THE JAMES DYSON FOUNDATION

JOURNEY TO SCHOOL

Design and Technology scheme of work

Key stage: 3

Duration: 6 weeks (approximately 12 hours)

Project overview: Design a prototype that solves a problem encountered on the journey to school.

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 SCHOOLS PROEJCT

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 carry out a project that places design firmly within a context. Teachers will recognise the opportunities for their students to explore some deep learning skills, while they tackle tasks which draw on their own experiences and concerns.

Students will be asked to tackle problems or frustrations which they identify with in relation to their own, or others', journey to school. This makes the introduction of this project relatively straightforward, because the context is relevant to every student.

Given the nature of the context, it is likely that most students will readily identify a number of problems or frustrations about their own journey to school. It is important that they recognise diversity – discussions about the journey to school should acknowledge that it will not be the same for everyone, because of factors such as distance, method of transport, mobility, home circumstances and personal perceptions. Students may want to consider challenges that others face, rather than their own needs.

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 which 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. If this is an issue, or if the teacher wants to channel the project in a particular direction, the scheme of work provides a range of specific scenarios for investigation. For some students, this can kick-start a process of ideas which leads on to design thinking.

If scenarios are used, they should still allow for students to invent their own solutions from the given areas of interest. The scenarios are backed up by easily available research, which indicates the range and severity of challenges.

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.

TEACHER'S NOTES CONTINUED

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.

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 is aimed at year 9 students, but it can be used successfully in years 7 and 8. If it is used in years 7 or 8, allowances should be made for these students' relative maturity and capacity for autonomous work.

The project is designed to overlap with the subject content requirements of the D&T GCSE, so that the transition to KS4 work is natural, progressive and logical.

'Journey to school' is structured to steer students and teachers through a strong iterative journey. Sufficient time should be allowed for planning, monitoring, testing and evaluating. Students should carry out these tasks to provide the evidence they need to make their design and technical decisions. Crucially, there must also be time available for students to reflect and refine their ideas through the stages of the project, so that failures can become learning opportunities.

Students are likely to highlight a good range of challenges from their own experiences, including some which have not been anticipated. To keep the project manageable, teachers may find that it helps to shortlist a range of potential problems associated with the journey to school. In addition to students' personal experiences, there is a good range of published information about possible dangers and challenges.

By the end of the project, students should have experienced a range of design possibilities and experimented with these to produce a range of early prototypes. This will help them to decide which solutions are most promising. They should be expected to explain and demonstrate how their prototypes work.

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 & techniques
- Evaluate – own ideas
- Evaluate – existing products
- Technical knowledge – making things work

OVERVIEW CONTINUED

Success criteria		
All	**Most**	**Some**
Make systematic observations.	Draw appropriate conclusions from observations.	Make connections and analytical commentaries from detailed observations.
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 and make a key contribution to achieving outcomes in a given time frame, taking account of the needs of all team members.
Carry out primary and secondary research.	Use research to inform design decisions.	Use research from a range of appropriate sources to develop innovative design decisions.
Create a design brief.	Meet the main objectives of a design brief.	Revise and adapt design briefs and solutions in the light of evaluation and new evidence.
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.
Identify, justify and understand the technical skills required to carry out their project.	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.
Identify, justify and understand the technical skills required to carry out the project.	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 set a challenge to improve aspects of their journey to school. They complete a range of activities to put their journey into a design context. They are put into teams to extend their individual perceptions of risks and dangers.

Resources

Sticky notes

Current news sources

Useful references

Boredpanda 'Journey to school': boredpanda.com/dangerous-journey-to-school/

DFT National Travel Survey – Travel to School 2017: www.gov.uk/government/publications/road-injury-prevention-resources-to-support-schools

PHE Road Injury Prevention, Safe Active Travel 2016: gov.uk/government/road-injury-prevention-resources

The Royal Society for the Prevention of Accidents (RoSPA): rospa.com/school-college-safety/teaching-safely/

Student survey in school (or student council)

Planning

Learning objectives	Teaching and learning activities
Understand scope of design challenge.	Teacher-led introduction to the theme 'journey to school.' Students are encouraged to describe their journeys to school. For example, the 'best part,' 'worst part,' 'most embarrassing'. Provide stimulus material to promote discussion e.g. **Boredpanda 'Journey to school' webpage.**
Observe and record events relevant to school journey.	Students make a personal diary of their own journey to school on one day. This should cover the whole journey, from leaving home to arriving in the first classroom of the school day. **Table continued overleaf**

WEEK 1: CONCEPTION CONTINUED

Categorise information gained from research to initiate design thinking.	Students use whiteboard or alternative to construct a wall display of key good or bad factors associated with their diary records. **Note**: A sticky note display is perfectly adequate, although mixed media can be used if available. The whole group makes contributions of positive and negative aspects of the journey to school. There should not be any 'wrong' contributions. They can be personal to students, but do not have to be. Teachers can also make contributions. Students are formed into groups of three to four. Student groups consider the wall of good and bad factors and identify five to seven main risks and dangers. Some additional risks may be identified through the session.
Understand and describe differences in scale or severity of observed events.	Student groups present a five-minute description of identified risks or dangers, explaining their initial perception of the severity, frequency and scale. Students may find some risks are experienced by all, many or few. **Note**: The teacher will need to manage sensitivities, safeguarding and confidentiality issues.
Discuss, moderate and give or receive feedback.	Students discuss presentations and provide feedback highlighting any further areas for discussion.

Curriculum mapping

Design skills	Technical skills
DA2 Use research, including the study of different cultures, to identify user needs. **DA5** Research the health and wellbeing, cultural, religious and socio-economic contexts of their intended users.	

WEEK 2: CONCEPTION

Overview

Students start to look at design techniques to help them to tackle their challenge. They work with evaluative methods to learn that they can apply logic to problems as a way to uncover potential solutions.

Resources

- Sticky notes
- Tablet
- Camera
- Notebook
- Whiteboard

Planning

Learning objectives	Teaching and learning activities
Understand how evidence can enhance anecdotal information. Seek out, identify and record appropriate evidence relating to key risks and dangers. Record evidence and its sources.	Students individually research their group's key risks or dangers. Research should draw on as full a range of secondary sources as possible. As a minimum, the frequency, scale and impact of the events should be covered.
Understand complex sources of information. Carry out systematic analysis of information. Make decisions and judgements based on a balance of evidence and personal feelings.	Student groups create an evaluation matrix where they can share their identified risks and dangers. The matrix should include: – Scale of problem (how widespread, geographically or numerically) – Frequency of events (locally or nationally) – Impact (severity or seriousness of events) – Who is affected (target groups) From the matrix, students can identify the highest priority problems that they want to tackle. Students may categorise them on a 'red/amber/green' scale of severity. **Note**: At this stage, you will be aware of the main problems your students are associating with the journey to school. If you wish to limit the number and scope of challenges, now is the time to work with students to categorise them under headings, such as: Traffic, strangers, bullying, theft or fear of the dark. However, students are usually clear from their matrix evaluations where they want to concentrate their design efforts.
Consider evidence and make conclusions based on agreed criteria.	Groups use their evaluation matrix to identify and agree on one problem that they will work as a team to solve.

WEEK 2: CONCEPTION CONTINUED

Curriculum mapping

Design skills	Technical skills
DA5 Research the health and wellbeing, cultural, religious and socio-economic contexts of their intended users. **DA6** Understand how to reformulate design problems given to them.	

WEEK 3: DEVELOPMENT

Overview

Students apply design ideas and techniques to support creativity. They start to 'think with their hands' by making very basic initial prototypes as a way to generate open-ended solutions.

Resources

Card, paper, glue, tape, textiles

3D printing, if available and appropriate

Useful references

Ramon Vullings, Igor Byttebier: 'Creativity Today':
slideshare.net/ramonvullings

Planning

Learning objectives	Teaching and learning activities
Use and develop teamwork skills by defining team roles and responsibilities and understanding effective communication.	Groups create at least six ideas to reduce or eliminate their selected problem.
Apply creativity techniques to develop open-ended solutions.	Students should be encouraged to use a wide range of creative techniques. These should avoid fixation on given solutions. Consider the following creative techniques: – Analogy – Biomimicry – Attributes analysis – Mind mapping – Morphological analysis – COCD Box analysis – NUF testing Teachers should avoid references to existing solutions or given examples. There is also an opportunity for a masterclass in creativity and innovation techniques.
Discuss, analyse and reach conclusions on selected potential outcomes.	Students agree a shortlist of at least three ideas to take forward for early prototyping. Students make their first three prototypes. This is an experimental phase, where quick and approximate prototyping helps students to understand the potential of their ideas through making. The making process should be rapid and use readily available materials and techniques. Prototypes should give an indication of their intended functions.

WEEK 3: DEVELOPMENT CONTINUED

Adapt, refine and develop initial ideas into one potential solution through design criteria.	Students use early prototypes to inform their iterative design process. They will need to narrow down their three design ideas to one solution, which they will take forward as their iterative development. Students apply simple design criteria to the prototypes: – Will it be wanted by users? – Is it novel? – Is it better? – Could it function? Students may find the answers to the design criteria from within their own group. However, if time allows, they may make more secure decisions if they can discuss their ideas with their peers or ask relevant professionals.

Curriculum mapping

Design skills	Technical skills
DA6 Understand how to reformulate design problems given to them. **DB7** Use a variety of approaches, for example biomimicry and user-centred design, to generate creative ideas and avoid stereotypical responses. **DB9** Develop and communicate design ideas using annotated sketches. **EA3** Select appropriate methods to evaluate their products in use and modify them to improve performance. **EA5** Test, evaluate and refine their ideas and products against a specification, taking into account the views of intended users and other interested groups.	**TK19** Understand the performance of structural elements to achieve functioning solutions.

WEEK 4: DEVELOPMENT AND REALISATION

Overview

Students start to think like design engineers. They define their tasks and identify ways to carry them out individually and as team members. They master skills as a means to a productive end, giving motivation and context to their technical learning.

Resources

This will depend on prototypes and systems identified to solve problems. It is useful to anticipate some likely ideas and their associated resource needs. For example, warning systems will probably require a selection of electronic sensors, programmable controllers and outputs such as lights, buzzers and motors. Design ideas that use worn protective devices may require a range of natural and synthetic textiles.

CAD software, if possible

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

Specialist prototyping equipment (if available), such as 3D printing, router and laser cutter

Planning

Learning objectives	Teaching and learning activities
Identify, select, prioritise and justify the group's needs to achieve objectives.	Student groups know the one prototype they intend to create to solve their journey to school problem. Student groups identify the additional skills they require to develop their functional prototype and negotiate their skills needs with teachers. This process will be supported or guided by teachers, depending on the maturity level of students.
Define knowledge requirements and recognise functional aspects of prototypes which will not succeed without new knowledge and understanding. Classify knowledge into areas that best support design developments – e.g. is it better to learn CAD rather than handmake a prototype?	**Masterclasses** Masterclasses should be timetabled to equip groups with the knowledge and skills to complete their design solutions. Teachers may anticipate these needs according to their local circumstances and their plans for coverage of any gaps in the national curriculum. Masterclasses might include: – Classification and properties of materials – Selection of materials – Performance of structures – Mechanical systems – Use of 2D and 3D design software – Electronic sensing, control and output systems – Use of specialist equipment
Classify and understand a broad range of available materials to achieve functionality.	Teams negotiate with teachers on the materials and components they require.
Analyse required tasks and be able to plan activities to meet deadlines.	Students decide roles and jobs within their teams to achieve their outcomes in the time available.

WEEK 4: DEVELOPMENT AND REALISATION CONTINUED

Understand basic work flows, such as ordered sequences of actions, so that the making of the planned prototype is not held up or interrupted. Referring to evidence, demonstrate team needs in terms of time, skills and resources.	Groups initiate the designing and building of their prototype to demonstrate the functions of their design solution. They will have a deadline of two weeks to make, trouble-shoot and refine their designs.

Curriculum mapping

Design skills	Technical skills
MB3 Use CAD/CAM to produce and apply surface finishing techniques, for example using dye sublimation. **MB10** Exploit the use of CAD/CAM equipment to manufacture products, increasing standards of quality, scale of production and precision.	**TK1** How to classify materials by structure. **TK2** About the physical properties of materials. **TK19** Understand the performance of structural elements to achieve functioning solutions. **TK20** Understand how more advanced mechanical systems used in their products enable changes in movement and force. **TK9** How to apply computing and use electronics to embed intelligence in products that respond to inputs. **TK10** Make use of sensors to detect heat, light, sound and movement such as thermistors and light-dependent resistors. **TK11** How to apply the concepts of feedback in systems. **TK12** How to control outputs such as actuators and motors. **TK 13** How to use software and hardware to develop programmes and transfer these to programmable components. **TK14** How to make use of microcontrollers in products they design and manufacture themselves. **MA7** Select appropriately from specialist tools, techniques, equipment and machinery, including computer-aided manufacture. **EB7** New and emerging technologies.

WEEK 5: REALISATION

Overview

Students focus on making a functional prototype. They should constantly revisit the original brief and user needs.

Resources

Design engineering and iteration (page 24)

As in week 4, there will be requests for additional parts, especially if electronic systems are being developed. It can be useful to have a wider range of items available, especially sensors and output devices.

Planning

Learning objectives	Teaching and learning activities
Understand that iteration is a cyclic, not a linear, process.	Students should follow their plans through towards a functional prototype. At this stage, there can be intense pressure on teams to achieve the best version of the first solution they created. While students should be supported to work towards quality prototypes, they should also recognise that failures are part of any design process and may lead to fresh iteration. Refer students to **Design engineering and iteration** (page 24) to help them understand the importance of iteration to improve their designs.
Integrate design ideas in new ways to synthesise and support alternative solutions.	Students check their design objectives and revise design criteria, if necessary.
Calculate and categorise most effective methods to achieve functionality.	Teams will incorporate structural integrity and strength, development of materials choices and accuracy in their prototypes.
Evaluate and justify own performance against criteria.	As the final prototypes develop, groups check that their solution still meets the specific needs of users by reference to their original evaluation matrix.

Curriculum mapping

Design skills	Technical skills
DA9 Take creative risks when making design decisions. **DB5** Use specifications to inform the design of innovative, functional, appealing products that respond to needs in a variety of situations. **DB6** Combine ideas from a variety of sources.	**TK18** Understand properties of materials, including smart materials, and how they can be used to advantage. **MA5** Communicate their plans clearly so that others can implement them. **MA7** Select appropriately from specialist tools, techniques, processes, equipment and machinery. **MB6** Recognise when it is necessary to develop a new skill or technique.

WEEK 6: PRESENTATION

Overview

Students will present their prototypes as design solutions rather than as finished models. Their key tasks are to discuss how their new idea will function to overcome a problem and to describe the journey they have made as designers to achieve objectives.

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
Describe, explain and justify the group's realisation of a design solution to a real problem.	Students present their design solutions to their journey to school problem. Groups will require some time prior to their presentations to prepare their prototypes and set them up. The audience can comprise other students from the same year group, students from student councils and, if possible, some parents/carers. As the project theme is relevant to all students, presentations should be structured to provide time for significant constructive feedback to each team.
Communicate concisely and clearly key aspects of design in a limited time.	Student groups highlight their design journey in terms of the evaluation and iteration that has informed their final prototype, as well as the technical skills which have contributed to its functionality. Refer students to **Top tips from Dyson engineers: giving presentations** (page 26).
Respond to constructive feedback.	Students provide constructive feedback to presentations and take on feedback from peers. Students can refer to **Top tips from Dyson engineers: providing peer feedback** (page 27).

Curriculum mapping

Design skills	Technical skills
DB9 Develop and communicate design ideas using annotated sketches. **DB10** Produce 3D models to develop and communicate ideas.	

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.

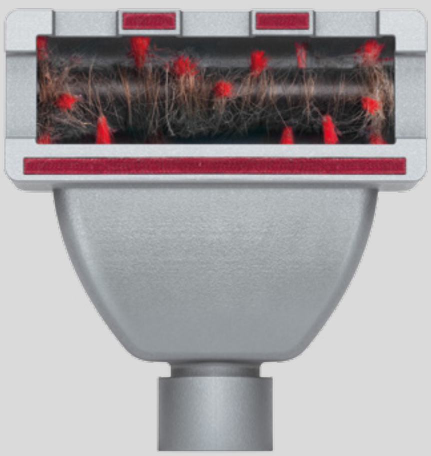
Design engineers thought about the fact that rubbing hair in a circular motion creates a ball – easy to suck up and no tangles. With this theory in mind, they tested dozens of ways to simulate the circular motion. The result was two counter-rotating discs, each with sturdy bristles, enclosed in polycarbonate 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.

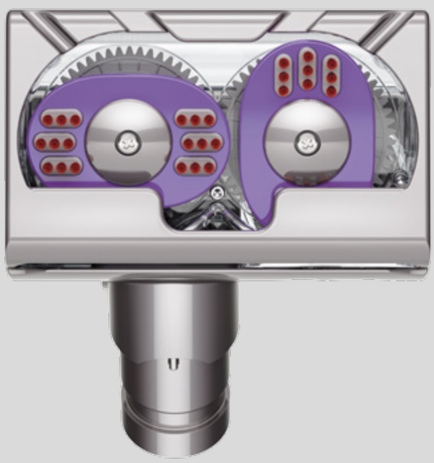
Repeat:

1. Explore
2. Create
3. Evaluate

Regular brush bar.
Tangles.



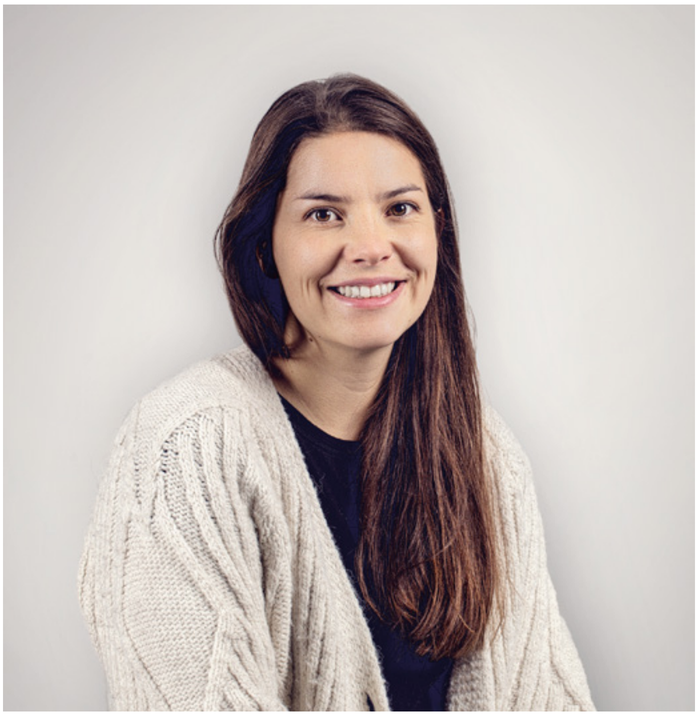
Counter-rotating discs.
No tangles.



MEET THE DYSON ENGINEERS

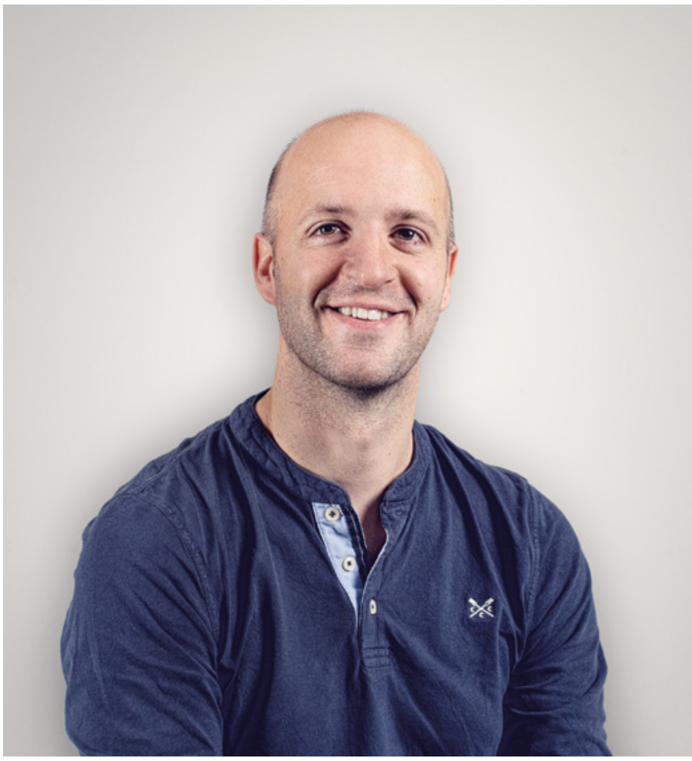
Laura
Design Engineer at Dyson

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, 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. State how you would like to deal with questions. Maintain eye contact and smile.	'Hello, welcome and thank you for joining us today!' '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. Your presentation must make sense to anyone who watches it.	'We're going to present our prototype…' 'It solves the problem in this way…'
Be concise.	Follow a simple structure. Organise who is speaking and when.	We chose this **design** because…' 'We used these **techniques** to develop it…' '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. Speak loudly and clearly. Believe in your design and prototype. 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. Keep on topic! Time yourself, practising your presentation to make sure you don't overrun.	

TOP TIPS FROM DYSON ENGINEERS

Providing peer feedback

George, 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. Make sure to begin by praising the team for their efforts. If you are struggling, think about how you would do things differently. Ask what their next steps are.	**Don't:** 'We don't think the prototype works very well.' **Do:** '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:** 'You should have done it like…' **Do:** 'Why did you choose to do…?'
Prioritise your feedback.	Focus on the most pressing issues first. Don't look to show up the designers. Instead, ask questions and offer solutions.	**Don't:** 'What colour is the on/off button going to be in the final prototype?' **Do:** '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. Use the word 'because'.	**Don't:** 'I don't like this.' **Do:** '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:** 'This looks ugly' or 'this looks good.' **Do:** '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:** 'This feature will never work.' **Do:** '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.'