). Brainstorm what these could be. Examples: Mercury March (a marching movement); Jupiter Jumping Jacks, Neptune Nod (nod the head while walking forward), etc. These are up to you!

- Once you have all agreed on the movements, (including how many repetitions of each should be performed) and demonstrated/practiced each of them, line the teams up around the orbit of Neptune, the furthest circle from the Sun. Space each team about 5-6 metres apart around the marked circle.

Continued on the next page...

INVESTIGATION 3:
DISTANCES BETWEEN PLANETS IN THE SOLAR SYSTEM

- On "go!" the first student from each team will run to the Mercury orbit line, perform the designated movement (remember that the Mercury orbit is only 1 step out from the centre, so space will be tight for that one), then run to the Venus orbit, perform that movement and continue to Earth and so on.

- Once Mercury is available, the second student from each team can follow and move to Mercury. The game continues until all members of each team have performed every move. Teachers will need to remind students of the movement and oversee students who are trying to move too fast.

2) Orbit walk:

- Divide students into teams of 8.
Colour coding the teams would help, e.g. give the Blue team blue stickers, Red team red stickers etc.
- Get the 8 members of each team to stand on the orbit circle of each of the planets, in a straight line from Mercury to Neptune (students will look like spokes coming out of a hub, as in a bicycle wheel).
- At the same time, direct all students to take 100 slow steps around their orbit.
Count along with them, so that students are roughly in step with each other.
- Students on the inner orbits (Mercury, Venus, Earth and Mars) will also need to keep count of how many times they complete an orbit around the Sun.
- When everyone on the team has completed 100 steps around, get them to note the position of the other members of their team. They will have moved out of line with each other.
- As they stand in their orbits, lead a discussion on how a planet's distance from the Sun affects its orbit. They should be able to see a relationship between these two variables.
- Ask if they are surprised at how many times Mercury orbits the Sun versus how many times Neptune gets in 100 steps.

(These activities were adapted from education.com and heart.org)

Assessment:

- Go back to their original Solar System drawings and ask students to redraw their Solar System picture with distances to scale (see if, by referring to their pocket Solar Systems, they can scale the drawing down so that it can all fit on an A3 sheet?)

Follow-up activities:

A mathematical activity:

Ask students to research how far each planet is from Earth.
Then calculate how long it would take to reach it if they were:

- Flying in a plane (900 km/h).
- Travelling by high speed rail (200 km/h).
- Driving in a car (80km/h).
- Power walking (10 km/h).

Cross-curricular Links:

Our Solar System

There are many opportunities to extend learning about the Solar System to other areas of the curriculum. Here are some suggestions:

Maths: Numeracy

- The activities described here touch on several areas from the Maths curriculum: 2-D and 3-D shapes, fractions. You could use measuring to calculate 'how big is the Moon?' using this ESERO activity. http://esero.ie/wp-content/uploads/2015/01/05_howbigisthemoon.pdf

SESE Geography

- These Solar activities will give children 'a sense of place and space' as set out in the Geography curriculum, i.e. our place is on Earth, which is part of vast space. You could explore physical features of the world (Earth) compared with those of other planets, in a discussion. Do other planets have mountain ranges, deserts, liquid oceans or rivers?

Drama

- Perform a play based on an adventure in the Solar System. Pluto is still included in this version; perhaps an adaptation could include a nod to Pluto's demoted status. Maybe children could also write a letter to the International Astronomical Union protesting Pluto's demotion, such as here: http://kardSunlimited.com/featured/holidays/the-day-we-killed-Pluto/
- Here's the drama activity: https://www.teachervision.com/tv/printables/TCR/1557345872_70-76.pdf
- Here's an idea for a play if you want to make up your own (script not included): https://www.teacherspayteachers.com/Product/Readers-Theatre-Solar-System-Play-748762
- Here's a scripted play about Pluto and its 'identity crisis': http://thegreatstory.org/plutoscript-kids.pdf

SESE History

- The introduction that these activities give to the Solar System could lead in to a nice discussion of space exploration for which you could use this resource from Space Kids as a starting point for discussion. Before any missions were sent into space, amateur astronomers were discovering the universe out there by observation using telescopes. A timeline is here: http://www.spacekids.co.uk/spacehistory/
- What other historical events were happening in the world at the same time as space was being explored in the 17th/18th/19th/20th century?

Cross-curricular Links:

Our Solar System

There are many opportunities to extend learning about the Solar System to other areas of the curriculum. Here are some suggestions:

Visual Art

- Once students understand the scales of all the planets, get them to make colourful papier mache models of the planets and hang them up in the classroom. For information about the planets' true-to life colours, see here: http://curious.astro.cornell.edu/about-us/58-our-solar-system/Planets-and-dwarf-Planets/Planet-watching/249-what-color-is-each-Planet-intermediate
- And a description of how to make papier-mache planets: http://lasp.colorado.edu/education/outerplanets/lessons/grades3-5/A%20Classroom%20Solar%20System.pdf

English: Literacy

- Use http://www.spacescoop.org/en/ as an inspiration point for children both to read about and then to write about their favourite topics in space. You could pick three stories, ask children to vote on which one they'd prefer based on the topic and read it out to the class, then ask them to write a short story and draw pictures. The articles are written in child-friendly language and are available in several different languages so are suitable for classes where not all children have English as their first language.

SESE Science Links

- Strand: Environmental awareness and care. This lesson on the Solar System could be linked with the Environment to help students understand that the Earth has finite resources and to foster an appreciation of the ways in which these resources are used (renewable versus non-renewable). This could be linked with a discussion on space travel and whether other planets could/should be mined in the future for their resources.

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