Transit Of Mercury



Monday 11th November 2019 Teacher's Activity Pack

1820

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Contents

Types of Activities	4
Teachers' Background Information	5
Safely Viewing the Transit of Mercury	6
Don't Look At The Sun Web quest	7
Safety Word search	9
Mercury Cryptograms	10
Spot the Mistake	13
Acrostic Poems	16
Mercury's Crater Maths	22
Mercury's Craters Investigation	24
Mercury Cupcakes	27
Composition of Mercury	28
Mercury Word Jumble	30

Types of activities in this book.

Look out for these symbols throughout the book for cross curricular links.





Practical/ Hands On



Difficulty ratings

Each student hand out comes with a difficulty rating: the more planets the more difficult the task. As a guide, 1 planet should suit a midability year 3 pupil, whereas 5 planets should suit a mid-ability year 8 pupil.



Student handout

Teacher notes

Teachers' Quick Background Information

What is the transit of Mercury?

This is when Mercury (the closest planet to the sun) comes between the Earth and the Sun. It can be seen as a small dark circle moving across the Sun.



The 2006 Mercury transit seen by SOHO. Picture from soho.nascom.nasa.gov



Jeremiah Horrocks observing the 1639 transit of Venus. Picture from venus.aeronomie.be

How often does it occur?

The transit of Mercury occurs 13-14 times a century, although the transits cannot always be seen from the UK. Transits only occur during May or November.

Will we be able to see the event with our eyes?

No. Mercury is very small in comparison to the Sun, so you will need to use either a projector or telescope. You must however make sure your pupils do not look directly at the Sun - if you turn to page 5, you will find ways of observing the event safely in your classroom or playground. Remember, like all astronomical events weather will have an impact, so make sure you have a rainy day back-up plan!



Mike Dumelow observing the transit of Mercury in 2003 using a solar filter at the end of the telescope. Picture from derbyastronomy.org

How can I link this event with the curriculum?

Like all astronomical events the links are endless. You may wish to combine it into an art lesson by getting your students to draw pictures of Mercury, or an English lesson where students write their own poetry. The transit was also viewed on the day of Charles II's coronation so it can also be brought into history lessons as well. This book is designed to give you some ideas and inspiration as well as differentiated pre-

Picture from www.exploratorium.edu

Safely viewing the transit of Mercury

Warning: Looking directly at the Sun for a prolonged period of time can cause permanent damage to the retina, leading to loss of vision or blindness.

To observe the Sun safely you need to filter out more than 99% of the Sun's light before it reaches your eyes. Mercury will appear very small and so you will not be able to see it without using one of the methods below.

Option 1: SolarScope

These relatively cheap solar projectors are an easy way to view the Sun. They start from £65, and they can also be used to monitor sunspots for other school projects. Several people can observe at the same time. www.solarscope.org

Option 2: Online Viewing

Several observatories will be showing live streams. Although this will take some of the excitement away, it will give you a clear view of what is happening and all your students will be able to watch it at the same time.

Option 3: Telescopic Viewing

If your school already has a telescope you must ensure you have a good quality filter over the telescope's front (never use the filter at the eye end as it may crack or melt in the concentrated heat). Viewing with a telescope will give the best views of sunspots.



Option 4: Optical Projection

Pinhole cameras will not work for viewing a transit of Mercury. You will need to use some binoculars to project it. DO NOT LOOK THROUGH THE BINOCULARS, OR PLACE YOUR HAND OR ANYTHING FLAMMABLE IN FRONT OF THE EYEPIECE. Trace the binocular lenses onto the side of a cardboard box. Cut out two eye piece lenses and place the binoculars through. Cover one lens with a lens cover or duct tape, and seal around the binoculars' eye holes to ensure no additional light is getting through. Point the binoculars towards the Sun while holding a piece of white cardboard about 30cm behind the eyepiece. It may take a little effort to find the image of the Sun but once you do, focus the binoculars to create a sharp image of the Sun.







Don't Look at the Sun!- Web quest



Every time there is a solar event you will find astronomers warning you to never look directly at the Sun. Even more importantly, you should not look at the Sun through a telescope unless you have a professional solar filter that covers the front of the telescope. Why?

By the end of this activity you will fully understand the dangers of looking directly into the Sun. You will need to use the internet to help you research the following tasks. Remember to write down the website you used for each task.

Task 1: Find out what these different parts of the eye do. Image: Source: Image: Source: Image: Source im

Task 2: Answer the following questions.

1. How much of the light do you need to filter out to safely view the Sun?

2. What would happen to your eye if you looked directly at the Sun for too long without protection?

3. Why would you not feel pain if your eye was being burnt?

Task 3: Find three safe ways to view the transit of Mercury. Explain how the viewing should be set up and include a diagram.

Method 1:	Diagram
Mothod 2:	
Wietnod 2:	Diagram
Method 3:	Diagram
Source:	

Putting it all together: Choose one of the following options below

Option 1: Poster

Design a poster for your school stating the dangers of looking directly into the Sun. The poster should include a diagram of the eye, what will happen to the eye, and how pupils can safely view a transit of Mercury.

Option 2: Newspaper

Write an article for your local newspaper explaining how the public can safely view the transit of Mercury. Make sure the readers fully understand the dangers of looking directly into the Sun.

Option 3: TV Talk show

You are a presenter of a morning breakfast show, and you need to prepare a script where you will interview a famous astronomer on how to safely view the transit of Mercury. Make sure you think carefully about how the astronomer might try to explain the event to the public.

Transit of Mercury Safety

Find the words in the grid below

У	В	Е	Μ	0	Α	Α	Е	6	Ι	D	Т	В	U	D	У	0	V	Ι	R	
Α	D	D	Т	F	D	Т	х	Ν	I	Ι	Ρ	Х	S	Ν	L	w	Е	0	х	
Ι	Т	м	J	w	м	Е	R	С	υ	R	У	Х	υ	У	н	L	Ρ	Q	н	
L	Α	х	G	S	Ζ	L	R	н	L	D	У	В	Ν	Ρ	Ζ	Ι	6	G	В	
0	J	L	F	Q	0	Е	F	Α	L	Ν	L	U	R	Е	Т	L	Ι	F	G	
5	Q	Ν	Ρ	М	w	5	w	L	R	Ι	R	U	Е	Х	L	Ι	D	Ζ	н	
D	х	Ι	0	Т	L	С	G	Т	Ν	F	Ι	у	G	J	L	S	М	Ζ	0	
v	L	F	т	у	н	0	Q	D	Ρ	0	Ν	J	Ν	Ρ	Ι	0	Α	У	н	
R	υ	х	х	х	В	Ρ	Ν	н	Α	Ζ	м	Ι	Α	۷	Е	L	Е	к	Ν	
Ζ	х	м	Q	R	В	Е	к	υ	R	Α	У	R	D	0	м	Ν	G	В	5	
В	D	Ν	0	Е	S	J	н	У	υ	Ζ	Ζ	F	Q	Ν	J	Ι	Ρ	Е	Т	
Ρ	0	в	Ζ	5	Α	V	С	В	к	w	R	Е	Α	R	т	н	У	Ι	D	
Ζ	D	Α	Н	Q	F	J	Е	L	0	Н	Ν	Ι	Р	R	Т	Е	E	S	w	
R	L	D	Ν	0	Ι	Κ	υ	Q	Ν	м	w	Н	Α	В	Е	В	Q	0	Т	
D	Ν	У	У	Ι	х	L	н	м	т	Α	Α	L	Ι	0	х	м	E	J	J	
Ι	v	S	R	Е	т	6	Ι	Q	F	Α	х	х	Ν	U	G	w	Α	Q	S	
R	v	L	0	м	к	E	Q	Ν	Q	Ι	х	у	L	Х	v	F	S	С	к	
Е	м	S	м	Q	w	L	R	w	0	х	Q	0	Е	E	L	к	В	0	Ρ	
С	С	0	С	Q	Α	0	w	Ν	D	J	R	к	S	Α	w	J	У	Н	D	
т	Q	Ι	Е	Μ	L	Q	J	Е	w	0	Е	Ι	S	Α	С	Α	Н	U	v	
MERCURY					E	EARTH							SUN							
TELESCOPE				F	TLT	ER					D/	DANGER								
RE	RETINA					E	EYES								BLINDNESS					
PINHOLE					(CAMERA DIRECT														
IN	FRAF	RED				F	PAIN	NLES	55											

111

<u>Mercury Cryptograms</u> (All of these cryptograms spell out the same message "Looking directly into the Sun can cause permanent blindness")



8 6 20 7 24 26 17 17



Hint: there is a double 'O' somewhere in this sentence and a double 'S' towards the end.

00000

A	B	С	D	E	F	G	Η		J] К		- []		N	0	Ρ	Q	R	S	Т	U		W	' X	Y	Z
	6	10	10	21	20	7	4		24	20	3	26	18	23	6	5		20	7	23	10		23	9	26	
		17	13	7		18	12	7		18	12	13	17	26		14	26	3	22	12	7	26	7	23		
									1	в (62	20	72	24 2	6 1	17 '	17									

Hints:

The most common letter in N.

The second most common letter is E.

There is a double 'O' somewhere in this sentence and a double 'S' towards the end.

Spot the mistake

This student has written a paragraph about Mercury. However they have made lots of spelling mistakes. Can you find all 10 mistakes?



Mercury is th smallest plant in the solar system, it is
also the planet closest to the Sun. Mercury does not
have any moons and it only takes 88 day to orbit the
Sun. at night time it is very cold on mercery, it can be
-173°C, but during the day it is very hot at 427°C, the
hotest day ever recorded in england is 37°C! Like
Earth, Mercury has lot of mountains and valleys, but
humans canot live there because there is no water.
We know all this because a spacecraft called Mariner
10 when to mercury and took pictures of its surface.

Use a thesaurus to find alternative words for the words below and then rewrite the passage in your book.

Word	Synonyms
Very cold	
Lots of	
Very hot	
but	12

Spot the mistake



This student has written a paragraph about Mercury. However they have made lots of spelling mistakes. Can you find all 15 mistakes?

Mercury is th smallest plant in the solar system, it is also
the planet closest to the sun. Mercury does not have any
moons and it only takes 88 day to orbit the Sun, at night
time it is very cold on mercery it can be -173°C but during
the day it is plistering at 427°C, the potest day ever
ne ady it is blistering at 427 C, me hotest day ever
meconded in england is 37°C! Like earlin, Mercury has lot of
mountains and valleys, Mercury also has lots of craters
where meteroids have crashed into the planet. We know all
this because a spacecraft called mariner 10 when to mercury
and took pictures of its surface.

Use a thesaurus to find alternative words for the words below and then rewrite the passage in your book.

Word	Synonyms
Very cold	
Lots of	
crashed	
smallest	13

Spot the mistake



This student has written a paragraph about Mercury. However they have made lots of spelling mistakes. Can you find all 15 mistakes?

	mercury is the first planet in the solar system, it is also the
	smallest. mercury is a terrestrial planets, this means it is
	has a solid surface. Unlike earth there is no atmosphere on
	Mercury, therefore it dose no rain and it has no clouds, this
	also means there is nothing to protet the plant from
	meteorites. Mercurys surface is very similar to our Moon. It
	has alot of craters due to meteorite collisions. Two
	spacecraft have visited Mercury, the mariner 10 flew by in
	the 1970s and messenger went around the planet 4 000 time.
	before crashing into the planets surface in 2015
-	before crushing into the plunets surface in 2013.

Use a thesaurus to find alternative words for the words below and then rewrite the passage in your book.

Word	Synonyms
smallest	
therefore	
similar	
A lot	14

Acrostic Poem Teachers' notes



An acrostic poem is a type of poetry where the first letter in a line spells out a particular word or phrase.

Example:

<u>An acrostic poem</u> <u>Creates a challenge</u> <u>Random words on a theme</u> <u>Organised by the letter</u> <u>Select your words carefully</u> <u>To form a word from top to bottom</u> <u>Is the aim of this poetry style</u> Choose a word then go!

A less common and slightly more difficult type of acrostic poem is where the last letter of each line spells out the word or phrase.

We all know a poem Is a fun way to be creative They make us happier But also academic They provide more depth to our education menu They can be enjoyed by a child or a teenager So on a rainy day bring out these tasks and enjoy

The most difficult of these is where letters in the middle of the acrostic spell out the word or phrase.

Fancy writing <u>a</u> poem Pi<u>c</u>k a topic of your choice You can w<u>r</u>ite about anything Let y<u>o</u>ur imagination run wild Choo<u>s</u>e the right words Writing your <u>t</u>houghts on paper Nothing is <u>i</u>mpossible Be <u>c</u>reative!

Mercury Transit Acrostic Poem





Mercury Transit Acrostic Poem





Mercury Acrostic Poem





Mercury Acrostic Poem



Mercury Acrostic Poem





Mercury's Craters



Unlike Earth, Mercury does not have an atmosphere, therefore there is nothing to protect the planet. As a result the surface of Mercury is covered in craters, similar to our moon.

Scientists study Mercury's craters to see if they can find out what caused them, and when and how the craters were formed. This research helps scientists find out more about our Solar system and what might one day happen to our own planet.

Find out if your maths is good enough to be an ESA astrophysicist...



Mercury's surface

1. On this crater label the circumference, the diameter and the radius.

3. The Hokusai crater has a radius of 41.6 km, how big is its a) diameter and b) area



2 This crater has a diameter of 155 km, how big is its a) radius and b) area?



4. The giant spider of this crater has an area of 17,671 km². Calculate it's a) radius, b) diameter



Mercury's Craters



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Mercury's Surface



Mercury's Craters Investigation Teacher Guidance



This is a variation on the already popular crater investigation. It is a simple, fairly tidy experiment that produces the intended results each time, but there will always be slight errors (e.g. the students might not be holding it at exactly 5cm) which can lead to discussions at the end of the lesson.

Technicians List

For every two students: 1 tray filled with sand 15 centimetre ruler Metre ruler Marble

Conclusion Guide answers for all sheets:

Why did you repeat the experiment 3 times and calculate an average? <u>To identify any</u> anomalous results. If there was an anomalous result we did not include it in the average, making our results more reliable.

What did you notice? <u>As the height of the marble increased the crater became larger.</u> Why do you think this happened? <u>This happened because the further the marble fell the</u> <u>faster it went, since as it gains speed it gains kinetic energy.</u>

How could you improve this investigation? We could have measured the depth of the craters/ we could have compared our results with other groups/ we could have used items bigger than a marble and compared/ we could have measured the speed of the marble just before impact.

Could you explain this in terms of Newton's 2nd Law? The marble is pulled down by gravity with an acceleration of 10 metres per second per second. This means that the marble gets faster the further it falls (until it reaches its terminal velocity), and the faster it falls the bigger its deceleration will be when it collides with the ground. As Newton's 2nd law states force equals mass times acceleration, the greater the acceleration the greater the force, so the greater the impact with the ground.

Mercury's Craters Investigation

Context:

Mercury is a rocky planet with virtually no atmosphere. As a result there are a lot of meteor collisions, and each time a meteor collides it forms a crater. In this investigation you will investigate how the speed of the meteor affects the size of the crater.

You will need:

A tray filled with sand, a metre ruler, a marble, a 15cm ruler

Method:

- 1. Hold the ruler up next to the sand.
- 2. Hold the marble at 5cm and drop the marble.
- 3. Carefully remove the marble and measure the diameter of the crater.
- 4. Repeat three times and calculate the average.
- 5. Repeat the experiment for the different heights.



<u>Results:</u>

Height of	Diamet	Average		
marble (cm)	1	2	3	(mm)
5				
10				
20				
40				
50				
75				
100				

Highlight the two columns you should plot into a line graph.

Use this checklist to help you draw your graph:

- Label your x axis
- **Label your y axis**
- Choose a sensible scale
- Plot your points carefully
- Draw a line of best fit

Conclusion:

Why did you repeat the experiment 3 times and calculate an average?

What did you notice? _____

Why do you think this happened? ______



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- 5. Repeat the experiment for the different heights.



Is this data continuous or discrete?

Plot these results in a line graph.

Results:

Height of	Diame	Average		
marble (cm)	1	2	3	(mm)
5				
10				
20				
40				
50				
75				
100				

Conclusion:

What did you notice? _____

Why do you think this happened? ______

How could you improve this investigation?_____





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- 5. Repeat the experiment for the different heights.



<u>Results:</u>

Height of	Diamet	ter of crate	er (mm)	Average	Is this data continuous or
marble (cm)	1	2	3	(mm)	uscreter
5					Which type of graph
10					should you use to show
20					this data?
40					Line graph
50					Pie chart
75					
100					Plot these results into a
					suitable graph.

Conclusion:

What did you notice? _____

Why do you think this happened? ______

Could you explain this in terms of Newton's 2nd Law?_____



Mercury Cupcakes

Mercury is a planet which is very close to the Sun, and it has a rocky surface with lots of craters. There are three major things that shape Mercury's surface today: meteor impacts, solar winds and solar radiation (i.e. heat). In this activity you are going to investigate how these affect the surface.



You will need:

Your favourite type of cupcakes (already cooked and cooled), icing sugar, silver chocolate balls, edible shimmer spray.

Step 1:

Carefully cut away the top of your cupcake to make a slight inward dent.

Step 2: Make the icing and pour it into the dent, and leave it to set for approximately 5 minutes.



Step 4:

Now let's see how the solar wind affects the surface. Spray the shimmer spray from the side of the cupcake across the top. Watch what happens to the surface - does it move at all? Try spraying the spray from different angles.



Step 3:

Drop the chocolate balls from different heights onto the cupcake. Try throwing the balls from different angles, like different meteors hitting the surface. Look carefully at the icing: how have the different drops affected it?



Composition of Mercury



Read this article from universetoday.com and answer the questions below.

Mercury is a terrestrial planet, like all of the 4 inner planets: Mercury, Venus, Earth and Mars. It's the smallest of them, and has a diameter of only 4,879 km at its equator.

Astronomers have estimated that Mercury is composed of approximately 70% metals and 30% silicate material. In fact, it's only slightly less dense than the Earth, with a density of 5.43 g/cm³.

Since Mercury is smaller than Earth, its gravity doesn't compress it down as much, so it actually has much heavier elements inside it. Geologists estimate that its core is very large, and mostly iron. The core probably accounts for 42% of Mercury's volume, while Earth's core is just 17% of our planet.

The core itself is about 3,600 km across. Surrounding that is a 600 km thick mantle. And around that is the crust, which is believed to be 100-200 km thick. The crust is known to have narrow ridges that



Figure 1: Interior of Mercury

extend for hundreds of kilometres. Planetary scientists think that the ridges formed when the planet cooled and contracted underneath the crust, causing it to collapse down.

One reason to explain why Mercury has such a large core is that it was impacted by a large planetesimal* early in its history. The impact would have stripped away much of the planet's crust, leaving just the thick iron core. A similar process also explains the formation of the Moon. It's also possible that Mercury formed before the Sun's energy output settled down. If it had twice its original mass, the Sun could have vaporised the surface of the planet, blasting it away with its powerful solar wind.

*Planetesimal: An object made of dust, rock and other materials. They can be hundreds of kilometres wide.

- 1. What are the four terrestrial planets?
- 2. How much of Mercury is made up of metals?
- 3. What are the three layers of Mercury and how thick are they?
- 4. Give two possible explanations for why Mercury has such a large core.
- 5. How is Mercury similar to the Moon?
- 6. Compare and contrast Mercury with Earth.

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*Planetesimal: An object made of dust, rock and other materials. They can be hundreds of kilometres wide.

- 1. What are the four terrestrial planets?
- 2. How much of Mercury is made up of metals?
- 3. What are the three layers of Mercury and how thick are they?
- 4. What is the main element in the core?
- 5. How was our Moon formed?
- 6. What is the density of Mercury?

Mercury Word Jumble Unscramble the words below.

1.	Ters	sitraerl								
2.	Mre	urcy								
3.	Sun									
4.	Tias	rnt								
5.	Ctrr	aes								
6.	Core	e								
7.	Mina	ate								
8.	Cru	st								
9.	Arei	rotsnmos								
10.	Erta	h								
11.	Ovr	esbe								
12.	Тро	lcesee								
13.	Fltie	er								
14.	Eye	S								
Trar	nsit	Mercury	Sun	Earth	n Astr	ronomers	Telescope	Mant	le Core	e Filter
			Terres	trial	Crust	Craters	Observe	Eyes		

NI	2	m	0	•
IN	a		c	•

e:		_								•
		Unscr dictic	<u>n</u> amble onary t	<u>Mercu</u> the w to help e	ry Word Ju vords belo o you write ach word.	umble w and t e a defi	then us inition	e a for		
1.	eetsTlrrira									
2.	Meyurrc									
3.	nSu									
4.	istanrT									
5.	arrsCet									
6.	reoC									
7.	tlMean									
8.	ruCts									
9.	rsrmnestooA									
10.	hraEt									
11.	bevOser									
12.	Tsopcleee									
13.	Feilrt									
14.	eEys									
	Transit Ea	rth Ey	ves M	lantle	Craters	Core	Crust	Sun	Filter	
	Astron	omers	Merce	ury T	errestrial	Teles	cope	Observe	5	

NI	2	m	2	•
1 1	a		c	•

e:			å
		Mercury Word Jumble Unscramble the words below and then write a definition for each word.]] () ()
1.	erltresiatr		
2.	myrceur		
3.	sun		
4.	ntatrsi		
5.	scrrtea		
6.	reoc		
7.	Inmaet		
8.	rscut		
9.	rmrsnaosoet		
10.	hrate		
11.	vesreob		
9. 10. 11.	rmrsnaosoet hrate vesreob		

Ŋ

12. spoeeetlc

13. elfrti

14. seey

Eyes	Ea	rth	Astronomers Su		Sun	Crust	Crust Mer		Craters	Terrestrial
		Mantle		Transit	Filter	Telesc	ope	Core	Observ	e