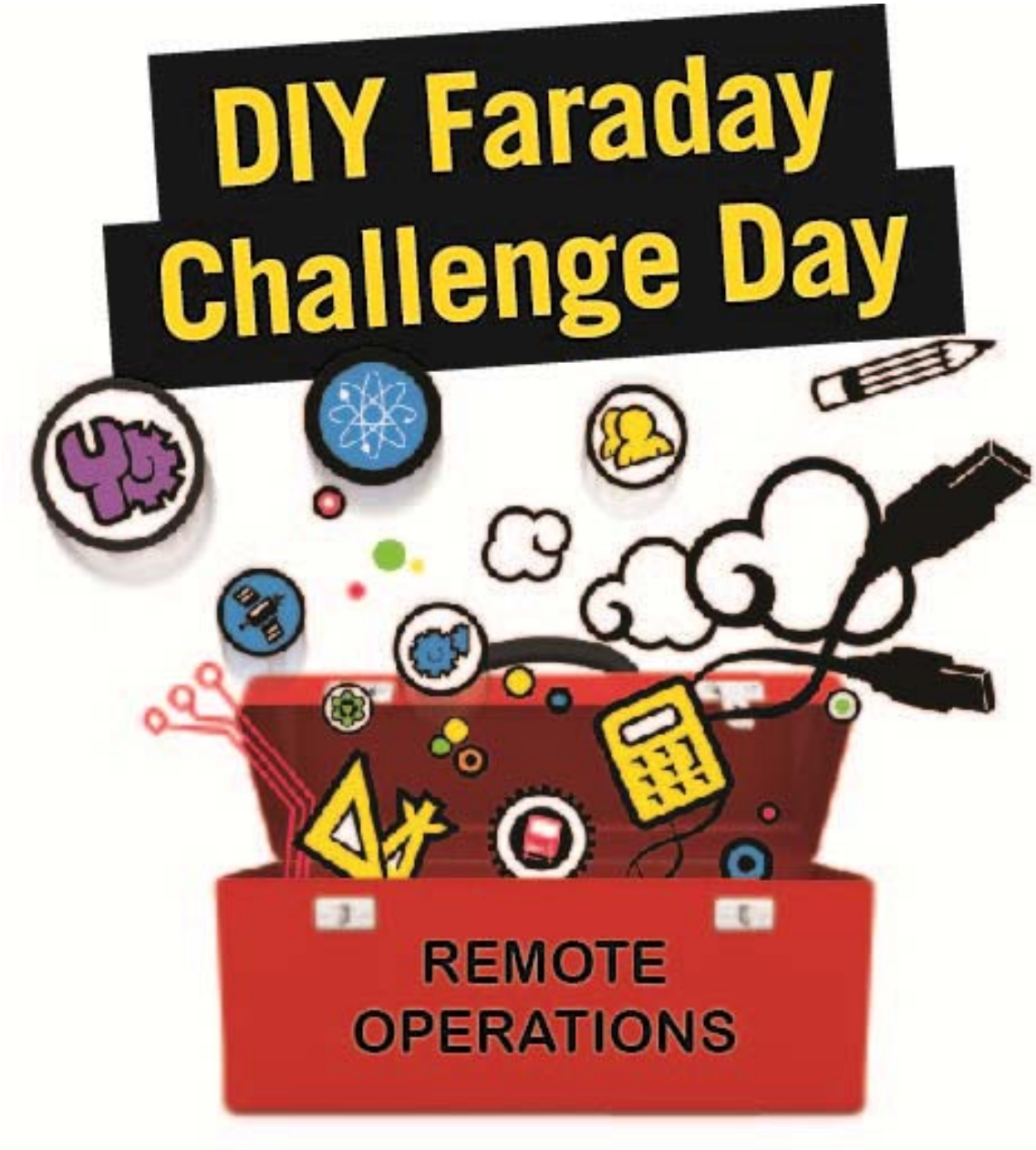

Student booklet

'Engineering to ensure effective remote operations'

Faraday Challenge Day

'Engineering to ensure effective remote operations'

CONTEXT
Engineering has always been of great importance to the health industry. Machines, equipment, techniques and procedures are developing at a great pace and rely on engineering research and development.

The field of bioengineering – the application of engineering principles to address challenges in the fields of biology and medicine, is advancing rapidly. As medical knowledge, techniques and expertise get more sophisticated, the needs to perform remote operations, to levels of minute accuracy, are becoming more and more necessary and common.

To be able to control a device from a remote location to the same degree of accuracy as if you were really there requires a high level of skill.

BRIEF
Design and make a device that can carefully pick up objects and accurately locate them on a given target. If successful, your prototype device could be further developed to become a competitor to the 'Da Vinci' robot.

The device must:
- be operated remotely from a distance of 1.1m away
- be able to be accurately controlled in order to perform small and accurate movements
- be able to be moved in both the horizontal and vertical planes
- be able to pick up several different sizes and shaped objects.

The device must be designed and manufactured so that objects, once picked up, will not be dropped or the surface of the body touched in anyway.

This is a 'life or death' challenge!

Assessment information and criteria

Key Area	Marks
Initial design sheets (x 3)	15
Development of ideas - idea sketches and notes - team interview	40
Accountants balance sheet	10
Quality of final product	20
Function of device	50
Team work	20
Learning log	20
Total	175

INITIAL DESIGN SHEETS – (session one)
These are the first sheets you need to hand in. It involves every member of your team (in your subject pairs) drawing their initial thoughts and ideas after being given the context and brief. Three sheets need to be handed in. They need to include sketches, notes, diagrams and annotations. It is really important that you let the judges know what you are talking about in your discussions otherwise they will not understand these sheets and you will not get high marks.

DEVELOPMENT OF IDEAS – (session two)
This section has two components – a team interview, and your sketches and notes explaining the development of your ideas. It is important you prepare for the team interview as there are a lot of marks riding on it. The development sheets you take to the interview should include your thoughts and decisions on materials, sizes, construction methods, problems you have encountered and modifications you have had to make.

ACCOUNTANTS BALANCE SHEET – (session three)
Everything you spend needs to be recorded together with a running total of your team's expenditure (money spent). The team need to keep a close eye on the balance sheet; marks will be awarded to the team that delivers best value for money (i.e. who spends the least amount of Faradays).

QUALITY OF FINAL PRODUCT – (final challenge)
How well is your device designed and made? Have you chosen the most effective materials to do the job and have you used the most appropriate construction methods? Although your device is only a prototype, it will need to perform its function under test conditions (after your own test runs). This part of the assessment is all about whether your device is 'fit for purpose'.

FUNCTION OF FINAL DEVICE – (final challenge)
This will be tested during the 'Final Engineering Challenge'.

- Can it perform the given task to a high standard – consistently and accurately?
- If it doesn't stand up to the test, can you explain why? You will still be given marks for understanding why your device hasn't worked and also for coming up with recommendations on how to improve it.

TEAM WORK – (throughout the day)
Your team working skills will be assessed throughout the day and marks will be awarded if you work effectively as a team.

- Does everyone have a clear role and are they working together effectively?
- Is your team communicating well?

This is really a crucial area, as it is the team that works the best together that generally wins.

TEAM LEARNING LOG – (final challenge)
Your two-minute learning log will be awarded a maximum of 20 marks. You will have to work as a team to provide the information needed for this video/presentation. The video production manager/presentation leader will be responsible for designing and producing your learning log to the highest standard. There is a help sheet in your booklets relating to this assessment area. You will not only be assessed on the content of your video/presentation, but also the quality of presentation and production.

Materials resource sheet

AVAILABLE TO BUY:

Material	Unit Cost
Elastic band x 1 (any size)	5 Faradays
Fishing line – 300 mm length	10 Faradays
Foam – 30 mm x 30 mm	10 Faradays
Jubilee clip x 1	10 Faradays
MDF 6.0 mm x 1200 mm x 20 mm	20 Faradays
MDF 6.0 mm 600 mm x 20 mm	10 Faradays
MDF 6.0 mm x 150 mm x 150 mm	20 Faradays
Modelling foam sheet 30 mm 150 mm x 150 mm	20 Faradays
Odd Box bin – any item	5 Faradays
Paper fasteners – 19 mm x 5	2 Faradays
Pre-cut arm x 1	10 Faradays
String – 300 mm length	5 Faradays
Technician to cut materials for you	10 Faradays
Hex nuts M3 x 16 mm x 5	10 Faradays
Hex nuts M3 x 30 mm x 5	10 Faradays

AVAILABLE TO USE:

Service	Unit Cost
Junior hacksaw/coping saw	10 Faradays
Hot glue gun plus one glue stick	10 Faradays
Screwdriver	5 Faradays
Files	5 Faradays
Glass paper	5 Faradays

Timings for the day

(Please note these timings are only approximate and may vary during the day)

09.15 **Teams arrive and take their seats**

09.30 **Session one**
- Deliver introduction with film and directions for the day
- Teams to embark on initial ideas stage (each subject pair to work on specific details)
- Teams continue with development of ideas stage (bring together the 3 pairs with their subject expertise)
- Team to decide on which idea to develop
- Learning log briefing

11.00 **Break (shop opens)**

11.10 **Session two**
- Introduce use of shop and technician – money, resources, equipment
- Teams to develop chosen idea into viable solution (application of scientific research into creative engineering solution)
- Teams start manufacturing

12.30 **Lunch**

13.00 **Session three**
- Finish off learning log scripts at the beginning of the session
- Produce final engineering solution
- Teams put their engineering solution to the test!

13.30 **Shop shuts**

14.00 **Faraday STEM Challenge commences**
- Learning logs are presented
- Teams present their engineering solution

14.45 **Results announced**

Accounting balance sheet

Team ……..

materials/services purchased	quantity	cost	Faradays remaining (Start with F150)
Total Faradays remaining			

Learning log help sheet

Your team learning log is a short presentation about what you have learnt throughout the day. It should last about 2 to 3 minutes, in total.

Your team needs to demonstrate to the judges what you know about each of the three subject areas and how you have used this to help you design and manufacture your prototype device.

These prompts might help you:

GENERAL CONTENT

- Are you capturing real learning (and not just *doing*?)
- Are the science, mathematics and design and technology specialists in your team talking clearly about the application of this knowledge and understanding?
- Is it interesting to listen to?
- Is it original in its content?

SCIENCE

There is a lot of science in this task, and you will need to identify the key areas and discuss them in relation to your device. Think about…

- What forces are being applied?
- What interactions, between which aspects of the design are causing the changes in motion required for your device to function?

MATHEMATICS

It is important that you and your team can identify the mathematical aspects of the problem you have been asked to solve. Sit down with your team and brainstorm all the different aspects of mathematics you can see, that would ensure lot of marks. Here are some tips:

- Can you simplify your device and represent it mathematically? (i.e. a diagram, or using variables?)
- Can you apply ratio or proportion to aspects of your device?

DESIGN AND TECHNOLOGY

The two key features you need to really think about and design effectively are the ‘claw’ or ‘gripper’ mechanism and the ‘trigger’ or ‘handle’. Both these features need a lot of thought in terms of ergonomics and function. Can you discuss:

- How you have designed the levers to achieve the movement you need?
- How are you going to ensure the degree of accuracy you need to be successful?
- Why have you used the materials chosen?
- What construction methods have you chosen and why?
- What were the main problems you encountered and how did you overcome them?
- How have you designed your device to ensure accuracy and consistency?

Video help sheet 1

The film is fundamentally a 'learning log' of the day. It should last about 2 to 3 minutes, in total.

You will be assessed on two key areas:

1. Your technical abilities in terms of producing the film
   - You will be judged on the quality of the audio (can you hear what everyone is saying)
   - Are you using the zoom feature?
   - Do the clips 'stitch' together well?
   - Is it creatively produced?

2. The contents
   - Are you capturing real learning (and not just *doing*?)
   - Are the science, mathematics and design and technology specialist talking clearly about the application of this knowledge and understanding?
   - Is it interesting to listen to?
   - Is it original in its content?

Format for the video:

Scene	Focus for scene	Suggested length of video
1.	Introduce your team, school and team members' roles and responsibilities	20 seconds
2.	Talk through the decisions surrounding why you have chosen your specific idea to develop. How is it going to work? What are the problems and how are you going to solve them?	30 seconds
3.	Interview the **Science specialists** Make sure you capture the science in the design of our prototype	30 seconds
4.	Interview the **Maths specialists** Make sure you capture the maths in the design of our prototype	30 seconds
5.	Interview the **Design and Technology specialists** Think about the practical application of your design, how will you make all the bits fit together?	30 seconds
6.	Interview each member of the team and capture their key learning throughout the day	20 seconds

If you have time, include a 'good bye' from your team!

Video help sheet 2

Remember this help sheet will form the bases of your team learning log video. Your team needs to demonstrate to the judges what you know about each of the three subject areas and how you have used this to help you design and manufacture your prototype device.

These prompts might help you:

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Top Tips for using a digital camera

1. Love the light
Keep the light behind the camera as much as possible, so that it shines on what you're filming.

2. Hold the ice cream
Press record and hold the camera at arm's length, pointing towards your face.
Now, if you hold the camera in your hand like you're holding an ice cream, you can tell us what you're thinking, walk about, even spin around, and it all looks fantastic!

3. Up to your neck in treacle
Don't move the camera too quickly: make every moment slow and steady.
Remember, it's not live, so there's no need to catch everything as it happens.
If you don't get it the first time, go back and try again.

4. When it's over, count to five
When you think the subject your filming has finished, keep the camera running and count to five before you stop recording. It's easier to edit – and you'd be surprised what happens when you're not expecting it.

5. Listen up
To make sure the camera can pick up someone's voice, you should be no more than your arm's length away from them.

6. Have fun!
Mess around with it – you can always delete what you don't like.