**DIY Faraday Challenge Day**

**Lighthouse Keeper Transfer**

**Student Booklet**

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**1. The context**

Lighthouse keepers often have to work in severe weather conditions, particularly when the lighthouse it situated off the mainland. This can make getting to and from the lighthouse very difficult and can mean keepers can be stranded in bad weather. You have been asked to design a way of helping these lighthouse keepers get back to the mainland even when boats cannot get out to them.

**2. The Brief**

Your team of engineers has been asked to design a way of getting lighthouse keepers back to the mainland from a lighthouse based on a small island 200 metres from the nearest land. Your design will need to carry the keeper safely across the waves which can be high during storms.

The concept engineers have already decided that a zip line from the lighthouse to the mainland is going to be the best approach so your task will be to design and construct a way of carrying the keeper on this line. You will also need to design a way of getting the transfer system back to the lighthouse once it is safe enough for the keeper to return to the lighthouse so that it is available in the next storm.



Engineers usually build prototypes to test out their ideas first so your prototype design will only need to carry the keeper 4 metres. Your prototype will also be much smaller than the final product so will not be able to carry a person. To represent the keeper, you are going to be given an egg to transfer safely across the distance and land on the mainland without it cracking or smashing.

You will need to think about how to warn people the keeper is transferring to the mainland or that the transfer system is being returned to the lighthouse and how it could operate safely in dark and stormy conditions. Your prototype must include at least one electric circuit.

You will need to work as a team as 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 transfer system.
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 transfer system must be able to:

* Carry an egg safely across a distance of 4 metres
* Be able to operate safely in severe weather conditions, including the dark
* Include at least one electric circuit
* Be able to be returned to the lighthouse for future use.

**3. Schedule for the day**

|  |  |
| --- | --- |
| 09:15 | Register your team |
| 09:30 | Welcome |
| 09:35 | Introduction to the IET Faraday Primary Challenge |
| 10:05 | Exploring forces mini-task |
| 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 |
| 12:00 | Test area open for 20 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**

Below are the items available to buy in the shop.

|  |  |  |
| --- | --- | --- |
| **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 |
| Corrugated plastic 15cm x 21cm | Each | 10 Faradays |
| Bubble wrap 50cm x 25cm | 1 piece | 5 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 |
| Pulley wheel 54cm | Each | 6 Faradays |
| Plastic cotton reel | Each | 8 Faradays |
| Weights | Each | 4 Faradays |
| **Electric components** | | |
| Copper wire - red | Per metre | 5 Faradays |
| Copper wire - black | Per metre | 5 Faradays |
| Crocodile leads | Each | 5 Faradays |
| Crocodile clips | Each | 2 Faradays |
| Terminal blocks | Each | 2 Faradays |
| Motor | Each | 4 Faradays |
| Pulley attachment for motor (black) | Each | 1 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 flashing bulbs | 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. Quality and performance of prototype transfer system | 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 transfer system **(3 marks)**
* Identifying the forces involved in their design **(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. Quality and performance of prototype transfer system (30 marks)**

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

* Quality of design and manufacture **(6 marks)**.
* Functionality – the transfer system carries the egg across the 4 metres without damage **(6 marks)**
* Functionality – the transfer system includes an electrical circuit which enhances safety, ease of use or range of use **(6 marks)**
* Safety and ease of use - the developments which enable your prototype to operate safely including ways in which forces are used or managed following testing. **(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)**