

SUITABLE FOR STUDENTS AGED 11-14

# How can we live smarter?

STEM Learning activity resources



**SUBJECT LINKS:**

Design and Technology,  
engineering, physics,  
maths and essential  
employability skills.

SUITABLE FOR AGE 11-14

# How can we live smarter?

STEM Learning activity resources

## Introduction

This programme has been created by STEM Learning, the largest provider of STEM education and careers support in the UK. It has been developed in partnership with Club leaders and supports essential employability skills and the Gatsby Careers Benchmarks.

This programme is part of A STEM Future, a suite of themed activity resources exploring how science, technology, engineering and maths will enhance our future.

## How can we live smarter?

Human beings are pretty smart. We have transformed the world and thought up some wondrous inventions. But what will the future hold for planet Earth and the people who inhabit it? Can we use new technology and innovations to improve the quality of our lives as well as the world we live in?

This programme investigates how you can use **design and technology** to find ways we can live smarter – from creating a game to save water at home, to investigating how we can use our living space more efficiently.

## Key information

**AGE RANGE:** 11–14

**SUBJECT LINKS:** design and technology, engineering, physics, maths and essential skills.

**DURATION:** a range of activities up to 60 minutes – 6 hours in total.

**FLEXIBILITY:** complete the whole programme over a half term or choose individual activities to suit the needs of your club.

**RESOURCES:** each activity includes a list of the resources required and a comprehensive set of Club leader and student notes.

**ESSENTIAL SKILLS:** Each activity identifies essential employability skills as recognised by the Skills Builder Framework.

**IMPACT MEASUREMENT:** each set of resources is designed to help evaluate and assess the progress of Club-based learning on Club members. A useful set of assessment tools are available at [www.stem.org.uk/enrichment/stem-clubs](http://www.stem.org.uk/enrichment/stem-clubs).

**ACHIEVEMENT:** students that successfully complete a complete set of activities can be rewarded with the downloadable STEM Clubs Certificate of Achievement. Successfully completing a set of themed activities enables students to enter for a CREST Discovery Award. Further information is available on the STEM Clubs website.

**APPROPRIATE VENUES:** club leaders can run most activities in general spaces e.g. classrooms, halls, and outdoor areas. Some activities need to be conducted in labs and workshops – these are marked clearly in the Club leader guide and in the table below.

**SAFETY:** each activity includes details about significant health and safety considerations, such as appropriate eye protection, gloves, etc. Club leaders should ensure that all equipment is handled with care, particularly sharp instruments. Advice and guidelines are available from CLEAPSS and SSERC, or see the STEM Clubs handbook (page 20). We recommend that practical activities are risk assessed before commencing and Club leaders must follow their employer or organisations policies.

**OTHER ACTIVITIES:** visit [www.stem.org.uk/resources/stem-clubs/](http://www.stem.org.uk/resources/stem-clubs/) for a wealth of ideas for STEM-related clubs.

**FURTHER SUPPORT:** the STEM Clubs Best Practice handbook can be found at [www.stem.org.uk/stem-clubs/support](http://www.stem.org.uk/stem-clubs/support). A selection of careers information, resources, programmes and guidance can be found at [www.stem.org.uk/stem-careers](http://www.stem.org.uk/stem-careers).



## Activities

1	<b>MICROFLATS:</b> in this activity students discuss and sketch / mock up a microflat – a small, flexible living space where objects can be converted from one purpose to another.	60 minutes	Page 4
2	<b>CLEANING OUR OCEANS:</b> in this activity students will simulate a small-scale oil spill, and investigate different methods of cleaning up the oil.	120 minutes	Page 7
3	<b>THERE'S AN APP FOR THAT:</b> in this activity students learn about the effects of waste on the environment and try to find a way to incentivise recycling by designing an app that allows households to log how much material they are recycling each week where points will be given depending on the amount of recycling that is done.	50 minutes	Page 10
4	<b>SMARTEN UP YOUR LIFE:</b> in this activity students discuss how advances in the kitchen might affect the future, and design their own product that has all the smart features they can think of. They will then try to sell their product to the CEO of an important 'smart' company using a PowerPoint presentation.	50 minutes	Page 16
5	<b>SMART SHOWERS:</b> in this activity students will do calculations where they can figure out how many litres of water they use per minute, and create a scoreboard to gamify the way they look at water usage at home.	40 minutes	Page 20
6	<b>FIGHTING HUNGER:</b> in this activity students learn about the fight against world hunger, and make their own version of a low-cost, highly nutritious food. They can experiment with the ratios to make the perfect recipe.	60 minutes	Page 23
7	<b>GET CREST DISCOVERY AWARDS:</b> By completing activities in this resource pack, your STEM Club members can get a CREST Discovery Award.		Page 28
8	<b>SKILLS BUILDER FRAMEWORK:</b> Introduction to the Framework that uses essential employability skills to develop student learning across four key domains: interpersonal, self-management, creative problem-solving and communication skills.		Page 29

**CLUB LEADER GUIDE: SUITABLE FOR AGE 11-14**

# How can we live smarter?

## 1 Microflats

### Objective

In this activity students discuss and sketch/mock up a microflat – a small, flexible living space where objects can be converted from one purpose to another.

**TOPIC LINKS**

🔗 Design and technology: designing a living space

**ESSENTIAL SKILLS SUPPORTED**

Listening, presenting, problem solving

**TIME**

🕒 60 minutes

**RESOURCES AND PREPARATION**

- squared paper (1cm squares might be easy as each square can represent 1m<sup>2</sup>)
- pencils
- pens
- cardboard or construction paper
- desktops or laptops (if available)

**HEALTH AND SAFETY:**

A suitable risk assessment must be carried out by the activity leader and any significant findings recorded: if carried out in schools, guidance from CLEAPSS or SSERC must be used where appropriate.

**DELIVERY**

- 1 Introduce the topic of the growing population of humans on Earth. Ask the students what they think might happen if the trend continues. Will we have enough food? Will we have enough space?
- 2 Ask students to research differences in living spaces in rural areas versus cities with high population density, such as Singapore, Mumbai or Manila. How big is a typical house or flat? How does that compare to the students' own city or town?
- 3 Show the class examples of multi-functional furniture. How would this make very small living space more homey and comfortable? Now set the challenge: imagine they are an interior architect at a successful company. A new client has asked them to design a microflat that will be comfortable to live in. (A microflat is typically defined as a one-room living space no more than 32 square metres.)
- 4 They should think about what kinds of things they need in their homes – what is a necessity, and what is a 'nice to have'? They should create a list of requirements that a microflat would need to have.
- 5 Once they are happy with their list of requirements, allow students to discuss amongst themselves some ideas for how they could design the space to accommodate everything on their list. You could also ask them to share with the whole class.
- 6 Explain that they will sketch and mock-up their own microflat ideas.
- 7 Guide students as they work through the student guide. Once their designs are complete, they can present them to class as if they were proposing the plans to their client. They could then revise their designs based on their classmates' feedback.

**TIPS**

- Give students options in terms of sizes:
  - easy - "large" 32m<sup>2</sup> home
  - difficult - 14m<sup>2</sup> home
- You could tell students that their client is very wealthy and money is no object, or you could set them a budget not to exceed.
- Clarify that each square on their squared paper is one square meter, and allow them to experiment with the overall shape of the flat before working out the furniture placement.



### DIFFERENTIATION IDEAS

**Support:** print out and provide several example designs, including multi-functional furniture and let students discuss these with classmates if they struggle to get started by themselves.

**Challenge:** if students are happy with their design, let them work out their design in cardboard (the squared paper can be stuck to the cardboard to help them with the measurements, while still adding the 3D aspect).

If computers are available, let students mock up their own home on the computer using online home design websites (a free example demo – see Useful links below).

### EXTENSION IDEAS

- 1 Finish the activity with a discussion about preferences and opinions.
  - can any of the students picture themselves in a micro flat in a big city like New York or Tokyo? Why, why not
  - can they picture a future where most of the population might be forced to live in micro flats
  - will the human population grow to the point where this is necessary
- 2 students could create a miniature model of their microflat

### USEFUL LINKS

-  **Planner 5D: free demo of a home design tool**  
<https://planner5d.com/>
-  **Makespace. A psychologist discusses why micro-apartments are popular in large cities**  
<https://makespace.com/blog/posts/why-are-micro-apartments-popular/>
-  **The New Yorker: Are Micro-Apartments a Good Solution to the Affordable-Housing Crisis?**  
[www.newyorker.com/business/currency/are-micro-apartments-a-good-solution-to-the-affordable-housing-crisis](http://www.newyorker.com/business/currency/are-micro-apartments-a-good-solution-to-the-affordable-housing-crisis)
-  **Business Insider: 22 examples of intriguing small living spaces**  
[www.businessinsider.com/the-worlds-craziest-micro-apartments-you-wont-believe-people-actually-live-in-2015-10?international=true&r=US&IR=T](http://www.businessinsider.com/the-worlds-craziest-micro-apartments-you-wont-believe-people-actually-live-in-2015-10?international=true&r=US&IR=T)

# How can we live smarter?



## 1 Microflats

### Your challenge

Imagine you're in charge of designing comfortable living spaces in a very crowded city. The population is high, so there's not a lot of space available. A new client has come in to ask you to design their microflat. The space is very small, but the client wants a comfortable place to live. Everything inside needs to be considered very carefully so no space is wasted!

**YOUR TASK** Think carefully about how you can make use of a very small space, and design a multipurpose microflat!

### WHAT YOU NEED TO DO

- 1 First, think about what your client will need in their living space. What is absolutely necessary and what is nice to have but not essential? It may be helpful to create a backstory about your client to help you decide. For example, a client who loves cooking might need more kitchen space. Make a list or ranking of what the space must include.
- 2 Find out how much space is available in the microflat.
- 3 Think of the shape of your flat. Sure, you can start with a square, but why not an L-shape? Tip: to keep it simple, stick to using square walls rather than circles.
- 4 Mind map what type of furniture you want to include in your home. Think about what you need as an absolute minimum. Beds that double as tables when folded up? A TV which can be folded upwards and hang up on the ceiling? Moveable walls that slide along the floor when they need to be moved out of the way? Make a list!
- 5 Draw the shapes of your furniture, sticking to realistic sizes. Sketch important shapes and colour them in before cutting them out.
- 6 Fill up your flat with your cuttings. Try to find the best fit for your clever furniture to make your house comfortable and original.
- 7 Once your design is complete, present it to the rest of the group who will act as your client. What is their feedback? Are there any changes you might want to make to your plan?

### FUN FACTS

- 1 While they're not for everyone, microflats actually help you save money and energy (which reduces your carbon footprint, and is good for the environment!).
- 2 Perhaps the greatest advantage of having a much smaller living space is that it also significantly reduces the time you need to spend on cleaning.

**CLUB LEADER GUIDE: SUITABLE FOR AGE 11-14**

# How can we live smarter?

## 2 Cleaning our oceans



### Objective

In this activity students will simulate a small-scale oil spill and investigate different methods of cleaning it up.

#### TOPIC LINKS

- 🔗 Design and technology: exploring properties of materials
- 🔗 Science: visualising chemicals in oil and observing the effect of dispersants

#### ESSENTIAL SKILLS SUPPORTED

Listening, presenting, problem solving

#### TIME

🕒 120 minutes

#### RESOURCES AND PREPARATION

Before the session set out the resources at different stations.

- materials for the booms:
  - nylon tights - 1 leg per team
  - paper towels
  - bendable straws
  - cardboard
  - cotton balls
  - feathers
  - wool - natural or knitting
  - foam wedge makeup sponges
- gratnells tray other large container (one per group)
- food colouring
- vegetable oil (200ml per group)
- 250ml beaker (one per group)
- glass stirring rod (one per group)
- water
- name-brand washing-up liquid
- notebook/paper
- glass bowl - (one per group)
- paper towels

#### DELIVERY

- 1 Explain that a lot of the energy we use in our daily lives comes from fossil fuels (oil, gas and coal), but the transport of fossil fuels has led to oil spills in our oceans. Oil spills are bad for marine environments, animals, and even humans.
- 2 Obviously it's vitally important that we remove oil from these marine environments. There are many different ways we can do this, and some measures are more effective than others.
- 3 Describe how booms are used to clean up oil. In Useful links below, there are two interesting videos about how booms can be made out of hair and nylon.
- 4 Tell students that they will use a model to simulate an oil spill and its clean-up.
- 5 Guide students as they work through the student guide.
- 6 After the practical, ask students the following comprehension questions:
  - was it hard to contain the oil to a small area in this experiment
  - which of the absorbent materials was able to absorb the oil the fastest? Rank them from worst to best and explain your reasoning.
  - you probably noticed that the oil and water don't mix. Did this make it easier or harder to remove it from the water
  - the food colouring in this experiment represented the chemicals that can be found in crude oil. Did anything happen with these chemicals in the oil during the experiment? What do you think this means

## CLUB LEADER GUIDE: SUITABLE FOR AGE 11-14

# How can we live smarter?

## 2 Cleaning our oceans

### DIFFERENTIATION IDEAS

**Support:** students simulate a small-scale oil spill and investigate the effectiveness of two different oil clean-up efforts.

**Challenge:**

- students can independently investigate how the amount of oil affects the clean-up strategy that works best. They can explore how doubling the oil spill affects the spread of the oil slick over the surface of the water. How does it affect the amount of time required to contain it

### EXTENSION IDEAS

- 1 Add a dispersant (washing-up liquid) to break up the oil "slick" surface into little droplets and ask the students how effective this would be in a clean-up. Dispersants contain molecules with a hydrophilic end (the "head") and hydrophobic end (the "tail"). These molecules attach to the oil, reducing the interfacial tension between oil and water, breaking up the oil slick. See more information in the Useful links section.
- 2 This topic can be further extended by including the clean-up of wildlife (e.g. birds) by dipping a feather in the oil and cleaning it with water or cleaning it with the dispersant.

### TIPS

- divide students into small groups of 3-6 students
- assign roles within each group before getting started. The roles are: observer, data collector, and oil remover. Two students can have the same role in each group
- this activity can be messy. Prepare enough paper towels and soap for clean-up
- all oil waste should be placed in refuse bins, only minimal oil remaining on surfaces/objects should be washed off with detergent and disposed of down the sink as it can separate out in the sewerage system. Ideally wipe most residue with paper towels and place in bin

### HEALTH AND SAFETY:

A suitable risk assessment must be carried out by the activity leader and any significant findings recorded: if carried out in schools, guidance from CLEAPSS or SSERC must be used where appropriate.

## USEFUL LINKS

-  10 impressive innovations for cleaning up oil spills developed since the Gulf disaster  
[www.treehugger.com/slideshows/clean-technology/10-impressive-oil-spill-clean-technologies-developed-past-five-years/](http://www.treehugger.com/slideshows/clean-technology/10-impressive-oil-spill-clean-technologies-developed-past-five-years/)
-  Nature: The science of dispersants  
[www.nature.com/news/2010/100512/full/news.2010.237.html](http://www.nature.com/news/2010/100512/full/news.2010.237.html)
-  YouTube video: Making a boom using hair and nylon nets  
[www.youtube.com/watch?v=aHuWyFVo62o](http://www.youtube.com/watch?v=aHuWyFVo62o)
-  YouTube video: Hair boom vs. conventional boom demo  
[www.youtube.com/watch?v=W68L53WkiAw](http://www.youtube.com/watch?v=W68L53WkiAw)



# How can we live smarter?

## 2 Cleaning our oceans



### Your challenge

Oil spills are pretty nasty. They can harm the environment, animals and even people living nearby. It's therefore vital that we keep the seas clean! Floating objects called booms (like a floating sock) help us today, but what materials are best to use and are there even better methods we should be using in the future?



**YOUR TASK** Simulate an oil spill and work out the most effective way to clean it all up again - what is the best material to be used as a boom?

### WHAT YOU NEED TO DO

- 1 Take the tights leg and carefully cut off the ankle and foot section. Cut four 10 cm lengths off the remaining tights leg. Tie a knot in one end of each segment.
- 2 Fill each segment of the tights with one of the absorbent materials to create a small sausage shape - try not to stretch the tights. Do this for each material until you have four booms with similar size, shape and density. Tie off the open ends.
- 3 Measure out 200ml of vegetable oil into the glass beaker. Add 10 drops of food colouring to make it easier to observe the oil. Mix with the stirring rod.
- 4 Half-fill the large container with cold water and pour 50ml of the oil mixture into the centre. Record your observations. Is there one big oil puddle or separate droplets? Does the oil spread out quickly? Does it sink or float? What happens if you gently blow on the surface?
- 5 **Phase 1**  
Place one of the booms in the oil and water. Move it around gently to soak up the spill. Squeeze out the boom into the bowl and place back in the water to remove the remaining oil. Work together to record all of your observations. How effective was the boom? How long did it take to remove 50%, 75% and 100% of the oil?

Repeat the experiment with each of the booms recording your observations for comparison.

### 6 Phase 2

What happens if you contain the oil in some way?

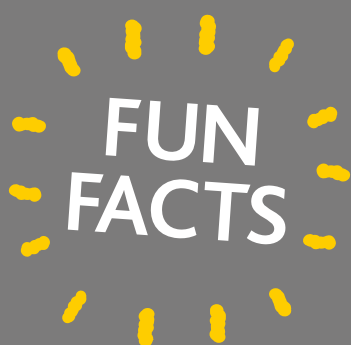
a) Repeat the experiment with the booms but use straws or cardboard to form barriers to stop the oil from spreading. How effective is this method? Observe and compare your findings.

b) Repeat the experiment but tie three of the booms together. Try containing the oil with the three connected booms and use the fourth to soak up the oil. How effective is this method? Observe and compare your findings.

- 7 Present your findings and compare results for each experiment with the other teams. Discuss how you could improve the booms to make them more effective and cost efficient.

### 8 To clean up:

Throw away the booms in the bin along with any other materials contaminated by the oil. Use paper towels to absorb as much of the oil as possible and throw away. Mix the remaining water with washing up liquid and carefully pour down the sink. Thoroughly wash the equipment with hot soapy water to remove the oil residue.



- 1 After the Gulf of Mexico oil spill, a non-profit organisation called "Matter of Trust" used human and animal hair stuffed into nylon stockings as an absorbent to contain and soak up the oil. They obtained the hair from hairdressers and pet stores and sent hundreds of thousands of pounds of hair wrapped in recycled nylon stockings to help clean up the pollution.
- 2 Scientists have investigated other ways for us to effectively and quickly clean up oil from our oceans. DNA research in one particular investigation suggests that bacteria could be used to eat the oil, cleaning the water. By understanding how to support these natural occurring microbes, we may also be able to better manage the aftermath of oil spills.


# How can we live smarter?

## 3 There's an app for that

### Objective

In this activity students learn about the effects of waste on the environment. They will design an app that incentivises recycling by allowing households to log how much they are recycling each week.


#### TOPIC LINKS

 Computing: app design

#### ESSENTIAL SKILLS SUPPORTED

Problem solving, leadership, teamwork

#### TIME

 50 minutes

#### RESOURCES AND PREPARATION

- pencils
- pens
- coloured markers
- rulers
- paper (plain, lined, squared)
- design worksheets (enough for one per group)
- optional: computers with internet access for student research and examples of recyclable materials

#### HEALTH AND SAFETY:

A suitable risk assessment must be carried out by the activity leader and any significant findings recorded: if carried out in schools, guidance from CLEAPSS or SSERC must be used where appropriate.

#### DELIVERY

- 1 Start by bringing up the problem of how much waste we produce in a single home. Ask students to think of the different things that they can recycle at home and list these on the board. Make sure they consider different types of plastic rather than just plastic in general. This could be a good chance to discuss the numbered symbols on plastic containers and examine which types are recycled in your local area.
- 2 Discuss WHY these things need to be recycled. Make a top 3 or 5 of the things that the class feels should be prioritised to be recycled.
- 3 Ask if everyone has separate recycling bins at home for each of those things. Then ask if anyone ever puts recyclable rubbish in a general rubbish bin anyway. Can they explain why/why not?
- 4 Explain that in this activity, they will work in groups to plan and design an app that would incentivise people to become more aware of their recycling habits.
- 5 Assist students as they work through the student guide.
- 6 Ask students:
  - would your app have a positive effect on waste and recycling
  - how would you measure this effect
  - who is the best recycler in your class? How could you test out your app idea with them to find out who earned the most points in one week

## TIPS

- bring in examples of waste recycling bottles and cardboard boxes
- have students think about any games they have played that use points as rewards
- research other apps to see how features similar to their ideas work
- think about user-journey - how will the user navigate through the screens. E.g. should there be back buttons on the screens or do they swipe from left to right
- keep it small-scale at first. Students might want to start out by letting people in one classroom compare scores for recycling only. Let them draw out what this would look like before they consider the complexity of an app that can be used by thousands or people
- the student guides contains three worksheets for the students to work out their app designs. It may be a good idea to prepare extra sheets for students who need to redo their work or want to add more screens



### DIFFERENTIATION IDEAS

**Support:** students could focus on one type of recycling (e.g. plastic, batteries, or clothes) and create one information screen describing why this material need to be recycled and what will happen if it isn't. They could then design two rough drafts for screens that show how the user would be able to use their recycling app.

**Challenge:** students could design three or more, detailed screens that show how the user would be able to use their recycling app.

### EXTENSION IDEAS

- 1 Let two or more groups that focused on different recycling materials to collaborate after the initial session to produce one large plan that incorporates the initial ideas of the separate groups.
- 2 Let students investigate how and if they can put their ideas into a more practical use.
  - can they apply their ideas (offline) to the class? For one week, students would need to log their recycling manually. The next session, scoreboards are drawn up on the board. This would happen without the use of an actual app, but it shows the picture of how this idea could work out
  - what would they need to do to actually turn their ideas into an app? (Check MIT App Inventor in the Useful links below)

## USEFUL LINKS

-  **Excess Logic: Top 5 - Solutions to recycling**  
<http://excesslogic.com/electronics/top-5-solutions-to-recycling-problems/>
-  **Studio: Paper prototyping: The 10-minute practical guide, with tips on how to design apps or web pages on paper**  
[www.uxpin.com/studio/blog/paper-prototyping-the-practical-beginners-guide/](http://www.uxpin.com/studio/blog/paper-prototyping-the-practical-beginners-guide/)
-  **MIT App Inventor – Anyone can build apps that impact the world**  
<http://appinventor.mit.edu/explore/>

# How can we live smarter?

## 3 There's an app for that



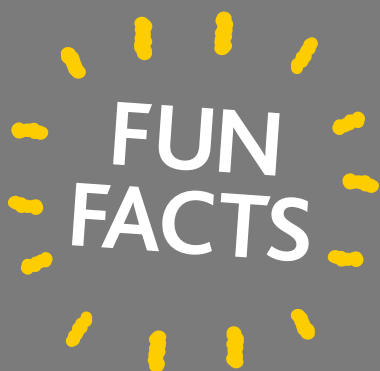
### Your challenge

Recycling has become an accepted part of our daily lives. But some people still don't recycle, or when they do, they do it wrong. This can be because people don't know the right way to recycle, or because they can't be bothered. But what if you could turn recycling into a game? Could this make the difference?

**YOUR TASK** Plan and design an app that allows households to score points by logging and sharing their recycling.

### WHAT YOU NEED TO DO

- 1 In your group, decide what recyclable material you will focus on for this activity. You may want to do some research to find out what is currently recyclable in your area, and be able to describe how and why this material should be recycled.
- 2 Create your information screen for the users that will download your app. In order to get people to recycle, it is important for them to know exactly why recycling that particular material is necessary. Use scientific information if you can find it and try to motivate your users. Sketch and scribble your ideas onto some paper, and work out your neat, final design on one of the design worksheets.
- 3 Next, decide on a system to turn recycling into a game: points need to be earned every time someone recycles. Decide how your point system works, and what this should look like. You have a lot of creative freedom, but here is some advice to help you:
  - Include one screen with a list of all the items that fall within your recycling category. The user can click on the object they recycled and indicate how many items they threw in the appropriate recycling bin (for example, 6 plastic drinks bottles - scoring lots of points in one go). Each item might have different points allocated to it. Show the amount of points each item is worth in the item list.
  - Include one screen that shows what the scoreboard could look like.
  - Include one screen where the user can see what they have recycled that day (or week, or month, or year!)
  - Include a screen where the user can save important information on a calendar. This would allow the user to make a note of when the recycling will be picked up next, so they won't forget to put the proper bins out on time.
  - Use drawings and pictures a lot! This saves the amount of text the user would see on the screen.
- 4 Once you have completed your mind map on all of the screens you wish to include, draw it out neatly on the worksheets attached.



- 1 70% of waste is recyclable, but only 5-30% of waste actually gets recycled, (depending on location).
- 2 The average person generates over 2kg of trash every day and about 1.5 tonnes of solid waste per year.
- 3 A glass jar or bottle can travel from a recycling bin to a store shelf in as few as 30 days.
- 4 Graphene is the world's first 2D material (it's a lattice that's only 1 atom thick!), and was discovered by the University of Manchester, it is so interesting because it is 200 times stronger than steel, thinner than anything else, and it's the world's most conductive material. The applications of this materials are vast and could be developed to create "smart" food packaging products to cut down on waste food, or keep food fresher for longer, tablets that you could roll up like a newspaper!

# How can we live smarter?

## 3 There's an app for that

### DESIGN WORKSHEET 1

Screen title:

Notes



# How can we live smarter?

## 3 There's an app for that

### DESIGN WORKSHEET 2

Screen title:

Notes



# How can we live smarter?

## 3 There's an app for that

### DESIGN WORKSHEET 3

Screen title:

Notes



**CLUB LEADER GUIDE: SUITABLE FOR AGE 11-14**

# How can we live smarter?

## 4 Smarten up your life

### Objective

In this activity students discuss how advances in the kitchen might affect the future and design their own product that has all the smart features they can think of. They will then try to sell their product to the CEO of an important 'smart' company using a PowerPoint presentation.

#### TOPIC LINKS

- 🔗 Design and technology: designing a smart product
- 🔗 Engineering: researching the internet of things

#### ESSENTIAL SKILLS SUPPORTED

Listening, problem solving, creativity, teamwork

#### TIME

🕒 50 minutes

#### RESOURCES AND PREPARATION

Students will need to prepare a week in advance (see point 2 in the Delivery section on the right)

- A3 paper
- plain paper
- pencils
- pens
- markers
- optional: computer with internet access for research

#### HEALTH AND SAFETY:

A suitable risk assessment must be carried out by the activity leader and any significant findings recorded: if carried out in schools, guidance from CLEAPSS or SSERC must be used where appropriate.

#### DELIVERY

- 1 Create a class mind map of the things they would like to see smart in their daily lives. What kinds of smart products could make different areas in their life easier? A case study for the students is the smart fridge.
- 2 Students need to prepare for this activity. For one week, they will need to do a study on all the tasks that happen at home in the kitchen. Who does them? How often? How long does it take? After their study, they need to bring their results in to analyse.
- 3 Ask if they can think of anything about their kitchen at home that could be easier. In the future, do they think going to the food shops will be necessary? How could this chore be eliminated? Students list the biggest chores (in terms of time or nuisance) and their ideas of how these could be eliminated.
- 4 Introduce the activity: in groups, they will need to research and mind map existing and non-existing features for the smart product of their choice that they believe is needed to eliminate a chore of their choice. Their end-product will be to create a PowerPoint presentation which they present to their peers. The context is that they are advertising a new product for development to the CEO of a 'smart' company they work for: 'SMART Creations'.
- 5 Assist students as they work through the student guide.





## TIPS

- Give each of the team members a role before they start their team mind map. For example:
  - engineer: focuses on the technical aspects of the activity
  - designer: focuses on making their poster and presentation stylish and appealing
  - marketing specialist: Focuses on thinking from the point of view of the audience and the CEO
  - speaker: responsible for presenting their end-product

### DIFFERENTIATION IDEAS




**Support:** let students design their futuristic smart fridge and build on what they learnt from the case study. Start with basic features that their fridge already has and build upon those. Or let students design a smart product that can be used to get rid of the chore of their choice.

**Challenge:** assign students a client that they must keep in mind during their designs. For example, what would they need to consider if they were designing for an elderly client, someone with mobility issues, etc?

### EXTENSION IDEAS

- 1 Investigate how they can put their ideas into action. How can student create smart devices using their own dumb stuff? (see Useful links below). Students could search the internet to find out what the possibilities are for them to smarten up their life.

## USEFUL LINKS

-  [Wired article: How to build a smart home with your own dumb stuff](http://www.wired.com/2015/03/build-smart-home-dumb-stuff/)
-  [Smart refrigerators illustrate why we need to define 'smart', by Vivint Smart Home](http://www.vivint.com/resources/article/smart-fridge)
-  [Why buying a smart fridge is a dumb idea, How-To Geek](http://www.howtogeek.com/260896/why-buying-a-smart-fridge-is-a-dumb-idea/)

# How can we live smarter?

## 4 Smarten up your kitchen



### Your challenge



It seems like these days everything is becoming technologically 'smarter'. How about our homes? Smart fridges will allow us to see on our phones exactly when we need to buy more milk or when our eggs will be out of date. Are there other smart devices we can add to our homes?

**YOUR TASK** Design, sketch up, and sell your own futuristic smart device to the CEO of the influential company 'Smart Creations'.

### WHAT YOU NEED TO DO

#### Phase 1 – research and mind map

For one week, study all the tasks that happen at home. Who does them? How often? How long does it take? Where could a smart device or new feature be useful to make one of these easier or more pleasant? Create a mind map with your ideas.

#### Phase 2 – decide on your two big ideas

What are the two features that have come out of your mind map that you are the most enthusiastic about? Name and describe each feature briefly. In your description, explain what the feature is for and how it would work. groups follow them?

### FEATURE 1:

What does the feature do? How does it work?

What are the unique selling points of my product? (e.g. What will make people want to buy it?)

# How can we live smarter?

## 4 Smarten up your kitchen

### FEATURE 2:

What does the feature do? How does it work?

What are the unique selling points of my product?  
(e.g. What will make people want to buy it?)

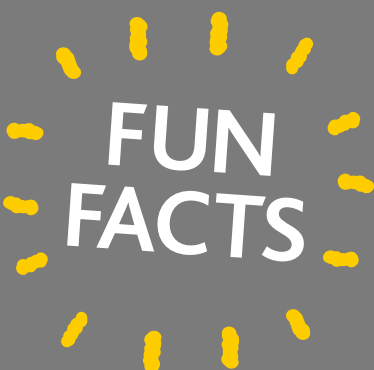
### Phase 3 – sketch it up

On plain paper, sketch up some different versions of what your final design for the two features should look like. Make notes.

### Phase 4 – create a presentation

Next, produce a presentation to convince the CEO of the smart company 'Smart Creations' to start making and selling your product. Consider the following points as you work on this:

- what makes your product appealing or sets it apart from others
- how does this feature make the buyer's life easier
- what materials and technology would they need in order for it to have this function
- what is your target audience? (Everyone, people who cannot go to the shop by themselves, young people, older people, very wealthy people, or maybe very technological people?)
- is this a very expensive feature to build



- 1 Smart fridges connected to the internet should get regular updates, or they might stop functioning properly. There have been instances in the past where this caused trouble for (maybe-not-quite-so) smart fridges.
- 2 Smart devices are not only useful in households – they are taking over everywhere. The technology involved in nursing today would likely surprise even the most devoted gadget freak. Nurses must increasingly master a host of complex technologies, from smart medical devices to tablet PCs.



CLUB LEADER GUIDE: SUITABLE FOR AGE 11-14

# How can we live smarter?

## 5 Smart showers

### Objective

In this activity students will do calculations where they can figure out how many litres of water they use per minute and create a scoreboard to gamify the way they look at water usage at home.

#### TOPIC LINKS

- Maths: calculating water usage

#### ESSENTIAL SKILLS SUPPORTED

Listening, presenting, problem solving

#### TIME

- 40 minutes

#### RESOURCES AND PREPARATION

- A3 sheets of (coloured) paper
- cardboard (to make their scoreboard more sturdy)
- coloured markers
- extension: Desktops or laptops with internet access

### DELIVERY

- 1 Start a discussion about the different topics students can think of that can lead to wastage of (natural) resources. They might have heard of their carbon footprint, but do they know about water footprints? (optional: have students think about their own water footprint)
- 2 Define the term water footprint and clarify that it is not just the amount of water consumed by human activity (eating, drinking, water needed for the resources we use) but that it also includes the amount of water we use to clean ourselves. Ask students to think about why their water footprint matters. For example, in dry summer months there can be water shortages which make it even more important not to waste excess water. Can anyone think how they might find out how much water is used at their home? (Most people have a water meter that is used by the water supplier to keep track.)
- 3 Introduce the goal of the activity: for them to make a scoreboard and reduce the amount of water that might be wasted at home.
- 4 Guide students as they work through the student guide.

TIPS

- The water footprint Extension idea (below) can also be used as a starter.

### DIFFERENTIATION IDEAS

**Support:** assist students with their calculations.

**Challenge:** imagine this device in every household! Can students predict when the demand for water is high – link this to variations in seasons/climate.

### EXTENSION IDEAS

- 1 Students could devise a game where points are gained by reducing the amount of water that is used each time they shower.
- 2 Water footprints: students could analyse in detail what their own water footprint is and think about areas in their daily lives where they could save water (see the calculator in the Useful links below).

### USEFUL LINKS

- Fast Company article: This Showerhead Changes Colour When You Use Too Much Water [www.fastcompany.com/3055446/this-showerhead-changes-color-when-you-use-too-much-water](http://www.fastcompany.com/3055446/this-showerhead-changes-color-when-you-use-too-much-water)
- Water Resources Institute article: 7 Reasons We're Facing a Global Water Crisis [www.wri.org/blog/2017/08/7-reasons-were-facing-global-water-crisis](http://www.wri.org/blog/2017/08/7-reasons-were-facing-global-water-crisis)

- Hunter Water information water heads (water wastefulness and showerheads) [www.hunterwater.com.au/Resources/Documents/Fact-Sheets/Saving-Water/showerhead-facts.pdf](http://www.hunterwater.com.au/Resources/Documents/Fact-Sheets/Saving-Water/showerhead-facts.pdf)
- The Water Footprint Network's webpage <http://waterfootprint.org/en/>
- Water Footprint calculator [www.watercalculator.org/wfc2/q/household/](http://www.watercalculator.org/wfc2/q/household/)

# How can we live smarter?

## 5 Smart showers



### Your challenge

About 95 percent of the water entering our homes goes down the drain. This is bad for the environment and expensive to people on water meters. How can we use smart technology to combat this wastage?

**YOUR TASK** In this activity, think up how to easily see when you are being wasteful under the shower and make a scoreboard to find out who is the least wasteful at home.

### WHAT YOU NEED TO DO

#### Phase 1 - calculations with water

- 1 A standard showerhead uses between 12 and 22 litres per minute. A water saving showerhead uses 9 litres per minute or less. Finish table 1 below to take a closer look at how much water is used up in different households.

TABLE 1:

	Average time in shower (minutes)	Average amount of water used per minute (litres)	Average number of showers a day	Total water used a day (litres)	Total amount of water used a month (litres)
Household A	7	9	4		
Household B	9	12	3		
Household C	6	20	4		

- 2 Now imagine that household C switches to a water saving showerhead that only uses 9 litres per minute. Everything else stays the same. Fill in table 2 - how much water will this family save in one month?

TABLE 2:

	Average time in shower (minutes)	Average amount of water used per minute (litres)	Average number of showers a day	Total water used a day (litres)	Total amount of water used a month (litres)
Household C					

# How can we live smarter?

## 5 Smart showers



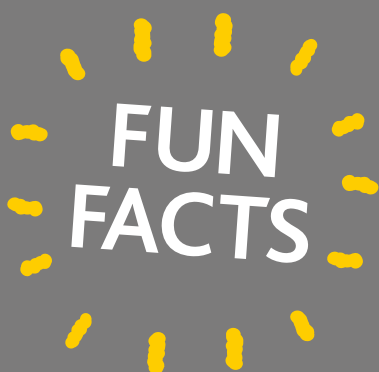
### Phase 2 - coming up with more solutions

- 3 Find out how much water your shower head at home uses per minute. If you cannot find this information, assume your shower head uses 15 litres per minute. Fill in the row in the table below for the time in minutes it would take you to use up the water amounts in the top row. (Tip: if you use up 15 litres per minute, it would take 40 seconds to use 10 litres).
- 4 Come up with a colour code for each of the amounts of water used, e.g. it could turn blue to orange to red depending on how long you have been showering.

Water used (litres)	10	20	30	40	>50
Time (min)					
Colour code					

### Phase 3 - time your showers!

- 5 For one week, have every member in your household keep track of the number of minutes they shower. Every time they shower! Create an A3 scoreboard. Include the following:
  - a way to indicate each day of the week
  - the names for all participants
  - for each participant:
    - the amount of time they showered that day (in minutes)
    - the amount of water they used showering that day (in litres)
    - the colour code according to table 3 (as a sticker, or using markers)
  - now that you know just how much water you use under the shower, can you think of any ways to save water? How could you ensure you shower in shorter sessions? Could you find a use for the cold water as you are waiting for the shower to warm up? Discuss with each other



- 1 A standard showerhead uses about 12 to 22 litres of water per minute. More efficient showers can reduce the amount of water down to only 6 to 9 litres per minute.
- 2 A water efficient showerhead can save thousands of litres of water per household per year.
- 3 As populations increase and incomes grow, so does water demand. There are 7.5 billion people in the world right now, and the numbers are still rising. Scientists are coming up with ways to allow us to use our water wisely (like smart showers), but people have to be careful with their water too so we all have enough to drink.

**CLUB LEADER GUIDE: SUITABLE FOR AGE 11-14**

# How can we live smarter?

## 6 Fighting hunger

### Objective

In this activity students learn about the fight against world hunger and make their own nutrition bar (using Plumpy’Nut as a case study). They can experiment with the ratios to make a nutritious and energy-rich recipe which can be tested using calorimetry.

#### TOPIC LINKS

- Design and technology: food technology, design considerations

#### ESSENTIAL SKILLS SUPPORTED

Problem solving, staying positive, teamwork

#### TIME

60 minutes

#### RESOURCES AND PREPARATION

- a range of nutrient-rich / high calorie foods, e.g. powdered milk, cooked brown rice, honey, raisins, dried fruit, e.g. dates, shredded coconut
- measuring cups
- electric balance
- spoons
- bowls

#### HEALTH AND SAFETY:

A suitable risk assessment must be carried out by the activity leader and any significant findings recorded: if carried out in schools, guidance from CLEAPSS or SSERC must be used where appropriate.

Make sure you are aware of any allergies before deciding which food items to bring. Nuts and nut products are banned in many schools.

Only allow students to taste their products if they are in a food safe environment (e.g. a food technology lab). Alternatively focus on the nutrient and energy content of the product, rather than the taste.

If there is not enough time/equipment/supervision, turn this into a demonstration and have the students calculate which group produced the most energy-rich paste for a pre-determined weight of the paste.

#### DELIVERY

- 1 Introduce the topic. In 2014, the second goal of the seventeen Sustainable Development Goals set up by the UN General Assembly was to work towards ending world hunger by 2030. Between 2014-2016, one in nine people were suffering from chronic undernourishment.
- 2 What does malnutrition look like? People with malnutrition lack the nutrients (carbohydrates, proteins, fats, minerals, vitamins – these could be introduced using the nutrition labels on different food items) necessary for their bodies to grow and stay healthy.
- 3 Ask students if they can name any effects of malnutrition and get a brief discussion going.
- 4 Food does not only provide nutrients, but also energy (go back to the nutrition label as students have likely heard of calories, but might not know what it stands for). Demonstrate how calorimetry can be used to determine the energy inside food (see BBC bitesize link in the Useful links below).
- 5 Ask if the students can think of any solutions to the problem of malnutrition.
- 6 The fight against malnutrition has been going on for a long time, but recently there was a breakthrough when Plumpy’Nut was introduced. Plumpy’Nut is used as a treatment for emergency malnutrition cases. It is cheap and high in protein. (See Useful link for more information.)

## TIPS

- This could be a messy activity so prepare plenty of paper towels.



- 7 Explain to students that they are going to make their own version of Plumpy'Nut. It will need to include a good mix of nutrients and be easy to transport and store for long periods. While Plumpy'Nut is specifically for severe malnutrition, they might want to create something with wider appeal, such as a food supplement for athletes, or a nutritious and portable food for camping, hiking, or even for astronauts going into space!
- 8 Support students as they make their product.
- 9 Once they have finished, ask them the following questions:
- 10 What other nutrients are required in a healthy diets? Are these present in your paste?
- 11 How many calories are there in 100 grams of your paste?
- 12 Other than by checking from the nutritional labels of your ingredients, how could you test how much energy there is in your paste compared to the products from other groups?

### DIFFERENTIATION IDEAS





**Support:** offer advice about the quantities of ingredients.

**Challenge:** allow fast finishers to consider how they could test the energy content in their food (in terms of calories). If the equipment and supervision is appropriate, let the students find the answer to that question using calorimetry (see BBC bitesize link in the Useful links below).

### EXTENSION IDEAS

- 1 This topic could be linked to other causes of world hunger and possible solutions. One option is the food that is thrown away and wasted (e.g. at home, but also at stores). Let the students think of possible solutions.

## USEFUL LINKS

-  Information about Plumpy'Nut  
[www.nutriset.fr/products/en/plumpy-nut](http://www.nutriset.fr/products/en/plumpy-nut)
-  Sustainable development knowledge platform: SDG 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture  
<https://sustainabledevelopment.un.org/sdg2>
-  The Guardian: Eight ways to solve world malnutrition  
[www.theguardian.com/global-development/2013/jun/08/eight-ways-solve-world-hunger](http://www.theguardian.com/global-development/2013/jun/08/eight-ways-solve-world-hunger)
-  Teens Health: Hunger and malnutrition  
<http://kidshealth.org/en/teens/hunger.html>



# How can we live smarter?

## 6 Fighting hunger



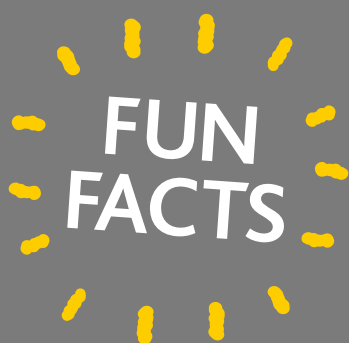
### Your challenge

While the world produces enough food to feed everyone, many third world countries are suffering from hunger and malnutrition. One amazing solution is Plumpy'Nut – a peanut-based paste that is cheap, easy to make and designed to give malnourished people the nutrients they require.

**YOUR TASK** Make your own version of Plumpy'Nut and find out how sometimes, the best solutions can be the simplest!

### WHAT YOU NEED TO DO

- 1 Select the ingredients that you want to use for your highly nutritious food. For each of the ingredients, carefully check the nutrition label on the packet (or research this on the internet) and write this down in the table below.
- 2 Use the electric balance to measure the amounts of each ingredient. Write the information down in the table.
- 3 Mix all your ingredients together into a thick paste. Keep adding ingredients if you are unhappy with the consistency, but make sure to weigh and record everything you add.
- 4 Check with your teacher if your version of the paste is acceptable.



- 1 Plumpy'Nut was made by French scientists at the company Nutriset.
- 2 Plumpy'Nut was initially inspired by a jar of Nutella.
- 3 The creators of Plumpy'Nut wanted to give their nutritious food an English name. They started with "pump", then "plump", then finally decided on Plumpy'nut.
- 4 A calorimeter is a piece of equipment designed to measure the energy released or absorbed during a chemical reaction or phase change. Food calorimetry allows us to determine the number of calories per gram of food. One kilocalorie (kcal) is the same as 4.2 kJ (kilojoules) and is the amount of energy needed to raise the temperature of 1 kg (kilogram) of water by 1 degree celsius.



# How can we live smarter?

## 6 Fighting hunger

5 Now calculate how many of each nutrient are actually added to your paste (based on the weight you have added of each of the ingredients).

Ingredient	Proteins (g per 100g)	Fats (g per 100g)	Carbohydrates (g per 100g)	Calories (per 100g)	Weight added (g)
<b>Total:</b>					

6 Calculate the nutritional content of your food by finishing the table.

- A 13-year-old roughly requires the following in terms of macronutrients per day:
  - protein: 150-170 grams
  - fats: 60-80 grams
  - carbohydrates: 200-220 grams

7 What can you say about the amount of nutrients and energy in your paste with that in mind? How much of your food would be needed to fulfil all of the requirements?



# How can we live smarter?

## 7 Get CREST Discovery Awards



By completing activities in this resource pack, your STEM Club members could get a CREST Discovery Award.

### ABOUT CREST

CREST is a scheme that inspires young people to think and behave like scientists and engineers. It is student-led, flexible and trusted. CREST helps young people become independent and reflective learners. With no set timetable, projects can start whenever you want, and take as long as you need.

### HOW TO GET YOUR CREST DISCOVERY AWARDS

You can use the activities in this pack to undertake a CREST Discovery Award.

- 1 Learn more about CREST Awards by visiting [www.crestawards.org](http://www.crestawards.org) or contact the CREST team on [crest@britishscienceassociation.org](mailto:crest@britishscienceassociation.org) for advice and support.
- 2 Sign-up for a free account - <https://my.crestawards.org/>
- 3 Select one or two activities that have open investigation potential and encourage extended research and scientific investigation. Projects should be made suitable for CREST Discovery Days. The CREST Discovery Getting Started guide has all the details! Download it from: <https://discoverylibrary.crestawards.org/getting-started-guide-discovery/62140325>
- 4 We suggest using the other activities to introduce and develop chosen topics.
- 5 Have each student complete a CREST Awards Discovery Passport.
- 6 Log in to your CREST account to submit the student project, pay the entry fee and request certificates. These will be posted to your delivery address.

### TAKING THEIR WORK FURTHER

If members want to take activities further, they can work towards a CREST Bronze or Silver Award.

CREST Bronze Awards require around ten hours of enquiry, project-based work, and Silver Awards require thirty hours of work at GCSE or equivalent standard. Using one of the activities for inspiration, they choose a question or topic to investigate.

Guidance on how to run CREST Bronze and Silver Award projects is available on the CREST Awards website [www.crestawards.org](http://www.crestawards.org)

# How can we live smarter?

## 8 The Skills Builder Framework



### The Activities and Employability Skills

Each activity within this resource pack has identified the essential employability skills it supports and develops in students. These skills have been mapped to the essential skills identified by the Skills Builder Framework, which breaks down eight essential skills into 16 teachable and measurable steps. Club leaders and teachers can use the activities to promote good practice and enhance each student's individual learning curve. Helping to promote transferable skills key to their education and future employment.

### ABOUT THE SKILLS BUILDER PARTNERSHIP

The Skills Builder Partnership brings together educators, employers and skills-building organisations around a common approach to building eight essential skills. Their programmes include training and resources, supporting schools and colleges to embed a rigorous approach to building skills and achieve the Gatsby Benchmarks. As an individual teacher or Club leader, you can freely access a suite of online teaching tools and resources, designed by their team of teachers to build essential skills. The suite includes learning activities, supporting videos, classroom resources, assessment tools and the Skills Builder Framework, which you can use in STEM clubs and classroom teaching.

### THE SKILLS BUILDER FRAMEWORK

The Skills Builder Framework breaks down eight essential skills into 16 teachable and measurable steps, providing a common set of expectations and a roadmap for progression. Step 0 is for the least experienced learners and Step 15 represents a highly skilled adult. The Framework can be used by teachers and Club leaders to talk to students about their skill strengths and areas for development and is a useful tool for framing conversations about careers and employability. Focusing student learning through the Framework, enables students to recognise their own essential skill levels and work to master them over time. The Framework can provide a language for students to articulate this progress to helping to develop employability skills and prepare students for future careers.

Skills Builder also provide multiple online assessment tools, including a student self-assessment, student-by-student teacher assessment and class-level formative assessment through the Skills Builder Hub. This means that programmes can be differentiated and focused to meet individual needs.



# How can we live smarter?

## 9 The Skills Builder Framework



### EIGHT ESSENTIAL SKILLS

The eight essential skills broadly break down into four domains we know both teachers and employers value.

#### Communication

- 1 Listening – ability to listen and understand information
- 2 Presenting – vocal communication of information or ideas

#### Creative Problem solving

- 3 Problem Solving – ability to find a solution to a complex situation or challenge
- 4 Creativity – use of imagination and the generation of new ideas

#### Self-Management

- 5 Staying Positive – ability to use tactics to overcome setbacks and achieve goals
- 6 Aiming High – ability to set clear, tangible goals and devise a robust route to achieving them

#### Inter-personal

- 7 Leadership – supporting, encouraging and motivating others to achieve a shared goal
- 8 Teamwork – working cooperatively with others towards achieving a shared goal

You can find out more about essential skills and the Framework on the Skills Builder website, <https://www.skillsbuilder.org/framework> and you can access resources on the Skills Builder Hub <https://www.skillsbuilder.org/hub>

You can find additional support and information on careers and employability skills on the STEM Learning Careers pages, <https://www.stem.org.uk/stem-careers>. You can also download the free Skills Builder toolkit from the STEM Learning website <https://www.stem.org.uk/rxfum6>



Notes

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## STEM Clubs Programme, led by STEM Learning

Achieving world-leading STEM education  
for all young people across the UK.



For more information on the  
programmes and publications  
available from STEM Learning,  
visit our website [www.stem.org.uk](http://www.stem.org.uk)