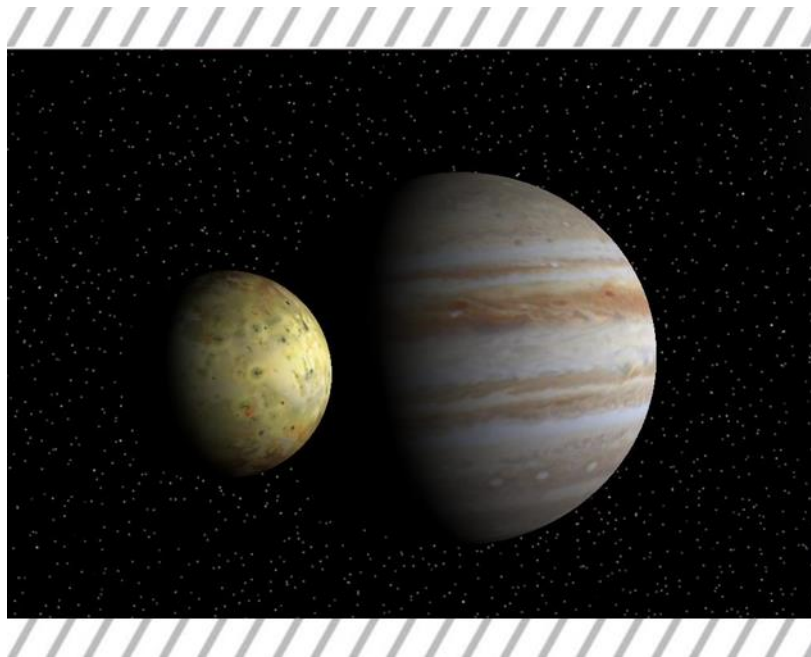




SECONDARY

Programme Guide 2016/17



About The Royal Observatory Greenwich

The Royal Observatory at Greenwich was founded by Charles II in 1675 and is one of the most important historic scientific sites in the world. Today the Observatory is a museum and science centre which provides access to information about space to schools and the wider public. A visit to the Observatory offers inspiring, curriculum-linked experiences delivered by REAL astronomers based around REAL cutting edge science.

What we offer

Whether you are looking for something to ignite the imagination and enthusiasm of your group, develop and stretch their knowledge or give them an insight into the working world of space science there will be something to suit.

Our content relates to space science and its associated branches of the STEM (Science, Technology, Engineering and Mathematics) subjects. It is not often that students get access to state of the art equipment, real scientific data and to chat to real scientists; at the Royal Observatory they do and it is what makes our education programme truly unique. As a result of our programme being so different we naturally get asked a lot of questions about it. Here we have answered some of the most frequently asked questions, if you have any others please do get in touch.

What does the Secondary Programme consist of?

For KS3, KS4 and Post-16 we offer a **Discovery Day**, a **Space Spectacular Day** or a **Study Day**. Depending on which you choose your visit can be made of: a planetarium show, an interactive workshop, a masterclass, a self-facilitated visit to the Weller Astronomy Galleries and a time-slot in the lunch room.

How much does a visit cost?

Study days run every Thursday and are by far the most popular choice for our secondary school visitors. The cost of a study day is £90 for 30 students and includes a: planetarium show, workshop, masterclass session and self-guided gallery tours.

If you would prefer to come along to only a planetarium show or workshop you can do although this would need to be on a non-study day. The workshops are free of charge and the planetarium shows carry a charge of £90 for 30 students.

Is the schools offer the same every day, all year round?

No, we understand that there are certain times of the year when it is easier and more appropriate to bring groups out on trips so we have designed our programme to fit in with our school visitors. Therefore, we have key stage specific **Discovery Days** and **Space Spectacular Days** on certain days throughout the year and vary the amount of **Study Days** on offer to meet the demand of our audiences. For information on what is on and when, please check with our bookings team.

What is new this year?

The 2016/17 is set to be a very exciting year with lots of new things going on such as:

NEW - Outreach

Until this year we haven't been able to offer outreach visits in schools. However, in the 2016/17 academic year we are releasing a small number of bookable secondary outreach slots so if you are interested please contact Liz Avery eavery@rmg.co.uk for more details.

NEW - Maths Festival

We will be running a Maths Festival on selected Fridays through February and March 2017. Maths Festival Days are aimed at KS3 students and will consist of a planetarium show (*Maths and Beyond*), a workshop (*Maths and the Milky Way*) and visits to our galleries. If you are looking for a way to connect maths to the real world using astronomy as the context then these are the sessions for you.

NEW – Planetarium Show and Workshop

Space Spectacular week in March 2017 we see the premier of our new planetarium show, *The Final Frontier* along with our new interactive quiz workshop *A Question of Space*. If you are looking for ways to enthuse as well as stretch your students then these days could be just the ticket.

NEW - Resources

As always we release new content in the form of videos, podcasts, blog posts and classroom resources on a regular basis so keep an eye on the website for more details.

To keep up to date with any new releases you can join the teacher forum or sign up to our newsletter. Take a look at the *Get Involved* section of our website for more details.

Our Secondary Programme Explained



Below you will find answers to some of the most frequently asked questions about the schools programme. If you have any more questions please contact the booking team as they will be more than happy to help.

What is a Discovery Day?

Discovery Days are designed to be very flexible visit days. It is up to you what sessions you select for your *Discovery Day*, you can choose from: a planetarium show, a workshop, a gallery visit, use of the lunch room or all of these. New to 2016/17 we also have a Maths Festival where we will be running maths themed *Discovery Days*. These only run on specific days so book quickly to avoid missing out. The bookings team will be able to timetable your day so you include all the components you want to.

What is Space Spectacular week?

Space Spectacular weeks are very special as they only run 3 times a year so you will need to book fast. Visits during *Space Spectacular* weeks are made of: a planetarium show a demo-filled quiz workshop, Time and Modern Astronomy gallery visits and a lunch room slot.

What is a Study Day?

The *Study Day* offer is exclusively for secondary groups with specific sessions for KS3, KS4 and post-16. The theme of a *Study Day* changes throughout the year but the structure is always the same as a *Discovery Day* with the addition of a masterclass session.

What is a planetarium show?

Think of our planetarium as a tour bus of the Universe taking you on amazing journeys to explore and experience the wonders of the night sky. Combining real images from spacecraft and telescopes with advanced CGI, all projected onto a fully immersive dome, the Planetarium can fly you over the Earth, transport you to distant galaxies, show you the birth of a star or land you on Mars.

What is a workshop?

The astronomer-led workshops are very interactive and have plenty of opportunities to ask questions and discover new things. The workshops use a combination of sound, film, demonstrations and team activities to explain different amazing scientific concepts with tools from physics and mathematics.

What is a masterclass?

These are KS3, KS4 and post-16 sessions linked to areas of the relevant key stage specifications and draw on cutting-edge observations, current astronomical research and careers in science. Choose from: Out of this World Careers (KS3, KS4 and post-16) *Galaxies and Cosmology* (KS4 and post-16), *Stellar Evolution* (KS4 and post-16) and *Observational Astronomy* (KS4 and post-16).

What else can I do on a visit day?

If a *Discovery*, *Study* or *Space Spectacular* day still doesn't satisfy your scientific appetite you can also visit our temporary exhibition gallery and the historic observatory site, including the Prime Meridian, the Great Equatorial Telescope and the Time and Meridian Galleries. We also have visit guides for those doing self-facilitated sessions which are available for free on the website.

Who develops and runs the sessions?

The sessions are all run by our real astronomers so there is always an expert available to ask any questions. All our content is developed by the astronomy education team in collaboration with our teacher's forum. All sessions are tested and evaluated with the teacher's forum and also with school groups to ensure that the content developed is exactly what teachers are looking for and what students will thoroughly enjoy!

Are there activities that can follow on from my visit?

Yes - LOTS. On our website you will find information about: our teacher forum, a growing collection of curriculum-linked classroom resources, videos (screenshots from two of our videos are below), podcasts, *Think Space* Lectures and even blogs. Check out the website for more details.



Workshops

Our interactive workshops take place in one of three purpose-built learning spaces in the Lloyd's Register Foundation Learning Centre and are designed to encourage active learning and hands-on scientific enquiry.



Each session is led by a Royal Observatory astronomer and lasts 45 minutes. Sessions offered at more than one Key Stage will be tailored to link to the curriculum of your group and can be further customized through the inclusion or exclusion of more challenging mathematics and physics content. Please speak to our bookings unit about any special learning needs or objectives when you book.

Supporting resources for teachers

Pre- and post-visit resources linked to our workshops which include background reading for teachers, discussion questions, classroom activities and extension work for advanced students are available on the Royal Observatory Greenwich schools website.

NEW to 2016/17

Title: Action Reaction: Forces In Space

Session level: KS3 and KS4

Session length: 45 minutes

Key points covered - Newton's laws of motion, types of force in various astrophysical objects including gravity, the electrostatic force and magnetism.

Workshop summary – students explore Newton's laws of motion and the origins of different types of force in various astrophysical objects including gravity, the electrostatic force and magnetism. They will see a series of demonstrations of these concepts and conduct experiments investigating the effects of air pressure and electromagnetic induction. They will also carry out some simple calculations to further explore these important concepts.

<p>Title: Seasons, Phases and Eclipses Session level: KS3 Session length: 45 minutes</p>
<p>Key points covered - the Earth, Sun and Moon, the relationship between the tilt of the Earth and Seasons, the observation and explanation of the phases of the Moon and the circumstances for eclipses. Bespoke equipment including a tellurium and digital smartboard models are used throughout to explain scientific concepts.</p>
<p>Workshop summary –In this interactive session students use both large scale astronomical models and digital simulations to review their understanding of the Sun-Earth-Moon system. They explore concepts of light, shadow, reflection and transmission and combine their knowledge to explain the more complex natural phenomena of the seasons, the phases of the Moon, and solar and lunar eclipses. Students are tested at the end with a short interactive quiz.</p>

<p>The Solar System and Beyond Session level: KS3 and KS4 Session length: 45 minutes</p>
<p>Key points covered – ICT skills, Kepler’s laws of planetary motion, orbits, Newton’s laws of gravity.</p>
<p>Workshop summary – students use astronomical software real astronomical data in this interactive ICT-based session to travel through the solar system investigating the orbits of the planets. They will also explore how the mathematics used to describe planetary orbits has been used to discover a massive black hole at the centre of the Milky Way Galaxy.</p>

<p>Maths and the Milky Way Session level: KS3 and KS4 Session length: 45 minutes</p>
<p>Key points covered – mathematical techniques including calculations, unit conversions and the construction and interpretation of graphs and charts.</p>
<p>Workshop summary – in this session students see how maths can be used to find out more about the world around us and beyond. They learn about calculating distances to other planets along with how to draw and interpret graphs. They will also then look at how the knowledge they build up in the workshop can even be used to help them find the travel time from extrasolar planets to our planet so they see how long alien life forms might have to travel if they were headed our way.</p>

<p>Exploring Exoplanets Session level: KS3, KS4, Post-16 Session length: 45 minutes</p>
<p>Key points covered – the electromagnetic spectrum and orbits.</p>
<p>Workshop summary – in this hands-on session students are introduced to the challenges of detecting small, faint extrasolar planets around bright stars and an infrared camera is used to demonstrate one solution to finding them. They learn how astronomers discover planets orbiting distant stars using another detection method by making and discussing measurements of their own exoplanet system, and applying their knowledge of light and gravity. They will then go on to analyse real data from the NASA space telescope Kepler and think about whether their exoplanets would be habitable.</p>

Studying Starlight**Session level: KS4 and P-16****Session length: 45 minutes****Key points covered** – the electromagnetic spectrum, reflection, absorption and emission of light and for P-16, the Doppler effect.**Workshop summary** – in this hands-on workshop, students learn how astronomers determine the properties of distant stars by examining spectra and applying their knowledge of the electromagnetic spectrum, the reflection, absorption and emission of light, and at KS5 the Doppler Effect. They also look through spectroscopes to identify gases and see the spectrum of the Sun. The mathematical content of this session can be tailored to the group.**The Expanding Universe****Session level: KS4 and P-16****Session length: 45 minutes****Key points covered** – Velocity, calculating distances and team working.**Workshop summary** – in this session students are introduced to the Citizen Science online project Galaxy Zoo, whereby members of the public can classify galaxies and contribute to scientific research. Students are given real data on galaxies from the Sloan Digital Sky Survey and plot a graph of velocity vs. distance. They use basic equations to determine large-scale properties of the Universe and are encouraged to think about the statistical significance of their result.

Planetarium Shows

Planetarium shows take place in the Peter Harrison Planetarium and are delivered live by Royal Observatory astronomers. Our state-of-the-art digital planetarium provides an inspiring, immersive and interactive learning experience, allowing students to examine the day and night-time sky, fly through our Solar System or enjoy visually stunning pre-recorded shows about the latest discoveries in astronomy.



Meet the Neighbours

Session level: KS3

Session length: 45 minutes

Key points covered – aspects of light and shadow, Earth, Sun, & Moon, forces in action, how we see things, scales in distance and size

Show summary– this amazing interactive show begins with an introduction to the sky, both day and night time and examine the apparent motion of the Sun and stars. They then lift off from Earth to hover over the North Pole and watch our planet spin on its axis, bringing night and day to different parts of the world. Going on to visit our nearest neighbour, the Moon, students first explore the origin of its phases and then land on the lunar surface. Flying out to view the entire Solar System, pupils learn or review the general appearance and arrangement of the planets, their relative sizes, and how fast they orbit around the Sun. After a trip through the outer Solar System, where comets and plutoids are found, the show concludes with a journey beyond the Solar System to consider the hundreds of extrasolar planets now known to orbit stars other than our Sun. The presenter explains how these alien worlds are discovered and how astronomers are working to find more. The show ends by zooming farther and farther from home to look at the Milky Way Galaxy then, some of the hundreds of billions of galaxies which form the cosmic web of our Universe.

<p>Maths and Beyond! This show only runs during our <i>Maths Festival Season</i>. Please ask the bookings team for more information. Session level: KS3 Session length: 45 minutes</p>
<p>Key points covered – Key Stage 3 Mathematics Curriculum. Maths in astronomy and parallel everyday applications of the same principles.</p>
<p>Show summary– <i>Maths and Beyond!</i> is a modular show, produced in-house by our Planetarium Astronomers. Schools will be able to build their own three-part show from six available 10 minute modules, resulting in a 30 minute school show. The modules variously target key areas in the KS3 Maths curriculum and relate mathematical principles to problem solving in astronomy, as well as more down-to-Earth situations! Each module poses a big question about space that we'll need maths to answer, such as “How Weird is the Sun?” and “How Does the Sun Shine?” Once everyone’s experienced the power of maths in solving such big puzzles, the last minute of each show includes an animated cartoon with a friendly astronaut to relate the principles to practical problems here on Earth, such as calculating how many songs can fit on an MP3 player. This highly adaptable show can be cut down or extended, and is presented live by a Royal Observatory Greenwich astronomer.</p>

<p>Solar System Galaxy Universe Session level: KS3, KS4 and P-16 Session length: 45 minutes</p>
<p>Key points covered – the solar system, our Milky Way Galaxy and the larger universe.</p>
<p>Show summary– in this inspiring interactive show, an ROG astronomer will take your students on a bespoke tour of the cosmos, exploring our place in space and the contents of our solar system, our Milky Way Galaxy and the larger Universe. The presenter will select between different versions of the show which are designed to emphasise the content best suited to the curriculum at various key stages.</p>

<p>We are Stars This show only runs at specific point in the school year. Please ask the bookings team for more information. Session level: KS3, KS4 and P-16 Session length: 45 minutes</p>
<p>Show summary– this beautiful show explores some of the most fundamental questions of all time; what are we made of and where did we come from? Narrated by Andy Serkis this animated show investigates the origins of life and how life on Earth connects to the evolution of our Universe.</p>

New for 2017!

March 2017 will see the arrival of *The Final Frontier*, a brand new planetarium show for KS3 audiences that will run during Space Spectacular weeks. Details will be released in late 2016 so keep your eyes peeled for more information.

Study Days

The *Study Day* offer is exclusively for secondary groups with specific sessions for KS3, KS4 and post-16. The theme of a *Study Day* changes throughout the year but the structure is always the same as a *Discovery Day* with the addition of a masterclass.



What is a master class?

These are KS3, KS4 and post-16 sessions linked to areas of the relevant key stage specifications and draw on cutting-edge observations, current astronomical research and careers in science. Choose from: *Out of this World Careers* (KS3, KS4 and post-16) *Galaxies and Cosmology* (KS4 and post-16), *Stellar Evolution* (KS4 and post-16) and *Observational Astronomy* (KS4 and post-16).

Think Space Lectures

If your group want to get more involved after their study day you can bring them back to one of our *Think Space* lectures. These run from Autumn to Spring and are after school lectures where a scientist will come in and speak about their research. Booking is essential. The lectures are pitched at key stage 4 and above. We also release a podcast interview with each of our speakers after the event so you can find out even more about them and their research.

Podcasts and Blogs

The astronomers at the Royal Observatory Greenwich regularly release new content so you and your students can stay up to date with the world of astronomy. We release monthly *Look Up* podcasts, regular *Spacebook* blog posts and even extra special podcasts of interviews when we have special guests. Check out the *Get Involved* section of the website for more information.

Galleries

With four galleries on offer there is sure to be something to grab your attention during a visit. Gallery guides are available on our website for you to download if you would like a highlights tour of the spaces.



Weller Astronomy Galleries

A visit to the Weller Astronomy Galleries is must do component of any schools visit. Three galleries comprise the middle floor of the Modern Astronomy Centre and contain a host of interactive exhibits allowing students to explore our current understanding of the Universe and how astronomers gather evidence to learn more about it.

- 1. Astronomy Inspires gallery** - the Astronomy Inspires gallery showcases two models of the Universe. One is a beautiful 19th century orrery demonstrating the motion of the planets known at that time. The other is a state-of-the-art projection wall summarizing our current understanding of the formation and evolution of the Universe, from the Big Bang to the present day in 4 minutes!
- 2. Astronomy Explores gallery** - the Astronomy Explores gallery highlights the many different techniques astronomers use to learn about the Universe and allows visitors to try some out for themselves. Learn how planets around distant stars are discovered through the interplay of light and shadow. See how different kinds of light reveal what distant stars are made of. Or try your hand at pointing a telescope or commanding a space mission.
- 3. Astronomy Questions gallery** - the Astronomy Questions gallery features an interactive table-top which allows visitors to pursue their own line of questioning with a panel of on-screen experts about some of the most exciting open questions in the Universe. Is there life on other planets? Do black holes exist? What is dark matter? Come to the Astronomy Questions gallery to find out!

The Micro-gallery

The Micro-gallery is found on the bottom floor of the Modern Astronomy Centre and is the home of the Insight Astronomy Photographer of the Year exhibition. We run a project each year called *Creative Cosmos* where students can learn the science behind some of these images, learn to take their own and win some amazing prizes along the way.

The Historic Observatory

The Royal Observatory at Greenwich, was founded by Charles II in 1675 and is one of the most important historic scientific sites in the world so don't forget to have a look around and soak up some of the history too.



The Prime Meridian - every place on Earth is measured in terms of its distance east or west from the Greenwich Meridian, which divides the eastern and western hemispheres of the Earth, just as the Equator divides the northern and southern hemispheres. Since the late 19th century, the Prime Meridian at Greenwich has served as the reference line for Greenwich Mean Time. It can now claim to be the centre of world time and was the official starting point for the new Millennium.

Flamsteed House – this is the original Observatory building at Greenwich, designed by Sir Christopher Wren in 1675 on the instructions of King Charles II. Take a fascinating glimpse into the apartments where the Astronomers Royal and their families lived and worked. Tour the beautiful Octagon Room, designed to observe celestial events including eclipses, comets and planetary movements then see one of the world's earliest public time signals, the bright red Time Ball, on top of Flamsteed House.

Time Galleries - The award-winning time galleries explore our need for accurate timekeeping and the role it plays in our everyday lives. Find out about two British solutions to the longitude problem, including Harrison's famous chronometers. Watch our horology conservators at work and learn about the provision of accurate timekeepers for the Navy. Explore the history of the development of timekeeping and find out about the role of time in our everyday lives.

The Meridian Galleries and Great Equatorial telescope - explore a display of historic telescopes, including the Great Equatorial Telescope, which is the largest of its kind in the UK and the seventh largest in the world. Completed in 1893, it was designed to keep the Royal Observatory at the forefront of contemporary astronomy. Visiting this section is free to schools that have booked onto one or more of our education sessions.

Site information

Supervision

You are legally responsible for your group at all times whether they are visiting the shop, having lunch, in a planetarium show, workshop, science theatre show or looking around the galleries so please ensure that you have sufficient staff with your group throughout the visit.

Arrival and Departure

On arrival you will be greeted by a member of our schools hosting team, who will provide you with orientation and take you to a place where you can store bags and coats. You may visit the PHP foyer to collect bags and coats at the end of your programme, before you leave the Royal Observatory. Note that if you intend to visit the historic site you may leave your bags and coats and collect them later.

Storage Facilities for Bags and Coats

Bags and coats are stored in cages in the Planetarium Foyer for groups who have booked a lunch space, with one cage used for bags (lunches) and another for coats. At lunch time you are responsible for transporting the cage in which lunches are stored to the Activity Space which also serves as our lunch room. These cages must return to the planetarium foyer after lunch. The space is permanently occupied, so possessions are secure. However, many students like to take small bags and valuables with them.

Lunch Facilities

If you require a lunch space, please make sure you have one booked prior to your visit. Due to limited space, lunch rooms are only offered to schools who have booked a full science programme. Lunch facilities are provided in the Activity Space, which is situated on the first floor of the Astronomy Centre. Capacity is limited and groups must adhere strictly to the lunchtime listed on the Visit Schedule. Please ensure the lunchroom is left clean and tidy after use. In good weather, many groups choose to enjoy a picnic in Greenwich Park.

Toilet Facilities

A disabled toilet is available next to the lunch room for emergencies or use during lunch time. The main toilets are on the lower ground floor, next to the micro-gallery. An early morning toilet stop is advised before programmes commence.

The Shop

The shop is also on the lower ground floor. If you would like to visit the shop you are advised to do so at the end of your visit. You are strongly advised not to visit the shop just prior to your planetarium show, as show start times cannot be delayed to accommodate students in the shop. To simplify purchases for primary school children, goody bags are available at £1.00 and £2.00. A Goody Bag form will be included your confirmation pack. Any orders must be placed at least one week prior to your visit.

The Café

Hot drinks and food are available for teachers in the café. However, please note that you are legally bound to ensure that the requisite number of teachers remain with your groups. Older students are welcome to make purchases from the café if they so desire.

How To Organise A Visit

There can be a lot to think about when organising a school trip so we have come up with a 'to-do' list to help you to make sure you have everything you need to make your visit to the Royal Observatory Greenwich as enjoyable as possible. If you have any questions don't hesitate to get in touch with the bookings team or take a look at the website.

Step one – choosing your sessions.

Top tip – book early. Our sessions are very popular, time slots are limited and all sessions must be booked in advance. We recommend choosing your sessions and booking them as early as possible to avoid disappointment.

Payment of sessions

To make sure you day runs as smoothly as possible we would highly recommend paying for your session when you book. Payment in advance can be taken by credit or debit card only. If you choose to pay on the day payment by cash, cheque, credit/debit card will be accepted. Please note that failure to pay for sessions prior to them commencing will result in your group not being allowed to take part in the session. Please also note that we no longer invoice schools for the visits.

Checklist question	For more information	Complete?
What date and time would you like to visit? Do you have some alternatives?		
How many students and accompanying adults will be visiting?	See the <i>Programme Guides</i> .	
Would you like to book a Discovery Day or Space Spectacular Day?	See the <i>Programme Guides</i> .	
What sessions would you like your visit to be made up of?	See the <i>Programme Guides</i> .	
If you are booking a planetarium show as part of your visit do you have the payment details?		
Would you like to book some time in the lunch space?		

Step 2 – booking.

Please telephone **02083126608** or e-mail **bookings@rmg.co.uk** to arrange your visit when you have completed step 1.

Checklist question	For more information	Complete?
Have you checked that the booking information sent by the bookings team is as it should be?	See booking information you have been sent.	
Have you read the cancellation policy?	See booking information you have been sent.	
If you have more than one class visiting at once have you split them up into groups of 30 and labelled them A, B, C, D?	See booking information you have been sent.	
Have you ensured that you have enough staff to supervise each group?	See the <i>Programme Guides</i> .	

Step 3 – planning.

Top tip – prepare each for your visit carefully to ensure it runs smoothly on the day.

Your journey - while we will do all we can to accommodate school groups who are delayed in transport, it is not always possible to reschedule learning sessions and planetarium shows for groups who arrive late for their sessions.

Your staff - please provide all accompanying adults with a copy of the timetable for the day and make sure you have enough supervising adults to satisfy the safety requirements.

Your students - please remind students to act responsibly while on site and ensure they know what to do if they get lost. Gallery staff are fully briefed on 'lost child' procedures and are always on hand to help. Risk assessment information can be requested from our Bookings Unit if required. You can also prepare your students for learning so they get the most out of their visit. Full information on each of our pre- and post-visit resources and extension activities is available online at rmg.co.uk/schools. Please check back frequently as this website is regularly updated.

Checklist question	For more information	Complete?
Would you like to do a pre-visit?	Ask the booking team for details.	
Have you read the health and safety requirements?	Ask the booking team for details.	
Would you like your class to complete any of the challenges in the visit guides?	These are available to download free from the website.	
Do you have all the information you need to plan your journey?	See the website for details.	
Have all accompanying staff been briefed?		

Step 4 – following on.

Top tip – tell us how we did and get more involved with our teachers forum.

Checklist question	For more information	Complete?
Would you like to get more involved with the teachers forum?	Contact Liz Avery on eavery@rmg.co.uk	
Have you seen the Classroom Resources?	See the website for details.	
Tell us what you thought, please get in touch and tell us what you thought of your visit.	Ask the bookings team for details.	