

SCIENCE MUSEUM

Teachers' Resource Pack

ENGINEER YOUR FUTURE

Top rover today



0664m

00664m

RUGGED
ROVERS

RUGGED
ROVERS

INFORMATION



Age
11-14
14-16

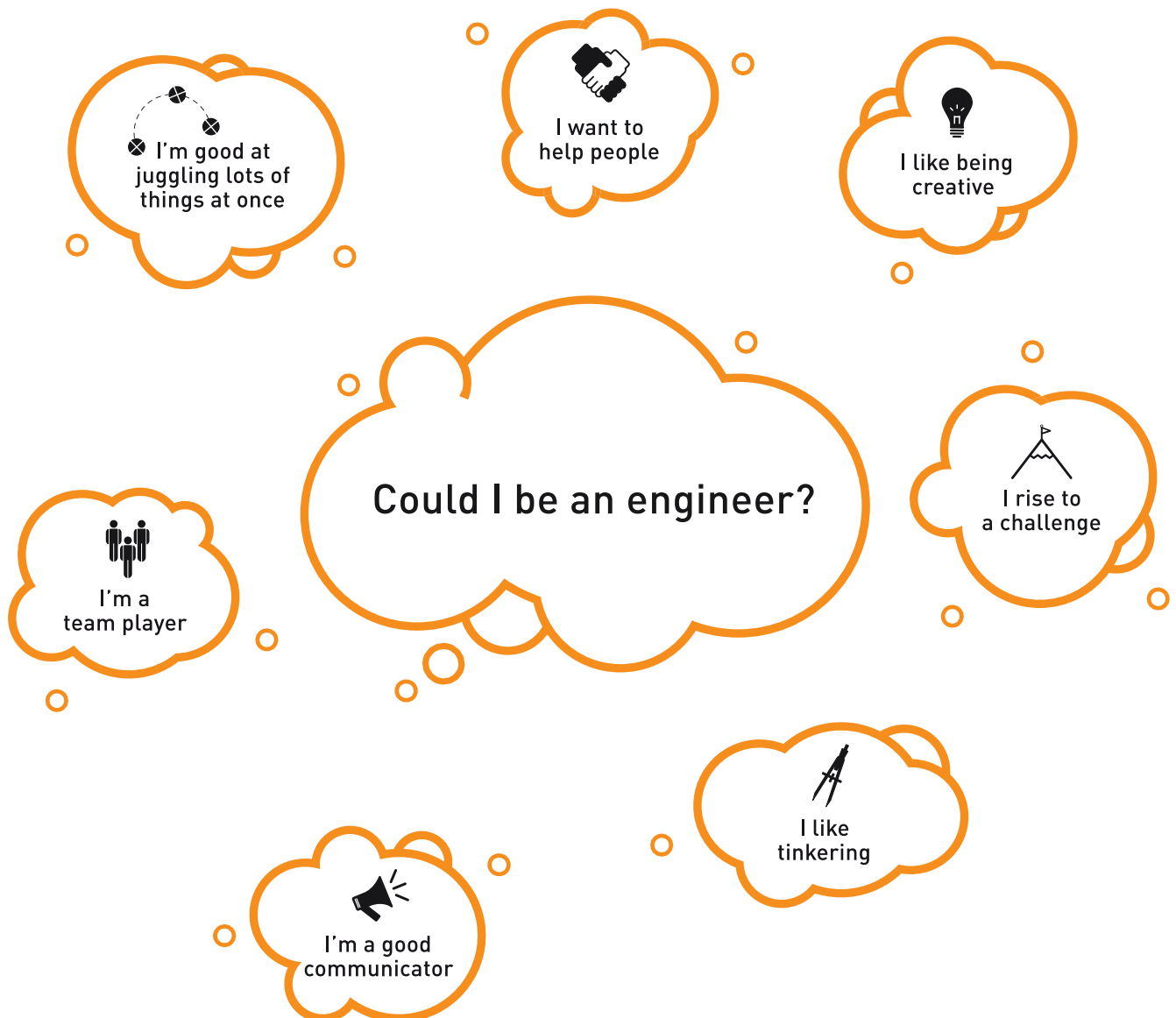
Topic

ENGINEERING

Location

LEVEL 3, SCIENCE MUSEUM, LONDON

DISCOVER YOUR POTENTIAL TO SHAPE THE WORLD WE LIVE IN...



Classroom activities

This pack was created in association with the *Engineer Your Future* exhibition at the Science Museum. *Engineer Your Future* aims to engage and inspire 11- to 15-year-olds about engineering careers, and is open until the end of 2017. Turn to page 37 to find information about visiting with students.

This pack includes three classroom activities. Use them together as pre-visit or stand-alone materials to encourage your students to explore the skills engineers use and discover inspiring women and men who use these skills every day.

Each classroom activity includes:



Teachers' notes



Student activity

The three activities are:

We Engineer film pages 2–10

In this short film you will encounter real-life engineers improving, adapting and testing to make faster racing yachts, safer houses and smarter prosthetics.

We've provided notes to turn the film and photos of the cutting-edge prototypes and models featured in the film into a stimulating classroom discussion about engineering skills.

Rugged Rovers game pages 11–13

Rugged Rovers is available as an online game and app that gives students the chance to try their hand at space-age engineering: Create a rover design and innovate to solve the problems of crossing a challenging alien landscape.

Use Rugged Rovers in Science or Design and Technology lessons or your STEM club as a fun interactive activity to get your students using and thinking about the engineering skills they possess – such as creative problem-solving and design progression.

Inspiring Engineers cards pages 14–36

Our selection of 35 'Inspiring Engineers' profiles show where an engineering background could take your students – from fuelling the future to creating movie visual effects.

Use the profiles to help your students explore careers in science and technology. The engineering jobs featured link to current KS3 and 4 programmes of study in Science, Design and Technology and Computing, to help engage your students across the curriculum.



We Engineer film

Teachers' notes

Engineers are always testing, adapting and improving things. The *We Engineer* film shows three groups of engineers who are working to make three very different things even better: faster racing yachts, safer houses and smarter prosthetics. Their cutting-edge prototypes and models are on display in the *Engineer Your Future* exhibition at the Science Museum.

Learning outcomes:

- To consider the different skills engineers use in their work
- To explore different applications of engineering

You will need:

- Our short film *We Engineer*, which you can download from <http://bit.ly/1wy2JgA>
- Double-sided print-outs of the student activity (pages 5–10), one for each discussion group

Using this activity

Watch the film *We Engineer* with your class. It lasts four and a half minutes in total, but we suggest pausing at two points to bring up thought-provoking questions for your students – see below.

Afterwards use the student activity sheets, which include images of the objects in the film, to prompt further discussion. Estimated duration 15 minutes.

Questions to ask during the film

Pause at between 55 seconds and 1 minute

Q: The film features three groups of engineers. What are they working on? What is most exciting/interesting for you? And why?

Pause at 3 minutes 40

Q: What sorts of skills do these engineers use/mention?

Designing and evaluating – engineers have to create designs that will work.

Making – engineers make all sorts of things, from boats to bionic hands.

Improving – engineers are always trying to make the best better.

Testing – every aspect of the things they make or fix can be tested to help engineers identify what needs to improve.

Adapting – engineers are ingenious, they find new uses for things. They find out about what people have done before and about inventions such as new materials that they might be able to use.

Finding and solving problems – engineers use investigative skills to find out what people need. In the case of the bionic hand engineers have to work closely with clinicians and patients to make the hand better for the people who use it.

Communicating – for example, engineers who go to disaster zones need to have good communication skills to talk to people who live there and work with them to help them rebuild their settlements.

Background information

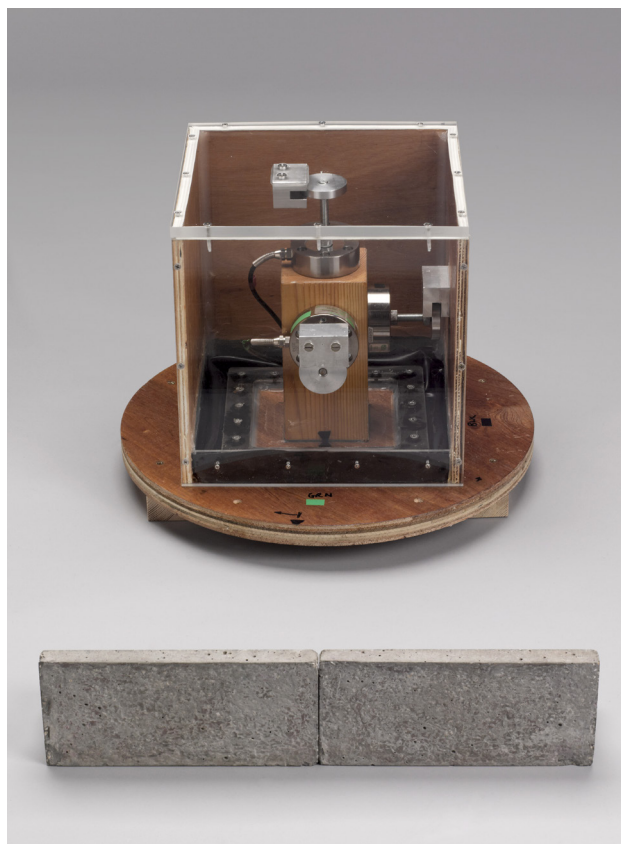
The *We Engineer* film and student activity sheets feature three objects:

A bionic hand

The BeBionic artificial hand is one of the most advanced prosthetics available today. It is controlled by electrical impulses from a patient's forearm muscles. With 14 different grip patterns and hand positions, the BeBionic hand can handle daily activities, from eating meals and carrying bags, to tying shoelaces and typing.

A house model

This is placed inside a 30-metre tank where engineers re-create a scaled-down tsunami wave. It is equipped with sensors that measure forces when the wave hits the model. Using this information, engineers can recommend safer building designs and help the areas affected to cope with the devastating aftermath of a tsunami.



A racing yacht

This America's Cup yacht model was used in wind tunnels to study the aerodynamic performance of the sails. Engineers use this data to refine sail design and improve the yacht's performance to help engineer a winner.



Useful links

The following websites provide more information useful for this activity:

bebionic.com
epicentreonline.com
hrwallingford.com
southampton.ac.uk/performanceports
wumtia.soton.ac.uk

Curriculum links

We Engineer and the suggested accompanying activities are relevant to the following aspects of programmes of study in England, and equivalent curricula in Scotland, Wales and Northern Ireland:

KS3 Science (DfE, September 2013)

Biology

The skeletal and muscular systems' biomechanics

The interaction between skeleton and muscles, including the measurement of force exerted by different muscles

The function of muscles and examples of antagonistic muscles

Physics

Energy changes and transfers – other processes that involve energy transfer

Forces – forces associated with deforming objects; stretching and squashing; springs; with rubbing and friction between surfaces; with pushing things out of the way; resistance to motion of air and water

KS3 Design and Technology (DfE, September 2013)

Design

Use research and exploration, such as the study of different cultures, to identify and understand user needs

Develop specifications to inform the design of innovative, functional, appealing products that respond to needs in a variety of situations

Evaluate

Understand developments in design and technology, its impact on individuals, society and the environment, and the responsibilities of designers, engineers and technologists



We Engineer film

Student activity

You want to make a prosthetic hand
for someone...

What does your hand
have to do?

What things will
you consider?

What would you
test to check that
your design
matches what you
wanted it to do?

Hold a pen? Pick up cutlery? Turn a doorknob?
Tie your shoelaces? Engineers making smarter
prosthetics are trying to program them to do all
the everyday things their users need. A
prosthetic hand has to be more robust than a
normal human hand as it cannot tell your brain
when you are hurting it.



Image: Jennie Hills, Science Museum, London



We Engineer film

Student activity

You want to make the fastest yacht...

What do you need
to consider?

What tests could
help you improve
your yacht?
Would your yacht tip
over in a storm?

What features
would make your yacht
win the America's Cup?

It is important to test prototypes against the harshest conditions the yacht will face. Wind tunnels, capable of generating airflows powerful enough to tear the roof off a building, test the aerodynamics of the sails and deck. The hull and keel get pulled through water tanks to see how easily they move through water and strength tests help make sure the mast will not snap mid-race.



Image: Jennie Hills, Science Museum, London



We Engineer film

Student activity

Your town is in an area that has a high risk of tsunamis. You want to make it safer...

What sorts of things
could make your
town safer?

What tests would help
you improve your
town's defences?

What places in our
country are at risk
from tsunamis? Could
our towns withstand
a tsunami?

Tsunami waves act like a fast tide moving huge amounts of water inland. They can cause destruction on a massive scale but there is very little information about how they affect buildings. When these rare disasters occur they do not always affect built-up areas, and when a tsunami hits it destroys measuring equipment. So engineers simulate tsunamis in huge wave tanks 30 metres long. Sensors inside models measure the forces that coastal buildings face, so engineers can design safer towns.

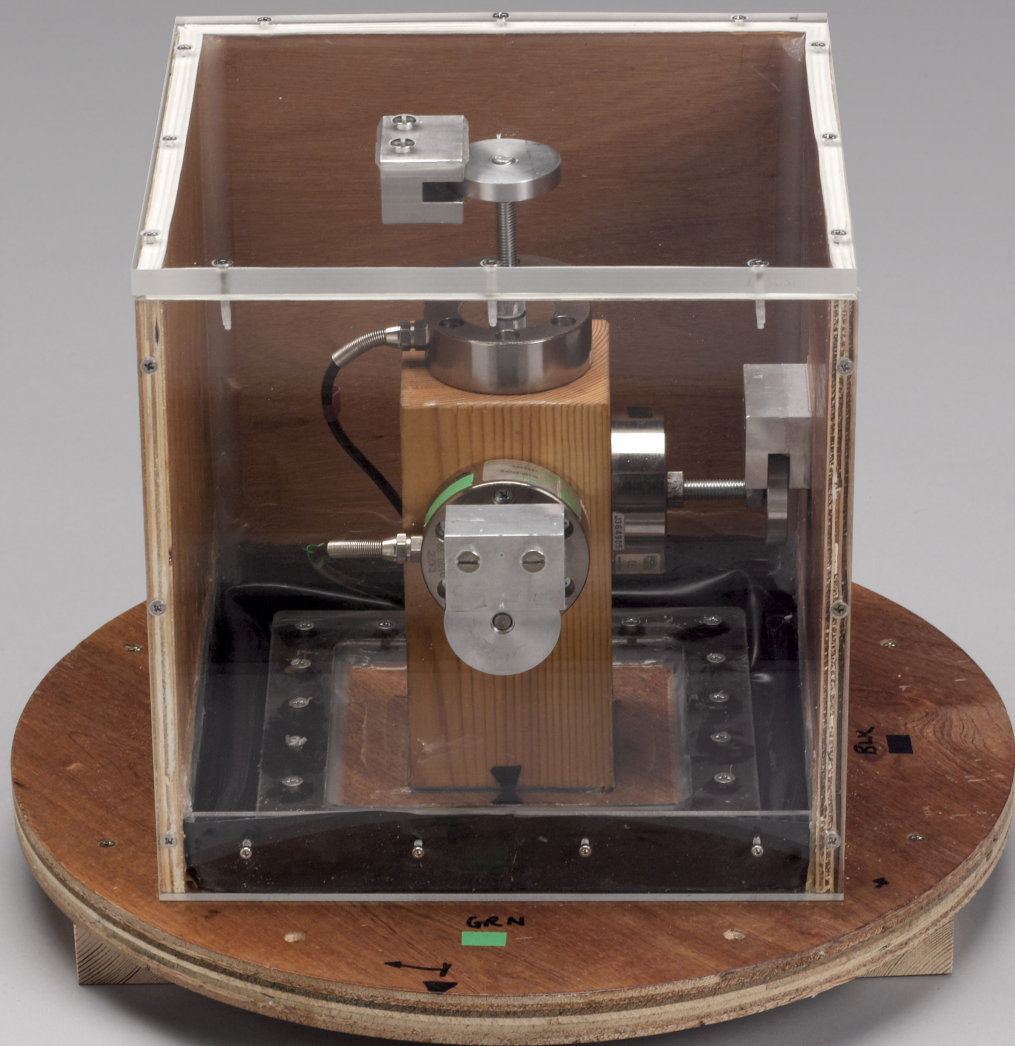


Image: Jennie Hills, Science Museum, London



Rugged Rovers game

Teachers' notes

It's time to get creative and solve some interplanetary problems! *Rugged Rovers* will get your students using and thinking about the engineering skills they possess.

This game will test and develop your students' problem-solving skills – skills that are key to a career in engineering. They'll design a rover and then let it loose on a challenging alien landscape. When they encounter a problem that stops their rover, they can redesign it to overcome the problem. Can your students problem-solve their way to the top rover score of the day?

These support materials provide ideas to help incorporate the game into a science lesson or STEM club.

Learning outcomes:

- Use problem-solving skills
- Design and test ideas to solve a problem
- Realise these are skills that real engineers use

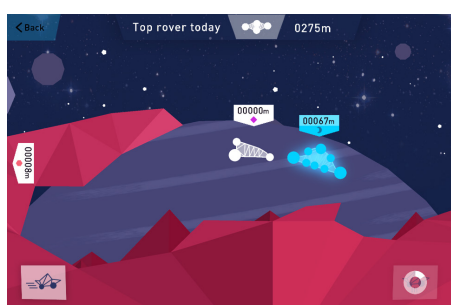
You will need:

- The *Rugged Rovers* game – you can download the app or play online at <http://bit.ly/1K74ZIG>
- Photocopies of the student activity worksheet, one for each student (page 13)

You might also like to print out the top tips sheet (page 12) for each student or use it yourself to give guidance.

Using this activity

After explaining the task, ask students to plan and design their rover on paper using the student activity sheet. Students then put their designs into practice by playing the game. Share the top tips to help students improve their designs. While students play the game use the print screen function to capture images of students' most successful rovers to prompt group discussion.



Useful links

<http://bbc.in/1jzNC6y>

A news story about the Mars Yard testing facility that helped inspire this game.

exploration.esa.int/mars

The web page of the Mars mission that these robotic rovers were based on.

Planning a visit?

Remind your students to bring their best ideas to try out on our large-scale projection of this game.

Curriculum links

Rugged Rovers and this activity are relevant to the following aspects of programmes of study in England, and equivalent curricula in Scotland, Wales and Northern Ireland:

KS3 Science (DfE, September 2013)

Working scientifically

Analysis and evaluation; Make predictions using scientific knowledge and understanding

Physics

Motion and forces; Forces; Balanced and unbalanced forces, moment as the turning effect of a force

KS4 Science (DfE, June 2014 draft)

Working scientifically

Develop and learn to apply observational, practical, modelling, enquiry, problem-solving skills and mathematical skills, both in the laboratory, in the field and in other learning environments

KS3 Design and Technology (DfE, September 2013)

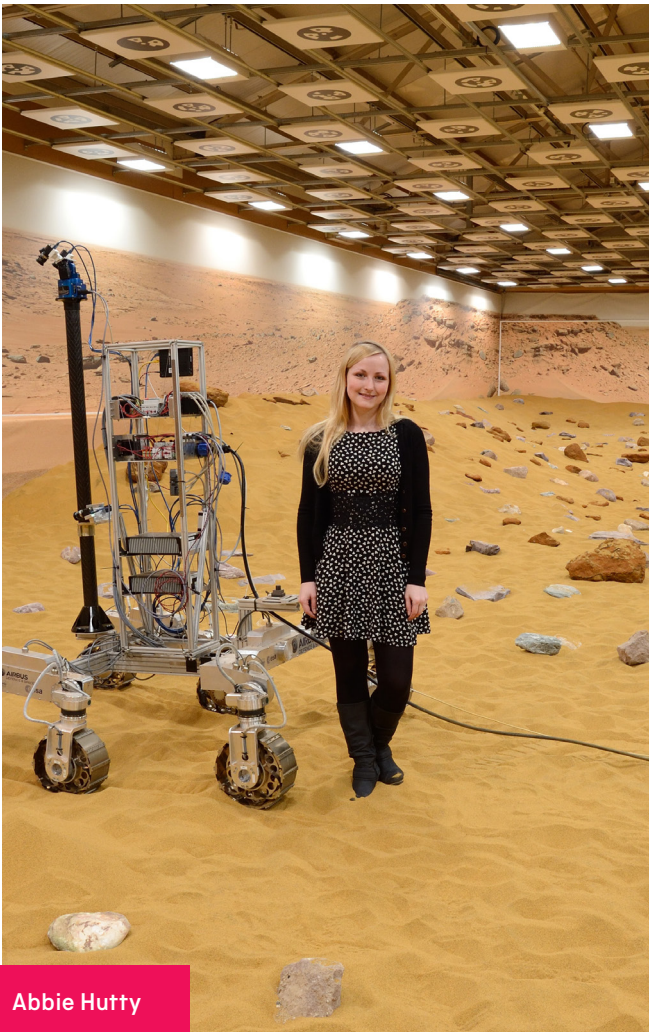
Design

Identify and solve design problems and understand how to reformulate problems given to them



Rugged Rovers game

Top tips



Abbie Hutton

Spacecraft engineer

Employer: Airbus Defence and Space

Image: Airbus Defence and Space

Top tips for a winning rover

Advice on the best design comes from rover expert Abbie Hutton, a structural engineer who led a team of engineers working on the ExoMars rover, ESA's first Mars rover, which is due to be launched in 2018.

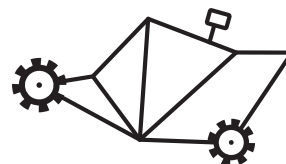
Abbie says:

- Think about how many wheels you're using and remember they don't all have to be the same size.
- Where is your engine? You can move it about to make your rover more stable.
- If your rover flips over, can you make it so that it works upside down too?
- If you make the wheels bigger it sometimes helps to keep the rover body from catching on rocks.
- Try to shape your rover so that the body is less likely to catch on sharp rocks or ledges.
- Steep slopes might make your rover's body tip up – unless you can make a really stable shape.
- Loose rocks are really tricky, but think about how you can shape the front of your rover to best push through them.



Rugged Rovers game

Student activity

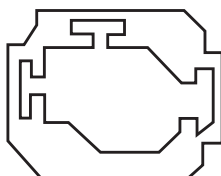


Rugged Rovers is a game that will test your creative problem-solving skills. Design a rover and then let it loose on a challenging alien landscape. Your rover will need to overcome all the problems of the rugged terrain. See how far it can travel.

Abbie Hutty is an experienced space engineer making robotic rovers. She helped make sure the game was true to real-life rover engineering. Now it's your chance to give rover engineering a try.

Before you start to play, draw your first design...

Draw a body around the engine



Why do you think it will be a winning rover?

You can add up to eight wheels

Now play...

How far did your first rover get? _____

What stopped it? _____

How far did your best rover get? _____

How did you change it to overcome problems?



Inspiring Engineers cards

Teachers' notes

In the UK thousands of people work in engineering, but we need more engineers to shape our future. The cards in this activity feature the profiles of 35 inspiring engineers to help show where studying science and maths can take you – from fuelling the future to creating movie visual effects.

Our lesson ideas offer suggestions for how to use the cards to help your students explore creative career opportunities in science and technology, widen their perception of people who use science in their work and expose them to a range of STEM employers.

These real-life case studies relate to many areas of the current KS3 and 4 Science, Design and Technology and Computing programmes of study. Use the table on pages 16–18 to link the different engineers to your teaching.

Learning outcomes:

- All sorts of different people can be engineers
- There are a wide variety of careers in engineering

You will need:

- Print-outs of the Inspiring Engineers cards (pages 19–36) – print the pages double-sided to get four cards per sheet and cut them as shown in the diagram to make a full deck (you'll need one set per group)

About the cards

There are 35 full-colour cards. They feature the profiles of engineers at work. They are divided into eight themed areas:

- Aerospace
- Construction
- Electronics & Computing
- Energy
- Entertainment
- Food
- Medical
- Transport

Each profile features an engineer's photo, name and employer, together with a brief description of his or her job and where this work might lead in the future – most of them also include a 'perk' of their work.



Suggestions for using the cards

Stimulating questions

Use these questions to help prompt class discussion about engineering careers:

How do engineers change your world?

Use the 'What I do all day' section on the cards to prompt discussion about how engineering affects the lives of your students – from providing their power to making the bands they listen to sound fantastic.

What skills do you need to be an engineer?

In the 'What I do all day' section of the cards, engineers often mention the kinds of skills they use – use these as a prompt for discussion.

Do you think of engineering as something women do? Why?

Over half of the engineers featured in this pack are women.

Where would you expect to find engineers at work?

Engineers work almost everywhere, from areas you might expect such as stations and power plants to places that might surprise you, including hospitals and film studios.

Engineer of the week

Ask students to create a poster about engineering. You could pull out aspects from the class discussion above. Leave a central slot to accommodate the profile of the 'engineer of the week' selected to reflect the themes you are covering in class – see the curriculum links on the following pages.

Engineering trump card game

Use the cards to make a game. Ask students to assign trump card points after a discussion about the work engineers do, or the kinds of skills engineers have.

We suggest choosing four or five features that vary across the set of cards and give each engineer a score. Discuss how students might rate the categories mentioned on the cards, or pick out their own categories based on what the cards say.

For example, are the engineers ecofriendly? Are they creative? Do they help people? Does their work seem futuristic?

Assemble an engineering super-team

Engineers have lots of different skills and areas of expertise – no one engineer knows everything, but often a team will encompass a lot of different skills. Ask your students to pick a team of ace engineers to solve some of the world's biggest challenges: who would they pick to be on their team?

Suggested challenges

- Ageing/growing populations
- Climate change
- Providing power
- Space exploration

How to succeed

Think about what you might have to know about to tackle this challenge.

Pick a team that has a variety of skills. Even if their work does not seem relevant at first, think about what skills they have. Do you have a team that includes creative thinkers, testers, data collectors and makers?

Tomorrow's Engineers quiz – Whose Crew Are You?

tomorrowsengineers.org.uk/whosecrewareyou

Your class can try this quiz to find out what area of engineering might be for them. The quiz results will roughly correspond to the eight themed areas covered by the cards.

Share your ideas

We would love to hear about the new ways you have used these cards in class.

Contact us at learningresources@sciencemuseum.ac.uk

Curriculum links

This table details the areas of the curriculum linked to the engineers featured in the cards.

Zone	Name	Type of engineer	Employer	Subject	Key Stage	Curriculum link
Aerospace	Ranah Irshad	Systems engineer	RAL Space	Design and Technology	3	Design, make and evaluate and technical knowledge sections of the curriculum
	Robin Freeman	Software engineer	Zoological Society of London	Biology	3	The interdependence of organisms in ecosystems Changes in the environment may leave individuals within a species, and some entire species, less well adapted to compete successfully and reproduce, which in turn may lead to extinction
				Biology	4	Living organisms are interdependent and show adaptations to their environment Methods of identifying species and measuring distribution, frequency and abundance of species within a habitat Positive and negative human interactions with ecosystems
				Design and Technology	3	Design, make and evaluate and technical knowledge sections of the curriculum
	Tom Wines	Mechanical engineer	Sheffield Advanced Manufacturing Research Centre	Design and Technology	3	Make and evaluate sections of the curriculum
Construction	Divindy Grant	Water engineer	Mott MacDonald	Chemistry	4	The Earth's water resources and obtaining potable water
	Roma Agrawal	Structural engineer	WSP	Design and Technology	3	Design, make and evaluate and technical knowledge sections of the curriculum
	Sakthy Selvakumaran	Innovation engineer	Laing O'Rourke	Design and Technology	3	Design, make and evaluate and technical knowledge sections of the curriculum
	Yewande Akinola	Environmental engineer	Arup	Design and Technology	3	Design, make and evaluate and technical knowledge sections of the curriculum
	Xi Liu	Environmental engineer	Imperial College London	Chemistry	4	The Earth's water resources and obtaining potable water Potential effects of increased levels of carbon dioxide and methane on the Earth's climate, and their mitigation
Electronics & Computing	Jack Pattison	Apprentice radio and rigging engineer	BT	Physics	4	Uses in the radio, microwave, infrared, visible, ultraviolet, X-ray and gamma-ray regions
	Jonathan Bell	Electronics engineer	Raspberry Pi Foundation	Computing	3	Use two or more programming languages, at least one of which is textual, to solve a variety of computational problems; make appropriate use of data structures; design and develop modular programs that use procedures or functions Understand simple Boolean logic and some of its uses in circuits and programming; understand how numbers can be represented in binary, and be able to carry out simple operations on binary numbers Understand the hardware and software components that make up computer systems and how they communicate with one another and other systems

Zone	Name	Type of engineer	Employer	Subject	Key Stage	Curriculum link
Electronics & Computing	Mark Crawley	Software engineer	IBM	Computing	3	Undertake creative projects that involve selecting, using and combining multiple applications, preferably across a range of devices, to achieve challenging goals, including collecting and analysing data and meeting the needs of known users
	Riyanat Shittu	Security engineer	BT	Computing	3	Understand the hardware and software components that make up computer systems and how they communicate with one another and other systems
				Computing	4	Understand how changes in technology affect safety, including new ways to protect online privacy and identity, and how to identify and report a range of concerns
Energy	Julie Rotchell	Electrical power project manager	ABB	Physics	3	Fuels and energy resources
				Physics	4	Renewable and non-renewable energy sources used on Earth, changes in how these are used
	Katie Fraser	Design engineer	Culham Centre for Fusion Energy	Chemistry	4	Potential effects of increased levels of carbon dioxide and methane on the Earth's climate, and their mitigation
				Physics	3	Fuels and energy resources
				Physics	4	Renewable and non-renewable energy sources used on Earth, changes in how these are used Nuclear fission, nuclear fusion and our Sun's energy
	Katrina Trigari	Systems engineer	EDF Energy	Chemistry	4	Potential effects of increased levels of carbon dioxide and methane on the Earth's climate, and their mitigation
				Physics	3	Fuels and energy resources
				Physics	4	Renewable and non-renewable energy sources used on Earth, changes in how these are used Nuclear fission, nuclear fusion and our Sun's energy
	Monisha Gower	Electrical engineer	National Grid	Physics	3	Fuels and energy resources
				Physics	4	How transformers are used in the national grid and the reasons for their use
	Rebecca Martin	Offshore wind research engineer	EDF Energy	Chemistry	4	Potential effects of increased levels of carbon dioxide and methane on the Earth's climate, and their mitigation
				Physics	3	Fuels and energy resources
				Physics	4	Renewable and non-renewable energy sources used on Earth, changes in how these are used
	Yasmin Ali	Chemical engineer	E.ON	Chemistry	4	Carbon compounds, both fuels and feedstock, and the competing demands for limited resources
				Physics	3	Fuels and energy resources
				Physics	4	Renewable and non-renewable energy sources used on Earth, changes in how these are used

Zone	Name	Type of engineer	Employer	Subject	Key Stage	Curriculum link
Entertainment	Andrew Harper	Acoustic engineer	Celestion	Physics	3	Frequencies of sound waves, measured in hertz (Hz); echoes, reflection and absorption of sound Sound produced by vibrations of objects, in loudspeakers, detected by their effects on a microphone diaphragm and the eardrum; sound waves are longitudinal
	Chris Lawrence	Software engineer	Framestore	Computing	3	Design, use and evaluate computational abstractions that model the state and behaviour of real-world problems and physical systems
	Emily Bonner	Civil engineer	Mott MacDonald	Design and Technology	3	Design, make and evaluate and technical knowledge sections of the curriculum
	Rosie Campbell	Research engineer	BBC Research and Development	Design and Technology	3	Evaluate section of the curriculum
Medical	Alison McGregor	Biomedical engineer	Imperial College London	Biology	3	Biomechanics – the interaction between skeleton and muscles, including the measurement of force exerted by different muscles
	Andrew Flewitt	Electronic engineer	Cambridge University	Biology	4	Uses of modern biotechnology including gene technology; some of the practical and ethical considerations of modern biotechnology
	Carolyn McGregor	Software engineer	University of Ontario Institute of Technology	Computing	3	Undertake creative projects that involve selecting, using and combining multiple applications, preferably across a range of devices, to achieve challenging goals, including collecting and analysing data and meeting the needs of known users
	Kaspar Althoefer	Robotics engineer	King's College London	Design and Technology	3	Design, make and evaluate and technical knowledge sections of the curriculum, particularly with respect to embedded intelligence and the use of creative ideas such as biomimicry
	Tarit Mukhopadhyay	Biochemical engineer	University College London	Biology	4	The process of discovery and development of new medicines Uses of modern biotechnology including gene technology; some of the practical and ethical considerations of modern biotechnology
Transport	Aimi Elias	Civil engineer	Transport for London	Design and Technology	3	Design, make and evaluate and technical knowledge sections of the curriculum
	Charlotte Mace	Civil engineer	Network Rail	Design and Technology	3	Design, make and evaluate and technical knowledge sections of the curriculum
	Emma Wilding	Apprentice vehicle safety engineer	Jaguar Land Rover	Design and Technology	3	Test, evaluate and refine ideas and products against a specification, taking into account the views of intended users and other interested groups
	James Ambrose	Railway engineer	Network Rail	Chemistry	4	Potential effects of increased levels of carbon dioxide and methane on the Earth's climate, and their mitigation
				Design and Technology	3	Design, make and evaluate and technical knowledge sections of the curriculum
	Ryan Chin	Urban engineer	Massachusetts Institute of Technology	Chemistry	4	Potential effects of increased levels of carbon dioxide and methane on the Earth's climate, and their mitigation
				Design and Technology	3	Design, make and evaluate and technical knowledge sections of the curriculum
	Teena Gade	Vehicle science engineer	Force India Formula One	Computing	3	Design, use and evaluate computational abstractions that model the state and behaviour of real-world problems and physical systems

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Inspiring Engineers
Aerospace

Could you shape the world we live in? Find out more:
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Inspiring Engineers
Construction

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Ranah Irshad

Job

Systems engineer

Employer

RAL Space

What I do all day

I design satellites and space probes to go into space and explore the universe.

Perk of the work

The things I invent go into space!

In future, engineers like me...

Will continue to explore the universe, discover new worlds, maybe even help humans colonise other planets.



Robin Freeman

Job

Software engineer

Employer

Zoological Society of London

What I do all day

I design trackers and drones to monitor and protect animals and try to understand how they're affected by our changing environment.

Perk of the work

Travelling the world helping animals like sea birds and tigers.

In future, engineers like me...

Will use new technologies to try and protect animals from extinction.



Divindy Grant

Job

Water engineer

Employer

Mott MacDonald

What I do all day

I come up with environmentally friendly ways to get water to cities. I use local resources like rivers and lakes, and clever techniques like rainwater harvesting.

Perk of the work

I get to work all over the world, from all over Europe, to Africa and Asia.

In future, engineers like me...

Will make sure people can get clean water, even as our climate changes.



Tom Wines

Job

Mechanical engineer

Employer

Sheffield Advanced Manufacturing Research Centre

What I do all day

I use robots, lasers, augmented reality and virtual reality to help manufacture cars, planes, even fighter jets.

Perk of the work

I get to use robots at work.

In future, engineers like me...

Will work in even more advanced factories where teams of robots make things like stealth planes and hybrid cars. You could even be greeted by a robot receptionist.

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Inspiring Engineers
Construction

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Sakthy Selvakumaran

Job

Innovation engineer

Employer

Laing O'Rourke

What I do all day

I use virtual reality to plan new ways to construct buildings. We use robots to make the big pieces, then cranes stack them up like a giant Lego jigsaw.

In future, engineers like me...

Will build new buildings, or even cities, at record speed, providing homes, schools and hospitals for our growing population.



Roma Agrawal

Job

Structural engineer

Employer

WSP

What I do all day

I use my maths and design know-how to make sure futuristic skyscrapers like the Shard don't fall down.

Perk of the work

I change the city skyline – I can see my creations all over London.

In future, engineers like me...

Will help make more space in crowded cities by building up.

Image: Nicola Evans, WSP



Xi Liu

Job

Environmental engineer

Employer

Imperial College London

What I do all day

I work out how to cover buildings with plants to make our grey cities green.

In future, engineers like me...

Will make city living healthier by designing beautiful plant-covered buildings and streets that collect water, prevent flooding, cool cities down and clean the air.



Yewande Akinola

Job

Environmental engineer

Employer

Arup

What I do all day

I design water and energy systems for buildings, to make great spaces for people to live and play.

Perk of the work

I get to work all around the world designing buildings, from luxury hotels in China to houses in Africa.

In future, engineers like me...

Will make ecofriendly buildings that work with the environment and use local resources like solar power and rainwater, all over the world.

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Inspiring Engineers

Electronics & Computing

Could you shape the world we live in? Find out more:
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Jonathan Bell

Job

Electronics engineer

Employer

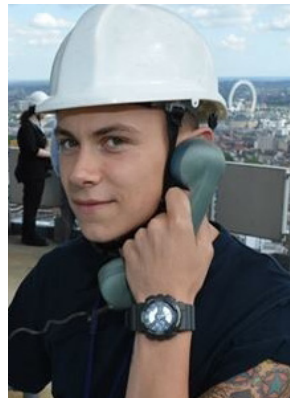
Raspberry Pi
Foundation

What I do all day

I help design and develop the Raspberry Pi, a small, cheap computer that helps people understand how computers work.

In future, engineers like me...

Will help future generations understand our increasingly advanced technology, so they can invent more.



Jack Pattison

Job

Apprentice radio
and rigging engineer

Employer

BT

What I do all day

I install radio dishes and other equipment that provides Londoners with mobile internet.

Perk of the work

I get to work at the top of the BT Tower.

In future, engineers like me...

Will work with the latest communication technology to keep people connected.



Riyanat Shittu

Job

Security engineer

Employer

BT

What I do all day

I monitor internet activity, looking for hackers, spotting attacks and protecting people online.

Perk of the work

There's always a new challenge, new code to write, a new task... it's never boring.

In future, engineers like me...

The job I'll be doing in 10 or 20 years probably hasn't been invented yet.



Mark Crawley

Job

Software engineer

Employer

IBM

What I do all day

My software analyses every shot of every Wimbledon tennis match, revealing the strengths, and weaknesses, of players to help them improve their game.

Perk of the work

I get to go to every Wimbledon tournament for free.

In future, engineers like me...

Will help fans and players get even more insight into their favourite sport.

Image: BT Saturn Research Team,
Adastral Park

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Katie Fraser

Job

Design engineer

Employer

Culham Centre for Fusion Energy

What I do all day

I create designs for a new kind of power plant called a fusion reactor that works like a miniature sun to create energy.

Perk of the work

I loved art and design at school; now I get to use my creative skills every day.

In future, engineers like me...

Will provide the world with clean, limitless energy.



Julie Rotchell

Job

Electrical power project manager

Employer

ABB

What I do all day

I manage teams of engineers who build the energy mega-systems that transmit power across cities, countries and continents.

Perk of the work

I work all over the world, from the US and Europe, to South Africa and South America and India.

In future, engineers like me...

Will help connect the 1.4 billion people who live without electricity in the world today to new sources of power, providing access to basic things like light and clean water.



Monisha Gower

Job

Electrical engineer

Employer

National Grid

What I do all day

I design and build power substations that send electricity to your home. I make sure they have sensors, giant fuses and switches to protect the grid from problems like lightning strikes.

In future, engineers like me...

Will make sure people can turn their lights on and power their smartphones, computers, even electric cars.



Katrina Trigari

Job

Systems engineer

Employer

EDF Energy

Image: Valerio Trigari

What I do all day

I make sure nuclear power plants get the maintenance they need to prevent nuclear disasters, like what happened after a tsunami hit a nuclear power plant in Japan.

In future, engineers like me...

Will design and look after safe nuclear power plants and new kinds of power plants to help power our world.

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Yasmin Ali

Job

Chemical engineer

Employer

E.ON

What I do all day

I work with a team to extract gas from under the North Sea. We measure the rock structure below the seabed to figure out where the gas is trapped, then drill into the rock to get it out. We even create undersea facilities manned by robots.

Perk of the work

I love experiencing unique environments, like going offshore by helicopter and living in the middle of the sea on gas platforms – it's like a whole other world out there.

In future, engineers like me...

Will continue to make sure people have enough energy to power their homes.



Rebecca Martin

Job

Offshore wind research engineer

Employer

EDF Energy

What I do all day

Wind turbines out at sea are under a lot of stress. Bad weather can make them difficult to get to, so I use sensors to constantly monitor them and make sure the blades keep on turning.

Perk of the work

I take trips out to sea and get up close to the wind turbines. I think they are a cross between a beautiful sculpture and an alien from *War of the Worlds*!

In future, engineers like me...

Will help meet everyone's energy needs by making clean, inexpensive and reliable wind power.



Chris Lawrence

Job

Software engineer

Employer

Framestore

What I do all day

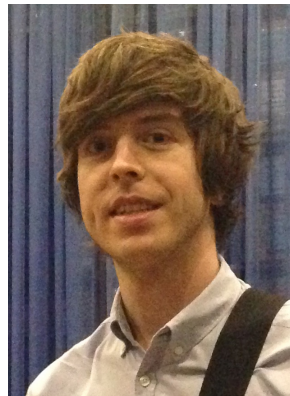
I create visual effects for blockbuster movies like *Gravity* and *Wall-E*.

Perk of the work

I won an Oscar for my work on *Gravity*!

In future, engineers like me...

Will work with movie directors and Hollywood stars to create more stunning, complex and realistic visual effects.



Andrew Harper

Job

Acoustic engineer

Employer

Celestion

What I do all day

I use computer modelling and prototyping to tinker with the structure of loudspeakers for bands like Arctic Monkeys and Guns N' Roses, to create their perfect sound.

Perk of the work

I get to meet and work with some of the best musicians in the world.

In future, engineers like me...

Will work with the rock stars of the future to create powerful live experiences.

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Rosie Campbell

Job

Research engineer

Employer

BBC Research and Development

What I do all day

I'm researching new technology for home entertainment, like smart wallpaper that can display photos and images, transforming your room and immersing you in another world.

In future, engineers like me...

Will make you feel like you're part of your favourite TV show using smart wallpaper, augmented reality and 3D technology.



Emily Bonner

Job

Civil engineer

Employer

Mott MacDonald

What I do all day

I design everything that futuristic stadiums like Wembley might need, like movable seats, jumbo screens and toilets... lots of toilets!

Perk of the work

I get to build a place where hundreds of thousands of people have a good time.

In future, engineers like me...

Will design stadiums that bring you up close and personal to your favourite band or sports team.



Caleb Harper

Job

Urban agricultural engineer

Employer

Massachusetts Institute of Technology

What I do all day

I create skyscraper farms. They grow edible plants in mist instead of soil.

Perk of the work

I love watching things grow – I think there's a tiny farmer in all of us.

In future, engineers like me...

Will feed the growing population by making sure there's fresh food for everyone who lives in cities, which could be 80% of us.



Ruby Reynolds

Job

Apprentice telecoms engineer

Employer

BT

What I do all day

I drive around hooking people up to super-fast internet.

Perk of the work

I don't have to work in an office all day.

In future, engineers like me...

Could connect homes to ultra-fast fibre broadband that lets you stream movies in ultra-high def and play virtual-reality games with friends in 3D.

Image: MIT Media Lab

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Andrew Flewitt

Job

Electronic engineer

Employer

Cambridge University

What I do all day

I use my knowledge of electronics and materials to make tiny nanosensors that monitor your body and tell you if you're getting sick.

Perk of the work

My technology could let doctors spot illnesses like cancer while they're still treatable.

In future, engineers like me...

Will develop technology that constantly monitors people's health, such as nanosensors that could be in your toothbrush, giving you a health check every time you brush your teeth.



Alison McGregor

Job

Biomedical engineer

Employer

Imperial College London

Image: Imperial College

What I do all day

I use hi-tech sensors to study how the GB rowing team move, making them go further with every stroke.

Perk of the work

I get to work with the UK's top athletes.

In future, engineers like me...

Will help athletes push the limits of human performance.



Kaspar Althoefer

Job

Robotics engineer

Employer

King's College London

Image: Lito Apostolakou

What I do all day

I'm designing new tools for surgery. My robotic octopus arm can get to hard-to-reach places inside patients without damaging delicate tissue.

Perk of the work

I get to use my robot test lab to make things to help people.

In future, engineers like me...

Will invent smaller, smarter surgical robots that can detect tumours inside the body, or even perform surgery without human control.



Carolyn McGregor

Job

Software engineer

Employer

University of Ontario
Institute of Technology

Image: Calvin Taylor, University of Ontario Institute of Technology

What I do all day

I make computer programs to keep an eye on thousands of readings from hospital monitors and spot if fragile newborns are getting ill.

Perk of the work

My research helps doctors save hundreds of lives.

In future, engineers like me...

Will give doctors a heads up when people are getting sick, before they can see symptoms.

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Aimi Elias

Job

Civil engineer

Employer

Transport for London

What I do all day

I am upgrading our Victorian underground stations, and designing shiny new ones.

In future, engineers like me...

Will design new stations and underground lines to get people around cities faster than ever before.



Tarit Mukhopadhyay

Job

Biomedical engineer

Employer

University College London

What I do all day

My team and I slice and splice genes and proteins to make vaccines that help your body fight illnesses like flu, HPV and anthrax.

Perk of the work

I help prevent outbreaks of disease, saving hundreds, or even thousands, of lives.

In future, engineers like me...

Will invent vaccines for new diseases, and work on preventing some of the illnesses we face today, like hay fever and HIV.



Emma Wilding

Job

Apprentice vehicle safety engineer

Employer

Jaguar Land Rover

Image: Stewart Writtle

What I do all day

I plan and carry out crash tests to make new car designs safer.

Perk of the work

I crash cars for a living!

In future, engineers like me...

Will test smarter cars with sensors that detect possible obstacles and automatically brake or steer you clear, stopping car accidents before they happen.



Charlotte Mace

Job

Civil engineer

Employer

Network Rail

What I do all day

I work on designing futuristic train stations with floors that generate electricity from people's footsteps, powering the station, and trains that drive themselves.

In future, engineers like me...

Will help people get around the country quickly and easily with new stations and fast trains, protecting the environment by getting people out of their cars.

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Image: City Science Initiative,
MIT Media Lab

Ryan Chin

Job

Urban engineer

Employer

Massachusetts Institute
of Technology

What I do all day

I design cars for future cities. My latest creation is an electric car that folds up and drives itself. Just hop in and go!

Perk of the work

I get to work with a team of super-smart people.

In future, engineers like me...

Will deploy self-driving electric vehicles that people can share to get around cities easily, without polluting the air.



James Ambrose

Job

Railway engineer

Employer

Network Rail

What I do all day

I invented a totally new kind of train powered by batteries. It's a lot more environmentally friendly than regular diesel trains.

In future, engineers like me...

Will invent better planes, trains and cars to get you from city to city without polluting the planet.



Image: Damian Harty

Teena Gade

Job

Vehicle science engineer

Employer

Force India
Formula One

What I do all day

I build virtual reality simulators to test race cars. We test everything, from the car's aerodynamics and tyres, to the driver's skills behind the wheel.

Perk of the work

I get to work with the world's fastest cars, and I even get to drive them... but only in the virtual world!

In future, engineers like me...

Will work with engineers and race car drivers to keep pushing the limits of speed.

Museum visit

Engineer Your Future is a free interactive exhibition that aims to engage and inspire young people aged 11–15 about engineering careers.

This exhibition will encourage students to think like engineers and enable them to explore the skills engineers use every day. Students can discover how engineering has shaped our world and the wide variety of places and jobs a background in science and maths could take them.

The exhibition is free to visit, though school groups should book in advance. It is located on the third floor of the Science Museum's Wellcome Wing and is open until the end of December 2017.

Why visit?

Bring your class to Engineer Your Future to inspire them about some of the many careers that can be pursued by studying maths and science.

Research has shown that most young people believe that science qualifications only lead to a narrow range of jobs such as scientist or doctor.

The exhibition takes a skills-based approach, identifying key engineering skills and building exhibition experiences around them. Visitors can learn about and try out engineering skills, identify that a variety of inspiring engineers also use these skills in their work, and discover that this is something they might be able to do themselves.

This exhibition features films and games alongside examples of real engineers who have taken an interest in science as the basis for a variety of exciting engineering careers that can impact on all our lives.

How to use *Engineer Your Future* in your visit

The exhibition is divided into four areas with game or film exhibits. Three areas focus on the skills engineers use and one area looks into where they work.

You and your students can explore:

- Testing and improving skills
- Systems thinking skills
- Ingenuity and problem-solving skills
- Who are engineers and where do they work?

Further information about the exhibition and activities is given on the next page.

Book a visit for your class

Call 020 7942 4777

Science Museum
Exhibition Road
London SW7 2DD

Find out more

sciencemuseum.org.uk/learning
sciencemuseum.org.uk/engineeryourfuture
learning-resources.sciencemuseum.org.uk

Engineer Your Future has been extended in association with the HM Government's Year of Engineering programme made possible with the support of:

Bechtel
Department for Business, Energy and Industrial Strategy

Engineer Your Future was made possible with the support of:

National Grid, ABB, BT, the Department for Business, Innovation and Skills, EDF Energy, IBM, Mott MacDonald and Network Rail, with additional support from EngineeringUK and the Royal Academy of Engineering.



This page summarises what you can see and do with your students in the *Engineer Your Future* exhibition at the Science Museum.

	Area summary	Learning outcomes	Questions for discussion
	<ul style="list-style-type: none"> Watch the short film <i>We Engineer</i> and see real-life engineers improving and testing faster racing yachts, safer houses and smarter prosthetics See the cutting-edge BeBionic prosthetic hand, the America's Cup racing yacht model and a model house and sea walls built to test tsunami defences featured in the film 	<ul style="list-style-type: none"> Engineering involves key skills such as improving, testing, making and adapting Engineers are always striving to make things better Engineering involves teamwork and communication 	<ul style="list-style-type: none"> What skills do these engineers use? What sort of things do engineers improve? What thing would you want to improve?
	<ul style="list-style-type: none"> Play our fun and challenging games to design and test some of the UK's most amazing complex systems including our power grid, rail network and airport baggage handling See the displays of engineers who use systems thinking in their everyday work 	<ul style="list-style-type: none"> Engineering involves key skills including systems thinking Systems thinkers juggle multiple factors to make a system that works; they need to understand and visualise complex networks, and cope with unexpected consequences Engineering involves teamwork and communication 	<ul style="list-style-type: none"> What factors or 'specifications' might you consider to make these systems work? (e.g. passenger numbers, eco points, safety, budget, supply v. demand, getting bags on planes) When have you juggled multiple factors to make something work in your life? How do you think life would be different if there weren't engineers to design the systems shown in the panels and games?
	<ul style="list-style-type: none"> It's time to try your hand at space-age engineering: create your own rover design and see if you can solve the problems of crossing an alien landscape See the display behind the game showing engineers using creative problem-solving in their everyday work 	<ul style="list-style-type: none"> Engineering involves key skills including creative problem-solving Engineers use creativity and novel thinking to find good solutions to problems 	<ul style="list-style-type: none"> What problems do you need to overcome on the terrain? (e.g. steep slopes, drops, gaps, gravel pits) What do you need to consider to solve these problems? (shape, number of wheels, size of wheels) Look at the panel behind the game showing a variety of engineers; what other problems are engineers trying to solve?
	<ul style="list-style-type: none"> Explore <i>FutureVille</i>, a city of the not-too-distant future, meet the engineers who work there and discover how engineers work everywhere, even in some surprising places See the display behind <i>FutureVille</i> with some of the routes you could take into engineering 	<ul style="list-style-type: none"> Engineering underpins every aspect of our lives There are many industries in which you can work and many roles you can fulfil There is more than one route into engineering, and engineering provides you with lots of career options 	<ul style="list-style-type: none"> Do any of the areas where engineers are working surprise you? What area most interested you? Do these jobs link with any of your interests or what you like to do in your spare time? Which route do you think suits you best?