

Resource Pack



Overview notes 'What's in the pack?'

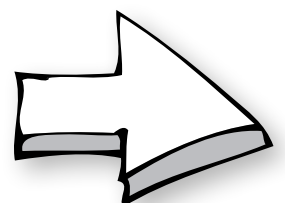
Tomorrow's Engineers
Career resources

Designed by



AURACREATIVE
CREATING BRAND BELONGING

www.aura-creative.co.uk





Tomorrow's Engineers

Careers information resources
for schools and colleges

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
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 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.

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 air craft; 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 6th 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 ICT Tech). Visit www.engc.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 BTEC 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 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.

Tackling salary questions

Research shows that engineers earn comparatively good salaries; yet talking about salaries with young people can be tricky. Emphasise the fact that employers continue to report a shortage of science, technology, engineering and maths skills, so the prospects for employment, progression and retention remain positive compared to roles that do not rely on these skills. The following average salaries will provide a framework for discussions:

- On average, **professional engineers** can expect to earn between **£25,000** and **£40,000** per year more than the national average salary.
- **Engineering graduates** start out earning around 20% more than graduates from other degree disciplines and can expect to earn significantly more over a lifetime.
- Those who become **engineering technicians** can expect to earn at least £6,000 more per year than the average mean salary for all employees.
- The average salary for **Chartered Engineers** is **£68,500** and for Incorporated Engineers it is **£51,000**.



Gender awareness

Great engineering careers exist for both boys and girls, with many companies actively seeking a more diverse workforce. It is important to reinforce positive and inclusive careers messaging. Engineers are as likely to be found working in robotics or healthcare as working on large infrastructure projects such as Crossrail and the Olympics. Providing realistic examples of women who have entered the profession whenever possible is important, as well as managing groups so that boys and girls have equal opportunities to ask questions. Use images in resources and presentations that represent a wide range of engineers and engineering careers. The **posters** and **postcards** in this pack include examples of male and female engineers and can be used to facilitate discussions. The **case studies** that feature on the postcards and on the Tomorrow's Engineers website also represent a diverse range of young engineers.

Providing examples of engineering

Research shows that young people are most inspired by modern and futuristic examples of engineering. The **postcards** supplied in this pack can be used to support discussions about the wide variety of products, challenges and corresponding careers that engineers are involved in. The **'Save lives as an engineer' poster** and **lesson plan** also provide an interesting, topical context for discussing the engineering involved in disaster relief. More examples and case studies can be found at www.tomorrowsengineers.org.uk

Routes in

There is a predicted demand for technician or apprenticeship level skills in engineering, yet apprenticeship routes are not widely understood. Try to cover **university**, **apprenticeship** and **vocational** routes into engineering in your discussions with young people. There are many positive examples of young people who have opted for an apprenticeship route and emerged with good qualifications and no student debt.

Equally, complex engineering requires high level skills – often at Master's level or beyond – and young people need to be sure they are choosing the right qualifications if they have a specific career in mind. Continuing with maths and science, especially physics, at A-level (or equivalent) will enhance the range of university courses that students can apply for. The **'Getting into engineering' poster** included in this pack may be helpful when looking at routes into engineering with students and there are two booklets included in this pack for student considering their post-16 options.

If you require more detailed information about the qualifications that support a career in engineering see the route maps on the 'resources' page of the Tomorrow's Engineers website – versions for England, Wales, Scotland and Northern Ireland are available to download from www.tomorrowsengineers.org.uk/resources

Encouraging independent research

Young people will benefit from hearing about the personal experiences of those working in engineering. Try to avoid advocating one route over another. Certain courses and routes may suit some young people better and they should be encouraged to explore these for themselves. A list of useful websites can be found at www.tomorrowsengineers.org.uk

What next?

Further
Information

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:



Join us at

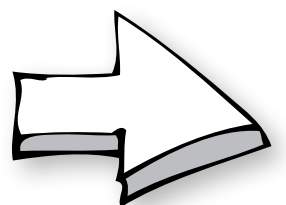


TomorrowsEngineers



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

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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?



Mairead, Design Engineer

See my story and others here



You could help engineer the next generation of electronic devices

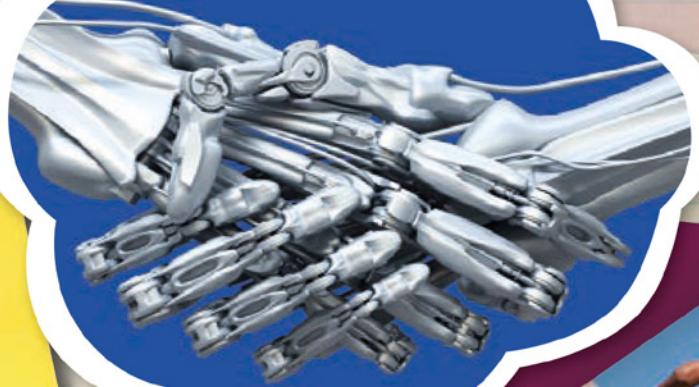
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Future lifesavers

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.



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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?



Louise, Rehabilitation Engineer

See my story and others here



You could help engineer the next life-saving solution

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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.



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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:

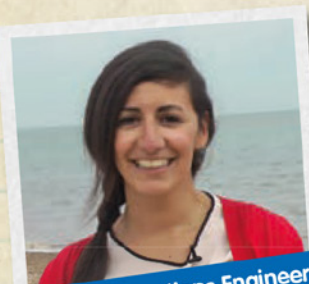
- Design & Technology
- Computing
- Chemistry



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?



Yasmin, Operations Engineer

See my story and others here



You could power the next generation

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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

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Tomorrow's Engineers

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



Hilary, Process Engineer
– Manufacturing



See my story
and others here

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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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.

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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

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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

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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?

You could engineer winning technology for future champions

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James, Sports Engineer

See my story and others here



On the move

Tomorrow's
Engineers

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

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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?



Regina, Trainee Engineer

See my story
and others here



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

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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.

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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



Martin, Marine Engineer

See my story and others here



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 parts of Africa and Asia due to a lack of safe drinking water and poor sanitation and many more are affected by floods.

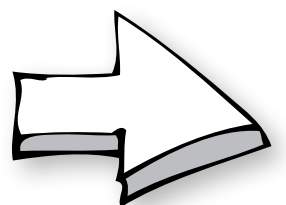
Imagine you're an engineer...

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

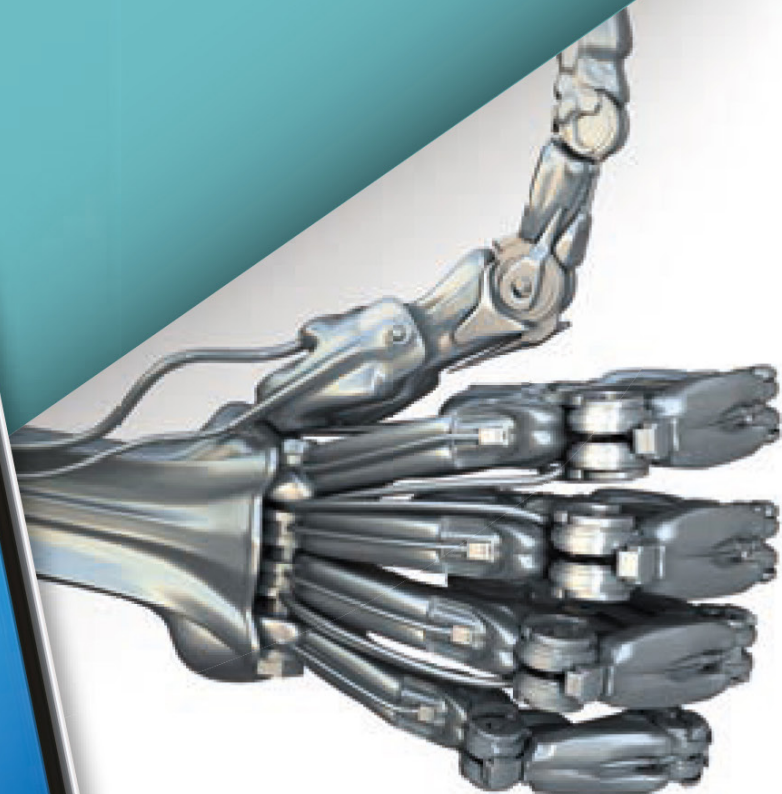
**Short leaflet
'What is
engineering?'
for young
people**





Tomorrow's Engineers

What is engineering?



Exciting
jobs...

...that make a difference



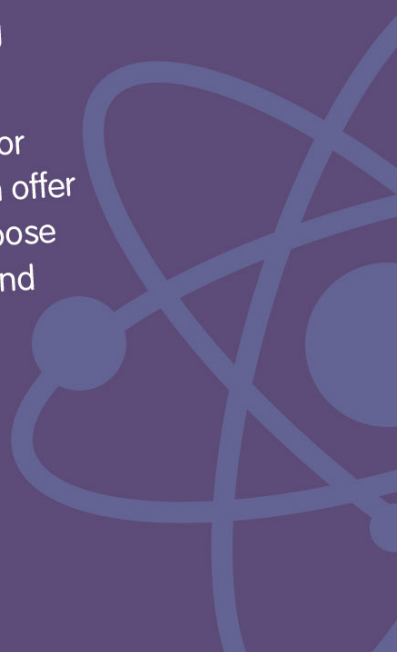
Engineering uses maths and science – especially physics – to improve the world around us and it all starts with what you learn in school. It can be creative, hands-on practical work, or problem solving.

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.



What's in it for you?

Roma

Structural Engineer, CEng
(university route)

"If you're a good problem solver then you can be an engineer."

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...



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.

16+

There are several different routes 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.

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.

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.

into engineering;

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

If you live in Scotland – www.myworldofwork.co.uk/modernapprenticeships

If you live in Wales – www.careerswales.com/en/

If you live in Northern Ireland – www.delni.gov.uk/apprenticeshipsni

To find out more about Engineering Technicians, visit:
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.

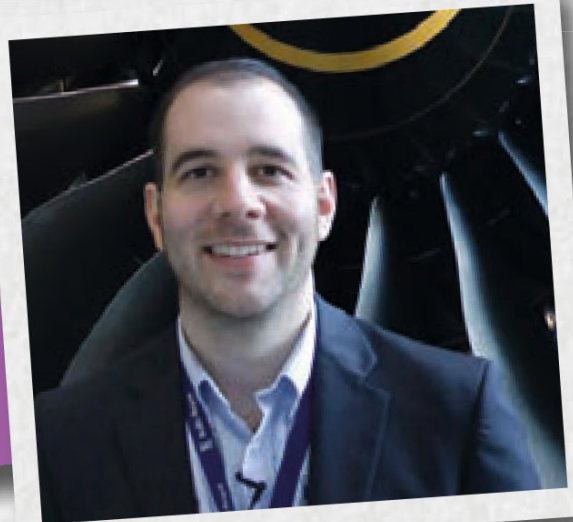
There are some vocational qualifications, apprenticeships and degree courses that will give you a head start on the road to professional registration. Check out the accredited course search tool and the database of Technician qualifications on the Engineering Council's website to see if your chosen course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

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."



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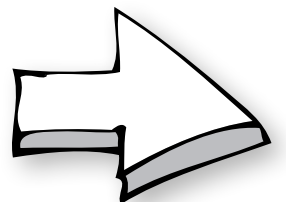


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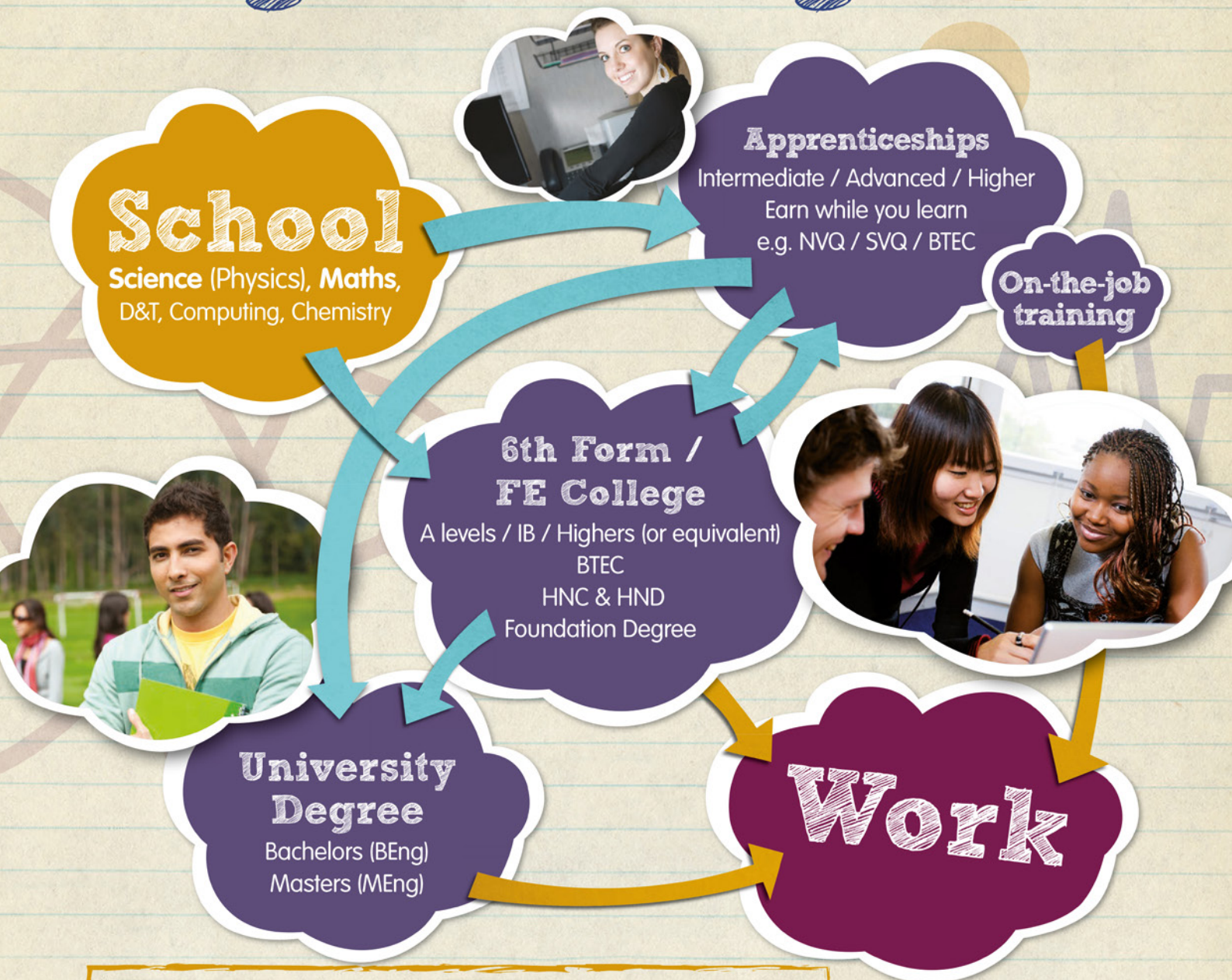
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**Display size
'Getting into
Engineering'
poster**



Getting into Engineering...

Tomorrow's
Engineers



University route



Yasmin Ali, Operations Engineer

Apprenticeship route

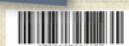


Richard Kirkland, Electrical Maintenance Technician

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



www.tomorrowsengineers.org.uk

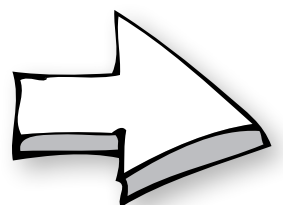


Display size posters:

**'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

Tomorrow's
Engineers

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 GET THINGS UP AND RUNNING

Restoring electricity and communications, critical for 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.

DESIGN-CREATE-INNOVATE

Use maths, science, design and technology
to help engineer a better future.



Alice Bond, (MEng), Structural Engineer,
Ramboll (Typhoon Haiyan, Philippines, 2013)

*Real life
engineers
working in
disaster relief*



Joshua Macabug (CEng), Search & Rescue
Engineer, SARAI (Nepal Earthquake, 2015)

Find out more at

tomorrowsengineers.org.uk/savelives

Nepal earthquake aftermath, 2015.
Will Oliver, EPA



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'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.

Suggested classroom discussion topics

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 spillages, 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.



Tornado in action



Avalanche rescue team

Students could be split into small groups to discuss one of the five poster headings

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.



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.



Supplying fresh water to affected areas

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?



Life detector



Search and rescue



Examining water sample in contaminated area

Present your group's discussion points on the chosen theme to the rest of the class



Beat the Flood

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



Houses damaged by flooding



Severe flooding
in Sheffield, 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

KS3 Design & Technology
(11-14 yr olds)

Technical knowledge –
properties of materials

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.



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.



Flood proof home in Bangladesh

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

Material	Height that the water was absorbed to (cm)	Mass added to the material (g)	Observations

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](http://www.tomorrowsengineers.org.uk/whosecrewareyou)



Credit: © Practical Action / Mehrab Ul Gani
Bangladeshi woman using elevated tube
well to access clean water during flood

Task 2

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 clamp 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 material 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.



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/beattheflood

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 engineer play in providing us with healthy water supplies, flood defence and emergency communications:

<http://faraday.theiet.org/resources/overview/engineers-save-lives.cfm>
<http://faraday.theiet.org/stem-activity-days/diy-challenge/index.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	www.practicalaction.org/schools
Engineers Without Borders	www.ewb-uk.org
The Red Cross	www.redcross.org.uk/What-we-do/Teaching-resources
Oxfam	www.oxfam.org.uk/education/resources
RedR	www.redr.org.uk
SARAIID	www.saraid.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.

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

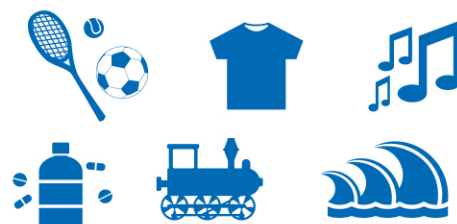
...and more



2

Work in your favourite industry

From food, medicine and renewable energy to sport, film and music – **scientists and engineers are needed everywhere**



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

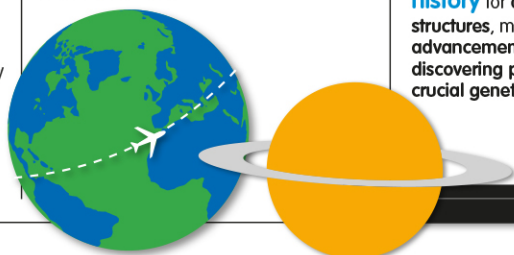
Capture tidal energy, design a robot, discover a cure for cancer... or do a job that doesn't even exist yet!

Continuing with maths and science – especially physics – keeps your options open for as long as possible for jobs in **science, engineering, technology, law, business, space, architecture** and much more.

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.**



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



Find out more about careers in science, technology, engineering and maths:
thebigbangfair.co.uk/careers

engineering: tomorrowsengineers.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



Tomorrow's Engineers