**DIY Faraday Challenge Day**



**Network Rail**

**Student Booklet**

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**1. The context**

Our railways help us to get to work, to go on days out, to travel to our favourite sports and meet up with friends and family. They also help transport things we use in our daily lives, our food, our post, even our vehicles. Without them our lives would be very different.

In the past decade rail travel has become ever more popular. Stations like London Waterloo and London Victoria now handle more passengers than the UK’s busiest airports and the numbers continue to rise.

Network Rail owns, operates and develops Britain’s railway structure, including 20,000 miles of track, 30,000 bridges, tunnels and viaducts and thousands of signals and level crossings. We also manage 20 of the UK’s largest stations and it is here that we need your help.

The rate of increase in rail passengers coming through our stations means we have to manage more waste, keep more passengers safe, comfortable and happy and ensure everyone can access the railway network.

**2. The Brief**

Your team of engineers has been asked to design and build a prototype bin to help manage waste on Network Rail stations. You will need to think about what would encourage passengers to use it. Stations can also be quite windy places and birds fly in and out. How will you stop rubbish being taken out by the birds or blown out by the wind? Your prototype must also contain at least one electric circuit.

A picture containing person, child, child, little

Description automatically generated

Remember engineers usually build prototypes to test out their ideas first so your prototype design may not do everything you want it to do. but it must do something.

You might need to think about people with different needs or disabilities if your bin moves around the station. Or you will need to think about how to attract people to it if it stays in one place.

You will need to work as a team of real-life engineers throughout the day if you are going to succeed in this challenge. To do this you will need to take on additional roles which will give some members of your team responsibility for managing your time, your money and the overall project.

You will present your ideas at the end of the day to the judge(s) and the other young engineers on your challenge day.

Your team will need to:

1. **Identify** ideas for your prototype bin.
2. **Construct** the design you have chosen.
3. **Manage** your budget effectively.
4. **Record** your ideas and the problems you have encountered during the day.
5. **Present** your final prototype for judging.

**Remember:**

Your prototype bin must:

* have something which will encourage people to use it;
* have a way to stop rubbish being taken or blown out;
* include at least one electric circuit.

**3. Schedule for the day**

|  |  |
| --- | --- |
| 09:15 | Register your team |
| 09:30 | Welcome |
| 09:35 | Introduction to the IET Faraday Primary Challenge |
| 10:05 | Circuit apprenticeship |
| 10:15 | **STAGE 1:** Planning and design |
| 10:30 | Allocation of roles |
| 10:35 | **STAGE 2:** Building and development   * Shop opens |
| 11.00 | **BREAK (working)** |
| 11.10 | Stage 2 continues: modification   * Testing area open for 15 minutes |
| 12.30 | **LUNCH (non-working)** |
| 13:00 | Stage 2 continues: final modification and testing |
| 13:45 | Shop closes |
| 14:00 | **STAGE 3: Presentations**   * Team presentations of their prototype * Final marking * Evaluation of the day |
| 14:45 | **Award ceremony**   * Feedback to teams * Presentation to winning team |
| 15:00 | **Finish – Engineering teams depart** |

**4. Shop resource sheet**

|  |  |  |
| --- | --- | --- |
| **Item** | **Unit** | **Cost** |
| **General items** | | |
| Masking tape | 30cm | 5 Faradays |
| Sticky tape | 30cm | 8 Faradays |
| Coloured card A4 | Each | 4 Faradays |
| Polyfoam A5 sheet | Each | 8 Faradays |
| Tissue paper | Strip 25cm wide | 4 Faradays |
| Corrugated plastic 15cm x 21cm | Each | 10 Faradays |
| Straws | 1 straw | 2 Faradays |
| Recycled Items (cardboard tubes, plastic trays) | Each | 5 Faradays |
| String | Per metre | 5 Faradays |
| Paper fasteners | 5 fasteners | 1 Faraday |
| Paper clips | 5 paper clips | 1 Faraday |
| Elastic bands | Each | 1 Faraday |
| Blu Tak | Small Strip | 5 Faradays |
| Wooden dowel 5mm | 1 stick | 8 Faradays |
| Wooden lolly stick | Each | 5 Faradays |
| Wooden wheel 54mm | Each | 4 Faradays |
| Pulley wheel 54mm | Each | 6 Faradays |
| Large cog | Each | 8 Faradays |
| Medium cog | Each | 5 Faradays |
| Small cog | Each | 3 Faradays |
| Plastic cotton reel | Each | 8 Faradays |
| Weights | Each | 4 Faradays |
| **Electric components** | | |
| Crocodile leads | Each | 5 Faradays |
| Motor | Each | 4 Faradays |
| Pulley attachment for motor (black) | Each | 2 Faraday |
| Gear attachment for motor (white) | Each | 2 Faraday |
| Motor holder | Each | 5 Faradays |
| Batteries - AA size | Each | 2 Faradays |
| Batteries – 9V | Each | 5 Faradays |
| Battery snap for 9V cells and AA battery holders | Each | 2 Faradays |
| Battery holder - 2 AA cells | Each | 1 Faradays |
| Buzzers 3V | Each | 5 Faradays |
| Switch | Each | 6 Faradays |
| Bulbs 2.5V | Each | 4 Faradays |
| Bulb holders | Each | 5 Faradays |

**AVAILABLE TO HIRE:**

|  |  |  |
| --- | --- | --- |
| **Item** | **Unit** | **Cost** |
| Faraday Challenge Leader consultancy time | 5 minutes | 10 Faradays |
| Hole punch | 5 minutes | 5 Faradays |
| Stapler | 5 minutes | 5 Faradays |

**FREE TO USE: *(Excessive use may result in a charge of 10 Faradays)***

Glue guns

Craft knives

Junior hacksaw

Wire cutter/stripper

Scissors

Screwdriver

Ruler

**5. Assessment criteria**

|  |  |
| --- | --- |
| **Criteria** | **Maximum marks awarded** |
| 1. Planning | 15 |
| 2. Development | 25 |
| 3. Accounting | 15 |
| 4. Product engineering | 30 |
| 5. Teamwork | 15 |
| **Total** | **100** |

**1. Planning (15 marks)**

Using Stage 1 and 2 of the planning and reflections sheet, marks will be awarded for:

* Identifying a minimum of 3 potential solutions for the prototype. **(6 marks)**
* Demonstrating creativity and innovation in the ideas **(3 marks)**
* Developing a detailed drawing of their chosen design for the Network Rail bin **(3 marks)**
* Show how their electric components will be connected to make a circuit **(3 marks)**

**2. Development (25 marks)**

Using Stage 3 of the planning and reflections sheet and observations of the teams, marks will be awarded for:

* Demonstrating STEM skills in building and development **(5 marks)**
* Demonstrating team resilience and a willingness to adapt initial ideas in developing and finalising the prototype. **(5 marks)**
* Providing an honest and accurate description of their problems encountered **(5 marks)**
* Identifying and implementing solutions to the problems encountered **(5 marks)**
* Providing an honest account of the effectiveness of their team work **(5 marks)**

**3. Accounting (15 marks)**

Using the accounts sheet and observation of the final prototypes, marks will be awarded for:

* Providing an accurate record of spending **(3 marks)**
* Effective and economical use of the budget **(7 marks)**
* Creativity in using the available resources **(5 marks)**

**4. Product engineering (30 marks)**

Using observations of the prototype during final presentations, marks will be awarded for:

* Quality of design and manufacture **(6 marks)**.
* Functionality – the bin meets the brief set **(6 marks)**
* Functionality – the bin includes an electrical circuit which enhances its purpose **(6 marks)**
* Safety and ease of use - the developments which enable your prototype to operate safely **(6 marks)**
* Creativity - how your prototype could be built in real life given the limited resources available. **(6 marks)**

**5. Teamwork (15 marks)**

Using observations of the team throughout the day, marks will be awarded for:

* How well you work as a team with all members contributing to the prototypes and carrying out their assigned roles **(5 marks)**
* Safe use of resources and components **(5 marks)**
* How tidy, safe and organised your working area is kept **(5 marks)**