

STEM club

*LET'S EXPLORE THE
UNIVERSE TOGETHER!*

CLUB LEADER

ACTIVITY DETAILS

RESOURCE LISTS

LEARNING OUTCOMES

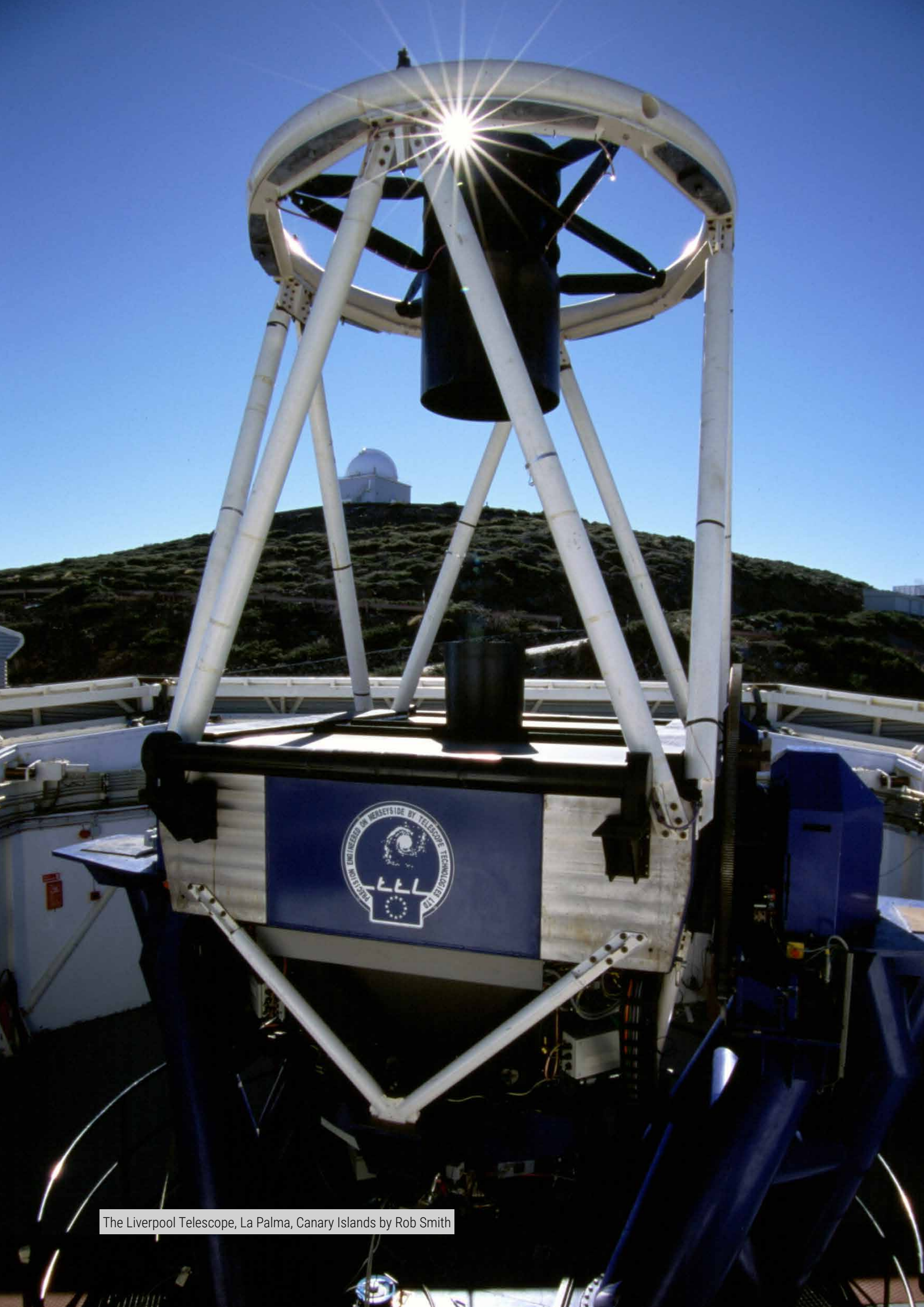
PROUD TO BE PART OF



Dumbbell Nebula by The Schools' Observatory

**BRONZE
PRIMARY EDITION**





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

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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 pupils of all ages and develop their love of STEM education.

What is the The Schools' Observatory STEM Club Programme?

This STEM Club programme provides three levels of activities; Bronze, Silver and Gold. Each level takes 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 pupil.

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 pupil booklet contains step-by-step instructions for each activity and spaces for pupils to record their work throughout the programme. The pupil 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 pupil 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 pupil 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 pupil 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

WARNING

Warning notices are used to remind pupils to be careful when completing the activity.

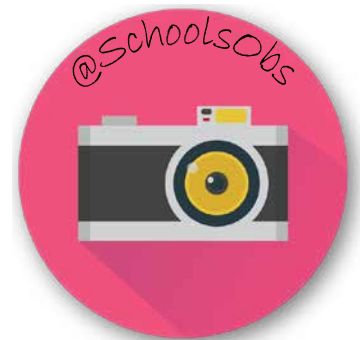


IMPORTANT

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



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



This is a tip. Useful information will be written like this to help it stand out from the activity steps.



SESSION 1: REGISTER FOR FREE

In this first session the pupils will be logging on to our website, using the Liverpool Telescope and finally having a go at a little space themed quiz.

Learning Objectives, pupils will learn:

1. how to log in to websites
2. how to request an image from the Liverpool Telescope

Each group will require the following:

REQUIRED RESOURCES	
☆	Computer instructions*
☆	Login details for the pupil accounts
☆	Enough computers for the pupils
☆	Books or access to space related websites

*The pupils' computer instructions for this session can be found here:

www.schoolsobservatory.org/stem-club/resources

You can either display these on screen or print them for each pupil/group.

ACTIVITY 1: GO OBSERVING

Before the session:

Prior to the session you will need to create a free teacher account on our website and then create the pupil accounts. This is a very quick and easy process.

First of all, go to www.schoolsobservatory.org/register and choose the option to 'Register as a Teacher'. This involves completing a short registration form.

Once you have registered an account, you can create pupil accounts under your login, which allows you to manage them. You can create a full class set of pupil accounts in one go, under the 'My Account' section, once you are logged in.

A full video tutorial of the process can be found here: www.schoolsobservatory.org/help/myaccount

During the session:

Have the list of the pupil usernames and passwords as the pupils will need these.

The pupils will be using our website to request an observation of the Moon from the Liverpool Telescope. The Liverpool Telescope is the world's largest fully robotic telescope and can be used for free via The Schools' Observatory website!

The section of the website the pupils will be using contains some very advanced features. Encourage the pupils to carefully follow the instructions in their booklets. If they ignore the instructions they could find themselves in more complex areas of the website which may cause confusion.



Pupils will use the 'Go Observing' section of the website and the instructions in their booklets to request an image of part of the Moon. Let the pupils know that they won't get their observation straight away but, given good weather, it should be ready by next week's session. On rare occasions the telescope may be closed for longer periods of time. For example, if the weather is particularly bad or there is a technical problem. This may mean that you need to be flexible in the order that you complete the sessions in this booklet.

When they get to step 4 in their booklets, encourage the pupils to click a light (or bright) part of the Moon. This is the area of the Moon currently visible and will improve the chances of their observation being successful and ready for next week's session.

Please note: at full or new Moon the image will be either fully light or fully dark. Clicking on a dark region will still submit an observing request, however, it may take some time for that region to be reilluminated enough for the telescope to capture its image.

ACTIVITY 2: STEM CLUB QUIZ

The pupils will undertake a short quiz. Provide the pupils with books, access to our website and any other resources you feel would help them answer the questions.

The answers are provided below. You may want to simplify the marks to just 1 per question.

1.	How many planets are there in our Solar System?	8
2.	Starting with Mercury, name the planets in order:	Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune
3.	Which is the biggest planet in our Solar System?	Jupiter
4.	What is the name of the only star in our Solar System?	The Sun
5.	How many moons does Mars have?	2 (Phobos and Deimos)
6.	What is a galaxy?	A large collection of stars held together by gravity
7.	Which galaxy are we in?	The Milky Way
8.	What is meant by 'orbit'?	When one object goes around another without touching it. An example would be the Moon orbiting the Earth. The object is held in its orbit by gravity.
9.	What object does Earth orbit?	The Sun
10.	What is a telescope?	An instrument that collects light and magnifies objects, making far away objects appear much closer.



SESSION 2: THE MOON

This week the pupils will be studying the Moon's surface and begin a Lunar Diary, tracking the changing appearance of the Moon as it passes through its phases.

Learning Objectives, pupils will learn:

1. how to use astronomical image viewing software
2. how to observe the surface of the Moon
3. how to use a table to record data

* The pupils' computer instructions for this session can be found here:

www.schoolobservatory.org/stem-club/primary-bronze

** If any pupils do not have their own Moon images back from the telescope in time for this week's session you can download one here:

www.schoolobservatory.org/gallery/iom/1706

*** www.schoolobservatory.org/get-started/view-images

LTIImage can be installed on the computers you'll be using or run from a memory stick. AstroLab can be used directly in an internet browser on your computer. This will depend on your schools individual setup. Further information can be found on the website link above.

Each group will require the following:

REQUIRED RESOURCES

- ☆ Computer instructions*
- ☆ Enough computers for the pupils
- ☆ Pupil logins for our website
- ☆ A saved image of the Moon **
- ☆ Our software (free)***
- ☆ Play-Doh
- ☆ Sharpened pencils
- ☆ Camera

Depending upon the software you use, you will need to run the session slightly differently. Please use the advice on the website to decide which will suit your school best.

ACTIVITY 1: VIEWING YOUR MOON

DOWNLOADING YOUR IMAGE

The pupils will be accessing their accounts and downloading the image of the Moon that they requested last week.

A week is usually plenty of time for the telescope to have successfully taken the requested image. If a pupil's file is not ready, this could be because the telescope is closed (due to technical maintenance or poor weather) or they may have picked a part of the Moon that was unobservable (dark) at that point in the lunar cycle.

Any pupil without an observation can use our archive to select an image of the Moon. Choose 'Lunar Features' in the 'Observing Programme' drop-down on the following page:

www.schoolobservatory.org/obs/arch



During the session:

Have a printed list of the pupil usernames and passwords ready because the pupils will need these. Help pupils save their downloaded image to a computer folder where they can easily find it again.

USING OUR SOFTWARE

The pupils will be using our free software. The pupils images can either be opened directly in AstroLab from their observations section of the website, or downloaded and viewed using LTImage. Use the appropriate supplementary material to guide you in this process.

Before the session:

The instructions in the pupil workbooks talk them through the process of 'scaling'. The telescope is very sensitive and collects over 50,000 shades of grey. Our eyes are only capable of discerning 50 shades. Scaling essentially adjusts the image so it can be viewed by the human eye. We have created step-by-step instructions as well as screencasts with further details on scaling and how it is done our software. These can be found here: www.schoolsobservatory.org/get-started/view-images.

ACTIVITY 2: PLAY-DOH MOONS

Provide the pupils with an amount of Play-Doh to create a Moon roughly the size of a tennis ball. They should then use a sharpened pencil to try and create the detailing of the Lunar surface.

During the session:

Encourage the pupils to look carefully at their telescope image of the Moon and to try and recreate all the features they can see on their Play-Doh version.

They should notice mountains, valleys, impact craters and 'seas'. Note: the dark areas on the Moon's surface were originally thought to be large expanses of water and so were called 'seas', but we now know they contain no water at all. They were actually created by volcanic activity, early in the Moon's lifetime.

Remember to take pictures of the models so the pupils can stick these in their workbooks.



ACTIVITY 3: LUNAR DIARY

The pupils will spend each evening over the next four weeks recording the shape of the visible moon. This should allow the pupils to see how the visible shape changes as the Moon passes through its phases.

Remember, check your pupils progress at each of the next four sessions.

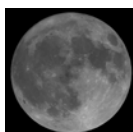


SESSION 3: SOLAR SYSTEM

This week the pupils will be learning about the different sizes of the planets in our Solar System. We recommend working in groups of up to three. They will use Play-Doh to create scale models of the eight planets.

Learning Objectives, pupils will learn:

1. how to follow step-by-step instructions
2. how to work as a team
3. how to visualise the size differences in the planets of the Solar System



Remind your students to complete their daily Moon diary from session 2.

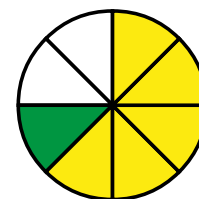
Each group will require the following:

REQUIRED RESOURCES

- ★ Play-Doh
- ★ Planet name cards
- ★ Rulers (for cutting the Play-Doh)

Each group should have at least 3 tubs of Play-Doh. If the tubs are very small tubs provide more. Each set of Play-Doh should be the same colour. You can find a recipe and risk assessment here: www.schoolsobservatory.org/things-to-do/make-play-doh-solar-system

The different colours used in their booklet are for guidance, to help them visualise the parts they will need to divide their Play-Doh into. For example, this pie chart shows 5 parts for Jupiter, 1 part for Saturn and 2 parts of left over Play-Doh.



Before the session:

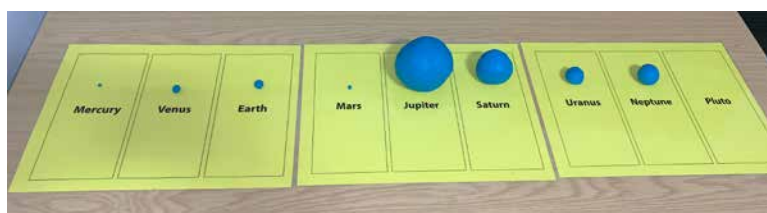
Ensure that each group has a set of planet name cards. These don't need to be anything more than post-it notes with a planet name on. They simply provide somewhere for the pupils to put their planets as they create them.

During the session:

Encourage the pupils to roll the remaining Play-Doh into a cylindrical shape before dividing it up. This will make the process of dividing into equal parts far easier than trying to divide a spherical ball of Play-Doh.

As they progress through the steps, their remaining Play-Doh will quickly become very small. The more accurately they can divide the cylinder into equal parts the greater the chance they will have enough Play-Doh to work with.

Completed steps 1 (above-right) and 10 (below) on laminated planet name cards.



SESSION 4: EXOPLANETS

This week the pupils will be studying planets.

They will be thinking about planets that orbit stars outside of our Solar System, known as 'exoplanets'. You may need to remind the pupils that the Sun is actually a star and most stars they can see in the sky will have planets orbiting them.

More in depth information about exoplanets and the detection of them can be found here: www.schoolsobservatory.org/learn/astro/stars/exoplanet

Learning Objectives, pupils will learn:

1. how to create scientific diagrams using labels
2. how to consider the elements needed for life to exist



Remind your students to complete their daily Moon diary from session 2.

Each group will require the following:

REQUIRED RESOURCES

☆ Pencil crayons

☆ Pencils

☆ Rulers

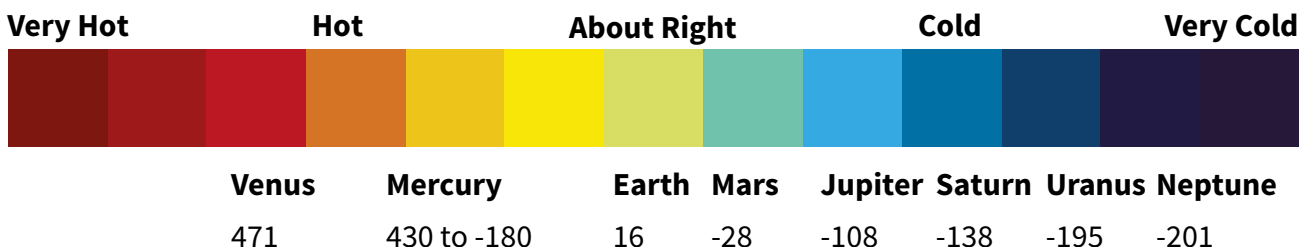
Ask the pupils to consider what an exoplanet might look like. Is it rocky or gas based? Will it have any moons? What (if any) life might exist there? Remind the pupils of what living things need and that they should consider this if their planet contains life.

The pupils will create a labelled poster of their planet, allowing their imaginations to run free!

Have a discussion about what makes planets habitable for humans, especially temperature - see the scale below. Talk to them about all the questions in their booklet.

Why not play a game of 'Pin the Planet'? Pupils guess where on the temperature scale each planet in our Solar System should be based on its average temperature. The answers in degrees Celsius are shown under the colour scale. You can download a poster version of this scale here:

www.schoolsobservatory.org/things-to-do/design-planet



Average temperatures source:

<https://solarsystem.nasa.gov/resources/681/solar-system-temperatures/>



SESSION 5: ROCKETSHIPS

This week the pupils will be building and launching a bottle rocket!

Whilst you may choose not to go into any detail, they will be witnessing Newton's third law in action: "for every action, there is an equal and opposite reaction". Essentially, as the bottle becomes pressurised it will force the cork, vinegar mixture and gas out (an action), which will in turn push the rocket skywards (an equal and opposite reaction).

You may wish to carry out this session as a scientific investigation, perhaps with each group changing one variable, such as the amount of baking soda.

Please note that this activity will require extensive adult supervision, during both the making and launching. During launch, the bottles will become highly pressurised and the cork will be forced out of the bottle with great force. You must ensure the pupils stay at a safe distance from the launch. If the rocket fails to launch, the bottle will remain highly pressurised so great care should be taken when retrieving the rocket. This should only be done by the adult supervisor.

The launch will also be quite messy, and is therefore best done outdoors!

Learning Objectives, pupils will learn:

1. that gas will fill a container
2. how to carry out a scientific investigation
3. Newton's third law



Remind your students to complete their daily Moon diary from session 2.

WARNING

This activity can be great fun but please make sure the pupils only launch their rocket outside and when you are present, as the bottles can become highly pressurised and launch at great speeds.



Optional:

If you want to accurately complete this activity, it may be useful to have the following resources: ruler, tablespoon, measuring jug.

A risk assessment can be found here:

www.schoolsobservatory.org/stem-club/primary-bronze

Each group will require the following:

REQUIRED RESOURCES

- ☆ Measuring jug
- ☆ A large empty drinks bottle
- ☆ 3 pencils
- ☆ Sticky tape
- ☆ White vinegar
- ☆ Baking soda
- ☆ 1 bottle cork
- ☆ 1 sheet of kitchen roll
- ☆ Pair of scissors
- ☆ A suitable outdoor space



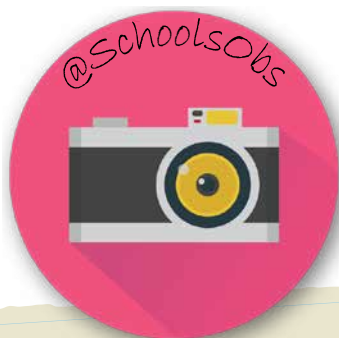
Before the session:

Ensure you have plenty of junk modelling materials to hand, especially if the weather will prevent going outside to launch. Encourage the pupils to decorate their rockets if time allows.

During the session:

Safety is paramount here. Consider the risks carefully and take precautions to keep pupils safe.

Remember to take a photo of the rockets before launch, as the messy process of launching may spoil their good looks!



IMPORTANT



Move at least two metres away from the rocket once you have started the reaction. The pupils should stand even further away.

If the rocket fails to launch, only a STEM club leader should go to check it. The cork was probably pressed in too tight and this will mean the bottle is highly pressurized. Great care should be taken in retrieving the bottle and removing the cork.

Top Tips

This activity is weather dependant. Wind severely impacts the rockets' ability to stand up and could direct a rocket towards those watching.

If this activity takes place on a day with poor weather, we recommend that groups decorate their bottle with paper/junk materials as a replacement activity.

Set up your camera(s) in advance. The reaction happens very quickly!

You may want to practice this activity on your own prior to the pupils watching.

The size of the bottle, amount of vinegar and bicarbonate of soda used and the tightness of the cork will affect the results.

If the mixture gets on your skin or clothes it will make you smell of vinegar.



Example 'junk' rocket by Maisie



SESSION 6: STARS

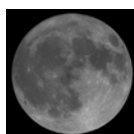
During this session the pupils will consider how many stars are visible in the night sky. This is a very practical session and largely weather dependent. The pupils will be undertaking a scientific investigation and then using addition and multiplication to estimate the total number of stars visible in the whole of the northern hemisphere sky.

Learning Objectives, pupils will learn:

1. how to carry out a scientific investigation
2. how to record results in a table

IMPORTANT

If the sky is too light (e.g. if your club takes place at lunchtime or in the summer months) set steps 1 - 6 in the pupils' booklets as homework, prior to this session.



Remind your students to complete their daily Moon diary from session 2.



Each group will require the following:

REQUIRED RESOURCES

☆ One piece of A4 paper

☆ Sticky tape

☆ One pencil

☆ Calculator

☆ Clear skies!

The pupils will create a paper tube and then choose a point in the sky. Holding their tube very still, they will count how many stars are visible through their tubes. They will record the results at five different points in the sky, then add these five results together, then multiply this total by 39. This will give an accurate estimation of the number of stars visible in the sky (in one hemisphere). If you double your answer you will get the number of stars seen by both the northern and southern hemisphere.

During the session:

Encourage the pupils to allow their eyes to acclimatise to the darkness. This means not looking at any lights for a few minutes before they start to count stars. This will enable the pupils' eyes to see far more stars.

You may wish to explain to the pupils that due to the spherical nature of the Earth, we are only ever going to see half of the night sky (one hemisphere).

You can discuss the results and how they may be different to pupils in different STEM Clubs. Clubs in rural areas with less light pollution will be able to see fainter and more distant stars. They will record a higher number than clubs in urban areas that have plenty of light pollution. Pupils can check their results on our website and add their numbers to our light pollution map.



NEXT STEPS...

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

We hope your pupils 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 13 of the pupil booklet there are details on how to share pupils' astronomical observations with us. The images you share with us may be showcased in our [Galleries](#) on The Schools' Observatory website.

You can share pupils' 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 pupils have ideas about how we can improve these booklets please email SchoolsObs@ljmu.ac.uk





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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Triangulum galaxy by The Schools' Observatory

**STEM
Club**

**PRIMARY
CLUB LEADER EDITION**

