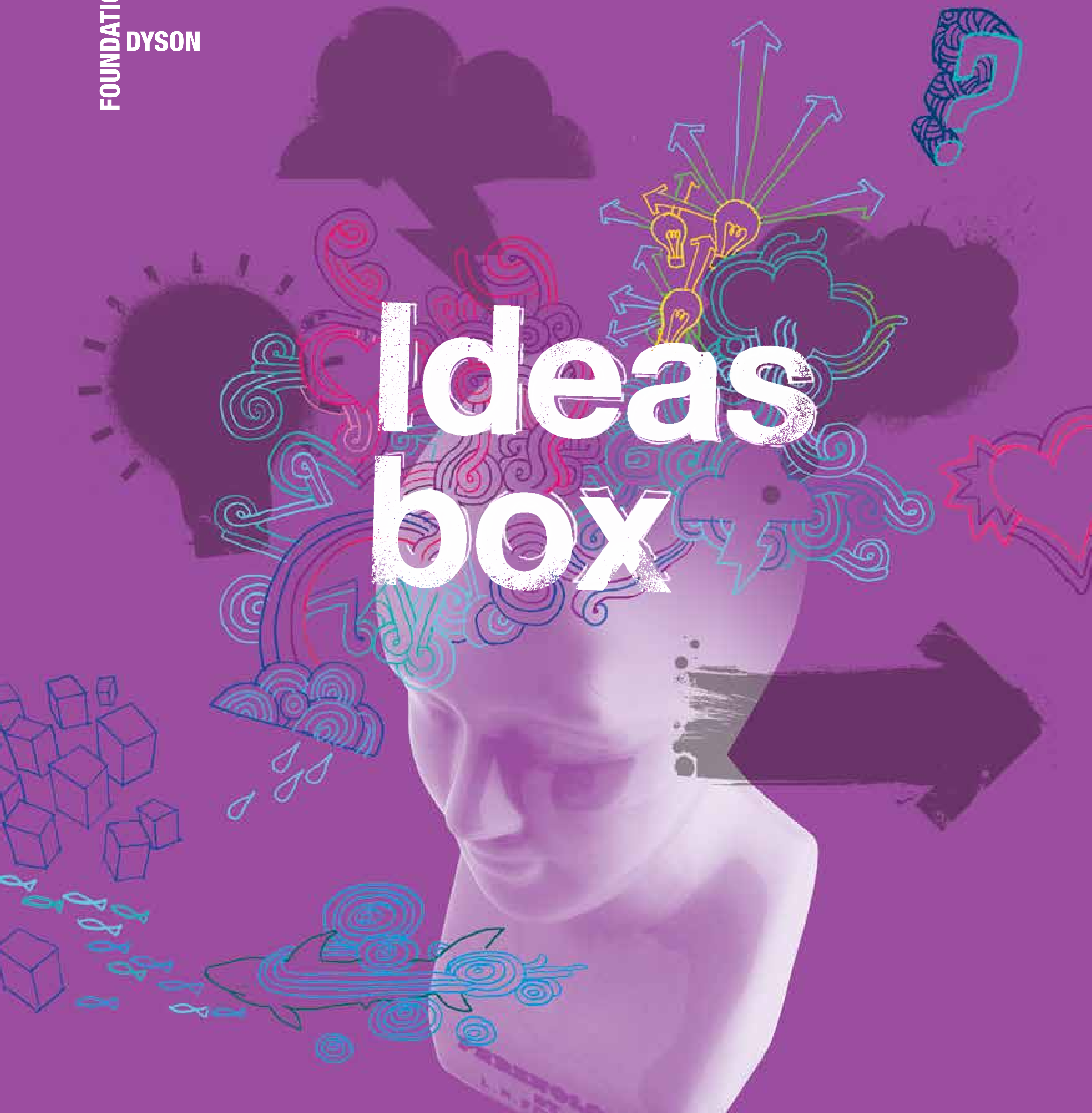
JAMES DYSON FOUNDATION

Ideas box

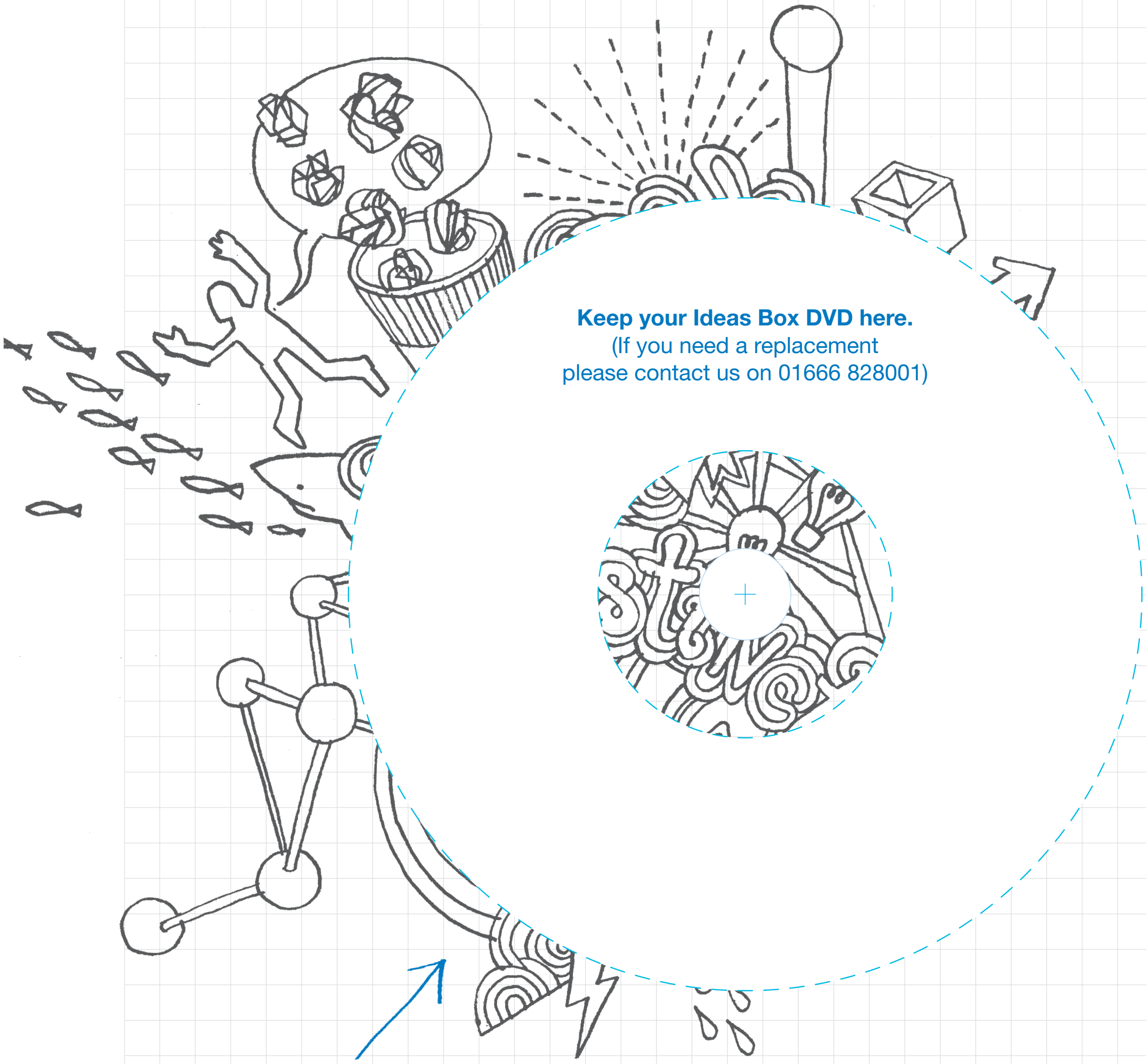


James Dyson Foundation

Teacher's Pack

www.jamesdysonfoundation.com

Welcome to the James Dyson Foundation teacher's pack.



Keep your Ideas Box DVD here.
(If you need a replacement
please contact us on 01666 828001)

Use this DVD in the classroom – it's full of useful stuff!

INCLUDED ON THE DVD:

Section 1: What is a design engineer?
Chapter 1 – James's story
Chapter 2 – Characteristics of a design engineer

Section 2: Design detectives
Chapter 1 – What am I?
Chapter 2 – Developing Air Multiplier™ technology

Section 3: Design
Chapter 1 – Sketching
Chapter 2 – Cardboard modelling

Section 4: Build

Section 5: Test and evaluate

Fact:

By the time today's primary school age students are of working age, the UK will need more than two million additional engineers.*

The James Dyson Foundation gets young people excited about design engineering. We want to show them that, with ideas and imagination, they could create the products of the future.

We believe the best way to do this is to get practical. This resource will guide you through the design process, giving students the chance to create their own product. They will develop their analytical skills, becoming more aware of the world around them and the thinking behind products they use every day.

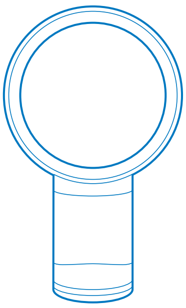
This pack can be used alone, but it also accompanies the **Ideas Box**. The box includes a **Dyson Air Multiplier™** fan as an example of solving everyday problems. Students will use their new analytical skills to go on a design hunt in the classroom finding something they think can be improved, then re-designing it.

They will start and finish the project by considering **'What is a design engineer?'** – spotting initial stereotypes and seeing how ideas change. The DVD includes real-life examples of Dyson design engineers, to support learning and give an insight into the world of design engineering.

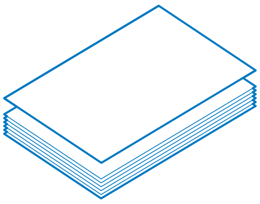
* Engineering UK 2012 Report

What's in the box?

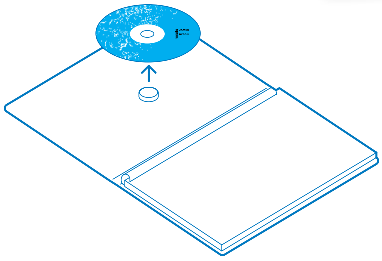
A Dyson Air Multiplier™ fan.



Informative posters for your classroom wall.

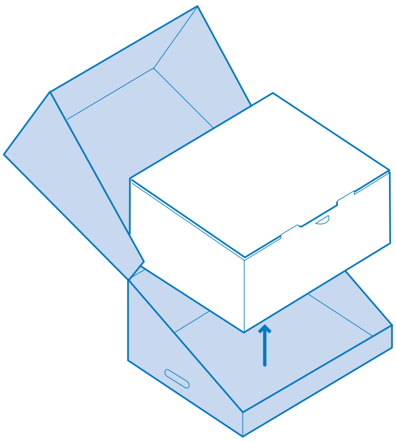


This teacher's pack, including DVD.

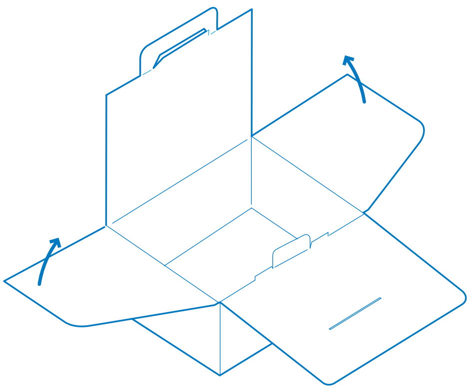


The Ideas Box turns into a display unit for the classroom, helping your class to track the progress of the project:

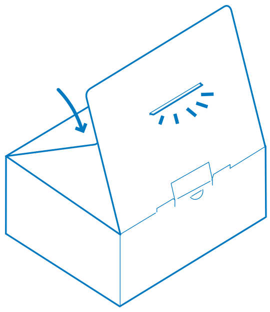
1 Remove the inner box from the outer box.



2 Starting with the inner box open, fold in the side flaps.



3 The brightly coloured label is the display board – prop it up by inserting the tab on the box lid into the slit in the display board.



Please remember!
Keep the outer box for returning the Ideas Box and Dyson Air Multiplier™ fan to the James Dyson Foundation.

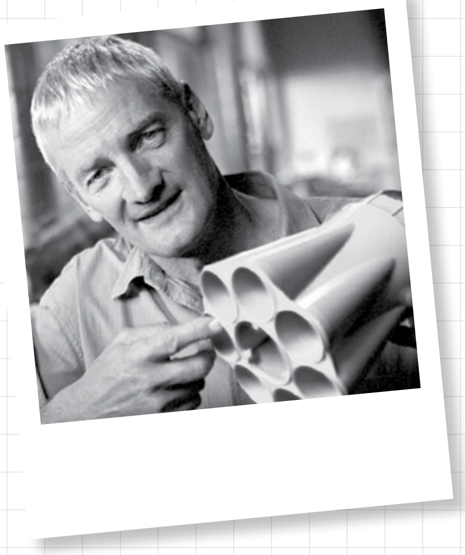
This pack has been designed to fit your timetable and lesson planning.
Feel free to photocopy, scribble and adapt it to your needs – it's yours to keep. As well as covering Design and Technology, there are additional activities on subjects including Numeracy, Literacy, and Enterprise.

You can find more resources at
www.jamesdysonfoundation.com

Contents

Section 1: What is a design engineer?

James's story



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

This frustration inspired James to develop the Ballbarrow. James 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.

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 knew he was on to something.

There was still a long way to go. James persevered with his idea, and after 5,127 prototypes, he produced the first Dyson vacuum cleaner.

See **What is a design engineer?** Chapter 1 on the DVD for more on James's story and an introduction to the project from James.

Characteristics that make a good design engineer:

1 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.

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

2 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.

Example: 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. Sideways rather than long-ways.

3 Perserverance

A perfect design doesn't happen straight away; design is a process. When something doesn't work first time, it's about sticking with it, making small changes, and ultimately 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.

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

4 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.

Example: your students!
All new designers need to have a bit of fighting spirit, and be prepared to keep going in the face of competition.

See **What is a design engineer?** Chapter 2 on the DVD for more characteristics.

Poster pointers

Poster 1:
What does a design engineer do?

Design is something, for someone, for some purpose. This is a useful definition of design in a nutshell. Refer back to it throughout the process. You could use it as a prompt for your discussion after the starter activity.

Get the students to guess how many prototypes James had to make before revealing that it was **5,127**.

Use the image of the design engineers as real life examples. Do they match student's perceptions of what a designer or an engineer looks like? Another good word to use for a design engineer is an **inventor**.

Pick up on the idea of frustration being a positive attribute. Something that is well designed is easy to use; something that frustrates you can be re-designed to work better.

Poster pointers

Poster 2:
Inventions through time

This poster should reinforce that design engineers come from all backgrounds, and work on lots of different projects.

You could use Fiona Fairhurst to talk about biomimicry – design inspired by nature. What natural shapes or structures could inspire the students? Other examples of biomimicry include Velcro® – inspired by burrs that stuck to Swiss engineer George de Mestral's dog.

It's important to emphasise that design will continue to develop. You could point out examples of products that have been invented in your students' lifetime, such as the tablet computer. This should link to the idea of them having the potential to become the next design engineer.

The idea of design and invention developing over time is a key message – point out the timeline on the right hand side.

Lesson 1

Section: **What is a design engineer?**
Duration: **1 hour**

Learning objectives:

1 Recognise stereotypes of design engineers.
2 Increased knowledge of famous inventors, and create an image of a design engineer.
3 Show that design engineers have certain characteristics that help them achieve.

Activity outcome:

– Completed person outlines for designer, engineer and design engineer.
– Completed game of design snap.

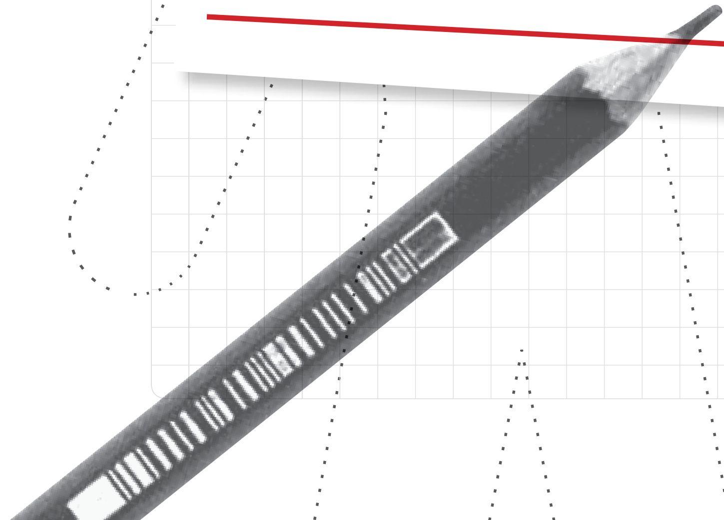
Things you will need:

– Individual copies of the **What does a design engineer look like?** (Resources page 11).
– Pencils and colouring pencils to complete the worksheet.
– A set of **Design snap!** cards (Resources page 12 and 13) for each table/group.
– Access to computers for research and printing.

Starter: 20 minutes

What does a design engineer look like?

Learning objective	Activity
1	Introduce the session and its objectives. Hand out the **What does a design engineer look like?** worksheets, (Resources page 11). Divide the class in two, and ask half to draw what they think a 'designer' looks like, and the other half to quickly draw what they think an 'engineer' looks like.
1	Hand out another copy of the worksheet, and ask them to now draw what they think a 'design engineer' is. Allow pupils to complete the worksheet. Prompt questions, if needed, could be: – What do you think they wear? – Where do they work? – What do they use?
1	Collect in worksheets. Point out any significant differences and also common themes between the drawings. Explain that you will put the pictures up as a wall display and we will see how ideas have changed at the end of the project. Put up poster 1 **What does a design engineer do?** (Resources page 7)



Main: 30 minutes

Design snap!

Learning objective	Activity
2	Introduce the main activity. Put up the second poster **Inventions through time** (page 8), and explain that an inventor is someone who designs products and that they have always existed.
1 & 2	Take suggestions from the class of inventors/inventions they know and record them on the board.
2	Introduce James using the **James's story** sheet (page 5) and/or DVD **What is a design engineer?** chapter 1.
2	Decide on groups. Give a set of **Design snap!** cards (Resources page 12 and 13) to each group and explain that you would like students to match the inventor to their invention.
2	Allow the students to try and match the cards. Prompt questions, if needed, could be: – When do you think that invention was created? – At what time might this person have lived?
2	Reveal the correct answers and discuss as a class.

Opportunity to use optional history extension activity page 49.

Plenary: 10 minutes

Characteristics of a design engineer

Learning objective	Activity
2 & 3	Take suggestions from the class as to what the inventors all had in common. Prompt questions: – What problems did they face? – How did they get round them?
3	Introduce the Dyson design engineer characteristics on Poster 1 using the **Characteristics that make a good design engineer** worksheet (page 6) to help you and the **What is a design engineer?** Chapter 2 on the DVD.
1, 2 & 3	Explain that the pupils will be acting as design engineers during this project, and making their own invention. To be good design engineers, it's important that they bear these characteristics in mind.

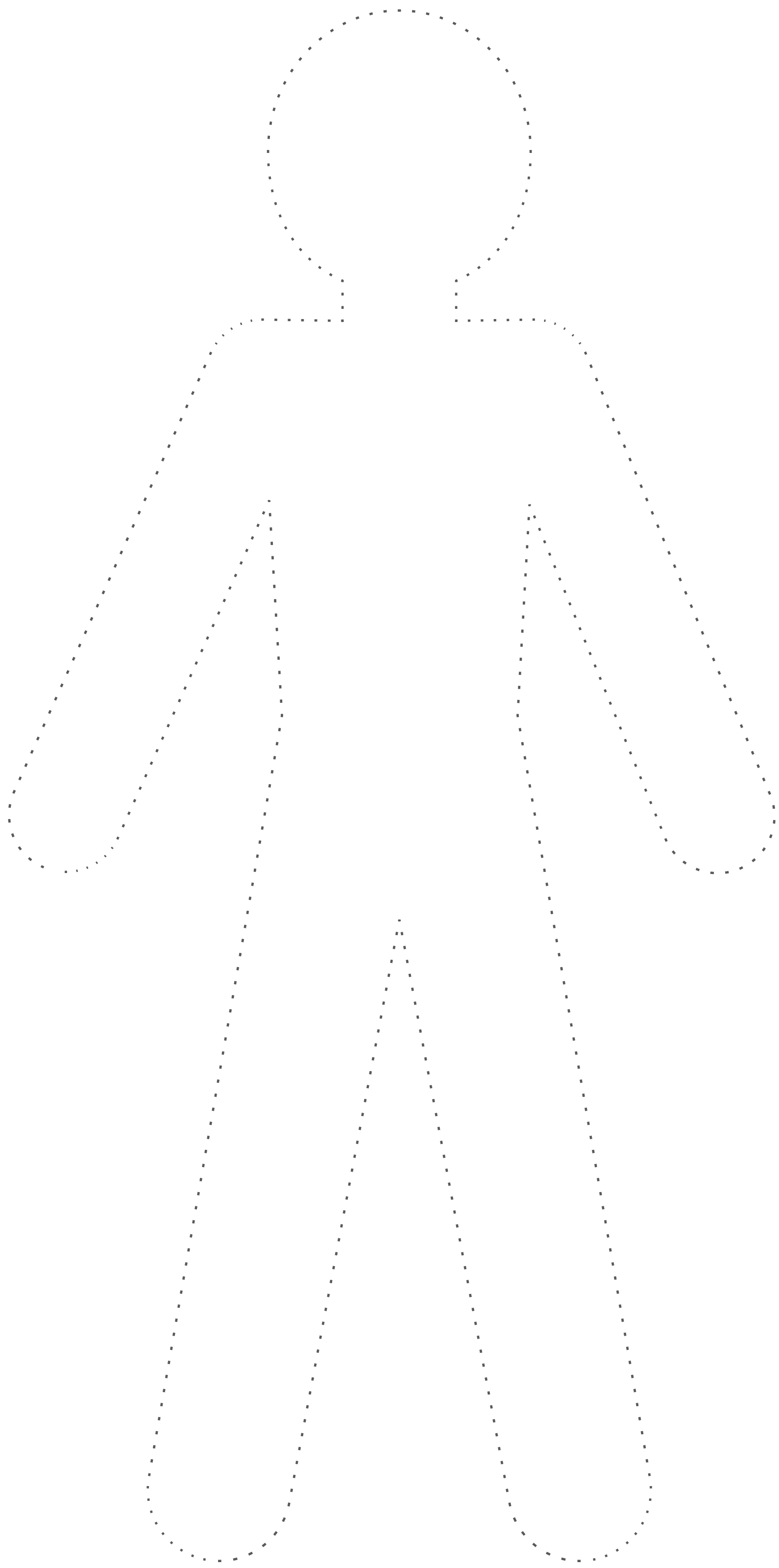
Lesson evaluation

To what extent have the lesson objectives been met?

What do I need to carry forward to the next lesson?

Notes on specific pupils/projects:

What does a design engineer look like?



Design Snap!

Can you match these design engineers to their inventions?

On the following page there are photos of five design engineers and their inventions.

Below is a grid with their names, the name of the invention, and the year it was invented.

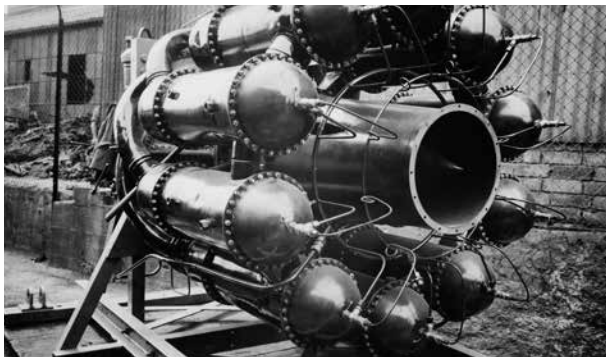
Create sets of design snap by printing off copies of the pictures and the chart, cutting them up, and asking students to try and match them. Refer to this copy in your pack for the answers (NB pictures appear in the order listed in the chart).

This activity can be extended by asking students to research a design engineer, and add these to a class set of design snap.

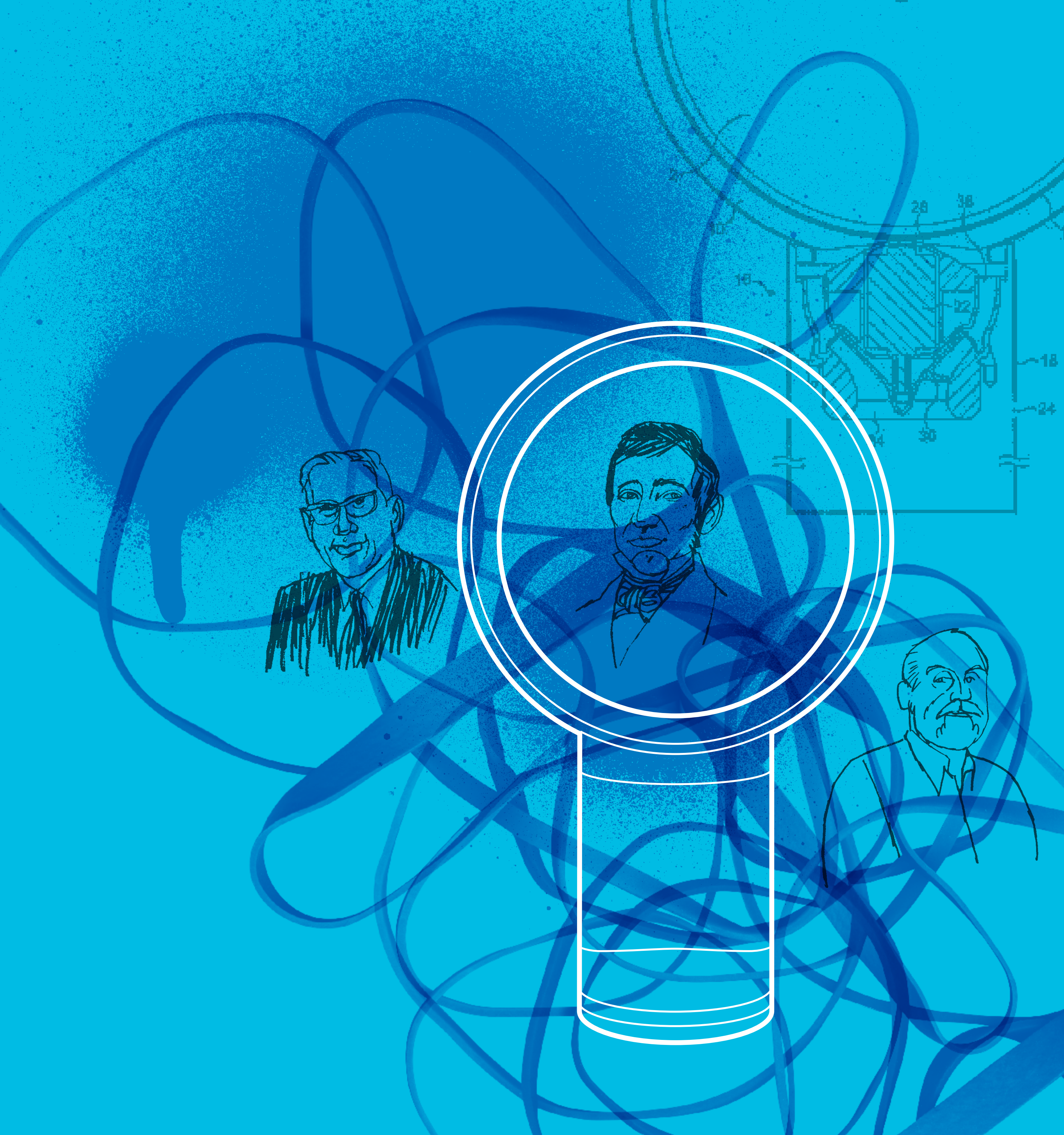
James Dyson	Bagless vacuum cleaner	1993
Alec Issigonis	The ‘Mini’ car	1959
Fiona Fairhurst	The ‘Fastskin’ swimsuit	2009
Frank Whittle	The jet engine	1930
Mary Anderson	Windscreen wipers	1903


746F


speedo

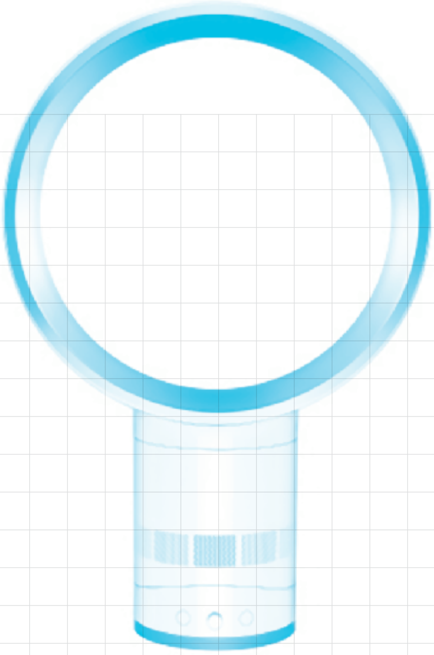


Section 2: Design detectives



Factsheet

Air Multiplier™ technology



Development story

Since 1882, electric fans have relied on spinning blades to cool people. But blades chop the air before it hits you – this is called buffeting. Fast-spinning blades can also 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. It is also hard to clean when it gets dusty. These were the problems that Dyson engineers were trying to solve when creating the Air Multiplier™ fan.

It took a team of engineers, scientists, and physicists four years to develop. Getting as much air through the fan as possible, and working on its centre of gravity – its balance – were the key points. They used maths to figure out exactly the right angle at which to accelerate the air.

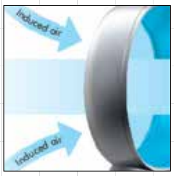
HOW DOES IT WORK?

An impeller draws air into the base of the machine, spinning up to 8000 times a minute. This is similar to the technology used in jet engines.

NB an impeller sucks air in. It's the opposite of a propeller.

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.



As the air passes over the ramp, it also draws air in from behind the fan. This is called inducement.

The air around the fan is also drawn in; this is called entrainment. As a result of inducement and entrainment, the amount of air is increased by 15 times.

The motor has been tested to the equivalent of 38,000 hours usage; that's 10 years usage at 10.5 hours a day.

It channels in 23 litres of air a second, that's almost 70 cans of coke!

OTHER FACTS

There is a dimmer switch so you can control exactly what speed you would like rather than being restricted to two or three pre-set speeds.

There are currently over 200 patents worldwide on the Dyson Air Multiplier™ fan.

It weighs in at less than 1.8kg, almost half the average weight of other fans.

See **Design Detectives:** Chapter 2 on the DVD. Let our engineers explain how it works and the process behind it.

Q&A

A short guide on how to answer some of the questions your curious class may have.

Why/how does a fan cool you down? Is the air chilled?
A fan moves air around more rapidly. This makes it easier for sweat to evaporate from your skin, helping you to cool down.

e.g. Think of a cold day. Often, it is the wind that makes you feel colder. This is called the windchill factor.

e.g. Blowing on hot soup to cool it down. The warmth from the soup heats the air around it. That layer of air rises because it's hotter than the surrounding air. The process repeats again. By blowing cold air onto the soup, you are accelerating this process. This is called heat loss through convection.

How does a normal fan work?
In a normal fan, the motor is located in the centre, and has blades attached to it. Each blade is at a slight angle, so that when the motor turns, the blades force air forward. The fan is taking air from the area behind, and blowing it forward.

How does a Dyson Air Multiplier™ fan work?
Air is sucked into the base of the machine. It is then drawn up into the loop, and forced out of a small gap and down a ramp causing the air to accelerate. As it goes over the ramp, more air from behind and around the fan is drawn in.

Why doesn't a Dyson Air Multiplier™ fan need blades?
It creates airflow in a completely different way (See **How does a Dyson Air Multiplier™ fan work?** page 15). Conventional fans create a wave-like pulse in airflow by 'chopping' the air with the blades.

What are the advantages?
Without spinning blades it is:
– Safer
– Easier to clean
– Less top heavy
– No chopping the air, so it's a smooth airstream.

Also, the motor acts as a weight in the base so that the fan can be tilted and stay in the position you choose.

What is it made of?
It is made from ABS, a type of plastic that is used to make light, rigid and moulded products. It has good shock absorbing properties and is also used to make car bumpers, crash helmets and modern golf club heads.

Why is it noisier when you turn it up?
The motor spins faster and draws in more air on a higher setting. The noise increase is due to more air rushing through the machine.

Poster pointers

Poster 3:
Everyday design

The aim of this poster is for pupils to realise that everything around them is designed, and that design engineers are the people behind that.

Something to note is the range of dates when the objects were invented. They're all still in use in the classroom today, but they span 500 years of development. Get the students to guess which is the oldest (Answer: the pencil in the 16th century).

This poster could be used as a stimulus before deciding on a product that the students want to create.

Lesson 2

Section: Design detectives
Duration: 1 hour

Learning objectives:

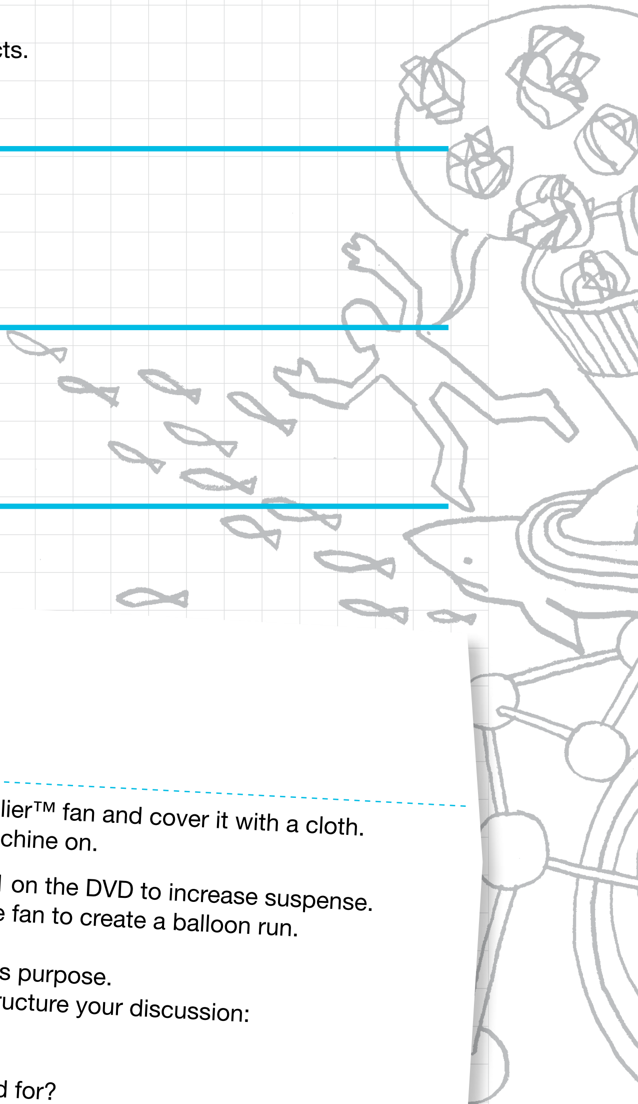
1 To become familiar with the idea of radically re-designing everyday objects.
2 To develop critical analysis skills.
3 To share ideas and discuss design possibilities.

Activity outcome:

– Class discussion around the Air Multiplier™ fan.
– Completed design hunt around the classroom.
– A class list of chosen products to improve.

Things you will need:

– The Dyson Air Multiplier™ fan.
– A selection of everyday objects around the classroom.
– Individual copies of the **PMI worksheet** (page 20).



Starter: 10 minutes

What am I and why?

Learning objective	Activity
1 & 2	Before the lesson, set up the Dyson Air Multiplier™ fan and cover it with a cloth. Don't reveal its purpose, name, or turn the machine on.
1 & 2	Use **Design Detectives: Chapter 1** on the DVD to increase suspense. It shows design engineers using the fan to create a balloon run.
1 & 2	Take answers and possible suggestions over its purpose. You could use the 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?
1 & 2	Reveal its purpose, and use the fan factsheet to explain and answer any technical questions. Use **Design detectives: Chapter 2** on the DVD. This uses real-life design engineers to explain the technology.
1 & 2	It is important to emphasise that it was designed to solve some of the problems with conventional fans, and that the students will be doing the same with this project – solving everyday problems. Link back to the characteristics of a design engineer from lesson one.

Main: 35 minutes

Design hunt

Learning objective	Activity
2	Explain to pupils that this part of the lesson is about them being design detectives. They will be applying their critical analysis skills to everyday objects, and working in groups to complete the activity.
2	Use the **Everyday design** poster 3 (page 17) to introduce the idea of design being all around them.
2	Explain to the pupils that they will be going around the classroom and hunting for objects or products that don't work well or have design possibilities.
2	Give the pupils some suggestions to inspire them. For example a school chair, a pencil storage box, a desk tidy or a book bag.
2	Explain that to support their thinking, the class will use an analysis technique called **Plus, Minus, Interesting** (PMI). Allow pupils time to discuss what they think Plus, Minus, Interesting means. **Definition for the teacher:** PMI is a way of looking at products from all points of view. **Plus** – pupils should list all the good or positive aspects of the product. **Minus** – pupils should list all the features that are not positive, are bad or do not work. **Interesting** – pupils should list the features that are interesting and could be developed further; they should look for possibilities in the product.
2	Put the class into pairs and give them each a **PMI worksheet** (page 20). This should include which object they have identified and why it does not work. An alternative method is to identify in advance a selection of objects around the classroom which you would like the students to analyse, including ones that you think would be a good project focus. Attach a large PMI sheet to each of these so that the students can record their thoughts as they visit each object.

Plenary: 15 minutes

Ideas evaluation

Learning objective	Activity
3	As a class, look at the objects that students have selected and ask students to share their findings. Pupils should be encouraged to talk about which aspects of the product frustrated them.
3	Decide as a class which objects could be realistically redesigned and improved. This will be the focus of the project. You could also consider dividing the class into small groups each with a different object to work on depending on time and ability.

Here's a few suggestions to get you started:

– desk tidy
– pencil case
– lunch box
– classroom storage
– light/nightlights
– playground equipment

PMI worksheet

Name:
(Design engineer in training)

Product:
Draw a quick sketch

Plus
What works well?

Minus
What does not work well?

Interesting
What do you find interesting or different about the product?

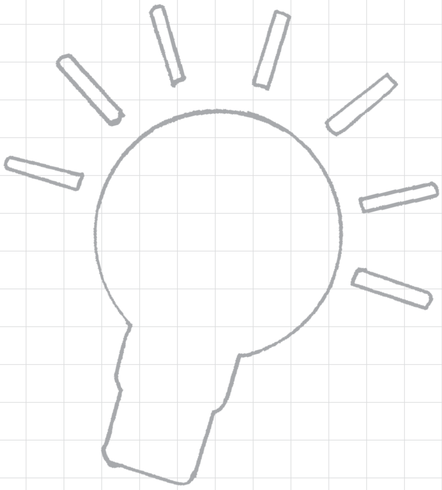
Section 3: Design

Dyson does it:

Design process

The 'Research, Design and Development' department at Dyson

Good ideas come from identifying problems with existing products, and solving them in a creative way.



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

The research section is responsible for looking into new and exciting technologies, often without a particular machine in mind.

RDD is then split into New Product Innovation (NPI) and New Product Development (NPD). It's NPI's role to think differently, and come up with new solutions to old problems. Their ideas are then passed to NPD who figure out how to make an idea work through building and testing prototypes.

Brief and specification

The starting point is a design brief. It explains the problem that the new product must solve, and any other factors the design engineer must consider. A product might need to be a certain size or perform a particular function. For example, for the DC26 machine, engineers had to solve the problem of modern homes having little storage space; their solution was a vacuum that's small enough to fit on an A4 sheet of paper.

The specification is then the measuring stick for a design – it's a list of requirements and features that a machine should have. The team will refer back to this throughout the design process.

Sketching

Sketching is an important way of communicating ideas. Each engineer carries a sketchbook which they use to jot down any sketches. They must sign and date each page to show who the idea belongs to. When they're working on a new design, they give it a code name so they can talk about it without giving away their secrets.

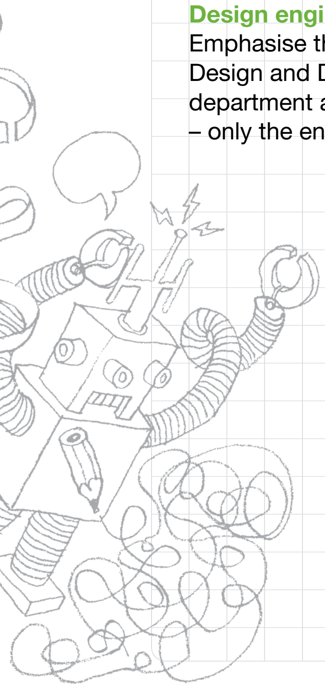
Poster pointers

Poster 4:
Design

The message to reinforce is that sketching is a means of communication – it's not art. These sketches are starting points that are then turned into 3D models. Use the quotation from James Dyson to support this.

To practice quick sketching, ask the students to draw a sketch of a product they've used that day on a Post-It®, and attach these to the right-hand side of the notebook image on the poster.

Design engineering is exciting! Emphasise that the Research, Design and Development department at Dyson is top secret – only the engineers are allowed in!



The example of Issigonis drawing his first design on a napkin over lunch is also good to reinforce the idea of drawing to explain and communicate.

Lesson 3a

Section: Design
Duration: 1 hour 20 minutes

Learning objectives:

1 Investigate how materials and components can be combined and joined accurately.
2 Understand that materials can be joined in temporary and permanent ways.
3 To explore techniques for reinforcing and strengthening materials.
4 To practice cutting materials safely and accurately using a range of experience appropriate tools.
5 Develop sketching techniques to improve communication of ideas.

Activity outcome:

– A completed series of 'skills spotlights'.
– A record of each skill learnt, using a range of different recording techniques.

Things you will need:
(select according to the skills being practiced)

– Range of materials, card, cardboard, correx, plastics, wood, dowelling, balsa wood, reclaimed materials (yoghurt pots, cereal boxes etc)
– Masking tape, sticky tape
– String
– Scissors
– Bench hooks, junior hacksaws, g-clamps
– Card drill
– Binders
– Sand (glass)
– Glue – various types
– Elastic bands
– Velcro® (self-adhesive)
– Utility snips
– Hole punch
– Paper fasteners
– Card cylinders
– Hammer, nails, panel pins

Starter: 5 minutes

Introduction to 'skills spotlights' and materials that will be used

Prior to this lesson the classroom will need to be set up with four work stations (groups of tables). A different 'skills spotlight' will need to be set up on each station. Necessary materials and tools are listed on pages 26 – 27.

Learning objective	Activity
1, 2, 3, 4 & 5	Explain to the students that today they are going to be learning and practising a number of different skills and techniques, which they may want to use when they make their final product. Emphasise that this is an opportunity to explore and experiment in order for them to make the appropriate design decisions.
1, 2, 3, 4 & 5	The teacher will then need to model some, if not all of the skills stations (this will depend on the age of the students and what experience they already have). Safety will also need to be highlighted here, especially on the tables where students are cutting materials.

Main: 1 hour (allow 15 minutes per station)

Design toolkit

Learning objective	Activity
1, 2, 3, 4 & 5	Students to spend 15 minutes on each station practising and refining the techniques. Students should spend 10 minutes practising the skill/technique and then 5 minutes tidying the table to get it ready for the next group on the rotation. It might be a good idea to get an adult helper to work on each of the tables, to help the students practice the skill. Whatever age, an adult must be on the table where students are cutting materials, especially if craft knives are being used.
1, 2, 3, 4 & 5	Throughout the lesson have mini plenaries to discuss any 'top tips' the students might have discovered along the way.
1, 2, 3, 4 & 5	Where possible the teacher should try and write down the tips that the students suggest. This will then be a good starting point for reminding students of the techniques when it comes to making the final product. The teacher could also take photos or videos of the students completing the tasks as a way of reminding them about the different techniques practiced at the beginning of the **Build** lesson.

Plenary: 15 minutes

Skills review

Learning objective	Activity
1, 2 & 3	Get the students to think about each of the different 'skills spotlights' one by one. In pairs get them to discuss: – What went well when practising the skill? – What did they find tricky when practising the skill? – How could they improve their technique when it comes to making the final product? – What did they think about the quality of the outcome?
1, 2 & 3	Get several students to share their feedback with the class and record for future reference.

Lesson evaluation

To what extent have the lesson objectives been met?

What do I need to carry forward to the next lesson?

Notes on specific pupils/projects:

Design toolkit ↙

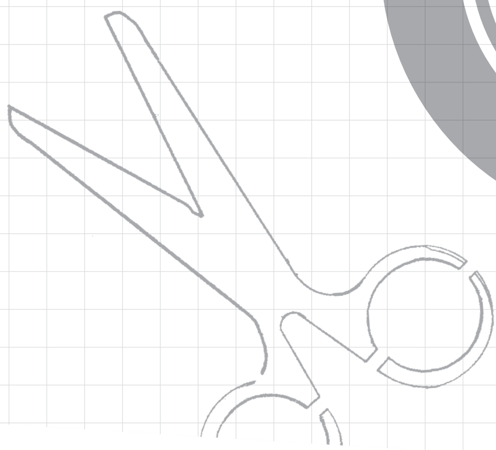
Below are some suggestions of 'skills spotlights' you could use to make up your design lesson.

The aim is to equip students with skills that will help them make their product. As the project is based around using paper, card, or wood, you should focus on these materials during this session.

Feel free to adapt these to your class and the project you have chosen.

This section can be combined with or extended using the 'Numeracy – nets and geometric shapes' (page 52) or 'Numeracy – measuring and recording' (page 54) optional activities. A 'Construct a cyclone' kit is provided in the 'resources' section on page 33.

There is also an opportunity to explore the properties of materials, linking to the primary science framework.



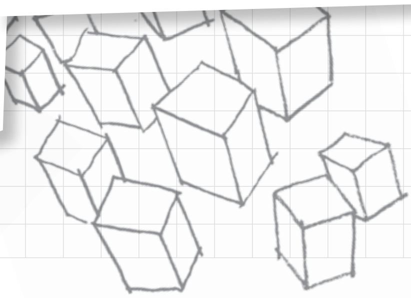
1. Sketching

Introducing sketching as a way of communicating ideas is an important part of the design process.

- **Isometric paper** is provided on page 28. Practice drawing shapes on normal paper and on the geometric paper. Ask the students to think about how it's different, whether it's easier and why?
- **If you have a class set of mini whiteboards**, use these to draw shapes or products around the classroom. These are useful for emphasising that sketching should be a quick activity to convey an idea, rather than a beautiful drawing.
- **Print photos of everyday objects**, and cover with transparent paper. Ask the students to sketch improvements. This could link back to the problem hunt in **lesson 2**.
- **Shading**. Using either printed images of geometric shapes, or shapes the students have drawn themselves (perhaps the ones from the geometric paper), practice shading the shapes to create a 3D effect.

2. Marking and cutting

- **Experiment with different cutting techniques** on the three different materials. Think about using a hole punch, scissors, a paper drill, a cocktail stick and blu tac, and for older students a craft knife with adult supervision and assistance.
- **Record which worked well, and which did not**. This could be in a chart, or as a speaking and listening discussion after the lesson. Record it in a format for the students to refer back to in the next lesson.
- These techniques could be used to **cut shapes as well as lines**. Students could try cutting out and assembling the cyclone on page 33.



See the **Design section Chapters 1 and 2** of the DVD and **poster 4: Design** for tips on sketching and cardboard modelling.

3. Joining materials

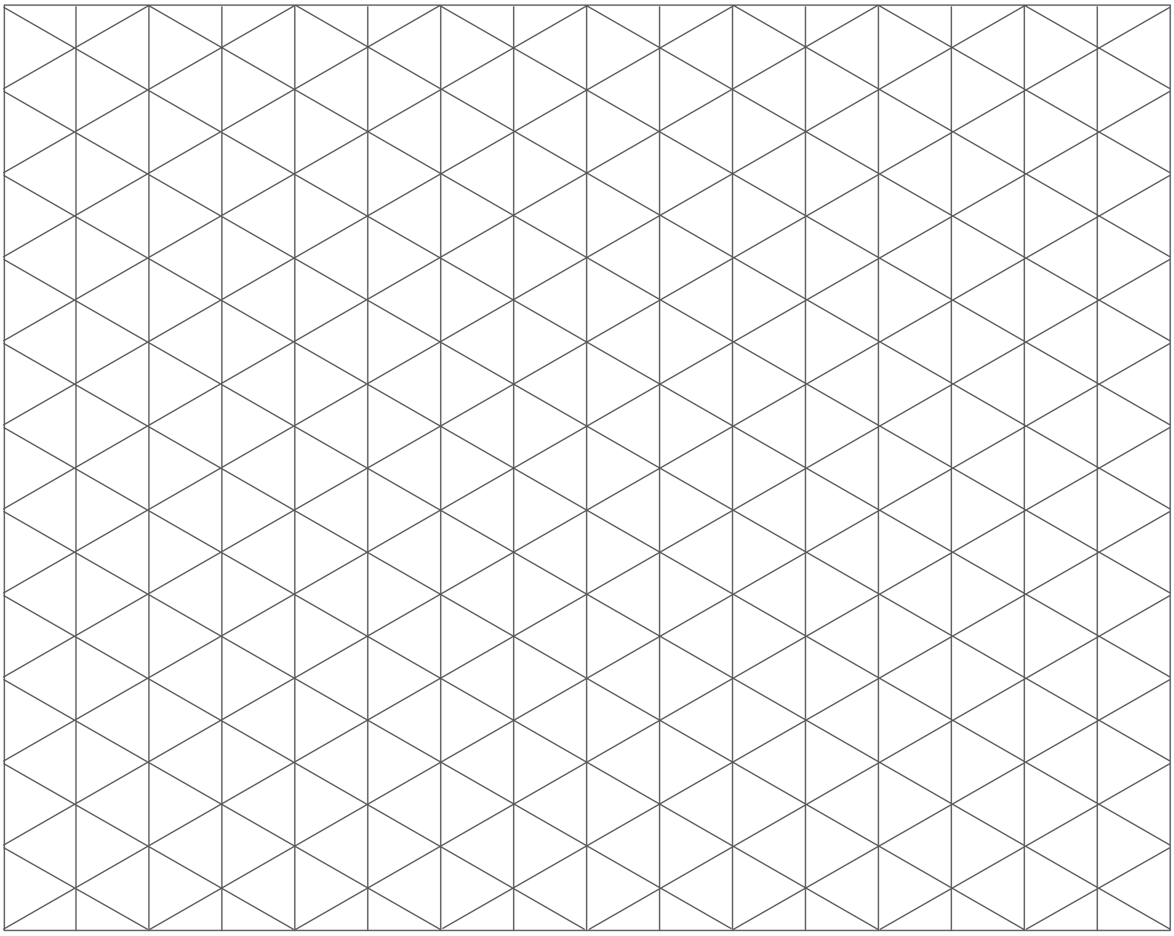
- **Experiment using different adhesives to join the materials.** You could use glue, staples, split pins, string, fabric or card.
- **You could experiment with joining different shapes**, such as attaching a cylinder (kitchen roll tube) to a box. Joining paper straws is also interesting.
- **Record what worked well, and what did not.** This could be in a chart, or as a speaking and listening discussion after the lesson. Record it in a format for the students to refer back to in the next lesson.
- **This can be developed** by using the joins to make basic hinges.

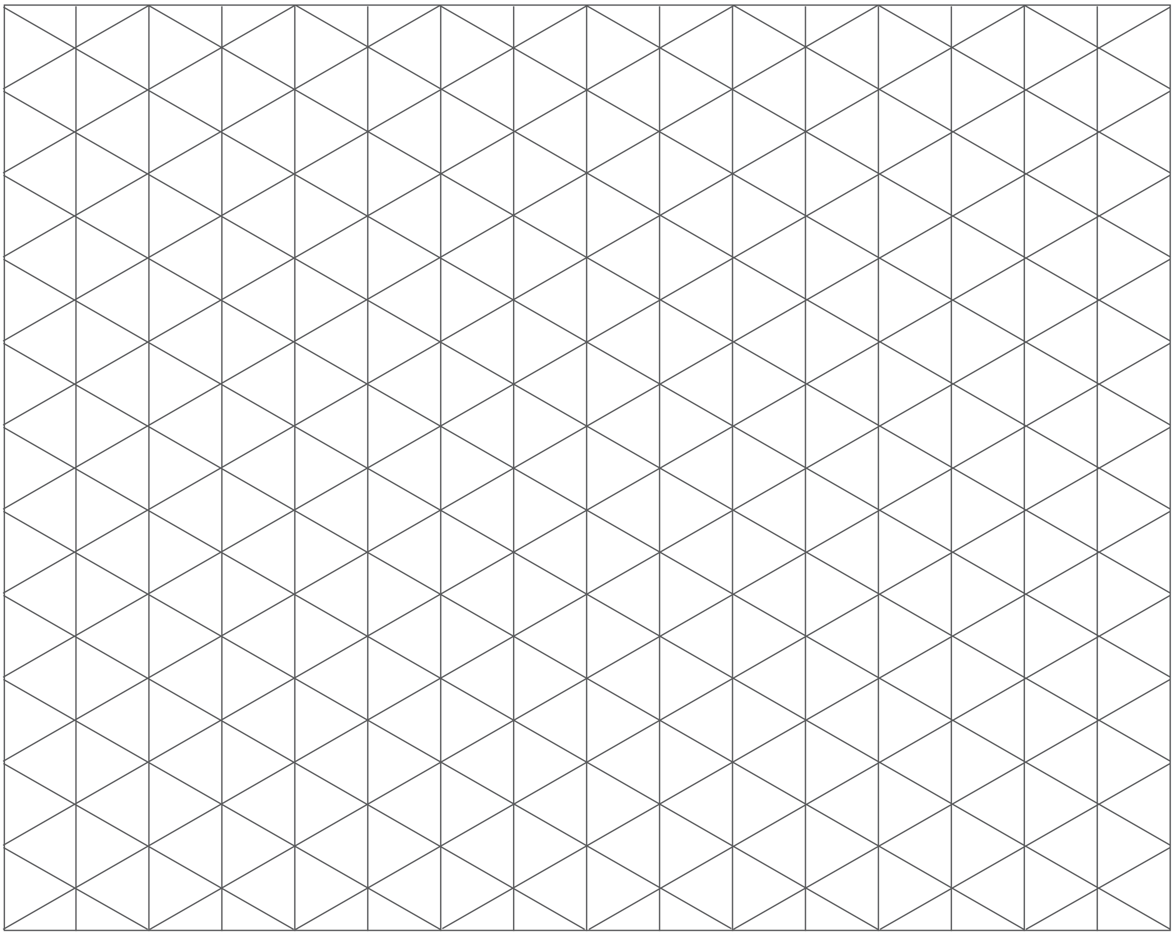
4. Strengthening and reinforcing

As the project is focused on paper, card and wood, it's important to learn how these structures could be strengthened to create a more robust prototype.

- **Paper can be folded to strengthen it.** Think about layering paper, gluing paper together, folding it, particularly into a concertina. By folding paper into a cylinder or cuboid shape, it can stand up.
- **Similar techniques can be used with card.** Students could also practice scoring in order to make a neat, straight fold. With corrugated card, bends and curves can be created by scoring in the middle of the corrugation. This helps to create neater models.
- **Wood could be used to create a basic cube or cuboid frame.**

Resources: lesson 3a Isometric paper





Brief:

Think you can do better...?

Choose something in your classroom or in the home that does not work well.

Identify the main problems with the product, and design something that works better.

Make your idea using paper, card or wood.

Lesson 3b

Section: Design
Duration: 55 minutes

Learning objectives:

1. Understand the importance of planning before making.
2. Exercise forward-planning skills.
3. Learn how best to break a challenge down into a series of tasks.

Activity outcome:

– Design specification(s) for the project.
– A class production plan.

Starter: 15 minutes

Introduce the brief and example specification

Learning objective	Activity
1	Introduce **The brief** (page 29) to the students. Get them to discuss what they think this means. Gather their initial thoughts about the project.
1	Go back to **Lesson 1 – What is a design engineer?** (page 9) – think about the characteristics of a design engineer. Question their ideas and challenge them to start thinking about the project as a design engineer.
1	Show them the words ‘design specification’ – what do they think this means?
1	Get 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.

Main: 30 minutes

Writing a specification

Learning objective	Activity
1 & 2	Ask the students to think carefully about who will be using their product and the function of the product (purpose). The **What does a design engineer look like?** worksheet (page 11) could be used to draw and describe their user.
1 & 2	Ask students to produce a specification. Hand out the **My specification worksheet** (page 32). Give them a limit on the number of criteria. As a teacher you might like to decide on some as a class together and then allow the students to set a few more themselves. They will need to think about 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...
1 & 2	The teacher needs to 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.

Plenary: 10 minutes

Production planning

Learning objective	Activity
2 & 3	As a class, or in groups if working on different projects, produce a production plan.
2 & 3	Consider using techniques such as flow charts.
2 & 3	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?
2 & 3	Record the class plan in a format that can be easily shared during the **Build** sessions.

Lesson evaluation

To what extent have the lesson objectives been met?

What do I need to carry forward to the next lesson?

Notes on specific pupils/projects:

My specification worksheet

Name: **(Design engineer in training)**

My specification is...

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

I am designing:

1 It must...

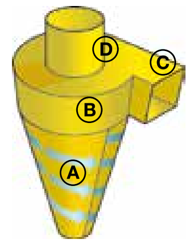
2 It should...

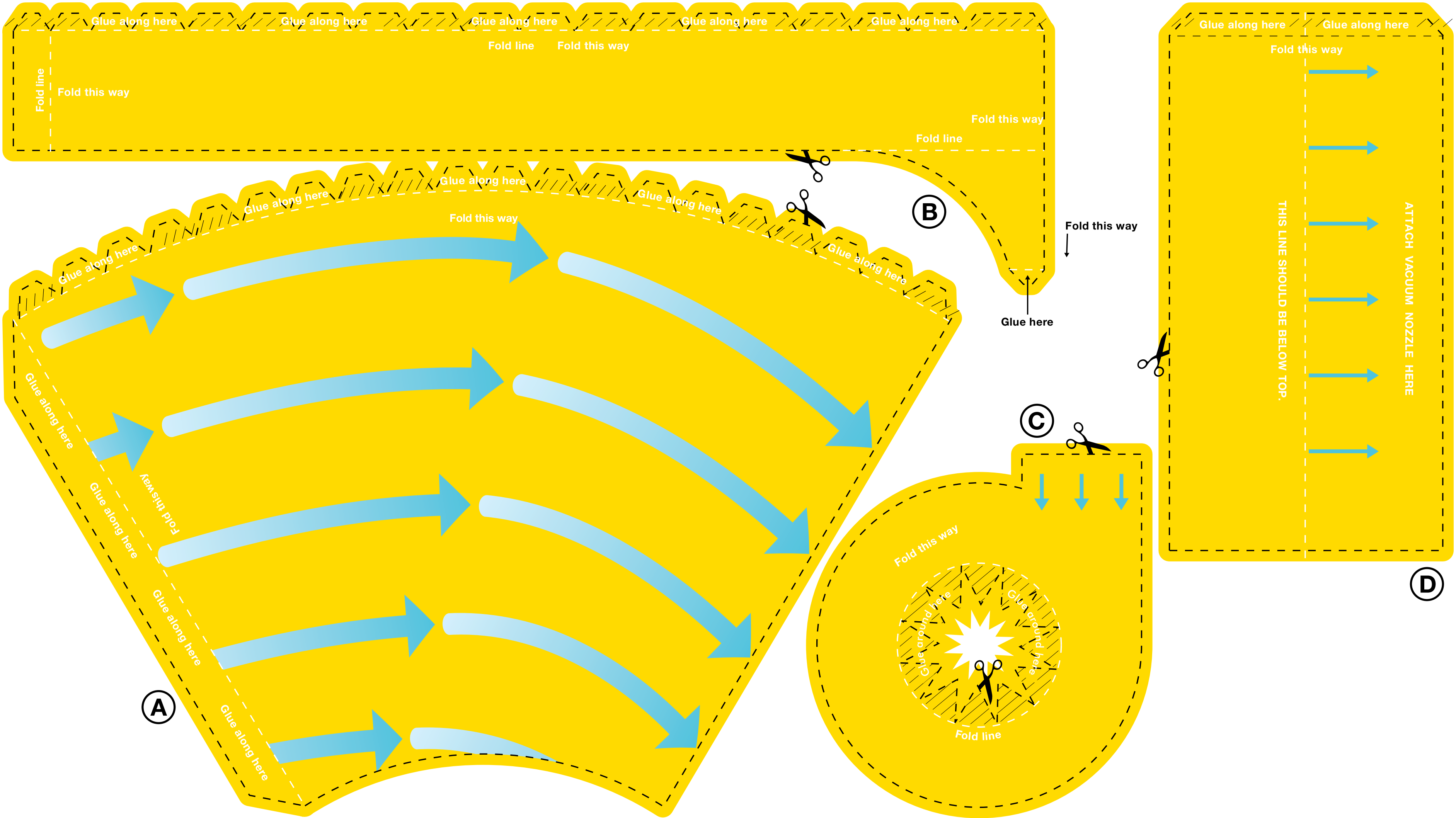
3 It would be nice if...

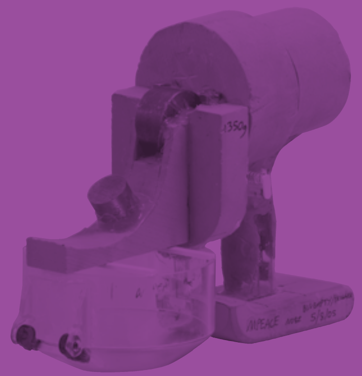
Create your own cyclone.

You will need thin cardboard or acetate, scissors and a glue gun.

1 Photocopy the templates on to a sheet of A3 acetate or thin cardboard.
2 Cut out **shape A** along black dotted lines. Score along the white dotted lines and fold. Glue the edge (as indicated) and stick to the opposite edge, creating a cone-like shape.
3 Cut out **shape B** along black dotted lines. The curve at the bottom right of **shape B** will create the cyclone's inlet pipe. Score along the white dotted lines and fold. Apply glue to the tabs on the top edge of shape A and attach the long straight edge of **shape B** to these tabs. The tab on the curved area of **B** should be glued and attached to the back of the folded edge, thereby making the inlet pipe.
4 Cut out **shape C** along black dotted lines.
5 Cut out **shape D** along black dotted lines. Roll into a tube along its width. Glue.
6 Apply glue to the tabs in the centre of **shape C**.
7 Slot the tube **(D)** into the hole in the centre of **shape C**. Half of the tube should protrude from the hole. Fix into place.
8 Apply glue to the tabs at the top **of shape B**. Sit **shape C** on top of these tabs and fix in place.
9 Now you can try out your very own cyclone! Attach the hose of a vacuum cleaner to the tube at the top of the cyclone **(shape D)** and turn on the cleaner. Hold some dirt or shredded paper to the inlet on the side of the cyclone. Now see how the cyclone separates the dirt from the air, spinning the heavier dirt to the edge of the cyclone.







Section 4: Build

Dyson does it:

CAD and prototyping

Sketching on paper is the starting point. When the design engineers have decided on one or two ideas they'd like to pursue, they start making 3D models of their design.

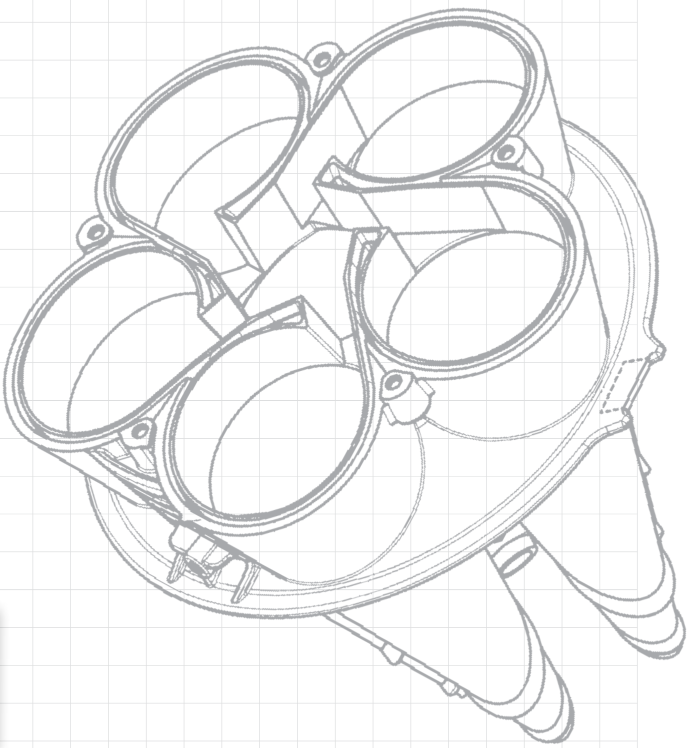
For each Dyson machine, hundreds of prototypes are created, starting with cardboard models – a simple, cheap, and effective way to test out what something might look like in 3D. Weights can then be added to these prototypes to see how a product might feel to use.

Computer Aided Design (CAD) is then used to create detailed computerised 3D images of individual parts, and even do virtual testing. Graphics for computer games are created in the same way.

After the CAD file has been created, it can be sent to a 3D printer – just as you would send a normal document to the printer. At Dyson, rapid prototyping machines are used. These take the CAD image and slice it into many thin layers – like a loaf of bread. The rapid prototyping machine then prints each of these layers and stacks them on top of one another to create a model.

These prototypes are expensive, costing up to £10,000 for one Dyson machine, but they're essential to get an accurate idea of how a machine will perform. By testing them and finding any weak spots, the design can be improved.

Once the design is finalised, the CAD file is sent to the manufacturers. Dyson machines are mostly produced by injection moulding. A metal mould is made in the shape of the part. Hot plastic is squirted into the mould and is left to set for a few seconds. The mould then opens up, and the part is taken out.



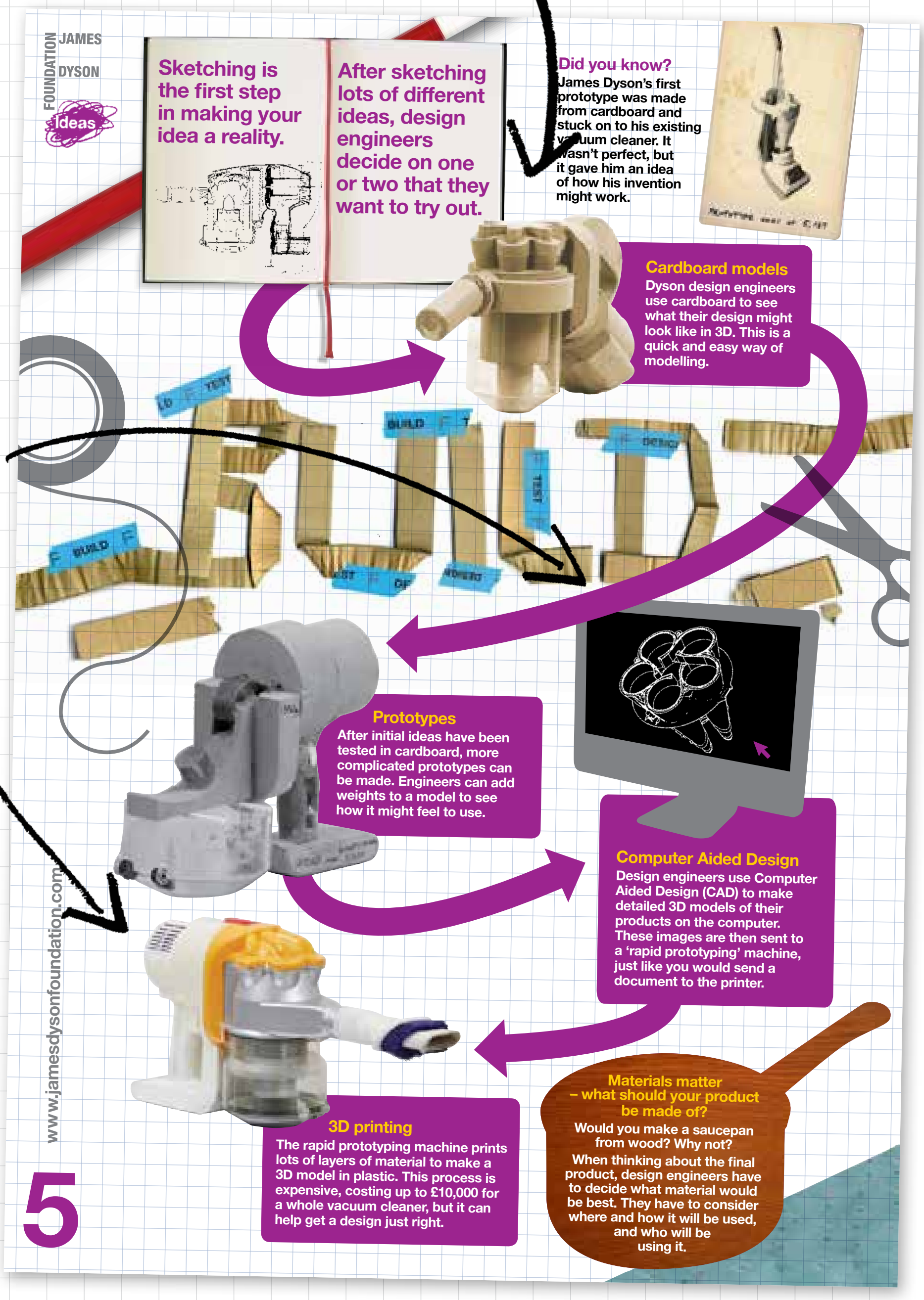
See **Build** section on the DVD to see CAD in action.

Poster pointers

Poster 5:
Build

This poster shows the ongoing development that's part of the design process. Many different models are made and improved upon before the machine is ready for the shops.

Emphasise that even professional design engineers start with simple materials, such as cardboard, and link this to materials you may be using in your project.



This is a good opportunity to talk about rapid prototyping and 3D printers. These machines print in layers to make a 3D model. Refer to the **Dyson does it** resource sheet (page 35) for more information on the process.

You could start a discussion on future uses for this technology.

For example:

– The University of Bath has made a 3D printer called the 'RepRap' that can make copies of itself for only £500 instead of the original £30,000. In a few years, every school, home, and office could have one – new products, such as an MP3 player, could be downloaded and printed instantly in your own home!

– Prototypes exist for 3D food printers. They use liquid food, such as vegetable puree or melted chocolate, instead of inks to print with.

Lesson 4a

Section: Build
Duration: 1hr–1hr 20 minutes

Learning objectives:

1 Feel prepared for the activity, and re-enforce skills learnt so far.
2 Develop practical skills.
3 Learn that design is a process, needing refinement.
4 Consider the properties of materials and make judgements as to the most appropriate.
5 Reinforce design decisions that were made, and learn to keep to a specification.

Activity outcome:

- Create a series of prototypes experimenting with different materials and their properties.
- In this lesson there are opportunities for speaking and listening activities which can enable the students to share their thoughts and opinions on the project so far.

Things you will need:

- Range of materials, card, cardboard, correx, plastics, wood, dowelling, balsa wood, reclaimed materials (yoghurt pots, cereal boxes etc)
- Masking tape, sticky tape
- String
- Scissors
- Bench hooks, junior hacksaws, g-clamps
- Card drill
- Binders
- Sand (glass)
- Glue – various types
- Elastic bands
- Velcro® (self-adhesive)
- Utility Snips
- Hole punch
- Paper fasteners
- Card cylinders
- Hammer, nails, panel pins

Opportunity to link to **Destructive testing** optional extension activity (page 56).

Starter: 10 minutes

Recap and prepare

This session is about trying out initial designs in different materials in response to the brief.

Learning objective	Activity
1	Prior to the lesson lay out the classroom using the ‘build’ related skills stations used in **lesson 3a**. Also include paper and sketching materials on each station.
1	Explain that design is a process, and part of that is prototyping and trying different ways of achieving your design. Use **Poster 5** and the **Build** section of the DVD for information on CAD and prototyping at Dyson. Link back to how design engineers work and the development of the Dyson Air Multiplier™ fan.
1	Recap the skills learnt so far, using the **Design toolkit** lesson (page 26). Remind students of the rules of the skills stations, e.g. number of students, safe use of the equipment and activities that can be carried out away from specific stations.

Main: 45 minutes – 1 hour

Practice and prototype

Learning objective	Activity
2	Divide students into small groups, and start each group at a different station.
2	Allow them 15 minutes sketching time to draw an idea. Then allow 10–15 minutes making time per station. Please note that this time can be adapted to age and ability.
2	Stop activities to highlight unsafe/safe practice.

Plenary: 10 minutes

Compare and contrast

Learning objective	Activity
3, 4 & 5	As a class, discuss which materials worked well, and for what purpose. Explore why that might be.
3, 4 & 5	Encourage students to think about which materials would be most suitable for their final product and why. Explain that this is what you will be doing in the next lesson. Before lesson 4b, opportunity to use optional **Numeracy** extension on **Nets and geometric shapes** or **Numeracy and enterprise** (page 52 and 53).

Lesson evaluation

To what extent have the lesson objectives been met?

What do I need to carry forward to the next lesson?

Notes on specific pupils/projects:

Lesson 4b

Section: Build
Duration: 1hr – 1hr 15 minutes

Learning objectives:

1. Develop practical skills and follow a production plan.
2. Apply materials knowledge and skills learnt.
3. Develop self-evaluation skills.

Activity outcome:

– By the end of this lesson the students should have produced a final product (however this lesson can be extended or repeated if more time is needed).

Things you will need:

– Range of materials, card, cardboard, correx, plastics, wood, dowelling, balsa wood, reclaimed materials (yoghurt pots, cereal boxes etc)
– Masking tape, sticky tape
– String
– Scissors
– Bench hooks, junior hacksaws, g-clamps
– Card drill
– Binders
– Sand (glass)
– Glue – various types
– Elastic bands
– Velcro® (self- adhesive)
– Utility snips
– Hole punch
– Paper fasteners
– Card cylinders
– Hammer, nails, panel pins

Starter: 5 minutes

Ready, get set...

Learning objective	Activity
1	Prior to lesson, lay out the classroom using the skills stations used in **lesson 3** and **4a**. Additional space and materials may be needed if many students need to visit similar stations at one time.
1	Refer back to the class production plan produced in **lesson 3b**, and have their specification to hand so they can refer back to it.
1	Ask the students to note on their production plan which station they need to visit to complete the different steps they have identified. They should draw on their experience from prototyping in **lesson 4a** to choose appropriate materials.

Main: 45 minutes – 1 hour

Go! Production

Learning objective	Activity
2 & 3	Following the class production plan from **lesson 3b**, students to produce their model.
2 & 3	Stop activities to highlight unsafe/safe practice.
2 & 3	During production allow students to discuss the development of their product with a partner. Discuss any changes that have been made during production and the reasons for these. Support the use of correct terminology.

This part of the lesson can be extended or repeated if more time is required.

Plenary: 10 minutes

'Spec. check'

Learning objective	Activity
3	Ask the students to re-visit their specification.
3	In small groups ask the students to share their products. Identify where they have deviated from the specification. 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/improvement?

Opportunity to use optional numeracy cross-curricular activity on 'measuring and recording' on page 54.

Lesson evaluation

To what extent have the lesson objectives been met?

What do I need to carry forward to the next lesson?

Notes on specific pupils/projects:

Section 5: Test

Dyson does it:

Testing

Facts:

15,000km

is the distance that the average Dyson prototype travels during endurance testing – that's 25 times the distance from London to Edinburgh.

5°C – 80°C

is the temperature range that Dyson's four custom built environmental chambers can imitate.

150

is the number of times a Dyson machine is dropped from a height of 250mm above the floor.

From robots to obstacle courses, see what Dyson machines are put through in the **Test and evaluate** section of the DVD.

Having a working product is not the end of the design process. You must test your design. It allows you to see what might happen to your product when people start to use it, to find the weak points, and improve it.

Mechanical testing

To simulate a lifetime of use, Dyson uses test robots. They can repeat complex actions many times in a controlled manner. One prototype will undergo 10,000 repetitions by a test robot.

High speed cameras are also used to help analyse what is happening. The high speed camera takes 40,000 frames a second, allowing the engineers to see things like tiny dust particles moving through the machine.

Real life testing

It's not just a case of testing mechanically, there is no substitute for getting the machine in human hands. Dyson has a user course – a kind of obstacle course – where a team tests the machines to breaking point. two hundred cycles of the user course must be completed before full scale production commences.

Scientific testing

Dyson also has a laboratory. Here scientists investigate how to make Dyson machines – and the places they are used – more hygienic. For example, with Airblade™ hand dryers this means killing the bacteria that live on damp hands. It's the same with germs.

Try it out:

The glitter test

See for yourself how wet hands transfer germs. Wash one hand and shake off excess water. Put that hand gently into a tray of glitter. What happens when you shake hands with the person next to you? And if they shake hands with someone else?

Poster pointers

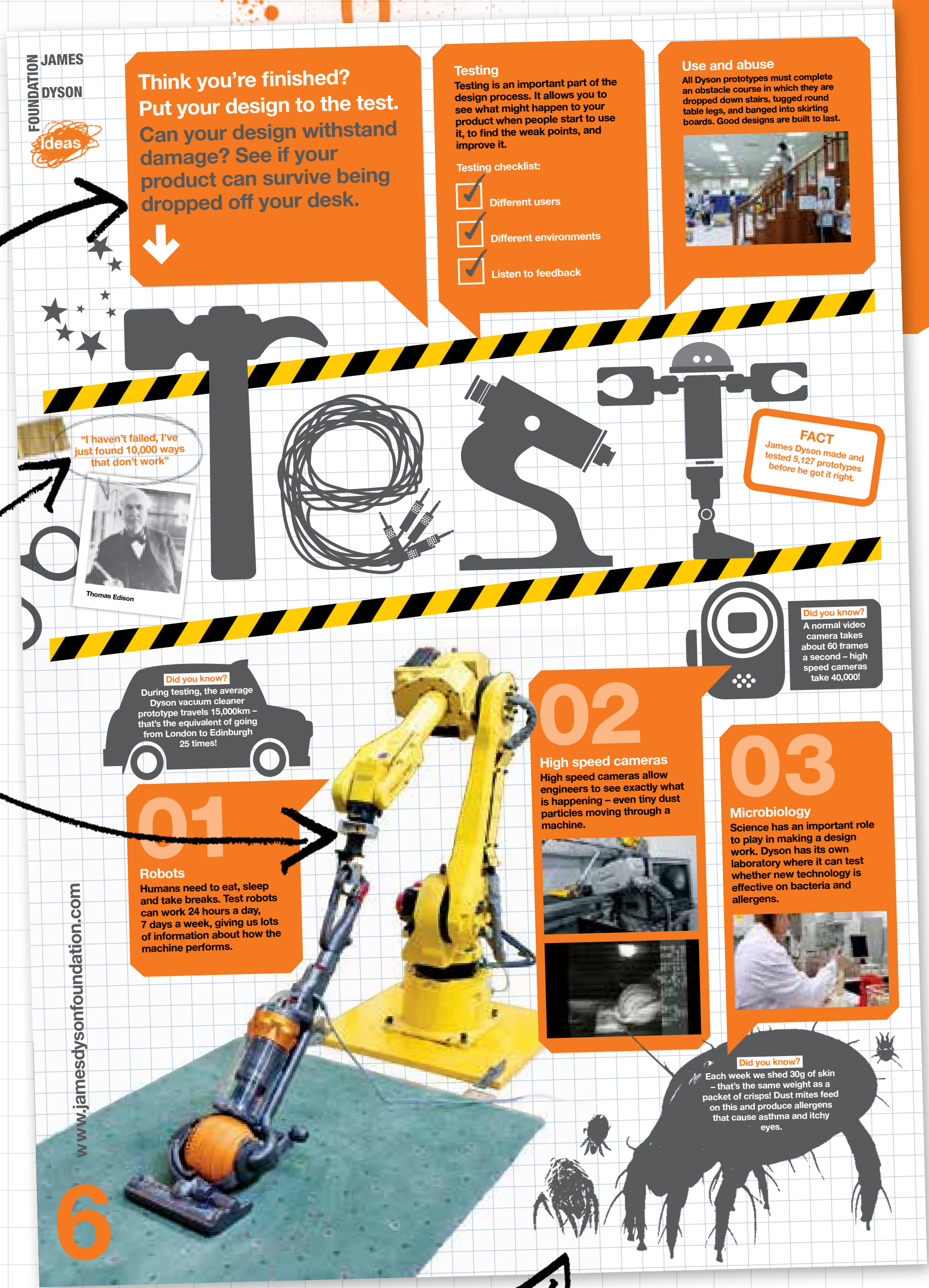
Poster 6:
Test

It's important to emphasise that making is not the end of the design process. Nor is testing. **Design, Build, Test** is a loop that is repeated many times to make the design as good as possible.

Refer to the 'think you're finished' section. Use it as a prompt for students to start evaluating each other's designs.

Accepting failure is a key theme. If a design fails, it's positive as it helps you to improve. Refer to the quotations from Thomas Edison and James Dyson as real-life examples.

Note the scale of testing that takes place; a machine must be tested for a lifetime's worth of use, so robots are used to help simulate that.



Use the 'Microbiology' section to show that other disciplines feed into design. In your projects you could draw on science and maths skills to record test results and look for trends. See the optional extra-curricular activities section for ideas.

Lesson 5

Section: **Test and evaluate**
Duration: **45 minutes**

Learning objectives:

1 Reinforce that designing and making is producing something, for someone, for some purpose.
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 has changed in the light of the project.
5 To celebrate achievement.

Activity outcome:

– Completed **PMI worksheets**.
– Updated or new **What does a design engineer look like?** worksheet (page 11).
– Comparative display.
– Pupils presented with certificate of achievement.

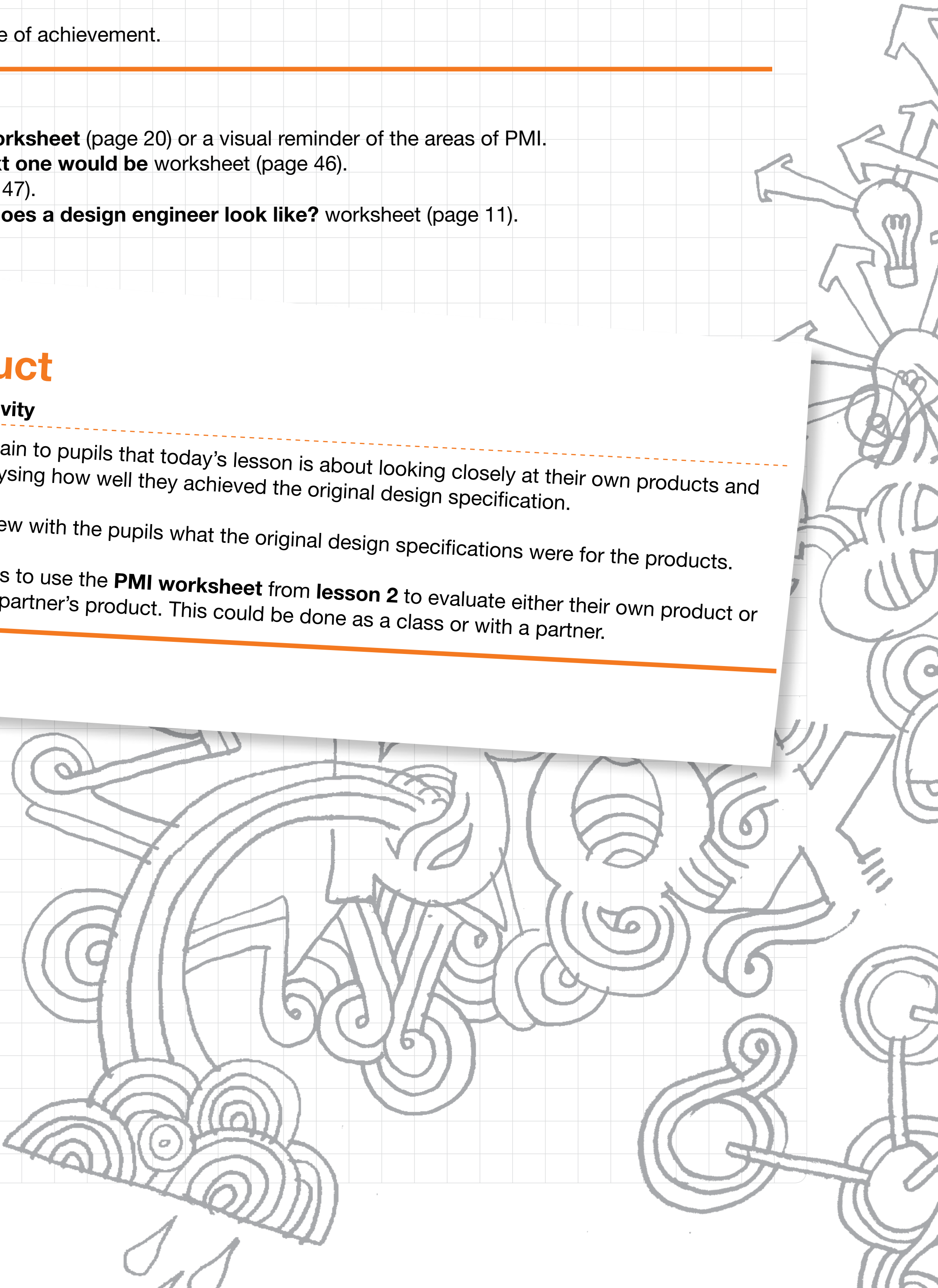
Things you will need:

– Individual copies of the **PMI worksheet** (page 20) or a visual reminder of the areas of PMI.
– Individual copies of the **My next one would be** worksheet (page 46).
– Achievement certificates (page 47).
– Individual copies of the **What does a design engineer look like?** worksheet (page 11).

Starter: 15 minutes

PMI my product

Learning objective	Activity
1	Explain to pupils that today's lesson is about looking closely at their own products and analysing how well they achieved the original design specification.
1	Review with the pupils what the original design specifications were for the products.
2	Pupils to use the **PMI worksheet** from **lesson 2** to evaluate either their own product or their partner's product. This could be done as a class or with a partner.



Main: 20 minutes

My next one would be...

Learning objective	Activity
3	Using the results of the PMI exercise, explain that you will now consider what **My next one would be,** using the worksheet on page 46.
3	Reinforce that this is a positive exercise by referring back to **James's story** (page 5) and his 5,127 prototypes.
2 & 3	Capture pupil's thoughts on how their ideas would develop. Consider using techniques such as photographing final products and sketching on any improvements. – Use minus points to think how these would be improved. – Consider problems experienced during the project and how they would overcome or avoid them next time. – Produce top tips for another class doing this activity.

Plenary: 10 minutes

What is a design engineer?

Learning objective	Activity
4	Ask pupils to think about what they now feel about the work of a design engineer? Have their ideas changed? Repeat the **What does an engineer look like?** exercise from **lesson 1**.
4 & 5	Allow pupils time to share their ideas with the class. Pupils 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.
5	Use a whole school assembly to present students with certificates of achievement.

Finished?
See the optional cross-curricular activities section for interesting ways to extend the project:

Literacy and writing skills, page 50: explore the difference between factual and persuasive writing.

Enterprise, page 51: pitch products to practice speaking skills and produce marketing materials.

Numeracy and enterprise, page 53: cost the products and exercise budgeting and decision skills.

Lesson evaluation

To what extent have the lesson objectives been met?

Notes on specific pupils/projects:

Name: (design engineer in training)

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 it possibly can be.

Use the 'Minus' points from your completed PMI worksheet to identify how you could make it even better next time.

Minus points	Ways I would solve them next time

Making a product is difficult.
Write down some of the problems you had, and think about how you could get round them next time.

Problems I had	Ways I would solve them next time

Top tips

Congratulations on completing your design engineering project!
Write down five top tips that you would give to someone else starting this project.

1

2

3

4

5

JAMES DYSON FOUNDATION

This is to certify that:

. . . .

has completed the Dyson design challenge and has shown the characteristics of a design engineer:

Frustration: finding something that frustrates you and designing it better

Wrong thinking: not being afraid to think differently

Perserverance: taking time to make your idea work

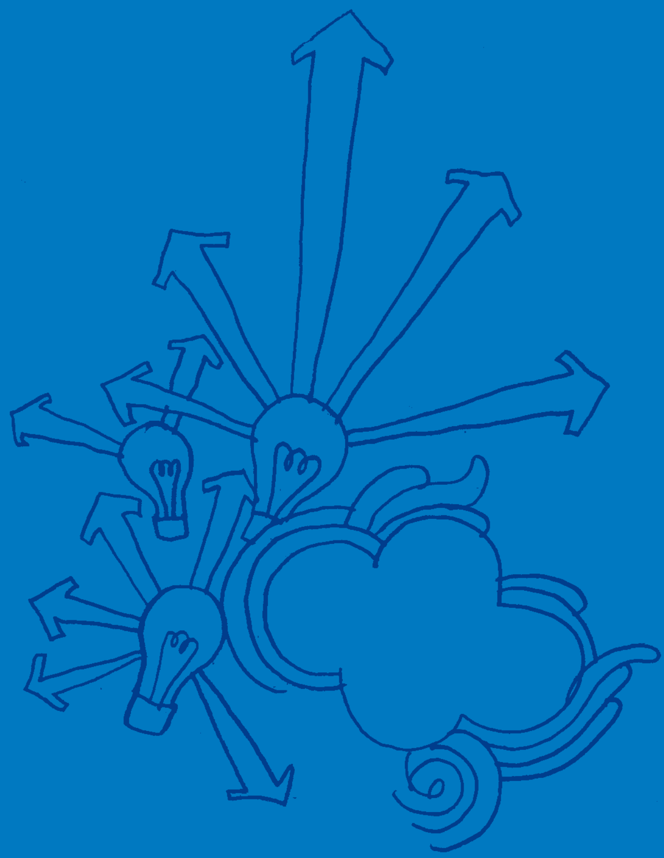
Underdog: keeping going even when there's competition

Date . . . .

Signed . . . .

wwwjamesdysonfoundation.co.uk

Extension activities



Optional cross-curricular activities

History

During or after lesson 1.

Why not use poster 2 as inspiration to find out more about the history of design.

Ask students to use the internet and other resources to find out about past design engineers and inventors. You could add this to your class set of **Design snap!**

You could also create a design timeline for the classroom. Plot the inventions you have found, add the modern inventions we use every day, and even look to the future. Can the students find examples of technologies that are in development? e.g. 3D printers have now expanded into food production.

Activity	Learning objective	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.	Raise awareness of design as non-static and developing.	Class timeline display.
Into the future – what's next?	Plant the idea that they can develop and contribute.	Class discussion.

Literacy and writing skills

This project presents many opportunities to incorporate and develop writing skills, particularly the difference between persuasive and factual writing.

Factual

- Ask the students to record their own instructions for the skills stations in **lesson 3a** (page 24). Think about the different ways this can be done, such as instructional videos or a series of photographs or diagrams.
- They could also record instructions on how to use their product, and link this to the specification set.

Persuasive

Write a letter to a friend or relative persuading them to buy your product. Use supporting questions such as:

- How has your product improved on the previous design?
- How is it different to the rival product? Why does that make it better?
- What do you know about this user that you think makes this product a good match for them?
- What are your product's interesting features?

This could also be done as a speaking exercise.

Producing a brochure gives the opportunity to combine these two skill areas, and also practice IT skills.

Activity	Learning objective	Activity outcome
Write instructions for skills stations, or for using their product.	Develop explanatory skills through writing.	Instructions.
Create a brochure.	Increased knowledge of non-fiction writing, and enterprise awareness.	Brochure for their product.
'Please Sir' persuasion – write a persuasive email to a friend/relative persuading them to buy their product over a rival product.	Practice persuasive skills in written form. Increased familiarity with email as a communication medium.	A persuasive email – consider sending them to the headteacher.
Share and compare.	Show that people have different interpretations and respond differently.	Class display of factsheets/ emails produced.

Enterprise

Marketing

Thinking about how you explain a product and present it to a wider audience is essential. It encourages students to consider end users, as well as developing explanatory and persuasive skills.

Challenge the students to produce their own advert. This could take different forms, such as a print advert, a shop window display re-created in the classroom, or a filmed advert for TV.

If your class produces filmed adverts, why not hold a mini film festival for the rest of the school or in a whole school assembly to finish off the project.

Dyson does it...

You introduce your machine, explain what it does, how it works and why it is better. It's then up to people to decide whether they want to buy it or not.

Dyson invents new technology to solve problems and make better machines, so explaining this technology in a quick and simple way is important.

To demonstrate the improvement, Dyson often compares its new machines to older versions.

Activity	Learning objective	Activity outcome
Compare and contrast – research different types of advert and use PMI to determine which the class find effective.	Raise awareness of different techniques of explaining and marketing a product. Develop enterprise knowledge.	Class discussion on differences and similarities.
Create your own advert – print or film.	Practice IT skills in conjunction with creativity.	A film or print advertisement for their project.
Share and compare.	Become aware of different interpretations and methods.	Class display of adverts produced.

The pitch

The ability to speak confidently and explain clearly are important skills to develop. Give your pupils the chance to pitch their product to the class, another teacher, or even the headteacher._

Consider using materials from the literacy and writing skills session and marketing session to support this activity.

Activity	Learning objective	Activity outcome
Strategy plan – working in groups think about the product's strengths and weaknesses and how you will present and persuade.	Practice identifying strengths and weaknesses. Develop planning skills in relation to speaking activities.	Presentation plan either verbally or on paper.
The pitch – pupils have two minutes to persuade the class/the headteacher to buy their product.	Develop persuasive speaking skills, and enterprise awareness.	Series of mini presentations from the class.
Recap and review.	Raise awareness of effective persuasive techniques.	Class discussion.

Numeracy

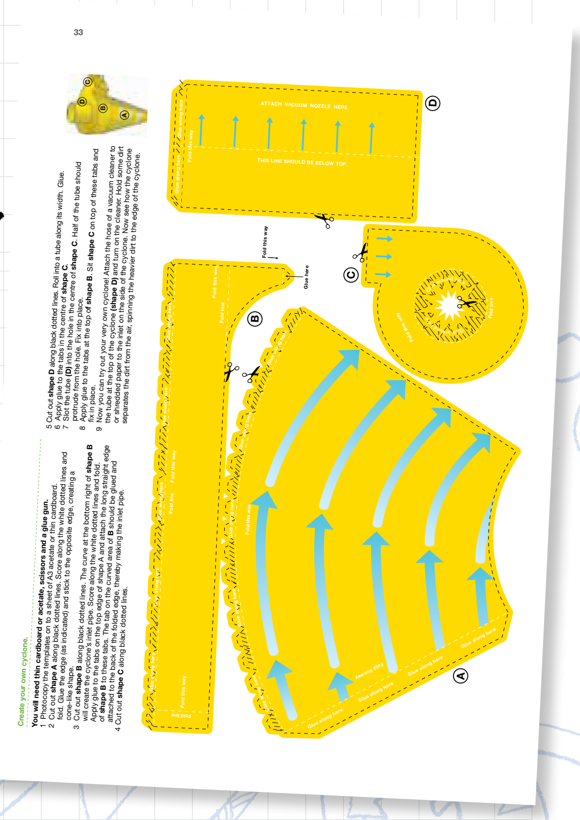
There are many opportunities to incorporate numeracy skills into the project, both within the lessons and as additional activities.

Use the **Build** section to practice measuring skills.

The **Test and Evaluate** section is also an opportunity to record results or opinions in graphical form.

On page 33 you'll find a **Create your own cyclone** resource. This could form the starter for a lesson based around nets and geometric shapes.

Another activity, linking enterprise and numeracy, is to **incorporate money calculations into the process**. This can be done by assigning students or groups a certain number of tokens; materials they may want to use should be given a price. The students will then have to make design decisions in conjunction with decisions around cost, using calculation skills.



Nets and geometric shapes

Extension to lesson 3a or 4a.

Activity	Learning objective	Activity outcome
An introduction to nets – present a range of different geometric shapes, with example nets.	Exercise 3D visualisation abilities. Increase familiarity with common shapes.	Increased awareness.
Creating nets. Allow students to draw and make their own nets. The cyclone net provided could be used here, or given to take home.	Applying mathematics to 3D problems. Improving making techniques.	Each student to have a completed net.
Recap and review. Show pictures of nets, and take suggestions from the students as to what shapes they make.	Cement knowledge, and re-enforce learnings.	Class discussion.

Numeracy and enterprise – addition and money handling

Before lesson 4b.
On completion of project alongside enterprise activities.

Activity	Learning objective	Activity outcome
Before the 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 businesses to consider.	Increase enterprise skills and awareness.	An exciting classroom environment. 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. (NB if working with a large group, set up two or more shops)	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. Re-enforce decisions made, and reward positive processes.	Class discussion.

Measuring and recording.

After lesson 3a or 4b.

Activity	Learning objective	Activity outcome
Show the class a selection of different objects. Take suggestions on how big they are. Using sketches or photos of their product, ask the students to estimate the lengths of different sides.	Practice estimating against a wide variety of objects.	Class discussion. Sketch an image of a product annotated with estimated measurements.
Measure up – using another sketch or photo, ask the students to carefully measure the different parts of their design, and mark them on. With a partner, ask students to compare these to their estimates, how close were they? Students could also rounding their measurements up to whole numbers. Higher level students could also look at and measure angles.	Improve ability to accurately measure objects. Raise awareness of discrepancies between estimation and measuring. Improve accuracy of estimation. Practice and improve ability to round numbers. Practice and improve ability to recognise and measure angles.	Sketch an image of their design annotated with precise measurements. Partner discussion comparing the two.
Give the class a limited time in which to arrange their projects in size order.	Increased ability to make numerical comparisons within data.	Projects lined up in size order.

Science

Wind-blown seeds

The Dyson Air Multiplier™ fan can be used for an activity on forces and movement.

This activity explores the topic of forces and movement, as well as allowing students to learn about plants and adaption. Additionally students will be required to make predictions, take measurements and relate science to familiar objects.

NB This activity could also be done with light everyday objects to see which travel furthest, e.g. feathers, paper, leaves, even paper aeroplanes!

Activity	Learning objective	Activity outcome
Before the lesson, find a selection of seeds (if this isn't possible see suggestions above). Ask if they recognise any. Explain that many types of seeds are naturally designed for dispersal by the wind.	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.

Destructive testing

Before lesson 4a.

This activity will extend student's knowledge of a range of everyday materials and of the properties that characterise them. It will also help students recognise what needs to be considered when a material is chosen for a particular use.

Activity	Learning objective	Activity outcome
Reveal a range of everyday materials to the class. (Plastic bags, wood, tinfoil, cardboard, paper, etc.) Discuss the properties of each with the class. Draw out similarities and differences between materials.	Understanding of materials and their properties.	Class discussion.
Each student is given a selection of materials. Ask students to perform various 'destructive tests' on the materials and write down observations for each material. Destructive tests could include: – Stretch test – Water resistance test – Drop test – Tear test	To plan and carry out a test safely. Improve measuring and recording skills.	Measurements completed and recorded.
Ask students to review each material and select the best one for building their prototype and why. Ask each student to present their chosen material to the class. Opportunity to show **Test and evaluate** section on the DVD.	Learning about materials and their properties and applying that knowledge. Exercise speaking and listening skills.	Preferred material chosen and class presentation completed.

Notes

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