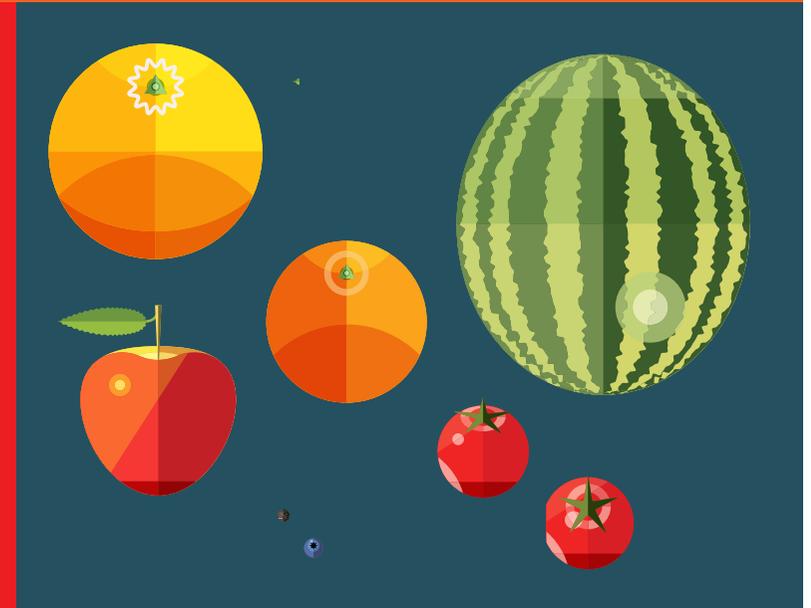


THE SUN AND OUR SOLAR SYSTEM

SCIENCE

Learning objectives

- ◆ Describe the movement of the Earth, and other planets, relative to the Sun in the Solar System
- ◆ Describe the movement of the Moon relative to the Earth
- ◆ Describe the Sun, Earth and Moon as approximately spherical bodies
- ◆ Use the idea of the Earth's rotation to explain day and night and the apparent movement of the Sun across the sky



THE SUN AND OUR SOLAR SYSTEM

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THE SUN AND OUR SOLAR SYSTEM

DISCOVER



Duration: 60 – 90 mins

Setting the scene

This activity will support pupils to understand the various sizes of the planets in our Solar System, in relation to each other. You might like to start this session by asking some of the questions below to stimulate a class discussion and prompt pupils to make an educated guess as to which planet each item represents.

How many planets are there in our Solar System?

Can you name any/all of them?

Which planet do you think is the biggest?

Are the planets the biggest things in our Solar System?

Activity: Fruit Solar System

Share the information in the factsheet 'Exploring our Solar System' with the pupils. Ask prompting questions once the information has been read to the pupils.

Then move on to undertaking the fruit Solar System activity described below:

Equipment needed (per group):

- ◆ 1 watermelon
- ◆ 1 large grapefruit
(or pomelo if available)
- ◆ 1 large apple
- ◆ 1 orange
- ◆ 2 cherry tomatoes
- ◆ 1 (large) blueberry
- ◆ 1 peppercorn

Optional: 3 large umbrellas or skipping ropes can be used to outline a large circle if preferred.

If obtaining the fruit is inconvenient, Play-Doh spheres can be made to similar dimensions for the smaller planets and bouncy balls can be used for the biggest ones.

Instructions

You can either choose to undertake this activity as a whole class, or group of pupils so that all pupils can take an active part in the activity. If you're going to group pupils then you'll need to multiply the equipment needed by how many groups you have.

Place all items on tables, either of groups, or at the front of the classroom. Start by telling pupils that four of the objects will be gas giants, as we have four planets which are gas giants. The other four will be the terrestrial (or rocky) planets. Encourage pupils to separate the objects into two groups of four, to represent the gas giants and the terrestrial planets.

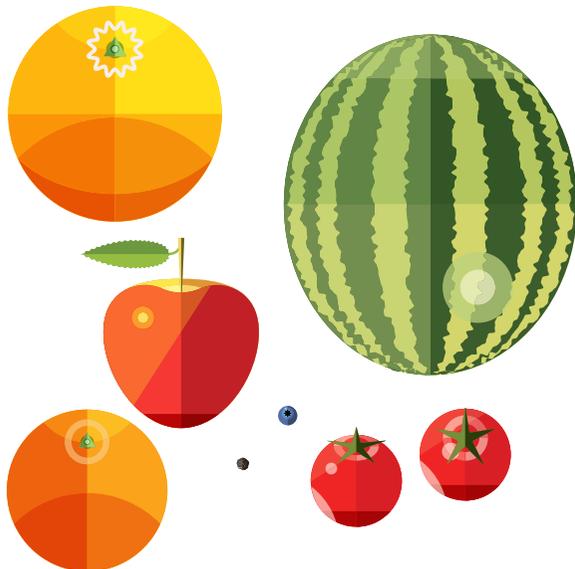
Then ask pupils to use what they learned from the 'Exploring our Solar System' factsheet to identify which planet matches with which object.

THE SUN AND OUR SOLAR SYSTEM DISCOVER



The objects are matched to their respective items below:

- ◆ Peppercorn: Mercury
- ◆ Cherry Tomatoes: Venus and Earth (If one is slightly larger than the other, the larger one should be Earth.)
- ◆ Large Blueberry: Mars
- ◆ Watermelon: Jupiter
- ◆ Large Grapefruit: Saturn
- ◆ Apple: Uranus
- ◆ Orange: Neptune



You could give the following hints to pupils who are having difficulty with the task. You may like to print these out for less confident pupils:

- ◆ 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 correct objects?
- ◆ One item should remain for Mars

Finally, ask pupils to order the planets by distance from the Sun. Since the distances involved are too big for the classroom, the objects can simply be placed beside each other.

Extension activity

If you'd like to extend this activity then you could ask pupils to order the planets so that there is a representation of distance. You can use the distances relative to the Sun-Earth distance which we can set as 1m. You can use the three large umbrellas to represent the Sun. Pupils will need to be able to accurately measure using a 30cm ruler and a 1m ruler (or longer if you have one). This activity is probably best completed outside or in the hall. See the table below for distances:

Mercury	40cm
Venus	70cm
Earth	1m
Mars	1m 50cm
Jupiter	5m 20cm
Saturn	9m 50cm
Uranus	19m
Neptune	30m

THE SUN AND OUR SOLAR SYSTEM EXPLORE

Explore activities: Space In London

You might like to focus your visit on allowing the pupils to extend their knowledge of the Sun and our Solar System.

Royal Observatory Greenwich

Blackheath Ave, London SE10 8XJ
020 8312 6565
bookings@rmg.co.uk

An obvious trip to accompany this topic is the Royal Observatory in Greenwich. The museum has a comprehensive schools offer. Please note that there is a charge to visiting the museum and to accessing schools workshops.

www.rmg.co.uk/plan-your-visit/schools/royal-observatory



ROYAL OBSERVATORY GREENWICH
© National Maritime Museum, Greenwich, London



Science Dome

Science Dome has a base in London and they can bring a mobile planetarium to your hall. They offer several different shows on themes of space and the Solar System and they can do up to five shows per day for a fee.

www.sciencedome.org.uk/index.html



SCIENCE DOME
© sciencediscoverydome

THE SUN AND OUR SOLAR SYSTEM EXPLORE

Science Museum

Exhibition Rd, London SW7 2DD
020 7942 4000
edbookings@sciencemuseum.ac.uk

The Science Museum also offers a range of school visit opportunities, as well as a specific 'we visit you' workshop entitled 'Mission to Mars.' To find out more about the visit opportunities at the Science Museum, or to book a trip, you can visit their website:

www.sciencemuseum.org.uk

The permanent exhibition 'Exploring Space' supports pupils' learning about the science of space exploration. The exhibition gives information on how we've sent spacecraft to other planets, walked on the Moon and peered into the heart of our galaxy and beyond. Find out more about this exhibition on the website:

www.sciencemuseum.org.uk/visitmuseum/plan_your_visit/exhibitions/exploring_space

Additionally, the IMAX Theatre at the Science Museum screens a range of films that are often strongly linked with space exploration. You can check the available screenings here:

www.sciencemuseum.org.uk/visitmuseum/plan_your_visit/imax

Please note that there is a charge for the IMAX screening.



EXPLORING SPACE EXHIBITION,
SCIENCE MUSEUM

© Science Mudeum

THE SUN AND OUR SOLAR SYSTEM

CONNECT



Duration: 60 mins (not including setup)

Setting the scene

Recap on the learning accessed during the Explore visit. Ask pupils to share knowledge that they gained from the visit and recap on the organisation of the planets in our Solar System.

Activity series 1 presents a series of practical activities exploring the concept of Day and Night. The practical activities follow on from each other so as to build pupils' learning about Day and Night in stages.

Activity series 2 allows pupils to utilise their research skills to create a class display about the Solar System.

Activity series 1: Day and Night

This activity is about the concepts of Day and Night. It should also help pupils to understand why an ancient scholar such as Ptolemy would have concluded that the universe was geocentric. (Earth should rotate from West to East, so that if looked down on from above they would be going anti-clockwise. But it does not matter too much for this exercise so long as each Earth spins in the same direction.)

There is also the option of an extension activity to consider eclipses and the phases of the Moon.

Tables in the centre of the classroom should be cleared to leave a large area free, then the classroom darkened.

Explain to the class that they'll be undertaking a series of practical activities about night and day. Arrange the class around the perimeter of the classroom. Encourage them to think of themselves as stars in our Solar System. They should all have torches, but their light would interfere with the experiment.

Also, it would be useful for the majority of the class (the audience) if they experienced the view from different positions relative to the Sun. However rather than all of them moving around the room each time, just get each child who plays the Sun to stand in a different position in the room. Then everyone gets to view "Earth" from the light side and the dark side.

Now follow the below series of activities, one after the other.

THE SUN AND OUR SOLAR SYSTEM

CONNECT



Activity 1A

A pupil is chosen to be Earth and stands in the middle of the room. Another pupil with a bright torch stands to one side as the Sun. Earth (slowly) rotates while the torch light is aimed at their tummy. The rest of the class sits around the perimeter of the room and calls (or whispers) out whether one particular side of Earth (the tummy) is in day or night for say four rotations.

Activity 1B

Two different pupils are chosen to be Earth and Sun. This time Earth holds a tiny character (called Tiny) in front of their tummy. Perhaps a Lego mini figure or even a small drawing of a stick person. Again as Earth rotates four times, the rest of the class will chant out whether the character is in day or night. But before they start, there is a question to think about:

Would Tiny know that she is on a planet which rotates?

After the rotations and chants the class can briefly discuss their answers. There is no reason for Tiny to think that she is rotating. All that she can see is Tummy-Land. She would think that she, and Tummy-Land, are staying still.

Pupils know that our planet spins, but do they notice? They only know it because they have been told. The equatorial part of our globe spins at 1670km/ hour. It is less at our part of the world (at our latitude we describe a smaller circle than the equator does). But even so – can we really feel, as we stand here, that we are on a planet

spinning at high speed?

Activity 1C

Another two pupils have a go as Earth and Sun, again with Tiny living on Tummy-Land. Before the four day and night rotations begin, there is another question to think about:

If Tiny does not know she is on a rotating globe, how would she explain the fact that the Sun is sometimes shining on her, and sometimes not?

(She has never been to Shoulder Blade Mountains on the other side of her planet. She has no way of communicating with anyone who lives there. So she cannot realise that the other side of her world is in darkness when she is in daylight.)

After the day and night rotations, what are the pupils' thoughts? Does it seem to Tiny that the Sun travels around her?

THE SUN AND OUR SOLAR SYSTEM

CONNECT



Activity 1D

Another pair of pupils take up the roles of Sun and Earth, again with Tiny. But this time Earth rotates **very slowly** a couple of times. Audience chants not “day” and “night” but “sunrise” “midday” “sunset” “midnight” “sunrise” etc. as appropriate for Tiny character. The class considers this question:

How would the changing sky look to Tiny?

Even the audience – the Stars. Would it seem to Tiny that the Stars are travelling around her too?

Activity 1E

If teachers trust a pupil to hold their mobile phone, they could even get another pupil playing Earth to hold the phone in film mode near their tummy instead of Tiny as they rotate. This would show the view that Tiny has. Or the teacher herself could play Earth for a few rotations.

What do pupils notice when they watch the film afterwards?

Does it seem like the Sun is moving, rather than the Earth is moving?

Also watching this film, can they see the Stars which are behind where Sun is shining from? Or can they only see the brightness of the torch in that direction? From watching the screen, does it seem like the phone is on a planet which is turning? Or does it look like everything else is revolving around the Earth?

THE SUN AND OUR SOLAR SYSTEM

CONNECT



Extension

Duration: 20 mins

This series of activities can be extended to allow pupils to consider the movement of the moon.

With Earth and Sun in similar positions as before, another pupil (Moon) revolves around Earth, about two metres away, given enough space. Moon always keeps their face pointing inwards towards Earth but they walk ultra-slowly, much slower than Earth's rotation. Sometimes Moon will block the light from Sun. Then they will have their back to the Sun and their front (towards Earth) will be in shadow. Tiny will experience a solar eclipse.

Sometimes Earth will block the light falling on Moon, a lunar eclipse. Moon's front will be in sunlight just before and straight after it is eclipsed by Earth. Sometimes only one side of Moon will seem illuminated to Tiny.

Pupils consider: *How does the light falling on the person being Moon equate to the phases of our real Moon?*

Also: *Why does the Earth not experience a solar eclipse every month?*

(It is to do with alignment. The Moon revolves around Earth at a 5 degree angle to the plane in which Earth revolves around the Sun. So it is not often that the three bodies are all in alignment.)



THE SUN AND OUR SOLAR SYSTEM

CONNECT



Duration: 150 mins

Activity series 2: Solar System Display

60 mins: research and planning.

60 mins: creating pictures and texts
to share and display.

30 mins: examine everyone's information
and discuss anything surprising.

Explain to pupils that this activity will support them in practicing their research skills and to work in groups to create a large class display about the Solar System.

Pupils should work in groups of three or four, and each group will be allocated a particular planet with one group allocated the Sun. Perhaps the teacher can pull a planet name "out of a hat" for each group to allocate who works on which planet.

It is recommended that pupils are directed to start their research using the 'Kids' section of the European Space Agency website:

<http://www.esa.int/esaKIDSen/OurUniverse.html>

Another useful source (which is mentioned on the NASA website) is called Amazing Space, pupils can scroll down the Fast Facts section:

amazingspace.org/resource/resource_index/solar_system/topic#fast_facts

Ask pupils to use the same metric units, so that all the information is easy to compare.

Also, all the statistics could be gathered into a big table as part of the display, for ease of comparison. Ask pupils to find statistics on the following, for their assigned planet:

- ◆ Diameter
- ◆ Orbital period (how long to travel around the Sun)
- ◆ Rotational period (how long to rotate on its axis)
- ◆ Temperature range or average temperature.
- ◆ How many Moons?
- ◆ Any Rings?
- ◆ Magnetic field?
- ◆ Atmosphere?
- ◆ Gravitational field, compared with the Earth?

THE SUN AND OUR SOLAR SYSTEM

CONNECT



For data on gravity, a handy website is:

www.phys.org/news/2016-01-strong-gravity-planets.html

Ask pupils to find their planet's gravity value in g. This is not to be confused with grammes. It is a convenient way of comparing the force of gravity on another body as compared with that on Earth. So Earth's force of gravity would be 1g and the force on other planets would be more or less than 1g.

In addition to the statistics gathered, each group should compose a short text about an interesting feature of their planet.

Suggestions for interesting facts include:

- ◆ Mercury: unusually heavy core and density, also the presence of (water) ice
- ◆ Venus: atmosphere and 'greenhouse effect'
- ◆ Earth: the oceans (liquid water is so unusual in the Solar System)
- ◆ Mars: Olympus Mons and the Valles Marineris
- ◆ Jupiter: the Great Red Spot and Ganymede
- ◆ Saturn: Rings and Titan
- ◆ Neptune: Great Dark Spot and wind speeds
- ◆ Uranus: Axial tilt and seasons (Uranus rotates on its side compared with other planets. This makes its seasons very different from other planets.)
- ◆ Sun: Coronal Mass Ejections and their effect on Earth.

Extension

If any groups finish very quickly, they can also do a small piece to add to the display on one of the following: the Asteroid Belt, Meteorites, Comets (including Halley's Comet). For this, it is more interesting to find general information rather than trying to gather all the statistics as above.

After the display has been created, it would be good to facilitate a discussion around the following:

- ◆ Compare the rotational periods of all the planets. Any surprises?
- ◆ Compare the temperatures of each planet, starting nearest to the Sun. Is there a surprise here too?



FACT SHEET 1: EXPLORING OUR SOLAR SYSTEM

Our Solar System is fascinating. It is also very complex and it has taken scientists many years to identify how it works. This factsheet will introduce you to some of the most interesting and important facts about how our Solar System operates.



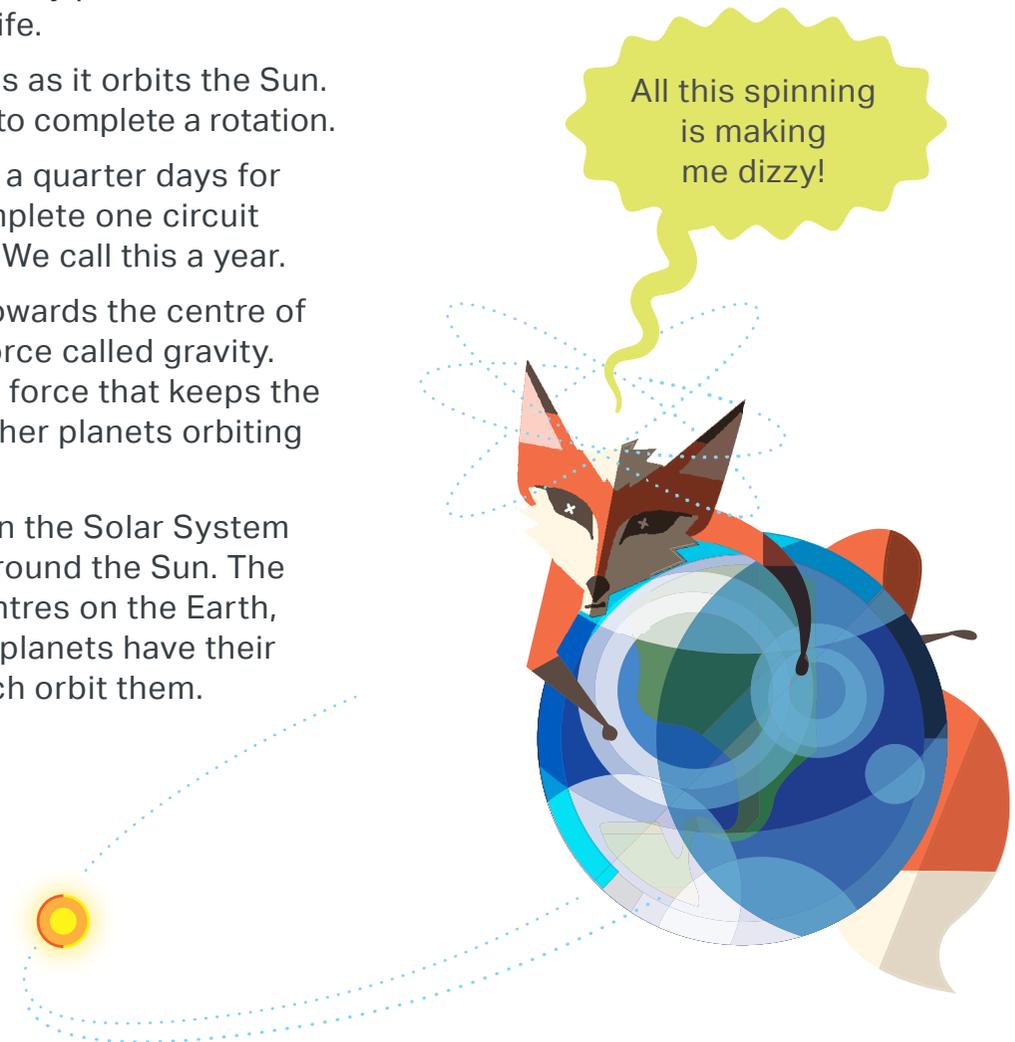
EARTH AND THE SUN
ELEMENTS OF THIS IMAGE FURNISHED BY NASA.

FACT SHEET 1: EXPLORING OUR SOLAR SYSTEM



Our Solar System: Top 10 facts

1. The Solar System includes the Sun, the Earth and seven other mainly spherical planets. Also, asteroids and comets.
2. The planets orbit around the Sun. An 'orbit' is a path or course that a planet takes around the Sun.
3. The Sun is a star – a massive spherical ball of hot gases that generates light and heat.
4. The closest planet to the Sun is Mercury, and the farthest away is Neptune.
5. The biggest planet is Jupiter, and the smallest planet is Mercury.
6. The Earth is the only planet that we know supports life.
7. The Earth rotates as it orbits the Sun. It takes one day to complete a rotation.
8. It takes 365 and a quarter days for the Earth to complete one circuit around the Sun. We call this a year.
9. You are pulled towards the centre of the Earth by a force called gravity. This is the same force that keeps the Earth and the other planets orbiting around the Sun.
10. Not everything in the Solar System orbits directly around the Sun. The Moon's orbit centres on the Earth, and many other planets have their own moons which orbit them.





FACT SHEET 1: EXPLORING OUR SOLAR SYSTEM

The Planets

The Earth is just one of eight planets that travel around the Sun.

The other planets are called Mercury, Venus, Mars, Jupiter, Saturn, Uranus and Neptune.

You'll explore the relative sizes of the planets in the Discover activity, but the mnemonic below can be used to help you remember the order of the planets:

My Very Educated Mother Just Served Us Nachos

Why not make up your own?

Can you make up another mnemonic to include the Asteroids which lay between Mars and Jupiter? They should not be ignored, after all some of the asteroids are bigger than Pluto, which is a dwarf planet.



FACT SHEET 1: EXPLORING OUR SOLAR SYSTEM



Royal Observatory Greenwich

London is home to one of the most important historic scientific sites in the world, the Royal Observatory in Greenwich.

The building of the observatory was ordered by King Charles II in 1675. For nearly 300 years, it was a working observatory, where Astronomers would investigate the positioning of the stars and planets. The first two Astronomers Royal – John Flamsteed and Edmond Halley – plotted all the stars visible in the northern and southern hemispheres.

The work of astronomers eventually led to the establishment of Greenwich Mean Time (GMT). At the Washington Meridian Conference of 1884, GMT was accepted as the time standard for the world.

You might like to find out more about the role of the Greenwich Observatory on your Explore visit. You can also find out more about the history of the Greenwich Observatory, and what it now offers as a museum, on the website:

www.rmg.co.uk/royal-observatory

