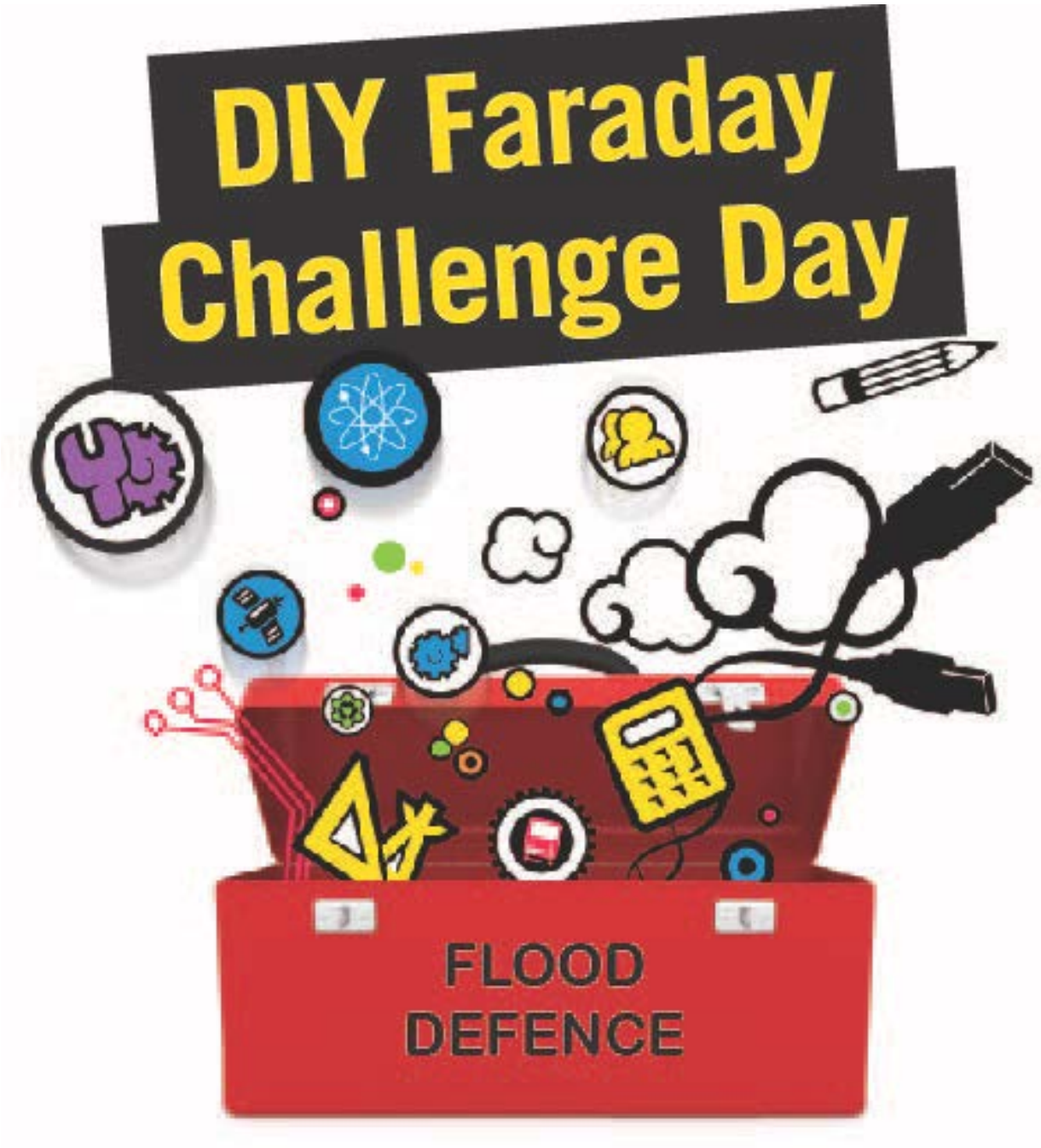

Student booklet

‘Urban dwellers adapt to global warming’

Faraday STEM Challenge Day

'Urban dwellers adapt to global warming'

CONTEXT

Over the past few years the UK has seen unprecedented flood levels across a range of urban areas, including Yorkshire, Gloucestershire, Worcestershire, Hampshire as well as large areas of Wales and Northern Ireland.

The Environment Agency says:

- Flooding happens naturally and cannot be completely avoided
- Around five million people, in two million properties, live in flood risk areas in England and Wales
- Changes in climate, such as more severe storms and wetter winters, will increase that risk

They estimate that over the next 80 years we will need to spend £22 to £75 billion on flood defences in England and Wales to combat the effects of climate change.

The vast majority of these people live on the edges of the flood risk areas and therefore are unlikely to be in a position of having their houses completely devastated by incoming water. Many people will however, have water that seeps into their homes, and the ability to move water quickly will help them reduce damage.

Assessment Information and criteria

Key Area	Marks
Initial design sheets (x3)	10
Development of ideas - idea sketches and notes	20
Accountants balance sheet	10
STEM questions	30
Learning log	30
Team work	10
The Challenge - quality of final product - amount of water moved in 1 minute	90
Total	**200**

1. 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.

2. DEVELOPMENT OF IDEAS - (session two)
This section is an important section and involves sketches and notes explaining the development of your ideas. You need to record your teams' agreed solution and then note down any changes or modifications you make, with reasons why you have changed the design. You need to think about materials, sizes, manufacture, including construction methods and ease of use (ergonomics).

You can use as many sheets as you want but it must be laid out so you can see the changes and why they were made. More marks will be awarded if you focus on the specific science, mathematics and design and technology issues and highlight how these have been tackled.

3. ACCOUNTANTS BALANCE SHEET – (session three)
This is a record of all the costs the team has incurred. It should inform us how you have spent your money, giving us a total of how much you have left. You will gain more marks if you can spend less money.

4. **STEM QUESTIONS - (sessions two and three)**
   This is an opportunity to allow your subject specialists to demonstrate their expertise related to the challenge. The questions are difficult; therefore it might be a good idea to get the whole team to support each pair. The questions need to be completed by 1pm.

5. **LEARNING LOG - (final challenge)**
   Your 2-minute video will be awarded a maximum of 30 marks. You will have to work as a team to provide the information needed for this video. The video production manager will be responsible for designing and producing your learning log to the highest standard. There is a help sheet in your booklet 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.

6. **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?

7. **THE CHALLENGE - (final challenge)**
   This will be tested during the 'Final Engineering Challenge.' Can it perform the given task and is it made to a high standard?

   - Marks are awarded for the amount of water moved from the lower tray to the upper tray, i.e. one litre of water or more = 60marks, half a litre of water = 30 marks and so on. Please note there are no additional marks for moving more than one litre of water (just bragging rights!).
   - 30 marks will be awarded if your device is made to a high standard, with no leaks and good functionality.

Materials resource sheet

AVAILABLE TO BUY:

Material	Unit Cost
MDF 6.0mm 150mm x 150mm	10 Faradays
Styrofoam sheet 25mm 150mm x 150mm	10 Faradays
Clear acrylic tube 50mm dia. x 200mm	20 Faradays
Jubilee clip x 1	10 Faradays
6mm Dowelling 300mm	10 Faradays
Straws (each)	5 Faradays
Parcel tape	5 Faradays
Plastic cups (each)	5 Faradays
PVC tubing 10mm dia. x 200	10 Faradays
Glass paper	5 Faradays
Technician to cut/drill materials for you (one off payment)	10 Faradays

AVAILABLE TO USE:

Service	Unit Cost
Junior hacksaw / coping saw	10 Faradays
Low melt glue gun	10 Faradays
Screwdriver	5 Faradays
Power drill (to be used by technician for free) plus drill bit	10 Faradays

Timings for the day

(Please note these timings are only approximate and may be changed to fit with your school 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**
- Hand in all learning logs at the beginning of the session ready for downloading
- Produce final engineering solution

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 F120)
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 principles is your device based upon?
- What form of motion is used in your device?

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 a lot of marks. Think about…

- Can you simplify your device and represent it mathematically? (i.e. a diagram)
- Can you calculate the volume of water being moved at any one time?
- Can you calculate the time it would take to move 1 litre of water?

DESIGN AND TECHNOLOGY

What do you think are the key features you need to think about to ensure your device works effectively? Think about…

- 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 be ‘user-friendly’?

Video help sheet

The film is fundamentally a 'learning log' of the day. It should last about 2 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 specialists talking clearly about the application of this knowledge and understanding? The STEM questions could form the interview (see pages 11-13)
   - 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	10 seconds
2	Talk through the decisions surrounding why you have chosen the idea you have 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 your prototype	20 seconds
4	Interview the Maths Specialists • Make sure you capture the maths in the design of your prototype	20 seconds
5	Interview the Design and Technologists • Think about the practical application of your design, how will you make all the bits fit together?	20 seconds
6	Interview each member of the team and capture their key learning from throughout the day	20 seconds

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

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 are 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 you're 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.

Team ……

STEM questions 1

1. List four design specifications for your device.

2. If this device was to be manufactured what scale of production do you think would be suitable and why?

3. Discuss two ergonomic considerations that would ensure your device performs effectively and efficiently.

4. If your prototype was to be commercially produced what would be the main materials used for the key components and why?

5. How could you make your product more environmentally friendly if it was going to go into production?

Team ……

STEM questions 2

1. What percentage of the population lives in flood risk areas in England and Wales?

2. Estimate the floor area of a typical house. [This represents the area that would be flooded.] You'll need to explain your assumptions and show your calculations.

3. Now estimate the volume of water that will need to be removed if the flood depth is 100mm.

4. About how long would it take for your pump to remove all this floodwater?

5. If you were able to manufacture your device for £8.36 (including packaging and all other costs) and sell it for £15.27 to 1.2 million customers, what profit would you make?

Team ……

STEM questions 3

1. Name the different parts of your solution and say which parts might be changed to help move the water quicker.

2. Draw your solution and label each part saying what each part does.

3. Explain how a simple pump works.

4. Evaluate your solution and identify what bit was the most important to the design e.g. size of the cylinder, or the valves you used.

5. Name one improvement you could make to your solution with regard to making your device more environmentally friendly.

The IET DIY Faraday Challenge Day ***'Flood defence'*** is based on the Faraday Challenge Day of the same name, a STEM activity day written and delivered by the Attainment Partnership on behalf of the Institution of Engineering and Technology (IET).

The IET Faraday 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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