Tomorrow's Engineers

Resource Pack

Overview notes 'What's in the pack'

Getting into Engineering...

School
Science, Physics, Maths, ICT, Computing, Chemistry

Apprenticeships
Financial Advisor, Management, Scientific Assistant

On-the-job training

University Degree
BSc, BEng, BSc(Hons), MEng

Engineering careers postcards

What is engineering?

Engineering is important...simple...cool...a superpower...

www.tomorrowsengineers.org.uk

‘Getting into engineering’ poster

‘What is engineering?’ leaflet
Overview
notes
‘What’s in the pack?’
What’s in the pack? How to use these resources

These resources are for use with young people. The accompanying notes cover some key points that you may like to consider if you are talking about engineering careers with young people.

**POSTCARDS**
A series of postcards for students, one for each member of the class. The postcards feature modern examples of engineering from a range of industries, including satellites, surgical robots, voice-activated televisions and solar powered laptops.

**Discussion Topics**: Based on current and future world challenges, such as reducing waste, coping with an ageing population, enabling space tourism and finding transport solutions for congested cities.

**POSTERS**
A2 posters to display in the classroom or at careers events, depicting routes into engineering, exciting future career opportunities in science and engineering, and a ‘disaster relief engineering’ poster with accompanying teacher notes and curriculum-linked lesson plan (‘Save lives as an engineer’).

**LEAFLETS**
A5 leaflets for different aged students, describing the opportunities presented by the engineering sector and looking at the different routes into engineering, along with information about work experience, degrees and apprenticeships.

**Ordering copies**: Additional copies can be requested from the ‘careers resources’ page of the Tomorrow’s Engineers website. All of the resources can also be downloaded directly: [www.tomorrowsengineers.org.uk/resources](http://www.tomorrowsengineers.org.uk/resources)

**STEM Ambassadors** can also request these resources through their usual point of contact in their Professional Engineering Institution.

**Website**: The accompanying website [www.tomorrowsengineers.org.uk](http://www.tomorrowsengineers.org.uk) has lots of information for students, teachers and advisers about engineering careers, including PowerPoint presentations, filmed case studies depicting real-life young engineers and career route maps.

**Questions**: Specific careers questions can also be addressed via the ‘contact us’ option on the website.

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Engineers are in demand

Did you know that skilled trade workers and engineers are the most in-demand jobs globally?

There will be an expected **2.56 million job openings** in engineering companies up to 2022. We need to double the number of engineering related apprentices and those taking engineering related college and university courses in order to plug the skills gap.

These resources are provided so that young people have access to up to date information about the wide range of engineering careers on offer, enabling them to make informed choices about their future.
Frequently asked questions about engineering careers

Answers to the questions that young people ask...

What is engineering?
Engineering is the practical and creative application of science and maths. Engineers use the knowledge they have in a specific field to make things work, to improve things and to solve problems.

What does an engineer do?
Engineers can be involved in building, testing and designing; they might work on large products like aircraft; small products like smart phones; buildings or infrastructure; energy sources such as wind, power or nuclear power; computing systems or software; transport; medicine; food; music; clothing and much more.

How much money can I earn?
Each industry sector is different as is each engineering job within that industry. Nevertheless, across the board, on average, professional engineers can expect to earn between £25,000 and £40,000 per year more than the national average salary.

Where do engineers work?
Engineers can work literally anywhere – offices, hospitals, studios, laboratories, power plants, at sea, film sets, construction sites, in space and underground. They are often employed by companies you may not immediately think of as needing engineers such as food manufacturers or healthcare companies.

What is an apprenticeship?
Apprentices are taken on by a range of engineering businesses. Apprentices typically spend the majority of their work week with an employer and the remainder at a local college or training provider. Apprentices get paid a weekly training wage and work towards a qualification over a period of 1 to 4 years. Apprenticeships exist at different levels and can be embarked on straight after school, after 5th form or college, or at a later point. Higher Apprenticeships often incorporate degrees and can be an attractive alternative to full time study at university. More information on apprenticeships and how to apply is available at www.tomorrowsengineers.org.uk/vocational.

What is a Chartered Engineer?
Chartered Engineers have gained the necessary qualifications and experience to become professionally registered and are able to use the letters CEng after their name. Other recognised professional statuses are Incorporated Engineer (IEng) and Engineering and ICT Technician (EngTech and ICTTech). Visit www.ingc.org.uk for more information and to search for accredited courses.

What qualifications do I need?
- For apprenticeships or college courses, good GCSEs (or equivalent) in maths and sciences. Other useful subjects include computing and design and technology.
- For university and higher apprenticeships, maths and physics A-level (or equivalent) or AICE Level 3 in an engineering related subject (or equivalent vocational qualifications). For chemical or biomedical engineering, chemistry is important. Grades and qualification requirements vary: check the UCAS website www.ucas.com for more information and see www.tomorrowsengineers.org.uk/university

Are scholarships or grants available?
A wide range of organisations offer grants and scholarships to support budding engineers. Visit www.tomorrowsengineers.org.uk/16-19/Funding/ for more information.

Do I need work experience?
Many universities request that applicants have work experience and employers see it as a positive sign that students are serious about getting into engineering. Visit the work experience section on the Tomorrow’s Engineers website to find out more.
Encouraging independent research

Young people will benefit from hearing about the personal experiences of people working in engineering, to help inspire them to consider it as a career path.

Gender awareness

Research shows young people are most interested in learning about engineering via hands-on projects. Providing realistic examples of women working in engineering careers is likely to be more successful in attracting young people to consider careers in engineering.

Tackling salary questions

Research shows that young people are more interested in hearing about engineering as a career opportunity, rather than the salary it may offer.

Providing examples of engineering

Research shows that young people are most interested in learning about engineering via hands-on projects. Providing realistic examples of women working in engineering careers is likely to be more successful in attracting young people to consider careers in engineering.

Salary Awareness

Research shows that young people are most interested in learning about engineering as a career opportunity, rather than the salary it may offer.
Find speakers, hands-on activities and places to visit...

- Organise a science, technology, engineering or mathematics (STEM) ambassador visit www.stemnet.org.uk/ambassadors
- Attend The Big Bang UK Fair www.thebigbangfair.co.uk
- Attend a Big Bang Near Me Fair or hold your own Big Bang @ School event nearme.thebigbangfair.co.uk
- Set up an after school STEM club www.stemclubs.net
- Arrange a school visit: Culture 24 www.culture24.org.uk
- Days out with the kids www.dayoutwiththekids.co.uk
- Find materials that support the curriculum, visit www.nationalstemcentre.org.uk for a range of free lesson resources and activities.

There are many more useful links for teachers on the ‘grown ups’ section of the Tomorrow’s Engineers website.

Sources of careers information:

A useful list of STEM careers websites can be found at:
www.thebigbangfair.co.uk/careers

General careers information:
https://nationalcareersservice.direct.gov.uk/

Apprenticeship vacancies:
www.findapprenticeship.service.gov.uk/apprenticeshipsearch
www.notgoingtouni.co.uk

University:
www.ucas.com
www.whatuni.com

If you are speaking to a group of young people about engineering careers there are PowerPoint presentations that can be used to support your discussions at www.tomorrowsengineers.org.uk/Engineering_presentation/

These careers information resources have been developed by:

Tomorrow’s Engineers www.tomorrowsengineers.com
IET www.theiet.org
IMechE www.imeche.org
ICE www.ice.org.uk

Join us at
Facebook www.facebook.com/TomorrowsEngineers
Twitter www.twitter.com/Tomorrows_Eng
Engineering themed postcards for young people
Marvellous mobiles

Mobile technology means we can now share music, films and photos with friends, almost anywhere.

Just one example of how engineers are connecting people.

Did you know?
Your mobile phone has more computing power than the computers used to land on the moon.

www.tomorrowsengineers.org.uk

DESIGN - CREATE - INNOVATE to help engineer a better future

ELECTRONICS

Engineers develop the latest electronic devices:

- Watches that monitor health
- Voice activated TVs
- Smartphones that can be unlocked by your fingerprint or eye scan
- 3D games consoles

Subjects you need for engineering:
- Maths
- Science - especially physics

Other useful subjects:
- Design & Technology
- Computing
- Chemistry

Exciting developments in wearable technology are helping us experience our lives in different ways.

Imagine you’re an engineer...

What type of clothing or accessory would you design and what functions would it have?

You could help engineer the next generation of electronic devices

DESIGN - CREATE - INNOVATE to help engineer a better future
Future lifesavers

Surgical robots allow doctors to remotely perform operations with the help of 3D cameras.

Just one example of how engineers are improving healthcare.

Did you know?
Within the last few years, thought-controlled bionic limbs have been developed, so amputees can feed themselves unaided.

www.tomorrowsengineers.org.uk

DESIGN - CREATE - INNOVATE to help engineer a better future

MEDICINE

Engineers are inventing many revolutionary products in healthcare:

- Laser eye surgery
- Artificial limbs for the injured and disabled
- Nuclear medicine for diagnosing and treating cancer patients
- Technology to restore movement, sight and hearing

Subjects you need for engineering:

- Maths
- Science - especially physics

Other useful subjects:

- Design & Technology
- Computing
- Chemistry

With an ageing population, engineers are facing many future healthcare challenges.

Imagine you’re an engineer...

What would you invent that would help make life easier for people with medical and physical needs?

You could help engineer the next life-saving solution

DESIGN - CREATE - INNOVATE to help engineer a better future

See my story and others here
Intelligent lighting

Lighting that knows when you’re in the room and when you’re not.

Just one example of how engineers are helping to save power.

Did you know?
The world’s first energy generating dance floor was launched in 2008. The kinetic energy produced by the movement of the dancing is converted into electricity which powers the dance floor’s LED lights.

www.tomorrowsengineers.org.uk

DESIGN·CREATE·INNOVATE
to help engineer a better future

POWER

Engineers are inventing many power saving solutions:

- Wind turbines that generate electricity for the home
- Cars that switch the engine off at traffic lights
- Smartphones that can be charged by running
- Solar powered laptops

Subjects you need for engineering:
- Maths
- Science – especially physics
Other useful subjects:
- Design & Technology
- Computing
- Chemistry

As the global population grows, our demand for energy increases, meaning we have to find new sources of power.

Imagine you’re an engineer...
How many energy efficient solutions can you come up with for your home or school?

You could power the next generation

DESIGN·CREATE·INNOVATE
to help engineer a better future

Yasmin, Operations Engineer
See my story and others here
Hair-raising

Gels, sprays, straighteners and tongs help us **look good**, whatever the occasion.

Just one example of how engineers are improving everyday products.

Did you know?
The ceramic materials used to make the plates in your hair straighteners can also be found in car brakes.

www.tomorrowsengineers.org.uk

**DESIGN-CREATE-INNOVATE**

to help engineer a better future

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**PRODUCTS**

Engineers help us to **look good, stay fresh and protect ourselves**, by manufacturing and developing:

- Deodorant and shower gel
- Self-tan and sun cream
- Advanced make-up that automatically matches skin tone
- Instant ‘one-touch’ hair curling devices

**Subjects you need for engineering:**
- Maths
- Science – especially physics

**Other useful subjects:**
- Design & Technology
- Computing
- Chemistry

Our desire to look and smell good has consequences for the environment, as the pots, razors, bottles and tubes we throw away often end up in landfill.

**Imagine you’re an engineer...**

How would you reduce the amount of waste produced by the cosmetics industry each year?

**You could help engineer** the next generation of eco-friendly products

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See my story and others here

Hilary, Process Engineer – Manufacturing

DESIGN-CREATE-INNOVATE
to help engineer a better future
Smart Satellites

Satellites are helping to save our planet. They monitor pollution, disasters and environmental changes and locate people who are destroying the rainforests.

Just one example of how engineers are protecting our environment and the species that inhabit it.

Did you know?
Satellite TV signals transmitted to the dishes on houses are beamed down from 36,000km above the Earth's equator – roughly a tenth of the way to the Moon.

www.tomorrowsengineers.org.uk

DESIGN-CREATE-INNOVATE to help engineer a better future

SPACE

Engineers design equipment to help us explore our own planet and the rest of the universe:

- Space telescopes to explore the unknown
- Satellites to monitor the weather
- Rovers and probes to detect objects in the solar system
- Space craft for future tourists

Subjects you need for engineering:
- Maths
- Science – especially physics

Other useful subjects:
- Design & Technology
- Computing
- Chemistry

Space agencies are planning to send people to the Moon and Mars in the next few decades.

Imagine you’re an engineer...
What would you need to think about in order to help people live on these other planets?

You could help engineer the first manned mission to Mars

Abbie, Spacecraft Structures Engineer

See my story and others here
Sporting success

Computers and sensors make it easier to study a sports professional’s technique and to develop unique, personalised equipment using 3D design software.

Just one example of how engineers are helping to give sporting heroes the edge.

Did you know?
An athlete’s race time can be measured to 1 millionth of a second using computers, pressure pads, lasers, high speed video and radio frequency tags.

www.tomorrowsengineers.org.uk

DESIGN-CREATE-INNOVATE to help engineer a better future

SPORT

Engineers improve the way we watch and play sport:
- Instant replay to help umpires and referees with their decisions
- Tracking devices so runners can accurately record distance and pace
- Smart fabrics that react to heat and light, with in-built digital technology
- 3D body scanners that calculate a player’s precise sportswear measurements

Subjects you need for engineering:
- Maths
- Science – especially physics

Other useful subjects:
- Design & Technology
- Computing
- Chemistry

Global sporting events like the Winter Olympics and Paralympic games produce exciting challenges for engineers – from coping with extreme weather to televising the events.

Imagine you’re an engineer...
What would you need to think about when designing sportswear and equipment for such events?

James, Sports Engineer

See my story and others here

You could engineer winning technology for future champions

DESIGN-CREATE-INNOVATE to help engineer a better future
On the move

It's been over 5,000 years since the wheel was invented. Since then, travel by road, water, rail and air has brought the world closer together.

Just one example of how engineers are making it easier for us to get around.

Did you know?
It took three years to drill the Channel Tunnel between France and the UK, using machines as long as two football pitches.

www.tomorrowsengineers.org.uk

DESIGN-CREATE-INNOVATE to help engineer a better future

TRANSPORT 🚗

Engineers design, create and maintain our transport system, from vehicles to ‘infrastructure’ like roads, tracks and stations. They also:

- Build bridges, tunnels and canals
- Plan airports based on factors such as wind speed and noise pollution
- Think up solutions for cyclists and cars to safely share the road
- Investigate new types of transport, such as hover vehicles

Subjects you need for engineering:
- Maths
- Science – especially physics
Other useful subjects:
- Design & Technology
- Computing
- Chemistry

As our cities become over-crowded, engineers need to find new ways to help people get around as quickly as possible to take the pressure off the tube, trains, trams and buses.

Imagine you’re an engineer...

What would your transport solution be for your nearest city?

You could engineer a new way to help people get safely from A to B

Regina, Trainee Engineer

See my story and others here

DESIGN-CREATE-INNOVATE to help engineer a better future
From waste to taste

Only 1% of the world’s water can be used by people, but there’s enough for all of us if it’s captured, treated and distributed efficiently.

Just one example of how engineers are helping us get the natural resources we need to survive.

Did you know?
The water you drink today has been around since dinosaurs roamed the Earth, hundreds of millions of years ago.

www.tomorrowsengineers.org.uk

DESIGN-CREATE-INNOVATE
to help engineer a better future

WATER💧

Engineers design systems for managing water that:

- Deal with waste water and sewage
- Allow ships to transport the goods we buy
- Reduce the risk of flooding
- Capture tidal energy

Subjects you need for engineering:
- Maths
- Science – especially physics

Other useful subjects:
- Design & Technology
- Computing
- Chemistry

Hundreds of thousands of children die every year in ports of Africa and Asia due to a lack of safe drinking water and poor sanitation and many more are affected by floods.

Imagine you’re an engineer...

How would you help remote villages access clean water?

You could help engineer a future in which everyone has enough clean water

DESIGN-CREATE-INNOVATE
to help engineer a better future

Martin, Marine Engineer

See my story and others here
Short leaflet
‘What is engineering?’
for young people
What is engineering?

Engineering is behind everything – from your smartphone and hair styling products to the lights you switch on and the shoes on your feet. So, if you enjoy maths and science at school, you too could be designing cutting-edge technology or providing water for drought plagued countries.
Engineering uses maths and science – especially physics – to improve the world around us and it all starts with what you learn in school. It can be creative, hands-on practical work, or problem solving.

You could work with materials and chemicals to design sports clothing, find new ways to preserve food, or make the latest skin care products.

Or why not join a team that designs driverless vehicles or makes transport safer, greener and more efficient? You could plan our road or rail networks to ensure we get around quickly, without stress. Or even design robots that do housework.

Then there are the engineers tackling some of the world’s most pressing problems – from dealing with cyber security and maintaining clean water and energy supplies to finding sustainable ways to grow food, build houses and travel.

Whatever you’re into – whether it’s music or wildlife, space or computer games, there’s a world of exciting possibilities on offer as there are dozens of different types of engineering to choose from. You could travel the world, meet interesting people and help improve our lives.
Engineers at all levels have the potential to have a fantastic career and to earn a great wage.

People who graduate from university with engineering and technology degrees earn approximately 20% more per year than the average salary for all graduates and can expect to earn significantly more over their lifetime than graduates from most other subjects.

Engineering technicians also earn a great deal more (approximately £6,000 more per year) than the national average wage. Registered Engineering Technicians (EngTech) earn, on average, over £25,000 more per year than the national average wage.

What’s more, the chances of finding and staying in employment are really good. Emerging fields like space and satellite technology, medical engineering, advanced manufacturing and design consultancy along with ‘green’ jobs in renewable energy, alternative fuels, zero carbon homes and new nuclear energy mean that the future is very bright for engineers.

The ability to think creatively and solve practical problems in a mathematical and scientific way – along with other skills such as team-work, leading projects and communicating – makes engineers highly employable.

Data is taken from EngineeringUK 2014: The State of Engineering.
Getting into engineering...

School
Science (Physics), Maths, D&T, Computing, Chemistry

Apprenticeships
Intermediate / Advanced / Higher
Earn while you learn e.g. NVQ / SVQ / BTEC

On-the-job training

6th Form / FE College
A levels / IB / Highers (or equivalent)
BTEC
HNC & HND
Foundation Degree

Work

University Degree
Bachelors (BEng)
Masters (MEng)
Routes into engineering

11 to 16 / At School

Studying science – especially physics – and maths at school will get you off to a great start. Design & technology, computing and chemistry can also be useful for certain types of engineering. These subjects give you some of the skills engineers use and are a great basis for engineering, construction, manufacturing and IT apprenticeships, college courses, university degrees or jobs.

Work Experience

If you’re interested in becoming an engineer, why not get work experience during the school/college holidays? Some universities are now requesting work experience as part of the application process for their engineering courses. So be one step ahead!

Work experience placements can be difficult to find, so start searching as soon as you can to ensure you’re not disappointed. Visit the ‘work experience’ section on the Tomorrow’s Engineers website for tips on where to start looking.
There are several different routes you can choose the path that’s best for you.

**Vocational qualifications**

Such as BTECs and NVQs in engineering, construction and the built environment or ICT.

Vocational courses prepare you for a particular job, industry or sector. They are often very practical and may include coursework assignments related to real-work scenarios, as well as links with employers. They can lead on to advanced and higher apprenticeships and university.

**Apprenticeships**

Apprenticeships allow you to earn money, combining on-the-job training with study. Apprenticeships are available at different levels – the higher level apprenticeships often incorporate university degrees within the learning element of their programmes and can lead on to professional registration. The combination of qualifications and workplace experience makes apprentices an attractive option for employers looking to recruit people with proven practical skills.

You’ll generally need a minimum of five GCSEs (or equivalent), including English, mathematics and science or technology subjects, often at grades A* to C due to competition for places.

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**University**

After completing your A-Levels, IB, Highers, BTEC Level 3 or equivalent, you may decide to go on to study engineering at university. Degree courses (BEng) normally last for 3 or 4 years whilst Masters courses (MEng) last for 4 or 5 years. Some courses involve a year working in industry, or a year abroad. The additional experience this provides can be highly beneficial when seeking employment.

Students can take a ‘general engineering’ degree or they might decide on a particular type of engineering, for example electronic engineering, design engineering, or one of the many other types of engineering! You normally need to have studied maths and physics (or chemistry for chemical and biomedical engineering), or a related vocational course to Level 3, in order to apply for engineering degrees at university.

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**Financial support**

Universities and the National Scholarship Programme offer bursaries to help with the cost of studying. Some professional engineering institutions and employers offer scholarships which are open to candidates with the right qualifications for particular courses. Many scholarships come with additional benefits such as guaranteed internships with the sponsoring organisation. More information can be found on the funding section of the Tomorrow’s Engineers website.
Many different types of engineering, construction, manufacturing and ICT apprenticeships exist, leading to jobs in a variety of industries, including transport, health, food, digital technology, construction, design and power.

We need to at least double the number of engineering and technology apprentices and technicians in the UK by 2020 in order to meet demand, so it’s a good time to be considering this pathway into your future career.

**A-Levels / Highers / IB**

By continuing with relevant subjects after your GCSEs (or equivalent), you could progress onto an engineering degree course at university or a higher engineering, manufacturing or IT apprenticeship.

Important subjects include: maths and physics. Chemistry may be required for certain engineering degrees, such as chemical or biomedical engineering. Other useful subjects for engineering degrees include: design & technology, computing and further maths.

You can find out more about apprenticeships here:

- If you live in England – [www.apprenticeships.org.uk](http://www.apprenticeships.org.uk)
- If you live in Scotland – [www.myworldofwork.co.uk/modernapprenticeships](http://www.myworldofwork.co.uk/modernapprenticeships)
- If you live in Northern Ireland – [www.delni.gov.uk/apprenticeshipsni](http://www.delni.gov.uk/apprenticeshipsni)

To find out more about Engineering Technicians, visit: [www.engtechnow.com](http://www.engtechnow.com)

**Beyond study**

Whichever route you take into engineering, once you have the necessary qualifications and skills developed in the workplace you can apply to become professionally registered with a professional engineering institution. Your registration options are: Engineering Technician (EngTech), ICT Technician (ICT Tech), Incorporated Engineer (IEng) or Chartered Engineer (CEng). Once registered, you can use these letters after your name so employers and customers can see that you’ve achieved a high standard of engineering professionalism.

There are some vocational qualifications, apprenticeships and degree courses that will give you a head start on the road to professional registration. Check out the accredited course search tool and the database of Technician qualifications on the Engineering Council’s website to see if your chosen course is one of them. You’ll also find a full list of professional institutions and benefits of membership: [www.engc.org.uk](http://www.engc.org.uk)
Get Involved

There are plenty of opportunities to get involved in engineering, whatever stage you’re at! From science and engineering clubs, fairs and attractions around the UK, to residential courses and competitions, take a look at the ‘get involved’ section on our website for further inspiration. You can also find case studies, activities, careers resources, quizzes and more information about careers in engineering.

Craig
Manufacturing Engineer (apprenticeship route)
“I like to be ‘hands on’ and to learn stuff on the job.”

Join us on Facebook and Twitter

Facebook.com/TomorrowsEngineers
Twitter.com/Tomorrows_Eng

www.tomorrowsengineers.org.uk
Display size 'Getting into Engineering' poster
Getting into Engineering...

School
Science (Physics), Maths, D&T, Computing, Chemistry

Apprenticeships
Intermediate / Advanced / Higher
Earn while you learn e.g. NVQ / SVQ / BTEC

On-the-job training

6th Form / FE College
A levels / IB / Highers (or equivalent)
BTEC
HNC & HND
Foundation Degree

University Degree
Bachelors (BEng)
Masters (MEng)

Work

www.tomorrowsengineers.org.uk

Find out more about the work of real-life engineers, like Yasmin and Richard, here

Yasmin Ali, Operations Engineer
Richard Kirkland, Electrical Maintenance Technician
Display size posters:

‘Save lives as an engineer’
(with teacher notes and lesson plans on the theme of disaster relief)

‘10 great reasons to become a scientist or engineer’
Save lives as an engineer

**Engineers Find and Rescue People**
Using equipment such as telescopic lenses, drones and radar devices that detect victims’ heartbeats, as well as cockroaches fitted with microphones, which can detect sounds coming from underneath rubble.

**Engineers Help People Survive**
Providing immediate shelter and transport networks and getting emergency water and sanitation services working, helping to prevent disease outbreaks.

**Engineers Help People Rebuild Their Lives**
Designing and making artificial limbs, wheelchairs and other devices to help people who have suffered serious injuries.
Training local people in building, farming and other skilled jobs, when there is a shortage in disaster-struck areas.

**Engineers Reduce the Impact of Future Disasters**
Improving warning and detection systems for tsunamis, volcanoes, earthquakes, typhoons and other natural disasters.
Creating apps to better coordinate the distribution of resources and relief.
Designing and using materials that can perform better in extreme conditions.

**Engineers Get Things Up and Running**
Restoring electricity and communications, critical for providing humanitarian relief in affected areas.

Find out more at [tomorrowsengineers.org.uk/savelives](http://tomorrowsengineers.org.uk/savelives)

**Design - Create - Innovate**
Use maths, science, design and technology to help engineers a better future.
‘Save lives as an engineer’ poster

Accompanying Teacher Notes and Resources

Teachers can use these notes to facilitate classroom discussions and plan lessons around the theme of the enclosed ‘Save lives as an engineer’ poster. These notes include:

- Suggested discussion topics on the theme of disaster relief engineering
- Questions and challenges for students to explore
- ‘Beat the Flood’ lesson plan with student worksheets
- A list of other recommended curriculum-linked resources on this theme

The poster and accompanying teacher notes are primarily aimed at STEM teachers, form tutors, STEM Ambassadors and those who work with secondary school aged students.

Further information and inspiration such as featured engineer profiles, quizzes, route maps, student and parent leaflets and ‘get involved’ sections for different age groups can be found on the Tomorrow’s Engineers website.

tomorrowsengineers.org.uk/savelives
What are the different types of natural and human-made disasters? For example:

- Earthquakes, tsunamis, floods, avalanches
- Hurricanes, tropical storms, tornadoes
- Volcanoes, droughts, wildfires
- Infectious disease pandemics, chemical spills, nuclear blasts
- Power service disruption and blackouts, cyber threats
- Biological weapons, civil unrest

Can these be categorised and ordered in different ways? For example:

- Natural and human-made disasters (is the division always clear?)
- Risk of disaster occurring – from highest to lowest risk. Does it depend on the part of the world?
- The most impactful to the least impactful; for example in terms of:
  - Number of deaths
  - Number of serious injuries
  - Risk of disease
  - Amount of damage to infrastructure
  - Number of agencies that will be involved in responding
  - Amount of time and money it will cost to rebuild the community/restore normal life

Ask students to think about the questions opposite in relation to each of the different poster headings. Some prompts and further information for teachers has been included after each question.

A photocopiable sheet of poster headings and tasks can be found on Page 4.
Discussion topics and challenges for students

1. Discuss the theme you have been given with your group.
   - Have students heard of these things or seen them in the news?
   - Which natural disasters can they remember hearing about?
   - What has had the most impact on students when hearing how people have been affected by disasters?

2. Looking at your heading, can you think of any other ways that engineers provide assistance?

Here are some additional examples for each heading that you could prompt your students to consider and discuss:

**Search and Rescue**
- Design/electronics engineers create devices such as personal beacons to locate rescue workers in avalanches.
- Mechanical engineers build programmes that automatically detect people in video feeds and measures their pulse using image analysis.
- Robotics engineers develop drones for use in search and rescue missions in areas that have lost signal.

**Surviving**
- Computer Aided Design (CAD) technicians and civil engineers come up with temporary solutions for shelter, water, waste disposal, infrastructure and transport, e.g. emergency mobile bridges that can be constructed within an hour.
- Biomedical engineers develop smartphone-based light microscopes to identify life-threatening diseases such as malaria.
- Electrical engineers help get power into temporary shelters – vital for operating theatres.

**Restoring/rebuilding**
- Structural engineers check that the buildings still standing are safe and oversee any stabilisation and demolition required.
- Civil/construction engineers make sure materials are used correctly (e.g. not using salt water in concrete). They work with the affected community, overseeing the re-construction of roads, houses, schools, hospitals, water pipes, sewage and drainage systems.
- Mechanical engineers get heating, ventilation, water and power systems working again.

**Reducing impact of future disasters**
- Robotics engineers design autonomous and self-controlled digging and sniffer robots to enter places that are dangerous for humans, e.g. to stabilise a nuclear reactor.

For more engineering careers inspiration, visit [www.tomorrowsengineers.org.uk](http://www.tomorrowsengineers.org.uk)

*Nepal earthquake aftermath, 2015*
3. In your groups, go online and read the stories of the two engineers featured on the poster: www.tomorrowsengineers.org.uk/savelives
   - Page 10 presents a list of useful websites that students could be directed to for further research on this topic (time permitting).

4. Imagine you’re a team of engineers. What would you need to think about when carrying out the tasks described under your poster heading?
   - Students could be prompted to think about factors such as: time; potential risks; threats; cost; availability of resources; working with other professionals such as aid workers, medical professionals and surveyors; local political situation; language barriers; legal requirements; reassuring and involving local people; and viability/durability of proposed solutions.

5. Can your team of engineers come up with a brand new solution or piece of equipment/technology that would help revolutionise the way we respond to disasters?
   - This task is all about getting students to be creative, practical and innovative – teachers could emphasise that these are three of the most important skills an engineer possesses.

6. What skills and personal traits do you think engineers working in this area might need?
   - Skills and traits include:
     - being creative, solution-focused, innovative and practical
     - having an enquiring mind
     - using technology
     - working in teams
     - communicating ideas
     - leading projects
     - managing budgets
     - working out how to do things efficiently
     - being resilient
     - remaining calm
     - identifying risks
     - working within tight timescales
     - coping with pressure
     - communicating with people on different levels
     - explaining complex technical information in a simple way
     - plus many more.

The groups could present their brand new solution (and/or discussion points) to the rest of the class.

For more engineering careers inspiration, visit www.tomorrowsengineers.org.uk
Themes

Engineers find and rescue people
Using equipment such as telescopic lenses, drones and radar devices that detect victims’ heartbeats, as well as cockroaches fitted with microphones, which can detect sounds coming from underneath rubble.

Engineers help people survive
Providing immediate shelter, transport networks and getting emergency clean water and sanitation services working, helping to prevent disease outbreaks.

Engineers get things up and running
Restoring electricity and communications, critical to providing humanitarian relief in affected areas.

Engineers help people rebuild their lives
Designing and making artificial limbs, wheelchairs and other devices to help people who have suffered serious injuries.
Training local people in building, farming and other skilled jobs, when there is a shortage in disaster-struck areas.

Engineers reduce the impact of future disasters
Improving warning and detection systems for tsunamis, volcanoes, earthquakes, typhoons and other natural disasters.
Creating apps to better co-ordinate the distribution of resources and relief.
Designing and using materials that can perform better in extreme conditions.

Tasks

1) Discuss the theme you have been given with your group
2) Looking at your theme, can you think of any other ways that engineers provide assistance?
3) Go online and read the stories of the two engineers featured on the poster. [www.tomorrowsengineers.org.uk/savelives]
4) Imagine you’re a team of engineers. What would you need to think about when carrying out the tasks described under your poster heading?
5) Can your team of engineers come up with a brand new solution or piece of equipment/technology that would help revolutionise the way we respond to disasters?
6) What skills and personal traits do you think engineers working in this area might need?

For more engineering careers inspiration, visit [www.tomorrowsengineers.org.uk]
Beat the Flood

Materials Testing
KS3 practical activities for science and D&T lessons

For more engineering careers inspiration, visit www.tomorrowsengineers.org.uk
What do you need to know?

Organiser’s notes

This activity is formed of two tasks, each of which will give students the opportunity to explore materials and their properties while learning about the important role engineers play in supporting international development.

It is taken from the Beat the Flood challenge developed by Practical Action (www.practicalaction.org/schools). Beat the Flood gives students the opportunity to apply their STEM skills to design, develop and test a model of a flood-resistant house.

Preparation

- Read the instructions and do a test run so that you are familiar with the tasks.
- Use the discussion points linked to the poster (listed earlier in these notes) to introduce and contextualise the activity.

Specific discussion points

In addition to the more general discussion points linked to the theme of ‘disaster relief’ (which can be found on pages 1 and 2), some specific points that could be introduced alongside this activity are:

- Flooding affects the lives of many people around the world. How can engineers help?
- What materials are best suited to building a flood-proof home?
- How might the choice of materials used to build a home impact on the environment?
- What types of engineers are involved in constructing new homes? (Structural engineers, civil engineers, building services engineers, electrical engineers, architectural engineers and engineering geologists are all involved).

Curriculum links

KS3 Science
(11-14 yr olds)
- Physics: motion and forces
- Physics: matter
- Experimental skills and investigation
- Analysis and evaluation
- Scientific attitudes
- Technical knowledge - properties of materials

KS3 Design & Technology
(11-14 yr olds)

After completing the tasks, encourage students to apply their knowledge and build a model of a flood-proof house, which can be tested by standing in a tray of water and squirting a hosepipe.

For more engineering careers inspiration, visit www.tomorrowsengineers.org.uk
Engineering challenge: Beat the Flood

You are a structural engineer working for an international development organisation, Practical Action. You are currently based on Watu Island, an area that is prone to flooding. Your job is to test materials and recommend which ones are most suitable for building flood proof homes, in order to improve living conditions for people on the island and potentially save lives.

Background info

Each year, floods cause massive destruction, often hitting the poorest, damaging homes and crops and killing thousands of people. Engineers work with international development agencies to design simple and affordable flood-resistant housing, as well as re-building communities in a number of other ways. As many scientists predict that climate change will lead to an increase in adverse weather conditions in the UK and other parts of the world, engineers are looking at how to develop flood-resistant communities.

Your task

The best materials for building flood-proof homes are those that are strong and water-resistant. You will need to test two things in a range of materials:

- **Tensile strength** (the maximum amount of stress a material can take before breaking)
- **Absorbency**

Your tasks are on the following pages. Once you have tested the materials and recorded your results, you must decide which materials are most suitable for building a new home. Remember that there are other factors to consider, such as the cost, availability and long-term durability of the materials.

Results Table

Testing materials for strength and absorbency

<table>
<thead>
<tr>
<th>Material</th>
<th>Height that the water was absorbed to (cm)</th>
<th>Mass added to the material (g)</th>
<th>Observations</th>
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For more engineering careers inspiration, visit [www.tomorrowsengineers.org.uk](http://www.tomorrowsengineers.org.uk)
Task 1

Testing the tensile strength of materials

Activity materials list
Each group will need:
2 x stands and clamps
Sets of 10g masses
Materials for testing (such as cling film, plasticine, plastic bottles, foil, food trays, straws, lolly sticks, clay, aluminium foil, grass, leaves)

Instructions
First set up the stands
They should be about 15cm apart and the clamps should be facing each other.

Next prepare your materials
Measure and cut materials to a standard size of 15cm x 2cm to ensure a fair test.

Attach your first piece of material between the two clamps.

Test the strength of different materials
Add 10g masses to the mid-point of the material, one after another, until the material breaks or bends. Keep repeating with all the different materials you have selected for testing.

Record your results
Use the table on page 7 to record the maximum mass (g) you were able to add to each of the different materials. Record your observations as you go. Repeat for each of the materials.

Now complete the materials absorbency test (on the next page)

Find out more about careers in engineering
Many different types of engineers are involved in responding to disasters and rebuilding communities. Engineers who construct new buildings in disaster zones, such as civil engineers, are in the Construction Crew. Try our Whose Crew Are You? quiz to find out which crew you’re in:

www.tomorrowsengineers.org.uk/
whosecrewareyou

For more engineering careers inspiration, visit www.tomorrowsengineers.org.uk

Bangladeshi woman using elevated tube well to access clean water during flood
Testing the absorbency of materials

Activity materials list
Each group will need:
- 1 x stand and clamp
- Timer
- 6 x 100ml glass beakers
- Food colouring
- Ruler
- Materials for testing (same as before)
- Scissors

Instructions
First set up the stands
The clamps should be about 15cm high.

Next prepare your materials
Measure and cut materials to a standard size of 15cm x 2cm to ensure a fair test.

Test the absorbency of different materials
Attach a piece of material to the stand and clamp so that it is held in a vertical position over a glass beaker containing 25ml of coloured water. (Use water dyed with food colouring to make it easier to see the progress of the water being soaked up by the materials).

Start the timer as you lower the first piece of material into the water. Leave the materials in the water for 3 minutes, then remove from the water. Repeat for each of the materials you are testing.

Record your results
Use the table on page 7 to record the distance (cm) the water has travelled up each of the materials, along with any observations you have.

Verdict
Once you have completed both the tensile strength test (task 1) and the absorbency test (task 2), decide with your group/partner, which of the materials is best suited to building a flood-proof home.

Now use what you’ve learned about the strength and absorbency of different materials, to design and build a model of a flood-resistant home.

For more engineering careers inspiration, visit www.tomorrowsengineers.org.uk
Related resources and useful links

Tomorrow’s Engineers activities

In addition to the Beat the Flood activity included in these notes, Tomorrow’s Engineers – in partnership with other organisations – has produced several KS3 curriculum-linked activities, including Cargo Drop, Heat Exchange and Desert Island Drinks:

www.tomorrowsengineers.org.uk/careers_resources/engineering_activities

Practical Action

A charity that uses technology to improve living conditions for people all over the world. Visit the website for STEM challenges and case studies, including more detailed ‘Beat the Flood’ materials:

www.practicalaction.org/schools
www.practicalaction.org/beatthefflood

Royal Academy of Engineering – curriculum resources

Disaster response: how do engineers save lives in the aftermath of a natural disaster? Some fantastic KS3 and KS4 curriculum resources provide longer learning activities to enhance and add context to the curriculum, or for use in a STEM club or for a STEM challenge day. Developed primarily to engage students with STEM subjects, such as D&T, ICT, science and maths, the resources give students the opportunity to learn by investigating big questions and ‘thinking like an engineer’. Themes include: aftermath of a disaster, emergency shelters, tents, water and toilets, filters and solar disinfection:

www.raeng.org.uk/education/schools/teaching-and-learning-resources/curriculum-resources

Institution of Engineering and Technology – educational resources

Engineers can save lives – KS3 and KS4 activities encouraging students to think about the role engineers play in providing us with healthy water supplies, flood defence and emergency communications:

http://faraday.theiet.org/resources/overview/engineers-save-lives.cfm

Institution of Civil Engineers – educational resources

www.ice.org.uk/disciplines-and-resources/educational-resources

Institution of Mechanical Engineers – educational resources

www.imeche.org/education

Careers websites – job profiles

https://nationalcareersservice.direct.gov.uk
www.prospects.ac.uk
www.icould.com

Charities involved in providing disaster relief and relevant teaching resources:

Practical Action
Engineers Without Borders
Thé Red Cross
Oxfam
RedR
SARAI

www.practicalaction.org/schools
www.ewb-uk.org
www.redcross.org.uk/What-we-do/Teaching-resources
www.oxfam.org.uk/education/resources
www.redro.org.uk
www.saraid.org.uk

For more engineering careers inspiration, visit www.tomorrowsengineers.org.uk
This resource was developed by the Tomorrow's Engineers careers group.

To order or download additional copies please visit the website, where more engineering activities, case studies and careers resources can be found.

tomorrowsengineers.org.uk/savelives
10 Great Reasons to become a scientist or engineer

1. Develop all this...
   - Artificial limbs for the injured and medicine for diseases like Ebola
   - 3D games consoles and solar powered laptops
   - Make-up that automatically matches skin tone
   - Systems to reduce the risk of flooding
   - Driverless vehicles and spacecraft for future tourists
   - Smart fabrics with in-built digital technology
   - Supercomputers that predict the effects of climate change

2. Work in your favourite industry
   From food, medicine and renewable energy to sport, film and music - scientists and engineers are needed everywhere

...and more

3. Earn great money
   On average, engineering apprentices earn over double the national minimum apprentice wage.

Minimum apprentice wage
Engineering apprentice wage

   The average starting salary for people with engineering and technology degrees is 20% higher than for all graduates.

4. Make a difference
   Help tackle some of the world’s biggest challenges, like responding to natural disasters, improving cyber security and developing clean energy sources.

5. Be in demand
   The UK needs over 2 million new scientists, engineers and technicians by 2022.

6. Choose your own route
   Go to college, do an apprenticeship, get a university degree or combine all three.

7. Have your pick of future careers
   Capture tidal energy, design a robot, discover a cure for cancer... or do a job that doesn’t even exist yet!

8. Travel the globe
   Work in dynamic teams with people from different backgrounds, all over the world.

9. Gain respect
   Be remembered for your work and go down in history for designing incredible structures, making awe-inspiring advancements in technology, discovering planets or identifying crucial genetic codes.

10. Design, create and innovate
    Subjects like design and technology, art and computing can help pave the way to careers that revolutionise the way we live.

Find out more about careers in science, technology, engineering and maths:
thebigbangfair.co.uk/careers
engineering: tomorrowengineers.org.uk
biology: rsb.org.uk/make-a-difference
chemistry: rsc.org/careers/future
physics: physics.org/careers
maths: mathscareers.org.uk

The Big Bang
UK Young Scientists & Engineers' Fair

Take our short quiz to discover your crew and gain careers inspiration: thebigbangfair.co.uk/whosecurreyou