STEM Club

LET'S EXPLORE THE UNIVERSE TOGETHER!

GO ASTEROID HUNTING

SPACE ART

MAKE YOUR OWN SUNDIAL

AND MORE...

PROUD TO BE PART OF

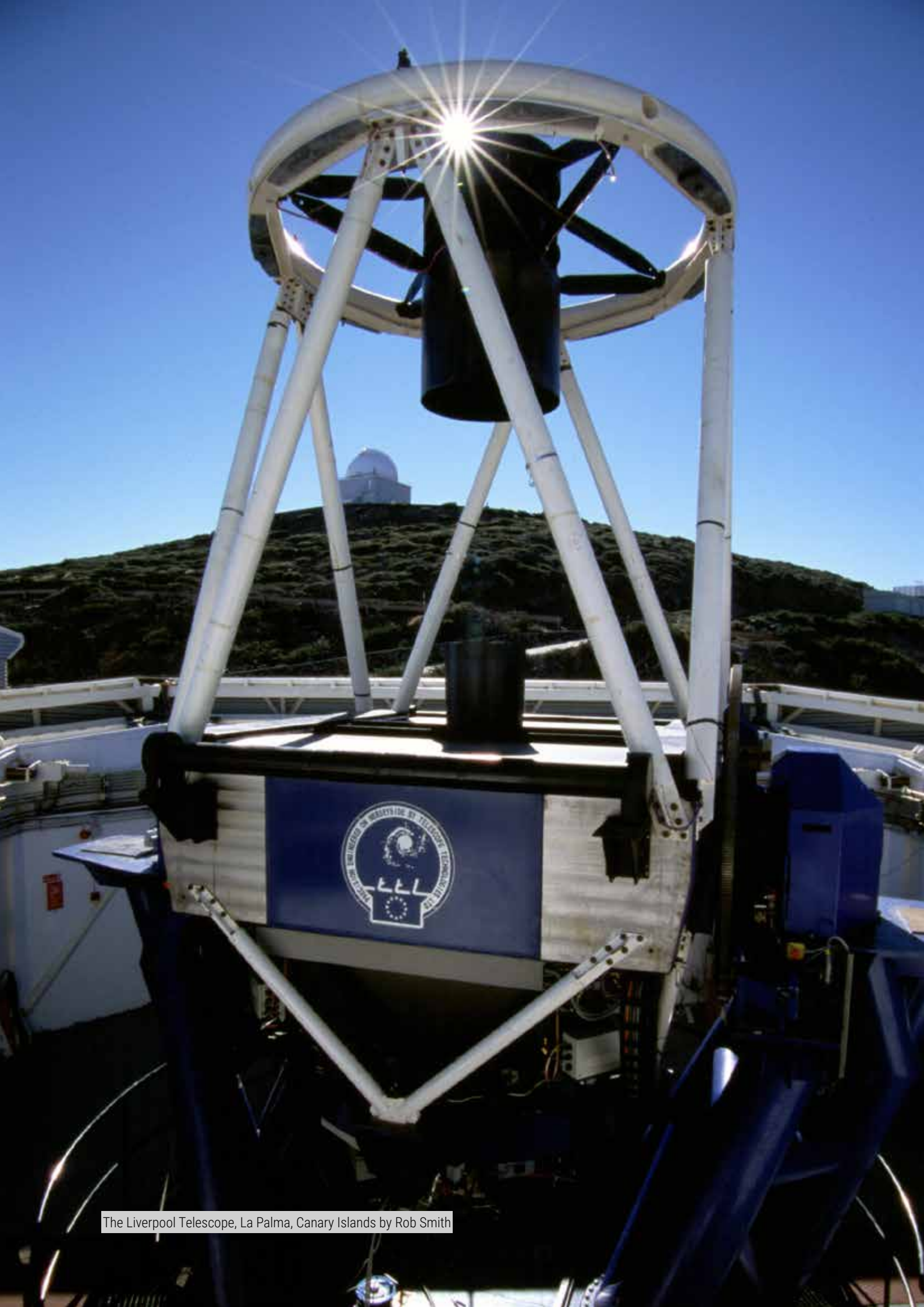
LIVERPOOL JOHN MOORES UNIVERSITY

Arp 142: The Penguin and the Egg by NASA-ESA/STScI/AURA/JPL-Caltech

SILVER
PRIMARY EDITION

nso

NATIONAL SCHOOLS' OBSERVATORY



The Liverpool Telescope, La Palma, Canary Islands by Rob Smith

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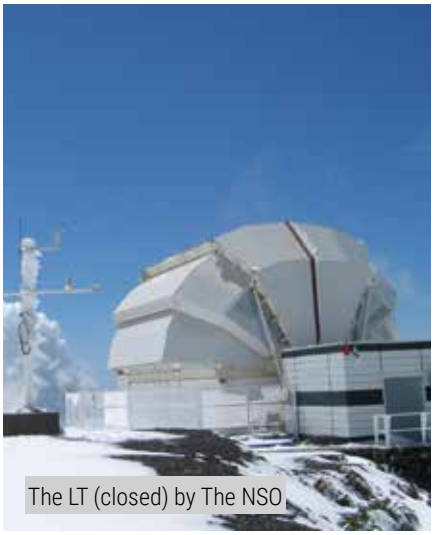

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SESSION 1: DAY AND NIGHT

In this session you will be using a ball of Play-Doh and a torch to discover how the rotation of the Earth causes day and night. You will also be creating your very own sundial to see how the Sun can be used to tell the time.

INTRODUCTION

We have day and night because the Earth spins. It takes 24 hours (one whole day) to make a complete turn. The Earth spins at over 1,500 kilometres per hour – that's over 4 times faster than a Formula 1 car at top speed!

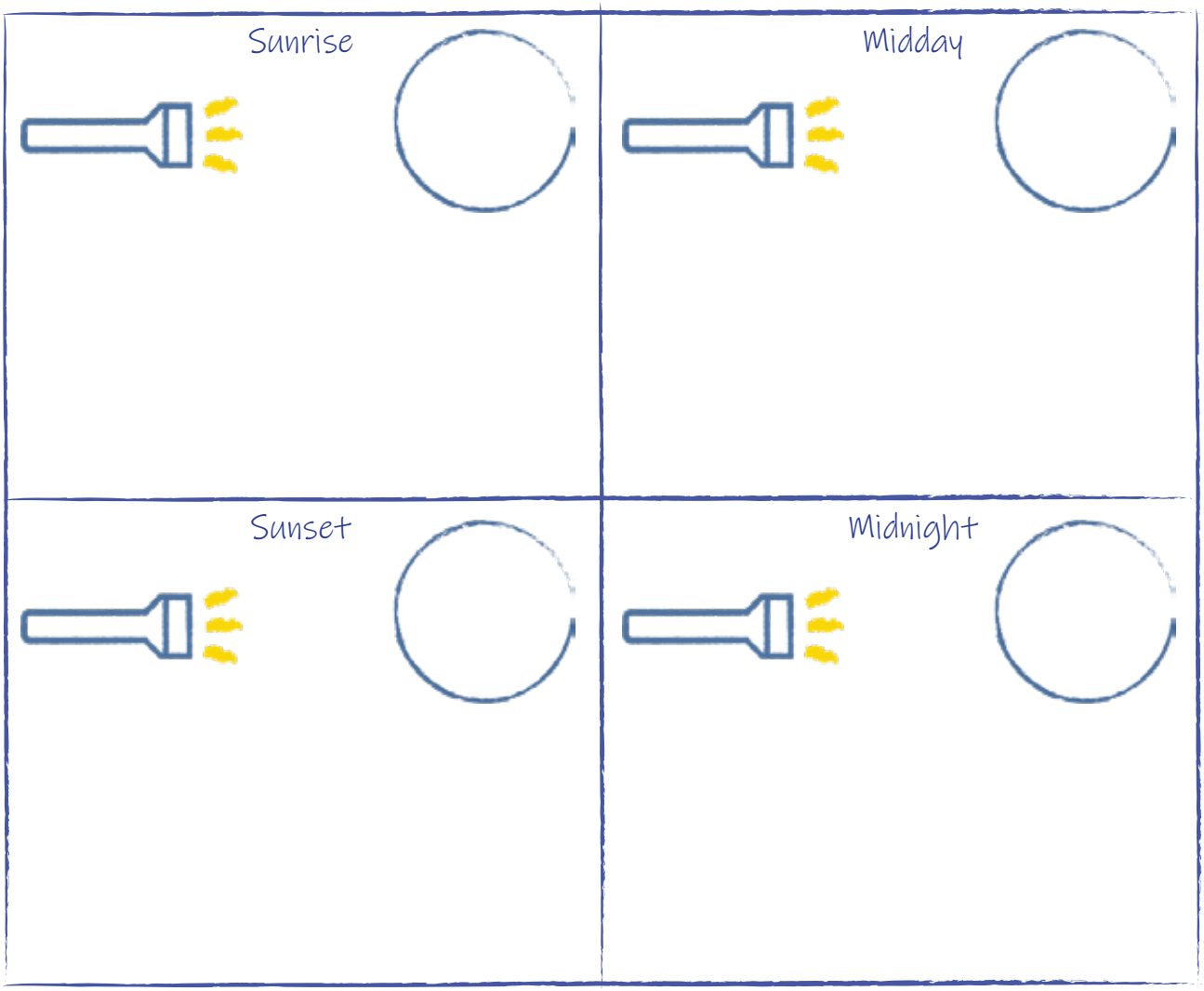
The Sun is always shining but because the Earth is spinning only half of the Earth can see the light from the Sun. The half of the Earth that is facing towards the Sun is in day-time. The other half of the Earth that is facing away from the Sun is in night-time and has no sunlight.

The Sun appears to rise in the East in the morning and set in the West in the evening. The Sun is not moving but looks like it is because the Earth is spinning.

Nightfall over Europe and Africa by NASA

ACTIVITY 1: CREATE YOUR PLAY-DOH EARTH

1. Your STEM Club Leader will give you some Play-Doh, shape this into the planet Earth. Mark where you are on the Earth using a pencil or a blob of Play-Doh.
2. Place your Play-Doh Earth onto the end of your pencil. Do this carefully, you don't want to squish your globe! You should now be able to make your Earth spin by turning the pencil.
3. Working in pairs, one person holds and slowly rotates the pencil anti-clockwise. The other person shines the torch on the Play-Doh Earth. Make sure the keep the torch steady! You should notice that half the Earth is in light (daytime) and half is dark (night-time) at any time.
4. Now find the location marker you made earlier. Rotate the Earth until the mark is where you think it would be at the following times of day: sunrise, midday, sunset and midnight. Make sure to keep the torch still!
5. In the four boxes on the next page, draw a diagram (or stick photographs) to show where the location marker you made would be compared to the torch. Underneath that, draw what you would see in the sky at that time of day or night.



Now try and answer the following questions:

1. How long does it take for the Earth to make one full rotation?

2. Why does the Sun appear to move across the sky?

3. In which direction does the Sun appear to rise in the morning?

4. In which direction does the Sun appear to set in the evening?

5. If it is daytime in your country, name a country where it is night time.

ACTIVITY 2: SUNDIALS

You are now going to make your own sundial and hopefully tell the time!

1. You STEM Club Leader will give you a printed sundial . Cut carefully around the outer edge of the sundial.
2. Fold the centre vertical line up and the two 'True North' lines down to create a triangle. This is called the Gnomon.
3. Glue inside the triangle to ensure it keeps its shape.
4. Take your sundial outside and point it north. Ask your STEM Club Leader if you are not sure.

Sundial, located in Reynold's Park, Liverpool, UK by NSO

What time is it on your sundial? _____

What is the actual time? _____

Hopefully, your sundial isn't too far off the actual time. If not, don't worry. Sundials are not very accurate. They can tell you which hour you are in, but not to the exact minute! That's why we use clocks now!

1. Why does the sundial create a shadow?

_____

2. Why does the shadow move throughout the day?

_____

3 What happens to shadows if the light source moves (higher/lower/closer/further away)?

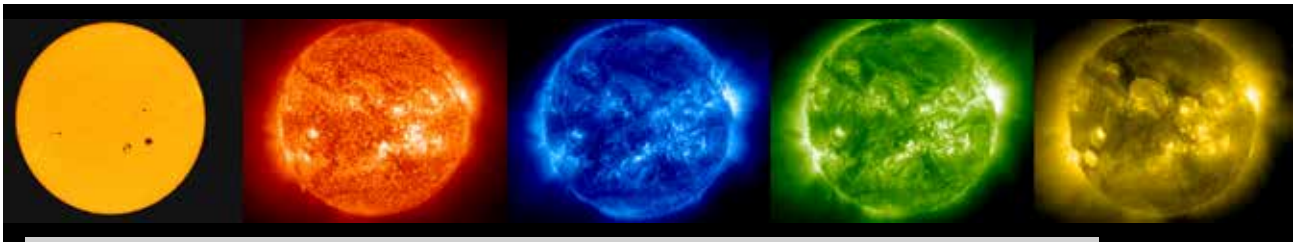
_____

Draw or stick a photo of your sundial here, showing its shadow:

SESSION 2: THE SUN

Astronomers don't just observe stars far away, they also learn about our Sun. In this session, you will be learning all about solar eclipses and the features that telescopes can see on the Sun.

The Sun is a star at the centre of the Solar System. All the planets, including Earth, travel around the Sun. The path they follow is called an orbit. It is dangerous to look at the Sun with our eyes but it appears as a bright circle in the sky. We can observe it with special telescopes that are designed to filter out the bright light. So what does the Sun look like?



Six pictures of the Sun taken at the same time by special cameras looking at different kinds of light By NASA/SOHO

Pictures of the Sun give us information about what the Sun is made of and some of its features. We are going to explore some of the different interesting features of the Sun and then you get to create a Solar Cookie.

A close up of the Sun showing the different kinds of light By NASA/SDO

ADDITIONAL

The Sun shines because it gives off energy as heat and light. It uses a process called nuclear fusion to make that heat and light. The Sun is a giant ball of hydrogen and helium gas. Those gases are the fuel for nuclear fusion. The Sun has been shining for 4 and a half billion years (that's 4,500,000,000 years!). It is about half-way through its supply of fuel. When it reaches 10 billion years old, it will run out of fuel and cool down.

The following resources might help you learn more about the Sun:

The Sun	www.schoolsobservatory.org/learn/astro/solsys/sun
Solar Flares	www.schoolsobservatory.org/learn/astro/solsys/sun/solarflares
Sunspots	www.schoolsobservatory.org/learn/astro/solsys/sun/sunspots

WARNING

You should never look at the Sun directly or indirectly without proper equipment designed for looking at the Sun. Viewing the Sun with your eyes, or through a telescope or binoculars could damage your eyes or even cause blindness.

SOLAR ECLIPSE

A solar eclipse happens when the Moon passes between the Earth and the Sun. The Moon stops the Sun's light from reaching the Earth. This casts a shadow of the Moon onto the Earth.

There are different kinds of solar eclipse. During a total eclipse, the Moon completely blocks the Sun and the only light left is a glow from the outer layer of the Sun. This does not happen very often because the Sun, Moon and Earth all need to be in a perfect line. During a partial eclipse, the Moon only blocks part of the Sun. The Sun appears to have a dark shadow on only a small part of its surface. These types of eclipse occur more often.

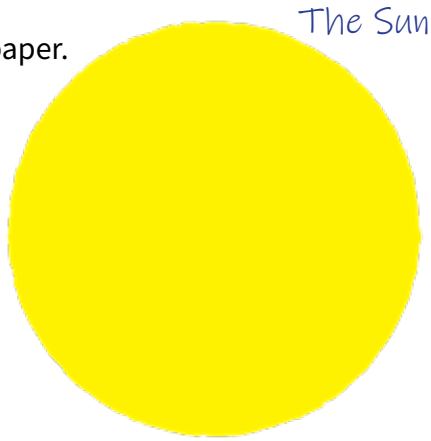
A total solar eclipse
By ESA/CESAR/Wouter van Reeven, CC BY-SA 3.0 IGO

Even though the Moon is much smaller than the Sun, it is much closer to the Earth. This is why it appears to be the same size in the sky.

ACTIVITY 1: SOLAR ECLIPSE PHASES

You can recreate the phases of a solar eclipse using two discs of paper.

1. Your STEM Club Leader will give you a paper Moon the same size as this Sun.
2. Slowly move the cut-out Moon from right to left across the front of this Sun. Notice how the shape of the Sun changes when it is blocked by the Moon.
3. Draw the shape of the Sun during the 5 phases of the eclipse as viewed from Earth.



Near start of the eclipse (just after first contact)

Half way to eclipse

Total Eclipse

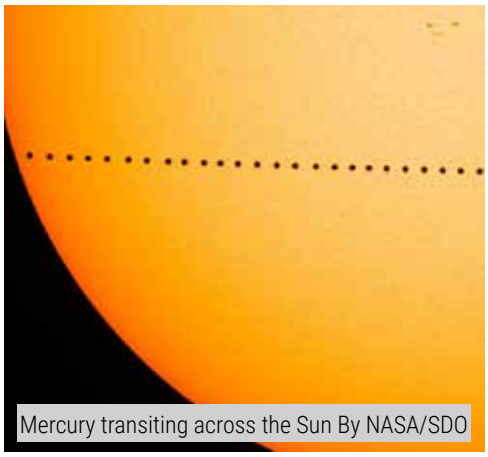
Half way from eclipse

Near the end of the eclipse (just before last contact)

TRANSITS

It is not just the Moon that can pass between the Earth and the Sun. When a planet passes between the Earth and the Sun and stops some of the Sun's light from reaching Earth, we call it a transit. The inner planets, Mercury and Venus can transit the Sun. This is because they have smaller orbits than the Earth. The other planets (Mars, Jupiter, Saturn, Uranus and Neptune) never pass between the Earth and the Sun.

Remember, it is dangerous to look at the Sun but there are ways to safely view a transit. You can project an image of the Sun using pin-hole camera or use a special solar filter. If you watch a transit you'll see a small dot move in a line or arch across the surface of the Sun. This is the planet!

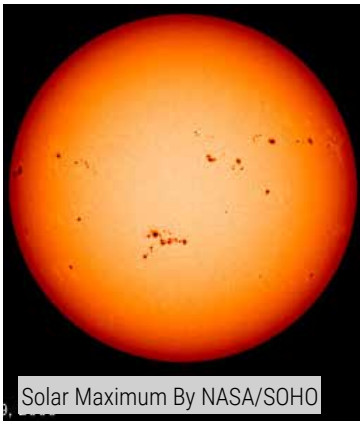


Mercury transiting across the Sun By NASA/SDO

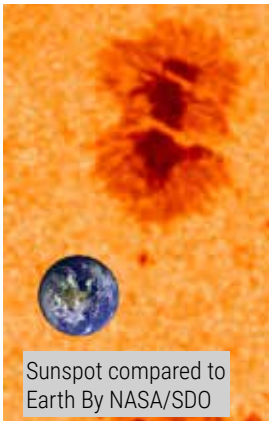
SUNSPOTS

Sunspots appear on the surface of the Sun as dark spots. They look dark because they are a cooler temperature than the surface of the Sun (but still very hot!). Sunspots can be huge – some are larger than the Earth!

Sunspots are caused by magnetic activity and usually appear in pairs where one is the North and one is the South - like a bar magnet. The number of sunspots changes over time. When the Sun is more active (Solar Maximum), there will be more sunspots on its surface. When the Sun is less active (Solar Minimum), there will be fewer sunspots. It usually takes the Sun 11 years to cycle through Solar Maximum and Minimum.



Solar Maximum By NASA/SOHO



Sunspot compared to Earth By NASA/SDO

SOLAR FLARES

Sometimes the Sun creates a huge explosion of energy called a solar flare. Solar flares are caused by the Sun's magnetic fields tangling, twisting, breaking and then reconnecting. Solar flares send out dangerous X-rays into space. We are protected from harmful X-rays by the Earth's atmosphere. Astronaut's suits and spacecraft protect them from X-rays in space.

Solar flares seen in extreme ultraviolet light By NASA/Goddard Space Flight Center

SOLAR LOOPS

A solar loop is a huge loop or arc of gas coming out of the surface of the Sun. They sometimes erupt and break away from the Sun. Solar loops are very large - some are thousands of kilometres long - and they are constantly changing.

Solar loop seen in extreme ultraviolet light By NASA/SDO

This picture was taken using a special telescope that can see the ultraviolet light being given off by the Sun.

ACTIVITY 2: SOLAR COOKIES

You are going to learn about what astronomers can see on our Sun. You're then going to show what you've learned by making your own version of the Sun using a cookie!

1. Use the information in your booklet (on pages 7 to 9) to learn what features astronomers can see on the Sun.
2. Using your cookie as the surface on the Sun, decorate it and include some solar features you have learned about.
3. Take a picture of (or draw) your solar cookie and stick it below.
4. Share descriptions of the features of your cookie with your class.
5. Eat the Sun!

Make solar loops using strawberry laces, sunspots using chocolate, or a transit using sprinkles. You could even make a solar eclipse with a chocolate based cookie and icing.

Your Solar Cookie:

SESSION 3: SPACE ART

In this session you will be making your own space art using the nebulae below as inspiration. Can you guess what these nebulae are called based on how they look? Write your guess under each picture. Your STEM Club Leader will give you some black paper and pastels, try to create your own nebula, don't forget to give it a name! You can blend and smudge the pastels to create the cloudy looking features you can see below.

[1]

Name:

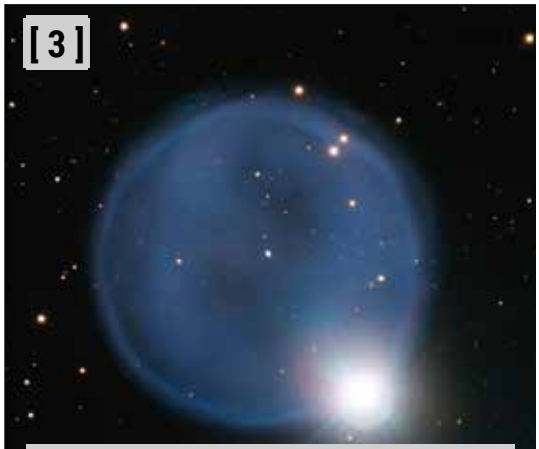
Credit: X-ray: NASA/CXC/SAO; Optical: NASA/STScI

[2]

Name:

Credit: NASA/ESA/Hubble

[3]



Name:

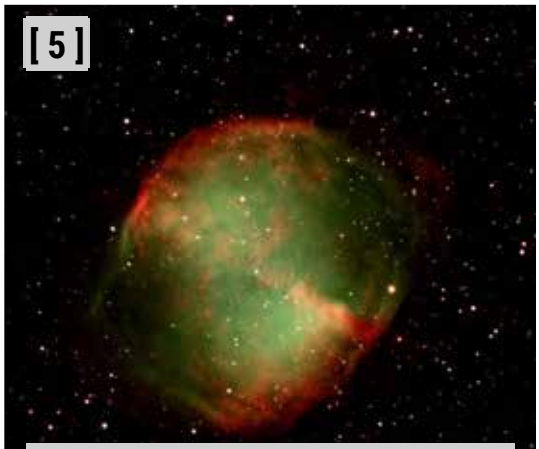
Credit: ESO

[4]

Name:

Credit: NASA,ESA,A.Fruchter(STScI), ERO (STScIST-ECF)

[5]



Name:

Credit: The NSO

[6]

Name:

Credit: The NSO

Your Space Art:

SESSION 4: ASTEROID HUNT

Asteroids are rocky objects that orbit the Sun. They are much smaller than planets. Using images from the Liverpool Telescope (shown on the inside cover of this booklet) you can join the hunt for asteroids! By looking at two images taken by the telescope a short time apart, you might be able to spot an asteroid moving.

The first thing we need to do is get a picture (or observation) of the night sky. There will be lots of bright spots in the picture. Most will be huge stars far away, but some could be small asteroids close by. We can spot asteroids because they appear to move against the starry background. If we take another picture of the same bit of sky a few minutes later the asteroid will have moved, but the stars will stay where they are. By comparing the pictures and noticing if anything has moved, we can find asteroids. It's a bit like keeping a camera still and taking two pictures of someone running past. In the second picture, the runner will have moved position.

Asteroid taken day 1 By The NSO

Asteroid taken day 3 By The NSO

You will now hunt for asteroids using a computer program called LTImage. Once you find it, add a drawing or photo below, circle the asteroid. Your STEM Club leader will give you instructions to:

1. Log in to the NSO Website
2. Get the images
3. Open and view the images in LTImage
4. Hunt the Asteroid

There is also a bonus section to find more asteroids. Happy Hunting!

Your asteroid:

SESSION 5: THE MOON

In this session you will be putting together a giant jigsaw of the Moon using observations taken by the Liverpool Telescope. You will also try to guess the size of a part of the Moon.

Try and fill in the blanks in these facts about the Moon. Your STEM Club Leader has the answers.

The Moon is our _____ neighbour in space.

The Moon _____ around the Earth.

It takes _____ days to orbit the Earth.

The Moon reflects light from the _____ (it does not create its own light).

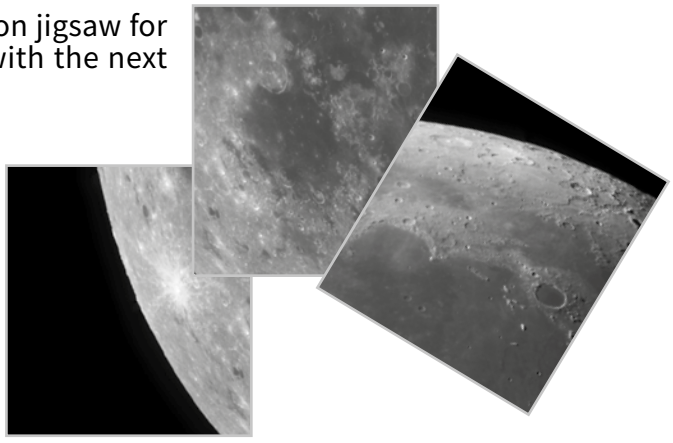
The Moon is the only natural place in space that humans have set foot on. The last Moon walk took place in the year _____.

The surface of the Moon has dark and bright regions, mountain ranges and lots of _____.

Phases of the Moon By The NSO

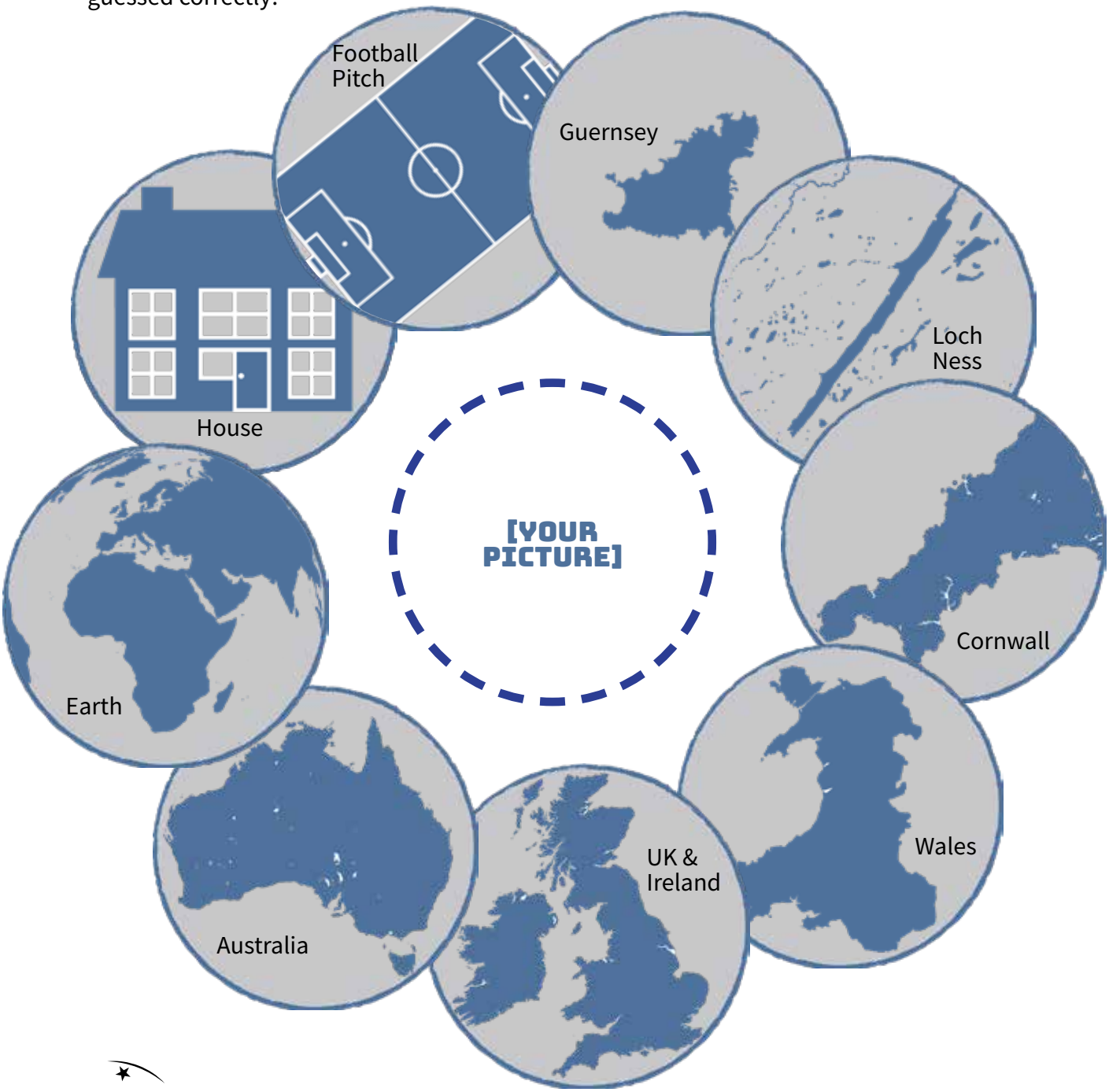
ACTIVITY 1: MOONSAIC

Your STEM Club Leader has printed out the Moon jigsaw for you. Each part of the jigsaw overlaps a little with the next part, so you can stick them together easily.



ACTIVITY 2: HOW BIG?

1. Your STEM Club Leader will give you a picture of part of the Moon. It will either be of a crater or mountain. Cut out and stick the picture in the empty circle below.
2. Find your crater or mountain on the full Moon Moonsaic from the first activity and then mark its position on this smaller Moon.
3. Look at the circles below. Which one do you think shows something the same size as your bit of Moon? Draw a line from your picture to the circle that you have chosen.
4. Check with your STEM Club Leader to see if you guessed correctly!



SESSION 6: MISSION TO MARS

This session we will be exploring Mars! When humans go to Mars we will need somewhere protected to live where there is air to breathe, food to eat, places to sleep and places to work.

We will need somewhere comfortable to relax after a long day working – and something to help us explore the surface of Mars when we venture outside.

You might want to think about the following things:

- ☆ How can we get oxygen to breathe?
- ☆ What will we eat and how will we prepare it?
- ☆ Where will we get water from?
- ☆ What can we do to relax?
- ☆ Where will we carry out experiments?
- ☆ How can we explore the surface?
- ☆ How can we communicate with people back on Earth?

Think about everything we need here on Earth to survive. Your mission is to plan a base camp on Mars, where people can live for a long time. Remember to label everything in your drawing of the base camp.

Keep in mind that the weather on Mars is extreme. The temperature can be as cold as minus 125 degrees Celsius in winter near its poles, and as hot as 20 degrees Celsius in the Summer at its equator. There are also strong winds and dust storms. The picture below shows a huge dust devil (like a whirlwind). It's wide enough that a large plane could fit inside it!

Artist's concept of an astronaut working on Mars by NASA

34 metre wide 'dust devil' on Mars taken by NASA's Spirit Rover

Your Martian Base Camp:

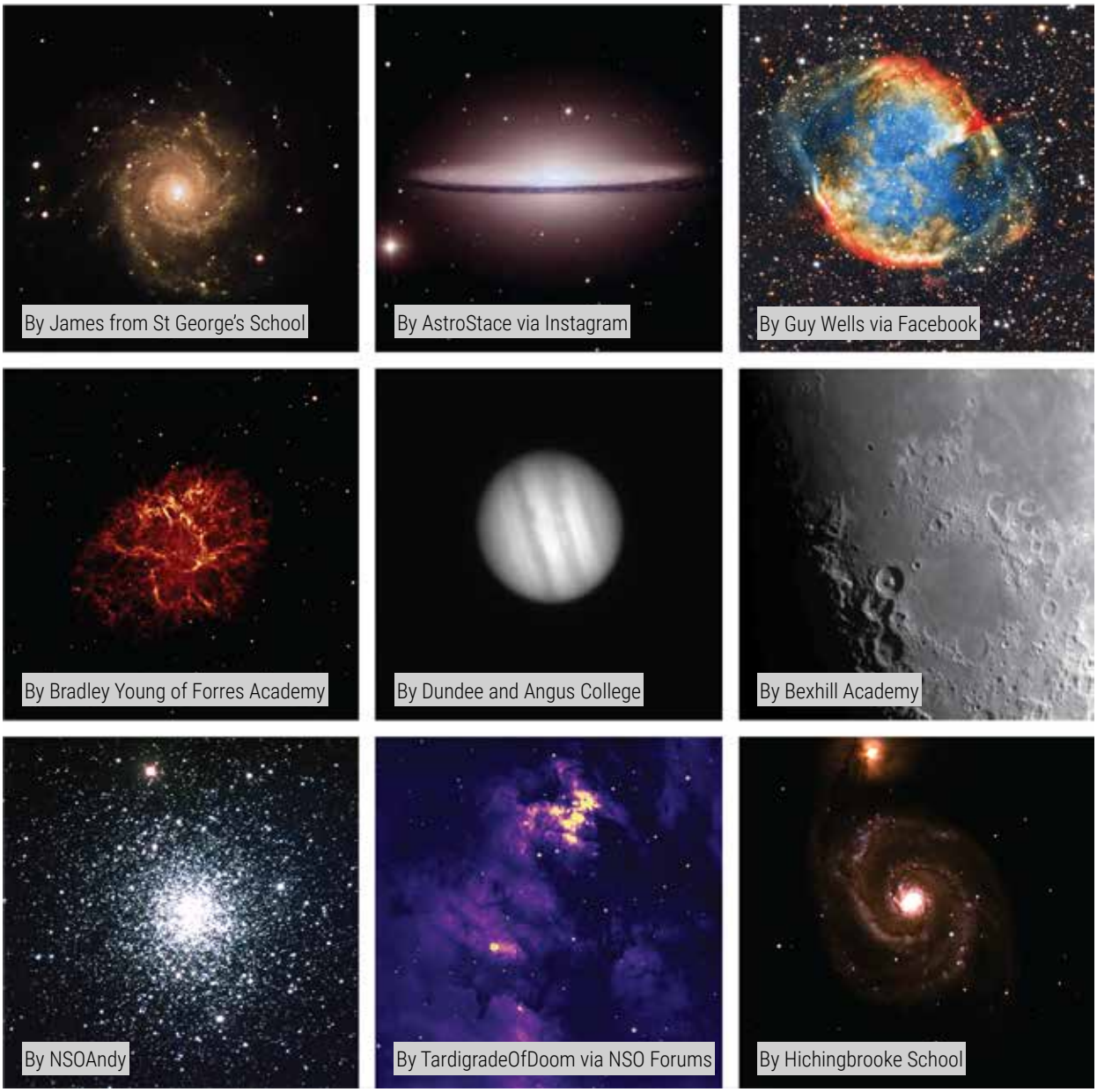
JUST FOR FUN!

SHOW THE NSO

We love to see the images you have created from your observations! Share your images with us and they might feature in our 'Show the NSO' gallery!

Ask your STEM Club Leader to share your images with us by:

- ☆ Tagging @SchoolsObs on Twitter or Instagram and using the hashtag #ShowtheNSO



By sharing your images with the NSO, you consent for the NSO to use your image on our website and social media accounts and/or for publicity.

WORD SEARCH

Can you find all the space words in the puzzle below?

z	t	t	o	k	s	g	l	g	n	m	s	u	y	g
a	f	v	n	t	s	k	d	a	i	p	u	j	a	a
d	q	d	h	f	t	p	t	c	g	o	n	s	a	s
t	s	p	a	c	e	g	m	o	h	m	s	t	e	t
e	c	l	i	p	s	e	a	r	t	h	p	e	j	e
o	z	a	h	o	t	x	r	s	a	s	o	l	a	r
e	d	n	u	g	m	w	s	k	y	v	t	e	q	o
g	u	e	h	b	o	u	h	w	k	d	q	s	u	i
u	s	t	a	r	o	l	a	q	j	s	y	c	l	d
v	u	k	k	o	n	h	d	s	y	u	n	o	u	p
u	n	g	j	k	a	f	o	y	y	n	x	p	g	p
o	l	m	n	m	e	g	w	s	z	d	h	e	j	d
a	m	p	h	d	a	y	f	x	r	i	g	u	v	l
h	s	l	i	g	h	t	m	h	o	a	v	b	x	m
v	y	p	d	h	x	w	w	t	m	l	n	g	h	v

asteroid
day
earth
eclipse
light
mars
moon
night
planet
shadow
sky
solar
space
star
sun
sundial
sunspot
telescope

Answers - page 21

WHAT'S NEXT?

Complete the sequences below by drawing the correct picture in the dashed boxes.

1.

2.

3.

Answers - page 21

Cats Eye Nebula by X-ray_NASA-CXC-SAO-Optical_NASA-STScI, Sombrero Galaxy by AstroStace, Moon by The NSO.

EXTRA ACTIVITY: BUILD A SOLAR VIEWER

1. Your STEM Club Leader will give you two pieces of paper. Keep one piece of paper to one side, this will be your image screen.
2. On the other piece of paper, cut a square hole (this is easier to do if you fold the piece of paper in half first).
3. Cut a piece of foil so that it is big enough to cover all of the square hole (your STEM Club Leader might have already done this for you).
4. Tape the foil over the hole on all sides.
5. Now take the pin/needle/paper clip to poke one small neat hole through the foil.
6. Place the blank piece of card on the ground and hold the one with the foil hole above it. Keep your back to the Sun and align the hole with the Sun so that a bright spot appears on the screen. The bright spot is the Sun!

WARNING

You should never look at the Sun directly or indirectly without proper equipment designed for looking at the Sun. Viewing the Sun with your eyes, or through a telescope or binoculars could damage your eyes or even cause blindness.

On a sunny day, and if the Sun is active, you should be able to detect a sunspot or a few!

Draw the features of the Sun you can see and describe what they look like:

The further away the hole is from the screen the bigger the image but it will also be more blurry. The closer the hole and the screen the clearer the features of the Sun will appear.

If the Sun is low in the sky, you might find that the image of the Sun is stretched and not circular. You could try propping up your screen so that the image of the Sun is more circular.

To make the image of the Sun brighter, you could try placing the screen piece of card in shadow or even creating the solar viewer within a shoebox.

WORD SEARCH - ANSWERS

Can you find all the space words in the puzzle below?

z	t	t	o	k	s	g	l	g	n	m	s	u	y	g
a	f	v	n	t	s	k	d	a	i	p	u	j	a	a
d	q	d	h	f	t	p	t	c	g	o	n	s	a	s
t	s	p	a	c	e	g	m	o	h	m	s	t	e	t
e	c	l	i	p	s	e	a	r	t	h	p	e	j	e
o	z	a	h	o	t	x	r	s	a	s	o	l	a	r
e	d	n	u	g	m	w	s	k	y	v	t	e	q	o
g	u	e	h	b	o	u	h	w	k	d	q	s	u	i
u	s	t	a	r	o	l	a	q	j	s	y	c	l	d
v	u	k	k	o	n	h	d	s	y	u	n	o	u	p
u	n	g	j	k	a	f	o	y	y	n	x	p	g	p
o	l	m	n	m	e	g	w	s	z	d	h	e	j	d
a	m	p	h	d	a	y	f	x	r	i	g	u	v	l
h	s	l	i	g	h	t	m	h	o	a	v	b	x	m
v	y	p	d	h	x	w	w	t	m	l	n	g	h	v

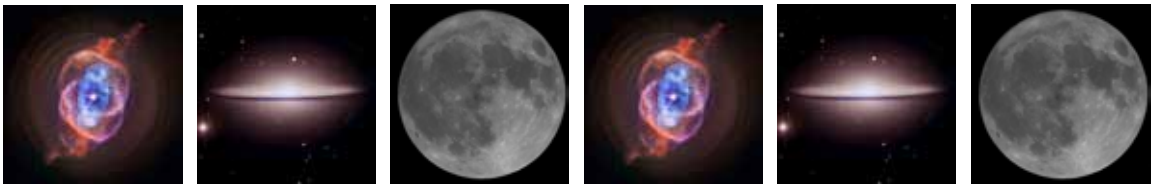
asteroid
day
earth
eclipse
light
mars
moon
night
planet
shadow
sky
solar
space
star
sun
sundial
sunspot
telescope

WHAT'S NEXT? - ANSWERS

Complete the sequences below by drawing the correct picture in the dashed boxes.

1.

2.



3.

Cats Eye Nebula by X-ray_NASA-CXC-SAO-Optical_NASA-STScI, Sombrero Galaxy by AstroStace, Moon by The NSO.

ABOUT THE NSO

The National Schools' Observatory (NSO) is a project run by Liverpool John Moores University (LJMU). We are part of LJMU's Astrophysics Research Institute (ARI). LJMU has a robotic telescope, called the Liverpool Telescope, which is located at the top of a very high mountain on La Palma in the Canary Islands. LJMU is one of the few UK Universities that owns and operates a professional telescope.

The NSO was created to help young people across the UK and Ireland use the Liverpool Telescope. You can read all about the NSO team here:

www.schoolsobservatory.org/about/nso/team

Congratulations! You have now finished the Silver STEM Club booklet! We hope you have enjoyed yourself and learnt a few things along the way. If you want to know about other topics that are not already on our website, ask your Stem Club Leader to email us and let us know! nso@ljmu.ac.uk

NOTES AND PICTURES

Use this page to write any notes or stick any pictures from your Silver STEM Club sessions.

[PLACE YOUR CERTIFICATE HERE]

NATIONAL SCHOOLS' OBSERVATORY

If you enjoyed the Silver award ask your STEM Club Leader about our Gold award, six amazing sessions taking you to the next level in your space adventure.

6 GOLD SESSIONS:

CREATE BEAUTIFUL IMAGES OF SPACE
LAUNCH YOUR OWN ASTRONAUT
THROW A STAR PARTY!
AND MORE...

PROUD TO BE PART OF

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