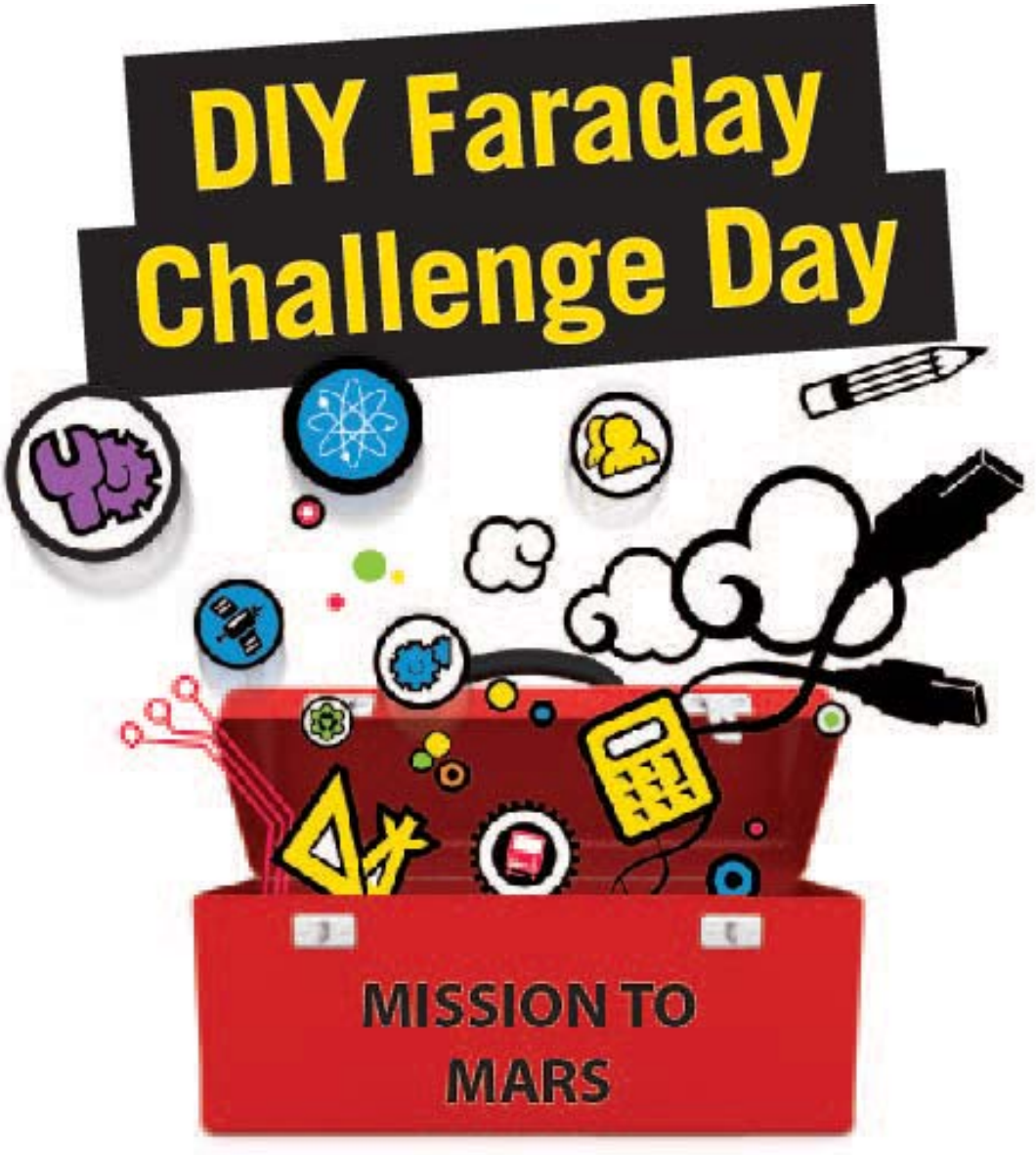
Education
The Institution of Engineering and Technology
Faraday

The IET
2013-2014



Teacher Booklet

Contents

1. About IET DIY Faraday Challenge Days

The IET DIY Faraday Challenge Day ‘Mission to Mars’ is based on the Faraday Challenge Day, a STEM activity day written and delivered by the National Schools Partnership on behalf of the Institution of Engineering and Technology (IET).

These challenge days give students’ aged 12-13 years the opportunity to research, design and make prototype solutions to genuinely tough engineering problems. The Faraday Challenges bring science, design and technology, engineering and maths (STEM) together in an engaging way, encouraging the development of students’ problem solving, team working and communication skills.

The Faraday Challenge Days are in high demand, and the IET has created the DIY Faraday Challenge Day to help meet the demand from schools wishing to participate. This resource comprises all the information schools need to run their very own challenge day, using items that are mostly readily available in schools.

This activity has been designed to be led in school by teaching staff; however the support of volunteers is vital to the successful running of the day. This guide outlines the ways in which IET Members, STEM Ambassadors and other volunteers can effectively support a DIY Faraday Challenge Day.

2. The Context

Humans have been exploring the Earth for many years, travelling abroad for holidays, organising explorations to the top of mountains, to the poles of the Earth and to the bottom of oceans.

What happens when this spirit of expedition is turned to the skies?

The Scenario

There are concerns about the future of humanity on Earth. Advances in technology have opened the door to some exciting possibilities. Projects have begun to investigate whether we can create a human colony on Mars.

'Make it 2 Mars' is a not-for-profit organisation who want to establish a human settlement on Mars.

"**The Mission Objective of '*Make it 2 Mars'* to establish a human settlement on the planet Mars in 2023."**

You are **engineering specialists**, and *'Make it 2 Mars'* is looking to **hire the best engineering team** to join their mission to establish a human settlement on the planet Mars in 2023. By being involved you will **become part of history**!

This is a once in a lifetime opportunity …

3. Student Brief

'Make it 2 Mars' would like your engineering team to design and construct the rocket which will transport supplies via Earth orbit to the astronauts on Mars. You are also required to build a system to transport your rocket to the launch site.

To be in the running your engineering team must be able to develop a solution that will allow quick, automated transit between the rocket facility and the rocket launch site. You must also show high manufacturing quality, innovation and creativity when constructing the prototype rocket.

Each engineering team must:

- **Construct** a prototype rocket which can launch using the system provided.
- **Design and build** a prototype automated vehicle or transport system which will move your rocket from the storage facility to the rocket launch site.
- Demonstrate how this transportation system works by **testing** it on a **simulated journey.**
- Demonstrate that the prototype rocket works by **launching** the rocket in a **simulated environment.**

Considerations

Your transportation system prototype must:

- Include an electrical component.

Your rocket prototype must:

- Be light enough to launch successfully.
- Be robust enough to sustain no damage on landing.

4. Raw Materials

ELECTRONICS STARTER ACTIVITY PACK

Item
▪ 1 x battery holder ▪ 2 x 1.5 Volt battery (AA size) ▪ 1 x motor with driver gear ▪ 1 black crocodile lead ▪ 1 red crocodile lead

STARTER PACK

Item
▪ 1 x wire cutters/strippers ▪ 1 x scissors ▪ 1 x rocket body former

ELECTRICAL COMPONENTS:

Item	Unit	Cost
Copper wire - red	Per metre	10 Faradays
Copper wire - black	Per metre	10 Faradays
Bare copper wire	Per metre	10 Faradays
Croc leads - black	Each	5 Faradays
Croc leads - red	Each	5 Faradays
Croc clips	Each	5 Faradays
Terminal blocks	Each	2 Faradays
Motor with cog attachment	Each	5 Faradays
Motor with pulley attachment	Each	5 Faradays
Motor holder	Each	5 Faradays
Batteries - AA size	Each	2 Faradays
Batteries - 9V	Each	5 Faradays
Battery snap - 9V	Each	2 Faradays
Battery holder - 2 AA cells	Each	1 Faraday
Buzzers 3 Volt	Each	5 Faradays
Switch	Each	5 Faradays
Magnet	Each	5 Faradays

Raw Materials continued

AVAILABLE TO BUY:

Item	Unit	Cost
Masking tape	30cm	5 Faradays
Double-sided tape	30cm	8 Faradays
Lollipop sticks	1 stick	1 Faraday
A4 plain paper	Each	1 Faraday
Coloured card A4	Each	1 Faraday
Foil 30cm x 30cm	Each	5 Faradays
Corrugated plastic	A5 sheet	5 Faradays
Bubble wrap 25cm x 25cm	1 sheet	2 Faradays
Straws	10 straws	10 Faradays
Recycled Items (cardboard tubes, plastic trays)	Each	5 Faradays
String	Per metre	1 Faraday
Paper fasteners	5 fasteners	1 Faraday
Paper clips	5 paper clips	1 Faraday
Elastic bands	10 bands	2 Faradays
Stopwatch	Each	30 Faradays
White Tak	Small strip	5 Faradays
Wooden dowel 20cm	2 sticks	4 Faradays
Pulley wheel	Each	5 Faradays
Cog – Large	Each	12 Faradays
Cog – Medium	Each	6 Faradays
Cog – Small	Each	3 Faradays
Wheel	2 wheels	10 Faradays
Polyfoam	1 A5 sheet	2 Faradays

AVAILABLE TO HIRE:

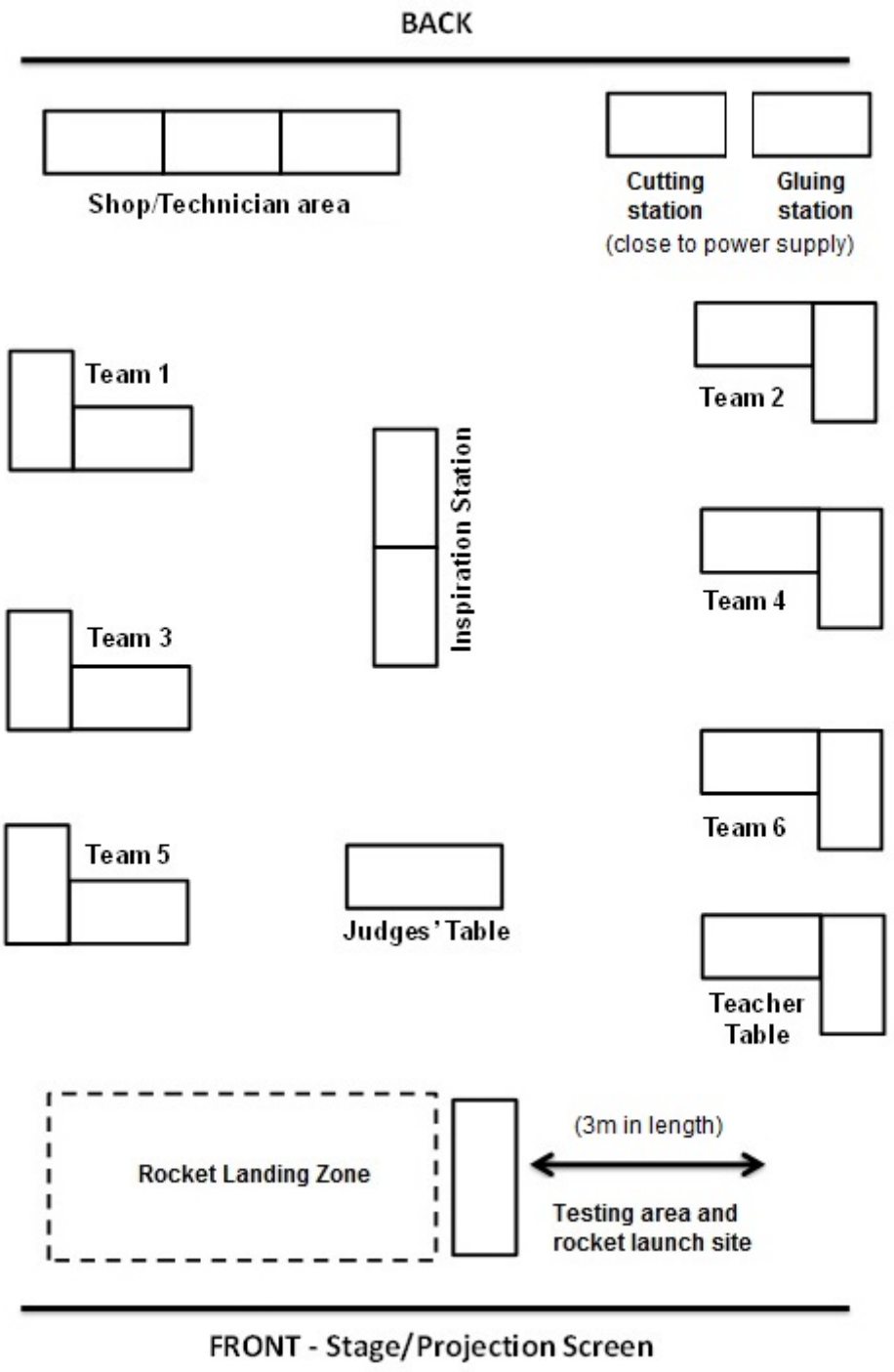
Item	Unit	Cost
STEM consultancy time	5 minutes	10 Faradays
Hole punch	5 minutes	5 Faradays
Stapler	5 minutes	5 Faradays
Screwdriver small	5 minutes	1 Faraday
Calculator	5 minutes	10 Faradays
Craft Knives + Technician	n/a	FREE
Glue guns	n/a	FREE

5. Programme

09:15	**Engineering teams arrive**
09:30	**Introduction to the DIY Faraday Challenge** ▪ Engineering career message & video
09:55	**Electrical briefing** ▪ Health and Safety briefing ▪ Electrical circuit activity
10:00	**Rocket briefing** ▪ Health and Safety briefing ▪ Rocket demonstration
10:10	**Role allocation activity**
10:25	**STAGE 1: Planning and research** • Brainstorming of ideas • Planning and research
10:55	**STAGE 2: Development and modifications** • Shop opens • Development, build and modify prototype solution
11:10	**Short break**
11:20	**STAGE 2 continued: Development and modifications** • Continued development and build of prototype • Modification of prototype • Testing
12:30	**Lunch – tools down**
13:00	**STAGE 3: Final build and testing of prototype**
13:30	• Shop closes • Sell back unused items • Submit accounting sheet to teacher
13:45	**STAGE 4: The final test** • Team presentations • Final test of prototypes
14:50	**Award ceremony** • Wrap up video • Final feedback and evaluation of the day • Announcement of winning team
15:00	**Finish - Engineering teams depart**

6. Room/hall layout required for IET DIY Faraday Challenge Day Event **(Not to scale)**

Each team table need 6 chairs. The Judges' table requires 2 chairs.



7. Marking Sheet

Assessment Criteria		Team 1	Team 2	Team 3	Team 4	Team 5	Team 6	Teacher Team
Planning and research	15							
Development of prototype	15							
Accounting Sheet	15							
Quality and performance of prototypes	30							
Presentation	15							
Teamwork	10							
Total score	**100**							

Team	School/Team name
1	
2	
3	
4	
5	
6	
Teacher	

8. Student Team Registration Form

Student Team Registration Form

Team No: …

DIY Faraday Challenge Date: ……..

Your School Name: ……

Your Teacher's Name: ……..

<u>Team Member Names (please print clearly)</u>

1 ……

2 ……

3 ……

4 ……

5 ……

6 ……

9. Assessment Information and Criteria

Criteria	Marks
1. Planning and research	15 marks
2. Development of prototype	15 marks
3. Accounting sheet	15 marks
4. Quality and performance of prototypes	30 marks
5. Presentation	15 marks
6. Teamwork	10 marks
Total	**100 marks**

1. Planning and research (15 marks)

Using the planning sheet provided, marks will be awarded for:

- Development of minimum of 2 solutions for each prototype (transportation system and rocket) **(4 marks).**
- Identification of potential problems, constraints and difficulties **(5 marks).**
- Recording your team's agreed solution - include the mechanical and electrical components of your transport system and how they work together **(6 marks).**

2. Development of prototype (15 marks)

Using the planning sheet provided, marks will be awarded for:

- Noting any changes and modifications made and the reasons for these **(5 marks).**
- Demonstrating skills in creativity and innovation to develop their initial ideas **(5 marks).**
- Demonstrating the team and individual skills to persevere with challenges in developing your solution **(5 marks).**

3. Accounting sheet (15 marks)

This is a record of all the costs the team has incurred. Marks will be awarded for:

- Accuracy of expenses **(5 marks).**
- Cost effectiveness **(5 marks).**
- Neatness of accountancy sheet **(5 marks).**

If there is a tie between teams at the end of the day the winning team will be the one who has the most Faradays remaining.

Continued… Assessment Information and Criteria

4. Quality and performance of prototypes (30 marks)

Your prototype solutions will be judged on:

- Manufacture quality - how well your prototype is made **(10 marks).**
- Creativity - designs must be innovative and creative, making best use of the resources available **(6 marks).**
- Functionality - must function effectively, easily and as planned **(6 marks).**
- Engineering - prototypes demonstrate quality of both electrical and mechanical engineering **(8 marks).**

5. Presentation (15 marks)

Your presentation should communicate:

- Why and how your team came up with the solutions including what makes them innovative and cost effective **(2 marks).**
- The STEM used in your solutions and the importance of engineering **(5 marks).**
- How your transportation system could be built in real life **(2 marks).**
- How could you power your transportation system in an environmentally friendly way? **(2 marks).**
- The presentation skills of your team in presenting your findings ***(4 marks).***

6. Teamwork (10 marks)

Marks are awarded for:

- How well you work as a team with all members working together effectively **(5 marks).**
- Ensuring that your work station and surrounding area enables safe working and are free from hazards at all times **(5 marks).**

Points will be deducted for not working as a safe and effective team.

10. Risk Assessment (page 1 of 2)

The following risk assessment is given as guidance. It is advised that the school refers to the CLEAPSS Model Risk Assessment Documents for D&T.

Risk Assessment and Operating Procedure - IET

Activity: IET DIY Faraday Challenge Days 2013–14			
Persons at risk	Students taking part in the Faraday Challenge Day and adults in the location		
Maximum Group Size	36 students	Recommended Staffing/Student Ratio	1:6

Risk Assessment	
Hazards	**Control Measures**
1. Launch of straw rockets – use as missile	Demonstration by the teacher only. Students to be supervised by a teacher.
2. Use of craft knives – risk of cutting	A member of staff will supervise the use of craft knives to cut any materials. A safety ruler will be provided.
3. Use of glue guns – risk of burning	The use of glue guns will be supervised by a school technician/teacher at all times and performed in a designated area. Glue guns will be low melt which reduces the risk of severe burns.
4. Use of electrical equipment – risk of electric shock	All electrical equipment is low voltage.
5. Use of electrical equipment – short circuit causing heating	Warn students of the possibility of burns when connecting and disconnecting components. All pupils will receive a briefing about correct use of electrical components.
6. Use of electrical equipment – moving parts	Warn students of the possibility of injury if they don't use the components (specifically motors) in the correct way.
7. Use of compressed air rocket launcher	Warn students of the possibility of injury if they don't use the launcher as designed. An adult will supervise the students at all times when using the launch system.
8. Launch of rockets	Ensure that students are fully aware when a rocket is to be launched. Only launch rockets at a designated time and in a designated location. Ensure students are a safe distance from the flight zone.
9. Use of rocket body former pipes – infection control risk	Ensure that students are aware that they are not to blow down the pipe. If this occurs teacher to disinfect the pipe.

Continued… Risk Assessment (page 2 of 2)

Risk Assessment	
Hazards	**Control Measures**
10. Basic use of hand tools (files, screwdrivers, scissors, hole punches) – risk of cutting or abrasion	The use of all cutting materials will be supervised by a school technician/teacher at all times and performed in a designated area.
11. Use of extensions cables – risk of tripping	Make sure that extension cables are not extended across the floor where students and adults will be walking. Ensure students and adults are aware of the location of the cable.
12. Location issues	
Further Action Required: 1. Ensure all persons staffing the DIY Faraday Challenge Days are aware of and competent to comply with this risk assessment and the control measures.	

Working Practice	
Group structure	
Restrictions	
Emergency Procedure	
Safety Equipment	First aid kit and fire extinguisher (electrical fires) to be provided by school.
Name and role of school representative	
Signature of the school representative	
Date of this Review	