THE JAMES DYSON FOUNDATION

# ON THE MOVE

**Design and Technology scheme of work**

**Key stage:** 3

**Duration:** 6 weeks (approximately 12 hours)

**Project overview:** Design a prototype that uses air or wind to make something that could transport people or products.

The James Dyson Foundation is a charity supported by Dyson Ltd.

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# OVERVIEW

# ABOUT THE SCHEMES OF WORK

This scheme of work has been designed to support you in delivering project-based, engaging and relevant Design and Technology (D&T) lessons that are mapped to the Key Stage 3 (KS3) national curriculum progression framework. KS3 is a key point in students' D&T learning, as it's at this stage that they need to make a choice about whether to continue studying D&T at Key Stage 4 (KS4). Offering students high-profile projects at these times can inspire them to want to continue learning about technology and engineering.

Through this resource, students will learn how to take risks, be resourceful, be innovative and be enterprising. They will also learn about design engineering and begin to develop the skills needed to become an engineer.

# LEARNING OBJECTIVES

## Objectives

- Understand how to use real design techniques to solve real problems.
- Analyse and apply iterative design processes.
- Identify and master the technical skills needed to produce design solutions.
- Produce a functioning prototype that could solve a relevant problem.

## ABOUT THE JAMES DYSON AWARD

# The UK faces an annual shortfall of 59,000 graduate engineers and technicians

Engineering UK, 2018

Students' closest experience of engineering in secondary education is through D&T. Too often the subject is taught through limited and irrelevant project work. This approach neither promotes student engagement in the subject, nor reflects the exciting reality of an engineering career.

The James Dyson Foundation believes that a D&T curriculum based on iterative design, problem-led and project-based learning is more relevant and engaging to students. As a result, students enjoy D&T more, their perception of engineering improves and more students choose to study D&T and pursue engineering as a career.

Between 2012 and 2018, we worked with five schools in Bath to test this hypothesis. We helped these schools to develop their D&T labs and worked closely with them to develop schemes of work that reflect our beliefs.

Thank you to the teachers and students at Writhlington School, Ralph Allen School, Wellsway School, Hayesfield School and Chew Valley School, who helped to develop the content for this scheme of work.

**As a result of our intervention:**

32% of students chose to study D&T at GCSE in 2017, against a national figure of 18%.

Over the course of the project, student uptake of D&T at GCSE increased by 37%, whilst the national uptake has decreased by more than a half.

7% of students across all the schools opted to study D&T at A Level in 2017, against a national figure of 1.7%.

Over the course of the project, there was a 156% increase in the number of students who would like to pursue a career in engineering.

Between 2012 and 2018, there was a 300% increase in the number of girls who would like to be an engineer.

# TEACHER RESOURCES

# TEACHER'S NOTES

## Context

We are challenging students to extend their knowledge and understanding of technology by applying practical and theoretical skills to recognisable contexts. The practical nature of this work should have a high degree of relevance to each student. They will all have experienced the force of air around them, and they will probably have experienced of some of the frustrations and opportunities presented by wind and air movement. There will be opportunities during the project to discuss some of the issues around energy generation and use, but primarily the project is intended to be an enjoyable way for students to experiment with achieving movement through making efficient models and prototypes.

## Autonomy

Please note that this project is designed to have open-ended outcomes. It does not set out to define products or systems which might make good designs. Rather it puts emphasis on the students identifying and developing good designs.

The variety of possible solutions enables students to retain a degree of autonomy over their design and decision-making. This may mean that some students create prototypes that do not achieve great functionality. It is important to recognise this as a normal and useful function of the design process.

## Scenarios

Design projects usually succeed if students readily identify problems to solve and negotiate approaches with their teachers. Sometimes, though, students can feel inhibited about coming up with problems. The project also has to work with the resources available to the school.

As this project is intended for year 8 students, it is possible that some of their design ideas, although creative, may be unfeasible to deliver. If this is the case, this scheme of work asks teachers to limit the scope of design outcomes to four scenarios: Reduced energy usage, work in the air, work in water and work on the ground. For some students, this can kick start a process of ideas, which leads on to design thinking. If these scenarios are used, they should still allow for students to invent their own solutions.

## Learning management

As this is an open-ended design challenge, the usual caveats apply about progress, pace and standards associated with practical work. The specified evaluation points enable teachers to hold students or teams to account for the progress they have made.

## Design iteration

While students should aim to create a high-quality final prototype, our goal is for students to practice the non-linear and iterative design process. They should understand that they need to master technical skills in order to create their design solutions.

The scheme of work requires that students produce a number of prototypes from the second week onwards. Making early rapid prototypes with card and glue, or through CAD and 3D printing, is part of the learning and evaluating process. It ensures that students make improved versions of their designs within the project's time allocation. Carrying out this design/make/evaluate cycle allows students to demonstrate skills in analysis, judgement and synthesis, while simultaneously developing their technical skills. The outcomes of students' work may be products or systems, but they will be prototypes and not finished products.

## Mapping

This project has been mapped to the KS3 D&T Progression Framework and to the D&T Programme of Study for KS3 (PoS 2014). Please note that this mapping is indicative only and acts as a guideline for teachers. You and your students will use a range of techniques and materials according to the needs of their design ideas, and some content may be covered in more depth than others. You can use your professional judgement as to what masterclasses and other teaching is needed to ensure students can demonstrate their design and technical skills.

# TEACHER'S NOTES CONTINUED

## JDF project backbone

This scheme of work has been created in line with the format that is applied to all James Dyson Foundation project work. This format is outlined below.

| Phase one: Conception |
|---|
| Introduction to the contextual area and identification of problems, issues and user needs |
| **Phase two: Development** |
| Research into evidence and sources |
| Analysis of risks, scale, impact and affected people |
| Compilation of the design brief, project plan and evaluation criteria |
| Compilation of individual sketches and drawings |
| **Phase three: Realisation** |
| Early prototyping of possible solutions |
| Evaluation and iteration |
| Taught masterclasses to achieve technical skills |
| Completion of iterated and developed prototypes |
| **Phase four: Explanation** |
| Presented explanation of the prototype and design process |
| Portfolio |

# TOP TIPS FROM TEACHERS

Our resources have been created with the help of our champion teachers in our five Bath schools. Below are some of their hints and tips for running a James Dyson Foundation project.

Shift the focus to the design process, as opposed to assessment and producing a finished product.

If possible, arrange for students to present their work to an external visitor. This allows the students to take ownership over their project.

Teach technical knowledge through practical activities – this way students are more likely to retain this knowledge.

Remember these key words when planning lessons: Risk, failure, autonomy, iteration and prototyping

Teach failure as a technical term, not a criticism or opinion.

Create a habit of constantly documenting students' work.

Test, test, test – fail, fail, fail.

Avoid linear processes.
Avoid fixation.

Be brave!

# SCHEME OF WORK

# OVERVIEW

## Project overview

This project examines the phenomena of air and wind and how it relates to design and engineering. It is intended to introduce students to how forces and energy are derived from these phenomena in natural and artificial contexts. In order to inspire learning and innovation, this scheme of work challenges students to use their knowledge to identify and solve human problems using air or wind.

The project is aimed at Key Stage 3 students. In the James Dyson Foundation Schools Project, it has been used successfully as an introduction to design iteration in years 7 and 8, but it also makes a good 'bridging' project with partner primary schools. Student outcomes should be viewed as ideas for development, with prototypes that demonstrate how solutions could work acting as key evidence. The ideas may currently be impractical and some may have been considered by engineers already. Through evaluation, successful students will be able to describe the attributes, strengths and weaknesses of their ideas.

To assist teaching and assessment, the range of ideas and solutions can be constrained by scenarios that channel broad thinking into more specific outcomes. If this tactic is followed, it works best if the scenarios are discussed and agreed rather than simply given.

Many human problems are likely to be identified by students from their own experiences and those of people they know. Be prepared for wider discussions to take place around contemporary issues such as sustainability, energy demand, inequality, pollution and cost.

Some useful scenarios can be negotiated around the ability of air and wind to create or inhibit movement of objects, e.g. balloons, wind turbines, parachutes, kites and windsurfers, boats and hovercraft.

The scheme of work includes evaluation checkpoints. This is to ensure that iterative development takes place and can be observed and recorded (although it may well be taking place naturally at many other points during the project).

Students tackling this design project will be producing ideas and solutions in a short time frame. They should be encouraged to embrace failures and things that don't go as planned as the key building blocks for their next, more refined, ideas.

## Curriculum mapping

This project is mapped to KS3 Design and Technology national curriculum/Programme of Study (PoS) 2014.

### The Programme of Study identifies seven key areas:

- Design – Understand contexts
- Design – Generate, develop, model and communicate ideas
- Make – Planning
- Make – Practical skills and techniques
- Evaluate – Own ideas
- Evaluate – Existing products
- Technical knowledge – Making things work

# OVERVIEW CONTINUED

## Success criteria

| All | Most | Some |
| --- | --- | --- |
| Make observations about natural and human events from given examples. | Make appropriate observations about natural and human events and provide individual examples. | Make connections and analytical commentaries from detailed observations of natural and human events, and provide comments on positive and negative effects. |
| Act as part of a team. | Make an effective contribution to a team and understand the needs of other team members. | Understand roles and strengths in working as a team. Make a key contribution to achieving outcomes in a given time frame, taking into account the needs of all team members. |
| Carry out secondary research from given sources. | Use secondary research to inform design decisions. | Use individual research from a range of appropriate sources to develop innovative design decisions. |
| Evaluate a series of design ideas using a set of evaluation questions. | Evaluate a series of design ideas using a range of evaluative tests and reach conclusions for further development. | Use a range of appropriate evaluative techniques to provide evidence and priorities for further development. |
| List design ideas and know how to develop them through experimental prototyping. | Understand how ideas can improve through iteration. | Use consistent design iteration to combine, synthesise and extend ideas into new concepts. |
| Use taught technical skills required to carry out project tasks. | Identify and apply the technical skills required to complete the project. | Identify, apply and explain how technical skills have been used to enhance functions and outcomes. |
| Make a contribution to a presentation. | Make a relevant contribution to a presentation which effectively explains the project process and outcomes. | Make a relevant contribution to a presentation which effectively explains, analyses and justifies the project process and outcomes. |

# WEEK 1: CONCEPTION

## Overview

Students are encouraged to look at a key natural resource and source of energy for the human race. The project links events that demonstrate the sheer power of wind forces with ways in which this power can be positively harnessed by nature and by humans.

## Resources

- Slideshow or images of wind events e.g. hurricanes, tornados
- Images of wind turbines, kites, wind chimes, paragliding etc.
- Sycamore or hornbeam seeds
- Ash seeds
- Birch seeds
- Maple seeds
- Dandelion/bulrush seeds (possibly poppy heads)

## Useful references

2017 Hurricane Maria facts
www.worldvision.org/disaster-relief-news-stories

Energy Saving Trust:
energysavingtrust.org.uk

## Planning

| Learning objectives | Teaching and learning activities |
| --- | --- |
| Discuss and recognise the interactivity between natural and human events. | 15-minute introduction session. |
| Observe and identify a range of natural events and objects that are moved by air. Describe how movement takes place and the role of airflow. | Students are asked to think about and suggest ways that wind affects life on earth. The purpose of the introduction is to agree that airflow and wind have a profound effect on everyday life.<br>Likely topics to be identified may be tornados, cyclones and hurricanes, as well as positive effects such as wind turbine power, sailing boats and kites, but the discussion should be open-ended.<br>The whole group should be encouraged to participate and construct a board or chart of their findings.<br>Students observe a range of natural objects that use air or wind for dispersal e.g. seeds. |

# WEEK 1: CONCEPTION CONTINUED

| | |
|---|---|
| Understand how teamwork can enhance design thinking.<br>Compare and contrast different dispersal methods.<br>Categorise key attributes of tested objects. | Students form into groups of 3 or 4.<br>Groups experiment with different seed types to see how they are moved in and through the air. Seeds can be dispersed from a suitable height to generate thrust and lift.<br>Each group records the distance travelled and their observation of the key features of each seed type:<br>– Winged and non-winged<br>– Light Weight/mass<br>– Surface area<br>– Shape |

## Curriculum mapping

| Design skills | Technical skills |
|---|---|
| **DA3** Identify and solve their own design problems.<br>**DB6** Combine ideas from a variety of sources.<br>**EB2** The positive and negative impact that products can have in the wider world. | **TK2** About the physical properties of materials. |

# WEEK 2: CONCEPTION

## Overview

Students start learning by mimicking what they have observed to make very basic objects which use the wind. In doing so, they start to use recognised design techniques to expand their ideas and apply them in new ways.

## Resources

Measuring equipment (time, distance and mass)

Card, paper, glue, tape

Dandelion/bulrush seeds (possibly poppy heads)

## Useful references

Biomimicry.net

## Planning

| Learning objectives | Teaching and learning activities |
| --- | --- |
| Experience and apply creativity techniques such as biomimicry as a design tool. | Students in their teams are challenged to:<br>– Create a design to replicate the action of one chosen seed using basic materials.<br>– Test/evaluate designs by dispersing from a consistent height and measuring the distance their designs travel. Their performance can be compared with that of the natural seeds tested earlier.<br>– Students produce a table of their test results together with the dispersal methods (e.g. gliding, parachuting, rotating/helicoptering etc.). |
| Describe applications of airflow for practical effects. | The students' next task is to apply their experiences to consider ways that wind or air can be useful for humans to transport people or objects. They should use the table they have produced to help guide their thinking. |
| Understand a range of distinct ways air/wind can be used to move things.<br>Analyse advantages and disadvantages of identified applications. | Each team should identify at least four potential applications for movement of people or objects. No visual prompts/research should be used at this stage, to avoid fixation on 'easy answers'.<br>Teams present applications they have identified. These could be: Kites, gliders, yachts, land yachts, parachutes, balloons, powered aircraft, kiteboards, quadcopters, windmills or wind turbines.<br>A 15-minute Q&A session can be used to add to the list and fill in any knowledge gaps.<br>Students usually identify numerous possible applications.<br>If the school's resources or curriculum dictate a limit to the scope of this project, now is a good time for teachers to negotiate a set of scenarios. These could focus, for example, on wind-powered applications in just one of the following elements: air, land, sea or energy use. |

# WEEK 2: CONCEPTION CONTINUED

## Curriculum mapping

| Design skills | Technical skills |
|---|---|
| **DA6** Understand how to reformulate design problems given to them.<br>**DA7** Work confidently within a range of relevant domestic, local and industrial contexts.<br>**DB7** Use a variety of approaches, for example biomimicry and user-centred design, to generate creative ideas and avoid stereotypical responses.<br>**EA3** Select appropriate methods to evaluate their products in use and modify them to improve performance. | **TK1** How to classify materials by structure. |

# WEEK 3: DEVELOPMENT

## Overview

By this stage, students have generated some ideas. They now examine these ideas in context by carrying out basic secondary research. They apply evaluative techniques to help them identify one idea which they conclude has the most potential for further experimentation.

## Resources

Sketching materials

CAD software and 3D printer (if available)

Paper

Silk-type textiles

String

## Useful references

Natural History Museum build your own wind turbine
www.nhmshop.co.uk/build-you-own-wind-turbine

## Planning

| Learning objectives | Teaching and learning activities |
|---|---|
| Understand the need for evidence as a basis for judgements.<br>Select and use appropriate research techniques, sources and processes. | Students carry out individual research into their group's potential ideas. This maximises information and knowledge in the group and provides individual evidence for each student.<br>Students will carry out mainly secondary research on background information, similar ideas and key features to support their ideas. |
| Analyse, judge and evaluate prototype products or processes using evidence. | Students should bring the key points of their individual research back to their groups. Depending on the age/maturity of the cohort, students may either share their findings informally (year 9) or be required to share two interesting features for each idea (year 7). |
| Appraise and make judgements on the range of potential solutions. | Students will now have to carry out an evaluation, using their research findings, to choose one idea to take forward as their design challenge. The selected design challenge should answer three evaluative questions:<br>– Is it different?<br>– Is it better?<br>– Would people use it? |

# WEEK 3: DEVELOPMENT CONTINUED

| | |
|---|---|
| Implement planning and teamwork to meet deadlines. | Student groups work on a rapid (30-minute) initial prototype to create a 3D visualisation of their design idea.<br>Each student creates individual design sketches for their design portfolio. |
| Identify, articulate and negotiate skills needs. | **Masterclasses**<br>At this stage, student groups have decided on and modelled their intended design creations.<br>Teachers and students should discuss these design ideas and agree the skills needed to complete more detailed prototypes.<br>Teachers may anticipate these needs according to their local circumstances and their plans for coverage of any gaps in the national curriculum. Masterclasses should be used accordingly, with the negotiated approach to skills needs ensuring they are both relevant and in context.<br>Masterclasses could cover:<br>– Classification of materials<br>– Electronic circuits<br>– Textile sources<br>– Making adjustments to the settings of equipment<br>– Performance of structural elements<br>– Joining techniques<br>– CAD/CAM |

## Curriculum mapping

| Design skills | Technical skills |
|---|---|
| **DA2** Use research, including the study of different cultures, to identify and understand user needs.<br>**DB5** Use specifications to inform the design of innovative, functional and appealing products that respond to needs in a variety of situations.<br>**DB8** Decide which criteria clash and determine which should take priority.<br>**DB10** Produce 3D models to develop and communicate ideas. | **EB7** New and emerging technologies.<br>**MB6** Recognise when it is necessary to develop a new skill or technique. |

# WEEK 4: DEVELOPMENT AND REALISATION

## Overview

Students are expected to have identified and acquired the skills they need to turn their ideas into made objects. As young designers and potential engineers, they need to plan how to use their time, skills and techniques to achieve functional prototypes in a limited time.

## Resources

Hand tools, saws, drills, sanders and joining devices (screws, bolts, nuts, clamps etc.)

3D CAD software/3D printer/laser cutting (if available)

Shaping and sanding equipment

Input from science and maths departments (lift and drag, area of circles, π etc.)

Multimeters

Design engineering and iteration (page 24)

## Planning

| Learning objectives | Teaching and learning activities |
|---|---|
| Master technical skills required to enable making and experimentation with a sufficient degree of precision.<br><br>Understand sequences of actions so that the making of the planned prototype is not held up or interrupted. | Groups initiate the designing and building of their prototype using air and movement. The purpose of the prototype is to demonstrate the functions of their design idea rather than aesthetics or surface finishes, unless they are relevant (e.g. if they affect lift or drag).<br><br>Students have limited time for the making phase. They will make a basic production plan by studying their sketches and initial prototype and agreeing tasks for each group member. Each stage of the creation of the prototype should be captured as a design record, using moving or still images and sketches. |
| Consider, revise and amend plans to overcome problems or incorporate improved methods. | Students will be making prototypes under time pressure. Things will fail, and mistakes will be made. Evaluation at this stage will enable students to use failures as the inspiration for development and further iteration of their design prototype.<br><br>Refer students to **Design engineering and iteration** (page 24) to help them understand the importance of iteration to improve their designs. |

# WEEK 4: DEVELOPMENT AND REALISATION CONTINUED

## Curriculum mapping

| Design skills | Technical skills |
|---|---|
| **DB3** (depending on school resources) Use 3D CAD to model, develop and present their ideas.<br>**EA3** Select appropriate methods to evaluate their products in use and modify them to improve performance. | **TK8** How to make adjustments to the settings of equipment and machinery.<br>**TK19** Understand the performance of structural elements to achieve functional solutions.<br>**TK20** Understand how more advanced mechanical systems used in their products enable changes in movement and force.<br>**MA4** Make simple use of planning tools.<br>**MA6** Match and select suitable materials considering their fitness for purpose.<br>**MA7** Select appropriately from specialist tools, techniques, processes, equipment and machinery, including computer-aided manufacture. |

# WEEK 5: REALISATION

## Overview

While students are refining the precision and accuracy of their prototypes, they apply the evaluative skills they have learnt to decide on iterations to their designs. They also experience working in teams under pressure.

## Resources

Resources required are the same as in week 4. Additional resource needs at this stage depend on the prototypes, as negotiated with teachers. They may include the following, but each student group's needs will be different:

- Measuring equipment
- Accelerometer
- Strain gauge

## Planning

| Learning objectives | Teaching and learning activities |
|---|---|
| Understand that iteration is a cyclic, not a linear, process.<br>Develop understanding of the use of systematic evaluation in an iterative process. | Groups conduct and record tests on their developing designs through each improvement. They should show links between early and late iterations through tests and evaluation. This evaluation should also include references back to the initial design idea and the evaluative questions:<br>– Is it different?<br>– Is it better?<br>– Would people use it? |
| Choose most effective design methods to achieve functionality.<br>Communicate effectively using a range of methods. | Groups' final iterations should incorporate sufficient accuracy to function in final demonstrations and testing.<br>Students create sketches and drawings to illustrate key features and components. |

## Curriculum mapping

| Design skills | Technical skills |
|---|---|
| **DA9** Take creative risks when making design decisions.<br>**DB9** Develop and communicate design ideas using annotated sketches.<br>**EA2** Actively involve others in the testing of their products.<br>**EA5** Test, evaluate and refine their ideas and products against a specification, taking into account the views of intended users and other interested groups. | **MA5** Communicate their plans clearly so that others can implement them.<br>**MB5** Adapt their methods of manufacture to changing circumstances. |

# WEEK 6: PRESENTATION

## Overview

The students' presentations of their ideas and prototypes are more than just a demonstration. This presentation is intended to also be a final testing session, where the robustness and functionality of their designs can be established.

## Resources

Top tips from Dyson engineers: Giving presentations (page 26)

Top tips from Dyson engineers: Providing peer feedback (page 27)

Appropriate setting for presentation and demonstration of student prototypes.

## Planning

| Learning objectives | Teaching and learning activities |
|---|---|
| Present, assess and justify progress and achievement. | Students prepare a presentation. This should demonstrate the design challenge, the design process they have followed, the key features and the functionality of their innovative design idea. |
| Communicate design ideas clearly and concisely.<br>Justify prototype in terms of fitness for purpose, methods used and performance.<br>Demonstrate accuracy and sufficient structural integrity of prototypes to operate and be tested on presentation day.<br>Understand that successes and failures can inspire creative design ideas. | The presentation format can be flexible but, given that the project theme is about movement, active presentations are likely to work best.<br>These can take the form of final testing sessions where student prototypes can be tried out inside or outside school, and where actual performances can be measured against predictions.<br>Student groups should be able to identify the outstanding successes and failures they have experienced, and also the technical skills they have gained during their design journey.<br>Refer students to **Top tips from Dyson engineers: Giving presentations** (page 26) and **Top tips from Dyson engineers: providing peer feedback** (page 27). |

## Curriculum mapping

| Design skills | Technical skills |
|---|---|
| **DB10** Produce 3D models to develop and communicate ideas.<br>**DB11** Use mathematical modelling to indicate likely performance before using physical materials and components, for instance when developing circuits or gearing systems.<br>**DB12** Give oral and digital presentations and use computer-based tools. | **TK16** Use learning from science to help design and make products that work. |

# STUDENT WORKSHEETS

# DESIGN ENGINEERING AND ITERATION

Design engineers are problem-solvers. They research and develop ideas for new products, and think about how to improve existing products.

Everything around you has been designed, from the smart phone in your pocket to the pen in your hand. Design engineers work on lots of different products. Their day-to-day job is varied but centres around the design process. Tasks may include brainstorming, sketching, computer-aided design (CAD) or prototyping new ideas.

An important design process is iteration. This is the repetitive method of prototyping, testing, analysing and refining a product.

Consider Dyson's vacuum cleaner tools.

Dyson engineers noticed that the spinning action of the brush bar on Dyson's Carbon Fibre Turbine Head could cause hair or other long fibres to wrap around the bar, slowing it down or stopping it altogether.

Instead of ignoring this problem, Dyson engineers set out to design a solution. The design brief: Create a cleaner head that doesn't tangle hair or fibres.

Design engineers thought about the fact that rubbing hair in a circular motion creates a ball – easy to suck up and no tangles. With this theory in mind, they tested dozens of ways to simulate the circular motion. The result was two counter-rotating discs, each with sturdy bristles, enclosed in polycarbonate casing. The spinning discs ball the hair, then it is sucked straight into the vacuum cleaner bin. Hygienic – with no mess.

Iterative design processes result in better solutions and better technology.

**Repeat:**

1. Explore
2. Create
3. Evaluate

Regular brush bar.
Tangles.

Counter-rotating discs.
No tangles.

# MEET THE DYSON ENGINEERS

**Laura**
Design Engineer at Dyson

I found engineering through a combined enjoyment of art and maths. While I loved both, I didn't want to spend my time solely doing one. Engineering is a great combination of the two, with the logic of maths but the creativity of art. I wasn't aware of engineering as a potential career option until I applied to the Arkwright Scholarship as a teenager. At this point, I realised how many different engineering specialities there were to choose from – some of them technical, but some much less so than I had originally thought. The wide range of possibilities available through engineering became clear, and I saw the potential to make a real difference to the world. Dyson gives me the opportunity to be creative, whilst still being backed up by the logic of maths and physics.

**George**
Senior Design Engineer at Dyson

When I started secondary school, my Grandfather took me to Coventry Transport Museum and I saw Thrust SSC (the current holder of the World Land Speed Record and first to break the sound barrier). I was fascinated by its design and aerodynamics. I started researching engineering feats: The Shinkansen (Bullet) train, Concorde, International Space Station and more. I wanted to find out everything about them – how they work and what technologies they use. I can't think of any other profession that would give me the freedom to design and build multiple prototypes, to learn through failure and success, and to create iterative changes and see their effects first-hand. Engineers are always pushing the limits, finding new materials, technologies and methods to solve problems that are important to society. I wanted to be a part of that community, inspiring through STEM (and design!) and making a difference with my career.

# TOP TIPS FROM DYSON ENGINEERS

## Giving presentations

Laura Reed, Design Engineer at Dyson

Being able to present your work is an incredibly valuable skill for engineers. It allows engineers to explain how their ideas have developed and how their prototype will function. This then prompts feedback from the stakeholder on the work done so far. This guide will help you to present your work successfully to your stakeholders.

| Tip | Actions | Examples |
|---|---|---|
| Make your presentation attention-grabbing. | Welcome your stakeholders with a thank you.<br>State how you would like to deal with questions.<br>Maintain eye contact and smile. | 'Hello, welcome and thank you for joining us today!'<br>'We would like you to ask questions at the end of the presentation.' |
| Clearly state the purpose of your presentation. | Summarise the aims of your presentation in one or two sentences.<br>Your presentation must make sense to anyone who watches it. | 'We're going to present our prototype…'<br>'It solves the problem in this way…' |
| Be concise. | Follow a simple structure.<br>Organise who is speaking and when. | We chose this **design** because…'<br>'We used these **techniques** to develop it…'<br>'Our prototype **functions** in this way…' |
| Be confident. | Practice beforehand to ensure you are clear on what you want to say and can deliver it with confidence.<br>Speak loudly and clearly.<br>Believe in your design and prototype.<br>If you are using PowerPoint, use pictures rather than words to make sure you are talking to your stakeholders, instead of reading your PowerPoint out loud.<br>Keep on topic!<br>Time yourself, practising your presentation to make sure you don't overrun. | |

# TOP TIPS FROM DYSON ENGINEERS

## Providing peer feedback

George Oram, Senior Design Engineer

Giving and receiving feedback is incredibly valuable for engineers. Constructive criticism offers insight that the designer may not have considered and provides direction for future iterations. This guide will help you prepare your insights and suggestions so that they are well received and highly valuable to your design team.

| Tip | How to... | Examples |
|---|---|---|
| Ask questions! | Prepare as many questions as possible.<br>Make sure to begin by praising the team for their efforts.<br>If you are struggling, think about how you would do things differently.<br>Ask what their next steps are. | **Don't:**<br>'We don't think the prototype works very well.'<br>**Do:**<br>'Please could you explain to us how your prototype functions? Have you thought about another way it could function?' |
| Put yourself in their shoes. | Think about how and why they may have done things a certain way. | **Don't:**<br>'You should have done it like…'<br>**Do:**<br>'Why did you choose to do…?' |
| Prioritise your feedback. | Focus on the most pressing issues first.<br>Don't look to show up the designers. Instead, ask questions and offer solutions. | **Don't:**<br>'What colour is the on/off button going to be in the final prototype?'<br>**Do:**<br>'The user said she can only carry up to twenty pounds at a time, so how can you make your design lighter?' |
| Feedback should be informative and educational. | Give specific examples and, when possible, context for what you like or dislike about a design and why.<br>Use the word 'because'. | **Don't:**<br>'I don't like this.'<br>**Do:**<br>'I don't think this will work because…' |
| Don't focus on only the positive or the negative. | Be sure your critique of the team's work is balanced and sensitive. | **Don't:**<br>'This looks ugly' or 'this looks good.'<br>**Do:**<br>'I like the changes you made to the handlebars, but I think a different material might make the grip more comfortable and look better.' |
| Provide constructive criticism. | Don't use words like 'always,' 'never,' 'best,' 'worst,' etc. | **Don't:**<br>'This feature will never work.'<br>**Do:**<br>'The Wi-Fi-activated alarm wouldn't work well, because it means you need to have access to Wi-Fi at home, which some people don't.' |