Let's Move to the Moon – Notes for session leaders

Many thanks for taking part in our 'Let's Move to the Moon' project which is funded by the UK Space Agency and supported by the Henry Royce Institute.

In the Mission Suitcase there is everything you need for your group to complete seven missions throughout which they will learn about different properties of materials and some of the challenging conditions faced in space that they will need to overcome to build a moon base. These set of missions would make an ideal science club project.

1) Safety

There are some safety considerations relating to some of the missions – these are highlighted in the mission booklets.

2) Feedback

We would really appreciate it if you, or your group, can upload your data from each mission.

Links (and QR codes) to the Google Forms for this can be found via the links in the booklet at the end of each mission. This information is **VITAL** for us when it comes to reporting the project to the UK Space Agency.

In addition, any additional comments about the project and photos you take (that you are happy for us to share via our websites and social media platforms would be fantastic – please email these to info@discovermaterials.co.uk (with the title 'UKSA Spacebox Feedback').

3) Equipment

The equipment for all mission can be found in the suitcase. We have stuck colour coded stickers on the equipment to make it easy t find. The different colours associated with the equipment for each mission is as follows (please not there is no colour coded sticker for Missions 0 and 7 as they do not require the equipment in from the suitcase).

Mission 1 = red	Mission 3 = yellow	Mission 5 = blue
Mission 2 = orange	Mission 4 = green	Mission 6 = purple

Please could you return all equipment to the boxes and if any of it is damaged **please let us know** so we can replenish or repair it before lending it to the next school.

4) Delivery of sessions

How you run the sessions is, of course, entirely up to you but we think that it will work best with groups of 3-4 students working together through the mission booklet.

Also, given previous experience, it may work best to run it in the following order shown in section 5.

a) Videos

We have recorded **videos** to accompany each mission and the links and QR codes for these can be found in the Mission Booklets.

The videos themselves are intended to set the scene of the mission for the students and to give an overview of the reasons why they are doing each mission.

There are pauses embedded in the videos – these are intended as breaks in the videos for the students to have discussions and carry out tasks if you wish (otherwise please feel free to let the video run as you can always watch it again).

There is also a progress bar ('Rocket of Progress') in the bottom right hand corner of each video to indicate how long is left.

b) Missions

There are **some missions** for which there **won't be enough equipment for all groups to carry out the mission simultaneously** (e.g. only one infrared thermometer is included in the suitcase for mission 3 and only 2 vacuum jars are included in the box for mission 5) and so you may need to several of the shorter missions with different simultaneously. The mission that we believe can be run simultaneously are indicated with an asterisk in the 'Mission Description' section.

c) Data tables and reporting

We have included **data tables** in the booklet for the students to fill in. They may use these or you may prefer for them to draw the tables out themselves (as it would be good practise). Again, this is entirely up to you. Also, please do not forget to upload the student's findings at the end of each session as it will form the basis of our reporting to the UK Space Agency – manky thanks in advance for doing the.

5) Mission Descriptions

Here is an overview of the missions in the booklet and approximate timescale in which we anticipate the students to finish each mission. We recommend that the students form groups of 3-4 to work together through the missions.

We would greatly appreciate it if you can let us know how accurate these estimates are and how long your students **actually took** to complete each mission.

There are some missions for which there won't be enough equipment for all groups to carry out the mission simultaneously (e.g. only one infrared thermometer is included in the suitcase for mission 3 and only 2 vacuum jars are included in the box for mission 5) and so you may need to several of the shorter missions with different simultaneously. The missions that we believe can be run simultaneously are indicated with an asterisk

Following reflection on some of the missions the order shown below is the recommended order in which the mission should be carried out:

***Mission 0** – Ida Noddack Challenge*

The students have to work out the code to the padlock in order to open the suitcase. The clues will be in the Mission Booklet.

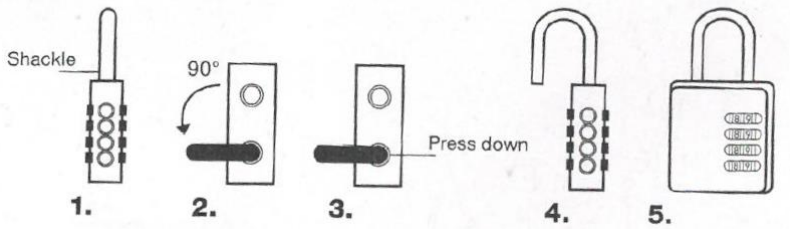
This mission will probably take about 15-30 mins to complete but if an ambassador delivers the suitcase they can give an introductory talk on the field of Materials Science before getting started on the suitcase.

If you need the code for the padlock it is 7517. If the padlock won't open, you can reset it using the instructions below:

To reset the combination:

1. Turn the dials and align the numbers to 0-0-0-0 so they are clearly visible in the windows.
2. Pull up the shackle and turn it 90° counter clockwise to align the lug on the shackle with the notch on the lock body.
3. Press and hold the shackle down firmly.
4. Now turn the dials to set your chosen combination.
5. Return the shackle back to the original position. Your personal combination is now ready to use.

Please keep these instructions for future reference.



***Mission 2** – Stephanie Kwolek Challenge (Equipment labelled with orange stickers in the suitcase)*

The students will test the mechanical properties of metal and plastic and discuss the requirements of the materials they may want to take to the Moon.

This mission will probably take less than 15 mins to complete

(time left over can be used to discuss the mission so far and what properties need to be considered when designing a moonbase).

***Mission 3** – Joycelyn Bell-Burnell Challenge (Equipment labelled with yellow stickers in the suitcase)*

The students will use an instant cool pack, cubes of different materials and an infrared thermometer to study how good different materials are at conducting heat by measuring the temperature of the cool pack and the temperature of the top surface of the material.

This mission will probably take between 45 – 60 mins to complete.

***Mission 1** – Cecilia Payne Gaposhkin Challenge (Equipment labelled with red stickers in the suitcase)*

The students will use the callipers, ruler and mass balance provided to calculate the density of different materials.

This mission will probably take about 60 mins to complete although some groups have found that it can take longer – please take no longer than 60 min on this mission.

***Mission 4** – Marie Curie Challenge (Equipment labelled with green stickers in the suitcase)*

Using UV colour changing beads, a long wavelength UV torch and sheets of different materials the students will investigate how good different materials are at absorbing UV light. This ability will be based on the colour changes of the UV beads after exposure to UV light through the different materials.

This mission will probably take between 45 – 60 mins to complete.

***Mission 5** – Helen Sharman Challenge (Equipment labelled with blue stickers in the suitcase)*

Using a vacuum jar and a hand pump the students will investigate the effect of a vacuum on a marshmallow, a balloon and a ping pong ball.

Please note that it works best if you have multiple marshmallows in the vacuum chamber and the size change of the marshmallows is more rapid (and usually more noticeable) when they shrink upon recompression of the chamber rather than when they expand whilst the pump is used.

This mission will probably take about 30 mins to complete.

***Mission 6** – Zaha Hadid Challenge (Equipment labelled with purple stickers in the suitcase)*

Using a 35mm film cannister, an effervescent vitamin C tablet and some water the students will learn about propulsion by launching their cannisters into the air and experimenting with the water : tablet ratio to see how high they can get their rocket.

This mission will be ideally done outside or in a room with a **high ceiling** and should take 30-45 mins to complete.

***Mission 7** – Benedetta Cappa Challenge*

This mission involves a Discover Materials Ambassador visiting the school to find out what the students have learned and help them to design poster showing their designs for a moon base and what materials they will take with them to build it.

The project will culminate with the Ambassador launching a large, 3D printed rocket.

Please identify a suitable, outside location in advance to launch the rocket.

6) Any questions?

If you have any questions regarding any aspect of the project then please do not hesitate to get in touch with us by emailing Chris Hamlett (c.a.hamlett@bham.ac.uk).

7) Troubleshooting and FAQs

Here are some questions and issues that teachers have had whilst running the missions and our suggestions of how to get round the problem(s).

Mission 1

Issue 1 - It took **too long** to measure the densities of all of the materials

Suggestion

- Please only measure the densities of the materials in the allocated time. We do not want you take too much time in measuring densities, we would much rather you move onto the next mission.

Issue 2 - Calculating **density of cylinder / tube** too challenging

Suggestions:

- Some students have found measuring the density of cylinder a bit too challenging so please rewatch the video for help.
- Feel free to calculate the density of the cubes used for Mission 3 as they are small cubes which your students may find easier to measure in order to calculate the density.

Issue 3 - Students couldn't use the **Vernier callipers**

Suggestions:

- We are not expecting the students to know how to use Vernier callipers – they have been included to show them an example of tools used by real engineers.
- If you are having issues reading Vernier callipers there is a YouTube video by 'Bob Weld' (not by us) that can be found here: https://www.youtube.com/watch?v=vkPIzmaIvN4).
- Feel free to simply use a ruler rather than the Vernier callipers if you want.