

'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

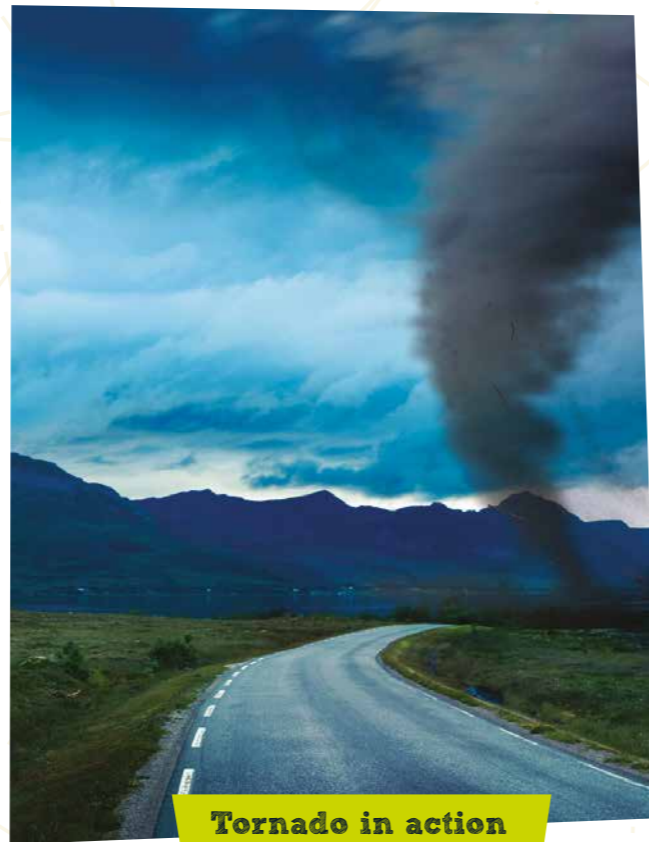


Avalanche rescue team

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.

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



Tornado in action

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:



Nepal earthquake aftermath, 2015

Search and Rescue

- Design engineers and 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.

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.

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.

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.

Discussion topics and challenges for students

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.

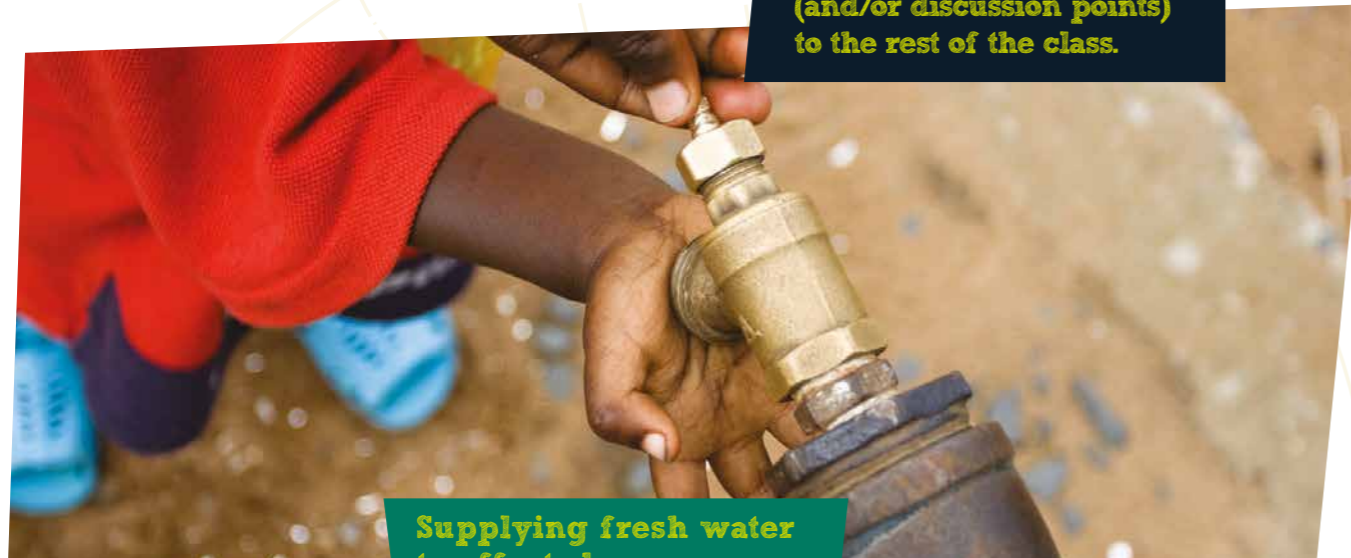
5. Can your team of engineers come up with a brand new solution or piece of equipment/technology that would help revolutionise the way we respond to disasters?

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

Disaster relief engineering: Group Tasks

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.

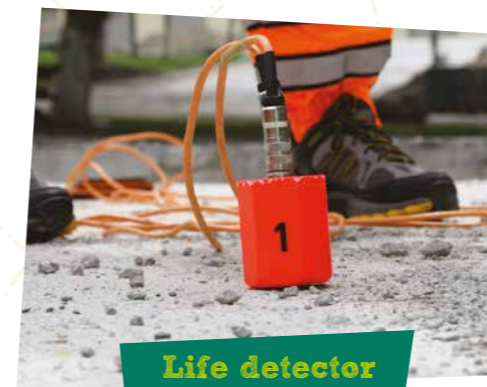
Creating apps to better co-ordinate the distribution of resources and relief.

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?

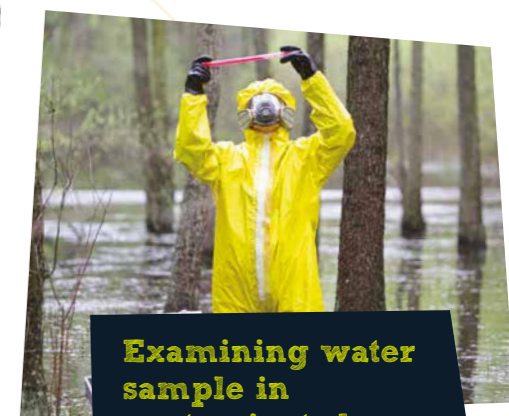
Present your group's discussion points on the chosen theme to the rest of the class



Life detector

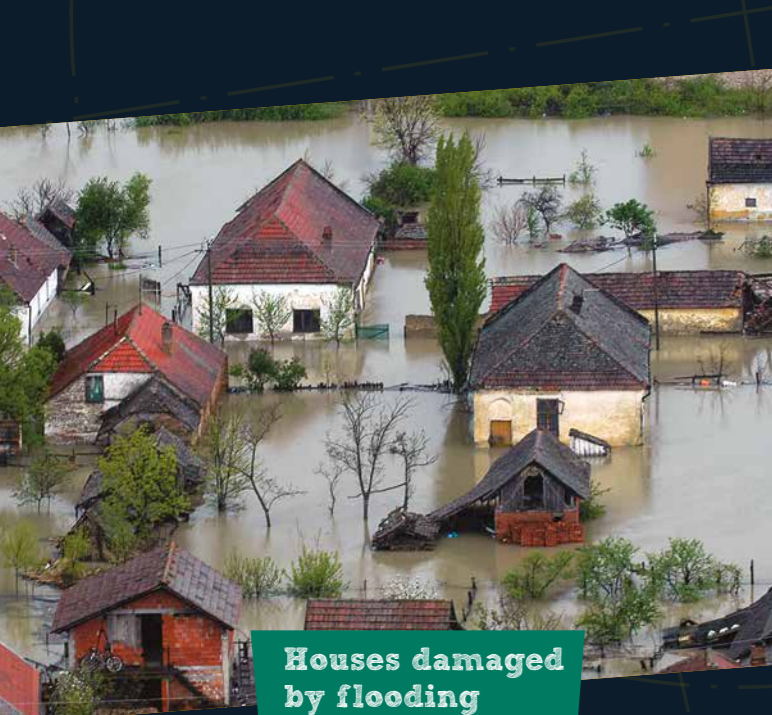


Search and rescue



Examining water sample in contaminated area

Beat the Flood



Houses damaged by flooding



Severe flooding in Sheffield, UK

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



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: forces and motion
- 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.



Student Section

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

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.

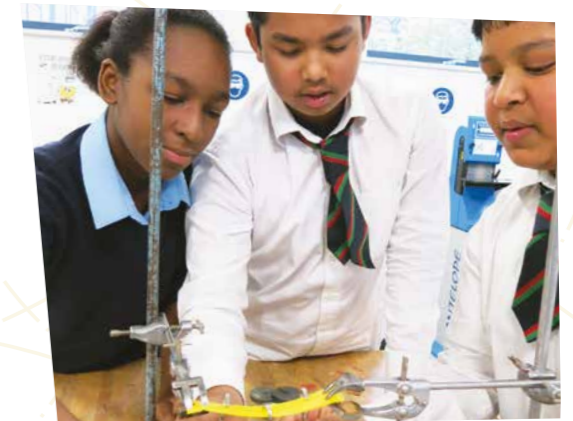
Now complete the materials absorbency test (on the next page)

Meet the future you Careers quiz for students

Many different types of engineers are involved in responding to disasters and rebuilding communities. Answer a few quick questions about your strengths and interests to find out which type of engineer you could be – will you be a Civilisation Saver, a Future Lifesaver, an Electric Dynamo... or a different type of engineer..?

Take the quiz online or find it on the App Store and on Google Play.

www.tomorrowsengineers.org.uk/quiz



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.

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. Find these in the resources section on the website

www.tomorrowsengineers.org.uk



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 'think 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:

<https://education.theiet.org/secondary/teaching-resources/>

<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

SARAID

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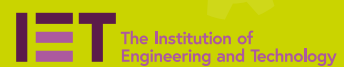


TomorrowsEngineers



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