ROYAL ACADEMY OF **ENGINEERING**

STUDENT'S VERSION

DISASTER **RESPONSE**

How do engineers save lives in the aftermath of a natural disaster?

This resource aims to give students the opportunity to investigate the science, technology, engineering and mathematics (STEM) aspects of disaster response.

Contents

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Foreword

It isn't until technology fails that we really begin to notice it.

A well-engineered technology should never make us think; it should give us the capabilities to go about our daily lives, to enjoy life and to develop ourselves. We have become so accustomed to engineering in the UK that most of us can't operate without it. How would we get clean water without the taps we have in every building? How would we protect ourselves from the elements without the roofs over our heads? How are we supposed to learn without a table and chair? How are we supposed to enjoy privacy without a door? We can almost take these mundane technologies for granted because we have never known our world without them.

So to really learn about the difference that engineering makes to people's lives, it is helpful to change the context. With this excellent resource, you can explore engineering in the context of a disaster.

Natural disasters affected 2.9 billion people and killed 1.2 million people between 2000 and 2012. There were 5,618 officially recorded natural disasters over those 12 years – from major world events such as the Indian Ocean Tsunami of 2004 to more localised events such as the annual cyclone in Bangladesh or a drought in Texas. Disasters are getting more frequent and more intense as human population grows, resources such as water become more strained, urban migration increases and the changing climate brings more shocks and stresses.

The good news is that we are getting much better at coping with and responding to disasters; trends show that death tolls are falling. A key reason for this is that we are building infrastructure that is less vulnerable to hazards – so we are better prepared. In engineering, no news is good news – engineering only really gets attention when things go wrong! Increasingly it is only the major, sudden disasters that we hear about. But we must bear in mind that a disaster takes more livelihoods than lives and, since technology enables most livelihoods, there remains a lot more work to do.

Engineering is the creative application of science to solve problems for people. Engineers have to be good at things, and they must also be good at people too. An engineer has a fundamental responsibility to get their maths and science right: if they don't, a building could collapse, a train might derail or people might be left without heat or electricity. This resource pack is a fantastic opportunity for you to explore the importance of being good at people, maths and science – and of the role of engineering in our world. We hope that you enjoy using it.

Andrew Lamb

Chief Executive
Engineers Without Borders UK

Engineers Without Borders UK is an international development organisation that removes barriers to development through engineering. Their programmes provide opportunities for young people to learn about technology's role in tackling poverty. Supported by the EWB-UK community, their members can work on projects around the globe.

About the activities

The activities are all about the problems faced by survivors of natural disasters, and the ways that engineers save lives by solving these problems.

Working in groups

Work in a group of four students for each activity.

Sometimes everyone needs to work together, but sometimes it is better to divide up what needs to be done.

Make sure you discuss how you are going to approach each challenge, and make sure everyone in the group understands what they need to do.

Thinking like an engineer

Each of the problem-solving activities will present you with a situation and a challenge.

You will need to use your science, technology and mathematics knowledge to suggest and trial solutions.

You will also need to 'think like an engineer'.

Recording

For each activity you should record as you work. Make a note of:

- any information you are using (and where you got it from)
- how you plan to solve the problem, and why you have chosen these solutions: this includes drawing labelled diagrams where relevant
- what you did (and if you modified your original plans, explain why you did that)
- what results you obtained, how sensible or realistic you think these results are and what they tell you.

'I love engineering because it influences the way we live our lives every minute of every day!'

Nicola Greene, civil engineer

1. Introductory activities

Student Activity 1A

How much warning?

"I've worked for many years with Engineers Without Borders UK, and having developed my knowledge and skills with them I've now had the opportunity to work in disaster relief. I'm now a member of RedR UK and on the emergency roster for Save the Children."

Tom Newby, structural engineer

Information

Natural disasters include hurricanes, tornadoes, floods , earthquakes, tsunamis, volcanic eruptions, wildfires and drought.

Some natural disasters build up over months, others happen very fast.

Challenge

What warning is there of different disasters? How quickly do some disasters move?

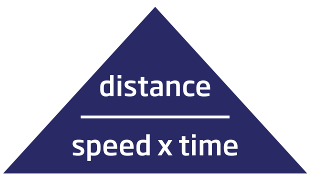
There are two tasks for you to carry out: a card sort and a set of warm-up calculations.

Card sort

1. Use the cards from **Student activity 1A support: Disaster card sort**. There are eight 'disaster cards' and three 'speed comparison' cards.
2. Place the disasters in order from top to bottom, with the ones where you might have least warning at the top and the ones with the most warning at the bottom.
3. Are there some disasters there would be no point in trying to run away from? Why not? Put the cards for these disasters to one side.
4. For the remaining disaster cards, put them in order of how quickly they move, with the fastest at the top and the slowest at the bottom.
5. Where should each of the 'speed comparison' cards go in this list?

Warm-up calculations

Use the formula: distance = speed x time



1. A wildfire is moving at 10 kph (3 m/s). How far will it have travelled in 10 minutes?
2. High winds are driving a wildfire directly towards a small town 5 km away. If the fire front is moving at 100 kph (28 m/s) how soon will it reach the town?
3. A tsunami warning has just sounded: the tsunami is 6 km off the coast and moving at 20 m/s. If it slows to 10 m/s as it moves onto the land, how long after that will it take to reach the base of a building 1 km from the shore? If you were on the edge of the beach when the alarm sounded, would you be able to reach the building and climb to the fifth floor before the tsunami arrived?

Yuttasak Jannarong / Shutterstock.com

Supplies ready to be sent to victims of the flood crisis in Thailand, November 2011.

Tom Newby

Truck delivering materials after the earthquake in Haiti in 2010.

Student Activity 1B

Aftermath

Information

Natural disasters include:

- hurricanes
- floods
- tsunamis
- wildfires
- earthquakes
- volcanic eruptions
- drought
- tornadoes

There are many different kinds of engineer, but what they all have in common is that they use their STEM subject knowledge and skills to solve problems.

Challenge

What kinds of problems face survivors after a natural disaster? What might engineers do to help?

1. Work in a group of four.
2. Each group will consider a different kind of natural disaster: your teacher will tell you which disaster to work on.
3. You need a large sheet of paper. Write down the type of natural disaster at the top of the sheet.
4. Divide the sheet into two columns. In the left hand column, make a list of the problems facing survivors after this type of natural disaster. For each problem, use the right hand column to suggest what engineers might do to help solve the problem.
5. Compare your suggestions with those of at least one other group:
   - Which of the problems are specific to a particular context (not just the type of disaster, but where it happens, or the time of year, for example)?
   - Which of the problems are general ones, and are associated with any disaster?
   - Are there some problems that are more urgent than others? Why?
   - Are there some problems that are not so urgent initially, but become important within a few days of the disaster?

"I worked in Sri Lanka after the tsunami, in Bihar (India) after flooding, and in Haiti after the earthquake. I used to work on technical aspects. Now it's strategic planning, mentoring and technical support."

Bob Reed, water supply and sanitation engineer

Bob Reed

2. Problem solving activities: solving immediate problems

Student Activity 2A

Emergency shelter

Information

When people are unable to stay in their own homes after a natural disaster, the first place they seek shelter is often a local sports hall or community centre if there is one. It has been suggested that severe weather and flooding could become more frequent in future, so it will be important to plan for possible events like this, and know where people could be evacuated to in an emergency.

The situation

There has been severe flooding locally, and any large local halls that are not at risk of being flooded will be used for emergency shelter. The school sports hall needs to be used to provide temporary shelter for people whose homes have been flooded (mostly couples and families with young children). They have left their homes in a hurry, bringing whatever they can carry with them.

The challenge

How many people could you accommodate overnight in the sports hall, and how might you do this?

1. Survey the hall: create a rough initial plan (not to scale), showing the basic shape and marking where the doors are. Write your measurements down on this.
2. Decide how much space you will need for each family, couple or individual.
3. Make a first estimate of the **maximum** number of people you could accommodate.
4. Now create a scale plan of the hall, showing the space you are allowing for each family, couple or individual.
5. What assumptions have you made about what additional items you might need to provide and the amount of space needed for each individual, couple or family?
6. Compare your plan with the plans produced by other groups:
   - What different assumptions did other groups make?
   - Which plan fits in the most people?
   - Which would be the most practical?

"I have worked in India and Tanzania, running workshops for developing communities on the principles of disaster management and the causes of natural disasters."

Vanessa Pilley, environmental scientist

THINKING LIKE AN ENGINEER

If you are solving problems creatively, you are thinking like an engineer! What skills did you use to help you carry out this challenge?

FEMA/Ed Edahl

Houston Astrodome, ready for the arrival of evacuees from Hurricane Katrina in 2005.

Student Activity 2B

What makes a good shelter?

(Left) A 'hexayurt' built from plywood sheet; (right) A family's tent next to a collapsed building after the earthquake in Haiti, 2010

Information

When most buildings in a region have been destroyed or are unsafe, people who can will leave to find shelter with relatives in another region. People who cannot leave will need temporary shelters to live in until they can rebuild their homes. Tents are often used for emergency shelter after a disaster, but they are not the only type of emergency shelter. The kinds of temporary shelters used depends on what can be made available quickly and what is best for local conditions.

In many parts of the world, it can be hot and sunny in the daytime but cold at night. Ideally, shelters should not only keep the inside warm when it is cold outside, but also remain at a comfortable temperature during the day. A good shelter also needs to keep people dry and protect them from UV radiation.

Bringing large amounts of resources into a region takes time and costs money.

- Building shelters from lightweight materials can reduce transport costs. It can also make it easier to construct the shelter onsite if individual pieces are light enough for one or two people to lift.
- Where 'scavenged' material can be recovered from the scene of the natural disaster, this can also reduce the need to rely on supplies which have to be brought in.

"I worked in Haiti following the 2010 earthquake where I was helping a team of Haitians to rebuild houses in rural communities."

Steve Fitzmaurice, civil engineer

"I worked in Haiti, following the devastating earthquake there in 2010. I ran a transitional shelter programme, planning and starting the construction of temporary schools and houses in the area around the epicentre."

Tom Newby, structural engineer

Tom Newby

The situation

The organisation you work for wants to produce a new design for a shelter that could be built by two people using mostly scavenged materials, or using lightweight materials which are shipped in. The shelter should be as light as possible, but must keep people comfortably warm even in cold weather.

The challenge

Design, construct and evaluate two model shelter solutions.

1. Find out what materials will be available.
2. Your group must create and evaluate two model shelters. Decide which basic model structure(s) you are going to construct, and what modifications, if any, you are going to make to the materials used in the construction. You will need to keep a record of your investigation as you work.
3. **Each shelter must have the same base area of 12 cm x 10.5 cm.**
4. Check that your plan will allow you to carry out the test methods that you have been shown before you build the shelter.
5. Build and test your two models.
6. Compare your results with those from other groups.
7. Present a short report or presentation that gives brief details of:
   - the materials and designs you used, with reasons why you chose them
   - how you carried out the tests you used in your evaluations and what the results were
   - what you discovered and what conclusions you reached.

THINKING LIKE AN ENGINEER

If you are solving problems creatively, you are thinking like an engineer! What skills did you use to help you carry out this challenge?

Student Activity 2C

Tents, water and toilets!

Asianet-Pakistan / Shutterstock.com

A relief camp in Pakistan, following flooding in September 2011.

Information

When most buildings in a region have been destroyed or are unsafe, people who cannot leave to find shelter with relatives in another region will need temporary outdoor shelters to live in until they can rebuild their homes. Often, relief agencies will organise the construction of temporary camps to provide shelter, water and toilets, and cooking facilities; they might also organise the delivery of food supplies.

Planning a temporary camp can involve surveying an open space and planning the best arrangement of tents or other shelters, along with things like water supply points and toilets. It can also involve arranging the initial delivery of tents (or other shelters) and arranging for the regular delivery of water and other supplies.

You would need to decide what size of tents would be most useful and how many you would need. Tents come in various sizes: some are meant for a family of four people, but there are also larger tents which can fit twelve or even twenty people in them. In most communities, you would expect a mixture of families, couples and individuals.

The situation

A major earthquake has demolished many buildings and there are few buildings where people can shelter indoors. Whole, extended families are affected, so there is little option to stay with relatives in another region. Temporary camps need to be built in any open spaces. As well as shelters, people will need drinking water, toilets and somewhere to wash.

The challenge

How many people could you provide temporary shelter for on the school sports field or other local open space?

About this activity

In this activity you are modelling a real life situation, and to do this you may need to make some simplifying assumptions.

You may find it helpful to use a spreadsheet to allow you to try out different starting values and build a model.

There are several tasks involved in this activity. You will need to use the findings from the different tasks to reach your final estimate, so it is important to make a record of your investigations as you work. Your record should include:

- a description of what you were trying to find out
- any equations or starting information you used
- any assumptions you made
- examples of worked equations using different data if relevant
- what you found out: include your opinion on how realistic or otherwise your findings are. (What would you do to improve the usefulness of your model?)

The tasks you need to carry out

A first estimate of capacity

1. You will need a printed plan of the open space. Mark out the area of usable open space on your printed plan.
2. Measure the dimensions of the open space, and work out its area.
3. Estimate how much room you need to allow in order to pitch a tent for four people to sleep in.
4. Estimate how many of these tents you could fit on the sports field if you only put tents on it, and so how many people there might be. (How much space should you allow between tents? Why?)
5. How does the size of tent you use affect the maximum number of people you can provide shelter for? Investigate the effect of using tents for 8, 12 or 16 people instead.
6. What would be the most efficient solution, based solely on this model?
7. What might be the limitations of this model? What other factors would be important in deciding what size of tents to use?
8. Choose a 'best size' of tent and draw a block of 20 tents by 2 tents to scale on a piece of paper. Place this on your printed plan.
9. Make three more blocks of the same size. How many of these blocks could you fit on the site?
10. Make a revised estimate of how many people you can shelter.

'I worked in Brazil in an area that flooded every year. We built strong water tanks and toilets which were lifted off the ground to ensure that clean water and health were not affected during flooded times.'

Nicola Greene, civil engineer

How much water will they need?

1. Use your revised estimate for the number of people.
2. Use the additional information from *Activity 2C support: Facts and figures* to estimate how much water you will need for drinking and cooking.
3. How many bowsers (towable water containers) or water tankers would you need to deliver this amount of water every day?
4. How many 11,000-litre storage tanks would you need to store one day's worth of water?
5. Estimate the amount of field you need to leave without tents to allow for the water to be delivered and stored. How many tent spaces will this take up?
6. How does this affect your plan for the number of people you could provide shelter for? Write down your revised estimate.

How many toilets will they need?

1. Use your revised estimate for the number of people.
2. Use the additional information from *Activity 2C support: Facts and figures* to estimate how many toilets you will need for everyone on the site.
3. Estimate how much space the toilets will need. How many tent spaces is this equivalent to?
4. How does this affect your plan for the number of people you could provide shelter for?

Conclusion and evaluation

1. What is your final estimate of the number of people you could fit on the site?
2. What value does this give you for the area per person?
3. If you had to make rough estimates of capacity for other sites, how might you do this?
4. Compare your values with those of other groups: what reasons were there for any differences?

THINKING LIKE AN ENGINEER

If you are solving problems creatively, you are thinking like an engineer! What skills did you use to help you carry out this challenge?

3. Problem solving activities: solving longer term problems

Student Activity 3A

Peace and quiet?

FEMA/Andrea Booher

There may be very little privacy in an emergency shelter

Information

Repairing or rebuilding homes after a natural disaster can take weeks or months, and people still need somewhere safe to live during that time. Conditions that are acceptable for the first few nights as emergency shelter are not acceptable for temporary accommodation over a longer period. As well as things like proper washing and cooking facilities, there is a need for personal space and privacy.

The situation

There has been severe flooding locally, and the school sports hall has been used to provide temporary shelter for people whose homes have been flooded (mostly couples and families with young children). It will take several weeks before some of the homes will be safe to live in. Families who still need to stay in the hall have also complained that the hall is very noisy, and they need some privacy. Some form of screening needs to be put up around each family space.

"I had considered becoming a lawyer so I could work in human rights or environmental protection – but actually as an engineer I could do things and see the results in action to a much greater extent."

Tom Newby, structural engineer

The challenge

Short version, concentrating on acoustic properties

1. Consider some possible screening solutions.
2. Compare the sound absorption/reflection properties of the screening materials available.
3. Identify the most suitable materials for screens based on this property.

Longer version, evaluating the stability of the structure as well

1. Consider some possible screening solutions.
2. Suggest two possible screening solutions that you could compare.
3. Construct prototype screens and compare the stability of the screens and how well they reduce the amount of sound reflected.
4. Produce a brief report, recommending the best solution.

THINKING LIKE AN ENGINEER

If you are solving problems creatively, you are thinking like an engineer! What skills did you use to help you carry out this challenge?

Student Activity 3B

Clean water? (Evaluating sand filters)

Elizabeth Sharpe

Assessing a site for a new water supply after a tsunami

Information

Following a natural disaster, water supplies may be disrupted and new supplies of water need to be set up. The problem is to turn a supply of muddy water into a supply of clean water, and the most common way of doing this is to allow the water to drain through a filter bed. There are two basic types of sand filter:

- The type that are usually used as part of a large scale, automated water treatment process are known as **rapid sand filters**. They remove suspended particles that make the water cloudy, but don't remove harmful microbes.
- The type of filters typically used where there is not a treated water supply are called **slow sand filters**, and take much longer to filter the water. They include a type known as **biosand filters**, where the process also removes most potentially harmful microorganisms. They run for a few hours each day to provide enough water for a single household . The low flow rate allows microorganisms to adhere to particles of sand throughout the filter. The water in the first few centimetres at the top of the filter contains enough oxygen for the microbes that feed on other, harmful microbes to survive there.

"I worked in Aceh, Indonesia from August 2007 to July 2008 to assist with redevelopment of rural water supplies after the December 2004 earthquake and tsunami."

Elizabeth Sharpe, hydrogeologist (water resources specialist)

The situation

You have been asked to trial four different small-scale filter arrangements that could be set up with readily-available plastic drink bottles, and produce a short report about what you have found out. The water being treated will be fairly muddy, but the water produced by the filter in normal operation should be clear.

The challenge

Evaluate the performance of different sand filters.

The four filter arrangements will all use the same size of fizzy drinks bottle, but use different materials for the filter media.

1. Make sure the bottle cap is screwed on: it should have four small holes in it.
2. Roll a piece of scrap paper or card to create a cone. Place it into the upturned bottle to make it easier to pour in the sand or gravel without spilling.
3. The first filter is just sharp sand. Pour the sand into the filter until it is about 10 cm from the open end.
4. Attach the bottle to the support stand using two clamps, one around the neck of the bottle, the other near the top of the sand layer. You can hold it in place more securely if you also wrap a piece of gaffer tape around the bottle and the stand.
5. Set up the other filters in the same way, filling to 10 cm from the top of the filter, but with the following materials:
    - 10 cm depth of gravel first, then sharp sand on top
    - a mix of gravel and sharp sand
    - 10 cm depth of gravel first, then play sand on top.
6. Place each filter in a tray or bowl on the floor, with a clean collecting container underneath the filter outlet.
7. Place the container of muddy water on a stool or bench above the filter.
8. Open the tap, so that water runs slowly into the filter. Adjust the flow from the tap to keep the water level in the filter steady at about one centimetre or so below the top of the filter bottle.
9. How long does it take for the filtered water to drip through and fill the container, and what does it look like? When the container is full, replace it with a clean, empty container.
10. Keep doing this until the water is running clear for two successive containers. Make a note of how long it takes to fill each container.
11. How much water did you need to run through the filter before the water ran clear? How much filtered water would the filter produce in an hour if you left it running?

"It is important in every situation that people have clean water to drink, cook and bathe in. When people cannot access clean water they may become severely dehydrated, get water-based illnesses and in severe cases may die."

Nicola Greene, civil engineer

12. Present a short report or presentation that gives brief details of:

- how you carried out the tests you used in your evaluations and what the results were
- what you discovered and what conclusions you reached
- changes you might make to improve the performance of the filter.

13. A typical biosand filter can filter 12 to 18 litres of water per hour. Look at the diagram of the biosand filter on the support sheet. What are the differences between your best filter and the biosand filters that are actually used to provide clean water?

THINKING LIKE AN ENGINEER

If you are solving problems creatively, you are thinking like an engineer! What skills did you use to help you carry out this challenge?

Student Activity 3C

The right size of filter

Information

A natural disaster may disrupt water supplies, so new supplies of water need to be set up. The problem is to turn a supply of muddy water into a supply of clean water, and the most common way of doing this is to allow the water to drain through a filter bed.

Slow sand filters have traditionally been used to filter water slowly and continuously. **Biosand filters** are a kind of slow sand filter that can work intermittently and are being used as a way for households to treat the water they need for themselves. The slow filtration process not only removes the suspended particles that make unfiltered water look cloudy, it also removes most potentially harmful micro-organisms.

The situation

You have been asked to suggest a suitable size of slow sand filter that could be sent to disaster areas. The bigger the cross-sectional area of the filter, the faster the output flow rate, but bigger filters use more materials and take up more room, so production and shipping costs are higher.

The challenge

Identify the best size of container to use for a household sand filter.

The household sand filter must meet the specification below:

- The filter must provide 40 litres of clean water each day.
- The output rate of a filter is described in $m^3/ m^2/$ hour, and the chosen sand filter arrangement will provide filtered water at a rate of 0.1 $m^3/ m^2/$ hour. (1 litre = 0.001 m^3; 1 m^3 = 1000 litres)
- Containers that could be used for holding the filter media are available in five diameters: 15 cm, 25 cm, 30 cm, 45 cm and 60 cm. All the containers are the same shape, with a square cross-section.

Which would be the best size to use?

Show how you arrived at your decision.

"I like the technical aspects of the work; thinking logically and systematically. But there is also a social element of the work we do – the projects we work on can have a huge impact on people's lives, hopefully improving them."

Steve Fitzmaurice, civil engineer

Source: CAWST – The Centre for Affordable Water and Sanitation Technology (www.cawst.org)

A child standing next to a biosand water filter

SODIS/Eawag

Setting up bottles of water for solar disinfection

SODIS/Eawag

SODIS bags

SODIS/Eawag

Drinking water that has been made safe by solar disinfection

Student Activity 3D

Solar disinfection

Information

Water supplied from taps in a temporary camp may look clean but still needs to be treated to kill harmful microbes before it is safe to drink. One way of doing this is to add chemicals, but this affects the taste of the water; another way is to boil the water, but this uses valuable fuel; another way is to use solar disinfection (SODIS).

Solar disinfection uses solar energy to kill microbes. The water is treated by putting it into clear plastic drinks bottles, then leaving the bottles out in the sunshine. This takes at least 6 hours, even in hot, sunny climates. UV radiation kills microbes. Some of the energy is also transferred to the water as sunlight passes through it, and the water gets warmer because it is absorbing energy.

The situation

Solar disinfection is going to be used to provide safe drinking water for the inhabitants of a temporary camp. Different sized bottles might be available. Sealable plastic bags suitable for storing food or liquids safely would also be available.

Some people say that putting the bottles on a shiny surface helps to make the process more effective.

To be effective, UV radiation in sunlight must reach all parts of the water in the container. The more UV that reaches the water, the more effective the treatment should be.

The challenge

Find out how differences in the way SODIS treatment is carried out might affect how effective it is. **Hint:** UV-sensitive beads change from white to coloured when exposed to UV radiation. UV beads float in water.

Some questions you might consider are:

- What containers work best?
- Should the containers be 'standing up' or 'lying down'?
- Does the surface that the containers are on make a difference?

Decide **how** you are going to investigate your chosen questions.

Write a brief report about what you have found out, suggesting what you think is likely to be the most effective way to carry out SODIS treatment.

About this activity

In this activity you are modelling a real life situation.

In real life, the treatment would take several hours in strong sunshine. As this is not the situation you are working in the water will not be fully treated.

DO NOT DRINK THE WATER.

THINKING LIKE AN ENGINEER

If you are solving problems creatively, you are thinking like an engineer! What skills did you use to help you carry out this challenge?

Asianet-Pakistan / Shutterstock.com

Queuing for drinking water after flooding in Pakistan in 2010

Student Activity 3E

Taps and waiting time

Information

When most buildings in a region have been destroyed or are unsafe, people who cannot leave to find shelter with relatives in another region will need temporary outdoor shelters to live in until they can rebuild their homes. Whenever a camp is set up, providing water is a priority.

Planning a temporary camp can involve surveying an open space and planning the best arrangement of tents or other shelters, along with things like water supply points and toilets. There are guidelines for deciding how many taps are needed and where they need to be so that nobody has to walk long distances or queue for hours.

The situation

There has been a major earthquake, and a temporary camp for 2,500 people has been set up. Adequate supplies of water for the number of people are delivered to the camp storage tanks, but pipes and taps need to be connected so that everyone has access to a water supply point, and the supply must meet the guidelines for queueing times. Your team has to organise temporary water supply points for everyone in the camp.

The challenge

Produce an initial report identifying how many supply points (taps) are likely to needed, and how the supply rate at each tap could affect queueing times.

About this activity

Use the information in Student activity 3E support: Facts and figures.

In this activity you are modelling a real life situation, and to do this you may need to make some simplifying assumptions. Your report must make it clear how you obtained any values, so identify any equations or starting information you used and any assumptions you made.

THINKING LIKE AN ENGINEER

If you are solving problems creatively, you are thinking like an engineer! What skills did you use to help you carry out this challenge?

"I was trained as a civil engineer but have always had an interest in water (hydro-power, dams, river engineering, etc.). Later, I developed an interest in water supplies for industry and for people which led to my joining UNICEF. With UNICEF, I became interested in the health benefits of water supply and sanitation, and how people behave with the facilities which we were trying to give them."

Kenneth Gibbs, water supply and sanitation engineer

4. Presentation activity: How do engineers save lives?

Student activity

Use the information and ideas that you have gathered from the introductory activities and the problem solving activities to present your answer to the big question: *How do engineers save lives in the aftermath of a natural disaster?*

Presentation specification

The presentation must:

- include a supported answer to the 'big question', '*How do engineers save lives in the aftermath of a natural disaster?*'
- Include examples of problems experienced by the survivors of a natural disaster and how engineers help to solve them.

The presentation could:

- refer to identified events, such as the superstorm that affected New York in 2012, the earthquake and tsunami that affected the Tohoku region of Japan in March 2011, or the earthquake that hit Haiti in 2010
- include relevant information about particular natural disasters and relief efforts
- include relevant information from internet-based research, identifying the source of the information
- identify specific examples of the contributions made by one or more types of engineer
- describe one or more of the challenges you worked on, and what you learned from them about the role of engineers
- explain the relevant science, technology or mathematics knowledge you used for a problem-solving activity.

The presentation could take a number of forms and could include:

- text
- photographs
- diagrams
- charts
- data.

As the UK's national academy for engineering, we bring together the most successful and talented engineers from across the engineering sectors for a shared purpose: to advance and promote excellence in engineering. We provide analysis and policy support to promote the UK's role as a great place from which to do business. We take a lead on engineering education and we invest in the UK's world class research base to underpin innovation. We work to improve public awareness and understanding of engineering. We are a national academy with a global outlook and use our international partnerships to ensure that the UK benefits from international networks, expertise and investment.

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