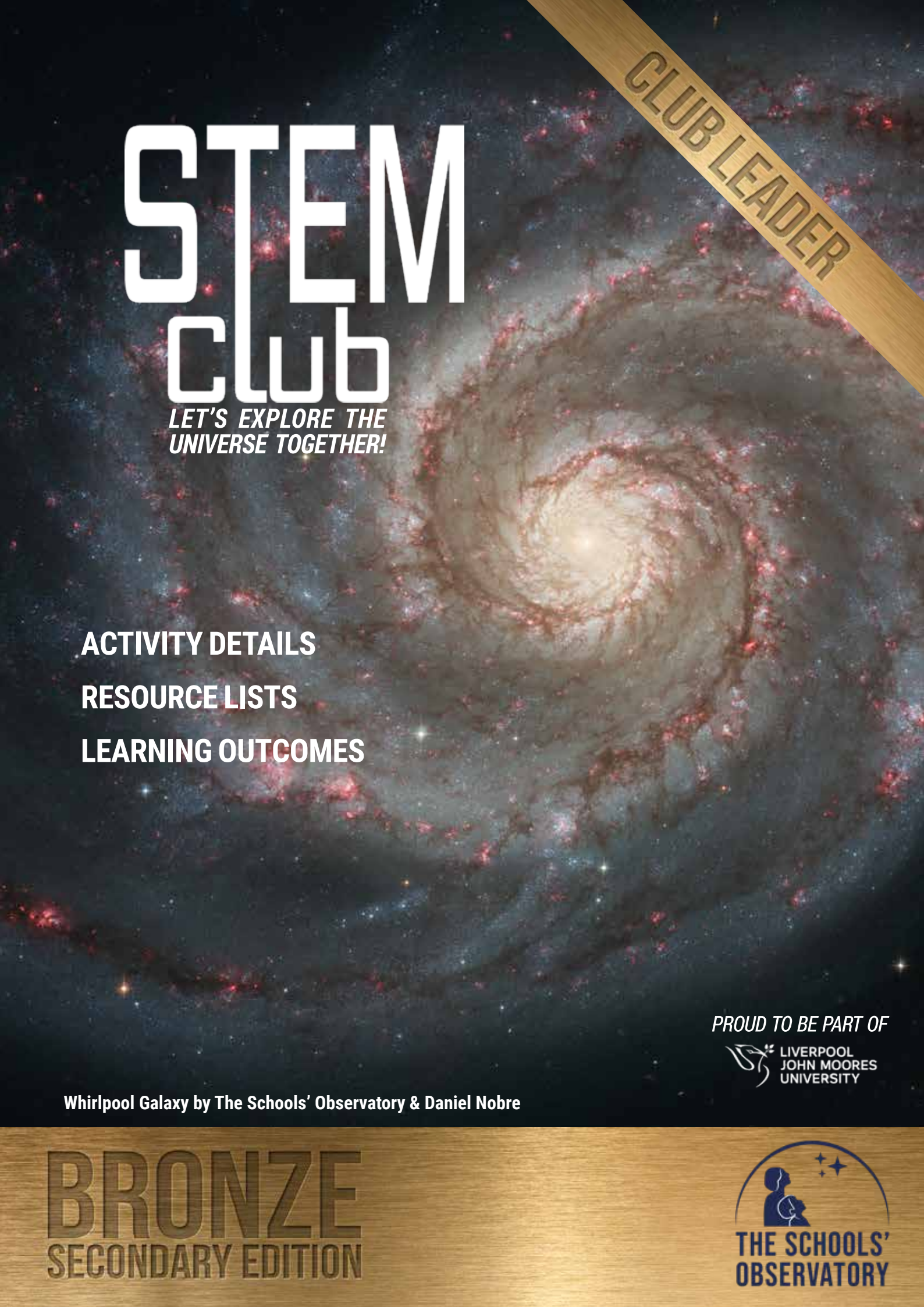


CLUB LEADER

STEM club

LET'S EXPLORE THE UNIVERSE TOGETHER!

ACTIVITY DETAILS

RESOURCE LISTS

LEARNING OUTCOMES

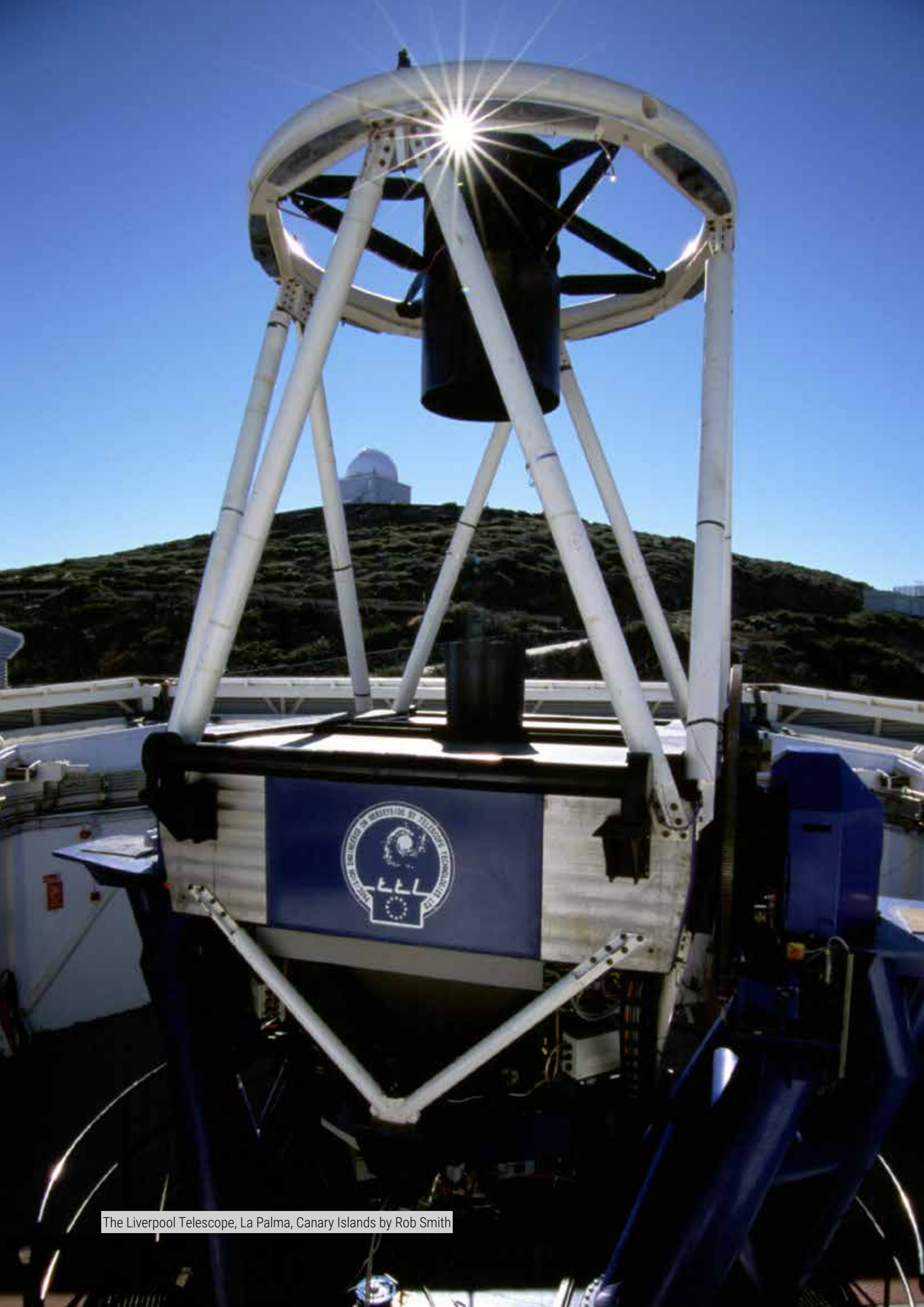
PROUD TO BE PART OF

LIVERPOOL JOHN MOORES UNIVERSITY

Whirlpool Galaxy by The Schools' Observatory & Daniel Nobre

BRONZE
SECONDARY EDITION

THE SCHOOLS' OBSERVATORY



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

CONTENTS

Secondary STEM Club - Bronze Award - Club Leader Edition

INTRODUCTION

The Schools' Observatory (TSO) is passionate about inspiring the next generation of scientists, programmers, engineers and mathematicians. We provide free access to the world's largest fully robotic telescope, and use the wonders of space to excite and amaze students of all ages and develop their love of STEM education.

What is The Schools' Observatory STEM Club Programme?

This STEM Club programme provides three levels of activities; Bronze, Silver and Gold, with each level taking six weeks to complete. The activities are designed to take around an hour each week and can be run by someone with little-to-no science background, making them ideal for a parent, teaching assistant or even an older student.

The programme includes two resource booklets and a series of supplementary documents, hosted on www.schoolsobservatory.org/stem-club. The STEM Club Leader booklet (this booklet) provides guidance notes on the activities, and details the resources and knowledge needed to successfully and easily run each session. The student booklet contains step-by-step instructions for each activity and spaces for students to record their work throughout the programme. The student booklet forms their individual record of achievement as they progress through the levels.

How To Use This Booklet:

This booklet contains six sessions. Each session will briefly explain the pupil activities, list the necessary resources you'll need and contains additional useful information, such as facts or web links. It will also give learning objectives for the session and provide any answers if relevant.

It would be useful to have your own copy of the student booklet to help you plan and deliver the sessions.

What Happens On Completion?

Once you have finished this STEM Club level you can download a certificate for your pupils from our website. Full details can be found on page 15 of this booklet.

ABOUT THE BOOKLETS

Both the STEM Club Leader and student booklets use the same style and formatting. This page contains a full set of examples.

1. Activity steps are numbered like this

Interaction with the booklet comes in the form of questions like this. With room for the student to write their answer.

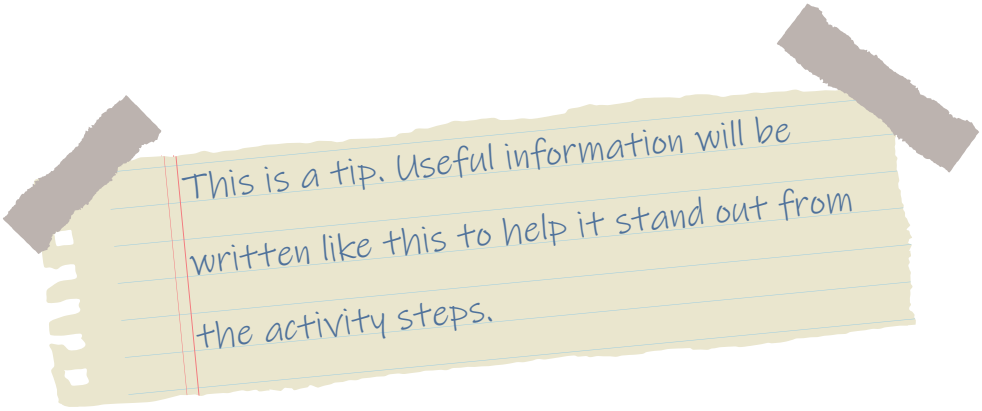
Full resource lists are included. The tables refer to materials needed per group e.g.

REQUIRED RESOURCES
☆ One piece of A4 paper
☆ One pencil

IMPORTANT

Important information is always highlighted in this way so hopefully the student will not miss anything vital to the activity.

It would be great if you tagged us on any social media posts **@SchoolsObs.**



SESSION 1: ASTEROID HUNT

In this first session the students will be using our website to download some observational data files. These observations were taken using the Liverpool Telescope and show the same part of the night sky. By 'blinking' through the series of 4 image files, the students will notice a moving object which will be an asteroid.

Learning Objectives, students will learn:

1. how to use astronomical software
2. how to blink through images to spot changes

Each group will require the following:

REQUIRED RESOURCES
☆ Computer instructions*
☆ Our free software**
☆ Access to computers

*The step-by-step instructions for the pupils can be found here:
www.schoolsobservatory.org/stem-club
You can either print them or display them on screen to the group.

** Our software is freely available from the website. There are different versions depending upon the equipment available at your school. To decide which option to use for your setting please read the guidance on the website:

www.schoolsobservatory.org/get-started/view-images

DOWNLOAD THE OBSERVATIONS

The students will be downloading 'NEO-190409.zip', NEO-100808.zip and NEO-100421.zip from our website:

www.schoolsobservatory.org/teach/activities/hunting_for_asteroids

Each zip file contains 4 fits files. Each file is named with the following format: NEO-date-code-number. The single digit number at the end dictates the order these files should be opened, for example...

NEO-190409-3878162004FM17-1-1.fits and NEO-190409-3878162004FM17-1-2.fits

Before the session:
Ensure you have investigated which software will suit your setting best and test the software for yourself prior to the session.

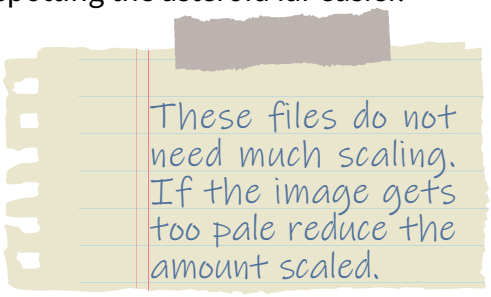
OPEN THE OBSERVATIONS

The students will be opening their data files in our software and completing a process called 'scaling'. This essentially involves telling our software the range of brightness that we want displayed. When they first open their image they will likely see a very black screen, with perhaps only the odd one or two white stars visible. We need to see more of the fainter stars and the process of scaling allows for this. The activity talks the students through the process but further instructions and support videos can be found on our website under the appropriate software links: www.schoolsobservatory.org/get-started/view-images/

During the session:
Ask the students to open the files from the set NEO-190409. Ensure the students open each of their four image files into our software in the correct order. The last digit of the file names are numbered 1-4 to help with this. Opening in the correct order will make spotting the asteroid far easier.

Encourage the students to scale each of their four files to a similar level, again this will make spotting the asteroid far easier.

If the images end up different sizes, the students can select 'Zoom to fill' from the 'Display' menu for each image to make them match.



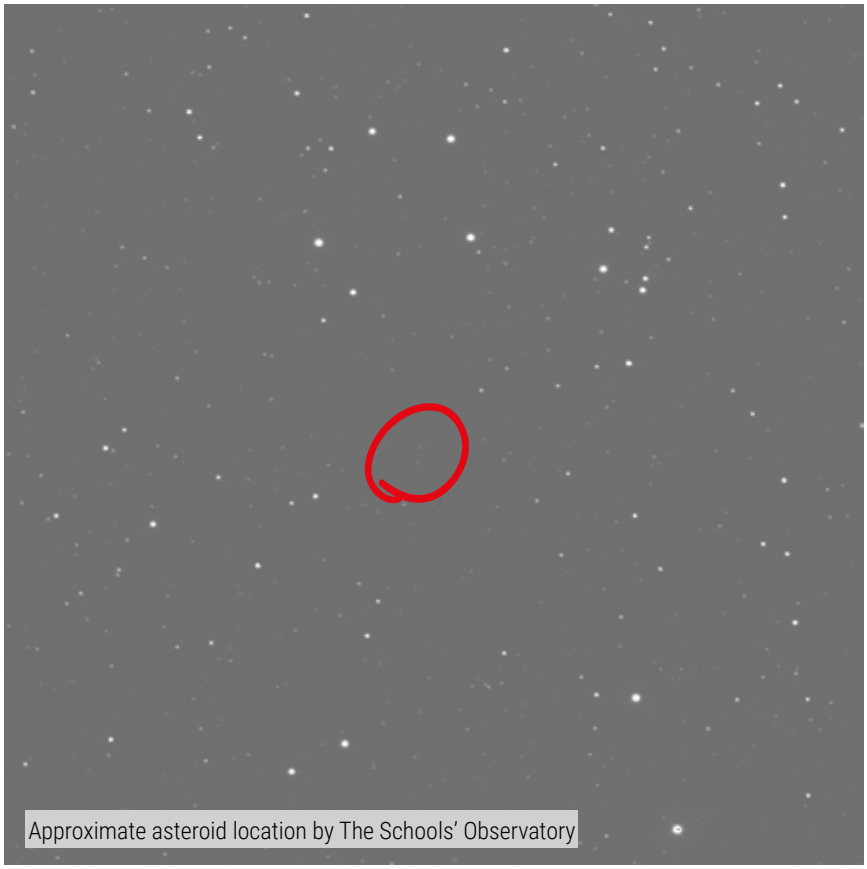
HUNT THE ASTEROID

Once they have opened all 4 image files and scaled each one it is time for the students to try and spot their asteroid.

The activity talks them through how to switch through the images quickly which reveals the asteroid easily. Perhaps before they do this encourage them to see if they can spot the asteroid with only one image. Ask them why this is not possible, and then explain that we need a series of images as we need to look for changes.

The process of switching quickly between the images is known as 'blinking'.

The asteroids are located towards the centre of the image in each case.


Approximate asteroid location by The Schools' Observatory

There is space in the pupils workbook to draw or paste a photograph of their asteroid. Ask them to circle the asteroid so they know where it was!

If you have time, find the asteroids in the files beginning with NEO-100808 and NEO-100421. There are potentially more asteroids to find in our 'Keep Watch on Asteroids' project:
www.schoolsobservatory.org/things-to-do/keep-watch-asteroids

SESSION 2: EGGNAUT

This session involves the students designing and making a capsule which will safely land an egg without breaking it. This activity is therefore best completed outside!

Learning Objectives, students will learn:

1. how to design for purpose
2. how Newton's Laws of Motion operate on a parachute

* The drinking straws can be any width but they must be at least 13 cm long.

The students will work in small teams to design and build a landing capsule. They will need to consider how their capsule will protect the egg, how they can slow the capsule down and how they can ensure they land close to the target area.

Each group will require the following:

REQUIRED RESOURCES
☆ 2 sheets of A4 paper
☆ 20 drinking straws*
☆ 20 craft sticks/wood splints
☆ 100 cm string of any size
☆ 100 cm masking tape of any size
☆ 5 rubber bands of any size
☆ 1 plastic bag
☆ 1 raw egg
☆ 1 pair of scissors

Before the session:
Ensure you have sufficient materials for each group and decide how long you will give them to complete the task. Remember to allow time at the end of the session for the groups to test their designs and determine the winning group.

Decide on how the groups will be judged, will they simply earn more points for protecting the egg or will they be immediately eliminated if the eggs breaks? Will they earn bonus points for being close to the landing area or do they need to land within a certain distance? Use your knowledge of the abilities of the group to determine how strict the success criteria can be.

During the session:
Consider explaining the science behind parachutes.

The free falling Eggnaut without a parachute is pulled downwards by the force of gravity. The Eggnaut accelerates downwards and its velocity increases. This is Newton's Second Law of Motion which states that the resultant force on an object = mass x acceleration (F=ma) where:

- ☆ force (F) is measured in Newtons (N), which in this case is the gravitational force
- ☆ mass (m) is measured in kilograms (kg)
- ☆ acceleration (a) is measured in metres per second squared (m/s^2)

For the falling Eggnaut, air resistance acts upwards (opposite to gravity) and increases as the velocity of the Eggnaut increases. The faster the Eggnaut falls the more air resistance force acts upwards.

Using a parachute increases the cross-sectional area of the Eggnaut and therefore increases the amount of air resistance acting upwards. An upward resultant force on the downward travelling Eggnaut would make it slow down - and hopefully land safely!

SESSION 3: MISSION TO MARS

Working in small groups the students spend this session thinking about what we as humans would need if we were to live on Mars. They will then attempt to design a base camp that fulfils these needs as far as possible. Encourage them to be as creative as they like with their solutions.

Learning Objectives, students will learn:

1. how to design for purpose
2. to consider what humans would need to survive and thrive

Each group will require the following:

REQUIRED RESOURCES
☆ Pencils
☆ Ruler
☆ Crayons

During the session:

This session is self explanatory, the student booklets have most of the instructions and information. However if you wish to we have additional information for you on our website:

www.schoolsobservatory.org/stem-club

The students will work in small teams to design and label a Martian base camp.

Encourage the students to think of how easy or difficult something would be to transport to Mars. Highlight the huge costs involved with heavier items and the fact that the journey there and back would take at least 18 months.

SESSION 4: THE MOON

During this session students will investigate the lunar surface by first completing a jigsaw of the Moon (Moonsaic!). The Moonsaic is an image of the Moon during its gibbous phase, taken by the Liverpool Telescope. They will then research a number of astronomical terms associated with the Moon. They can use the labels to identify these features on the lunar surface.

Learning Objectives, students will learn:

1. to use a range of sources to research astronomical terms
2. to use observational skills to locate and identify features on the Moon's surface

Each group will require the following:

REQUIRED RESOURCES
☆ Moonsaic segment print outs*
☆ Sticky tape
☆ Scissors
☆ Arrow labels (page 12)
☆ Research materials

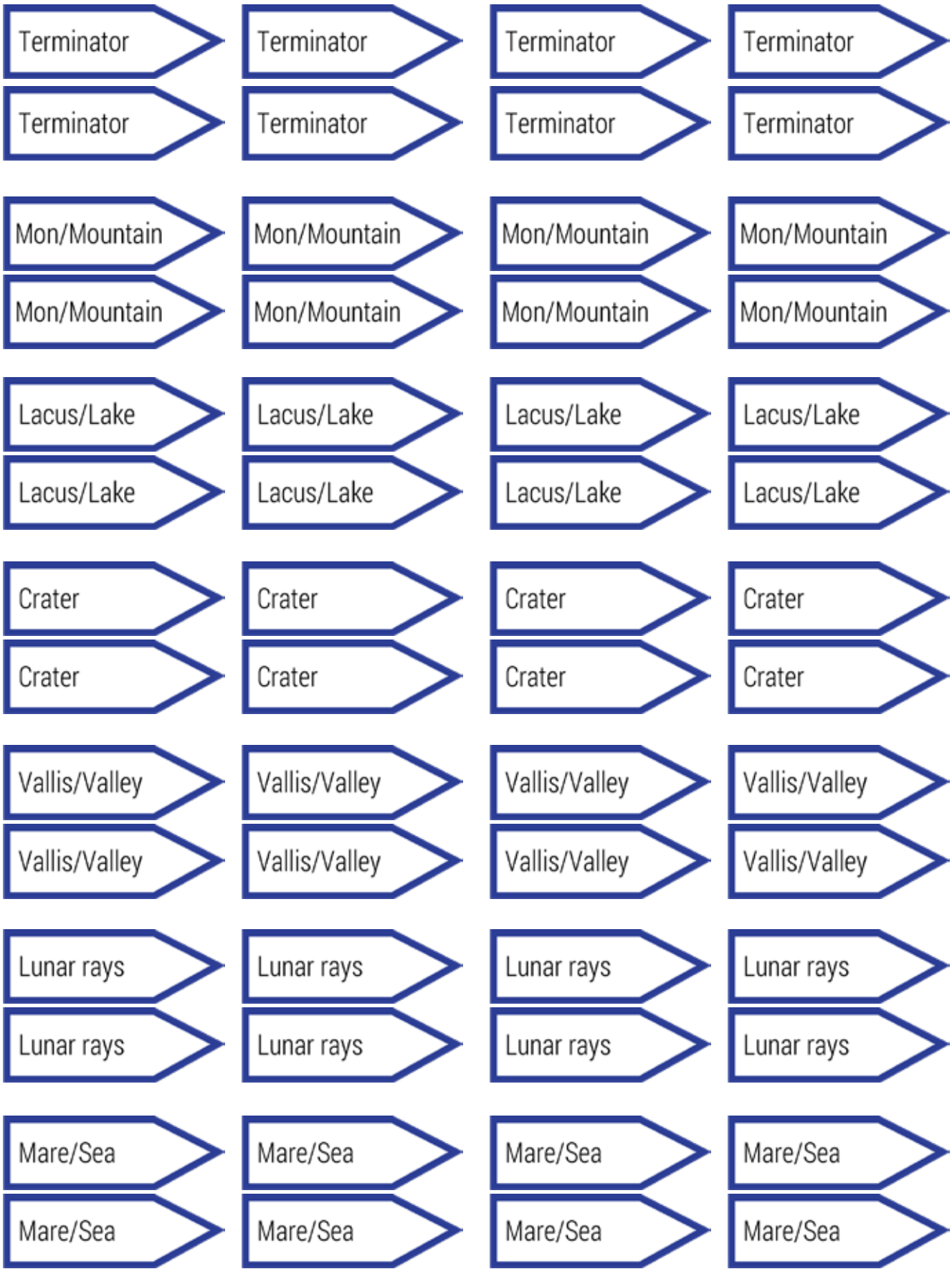
*Please download the "Moonsaic - Last Quarter" zip file from:
www.schoolsobservatory.org/things-to-do/moonsaic

The students will work in small teams to cut out and put together the large Moonsaic, a jigsaw of an image of the Moon, taken by the Liverpool Telescope. This is a very high resolution image of the lunar surface and will allow the students to then research and identify features they can see on the Moon.

During the session:
The students will need to research the meaning of a number of terms, all of which will be found on our website.

ARROW LABELS

Copy this page and cut out the arrows.



SESSION 5: STARS

During this session the students will spend some time looking at the night sky. It is best therefore to run this session on a clear evening.

The students will count the stars they can see through a tube at five random spots in the sky. They will then work through a series of calculations to give them an estimation of the total number of stars visible in the entire night sky.

This session can then be used to lead a discussion around the issue of light pollution and how different locations would yield different results, e.g. a rural location with little light pollution would allow the students to see far more stars than an urban location with street lights, homes and cars all emitting light.

Learning Objectives, students will learn:

1. how to use algebraic formulae to solve mathematical problems
2. the importance of taking multiple measurements during scientific enquiries
3. the impact light pollution has on astronomy

Each group will require the following:

REQUIRED RESOURCES
☆ One A4 sheet of paper
☆ Sticky tape
☆ One pencil
☆ Calculator
☆ Clear skies!

The students will create a tube and point it at a random part of the sky. Then without moving the tube, they will count the number of stars they can see. They will repeat this a further 4 times and then follow the calculations in the student workbooks to obtain an estimation of the total number of visible stars in the night sky.

During the session:
Encourage the students to allow their eyes to adjust to the dark before they begin counting stars. This involves not looking at any light for at least 5 minutes (20 minutes would be best) and will make a huge difference in how many stars will be visible to them.

SESSION 6: ASTRO-PICS

During this session the students will be creating astro-pictures. This activity is best suited to photography and if your school has digital cameras and tripods we would urge you to utilise these. However, if not, the activity can be done by asking the students to have a go at sketching or painting a view of the night sky, just like the astronomers of old had to do!

Learning Objectives, students will learn:

1. how to take photographs of dark scenes
2. the importance of creativity in science
3. how to look for objects in the night sky
4. how to appreciate the night sky in their home area

Each group will require the following:

REQUIRED RESOURCES
☆ Access to a digital camera
☆ A tripod
☆ Photo editing software
☆ Clear skies
☆ Creativity!

Optional:
If you do not have the digital resources, you will need art supplies for the students to create their astro-pictures.

The students will ideally be creating an image of their own and will therefore need to be outdoors. If the weather prevents this, consider providing the students with a range of astro-pictures and ask them to recreate one using paints, pencils or pastels. A vast selection of images can be found on our website under the Galleries section, or from the NASA website.

Ensure the students think about why they like their image. Is it simply due to the aesthetics or is there a scientific significance to the image?

During the session:
Encourage the students to allow their eyes to acclimatise to the darkness by not looking at any light source for at least 5 minutes, this will allow them to see fainter stars.

NEXT STEPS...

Congratulations on completing the Bronze level of The Schools' Observatory STEM Club!

We hope your students have enjoyed the last six weeks and are proud of their completed workbooks. You will notice that the final page of their workbooks contains a space for their certificate. To obtain your certificates, please complete this short online form:

www.schoolsobservatory.org/stem-club/certificates

Once you submit the form, you will be able to download your certificate.

You can access the Silver level booklets here: www.schoolsobservatory.org/stem-club

Thank you for being part of The Schools' Observatory STEM Club!

JUST FOR FUN

We love to see the images that pupils have created from their observations! On page 17 of the student booklet there are details on how to share students' astronomical observations with us. The images you share with us may be showcased in our Galleries on The Schools' Observatory website.

You can share students' images with us by:

- ☆ Tagging @SchoolsObs on Twitter or Instagram

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

FEEDBACK

We love to hear from our users about how we can improve our services. If you or your students have ideas about how we can improve these booklets please email SchoolsObs@ljmu.ac.uk

THE SCHOOLS' OBSERVATORY

For more lesson ideas and interactive workshops visit the 'Things to Do' section of our website.

WWW.SCHOOLSOBSERVATORY.ORG/THINGS-TO-DO

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