**The IET**



**Smart Cycle**

**Teacher Handbook**

**Could you be our engineer….?**

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

The IET Education website hosts a wide range of teaching resources for science, design and technology and maths. These include classroom activities with film clips, online games, posters, careers resources and STEM activity days.

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**Stay safe**

Whether you are a scientist researching a new medicine or an engineer solving climate change, safety always comes first. An adult must always be around and supervising when doing this activity. You are responsible for:

* ensuring that any equipment used for this activity is in good working condition
* behaving sensibly and following any safety instructions so as not to hurt or injure yourself or others

Please note in the absence of any negligence or other breach of duty by us, this activity is carried out at your own risk. It is important to take extra care at the stages marked with this symbol: ⚠

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# Introduction

The Institution of Engineering and Technology (IET) is one of the world’s leading professional societies for the engineering and technology community. As a charity we are committed to the advancement of science, engineering and technology, encouraging young people to study the Science, Design and Technology, Engineering and Mathematics (STEM) subjects and to consider careers within the engineering and technology sectors. We provide a wide range of activities, classroom materials and other learning resources, including the IET Faraday Challenge Days, to schools across the UK.

**Who is it for?**

The Faraday Challenge ‘Smart Cycle’ has been designed for six teams of six students (36 students in total) aged between 12-13 years.

The challenge has been specifically designed to give students the opportunity to research, design, develop and make creative solutions to genuinely tough engineering problems, independent of their level ability. This activity is therefore suitable for a range of different ability levels however, without adaptation, the challenge will work best for students who can work effectively as a team and have good problem solving and perseverance.

**How to use the challenge resources**

The aim of this challenge is to introduce students to cutting edge technology which engineers are, and will be using in the future and this challenge will work best if you have access to 3D printers at your school or a local venue. The use of 3D printers can be substituted for making prototypes out of cardboard, as many conceptual designs are created by engineers however running this challenge could be a great opportunity to make links with a local university, college or industry. Even if your students can not print their creations on the day itself you may be able to go and see the printers in operation or have their designs printed and sent back to the school. This may mean splitting the day into different sessions for example:

Session 1 – Imagine and Design (incorporating stage 1 and 2)

Session 2 – Create (cardboard concept designs could be made as well as or instead of printing the designs) (incorporating stage 3 and 4)

Session 3 – Present (incorporating stage 5)

The resources are set up to be used with specific design software and printers and so may need to be adapted to fit with the technology that you have available.

**Useful links for software and 3D printing facilities**

If your school does not currently have access to 3D printers and design software then the links below may be useful to find free online software and places which offer use of their 3D printers.

There are a number of FabLabs across the UK which offer a place to complete fabrication activities, a list of these can be found at <http://www.fabfoundation.org/fab-labs/> and you can find local 3D print facilities at <https://www.3dhubs.com/>

Autodesk offer free software for 3D design and printing at <http://www.123dapp.com/> and offer advice for finding 3D printer facilities.

# The Faraday Challenge: Smart Cycle

The Faraday Challenge aim is to help students to realise the ideas and knowledge they have, perhaps without realising it, are key skills in engineering and technology professions.

Engineers are vital in improving safety. To improve transport safety it is engineers that are needed. As the engineering team, students are challenged to develop an engineering solution to ensure clear communications to cyclists. This challenge will develop the students’ problem solving, team work and communication skills.

**The context**

More and more people are taking to cycling for competition, personal transport and leisure. The benefits of cycling are obvious; it is enjoyable, cost effective, improves fitness and is a sustainable way to travel.

  

**How can we improve the experience for cyclists and encourage more people to take to cycle paths this summer?**

**The scenario**

As the number of cyclists increases the **need for better signage on cycle routes** increases. Cyclists also require **up-to-the-minute information about their route** to improve their experience and make sure their journey is safe and enjoyable.

 

**Current cycle route signs do not provide the information that cyclists need.**

*‘Smart Cycling’* is a company looking into how we can improve cycle routes throughout the UK. They have identified the need for smarter communication with cyclists along cycle routes and highlighted the need for cyclists to be able to clearly see the route markers even in the dark and to have up-to-date information about weather conditions and route conditions.

**The brief**

Students are challenged to design and create a prototype Smart Beacon which will be used to communicate information to cyclists. When used, together with other Beacons, along a route, cyclists will be able to identify a safe cycling route which they can use.

The Beacon must contain electronic components to allow it to communicate information to cyclists, this may be done by reacting to external conditions e.g. light or temperature and then sending a signal to the cyclists who pass it on their route.

**Yes**

**No**

**Sensor**

**Are conditions met?**

**Change to system e.g. light on/off**

**No change to system**

**What and how the Beacon communicates is up to the team.** As a team students need to identify which problems the Beacon will solve and then work towards designing and building a system to solve them. Will the Beacon be useful in the dark? Will it identify the cycling level of the route – easy, medium or hard? Will it communicate the length of the route? Will it communicate information about the route immediately ahead e.g. water hazard, steep hill or jump?

For the product to be the best that it can be, it must be creative and innovative. Each team must:

1. **Identify** a range of problems that cyclists encounter.
2. **Identify** the problem that their Beacon will solve and **design** a solution.
3. **Design** the outer shell of the Beacon.
4. **Construct** the electronics which will be housed in the Beacon.
5. **Print** the outer shell of your Beacon.
6. **Create** a name and brand for your Beacon.
7. **Develop** your marketing presentation.
8. Demonstrate the capabilities of the Beacon by **presenting** it to the judges in a controlled

environment.

**Considerations**

The Beacon must:

* Fit within the dimensions given.
* Include an electrical component.
* Communicate at least one piece of information to passing cyclists.

# Beacon design and printing information

The information below is designed to ensure that six teams were able to print a beacon within a one day event. The recommended 3D design software to use is Autodesk Inventor and the printers recommended are Denford UP Plus 2 printers (<http://website.denford.ltd.uk/>) with accompanying software. The maximum dimensions below are given as the maximum print area of the UP Plus 2 printer so these may differ depending on the printers you are using. It is worth checking to ensure that you use compatible design software, however there is a range of free design software online if you do not have access to the software at school.

It is worth carrying out the following tasks in the design software prior to the challenge day if you are new to using it:

* Create a solid cube
* Hollow the cube
* Cut a hole in one face of the cube

These tasks are the fundamentals for the design aspect of the challenge and although the students will create different designs, these simple functions should be easily adapted to create most designs.

**Blueprint details**

Engineers are innovative problem-solvers, they often adapt and improve on existing designs to create new products which are required to solve a current issue. To help students get started there are Beacon shell blueprints available to purchase from the shop. There are three designs – A, B and C. Each needs a different level of modification from the 3D design engineer to be suitable for your Beacon. Students will need to adapt the blueprints so that the Beacon design is individual and fits the electronic components that you need to house in it. These blueprints can be found in the student information booklet.

**3D Printing**

* We have based all recommendations on using UP! Plus 2 3D printers.
* Beacons will be printed using ABS filament. Students will be required to pay for the material that they use and the time they use your printer for. The material is already loaded into the printer, **so students do not need to buy the physical print material from the shop but they do need to pay Faradays for the print material and time to the shop when they begin printing**.
* Further information about the printer will be given by the facilitator at the 3D design and print engineers briefing at 10.30am.

**Weight of printed Beacon shell**

* Engineers have to work within a specification when designing and building a new product, there is a weight limit for the beacon. **Cost penalties** will be issued for Beacon shells which weigh more than **20g**. There will be a cost penalty of 1 Faraday for every 1g that is over the weight limit of the Beacon.
* It is the students’ responsibility to record the weight of the printed Beacon and the time that it takes to print in their Planning and Reflections sheet.

**Dimensions**

The Beacon design must not be larger than the dimensions given below. If it is then it will not be able to be printed.

Wall thickness needs to be 3 mm

135 mm

140 mm

140 mm

**Breakdown of print related costs**

* **10 Faradays for up to 20g of material used.**
* **1 Faraday per 1g over the 20g weight limit.**
* **10 Faradays per 30 minute time block of printer use.**

# Briefing for engineers and project managers

Briefings are given to the different engineers to allow them more focused information about their roles and the equipment that they will be using to complete the challenge. This also allows the students to ask questions about the software, printers, presentation, electronics involved in the challenge.

Update these briefings to reflect any information specific to the Challenge Day you are running.

**Briefing for 3D print designers and engineers – to be done at design station.**

* Ask them to bring the 3D print and design handbook to briefing.
* Ask them to make a folder on the desktop for their team name – all designs **MUST** be saved in this.
* Show them where Autodesk inventor (or equivalent) is.
* Show them tutorials on ‘get started’ – ‘create’ is the best one to use initially as an introduction.
* Explain how the 3D printer works.
* Talk them through contents of instruction booklet and tell them to look at the 3D Design and Print information sheets for other information relating to printing. (Tell them they cannot design something which will take the print right to the edges of the print area as it will not print properly and will be too expensive).
* Explain about costing of print time and print material and tell them to keep money aside for this (remind them that print time is in 30 min units).
* Explain that they will need to have their design finished or nearly finished **by 12.00** for preparing to print so if they are going to use a blueprint they need to make that decision by 11.30 at the very latest. Important to stress that they should work within their comfort zone – we can help but we cannot do it for them!
* Explain that they will be able to see a preview of their design to calculate print costs.
* Remind them that the beacon design must house the electronics if possible so they should work with their electronic engineers to ensure this.
* Facilitator must see design before it is sent to print.

**Briefing for electronic engineers and project managers – to be done at laptop station.**

* Ask them to make a folder on the desktop for their team name – the presentation **MUST** be saved in this. Remind them to save regularly.
* Ask them to bring the Electronics instruction manual and the student handbook.
* Show them where the electronics video tutorials are.
* Show them the Electronics instruction manual and point out the connections on the back of the breadboard (tell them not to take the sticker off though)
* Remind them that they should work within their comfort zone with the electronics as we can help but we cannot do it for them. Remind them that circuit can be simple or complex as long as it communicates the information required but we **MUST** see their design in Stage 2 reflections.
* Remind them that the design engineers will need to know the dimensions of their circuit so that they can design the beacon around this.
* Explain the contents of the presentation and remind project managers that all the team should be involved in this.
* Remind them that the presentation must include a demonstration of their beacon and how it works – remember, this is a pitch for your product to the Smart Cycle group.
* Show them the marking criteria in the student handbook.
* Tell them that the presentation must be ready by **14:00** for CL to collect on a USB.

**Alpha**

**Alpha**

# Assessment Criteria

Students will be judged on the following areas:

|  |  |
| --- | --- |
| **Criteria** | **Marks** |
| 1. Planning and research | 15 marks |
| 1. Development of prototype | 10 marks |
| 1. Accounting sheet | 10 marks |
| 1. Quality of prototype | 20 marks |
| 1. Function of prototype | 20 marks |
| 1. Presentation | 20 marks |
| 1. Teamwork | 5 marks |
| **Total** | **100 marks** |

1. **Planning and research (15 marks)**

Using Stage 1 of the planning sheet provided, marks will be awarded for:

* Identifying different information that cyclists need when out cycling ***(4 marks)****.*
* Ideas about how to communicate different information to cyclists using a Beacon ***(4 marks)***.
* Identifying the information that your Beacon will communicate to cyclists ***(1 mark)****.*
* Identify the advantages and disadvantages of your final design ***(2 marks)****.*
* Recording your team’s agreed solution - include both the shell design and electrical components of your Beacon and how they work together ***(4 marks)****.*

1. **Development of prototype (10 marks)**

Using Stage 2 of the planning sheet, provided marks will be awarded for:

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

1. **Accounting sheet (10 marks)**

Use accountancy sheet (page 9) to record all of the costs the team has incurred. Marks will be awarded for:

* Accuracy of expenses – remaining Faradays matches with accountancy sheet ***(2 marks)****.*
* Accuracy of expenses – shop manager records matches accountancy sheet ***(2 marks)****.*
* Cost effectiveness ***(4 marks)****.*
* Clarity of accounting sheet ***(2 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.*

**Quality of prototype (20 marks)**

Your prototype solutions will be judged on:

* Manufacture quality - how well your circuit is designed to communicate something to the cyclists ***(4 marks)***.
* Manufacture quality – how well you shell is designed ***(4 marks)***.
* Creativity - designs must be innovative and creative, making best use of the resources available. You will be awarded more marks if you design the circuit and the beacon yourself or significantly modify a blueprint rather than just printing a blueprint beacon design ***(8 marks)***.
* Demonstration of the team and individual ability to challenge themselves and persevere with the challenge ***(4 marks)***.

1. **Function of prototype (20 marks)**

* Functionality – how effectively the beacon communicates important and useful information to the cyclists ***(10 marks)****.*
* Functionality –How well the beacon and electronics fit together to do the job intended ***(10 marks)***.

1. **Presentation (20 marks)**

Your presentation should communicate:

* What information your Beacon will communicate and why you chose this ***(2 marks)***.
* How your beacon works ***(2 marks)***.
* How you would weatherproof your beacon ***(1 mark)***.
* How you would power your beacon e.g. renewable energy, wired into the mains ***(1 mark)***.
* The STEM used in your solutions ***(4 marks)***.
* The importance of engineering to the future of cycling ***(1 mark)***.
* Honest reflection on your teamwork throughout the challenge and how the different roles have worked together ***(5 marks)***.
* The presentation skills of your team in presenting your findings ***(2 marks)***.
* Effective use of presentation software ***(2 marks)***.

**Don’t forget that you must show your working beacon during your presentation!**

1. **Teamwork (5 marks)**

Marks are awarded for:

* How well you work as a team with all members working together effectively ***(3 marks)***.
* Ensuring that your work station and surrounding area enables safe working and are free from hazards at all times ***(2 marks)***.

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

# Snapshot and tips for the Faraday Challenge Day

**SETUP:**

|  |  |
| --- | --- |
| **08:00**  Set up for the day | * Student work stations, Inspiration station, Judges area (room layout and requirements, p. 18). * Laptop station/Computer area. * Design station/Computer area. * 3D printers. * Materials shop/Technician’s area. * Get extra help from colleagues (at least two colleagues). |
| **09:15-9:30**  Students arrive | * One team per table (6 teams of 6 students). * Teams complete registration forms. |

**INTRODUCTION:**

|  |  |
| --- | --- |
| **9:30**  Introduction | * Introduction to the day and IET and housekeeping. * Introduce engineering, STEM and careers message. |
| **9:35**  Video Briefing | * Show the briefing film. * Re-cap of the challenge. * Re-cap of the final test. * Project development overview - key stages. * Overview of how students can win points. A full overview can be found in the student booklet. |
| **9:45**  Tools to help you | * Provides an overview of how students can seek support throughout the challenge. |
| **9:50**  Role allocation activity | * Each student must take on a specific role to complete the challenge successfully. A brief overview of these roles has been provided on page 26 and full job descriptions have been provided in the Students’ Pack. * Students will need to choose their role within their team. |

**STAGE 1:**

|  |  |
| --- | --- |
| **9:55**  **STAGE 1:** Planning and research | * Identifying information that cyclists need and how this can be communicated to them. * Brainstorming, planning and research. * At the end of this stage, teams should complete stage 1 on their planning and reflections sheet. |

**STAGE 2:**

|  |  |
| --- | --- |
| **10:05**  **STAGE 2:** Design and Budget | * The shop opens – you may like to suggest that only the Accountant role is able to go to the shop to purchase materials in avoid the shop manager becoming inundated. * Students commence development and build of solution. * At the end of this stage, teams should complete stage 2 on their planning and reflections sheet. |

**STAGE 3:**

|  |  |
| --- | --- |
| **10:25**  **STAGE 3:** Development and modifications | * The shop opens – you may like to suggest that only the Accountant role is able to go to the shop to purchase materials in avoid the shop manager becoming inundated. * Students commence development and build of solution. |
| **10:30**  Briefings | * Brief the design and print engineers and set them up on the computers. * Brief the electronic engineers and project managers and set them up with computers. |

|  |  |
| --- | --- |
| **11:10** | **Short break** |

|  |  |
| --- | --- |
| **11:20**  **STAGE 3:** Development and modifications continued… | * In this session students will continue the build and development of their solution. * They must also discuss and implement modifications of their solution. * At the end of this stage, teams should complete stage 3 on their planning and reflections sheet. |
| **12:00**  Print station opens | * Teams should be at a stage where they can start printing their beacon designs. * Move print engineers and designers to printer table with laptops. * Begin bed heat 1 hr. * Finalise designs, convert to STL file and prepare for printing. * Once bed is heated up print design. * **Last print has to begin at 12.20pm.** |

|  |  |
| --- | --- |
| **12:30** | **Lunch** - tools down |

**STAGE 4:**

|  |  |
| --- | --- |
| **13:00**  **STAGE 4:**  Final build and testing | * Teams are to make final amends to their prototype and ensure that they have everything required to send and decipher a code. * Teams to complete final reflections and prepare for 5 minute presentation which focuses on the science, engineering, technology and mathematics skills, knowledge and understanding they have used in developing their prototype. |
| **13:30** | * Shop closes! * Get teams to submit accounting and planning and reflection sheets to the facilitator. * Develop presentation and rehearse. |

**STAGE 5 - FINAL TEST:**

|  |  |
| --- | --- |
| **13:45**  **STAGE 5:** Presentation and test of beacon prototype | * Team’s present planning and reflections from stages 1, 2 and 3 to the Judges – teams should have a maximum of 5 minutes to present. * Demonstration of each team’s prototype beacon. It does not matter if the electronics are separate from the shell, the presentation should demonstrate the ideas, engineering principles and overall effectiveness of the beacon design. |

**WRAP-UP:**

|  |  |
| --- | --- |
| **14:50**  Award ceremony | * Highlights strengths and areas for improvement on each teams’ solution. * Announcement of winning team. |
| **15:00**  Finish | * Students depart. |

# Checklist for running the Faraday Challenge Day

|  |  |  |
| --- | --- | --- |
| **Student tables** | **Quantity** | **Note** |
| Team station label (team number) | 1 per table | See Teacher extras |
| Student team registration form | 1 per table | See p. 25. |
| Student Booklet | 1 per table | See Students’ Pack. |
| Roles and responsibilities (A4 sheet) – Project Manager, 3D Design Engineer, 3D Print Engineer, Electronic Engineer and Accountant | 1 per role per table | See Students’ Pack. Each team will require 2 Electronic Engineers. |
| Role Cards (Name Cards) – Project Manager, 3D Design Engineer, 3D Print Engineer, Electronic Engineer and Accountant | 1 per role per table | See Teacher extras  Each team will require 2 Electronic Engineers. |
| Planning and Reflections sheet | 1 per table | See Students’ Pack |
| Blank paper | 1 per table | Provided by your school. |
| 3D Design and Print Information Booklet | 1 per table |  |
| Electronics Information Booklet | 1 per table |  |
| Faraday branded currency | Each team should have F150 with the following breakdown:   * 10x F10 * 8x F5 * 10x F1 | See Teacher extras |
| 30cm ruler | 1 per table | Provided by your school |
| **Teacher** | **Notes** |  |
| Teachers Booklet |  | Current document. |
| PowerPoint Presentation with notes |  | See Teachers’ Pack. |
| AV pack |  | See Teachers’ Pack. |
| Audio visual equipment – projector and sound |  | Provided by your school. |
| Assessment Matrix |  | See Teachers’ Pack |
| Certificates | 1 per student | See Teacher extras |
| Gaffa Tape | To secure wires if necessary |  |
| Heat gun/Hairdryer | To be used for testing if temperature sensors are used in the electronics |  |

**Continued….Facilitator checklist**

|  |  |  |
| --- | --- | --- |
| **Shop** |  |  |
| Materials list for shop manager/technician |  | See p. 21-22. |
| Materials price tags |  | See Teacher extras |
| Shop manager/technician balance sheet |  | See Teacher extras |
| Faraday branded currency | **Shop change kitty:**   * 20x F10 * 20x F5 * 40x F1 | See Teacher extras |
| STEM Consultant name tag |  | See Teacher extras |
| STEM Consultant card |  | See Teacher extras |
| **Signage** | **Notes** |  |
| Inspiration station | 1 | See Teacher extras |
| Shop | 1 | See Teacher extras |
| Print Station | 1 | See Teacher extras |
| Design Station | 1 | See Teacher extras |
| **Inspiration Station** | | |
| Physical items (i.e. security lights, signs, colour changing items, print outs (electronic circuit symbols, hazard symbols) or images (road signs, cycle paths etc.) to inspire pupils and get their creative minds working. | | |
| **Print Station** | | |
| 6x3D printers | | |
| **Design Station** | | |
| 12 laptops or other devices. Six laptops require 3D design software and Six laptops require presentation software. | | |

# Room layout

The room layout given below is a guide and is designed based on the use of laptops and six portable 3D printers. Please adapt the room layout to suit your schools individual needs for the activity.

Each team table need 6 chairs. The judges table requires 2 chairs. The shop requires 1 chair. Plug sockets and extension leads need to be available for 6 printers at the print station, 6 laptops at the design station and 6 laptops at the laptop station. The position of the printer and laptop stations can be changed to accommodate power points and avoid drafts but all three stations must remain together.

Design station for 6 laptops and 12 chairs

Shop

Student team tables x 6

Laptop station for 6 laptops

Print station for 6 3D printers with laptops – **N.B. this must not be close to a door, window or be in a draughty position.**

Inspiration station

Judges table

le

Extension reel (under tables and lead taped)

|  |  |
| --- | --- |
| **09:30** | **Introduction to the Faraday Challenge Day** |
| **09:35** | **Introduction to the Challenge!** |
| **09:45** | **Role allocation activity** |
| **09:50** | **STAGE 1: Identifying the problems and initial ideas**   * Brainstorming of ideas * Planning and research |
| **10:05** | **STAGE 2: Design and budget**   * Final designs created * Shopping list created |
| **10.25** | **STAGE 3: Development and modifications** ⚠   * Shop opens * Development and build of prototype solution |
| **10.30** | **Briefings**   * 3D print engineers and designers at design station * project managers and accountants at presentation station * electronic engineers at presentation station |
| **11:10** | **Break** |
| **11:20** | **STAGE 3 continued: Development and modifications** ⚠   * Continued development and build of prototype * Modification of prototype |
| **12:00** | **Print station opens** |
| **12:20** | **Last admission to print station** |
| **12:30** | **Lunch** – Tools down |
| **13:00** | **STAGE 3 continued: Development and modifications** ⚠   * Continued development and build of prototype electronics * Develop presentation using laptop * Collect printed prototype once ready and combine with electronics |
| **13:30** | **STAGE 4: Presentation**   * Shop closes * Submit accounting sheet to Facilitator * Develop presentation using laptop and rehearse |
| **14:00** | **Project Manager submits presentation to Facilitator** |
| **14:15** | **STAGE 5: Final test** ⚠   * Teams present prototypes to the judges |
| **14:50** | **Award ceremony**   * Final feedback and evaluation of the day * Announcement of winning team |
| **15:00** | **Finish** |

# Schedule for the day

# **Risk assessment example** (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: Faraday Challenge Days Smart Cycle** | | | |
| **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** | |
| * **Use of electrical equipment – risk of electric shock** | | All electrical equipment is low voltage. | |
| * **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. | |
| * **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. | |
| * **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. | |
| * **Use of 3D printer with heated plate and nozzle – burn risk** | | Ensure that students are aware that they should not touch the nozzle or plate of the printer. Adults to remove the plate after the print is finished. | |
| * **Use of scrapper to remove printed object from the 3D printer plate – risk of cutting or abrasion** | | Where it is necessary to use the scrapper to remove the printed object this will be done by an adult. | |
| **Location issues** (to be completed by Host School) | |  | |
| Further Action Required: 1. Ensure all persons staffing the Faraday Challenge Days are aware of and competent to comply with this risk assessment and the control measures. | | | |

**Risk assessment example** (page 2 of 2)

|  |  |
| --- | --- |
| **Working Practice** | |
| **Group structure** | Two members of staff from the host school present during the whole day to oversee use of equipment and to keep order. |
| **Restrictions** | Unknown premises. |
| **Emergency**  **Procedure** | Follow the lead from the Host School.  Facilitator to be fully briefed on risk assessment procedure prior to the day. |
| **Safety Equipment** | First aid kit and fire extinguisher (electrical fires) to be provided by Host School. |
| **Signature of the school representative** |  |
| **Date of this Review** | March 2014 |

# Assessment matrix

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Assessment Criteria | | Team  1 | Team  2 | Team  3 | Team  4 | Team  5 | Team  6 |
| Planning and research | 15 |  |  |  |  |  |  |
| Development of prototype | 10 |  |  |  |  |  |  |
| Accounting Sheet | 10 |  |  |  |  |  |  |
| Quality of prototype | 20 |  |  |  |  |  |  |
| Functionality of prototype | 20 |  |  |  |  |  |  |
| Presentation | 20 |  |  |  |  |  |  |
| Teamwork | 5 |  |  |  |  |  |  |
| Faradays Spent |  |  |  |  |  |  |  |
| **Total score** | **100** |  |  |  |  |  |  |

|  |  |
| --- | --- |
| **Team** | **School/Team name** |
| 1 |  |
| 2 |  |
| 3 |  |
| 4 |  |
| 5 |  |
| 6 |  |

# Full list of materials available to purchase, cost and units

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Item** | **Description** | **Unit** | **Cost** | **Min/ event** |
| Copper wire - red | Insulated wire - red | Per 30cm | 5 Faradays | 1 roll |
| Copper wire - black | Insulated wire - black | Per 30cm | 5 Faradays | 1 roll |
| Croc leads - black | Lead with crocodile clips at each end - black | Each | 5 Faradays | 12 leads |
| Croc leads - red | Lead with crocodile clips at each end - red | Each | 5 Faradays | 12 leads |
| LED bulb – single colour | Red, white and orange available. Comes with a resistor which is required in the circuit | Each | 5 Faradays | 6 of each colour |
| LED bulb - flashing | Flashing LED bulb – one colour only. Comes with a resistor which is required in the circuit | Each | 10 Faradays | 12 |
| Terminal blocks | Set of two terminal blocks which can be used to connect wires in a circuit. Requires a small screwdriver | Each | 2 Faradays | 48 pairs |
| Temperature sensor | Component that detects the ambient temperature and changes resistance to allow a current to flow through a circuit | Each | 5 Faradays | 12 |
| Light dependent resistor | Component that detects the light level and changes resistance to allow a current to flow through a circuit when it becomes dark | Each | 5 Faradays | 12 |
| Buzzers 3 Volt | Component which emits a noise when connected to an electronic circuit. Requires 2 AA batteries in a circuit | Each | 5 Faradays | 6 |
| Batteries - AA size | 1.5V batteries | Each | 2 Faradays | 24 |
| Battery holder – 2 x AA | Required when using 1.5V batteries. Requires 2 AA batteries | Each | 1 Faraday | 12 |
| Breadboard and wire set | Small breadboard for building and testing circuits. 5 jump wires included. | Each | 15 Faradays | 12 and one box of wires |
| Bulb 3V | Round bulb which requires 2 AA batteries in a circuit. Bulb holder required | Each | 2 Faradays | 6 |
| Bulb holder | Simple bulb holder which allows bulbs to be added to a circuit | Each | 1 Faradays | 6 |
| Transistor | Used to adjust the reaction of sensors in a circuit e.g. change light on when light falls on LDR to light off when light falls on LDR | Each | 10 Faradays | 6 |
| Resistor | A component used in a circuit to ensure that the correct current is supplied to other electrical components in a circuit. Especially LEDs | Each | 5 Faraday | 24 |
| Potential divider | Used to adjust the sensitivity of a sensor in an electrical circuit | Each | 10 Faradays | 6 |

**3D design options:**

|  |  |  |
| --- | --- | --- |
| **Item** | **Unit** | **Cost** |
| 3D Design A | 1 digital copy on USB | 10 Faradays |
| 3D Design B | 1 digital copy on USB | 20 Faradays |
| 3D Design C | 1 digital copy on USB | 50 Faradays |

**3D print material and time:**

You do not need to purchase the physical items in the shop but you will need to calculate the cost of your print time and material and give this money to the shop manager.

|  |  |  |
| --- | --- | --- |
| **Item** | **Unit** | **Cost** |
| Print material | Up to 20g | 10 Faradays |
| Print time | 30 minutes | 10 Faradays |

**AVAILABLE TO HIRE:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Item** | **Measurement** | **Cost** | **Min/event** |
| Wire strippers | 5 minutes | 5 Faradays | 3 |
| Small screwdriver | 5 minutes | 1 Faradays | 3 |
| STEM Consultant | 5 minutes | 10 Faradays |  |

**AVAILABLE FOR USE:**

|  |  |  |
| --- | --- | --- |
| **Item** | **Description** | **Cost** |
| Autodesk Inventor Professional | 3D design software | FREE |
| PowerPoint | Basic software for creating a presentation | FREE |
| Tutorials | Tutorial files and links to online tutorials to help you familiarise yourself with the different software. All tutorials can be found in the Tutorials folders on the desktop of the laptop | FREE |