STEM Club

LET'S EXPLORE THE UNIVERSE TOGETHER!

CREATE BEAUTIFUL IMAGES OF SPACE

LAUNCH YOUR OWN ASTRONAUT

THROW A STAR PARTY!

AND MORE...

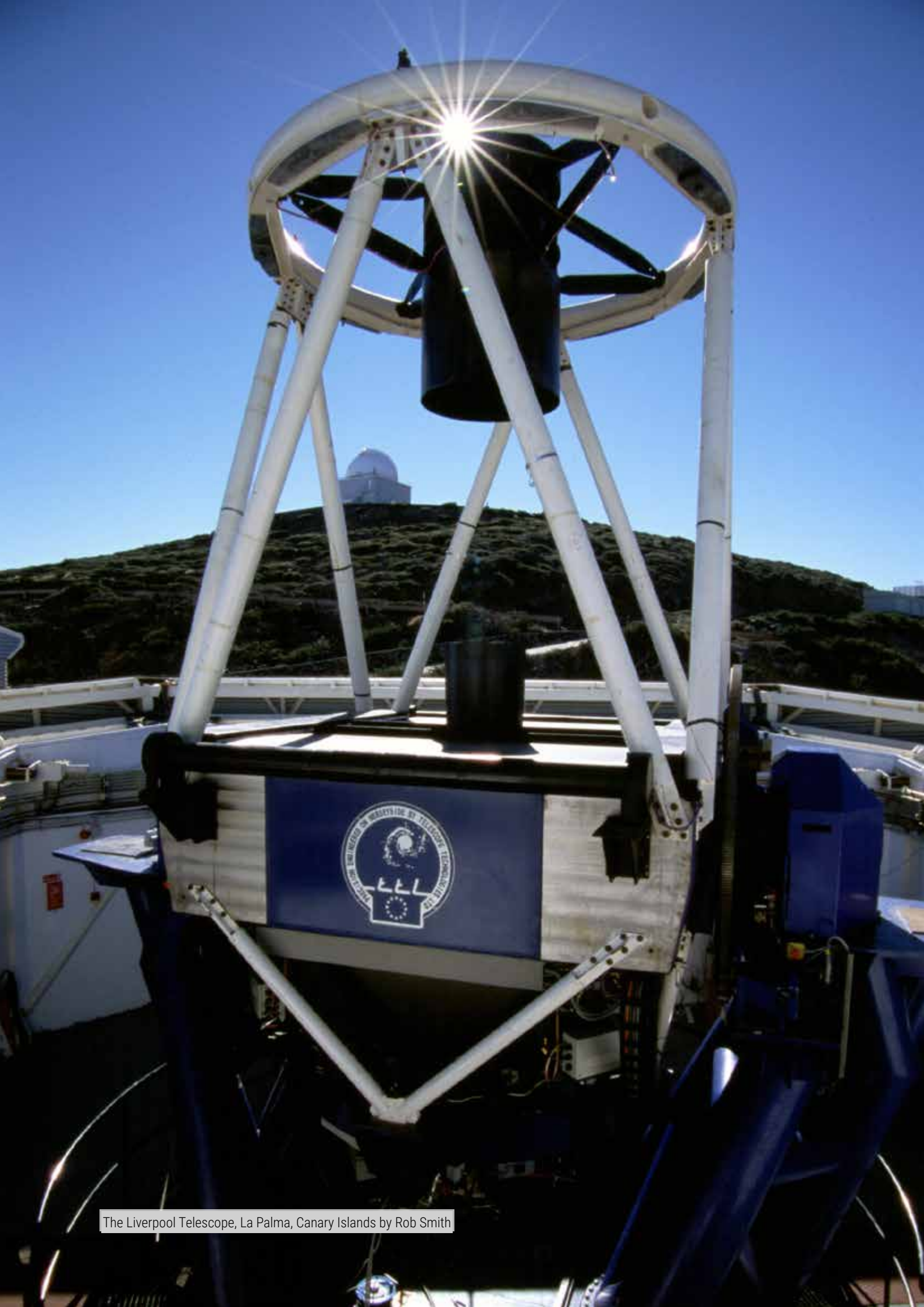
PROUD TO BE PART OF

LIVERPOOL JOHN MOORES UNIVERSITY

Butterfly Nebula by NASA, ESA, and the Hubble SM4 ERO Team

GOLD
PRIMARY EDITION

THE SCHOOLS' OBSERVATORY



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

CONTENTS

Primary STEM Club - Gold Award

Your Name: _____ Age: _____

SESSION 1: THE SOLAR SYSTEM

In this session you will be learning about the scale of our Solar System and the orbits of the planets.

ACTIVITY 1: SOLAR SYSTEM IN YOUR POCKET

In this activity you will make a scaled down model of the Solar System. Our Solar System contains the Sun, eight planets with their moons, and many smaller objects that include dwarf planets. First, can you name the 8 planets of the Solar System in order? Fill in the blanks below:

M _____ J _____

V _____ S _____

E _____ U _____

M _____ N _____

Instructions:

1. Your Club Leader will give you two blank strips of paper. Write 'Sun' at one end and 'Dwarf Planets' at the other end, on both strips of paper.
2. Take one of the strips of paper and estimate where you think each of the 8 planets should be between the Sun and the Dwarf Planets. Write the name of each planet on the strip of paper to show your answers.
3. Use your second strip of paper to plot the correct position for each planet – your STEM Club Leader has the instructions for this bit.
4. Compare your two strips of paper. Were your estimates close to the correct answer?

Write down something that surprised you about your results:

_____

_____

All of the dwarf planets, apart from Ceres, live at the outer edges of the Solar System.

ACTIVITY 2: MAPPING THE SOLAR SYSTEM

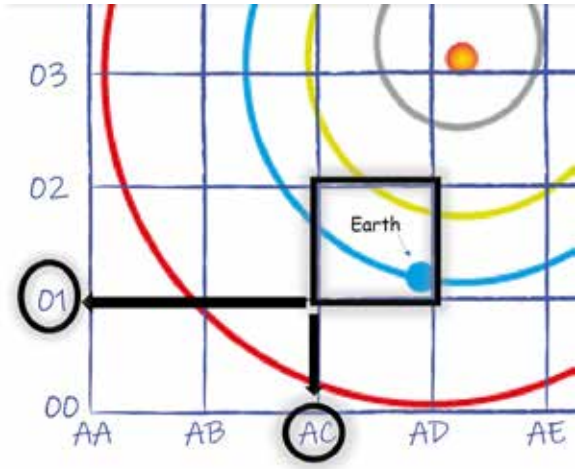
Each of the eight planets travels around the Sun in a path called an orbit. An orbit is when one object in space (for example a planet or a moon) goes round another one without touching it.

The planets each take a different amount of time to complete one orbit of the Sun. The further a planet is from the Sun:

- ☆ the slower it moves
- ☆ the further it has to travel to complete one orbit

So the further from the Sun a planet is, the more time it takes to complete an orbit. It takes the Earth 1 year to complete an orbit. Mercury orbits the Sun every 88 days. Neptune takes nearly 165 years to complete an orbit!

The model you made in Activity 1 shows the planets all in a line. In reality, they are spread out around the Sun. In this activity, you are going to use grid references to plot the positions of the planets.



Grid references tell us the position of something using horizontal and vertical lines arranged in a grid. Each line has a number or letter.

Grid A below shows where the inner rocky planets were on 1st January 2021. We've added the paths that the planets follow around the Sun, these are their orbits. The grid is made up of squares that are identified by their grid reference numbers.

In the example, planet Earth is in grid square AC01.

Q1 Which grid square is Mars in? _____

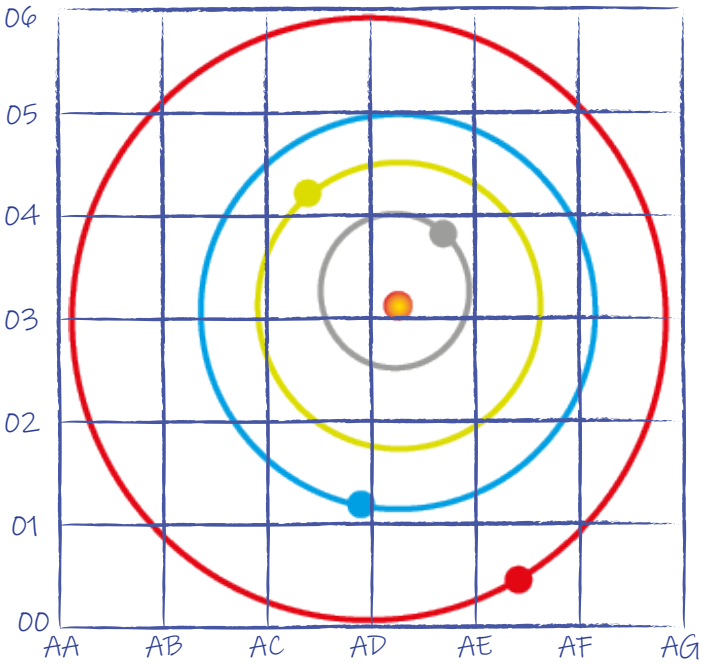
Q2 Which planet is in grid square AC04? _____

Grid A

Date: 1st January 2021

Legend

- Sun
- Mercury
- Venus
- Earth
- Mars



You will now fill in Grid B (on the next page) to show the positions of the planets at a different point in time.

1. Your Club Leader will give you a list of planets and their grid references.
2. Copy the date at the top of the list into the space on Grid B.
3. Plot the positions of the planets on this date, using the list of grid references.

ACTIVITY 3: PLANET EXPLORERS

Now challenge someone to a game of Planet Explorers!

Aim of the game: Try and find where all four of your opponent's planets are.

Rules and how to play:

1. You need to play against someone with a different date at the top of their Grid B.
2. Don't let your opponent see your Grid B!
3. Take turns to 'launch' to your opponent's planets by calling out a grid reference. For example, 'AD03'.
4. Your opponent will check that grid reference in their Grid B and will tell you if your guess is correct or not.
5. Mark your shot as a landing (O) or a miss (X) on your empty Grid C.
6. When your enemy launches towards you, you must say if it was a "landing" or a "miss", according to whether there is a planet there or not.
7. Mark any of your planets that get landed on with an 'O' on your Grid B.
8. The first person to land on all of their opponent's planet's wins!

Planets move, or orbit, around the Sun in an anti-clockwise direction – bare this in mind when you compare your grid with your opponents.

If you know the date on your opponent's grid B, you may be able to estimate where the planets are in their orbit.

Legend

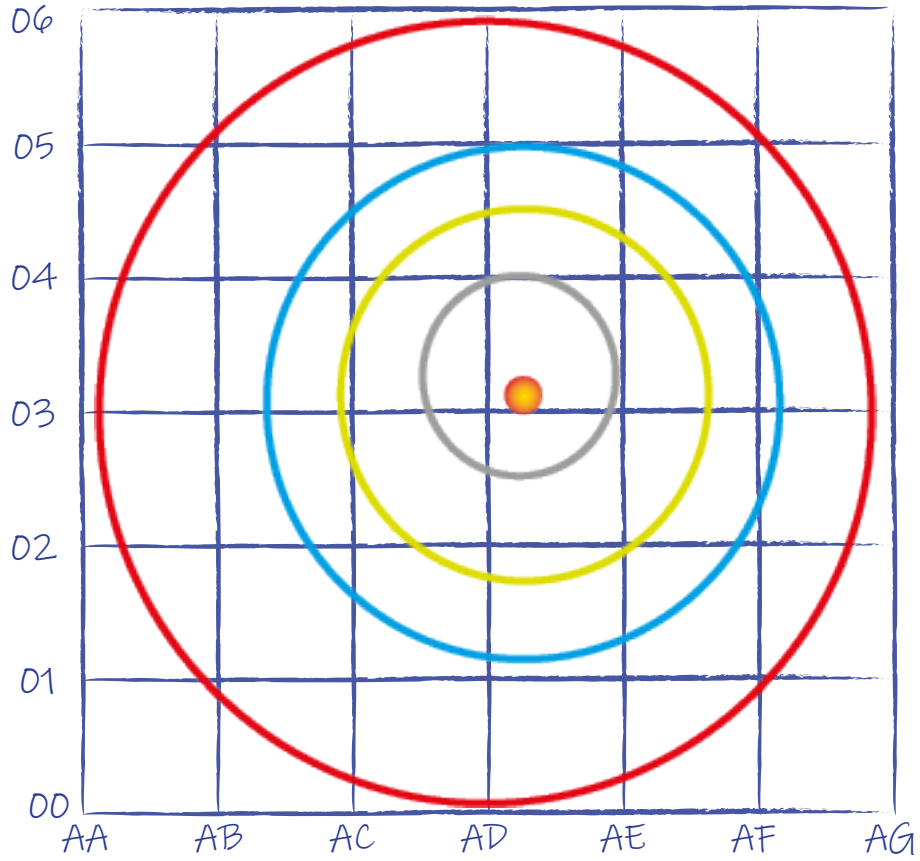
- Sun
- Mercury
- Venus
- Earth
- Mars

Make sure your opponent can't see the positions of your planets.

Mark your opponents shots as:

Landing =O
Miss = X

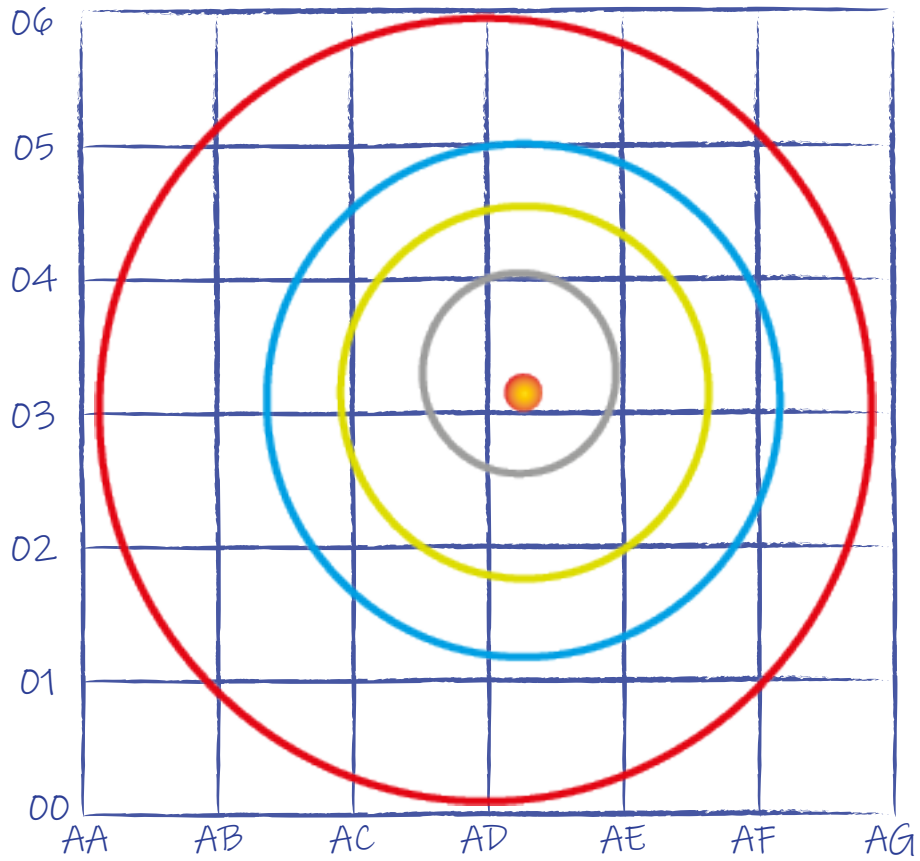
Grid B - Date: _____



Your Opponents Grid - Date: _____

Mark your shots as:

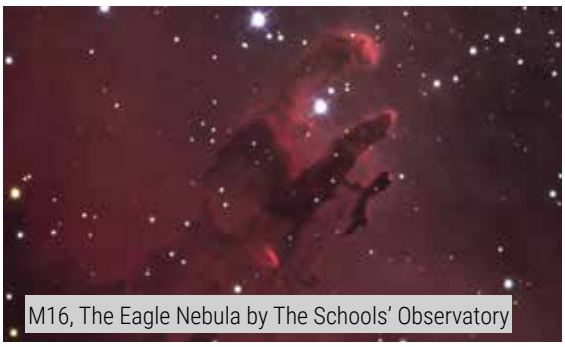
Landing =O
Miss = X



SESSION 2: THE NIGHT SKY

In this session you are going to play a game to learn about the objects that astronomers study in the night sky and then create pictures and models of constellations.

Some objects are bright enough to see with your eyes (like the Moon or some of the planets), others can't be seen without a powerful telescope (like galaxies or distant nebulae). Galaxies are huge collections of stars held together by their gravity. Our galaxy is called the Milky Way. Nebulae are very big clouds of dust and gas within our galaxy.


M16, The Eagle Nebula by The Schools' Observatory

Astronomers can see nebula and galaxies because they contain stars that shine. The only star in our Solar System is the Sun. Astronomers can see the planets, dwarf planets and moons because they reflect the light from the Sun.

Throughout human history and across many different cultures, people have given names and mythical stories to the star patterns they see in the night sky. We call these imaginary pictures 'constellations'. Astronomers use constellations to help them remember where to find certain stars, nebulae and galaxies. There are 88 constellations that cover the entire sky.

People often think that the stars in a constellation are linked. However, they are actually at very different distances from the Earth. This means that the stars in a constellation only make that picture when viewed from Earth. If you were somewhere else in our galaxy, the patterns of stars would look completely different.

ACTIVITY 1 – ASTRO CARDS

The set of Astro Cards contain facts about just some of the objects that astronomers study in space, including: planets, moons, dwarf planets, stars, nebulae and galaxies.

Aim of the game: win all the cards to end the game.

Categories:
FIRST IDENTIFIED: oldest wins
DISTANCE: largest wins
DIAMETER: largest wins
BRIGHTNESS: brightest (largest number) wins

Your STEM Club Leader will read out the rules of the game. While you are playing, try and answer these questions:

1. After the Sun, which object is the next brightest? _____

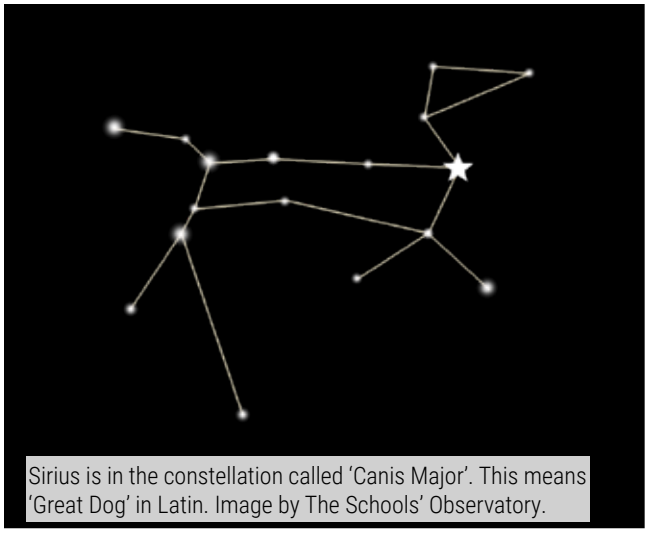
2. Which planet was discovered most recently? _____

3. Ganymede is a moon of which planet? _____

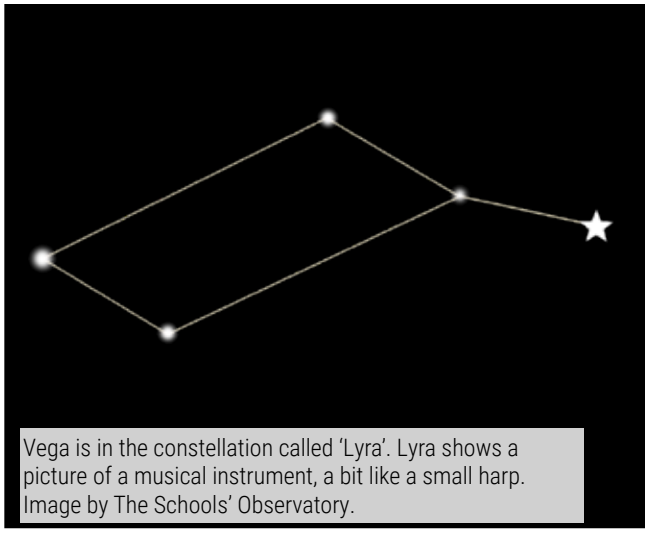
Objects that are smaller or further away, look less bright. You may have noticed during the game that fainter objects were discovered more recently. This is because the invention of telescopes (and then bigger and better telescopes!), allowed astronomers to see much fainter objects.

ACTIVITY 2 – PICTURES IN THE SKY

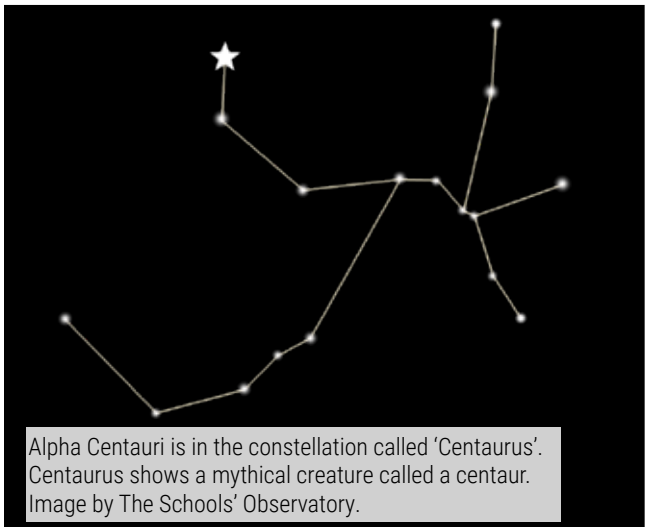
The star cards in the Astro Cards game showed the imaginary lines that create the constellations that the named stars are part of. Here are some examples of constellations:



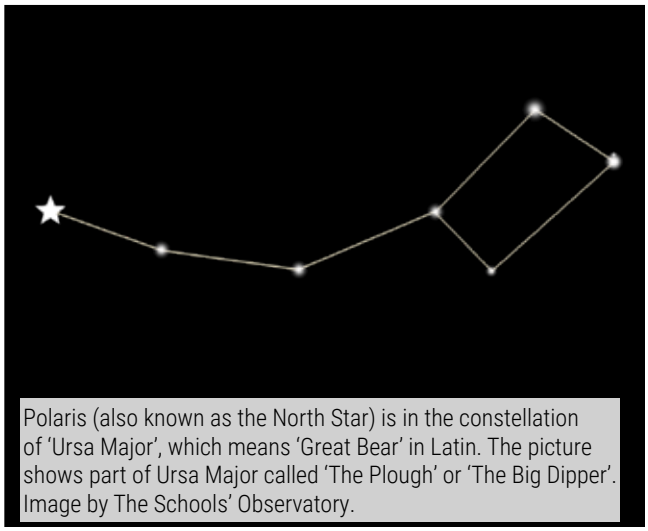
Sirius is in the constellation called 'Canis Major'. This means 'Great Dog' in Latin. Image by The Schools' Observatory.



Vega is in the constellation called 'Lyra'. Lyra shows a picture of a musical instrument, a bit like a small harp. Image by The Schools' Observatory.



Alpha Centauri is in the constellation called 'Centaurus'. Centaurus shows a mythical creature called a centaur. Image by The Schools' Observatory.



Polaris (also known as the North Star) is in the constellation of 'Ursa Major', which means 'Great Bear' in Latin. The picture shows part of Ursa Major called 'The Plough' or 'The Big Dipper'. Image by The Schools' Observatory.

In this activity you will create your own constellation. Your STEM Club Leader will give you some materials to use.

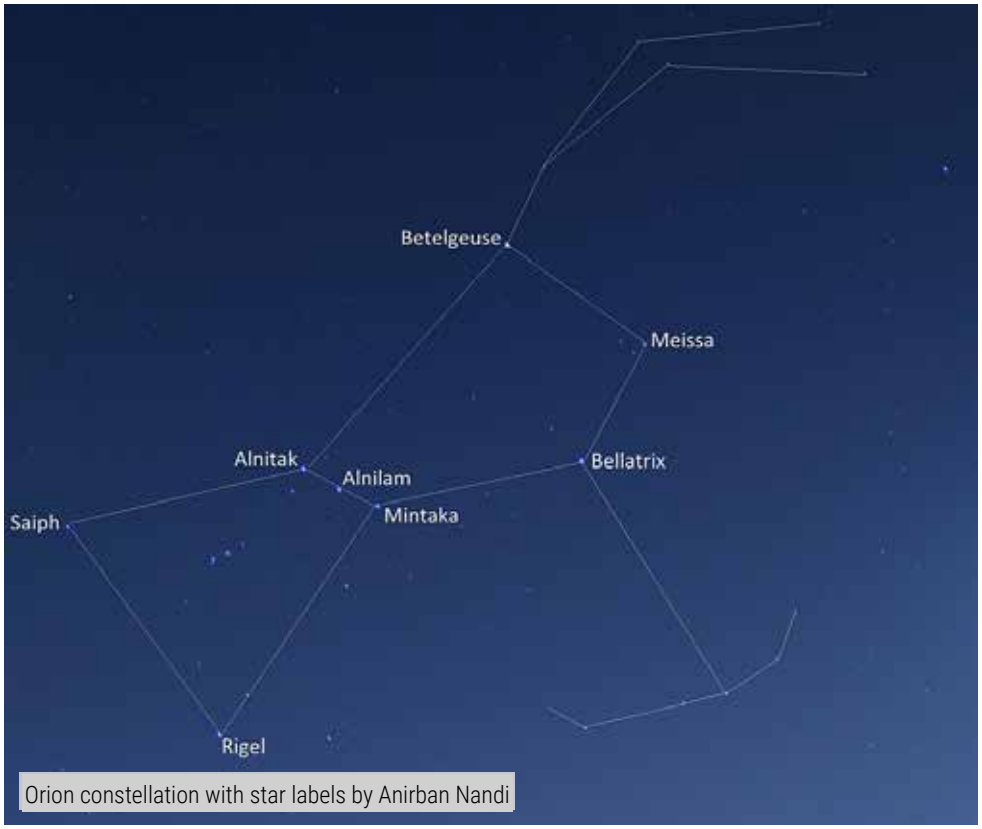
Choose your favourite animal, object or character from a story. The challenge is that you can only use up to **10 stars** to create your constellation.

Once you've finished, pair up with a friend and try to guess each other's constellations.

Draw or trace the outline of your picture first. Then rub out any pencil lines once your stars are in place.

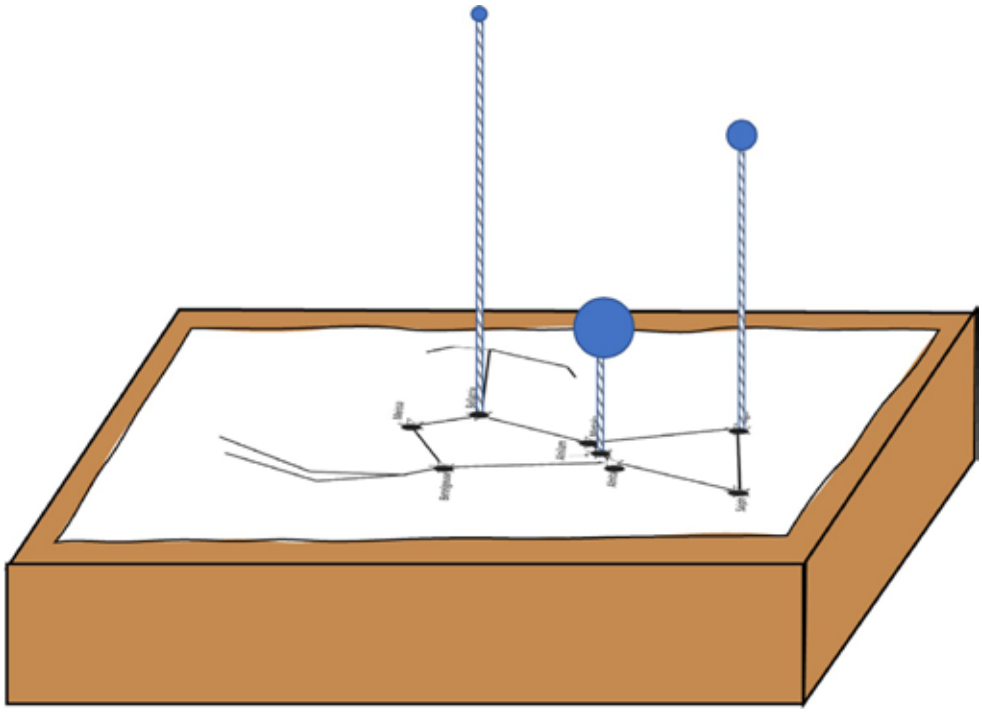
ACTIVITY 3 – 3D CONSTELLATIONS

This is the constellation of Orion. It's named after Orion, a hunter in Greek mythology. Orion's recognizable shape (including three stars that make up Orion's belt) can be seen around the world. But what would Orion look like if you were at the other end of the Milky Way? Would it look the same?



Orion constellation with star labels by Anirban Nandi

You are going to construct a 3D model of the stars in the constellation of Orion using the instructions below. Your STEM Club Leader will give you the materials you need. It will look something like this:



Instructions

1. Tape your star map of Orion to the top of your base material.
2. Using a pen or pencil, punch a hole through the paper and the base material at the location of each star.
3. Using the table below, cut each straw to the correct scale distance. Insert each straw through the correct star hole.
4. Using the table below, make the correct number of small, medium and large stars. Use the material your STEM Club Leader has given you to make spherical 'stars'. Small stars should be about the same width as the straw. Medium stars should be twice the size of the small stars. Large stars should be about twice the size of the medium stars.
5. Fix your 'stars' to the top of the straws. Make sure you use the correct sized stars in each location.
6. View your model from above. This is our view from Earth. Do the 'stars' show the pattern of Orion?
7. View your model from the side. Do the 'stars' show the pattern of Orion?

Star Name	**Star Size**	**Length of Straw (cm)**
Alnilam	Large	4
Alnitak	Large	13
Bellatrix	Small	20
Betelgeuse	Medium	14
Meissa	Large	8
Mintaka	Large	5
Rigel	Medium	12
Saiph	Medium	13

SESSION 3: THE EGGNAUT CHALLENGE

This week your mission is to work as part of a team to design and build a vehicle that will protect your 'Eggnaut' from the perils of landing on another world.

Your STEM Club Leader will test if your vehicle is successful by dropping it, with the 'Eggnaut' inside, onto the landing area.

The objective is for your 'Eggnaut' to survive the landing without a crack.

The rules:

1. Your vehicle must land as CLOSE as possible to the centre of the landing zone.
2. You can ONLY use the materials provided by your STEM Club Leader.
3. You do not have to use all the materials.
4. Your vehicle must FIT inside a space that is 30 cm wide, 30 cm long and 30 cm high.
5. Your vehicle's mass must be less than 400g (OPTIONAL RULE)

Are you including optional rule 5?
Ask your STEM Club Leader. Then tick the correct box.

Yes ☐ No ☐

WARNING

If your egg accidentally breaks while you are building your vehicle, let your club leader know immediately.

RESOURCES (PER ROCKET)

- ☆ 2 Sheets of A4 paper
- ☆ 5 Lollypop sticks
- ☆ 100 cm of string
- ☆ Tape
- ☆ 5 Rubber bands
- ☆ 1 Pair of scissors
- ☆ 1 Raw egg
- ☆ 1 30 cm ruler

Optional: weighing scales

You will be working as part of a team. Make sure everyone is involved and help prevent problems by listening to each other.

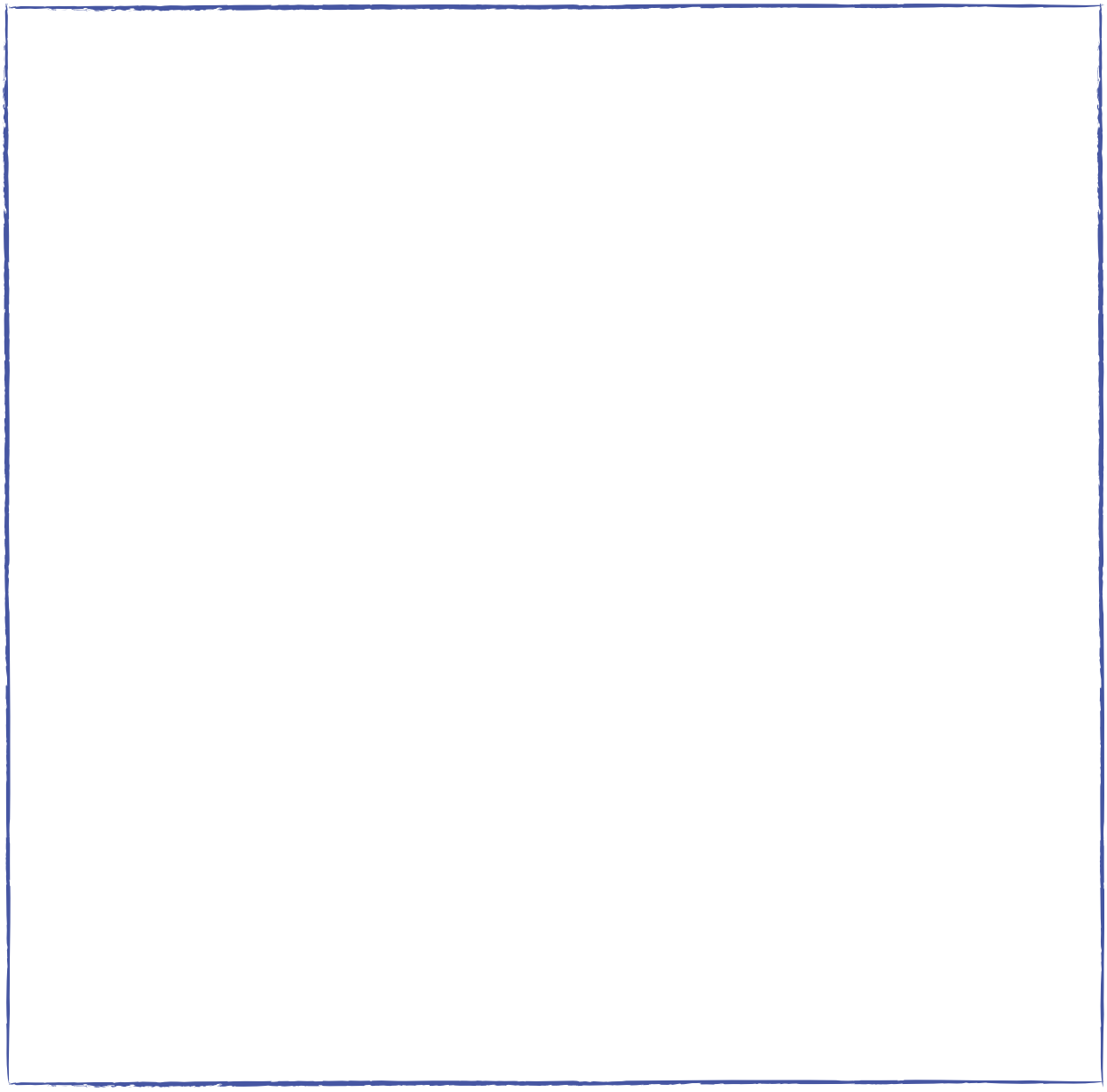
Designing your vehicle

As a team, discuss ideas and decide on a design for your vehicle. Draw your design in the box below.

Things to consider and discuss as a team when designing your vehicle:

- ☆ How can we design the vehicle to protect the Eggnaut?
- ☆ What can we design into the vehicle to make sure it lands in the centre of the landing zone?
- ☆ How can we slow it down?
- ☆ How can we cushion its impact?
- ☆ What forces do we need to consider?
- ☆ Can we think of any inspiring machines or devices that also slow things that are falling?

Your Design:



Q1. How will your design keep the 'Eggnaut' safe?

Q2. How will you make sure your 'Eggnaut' lands in the landing zone?

Testing your vehicle

Was your team's design successful (tick all that are true):

- ☐ Our egg did not crack.
- ☐ Our vehicle landed near the centre of the landing zone.
- ☐ We followed all the rules.

Q1 Why do you think your team got that result?

Q2 What would you do next time to improve your design?

SESSION 4: THREE COLOUR NEBULA

In this session you will be making a colour image of a **nebula**. A nebula is a massive cloud of dust and gas in space.

Colour pictures are very useful for astronomers. However, the Liverpool Telescope only measures the brightness of light. It doesn't take colour pictures. So, astronomers put special coloured glass filters on the telescope to find out about colours in space. Each filter only lets through light from a particular part of the rainbow. It's a bit like holding up some red-coloured glass in front of your eye and then holding up some blue-coloured glass and seeing what the difference in brightness is.

You are going to use our software to combine three images of a nebula taken by the Liverpool Telescope (a red image, a blue image and a green image) to make a colour picture.

Thor's Helmet (a nebula) by The Schools' Observatory

Your STEM Club Leader will give you instructions, make sure you follow all the steps.

1. Log in to our Website
2. Get the Images
3. Run the Software
4. Open and Combine the Images
5. Align the Images
6. Scale the Image
7. Save your Picture

Once you have got the hang of this you can use 'Go Observing' on The Schools' Observatory website to request your own sets of 3-colour images from the Liverpool Telescope.

SESSION 5: SPACE CAREERS

In this session you will discover that there are lots of different jobs for people who enjoy space and science and that space jobs are for everyone! You will also think about the skills and qualities you have, and how you could use them in the future.

ACTIVITY 1: SPACE FOR EVERYONE

1. What job could you do if you are interested in space and science? List as many as you can:

2. Do you think you will have a space or science job when you are older? _____
3. What is a stereotype?

Your Club will now play the 'Space for Everyone' Quiz! Your STEM Club Leader will read out a statement and you must vote on whether you think it is true or false.

ACTIVITY 2: SPACE SKILLS

1. What skills or qualities does an astronaut need to do their job? List as many as you can:

Your Club will now play the 'Space Skills' Game. Your STEM Club Leader will tell you what to do.

Rules of the Game!

1. Everyone in your club will stand up.
2. Your STEM Club Leader will read out one statement at a time relating to a particular job – they won't tell you what the job is just yet!
3. If you agree with the statement, stay standing up.
4. If you disagree with the statement, then sit down.
5. Once all 5 statements have been read out, your club leader will reveal what the job is.
6. If you are still standing, you have some of the skills and qualities needed to do that job!

After the game…

1. Do you think you will have a space or science job when you are older?
2. What have you learned today about jobs in space and science?

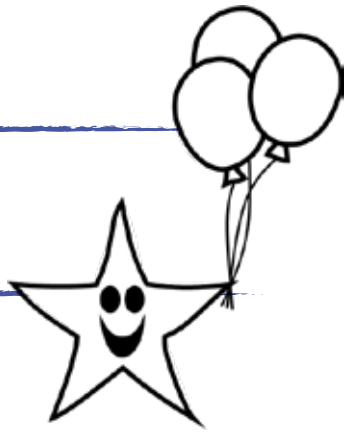
You can research Space Jobs and discover some of our Career Heroes on our website: www.schoolsobservatory.org/careers

SESSION 6: STAR PARTY!

This week your club will have a Star Party to celebrate completing The Schools' Observatory STEM Club! Congratulations!

Find some time during your Star Party to answer these four questions. Think about what you have done during your STEM club sessions. Look back through your booklet to help you remember.

1. What is the most important thing you've learned?



2. What surprised you the most?

3. What do you want to learn more about?

4. How could you share what you have learned with others?

Star party photo:

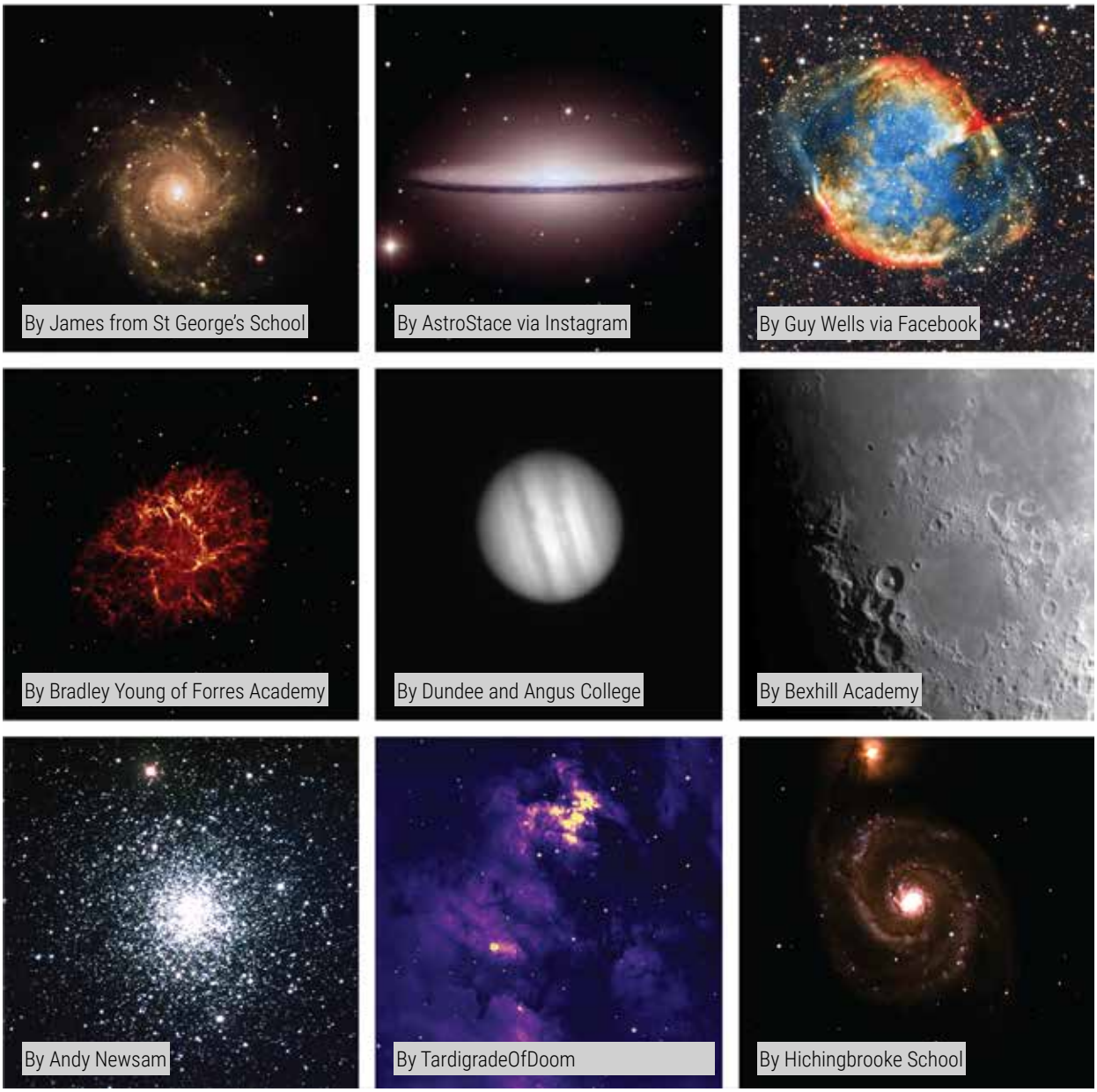
JUST FOR FUN!

SHARE YOUR IMAGES WITH US

We love to see the images you have created from your observations! Share your images with us.

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

- ☆ Tagging @SchoolsObs on Twitter or Instagram



By sharing your images with us, you consent for The Schools' Observatory to use your image on our website and social media accounts and/or for publicity.

WORD SEARCH

Can find all the space words in the puzzle below?

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

colour	moon	orion	space
constellation	nebula	planet	star
earth	night	sky	sun
eggnaut	orbit	solarsystem	telescope

Answers on page 22.

ABOUT THE SCHOOLS' OBSERVATORY

The Schools' Observatory (TSO) is proud to be part of 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.

We were created to help young people across the UK and Ireland use the Liverpool Telescope. You can read all about our team here: www.schoolsobservatory.org/about/team

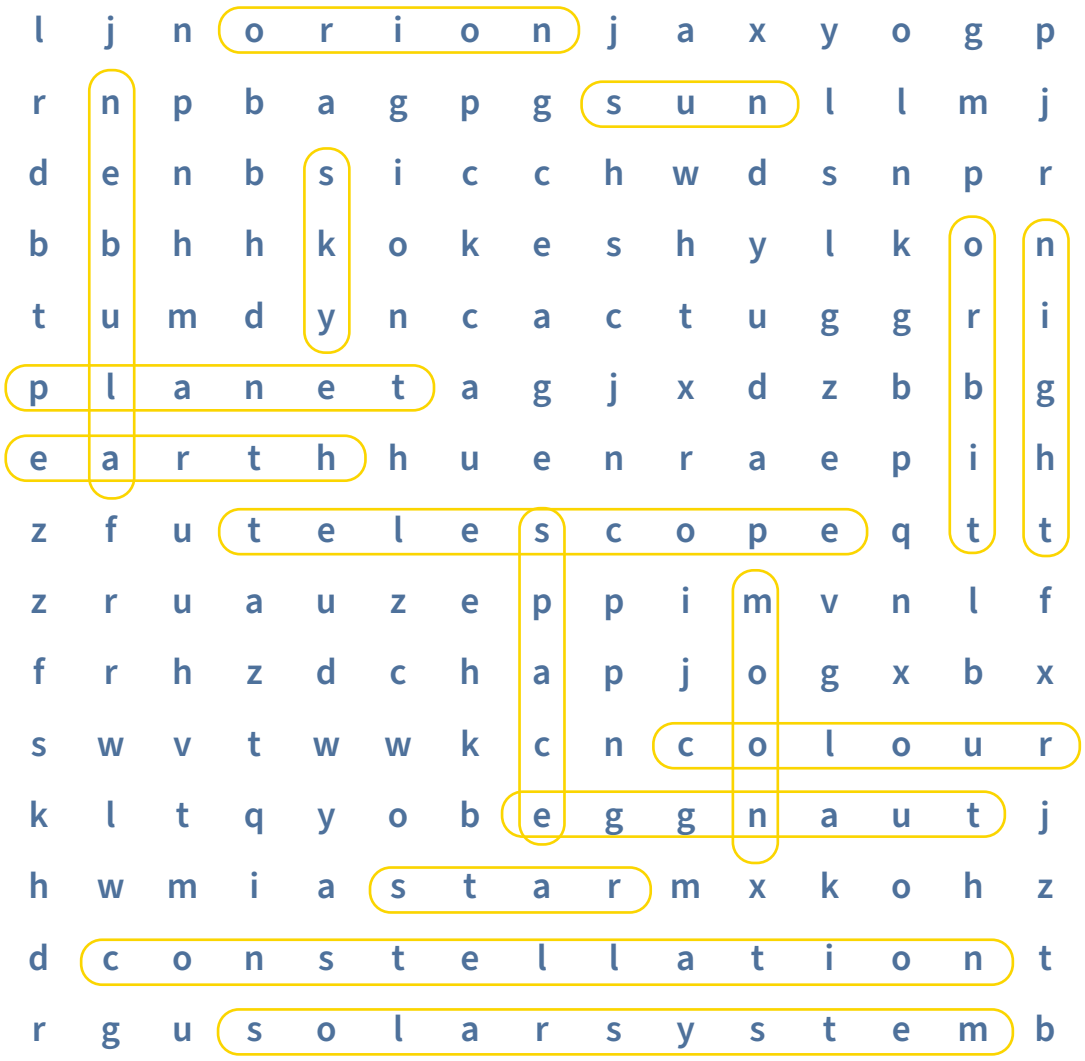
Congratulations! You have now finished the Gold STEM Club booklet! We hope you have enjoyed yourself and learnt a few things along the way.

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! SchoolsObs@ljmu.ac.uk

NOTES AND PICTURES

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

WORD SEARCH - ANSWERS



[PLACE YOUR CERTIFICATE HERE]

THE SCHOOLS' OBSERVATORY

If you enjoyed these STEM Club Booklets you can continue your space adventure by visiting our website, where we have lots more activities to discover.

WWW.SCHOOLSOBSERVATORY.ORG

PROUD TO BE PART OF

LIVERPOOL JOHN MOORES UNIVERSITY

Triangulum galaxy by The Schools' Observatory