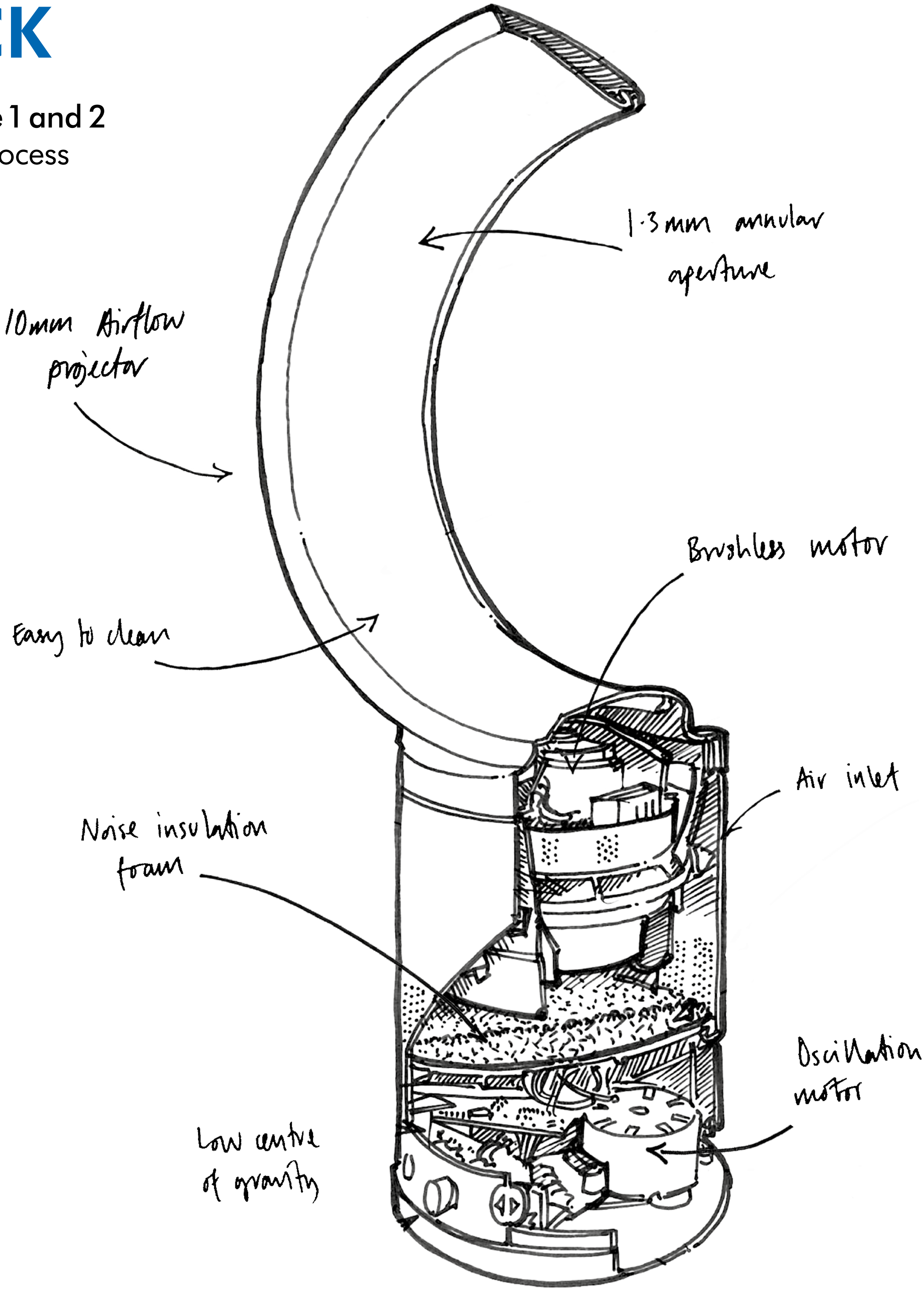
THE JAMES DYSON FOUNDATION

TEACHER'S PACK

Key stage 1 and 2

Design process



CONTENTS

You can find all the videos on our website:
jamesdysonfoundation.co.uk

INTRODUCTION

This teacher's pack will introduce your students to the design process, helping to develop their analytical skills.

This teacher's pack accompanies the Design Process Box. The Design Process Box includes a Dyson Air Multiplier™ fan as an example of an invention that solves an everyday problem. Students will learn about the fan's development using their engineering skills to redesign something that needs improving in the classroom.

Students will also learn what a design engineer is – spotting stereotypes and challenging preconceptions. The videos, which you can find on the James Dyson Foundation website, contain interviews with Dyson engineers to give an insight into the world of design engineering.

This pack contains five lesson plans and posters for your classroom. It also contains summary information for you, the teacher, explaining how the lessons relate to design engineering.

The Design Process Box is designed to support the curriculum for Design and Technology at both Key Stage 1 and Key Stage 2.

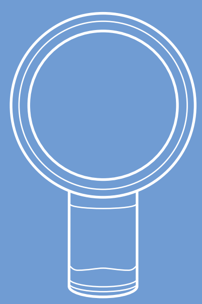
If you follow the lesson plans provided, students will:

- Use design criteria to inform the design of a functional product, aimed at a particular individual or group
- Generate, develop, model and communicate their ideas through discussion and prototyping
- Select tools and equipment to perform practical tasks
- Apply their understanding of how to strengthen, stiffen and reinforce structures
- Evaluate their ideas and products against their own design criteria and consider the views of others to improve their work.

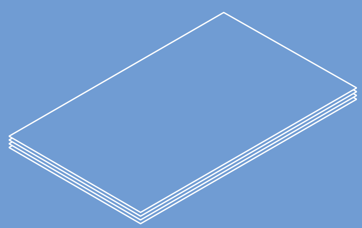
The Design Process Box can also be used to support learning in other subjects, including History, Literacy, Enterprise and Numeracy. Review the extension exercises on pages 36–37 to find out more.

What's in the box?

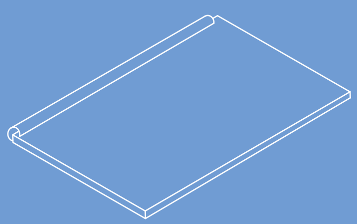
Please note: Ensure you keep the outer box for returning the Design Process Box, including the Dyson Air Multiplier™ fan, to the James Dyson Foundation.



A Dyson Air Multiplier™ fan



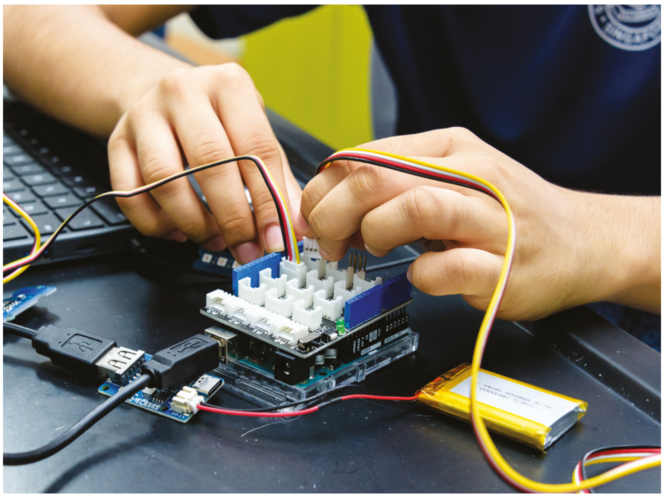
Informative posters for classroom walls

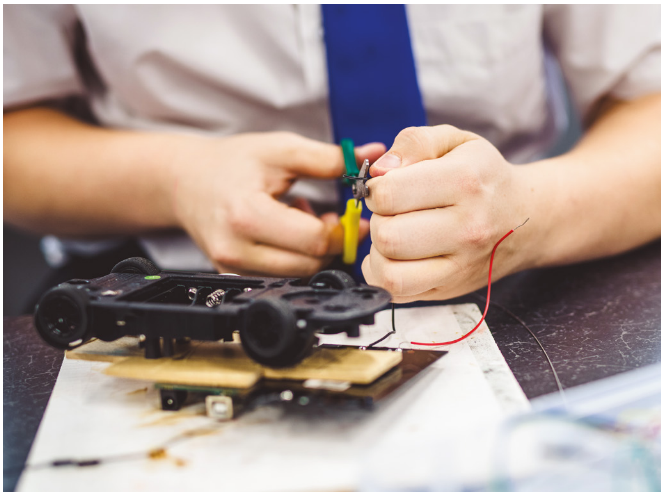


Teacher's pack

The James Dyson Foundation is Dyson's registered charity. Set up in 2002, it exists to inspire the next generation of engineers through educational resources, workshops and an international design competition.

"Young engineers have the passion, awareness and intelligence to solve some of the world's biggest problems. I set up the James Dyson Foundation to inspire the next generation of engineers with hands-on learning and experimentation, helping them to connect the theory they learn in the classroom with exciting and important engineering problems and solutions in the outside world."



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SECTION 01
WHAT IS A DESIGN ENGINEER?

Students will learn who Sir James Dyson is and how he came to be an inventor. They will also learn about the role of a design engineer.


dyson

SIR JAMES DYSON

Sir James Dyson was born in Norfolk in 1947. After studying Art and Classics at school, he went to the Royal College of Art (RCA). James studied many different types of design at RCA, but developed a real interest in design engineering. When he graduated in 1970, James joined an engineering company called Rotork. His first project was the Sea Truck, a high speed boat for use in the Royal Navy.

A few years later, James renovated his house. He became frustrated with his wheelbarrow – the narrow wheel meant it got stuck in the mud and was hard to balance, and cement stuck to the metal sides.

This frustration inspired James to develop the Ballbarrow. He replaced the small wheel with a large inflatable ball, making it easier to move. He also changed the material to lightweight, non-stick plastic. Thinking differently helped James to solve a design problem.

In 1978 James bought a new vacuum cleaner – the Hoover Junior. However, it didn't work as well as he'd hoped. As he vacuumed, the Hoover lost suction and didn't pick up the dirt. Taking it apart, he discovered that its bag was clogging with dust, causing the suction to drop.

One day, when James was out walking, he passed a factory. On its roof was a special system to separate dirt from the air and expel clear air – it was a cyclone.

This inspired James to try the same with his vacuum. He rushed home and built a mini cardboard cyclone – and it worked!

James persevered with his idea and after 5,127 prototypes, he produced the first bagless vacuum cleaner, known as the DC01.


Sea Truck


Ballbarrow

DC01 vacuum cleaner

CHARACTERISTICS OF DESIGN ENGINEERS AND INVENTORS

Frustration

Frustration can be seen as a bad thing, but for design engineers it can be the starting point for a really good idea. Identifying what frustrates you about an existing product can help you to make it even better. A successful and well designed product is something that is easy to use.

Sir James Dyson

James' frustration with the vacuum bag encouraged him to rethink it, and use a cyclone design instead.

Wrong thinking

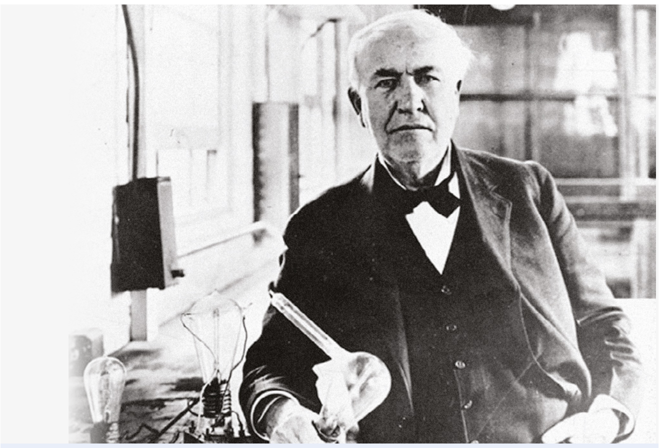
Wrong thinking is allowing yourself to think differently, not just going along with what everybody else thinks. Keeping an open mind can lead to a solution that no one has ever thought of before. It's about thinking your way around a problem, and seeing solutions that other people might not.

Alec Issigonis

To answer his brief of creating a small car that could still carry four adults, Alec decided to put the engine in the opposite way round, creating more room for other mechanical engineering.

Perserverance

A perfect design doesn't happen straight away; design is a process. When something doesn't work the first time, it's about sticking with it, making small changes, and making your design stronger. You have to learn from the things that went wrong, find out why and use that experience to make them better.

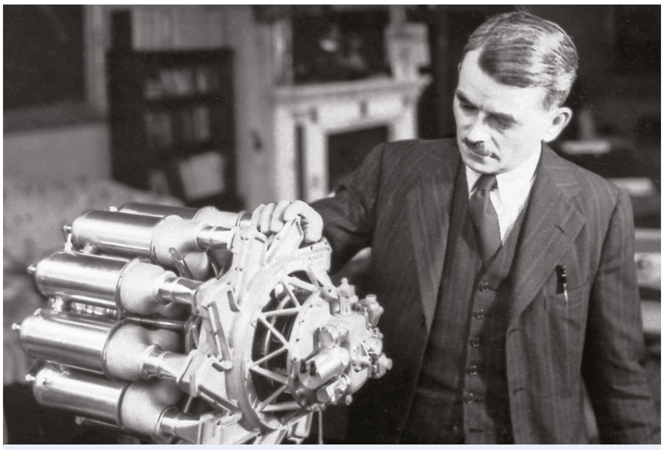


Thomas Edison

"I haven't failed, I've just found 10,000 ways that didn't work."

Underdog

If you're designing a new product, or improving someone else's, you will have to convince people that your product is better. You will have to explain your product clearly, and talk passionately about it. Design engineers need to be determined.



Frank Whittle

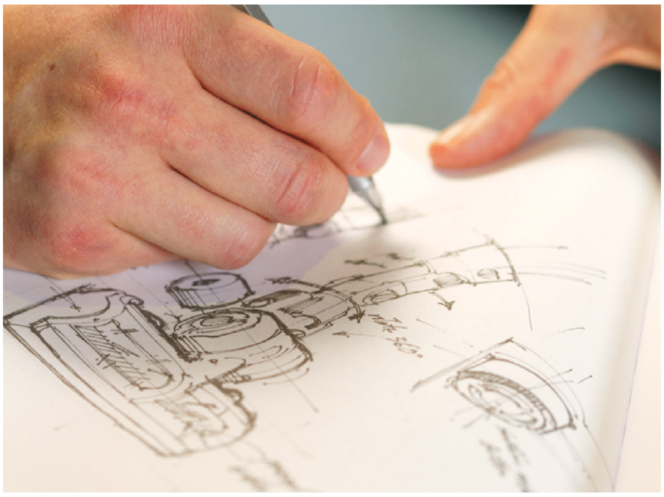
The Air Ministry turned down Whittle's idea for gas turbine driven propellers – so he patented the idea himself. The jet engine went on to revolutionise flight.

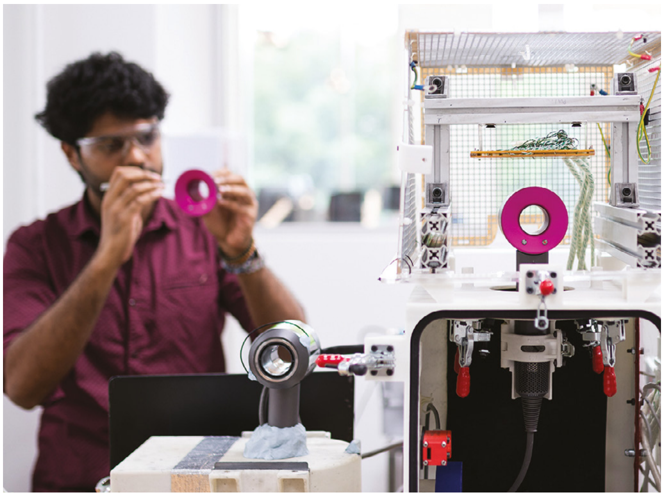
WHAT DO DESIGN ENGINEERS DO?

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 smartphone in your pocket to the pen in your hand. Design engineer's jobs vary from day to day but centres around the design process. Tasks may include brainstorming, sketching, computer-aided design or prototyping new ideas.

Design engineers work within the Research, Design and Development department at Dyson, known as RDD. It's a top secret department – only the engineers are allowed in.





LESSON 01
WHAT IS A DESIGN ENGINEER?

Duration: 1 hour
Resources: Pencils and paper, Poster: Real life engineers, Video: Sir James Dyson's Story, Video: Characteristics of a design engineer, Video: How I became a design engineer.

Learning objectives:

1. Understand what design engineers do and recognise stereotypes.
2. Improve knowledge of famous design engineers and inventors.
3. Recognise the characteristics that successful design engineers share.

What does a design engineer look like? (15 minutes)	
Learning objective	**Activity**
1, 2	Introduce the session and its objectives. Hand out pencils and paper. Ask the class to draw what they think a design engineer looks like. Prompt questions could be: – What do they wear? – Where do they work? – What do they use? Collect the drawings. Discuss any significant differences or common themes between the drawings. Explain that the class will redraw their pictures at the end of the project, to see how their ideas have changed. Put up **Poster: Real life engineers**.

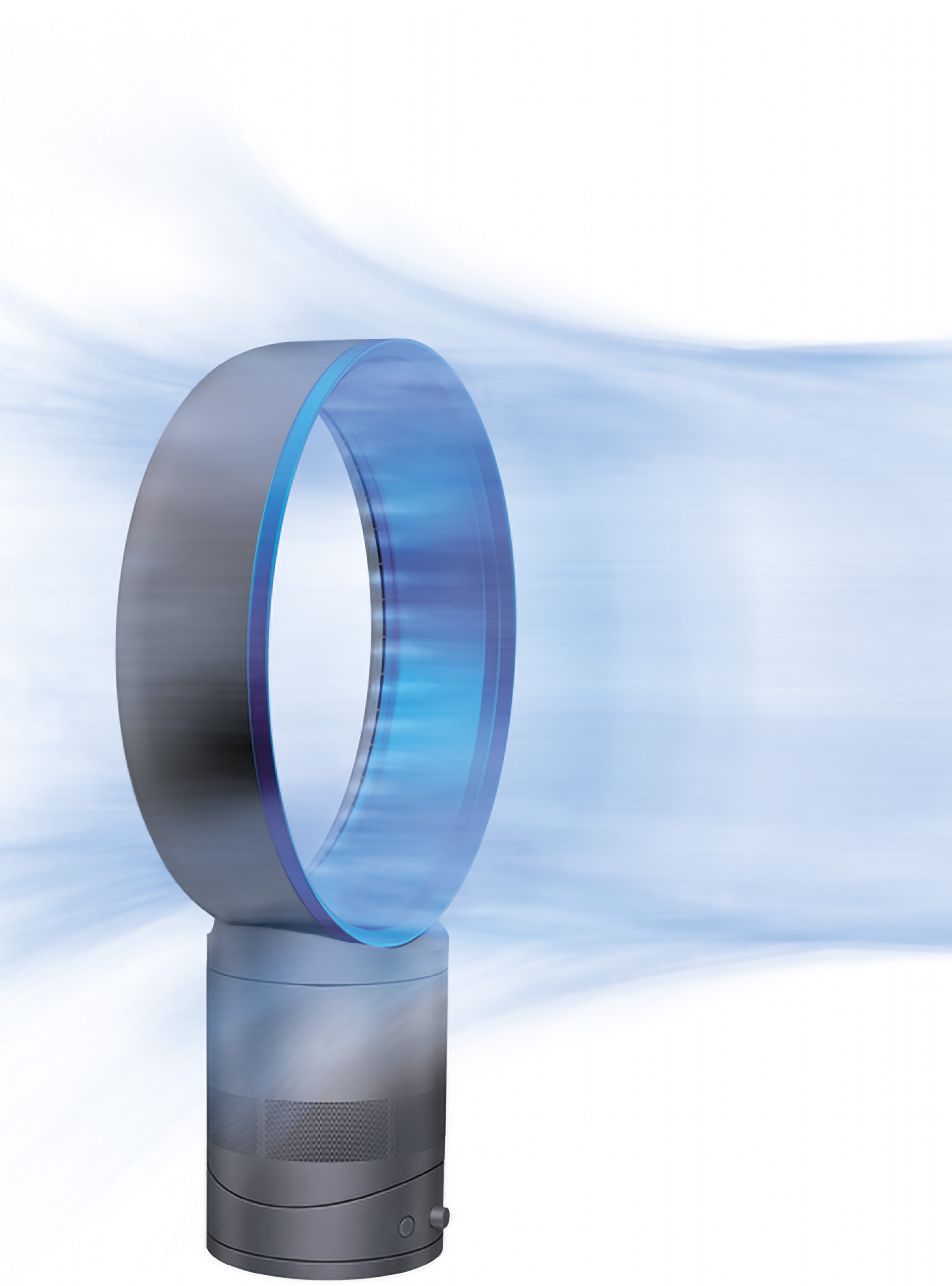
Characteristics of a design engineer (30 minutes)	
Learning objective	**Activity**
1, 2, 3	Explain that a design engineer is someone who designs inventions, and that everything they use in day to day life has been designed by someone. Take suggestions from the class of inventions and design engineers they know and record them on the board. Introduce Sir James Dyson using **Video: Sir James' Dyson Story.** As a class, discuss the characteristics that James showed when developing the bagless vacuum cleaner. List them on the board. Watch **Video: Characteristics of a design engineer**. Discuss the video. Were any of the characteristics surprising?

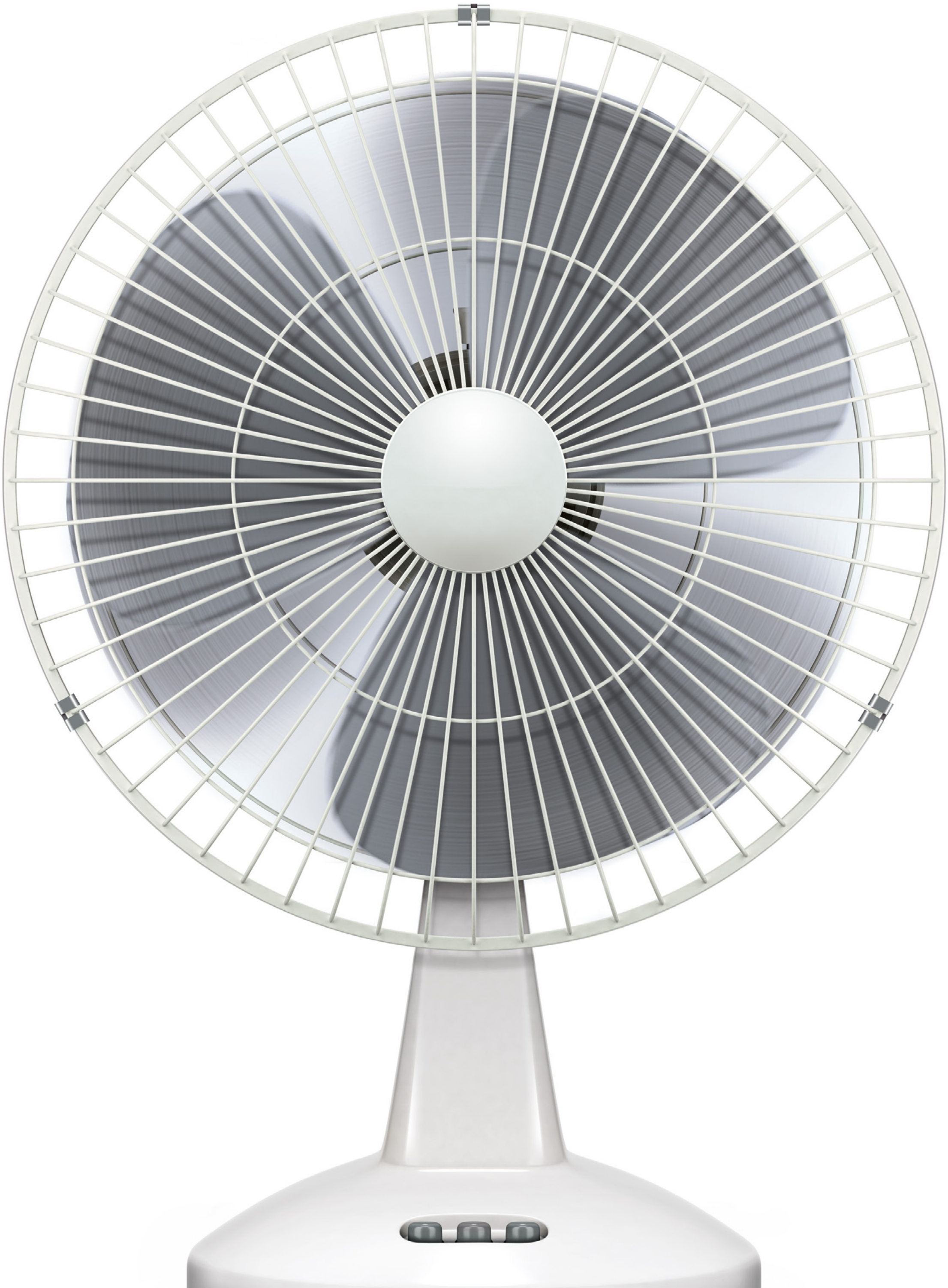
Real life design engineers (15 minutes)	
Learning objective	**Activity**
1	Watch **Video: How I became a design engineer**. In groups, discuss the following questions: – What did the design engineers enjoy when they were young? – What did the design engineers study at school? – What did the design engineers study at university? – What do the design engineers do day-to-day? As a class, ask the students to discuss what they think they would like and dislike about being a design engineer. Explain that they will have the chance to find out as they will be acting as design engineers to make their own invention.

SECTION 02
PRODUCT ANALYSIS

Students will learn how to develop critical analysis skills to redesign products that need improvement.

Students will also learn about the design process behind the Dyson Air Multiplier™ fan, including the engineering principles that were considered in its development and how the fan works.





Identify the problem

THE SOLUTION

Since 1882, electric fans have relied on spinning blades to cool people. But fast-spinning blades can be dangerous.

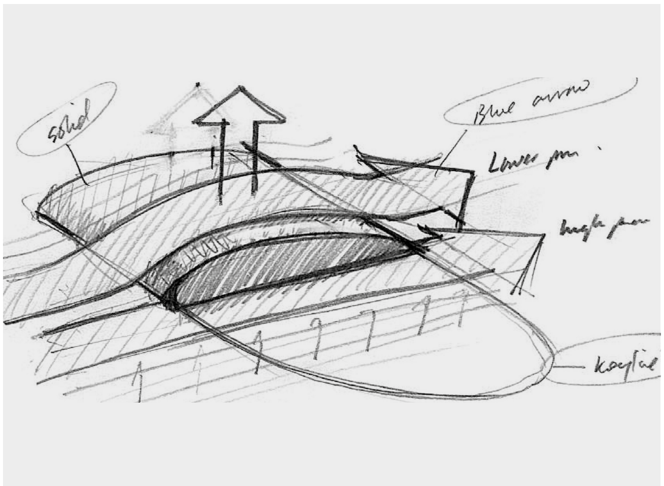
The very first fans had no cover to protect users. Even with the grill on modern fans, children can put their fingers through or objects can be pushed into the blades. Bladed fans are also hard to clean. These were the problems that Dyson engineers solved when they developed the Dyson Air Multiplier™ fan.

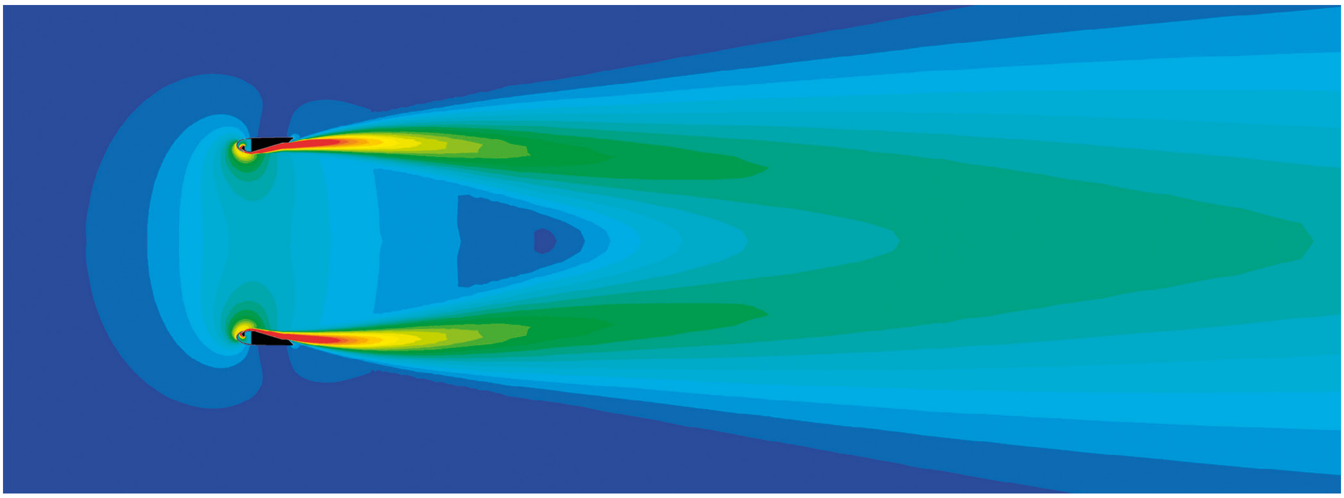
Find a way to solve it

FLOW RATE AND VELOCITY

As engineers started to investigate how to make traditional cooling fans better, they had to consider both flow rate and velocity. Flow rate is the volume of air moved, while velocity is the speed at which the air moves.

An airfoil-shaped ramp within the fan loop generates optimum airflow. Engineers studied the wings of owls and other birds of prey to help develop the aerodynamic geometry, also known as biomimicry. This is when inspiration is taken from natural selection solutions adopted by nature and translating those principles into human engineering. The ramp is angled at sixteen degrees to create an ideal balance of air velocity and flow rate – a refreshing flow of air which doesn't blow things off your desk.





THE DYSON AIR MULTIPLIER™ FAN

How does it work?

1

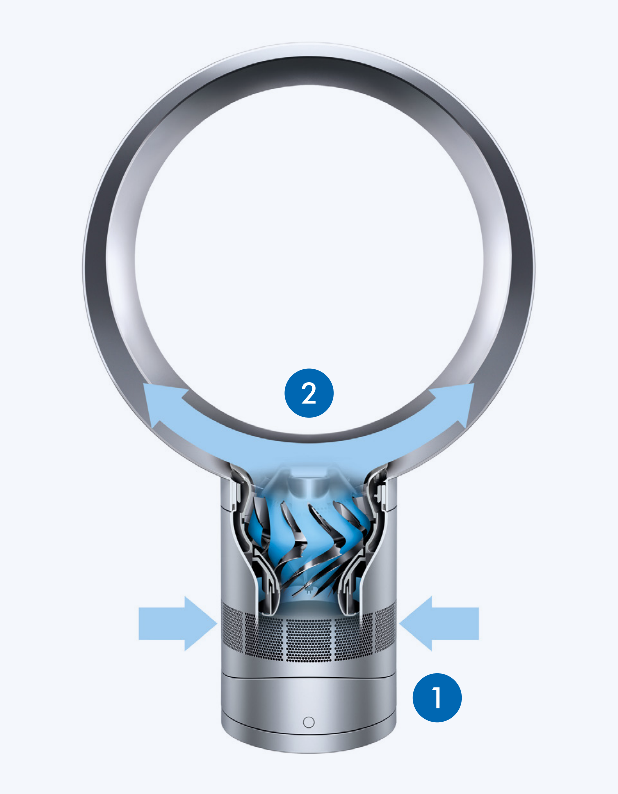
Air is drawn into the base by an impeller spinning 6,800 times a minute. This works in a similar way to the inlet of some jet engines.

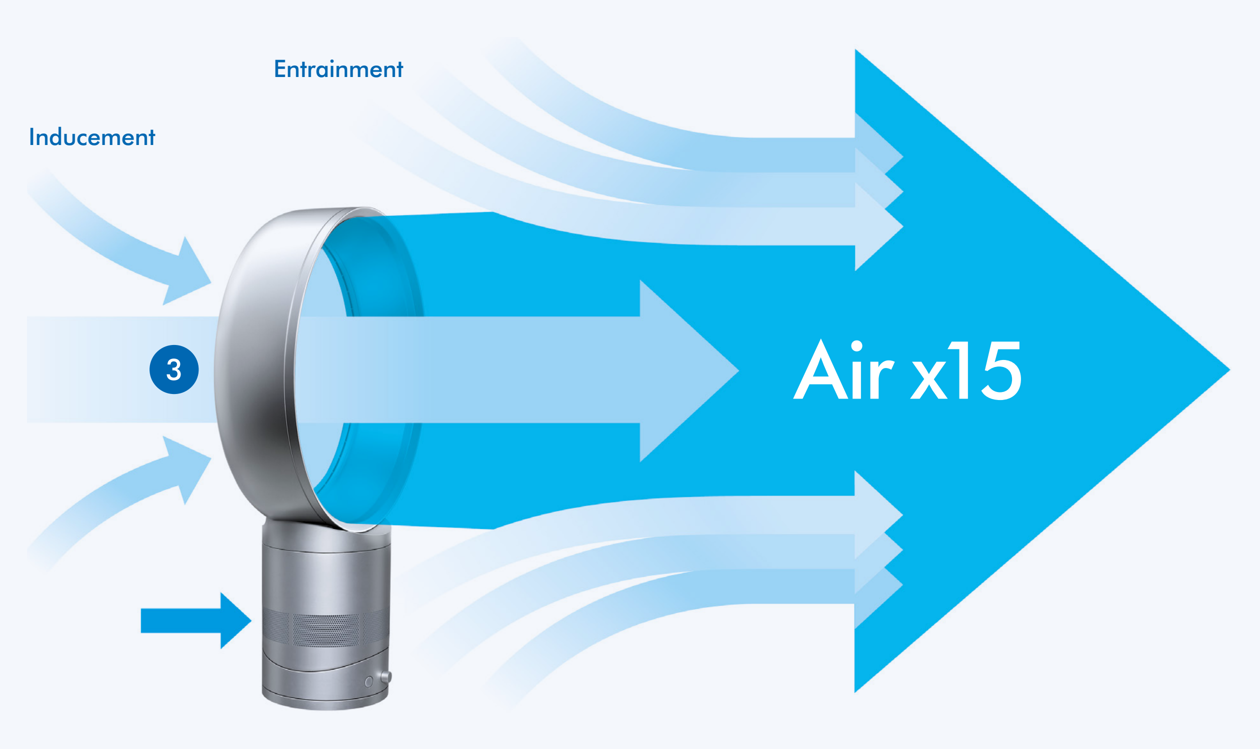
2

Air is forced up into the loop and accelerated out through a small gap the size of a fingernail. This creates a jet of air. This air then passes over the ramp visible from the outside which channels its direction.

3

As the jet of air passes over the ramp, it creates a region of low pressure which draws air in from behind the fan, this is called inducement. As it exits the amplifier, more air is dragged in from around the fan, this is called entrainment. As a result of the inducement and entrainment, the amount of air expelled is multiplied 15 times.





THE DYSON AIR MULTIPLIER™ FAN
FUN FACTS

1st

fan to multiply and circulate air without the need for fast-spinning blades

68

engineers developed the Dyson Air Multiplier™ technology in three years

400

patents for the Dyson Air Multiplier™ exist worldwide

370

litres of air per second is channelled on maximum setting

38,000

hours of usage is tested on the motor

1.8kg

almost half the average weight of other fans

LESSON 02
DESIGN DETECTIVES

Duration: 1 hour
Resources: The Dyson Air Multiplier™ fan, Video: Product analysis: What am I?, Video: Developing Air Multiplier™ technology, Poster: Everyday design icons, PMI worksheet.

Learning objectives:

1. To become familiar with the idea of radically re-designing everyday objects.
2. To develop critical analysis skills.
3. To share ideas and discuss design possibilities.

What am I and why? (10 minutes)	
Learning objective	**Activity**
1, 2	Begin the lesson by sharing an image of the Dyson Air Multiplier™ fan. Don't reveal it's purpose or name. Use the **Product analysis: what am I?** video to increase suspense. It shows design engineers using the fan to create a balloon run. Take answers and possible suggestions as to its purpose. You could use these six essential questions to structure your discussion: – User: Who has it been designed for? – Purpose: What need has it been designed for? – Design decisions: What choices have been made? E.g. materials, style, colour, textures, shape. – Innovation: How is this machine unique? – Functionality: Does it work? How well does it work? – Authenticity: Is it being used for the purpose it was designed for? Reveal its purpose, and use **Video: Developing Air Multiplier™ technology** to help explain the technology. It is important to emphasise that the Dyson Air Multiplier™ fan was designed to solve some of the problems with conventional fans. Remind the students that they will also get the opportunity to design a solution to an everyday problem. Remind them about the characteristics of a design engineer discussed in lesson one.

Design hunt (30 minutes)	
Learning objective	**Activity**
2	Explain to students that this part of the lesson is about them being design detectives. They will be applying their critical analysis skills to everyday objects, working in groups to improve them. Use **Poster: Everyday design icons** to introduce the idea of design being all around them. Explain to the students that they will be going around the classroom and hunting for objects or products that don't work well or have design possibilities. Give the students some suggestions to inspire them. For example: a school chair, a pencil case, a desk organiser or a book bag. Explain that to support their thinking, the class will use an analysis technique called Plus, Minus, Interesting (PMI). Allow students time to discuss what they think PMI means. PMI is a way of looking at existing products from all points of view: – Plus: List all the good or positive aspects of the product. – Minus: List all the features that are not positive, are bad or do not work. – Interesting: List the features that are interesting and could be developed further; they should look for possibilities in the product. Split the class into pairs and give them each a PMI worksheet to complete after they have considered different objects in the classroom, selecting one to focus on. An alternative method is to identify a selection of objects around the classroom in advance which you would like the students to analyse, including ones that you think would be a good project focus. Attach a large PMI worksheet to each of these so that the students can record their thoughts as they visit each object.

Ideas evaluation (10 minutes)	
Learning objective	**Activity**
3	Ask students to share their findings. Students should be encouraged to talk about which aspects of the product frustrated them. Decide as a class which objects could be redesigned and improved: this will be the focus of the project. Divide the class into small groups, each with a different object to work on in the next lesson.

SECTION 03
DESIGN. BUILD. TEST.

Students will learn about the importance of planning and sketching design ideas within the design process. They will also understand different prototyping methods and the significance of iterating designs.

Early prototype of the
first Dyson cylinder ball
vacuum cleaner.

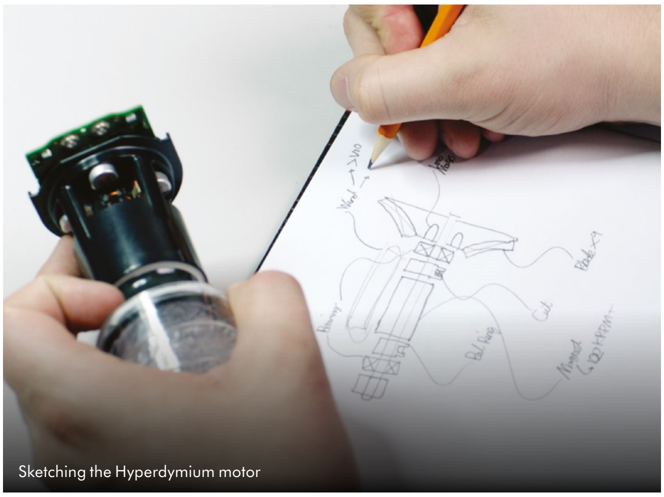
THE DESIGN PROCESS

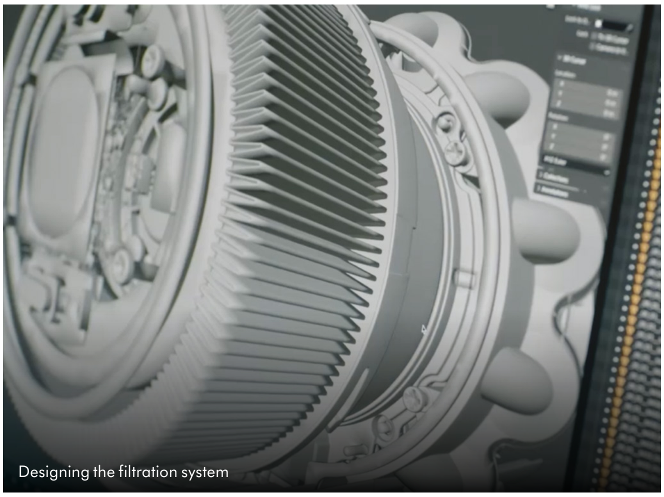
The design process always begins with a brief. It is made up of three stages: design, build and test. The process is not linear, design engineers will go back and forth between these stages when developing an idea.

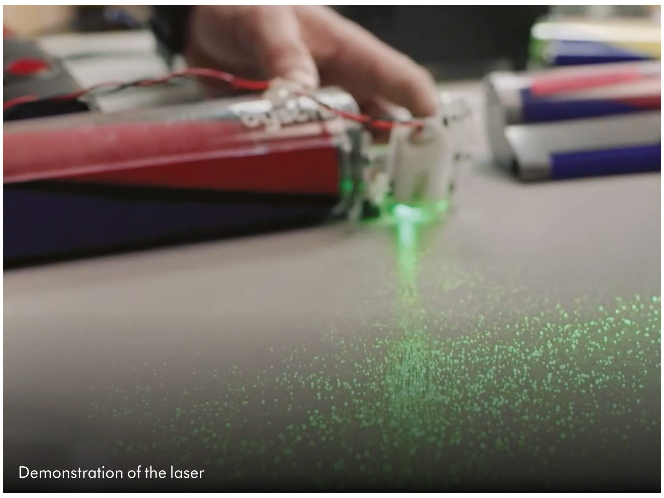
A design brief explains the problem that must be solved as well as other factors that the design engineer must consider. For example, sustainable materials and size.

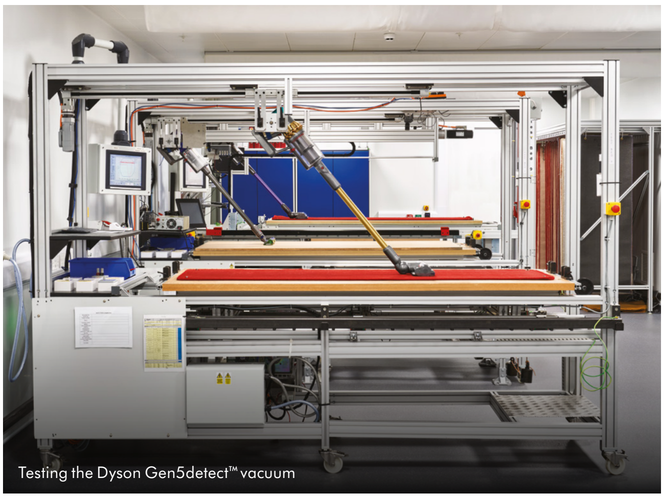
The specification is the measuring stick for a design. This is a list of requirements and features that the solution will need to include. It should always be referred back to throughout the design process.

The Dyson Gen5detect™ cordless vacuum started with a brief to design the latest, best-in-class, most hygienic Dyson cordless vacuum cleaner. It is powered by a fifth-generation Dyson Hyperdymium motor which took Dyson engineers over 4.5 years to develop, which equates to roughly 337,500 hours of engineering. In total, it took over 2,500 prototypes to develop the Dyson Gen5detect™ cordless vacuum.


Sketching the Hyperdymium motor

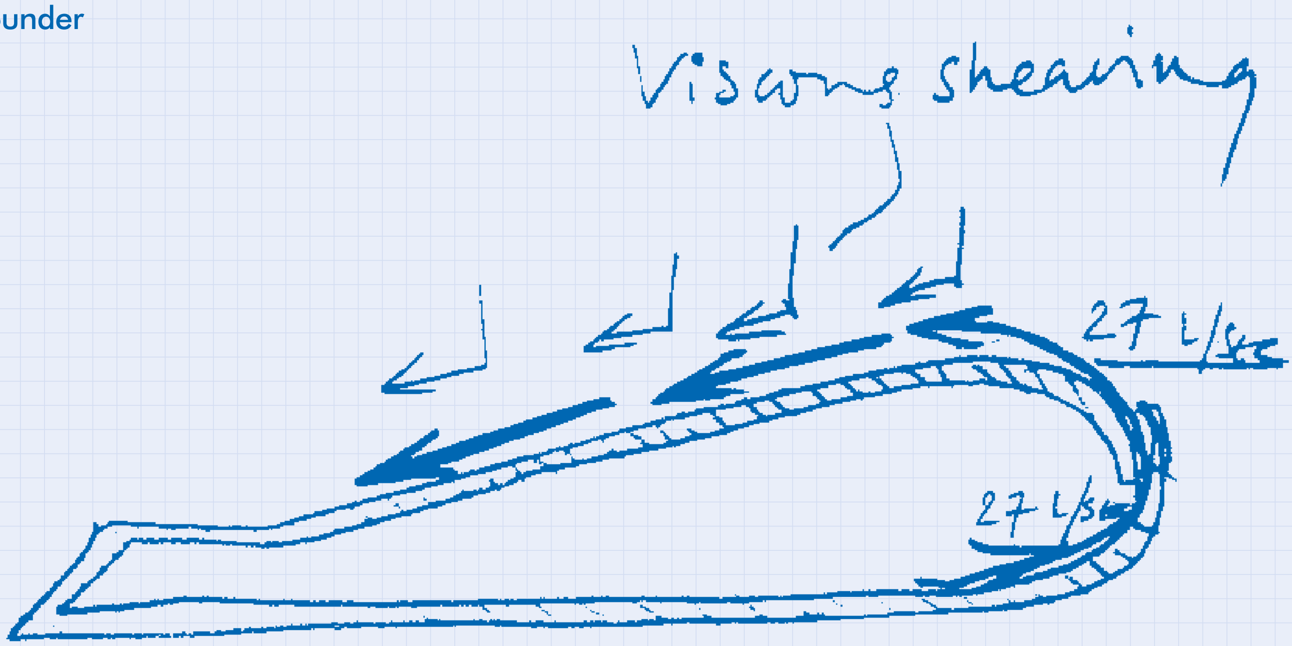

Designing the filtration system

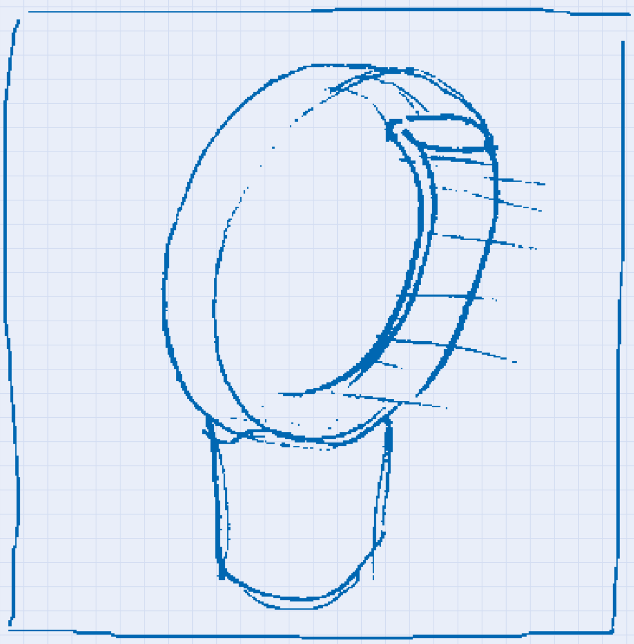

Demonstration of the laser

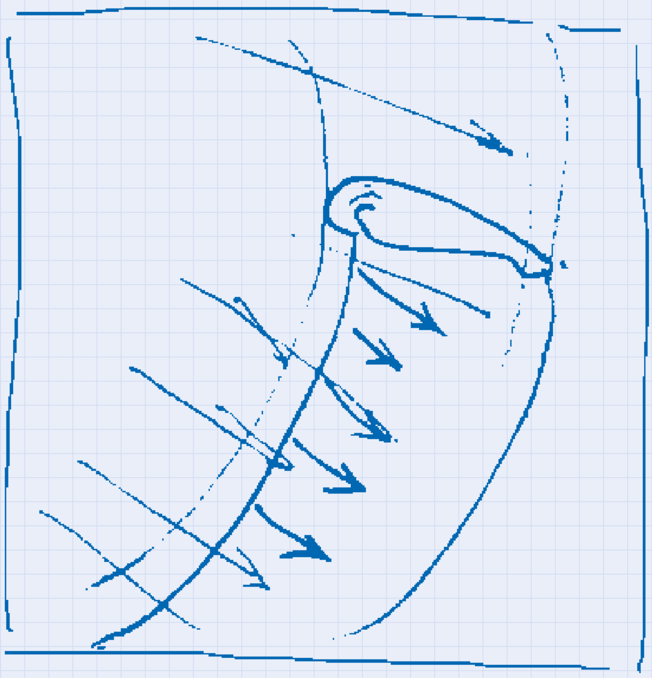

Testing the Dyson Gen5detect™ vacuum

“Sketching brings science and art together. A design engineer uses sketches to show how something will work as well as what it might look like.”

Sir James Dyson
Founder



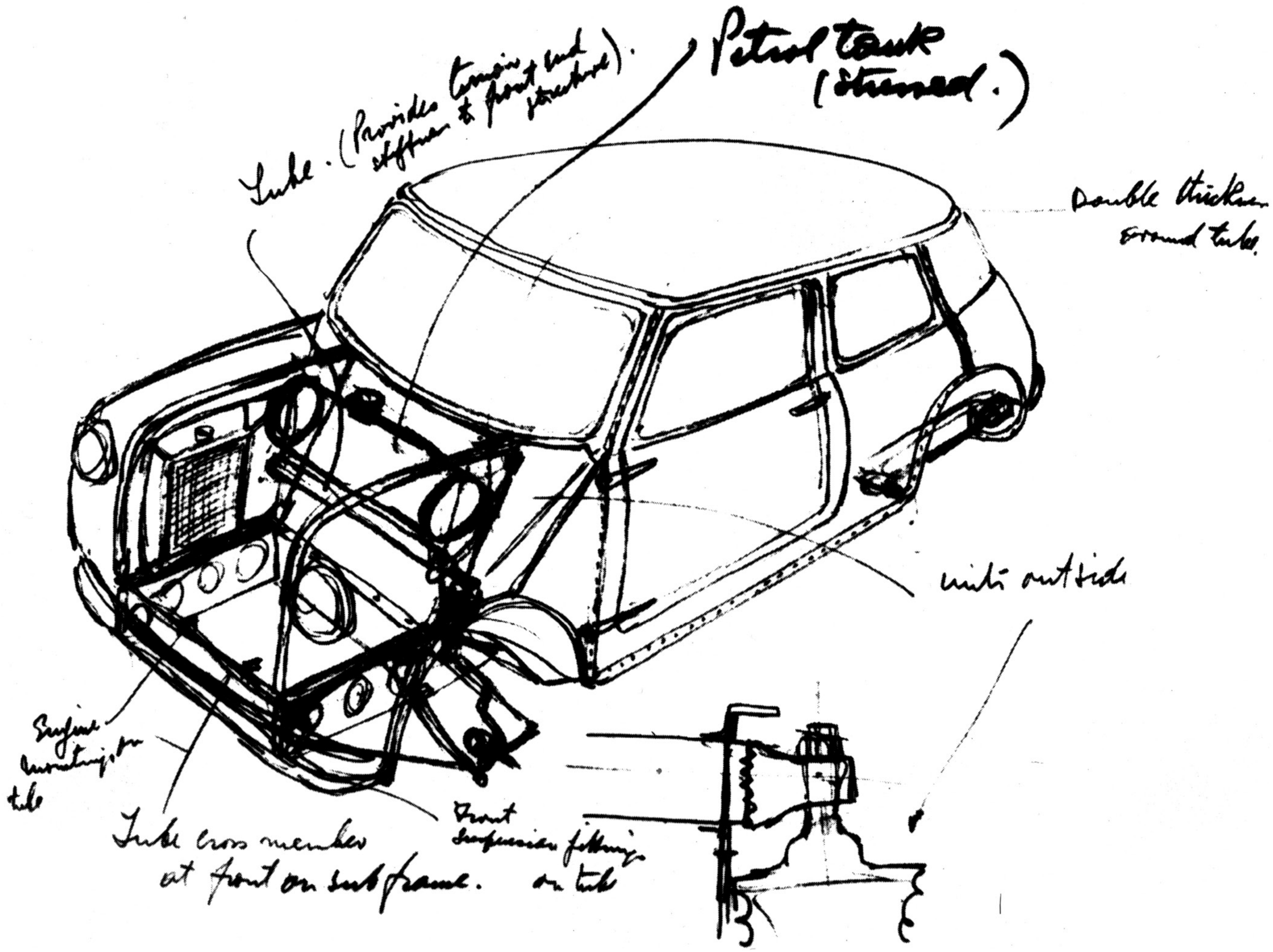




THE DESIGN PROCESS
SKETCHING

Sketching is an important way of communicating ideas. Every Dyson engineer uses a sketchbook. This is used to take notes on the design brief and sketch and plan out their ideas. They must sign and date each page to show who the idea belongs to.

A great example of a sketch turning into an invention was when Alec Issigonis, the inventor of the Mini, sketched his first idea on a napkin whilst having dinner.



THE DESIGN PROCESS
PROTOTYPING

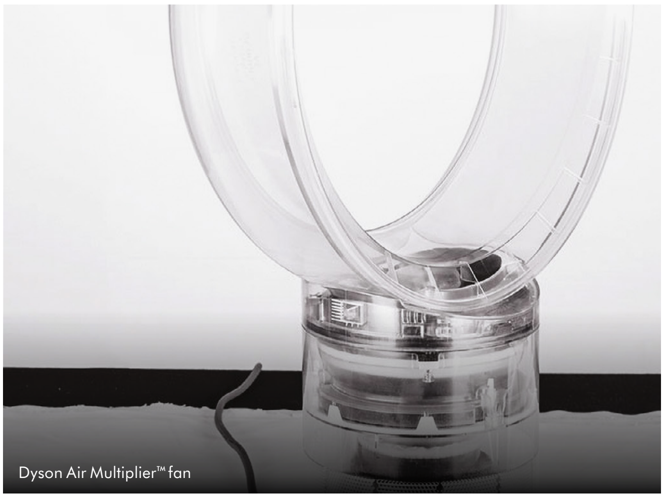
Once design engineers have decided on some ideas they'd like to test, they start by making models of their design.

This means there have been hundreds of prototypes of Dyson machines made throughout the years. These are often created from cardboard in the beginning – a simple and effective way to demonstrate what something might look like in real life. Design engineers may add weights so they can get an idea of what the product will feel like in use.

Computer-aided design (CAD) is used to create detailed, computerised 3D images of individual parts – and even to do virtual testing. After the CAD file has been created, it is sent to the 3D printer – in the same way you would send a normal document to a printer. At Dyson, rapid prototyping machines are used. These take the CAD image and slice it into many thin layers. The rapid prototyping machine prints each of these layers, stacking them on top of each other to create a 3D model.

Rapid prototypes are essential to give the design engineers an accurate idea of how a machine will perform. By testing them and finding weak spots, the design can be improved. Many different models are made and improved before the machine is ready for manufacture.

Dyson DC16™ handheld vacuum



Dyson Air Multiplier™ fan

Dyson Supersonic™ hair dryer

THE DESIGN PROCESS
TESTING

A working product is not the end of the design process. You must test your design to find the weak points. Failure is a good thing as it helps design engineers to improve the product.

Design engineers create tests that replicate how the machine will be used in real life so they can understand what might go wrong once customers start to use it. This will mean lots of mechanical and scientific testing – as well as real life testing. There's no substitute for getting a machine into human hands. Dyson has teams which tests every one of its machines.

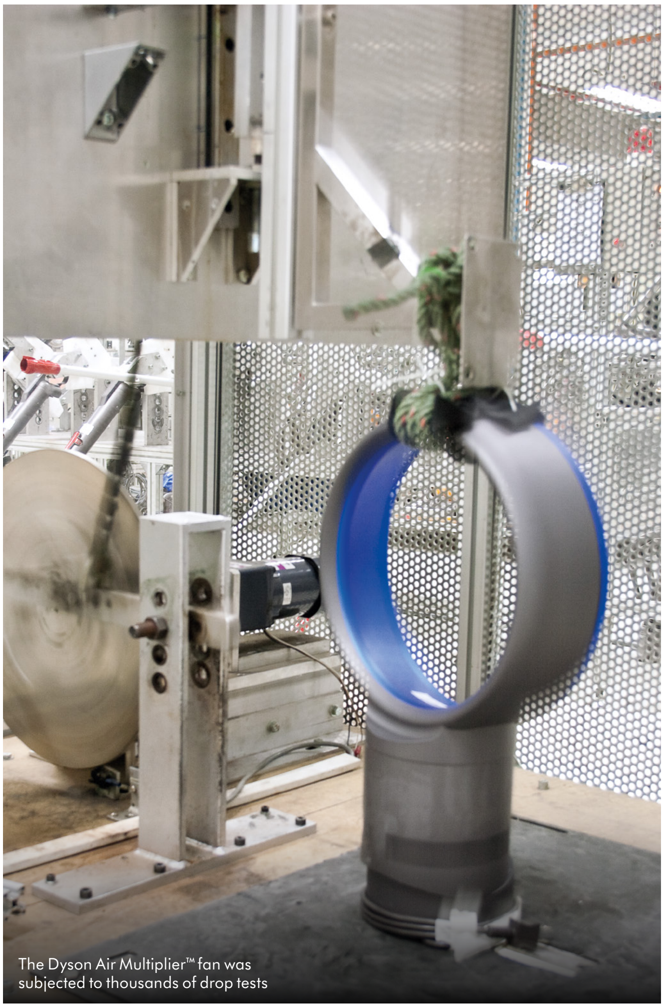
Testing the Dyson Air Multiplier™ fan

Dyson uses test robots to simulate a lifetime of use. Robots can repeat complex actions many times, in a controlled manner. For example, the the Dyson Air Multiplier™ fan's tilt operation was tested to 54,750 cycles, back and forth.

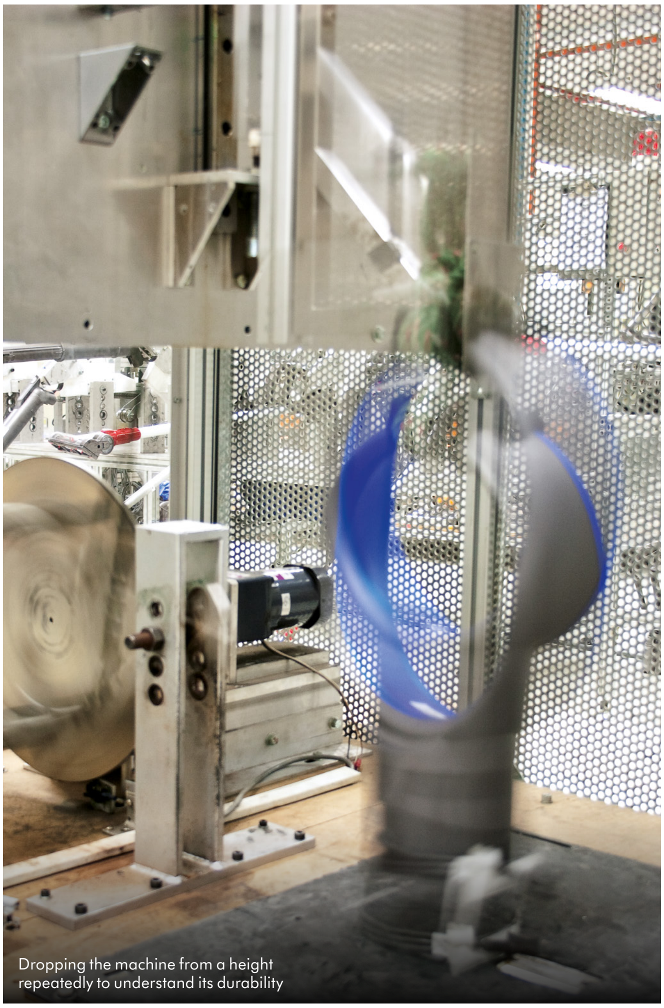
Dyson's fluid dynamics engineers ran hundreds of simulations to measure and map airflow – allowing them to better understand it and how to control it. High speed cameras were used to analyse what was happening. The camera takes 40,000 frames a second, allowing the engineers to see things like tiny dust particles moving through the machine.

Every aspect of a Dyson machine's performance is tested – even the way it sounds. The Dyson Air Multiplier™ fan was tested in a semi anechoic chamber; a soundproof room. 10 microphones recorded every noise that the machine made, helping the engineers to identify unpleasant tones. The engineers then built a transparent prototype and passed ultraviolet paint through the machine. Where the paint stuck to the fan loop the engineers knew there was an obstruction which caused turbulence in the airflow and therefore created noise.

Another test involved replicating conditions in a busy kitchen. The Dyson Air Multiplier™ was confined in a box into which flour, cooking oil and dust were pumped, to make sure the 1.3mm aperture didn't block.



The Dyson Air Multiplier™ fan was subjected to thousands of drop tests



Dropping the machine from a height repeatedly to understand its durability

Millions of tiny particles were injected into the airflow to make flow patterns visible to laser technology. This technique is called Laser Doppler Anemometry. The engineers were then able to use lasers to track the speed and direction of the particles, allowing them to create a detailed map of the airflow.

LESSON 03
DESIGN

Duration: 1 hour 30 minutes
Resources: Pencils and paper, Worksheet: My specification, Video: Sketching.

Learning objectives:

1. Understand the importance of planning before making.
2. Learn how to break a challenge down into a series of tasks.
3. Understand how to use sketches to communicate ideas.

Introduce the brief and example specification (10 minutes)	
Learning objective	**Activity**
1	Give the students their brief: choose something in your classroom that could be improved. Identify the main problems with the product and design something that works better. Make your idea using paper, or cardboard – or choose any other materials you have available. Ask the students to discuss the brief. Gather their initial thoughts about the project. Go back to **Lesson 01: What is a design engineer**? Think about the characteristics of a design engineer. Question their ideas and challenge them to start thinking about the project as a design engineer. Show the class the words 'design specification' – what do they think this means? Ask the students to think about why a design engineer would need to come up with a design specification. Explain that it helps to channel their thinking about the user and purpose of the product. It also helps to give them some parameters to work within.

Writing a specification and sketching ideas (1 hour)	
Learning objective	**Activity**
1, 2, 3	Break the students back into the groups chosen at the end of **Lesson 02: Design detectives**. Ask the groups to think carefully about who will be using their product and what its function is. You may want to ask them to draw their user. Ask students to work in their groups to produce a specification. Hand out **Worksheet: My specification** (page 33). Give them a limit on the number of criteria. You might like to decide on some criteria as a class and then allow the students to set a few more themselves. Students will need to consider the size, weight, appearance and function of the product when thinking about the specification, which will vary depending on the project undertaken. Divide the specification into: – It must... – It should... – It would be nice if... Explain to the students that they will refer to this specification throughout the designing and making process to make sure they are on track. They can then use the specification to test and evaluate their product once it is complete. Once the students have identified the specification for their design, they can begin to sketch their product. Explain that sketching is an important communication tool for engineers. Sketches show not only how the product will look, but also how it will work. Use **Video: Sketching** to support your explanation. Ask students to draw a picture of what they think their product should look like, using annotations to explain how it will meet the specification criteria. Encourage groups to discuss different possibilities. Ask groups to share their specifications and annotated sketches with the class.

Production planning (20 minutes)	
Learning objective	**Activity**
2, 3	In their groups, students should produce a production plan. Consider using techniques such as flow charts. Key questions could include: – What steps do you think you will need to take? – How many steps will it take to make your product? – Have all the steps been included? – Is more detail required? – Can your plan be understood by someone other than you? Make sure students record their production plan in a format that can be easily followed during the next lesson.

LESSON 04
BUILD

Duration: 1 hour 30 minutes
Resources: Paper and pencils, materials to construct prototypes with, adhesives to join parts together, tools to cut up material and construct prototypes, Video: Dyson does it: Build, Video: Cardboard modelling, Poster: Design process.

Learning objectives:

1. Develop practical skills.
2. Learn that design is an iterative process.
3. Consider the properties of materials and make judgements as to the most appropriate.
4. Reinforce design decisions that were made, and learn to keep a specification.
5. Develop self-evaluation skills.

Prepare (15 minutes)	
Learning objective	**Activity**
1, 2, 3, 4	Begin the lesson by explaining that design is a process, and part of that is prototyping and trying different ways to achieve your design. Refer to **Poster: Design process**. Explain that in this lesson the students will be working in their groups to prototype their product. Show the students the different materials they will have to work with. As a class, discuss the properties of these materials and consider which will be most appropriate for different aspects of construction. Ask the students to think about the different ways they can use each material. Show them **Video: Cardboard modelling** – this will give them tips to help them manipulate cardboard. Remind the groups to have their specification and production plan to hand, and to keep referring to them.

Go production! (1 hour)	
Learning objective	**Activity**
1, 2, 3, 4	Based on their sketches from the previous lesson, the student groups should begin to produce their model. Remind them that they don't need to produce a perfect model straight away: an important part of the design process is iterative improvement. They should build several prototypes of part or all of their product before settling on a final version. Stop activities to highlight unsafe/safe practice. During production, encourage student groups to discuss the development of their product, including changes that should be made and the reasons for these. Support the use of correct terminology. Make sure that students record how each prototype has changed – and why. This part of the lesson can be extended or repeated if more time is required.

Specification check (15 minutes)	
Learning objective	**Activity**
2, 4, 5	Ask the students to re-visit their specification and compare it to their prototype. Ask the student groups to share their products. They should identify where they have deviated from the specification and offer reasons for these changes: – How did the change improve the product? – What part of the product did it affect? – Why did this need changing/improving? Finish the lesson by watching the **Video: Dyson does it: Build**, to understand the high-tech prototyping methods used at Dyson.

LESSON 05
TEST AND EVALUATE

Duration: 1 hour
Resources: Worksheet: PMI, Worksheet: My next one would be..., Video: Dyson does it: Test, Dyson design challenge certificate

Learning objectives:

1. Understand that testing helps to identify issues with design, meaning improvements can be made.
2. Develop analysis skills through using PMI.
3. Relate the design process in the classroom to the real life design process and the need to revisit and improve.
4. Appreciate how perceptions of the work of a design engineer have changed in light of the project.

Planning the test (25 minutes)	
Learning objective	**Activity**
1, 2	Explain to the students that today's lesson focuses on the last two steps of the design process: testing and evaluation. Ask students to consider: – Why do you think it is important to test a prototype? – What could happen if an engineer does not test their design? – What do you think happens if a design passes a test? – What happens if it fails? Introduce the Dyson testing process using **Video: Dyson does it: Test**. Discuss the video as a class. In their groups, ask the students to design a plan for how they would test their own products. Explain that the test should identify the aspects of the design that need improving. You may want to ask them to consider the following questions: – How will users interact with the product? – What types of accidents could happen while someone is using the product? – Which are the strongest and weakest parts of the product? Ask the groups to share their testing plan with the rest of the class. Discuss and give feedback. Consider extending this opportunity by trying one or more of the student-designed tests.

Product analysis (1 hour)	
Learning objective	**Activity**
1, 2, 3	Explain that once engineers have completed testing, they evaluate their results and iterate their design. Ask student groups to review the original design specifications for their products. Next, ask them to use **Worksheet: PMI** to evaluate either their own work, or the work of a different group. Using the results of the PMI exercise, explain that the students will now consider what their next one would be using **Worksheet: My next one would be...**. Refer back to James' story (page 8) and his 5,127 prototypes. Capture students' thoughts on how their ideas would develop. Consider using techniques such as photographing final products and sketching on improvements. Mark the photograph with minus or plus points on parts that would be improved or changed. Consider problems experienced during the project or how they think their product would endure the tests they designed. How would they overcome or avoid problems or failed tests next time? Produce top tips for another class doing this activity.

What is a design engineer? (10 minutes)	
Learning objective	**Activity**
3, 4	Ask students to think about how they now feel about the work of a design engineer. Have their opinions changed? Repeat the drawing of an engineer (page 11) exercise from Lesson 01. Allow students time to share their ideas with the class. Students could create a comparative wall display of their work. It could include their sketches, photographs of their work and their final products. The display could include information about the design process. You could have a class presentation session or a whole school assembly to present the students with their Dyson design challenge certificate (page 35).

WORKSHEETS 01–03

WORKSHEET 01
PMI

Use this worksheet to consider your own product analysis.
Sketch out your ideas, think about what works well, what could be improved and what makes the product different.

Name:

Product sketch:

Plus:

What works well?

Minus:

What doesn't work well?

Interesting:

What do you find interesting or different about the product?

WORKSHEET 02
MY SPECIFICATION

Write a list of things you want from your product. Divide it into three sections based on how important each item is.

Name:

I am designing:

It must...:

It should...:

It would be nice if...:

WORKSHEET 03
MY NEXT ONE WOULD BE...

Having a working product is not the end of the design process. Design engineers will repeat the Design. Build. Test. loop many times to make their product as good as possible.

Name:

Minus points	Ways in which I would solve them next time
Use the minus points from your completed PMI worksheet to identify how you could make your product better next time.	

Problems I had	Ways in which I would solve them next time
Making a product is difficult. Write down some of the problems you had and think about ways you could solve them next time.	

Certificate of completion
Design process challenge

This is to certify that

____

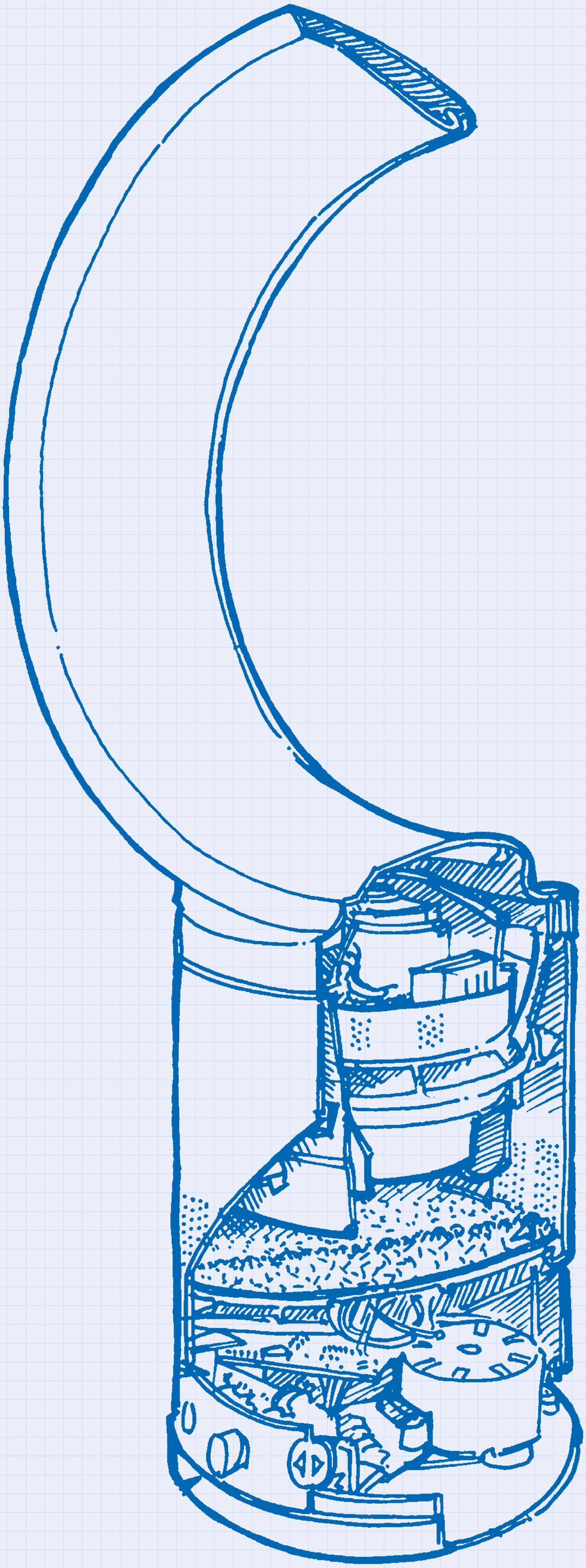
has completed the James Dyson Foundation design process challenge and has shown the characteristics of a design engineer.

Signed

____

Date

____



THE JAMES DYSON FOUNDATION

EXTENSION ACTIVITIES

The following are extension activities to support with the curriculum across the following subjects: Literacy and writing skills, History, Enterprise, Numeracy and Science.

Literacy and writing skills		
Activity	**Learning objectives**	**Activity outcome**
Write instructions for how to use the group product	Develop explanatory skills through writing	Instructions
Write a letter to a friend or relative, persuading them to buy this product over a competitor's	Practice persuasive writing Improve familiarity with letter writing	A persuasive letter
Create a brochure for the group product	Improve non-fiction writing Improve IT skills and enterprise awareness	Product brochure

History		
Activity	**Learning objectives**	**Activity outcome**
Research a design engineer using the internet and other resources	Develop research skills and knowledge of design engineers	Information gathered
Create a design timeline for the classroom	Improve awareness of design and how it has evolved	Class display

Enterprise		
Activity	**Learning objectives**	**Activity outcome**
Research different types of advert and discuss which the class finds most effective	Improve awareness of the different ways of explaining and marketing a product	Class discussion of differences and similarities
Create an advert for the group product: print or film	Learn how to persuade through advertising Practise IT skills	Film or print advertisement
Strategy plan: Work in groups to think about the product's strengths and weaknesses, and how people could be persuaded to buy it. Write a plan for a product pitch	Identify strengths and weaknesses Develop planning skills in relation to presentations	Written presentation plan
The pitch: Groups have two minutes to persuade the rest of the class to buy their product	Develop persuasive speaking skills	Series of presentations from the class

Numeracy and enterprise		
Activity	**Learning objectives**	**Activity outcome**
Before the Lesson 04: Build class, set up a shop. It should contain all the materials and tools they will need to use, along with a price. As each student comes into the class, give them a set number of tokens Explain the difference between cost and profit, and how important they are for business	Increase business skills and awareness	Practice using number sense skills, addition and subtraction Listening and discussion activity
Ask the students to look at their designs and make a shopping list of what they need. They will then visit the shop, write the cost next to the material, and add up the price of their list They can then re-visit and adjust their designs or material choices depending on their number of tokens and budget	Exercise planning skills Learn to think about materials and their properties and apply that knowledge. Develop basic arithmetic. Raise awareness of budgeting and related decision making	A materials shopping list for their design to which prices can be added and amended according to their budget
Recap and review: – What changes did they have to make? – Were some decisions harder than others? Why? – Whose project was the most expensive? Why? – Whose was the cheapest? (This could be shown in graph form)	Exercise speaking and listening skills Reinforce decisions made and reward positive processes	Class discussion

Science		
Activity	**Learning objectives**	**Activity outcome**
Before the lesson, find a selection of seeds. Ask if the students recognise any. Explain that many types of seeds are naturally designed to disperse in the wind This activity could also be done with light everyday objects to see which travel furthest – e.g. feathers, paper and leaves	Increased knowledge of plant structures Increased awareness of what's in their local environment An awareness of the presence of design in nature	Class discussion
Using the Dyson Air Multiplier™ fan as a source of wind, measure which seeds are best at travelling the furthest by wind	Practice measuring and recording skills Improved observational skills	Measurements of distance by seed type (this could be recorded in a chart format)
Discuss how different objects behave in the wind. Discuss how the shape of the seed is adapted to travelling by wind. Opportunity to discuss other methods of seed dispersal	Understanding of how wind affects the movement of objects and how shape can have an impact Understand that seeds are adapted	Class discussion

“To break performance barriers, you can't be afraid to go back to the drawing board. That's how you pioneer.”

Sir James Dyson
Founder

You can find more James Dyson Foundation educational resources online at www.jamesdysonfoundation.co.uk

Share your experiences with us:

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