

ACT ON STEM

TEACHER'S RESOURCE PACK

KS2 TEACHING RESOURCES TO COMPLEMENT
NATIONAL CURRICULUM LESSONS



SCIENCE



TECHNOLOGY



ENGINEERING



MATHS



north wales economic ambition board
bwrdd uchelgais economaidd gogledd cymru

HOW TO USE THIS RESOURCE PACK

This resource is supported by online links for further reading and activities. Where possible we have given the URL for the web link. Where not stated, please refer to our online version www.actonstem.co.uk

These resources have been developed by the North Wales Economic Ambition Board specifically for teachers of KS2 pupils in North Wales in response to a plethora of research findings, and employer recommendations, that encouraging STEM awareness, promotion and intervention in the classroom in the **primary years** is vital to plan a skilled future workforce.



THIS SHORT YOUTUBE FILM ABOUT THE REGION'S EMPLOYERS SHOULD BE VIEWED TO SET THE SCENE. TO ACCESS ALL WEB LINKS, PLEASE SEE ONLINE VERSION OF THIS DOCUMENT WWW.ACTONSTEM.CO.UK

Professionals and teachers should use this pack:

- as an additional and complementary resource to the current teaching and learning methods used and not be used as a 'bolt-on' or 'one-off' activity,
- to demonstrate that employers based in North Wales place high value on 'STEM' skills across the curriculum and is increasing for future work across many sectors,
- to reinforce key messages from these resources across a range of subjects taught, not just in science and maths subjects,
- to relate classroom learning into real life scenarios and situations in order to reinforce that academic learning has lifelong value and relevance.

Parents and guardians should use this pack to:

- raise your own awareness of up to date employer skill needs and learn from these resources too,
- realise the high value placed on STEM skills by employers in North Wales,
- develop your knowledge and understanding by using the links and information to find out more from expert sources,
- influence and support your children to make good choices about their future education, training and careers.

Pupils should use this pack to:

- learn the relevance and value of academic subjects in the workplace,
- enhance their learning from the film to show real work situations in North Wales,
- be inspired, informed and educated about the value of STEM subjects to the world of work.

“I in 5 new jobs in the UK by 2022 will be STEM jobs”

Working Futures 2015



www.careerswales.com/en/spotlight-on-stem

Learning Wales classroom resources – Focus on science:



learning.gov.wales/resources/browse-all/focus-on-science

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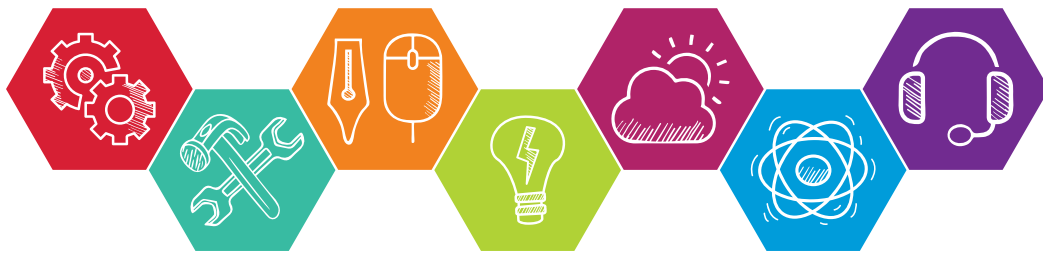


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INTRODUCTION



Science, Technology, Engineering and Mathematics are frequently grouped together as 'STEM'. Not necessarily because of the content of the subjects, but because of the way of thinking that is required to be competent in any of the STEM subjects.

Training in STEM skills teaches critical thinking and an important lesson in using knowledge and applying it in new ways, and it is this approach that employers within North Wales will be looking increasingly for within the emerging labour market across the region.

The importance of the 'STEM' agenda is crucial in its linkages with the regional economic priorities for North Wales, particularly in growth industries in North Wales such as **Energy, Environment, Advanced Manufacturing and Creative and Digital Media.**

Children and young people need to be inspired, informed and educated at an early age about the benefits of STEM in order to take full advantage of employment projects North Wales has to offer such as Wylfa Newydd, Menai Science Park, Advanced Materials and Manufacturing and Energy Island projects.

The North Wales Economic Ambition Board, with partner organisations, has commissioned the development of this pack in response to findings from a recent audit of STEM activities delivered in North Wales primary and secondary schools and further education colleges. During the audit period in 2014, a total number of 1,674 STEM interventions were delivered in education establishments across North Wales, however: '61% of the STEM education provided in North Wales can be classified as 'one-off' ... Provision of random, one-off activities will do little to impact on young people's subject and career choices.'

These classroom materials have been developed with local employers to inspire and engage KS2 pupils on the value and relevance of STEM skills - from the classroom to the workplace.

They provide an introduction to pupils in KS2 on the value and relevance of STEM subjects to their future jobs and careers in North Wales.

A strong partnership between the pupils, professionals and parents is key to the region providing a tailored workforce and a genuine interest in the opportunities that North Wales can provide as a sustainable career pathway for its children and young people.

ACKNOWLEDGEMENTS

The following individuals, agencies and organisations were approached for their expertise and knowledge. We are grateful for their time and support in particular to those who provided financial support.

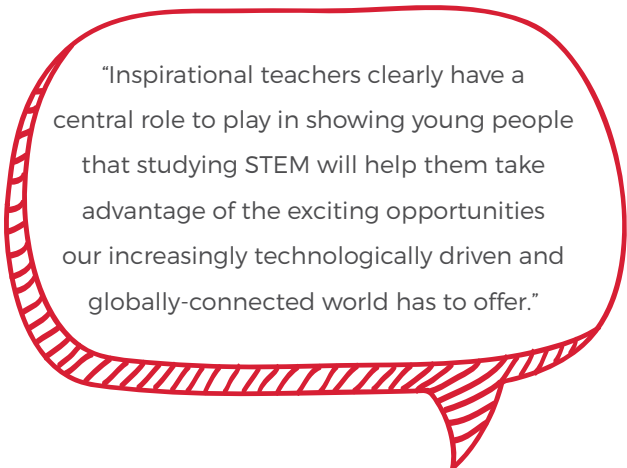
Careers Wales	Nerys Bourne
Chwarae Teg Thank you for your financial contribution.	Joy Kent Emma Tamplin
Comtek	Asker Sheibani Christine Sheibani
Follow Films	Graham Cooper Hollie Harmsworth
Money Penny	Diane Alpin Sarah Baker
NSAN	Alli Hunt
NWEAB	Ffion Jones Iwan Thomas
Prifysgol Bangor University	Alix Charnley Medwyn Roberts (Intern)
Pŵer Niwclear HORIZON Nuclear Power Thank you for your financial contribution.	Helen Grundy Rhodri Sellers Claire Burgess
Reaching Wider North and Mid Wales Thank you for your financial contribution.	Paula Griffiths
Siemens	Ann Murphy
SP Energy Networks	Roy Jones Anna Bromilow
The National STEM Centre, York	Gill Collinson
Theatr Clwyd, Yr Wyddgrug	Emyr John Annie Dayson
Tre-Ysgawen Hall Hotel and Spa	Neil Rowlands
Watkin Jones	Shannon Treadwell
Allenni (Môn Community Performance Group)	Young actors
Ysgol Bryn Gwalia, Yr Wyddgrug Sir Y Fflint	Janine Davies Kate Eastman
Ysgol Gwaun Cynfi, Deiniolen	Mr Rhys Ab Elwyn

INSPIRATIONAL QUOTES

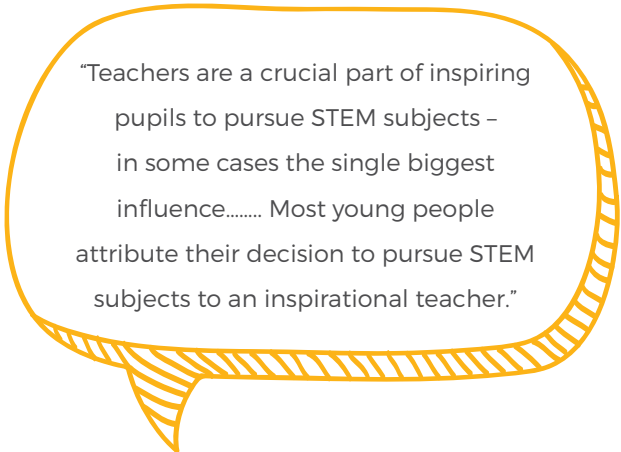
Professor Tom McLeish, Chair of the Royal Society's Education Committee, 2016

A practical guide to supporting STEM teaching in schools and colleges

 <https://royalsociety.org/-/media/policy/Publications/2016/business-toolkit.pdf>



"Inspirational teachers clearly have a central role to play in showing young people that studying STEM will help them take advantage of the exciting opportunities our increasingly technologically driven and globally-connected world has to offer."



"Teachers are a crucial part of inspiring pupils to pursue STEM subjects – in some cases the single biggest influence..... Most young people attribute their decision to pursue STEM subjects to an inspirational teacher."

The Royal Society, May 2016

A practical guide to supporting STEM teaching in schools and colleges

 <https://royalsociety.org/-/media/policy/Publications/2016/business-toolkit.pdf>

**Sir Paul Nurse,
President of the Royal Society**

A practical guide to supporting STEM teaching in schools and colleges

 <https://royalsociety.org/-/media/policy/Publications/2016/business-toolkit.pdf>



"Build careers awareness from primary school onwards by giving children exposure to role models, such as professional scientists, engineers and technologists."

Katja Hall,
Deputy Director-General, CBI

Tomorrow's World, Inspiring Primary Scientists, CBI 2015

 <http://www.cbi.org.uk/tomorrows-world/assets/download.pdf>

"It is clear that we have some way to go in fixing the pipeline for STEM skills – but quality primary science education is a clear and important part of this solution."

"Unless science is exciting, interesting and challenging in primary school, the pipeline will clog long before secondary level. If we do not fix the issues early on, anything else further down the line just becomes a sticking plaster."

Tomorrow's World, Inspiring Primary Scientists, CBI 2015

 <http://www.cbi.org.uk/tomorrows-world/assets/download.pdf>

STEM Guidance for Schools and colleges in Wales, 2012

Guidance for Schools and Colleges in Wales

 <http://gov.wales/docs/dcells/publications/121008stemguidanceen.pdf>

STEM in Key Stage 2

"The concept of engaging enquiring minds to be able to adapt their knowledge and understanding to new situations or to solve problems creatively, can be effectively developed through all STEM subjects."

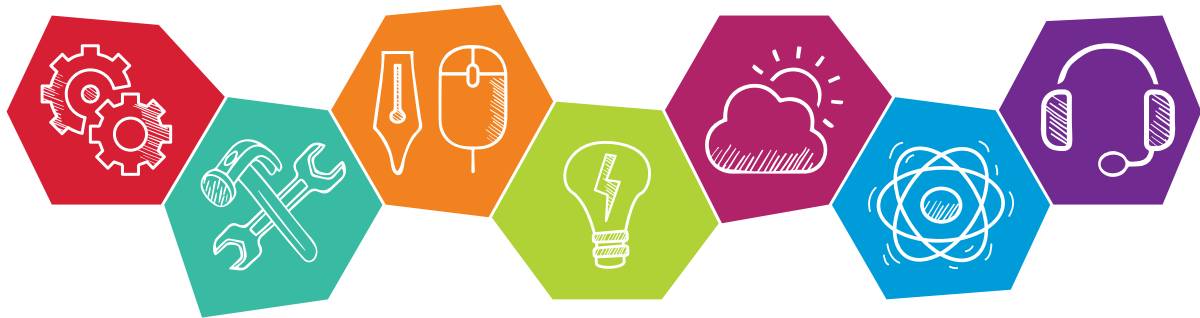
"We believe that teachers are crucial in developing and inspiring young people to become the scientists and engineers of the future. But there is a much wider role that we can all play in helping teachers to make STEM-related subjects more engaging by opening young people's eyes to their relevance to themselves and their own lives."

Ian Duffy,
Community Development Manager, BP plc

Why your business should go back to school: How you can inspire the next STEM generation

 https://www.stem.org.uk/sites/default/files/pages/downloads/ProjectEnthuse_FINAL_0.pdf

A QUICK GUIDE



INDUSTRY/ JOB AREAS KS2 CLASSROOM ACTIVITIES

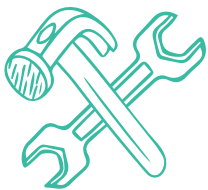
- Advanced Manufacturing**
1. Paper Design
 2. SIEMENS' STEM Club activity
 3. Optical Illusions



SUMMARY OF THIS INDUSTRY

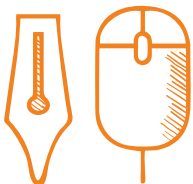
Advanced Manufacturing is creating important everyday items as part of a team. Designing, testing and building are just some of the areas of manufacturing. Aeroplanes, cars, hospital machines, even shampoo, would not exist without the skills of advanced manufacturing. North Wales is an area with expertise in Advanced Materials and Manufacturing.

- Construction**
1. Crank & Container
 2. LEGO® construction team project
 3. Construction- spot what's wrong!



Construction, or building, has one of the widest varieties of job roles of any other industry. Not only are there skilled teams needed on building sites such as – plasterers, electricians and machine drivers - but there are large numbers of people behind the scenes responsible for buying, planning, designing and making sure everything happens on time, on cost and safely.

- Digital & Creative Media**
1. Money & Materials
 2. Create your own gadget
 3. NASA Drinking-Straw Rocket



The creative industries such as media, art and design, have a strong presence within North West Wales particularly in Gwynedd and are forecast to grow further in pockets across North Wales. The skills and requirements are wide-ranging, from IT, social media and creative skills to sales and marketing, development of web sites software development and engineering.

INDUSTRY/ JOB AREAS

KS2 CLASSROOM ACTIVITIES

SUMMARY OF THIS INDUSTRY

Energy



1. Using Electricity
2. Scottish Power Activity – Power wise

Energy Suppliers provide an important service; they help bring electric and gas power to our homes, schools, offices, hospitals and other places across the country. Large generators using heat and turbines help create electricity which then travels everywhere through power lines. This large system needs to be looked after by a team of skilled people to make sure that everything works. There are many new energy projects being developed in North Wales.

Leisure & Tourism



1. Boys & Girls & Work
2. Create your own leisure business
3. Ice Cream Van map activity

Leisure & Tourism are all the places and businesses people go to for enjoyment, whether they live locally or are on holiday. North Wales is fast becoming a 'hot spot' for the best outdoor tourism activities in the UK. There are a huge range of jobs, skills and qualifications for this sector.

Nuclear



1. Codebreakers
2. Horizon Nuclear Power Activity

North Wales has a history of nuclear power generation, based in Wylfa and Trawsfynydd. A new nuclear power plant is planned for Wylfa. Building the plant will start in 2018 and the plant will become operational in 2025. The nuclear industry needs a broad range of skills such as technicians, planners, scientists, engineers, managers etc.

Telecommunications



1. Shift Success
2. Work out the building budget
3. Guess the Mystery Caller game

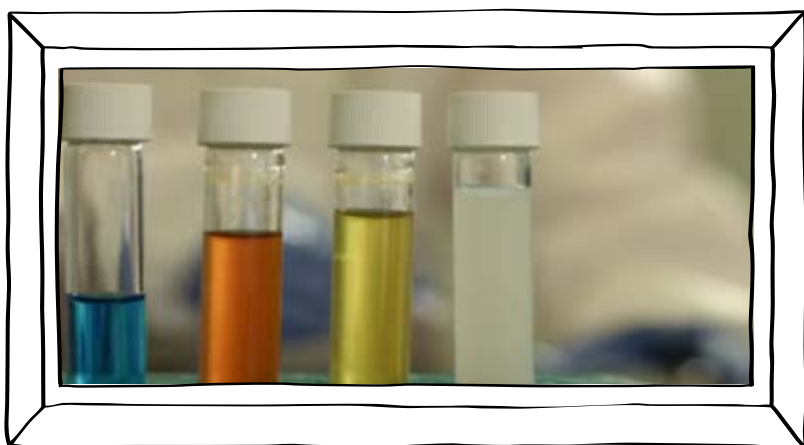
Call-centres are an effective and efficient way for businesses to provide customer service. Those who answer the phones are known as agents. They answer thousands of calls a day from customers from all over the UK and abroad. Agents need clear voices, pleasant manner, good listening skills, clear instructions and good team workers. North Wales has a number of large call centres.

WORKING IN ADVANCED MANUFACTURING



What? How? Why?

Advanced Manufacturing is creating important everyday items as part of a team. Designing, testing and building are just some of the areas of manufacturing. Aeroplanes, cars, hospital machines, even shampoo, would not exist without the skills of advanced manufacturing.



**Show this video to
pupils to set the scene**

www.actonstem.co.uk

Skills Needed:

- Ability to problem solve
- Understanding why & how things work.
- Ability to explain findings to a team with different skills.
- Strong reading, writing & communication skills.
- Understanding rules & guidelines.
- Understands computers – able to work creatively with technology for design roles.
- Attention to detail.
- Desire to be on the cutting edge of technological developments.
- Minimum of Maths GCSE with further qualifications required for advancement.
- Advanced Apprenticeships and Company Education Programmes for school leavers are strong work-based alternatives to a university degree.

“One in five people in advanced manufacturing are women and they earn very high salaries. Could one of these women be you?”

Chwarae Teg



ADVANCED MANUFACTURING JOB EXAMPLES

Manufacturing Engineer | Average Salary: £32,000 (Oct15)

Manufacturing engineers have a high level of technical expertise and skill, which they use to plan, design, set up, modify, optimise and monitor manufacturing processes.

Manufacturing engineers are designers, as well as analytical and creative thinkers. They can operate on their own initiative but also contribute as a team member working with engineers from various disciplines.

Up-to-date full information:

 www.careerswales.com/en/career-search/search?jobTitleId=10418

QA (Quality Assurance) Product Release Officer | Average Salary: £20,000 (Oct15)

QA Product Release Officers are responsible for ensuring products meet the established standards of quality including reliability, usability and performance.

The testing of products is an important part of the manufacturing process and requires a strong mixture of knowledge, judgement and decision-making.

Up-to-date full information:

 www.careerswales.com/en/career-search/search?jobTitleId=55799

Technical Operations Scientist | Average Salary: £35,000 (Oct15)

Working for the Technical Operations Department, Scientists are involved in improving and resolving issues with product performance.

Design, chemical analysis, leading experiments and team work are all key elements of the job role.

Up-to-date full information:

 www.careerswales.com/en/career-search/search?jobTitleId=10354

Check out other jobs in Advanced Manufacturing...

 www.careerswales.com/en/tools-and-resources/job-trends/advanced-materials-manufacturing/



CLASSROOM ACTIVITY PAPER DESIGN

TEACHER'S
GUIDE

In groups- pupils must construct a small table using rolls of newspaper to hold the weight of a single book. The activity could begin with a design phase and a discussion of other paper-based materials to include in construction. The finished table should not only be practical in being weight bearing but colourful too!

KEY SKILLS (NATIONAL CURRICULUM)

**PROBLEM
SOLVING**

**WORKING
WITH OTHERS**

**DESIGN &
MAKING**

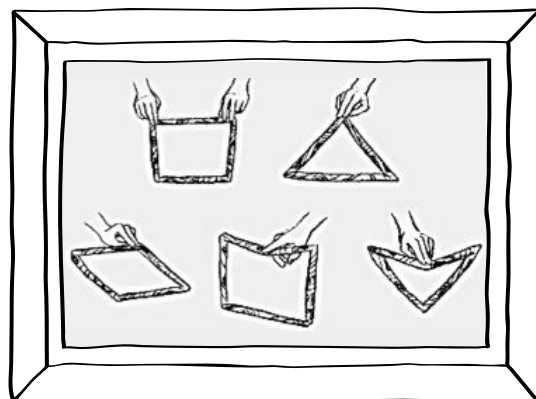
**PRESSURES
& FORCES**

PREPARATIONS & MATERIALS:

- Collection of Newspapers
- Medium weight book (textbook or storybook)
- Sello-tape or masking tape
- Paint

METHOD

1. Begin by explaining to the pupils the object of the task – constructing a table capable of holding a book that is shown to the classroom.
2. A design phase is recommended so that the pupils in their groups can decide upon the look of the table and familiarise themselves with the materials.
3. The design phase should consider limiting the amount of paper and tape used. There isn't a limitless supply of paper and tape and efficient use of resources is an important design aspect.
4. During the making process it is important to demonstrate to each group the potential properties of paper, emphasising how bundles of rolls are stronger than single ones and the forces and pressure relative to shape (see below). Groups could test a smaller scale model to start with.



5. Once each group is satisfied with their table, it is then time to go around the class and test whether the table can support the weight of the book.
6. The majority of the tables won't work on the first try, so it is now a process of classroom discussion to see how the table could be improved e.g. more tape for unrolling tubes, adding trusses to create added support (see below).



7. Once the table is able to fully support the book, it's time to add colour to the creation.
8. **Remember: Be Creative! A table doesn't need four legs to be considered a table.**

LEARNING OUTCOMES

- Design & manufacturing task that requires problem solving, experimentation and quality testing – skills required in the advanced manufacturing sector.
- Understanding and integration of creativity combined with STEM.
- Ability to bring together pupils of varying age and ability across KS2 – ideal for smaller classroom numbers.
- Provides pupils with an insight into the journey of product development and the greater possibilities of advanced manufacturing.

FURTHER INVESTIGATION & RESOURCES

 nwef.infobasecymru.net/IAS/launch

Paper table demo:

 www.youtube.com/watch?v=zOTuaqcxa0I

Advanced Manufacturing – the paper battery:

 whatis.techtarget.com/definition/paper-battery

Siemens:

 www.siemens.co.uk

How It's Made:

 science.howstuffworks.com

Produced in association with thanks to: **SIEMENS**



CLASSROOM ACTIVITY OPTICAL ILLUSIONS

TEACHER'S
GUIDE

WHAT ARE OPTICS?

You rely on optics every day. Your digital camera, wireless mouse, and even your Blu-ray disc of your favourite film are all technologies enabled by the science of optics.

Optics is the science of light and includes the study of sight and what we see through our eyes. Optics is used by the medical profession, scientists and engineers.

WHAT IS AN OPTICAL ILLUSION?

It's not magic, it's science!

Optical illusions can use colour, light and patterns to create images that can be deceptive or misleading to our brains. The information gathered by the eye is processed by the brain, creating a perception that in reality, does not match the true image. Perception refers to the interpretation of what we take in through our eyes. Optical illusions occur because our brain is trying to interpret what we see and make sense of the world around us. Optical illusions simply trick our brains into seeing things which may or may not be real.

Pupils should work in pairs or 3's to look at these optical illusions and discuss what they see and see how the brain can trick them into seeing different things. There is no right and wrong answer!

Try out some of these illusions and discover just how tricky it can be for your brain to accurately interpret the images from your eyes.

1. WHICH END OF THIS BAR LOOKS DARKER?

Cover everything except for the bar with a piece of paper above and below the bar shape.



The bar is all the same shade of green. But when it is next to the lighter green, it looks darker, and when it is next to a darker green, it looks lighter.

Your brain judges the colour of the bar depending on what is next to it.

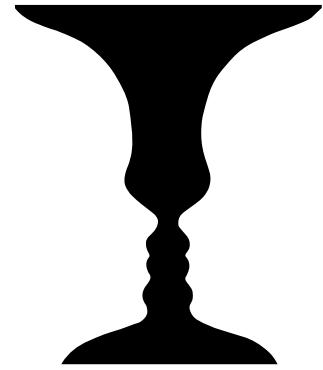


2. WHAT CAN YOU SEE?

A vase... or two faces?

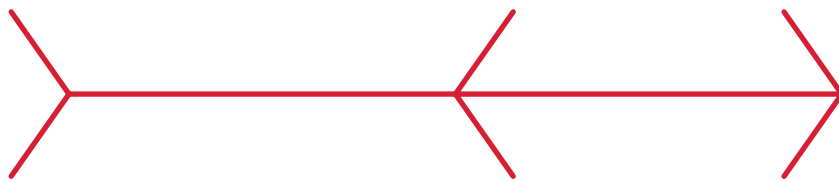
Both answers are correct! You can see both at the same time, but your eyes can only focus on one at once.

When you see the two white faces, facing each other, you can't properly see the vase; when you see the vase, the faces just become a white background.



3. WHICH IS LONGER?

Look at these two sections of line. There are 6 stems and one line running through the middle. There are two sections, left and right. Which line seems longer, on the left or right? Now, measure each section with a ruler. Which line is longer?



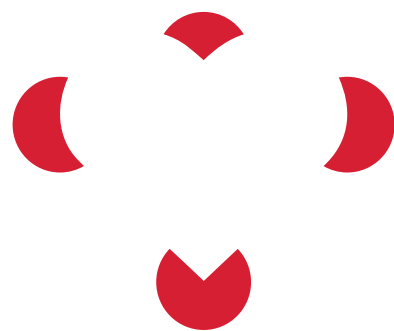
Both sections are exactly the same length, but the section with the lines sloping outwards on the far left hand side looks longer. The lines sloping inwards makes the line look shorter. Your brain judges things by what is around them and is tricked by the extra lines sloping in different directions.

4. MISSING SHAPES

Look at this picture. Can you see a triangle?



Look at this picture. Can you see a heart?



There are no triangle or heart shapes in these pictures!
Your brain sees the edges of where the shapes could go and imagines the rest!

Take a look at some more optical illusions on line faculty.washington.edu

- Are you interested and curious about why and how the brain and eyes work this way?
- Would you like to find out more about optics? Optics is used in science, for solving crimes, building things and engineering, health and medicine, film and media.



WORKING IN CONSTRUCTION (OR BUILDING)



What? How? Why?

Construction, or building work has one of the widest varieties of job roles of any other industry. Not only are there skilled teams needed on building sites - such as plasterers, electricians and machine drivers - but there are large numbers of management roles behind the scenes responsible for project management, buying, planning, designing and making sure everything goes smoothly.



Show this video to pupils to set the scene

www.actonstem.co.uk

Skills Needed:

- Ability to solve problems.
- Able to work well in a team – team work.
- Strong reading, writing and communication skills.
- Understanding of numbers – costs & measurements.
- Attention to detail.
- Understanding of health & safety.
- Strong listening and communication skills.
- Basic level of geometry and computers are useful.
- Variety of training courses available related to different construction jobs.
- Work Experience/Apprenticeship Experience.

“Only one in ten people in the construction industry are women. It’s not all about building sites; we need people to design and check new buildings too. Could this be you?”

Chwarae Teg



CONSTRUCTION JOB EXAMPLES

Construction Manager | Average Salary: £55,000 (Oct15)

Construction Managers are responsible for planning, organising and planning construction projects, usually looking after a variety of projects at one time.

Managing a construction project is very important work as everyone in the team needs to know what they need to do and in what order. Looking after people and making sure they know what they are doing.

Up-to-date full information:

 www.careerswales.com/en/career-search/search?jobTitleId=10345

Architectural Technician | Average Salary: £25,000 (Oct15)

Architectural Technicians give support to building designers, making sure the designs & plans are usable and safe.

The link between the architect's idea and the finished construction is the Architectural Technician.

Up-to-date full information:

 www.careerswales.com/en/career-search/search?jobTitleId=10171

Procurement Officer | Average Salary: £30,000 (Oct15)

Procurement Officers (Buyer) are responsible for buying the materials needed for construction projects. Making sure the building materials are provided on schedule and according to budgets.

Careful calculations and planning are needed to make it all effective.

Up-to-date full information:

 www.careerswales.com/en/career-search/search?jobTitleId=55249



Check out other jobs in Construction....

 Spotlight on Construction: www.careerswales.com/en/spotlight-on-construction/

 Construction Growing: www.goconstruct.org/en/finding-a-role-for-you/construction-growing/

 Information for Employees: www.goconstruct.org/en/information-for-employers/resources/

Produced in association with thanks to:



CLASSROOM ACTIVITY CRANK & CONTAINER

TEACHER'S
GUIDE

In groups- pupils must construct a crank & container to lift marbles from the ground to the edge of the table. The groups will be split into two teams, one to construct the crank and the other to construct the container. The two teams will then come together to join both there constructs together to form a crank & container unit!

KEY SKILLS (NATIONAL CURRICULUM)

**PROBLEM
SOLVING**

**WORKING
WITH OTHERS**

**LEVERS,
PULLEYS &
GEARS**

**DESIGN
& MAKING**

PREPARATIONS & MATERIALS:

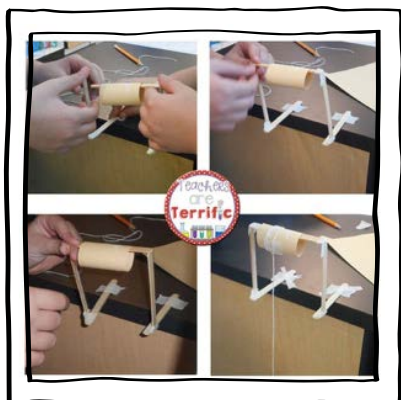
- Ice Lolly sticks
- Newspapers
- Scissors
- Sello-tape or masking tape
- Marbles
- Exercise paper
- Kitchen or wrapping paper cardboard tubes
- String
- Whiteboard/Smartboard

METHOD

1. Begin by explaining to the pupils the object of the task – constructing a crank & container system capable of lifting a small number of marbles from the ground to the edge of the desk/table. The task might benefit from a bit of role-play by pretending that the pupils are making a “crane” to lift “building blocks” onto the “construction site”.
2. Using a cardboard tube and string – demonstrate to the pupils the mechanics of a pulley/lever- how the string can wrap around and shorten when the tube is turned gradually. The same material, the cardboard tube, can also be used to form the cradle of the container when cut in half.
3. Place the pupils in groups- then ask them to decide and form two separate teams. One team to construct the crank unit and the other to construct the container unit.
4. Each group should have the following at their work stations: 2 cardboard tubes (one per team), 2 pairs of scissors (one per team), sello-tape/masking tape, newspaper + marbles (container team) and 6 ice lolly sticks + a large length of string (crank team).
5. Set the two teams to work. The length of time required is down to the teacher’s own discretion. If the Crank Team struggle in forming a design there is an image (below) for guidance. Both teams must work separately.



6. Once both teams have been given their necessary time and are happy with their end product - they must join together!
7. The reassembled groups must then work together to attach both units to create a fully functioning Crank & Container.
8. Presentation & discussion can then take place to better understand the development process.



LEARNING OUTCOMES

- Design & manufacturing task that requires problem solving, experimentation and quality testing – skills required in the construction sector.
- Ability to bring together pupils of varying ages across KS2 – ideal for small & large classroom numbers.
- Provides pupils with an insight into the challenges of civil engineering.

FURTHER INVESTIGATION & RESOURCES

 nwef.infobasecymru.net/IAS/launch

Inspired by

 www.teacherspayteachers.com/Product/STEM-Engineering-Challenge-Same-Supplies-Two-Tasks-Rescue-Devices-1778193

Pulleys (video)

 www.youtube.com/watch?v=9T7tGosXM58

Watkin Jones:

 www.watkinjones.com

Produced in association with thanks to:



CLASSROOM ACTIVITY BUILDING SHAPES

TEACHER'S
GUIDE

Using a number of straws and marshmallows pupils need to build various shapes or constructions.

There are two practice sessions, one of the teacher demonstrating how to build a 3D pyramid and the other practice session building a 3D cube.

KEY SKILLS (NATIONAL CURRICULUM)

**PROBLEM
SOLVING**

**WORKING
WITH OTHERS**

**DESIGN
& MAKING**

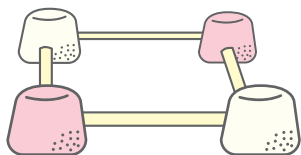
PREPARATIONS & MATERIALS:

- Packets of marshmallows / or blue tack / soft clay
- Exercise paper for drawing designs
- Drinking straws / or long spaghetti
- Pens

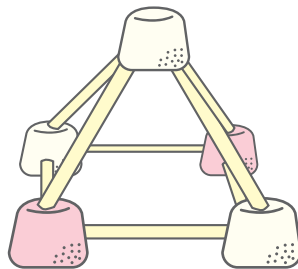
METHOD

1. Begin by explaining to the pupils the object of the task – building different shapes, starting with a simple pyramid, a cube, then a 3 storey tower!
2. Using 5 marshmallows and 8 drinking straws, the teacher can demonstrate to the pupils how to make a 3D shape of a pyramid
3. Each pupil can then practice making the 3D pyramid

Build a square using short straws and 4 marshmallows.



Add four longer straws and one marshmallow to make a pyramid.



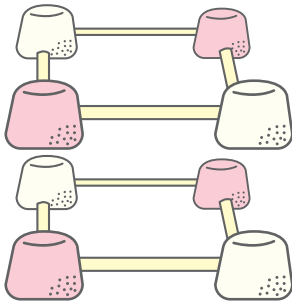
Test the strength of the pyramid by pushing on its tip. Can you lean a book against the pyramid?

A pyramid is strong because it is good at spreading out weight. If you push the tip, or lean a book against the side, the weight will spread through the straws and be supported.

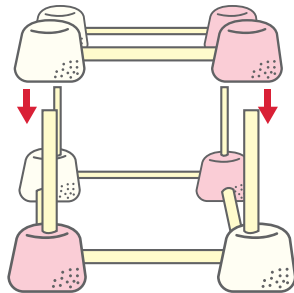
4. Place the pupils in groups of 3-4, ask them to draw a plan of how they can build a cube. Then giving each team 8 marshmallows and 12 straws, ask them to build a 3D model of a cube.



Use short drinking straws and marshmallows to build 2 squares.

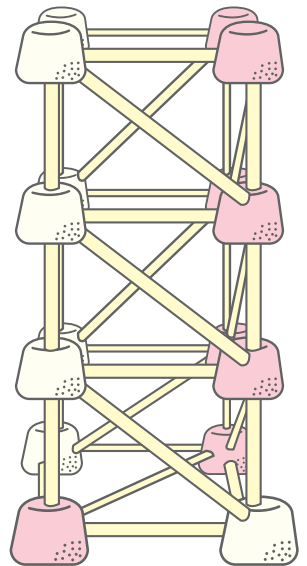
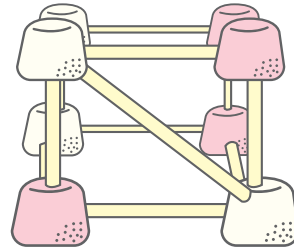


Use four more short straws to join the squares, making a cube.



Trim six longer straws and add one straw to each square to make a diagonal.

Adding diagonals makes the cube less wobbly!



Make more squares. Join them onto the cube to make a tower, adding diagonals as you go. Place a cardboard platform on top and see if the tower can support a toy.

The tower is strong because it is supported by the sides around it, and the diagonals stop the sides from twisting out of shape. The tower can support a toy because the toy's weight spreads through all the straws and is supported equally by each one.

5. Each group will have time to draw their design and work out how many straws and marshmallows they need.

6. The actual building phase could be a timed or untimed activity, depending if an element of competition is to be added in. A building contractor must work on time, be reliable and reach deadlines!

7. Pupils can give a short presentation and a discussion can take place to understand the successful plans and actual finished constructions. What went well? What went wrong? Why do some fall down? What makes a strong construction?

LEARNING OUTCOMES

- Design & manufacturing task that requires problem solving, experimentation and quality testing – skills required in the construction sector.
- Ability to bring together pupils of varying ages across KS2 – ideal for small & large classroom numbers.
- Provides pupils with an insight into the challenges of civil engineering.

FURTHER INVESTIGATION & RESOURCES

www.goconstruct.org/construction-jobs/ • www.careerswales.com/en/spotlight-on-construction/

www.youtube.com/channel/UCDceRPtnH1X47XshdmN50Fw

www.northwaleseab.co.uk/jobs-and-skills/

Produced in association with thanks to:



CLASSROOM ACTIVITY DR. LEGOFF'S LEGO®

TEACHER'S
GUIDE

Activity courtesy of LEGO® and Dr. D. LeGoff© 2004



TEAM WORK!

DR. LEGOFF'S LEGO® CHALLENGE IS ALL ABOUT TEAM WORK.

Pupils should enter groups of 3 or 6 and select a role each or in pairs:



1 X ENGINEER



1 X BUILDER



1 X PART SUPPLIER

Using a big box of LEGO® (supplied by the school) each team will have to construct a building using the 3 roles above.

THE CHALLENGE

The **Engineer** must act first and design a building. The engineers should provide a drawing.

The design is then passed on to the **Part Supplier** who must find the Lego pieces that will match with the idea of the design engineer.

These pieces are then passed on to the **Builder** to begin construction.

The **Engineer** will then show the design to the **Builder** and discuss this so they can understand which pieces will go where and in what order.

Once the basic foundation has been built - the **Engineer** will oversee the construction and provide advice to the **Builder**.

The **Builder** will communicate with the **Part Supplier** on what pieces are needed.

Teamwork + communication = SUCCESS

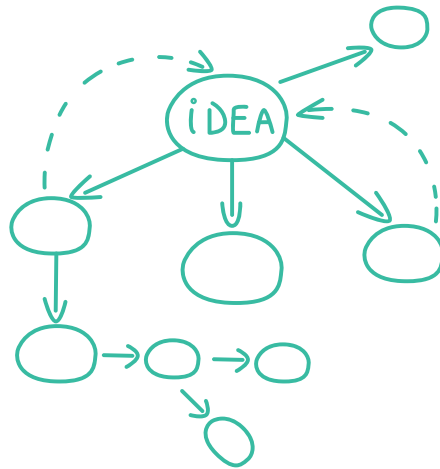


Produced in association with thanks to:



CLASSROOM ACTIVITY PROBLEM SOLVING

TEACHER'S GUIDE



One of the valued skills in the construction industry is the ability to solve problems, or even better, put plans into place to avoid them happening in the first place!

Good team work and communication are two key skills in the construction industry that can help to solve and avoid problems.

This task is an opportunity for pupils to look at pictures of construction mistakes and try to solve them.

Imagine you are a construction site inspector coming to 'sign-off' important work after a job has finished and you see these mistakes, what would you do?

FOR THIS TASK PUPILS SHOULD:

- Spot the mistake in each picture
- Explain why it's a mistake
- Explain what will happen if someone tried to use it
- Provide solutions or ways of correcting it.
(The solution could be that some major work needs to be carried out or a total replacement of the product.)

This task is ideal to work in groups of 4-5 pupils to generate discussion and ideas.

The learning outcome of the task is to demonstrate how vital communication and team work is in the construction industry, and other jobs too!

MORE PROBLEM SOLVING RESOURCES FOR KS2 TEACHERS:



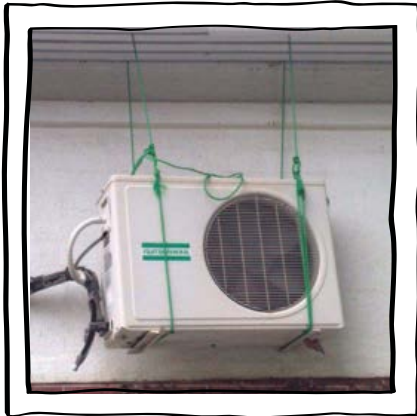
www.topmarks.co.uk



www.nationalstemcentre.org.uk



CAN YOU SPOT WHAT'S WRONG IN EACH OF THESE PICTURES?



Produced in association with thanks to:



WORKING IN DIGITAL & CREATIVE MEDIA



What? How? Why?

Digital & Creative Media is a wide term that covers computer technology, the internet, television, film and theatre. Specialist Engineers & Technicians help repair and update electrical and computer systems. Fixing computers is one part of this work and is a form of recycling as it reduces unnecessary waste.



**Show this video to
pupils to set the scene**

www.actonstem.co.uk

Skills Needed:

- Ability to solve problems
- Understanding why & how things work.
- Strong reading, writing, IT and communication skills.
- Creative thinking and flair
- Understands computers
- Attention to detail
- Desire to be on the cutting edge of technological developments.
- Work Experience
- Advanced Apprenticeships and Company Education Programmes for school leavers are strong work-based alternatives to a university degree.

Digital & Creative media offers amazing career opportunities for girls and boys. It really is the future and can be highly rewarding!

Chwarae Teg



DIGITAL & CREATIVE MEDIA JOB EXAMPLES

Electrical Engineer | Average Salary: £30,000 (Oct15)

There are many different types of Electrical Engineers, they do a mixture of jobs- design, fix, test and research.

Electrical Engineers can work on a variety of projects- telephones and televisions to spaceships and satellites. Fixing and repair are one of the most important jobs an Electrical Engineer is involved in as they make sure all the technology is working as it should without any problems.

Up-to-date full information:

 www.careerswales.com/en/career-search/search?jobTitleId=10082

Stage Manager | Average Salary: £25,000 (Oct15)

They are responsible for managing the successful delivery of a show. They have to manage rehearsals, actors, costumes, props, and work with the director and theatre staff. They have to understand all of the technical parts of the show too, like lights, sound and the set. They have to make sure that a show is run properly and correctly, and deal with any emergencies or problems along the way. To do this you have to be really good at talking to people, and be able to tell them what they need to be doing. You need to be a good problem solver, and able to think on your feet.

Up-to-date full information:

 www.careerswales.com/en/career-search/search?jobTitleId=10598

Developer | Average Salary: £35,000 (Oct15)

Developers help improve things such as computer systems and other technology by suggesting and making changes.

These improvements help with everyday items to make things easier at home, work or school.

Up-to-date full information:

 www.careerswales.com/en/career-search/search?jobTitleId=55056



Check out other jobs in Digital & Creative Media

 www.careerswales.com/en/tools-and-resources/job-trends/it-telecommunications/

 www.careerswales.com/en/spotlight-on-creative-industries

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CLASSROOM ACTIVITY MONEY & MATERIALS

TEACHER'S
GUIDE

Pupils must figure out the individual cost of a collection of important materials. The total value of the materials is already provided along with a list of costings– it's a matter of problem solving and organising of information to work out what the price is for each item.

KEY SKILLS (NATIONAL CURRICULUM)

**PROBLEM
SOLVING**

**MANAGE
MONEY**

CALCULATIONS

**DATA
HANDLING**

PREPARATIONS & MATERIALS:

- Whiteboard/Smartboard
- Exercise paper
- (Optional) props
- Attention of the Classroom

METHOD

1. Ask the pupils to imagine the materials needed for a particular industry e.g. the digital industry.
2. Proceed to draw/write (images/names) of 5 of these possible items (see below):



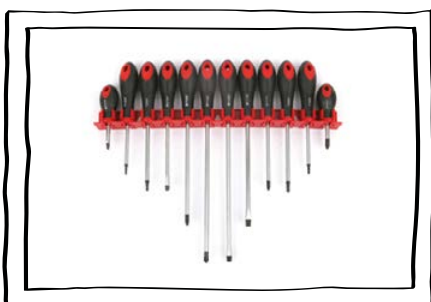
SAFETY GLASSES



SOLDERING IRON



SAFETY GLOVES



SCREWDRIVERS



WORK LAMP



3. The total value of the items shown = £68

4. Using the list of costings below- pupils must figure out the individual cost of each item.

5. You may wish to give the cost of one item as a starter, if you think the pupils need this to work out all the other costs. Safety Glasses = £2

Safety Glasses + Soldering Iron = £10

Soldering Iron + Safety Gloves = £14

Safety Gloves + Screwdrivers = £26

Screwdriver + Work Lamp = £52

6. The method of solving the problem is as important as the final answers. Once the pupils have determined the answer for 2 of the items they will be able to complete the mathematical puzzle.

Solution: Glasses = £2, Soldering Iron = £8, Gloves = £6, Screwdrivers = £20, Lamp = £52

LEARNING OUTCOMES

- Provides pupils with an insight into the concept of managing money in the working world.
- Maths puzzle concerning relationships of numbers, mental strategy, expressions and calculations.
- Role-play designed to simulate the critical thinking and responsibilities required within the digital sector at an accessible level to Key Stage 2.

FURTHER INVESTIGATION & RESOURCES

- This exercise could be altered or simplified for varying skill levels.

 nwef.infobasecymru.net/IAS/launch

Money Management KS2 DfE

 webarchive.nationalarchives.gov.uk/20130401151715/

 www.education.gov.uk/publications/eOrderingDownload/MM-BPrimary-Toolkit-KS2.pdf

• Comtek

 www.comtek.co.uk

Produced in association with thanks to: 



CLASSROOM ACTIVITY CREATIVE STEM

TEACHER'S
GUIDE

This activity is a short complementary task with other subjects to practice skills in reading, writing and communication. The task also raises the awareness of the Digital and Creative Media employment sector in Wales and North Wales.

The Creative industries are some of the fastest growing sectors in Wales. They cover a wide range of jobs in different sectors, from technical roles in digital media, TV, theatre or film to the performing arts and more traditional crafts.

You could find yourself working on a TV or film set, developing apps, curating in a museum, designing the latest fashions, performing on stage, or maybe creating your own works of art.

The Creative industries are fast moving, innovative and exciting, so be prepared for a lot of competition to get in.



KEY SKILLS (NATIONAL CURRICULUM)

**PROBLEM
SOLVING**

**WORKING
WITH OTHERS**

COMMUNICATION

PREPARATIONS & MATERIALS:

- Picture cards of stage productions - could project on powerpoint screen or colour copies
- Discussion questions
- Answer sheets

METHOD

1. Introduce the sector – Digital and creative industries
2. Use the careers Wales.com infographic. <http://www.careerswales.com/en/spotlight-on-creative-industries/>
Also, look at the brief explanation in the introduction section on this resource.
3. The 'digital and creative industries' are a 'growth' employment area in North Wales. One of the places to work in are theatres – do you know where the main theatres are in North Wales?



Galeri, Caernarfon

Pontio, Bangor

Colwyn Bay

Rhyl Pavillion

Ucheldre Centre, Holyhead

Neuadd Dwyfor, Pwllheli

Venue Cymru, Llandudno

Theatr Stiwt, Wrexham

Theatr Harlech

Theatr Twm o'r Nant

Royal International Pavilion, Llangollen

Theatr Fach, Dolgellau

**Numerous education,
community and voluntary
theatre groups**

4. A Theatre is a bit like a cinema, only the actors are 'real' and on stage performing a live show, like a pantomime or drama. It's similar to a school Christmas show or performance, only on a much bigger stage and with lots of people involved.

One of the people involved would be a 'Stage Manager'

5. Stage Managers are responsible for managing the successful delivery of a show.

They have to manage rehearsals, actors, costumes, props, and work with the director and theatre staff.

They have to understand all of the technical parts of the show too, like lights, sound and the set.

They have to make sure that a show is run properly and correctly, and deal with any emergencies or problems along the way.

To do this you have to be really good at talking to people, and be able to tell them what they need to be doing. You need to be a good problem solver, and able to think on your feet.

6. Look at the theatre stage show photographs and discuss:

- How many things do you think need to be made or built?
- What technology might be used for the scene?
- What is a prop, and what is the set?
- What jobs are there in the theatre for a show like this to take place ?
- How many theatres are there in your area?





LEARNING OUTCOMES

- Practice to improve reading and writing
- Communicating with each other
- Finding things out and research
- Group discussions, taking turns
- Listening to others

FURTHER INVESTIGATION & RESOURCES

- **Careers Wales.com – Working in Creative Industries factsheet:**

 www.careerswales.com/en/spotlight-on-creative-industries/

- **Enter the creative industries:**

 creativeskillset.org/creative_industries

- **Creative and Cultural Skills:**

 ccskills.org.uk

Produced in association with thanks to: **THEATR CLWYD**



CLASSROOM ACTIVITY

CREATE YOUR OWN GADGET

TEACHER'S
GUIDE

Where would we be without Facebook? Mobile phones? Tablets? Laptop?

The IT and Telecommunications industry is responsible for all of these developments. It's probably the industry which faces the fastest pace of change. It involves the use of computers and communication networks to collect, store, process and give out information. Each year hundreds of new products are introduced and existing ones are improved.

Can you believe that mobile phones were the size of bricks when they first become available during the 1980s!



Technology and gadgets have changed a lot since the very beginning – here are some of the items we see around us today:



TASK for pupils:

Do you want to change technology, improve a gadget or invent a new one?
What would you do?



Draw your ideas and use your imagination!

Important things to remember when inventing something new:

- How does your gadget improve on the original, if there is one?
- What makes your gadget special and different?
- Who will use your gadget?
- Is your gadget for work, just for fun or maybe both?
- How much will it cost?
- Where will you sell it?

Produced in association with thanks to:



CLASSROOM ACTIVITY

MISSION: SODA-STRAW ROCKET

TEACHER'S
GUIDE

Activity courtesy of NASA and National STEM Centre UK © 2009



NOTE FOR TEACHERS: Need plenty of preparation time! Watch the YouTube demo video first.

PREPARATIONS & MATERIALS:

- Activity Time: 20 Minutes
- Materials Needed:
- Drinking Straw Templates
- Sharpened Pencil
- Scissors
- Tape
- Drinking Straw

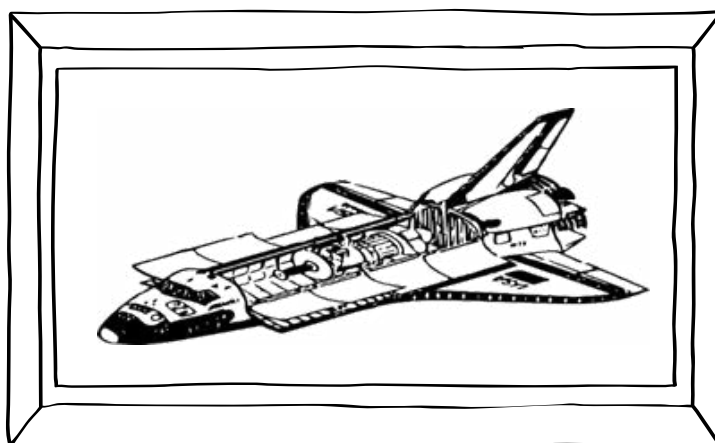


**Show this video to
pupils to set the scene**

www.actonstem.co.uk

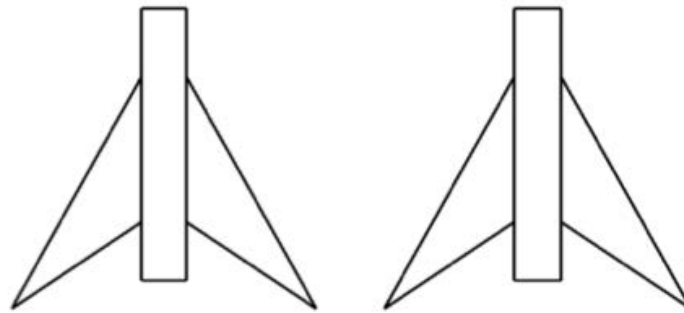
TEACHERS - Please watch the demo video first!

1. Carefully cut out the rectangle (see reverse). This will be the body tube of the rocket. Wrap the rectangle around a pencil length-wise and tape the rectangle so that it forms a tube.
2. Carefully cut out the two fin units (see reverse). Align the rectangle that extends between the two fins with the end of your body tube and tape it to the body tube. Nothing should stick out past the body tube! Do the same thing for the other fin unit, but tape it on the other side of the pencil, so you have a "fin sandwich."
3. Bend the one fin on each fin unit 90 degrees so that each fin is at a right angle to its neighbour. When you look along the back of the rocket, the fins should form a "+" mark.
4. Using the sharpened end of your pencil, twist the top of the body tube into a nose cone. Measure your nose cone from its base to its tip and record the length on your Data Log and on the rocket itself (For the Data Log (see example-reverse), create a chart on a piece of paper with columns labelled "Rocket Length" and "Distance Travelled." For every attempt, fill in the log).
5. Remove the pencil and replace it with a drinking straw. Blow into the straw to launch your rocket! Record the distance it travels on your Data Log.





Rectangle Template



Soda-Straw Rockets fin units

Soda-Straw Rocket Data Log

Distance Traveled (in cm)

Length of Nose Cone	Trial #1	Trial #2	Trial #3	Trial #4	Trial #5	Notes
Control						

Data Log example

FURTHER INVESTIGATION & RESOURCES



www.nationalstemcentre.org.uk



Watch a demo video at www.actonstem.co.uk

Produced in association with thanks to:



WORKING IN THE ENERGY SECTOR



What? How? Why?

Energy Suppliers provide an important service; they help bring electrical/gas power to homes, schools, offices, hospitals and other places across the country. Large generators using heat and turbines help create electricity which then travels everywhere through power lines. This large system needs to be looked after by a team of skilled people to make sure that everything works.



Show this video to pupils to set the scene

www.actonstem.co.uk

Skills Needed:

- Ability to solve problems.
- Understanding why & how things work.
- Strong reading, writing and communication skills.
- Understanding rules & guidelines.
- Strong listening skills.
- Able to work well in a team – team work.
- Attention to detail.
- Understanding of health & safety.
- Minimum of A* - C grade GCSE.
- Advanced Apprenticeships and Company Education Programmes for school leavers are a strong work-based alternative to a university degree.

Earning a high salary and helping the planet. One in five people in this industry are women, and they do everything from recycling to eliminating pollution

Chwarae Teg



ENERGY SECTOR JOB EXAMPLES

Jointer | Average Salary: £20,000 (Oct15)

Cable jointers work primarily on the electrical underground cable network, installing and maintaining connections over a range of voltages to ensure that the electricity supply meets customer needs and the network maintains high standards. The role involves connecting cables to the system as well as finding faults and repairing problems which may have developed through age or damage. Some cable jointers will also assist with jointing across gas and water networks.

Up-to-date full information:

 www.scottishpower.com/pages/jointers.asp

Fitter | Average Salary: £25,000 (Oct15)

Fitters repair important equipment that help produce all the energy that gets sent out across the country. Fitters must follow important instructions and diagrams to get the job done and are skilled in different areas such as electronics and hydraulics.

Up-to-date full information:

 www.careerswales.com/en/career-search/search?jobTitleId=50084

Business Developer | Average Salary: £35,000 (Oct15)

Business Developers talk with managers and other important staff to see how they can improve the company's image and make how things get done easier.

Creativity is usually an important skill along with an understanding of numbers and costs. There are lots of different types of Business Developers.

Up-to-date full information:

 www.careerswales.com/en/career-search/search?jobTitleId=5000115



Energy Sector Resources....

 www.careerswales.com/en/tools-and-resources/job-trends/the-energy-sector/

 nwef.infobasecymru.net/IAS/launch

 www.spenergynetworks.co.uk/news/pages/primary_pupils_energised_by_sp_energy_networks_visit.asp

Produced in association with thanks to:



CLASSROOM ACTIVITY USING ELECTRICITY

TEACHER'S
GUIDE

In groups- pupils must determine the electricity usage in the classroom using a basic floorplan they have drawn up together. The areas that consume electricity would be coloured in orange, whilst those that they believe consume the most electricity would be coloured in red. Once complete the second stage is asking the pupils to write down the ways that they could reduce energy consumption, thereby reduce the school's carbon footprint and helping the environment in the process.

KEY SKILLS (NATIONAL CURRICULUM)

**PROBLEM
SOLVING**

**WORKING
WITH OTHERS**

**ENERGY -
ELECTRICITY**

**SCIENTIFIC
ENQUIRY**

PREPARATIONS & MATERIALS:

- Whiteboard/Smartboard
- Coloured pencils & rulers
- Exercise paper
- Attention of the Classroom

METHOD

1. Begin by asking the pupils what they understand about electricity, energy and the environment using the information covered previously in the classroom.
2. Ask the pupils to neatly draw a rectangle on a blank piece of paper to represent the classroom and then ask them to create a "bird's eye view" of everything that's in it - desks, radiators, computers etc.
3. Using coloured pencils, ask the pupils in their selected groups to colour in the objects they believe use up electricity in orange & what uses the most amount in red.



4. Having examined the work and chatted with each individual group – ask the pupils to discuss and write down in their groups, the variety of ways they could reduce the energy consumption of the classroom e.g. motion-sensor lights, energy-saving lightbulbs etc.
5. Complete the exercises by having a classroom discussion of the findings and their feasibility relative to the school.

LEARNING OUTCOMES

- Generates awareness of environmental issues such as: carbon footprint, energy consumption and becoming “green” in the classroom
- Provides pupils with an opportunity for investigation & enquiry
- Simulates the concept of an Action Plan by getting the pupils to think of ways to reduce the school's carbon footprint.
- Provides pupils with an opportunity to connect with their locality and the role & responsibility they play as individuals within their community and within the overall global context.



FURTHER INVESTIGATION & RESOURCES

- This exercise could be extended to include a poster activity about saving energy in the classroom.

- Benefits of working in the local energy sector:

 nwef.infobasecymru.net/IAS/launch

- Flash game “Mission: Reduce Energy”

 BBC Eco Friendly - www.bbc.co.uk/scotland/education/sym/eco/eco_friendly.shtml?page=index

- SP Energy Networks:

 www.spenergynetworks.co.uk

Produced in association with thanks to:



The magic of making electricity

Introduction

This sequence of lessons explores how electricity was first generated in a way that could do useful work. This first part uses the idea of 'hand crank' technology to introduce the idea of using movement to produce electricity. The next section looks at how this can be scaled up using a flow of water and the final part looks at the possibilities that large scale electricity generation made possible.

The materials therefore present pupils with opportunities to apply their understanding of circuits and consider how technological changes impact on people.

Overall learning objectives

- To understand how creative thinking and scientific ideas can be harnessed to solve problems and improve quality of life
- To understand how natural resources can be used to provide useful services
- To apply ideas about generating and using electricity to powering circuits

Overall learning outcomes

- To explain how electricity can be produced and used
- To suggest advantages it offered
- To apply ideas about circuits to solve problems and develop solutions

Curriculum learning objectives:

Let there be light will support the following national curriculum learning objectives at KS2.

Science:

Pupils should be taught to:

- associates the brightness of a lamp or the volume of a buzzer with the number and voltage of cells used in the circuit
- compare and give reasons for variations in how components function, including the brightness of bulbs, the loudness of buzzers and the on/off position of switches
- use recognized symbols then representing a simple circuit in a diagram.

Technology:

- understand how key events and individuals in design and technology have helped shape the world

Geography:

- describe and understand key aspects of human geography, including: types of settlement and land use, economic activity including trade links, and the distribution of natural resources including energy, food, minerals and water

Links to Curriculum for Excellence and Northern Ireland Curriculum are also available at:
www.siemens.co.uk/education/curriculum

Episode 1

The magic of making energy

Resources required:

- Hand crank torch (real or image)

Learning objectives

- To understand how electricity can be made and used
- To apply ideas about generation to a range of contexts
- To identify advantages and disadvantages of a particular technology

Learning activities

1. Start off by asking pupils if they think it is possible to make electricity and encourage ideas.

Display these on the board. They might include:

- Lightning
- Generating a static charge, such as rubbing your feet on a nylon carpet
- Using a battery
- Setting up a petrol generator
- Building a power station

Then ask which of these might be useful if you were stranded a long way from anywhere and needed electricity to produce light. Show pupils an image of (or preferably a real) hand crank torch and explain how it works.

Ask what is being turned into what and draw out that movement is being turned into light.

2. Say that this is only practical for devices that use a relatively small amount of electricity (i.e. devices that might otherwise be battery powered). Ask for suggestions as to what else could have a 'hand crank version'. Ask pupils to come up with ideas and sketch them.

Display the sketches around the room and ask pupils to go round and look at them. They should then identify advantages and disadvantages of 'hand crank technology' and summarise these in a table. Use activity sheet 1



Outcomes

- To describe what 'hand crank technology' can do
- To suggest various applications
- To identify advantages and disadvantages

Episode 2

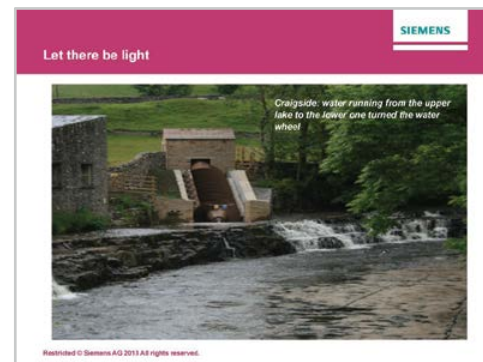
Electricity from falling water

Resources required:

- plastic cotton reel
- an axle (knitting needles are good but plastic rod is safer)
- plastic card
- plasticine

Learning objectives

- To understand the advantages of water powered generators
- To investigate features of water turbine design
- To evaluate their designs



Learning activities

1. Show the hand crank torch again and ask pupils to recall the advantages and disadvantages of this technology. Two of the limitations are that it gets quite tiring to repeatedly squeeze and relax a handle and that it doesn't actually produce much electricity.

2. Show a picture of (or, preferably, demonstrate) a stream of water from a tap and ask for ideas about how the force of water falling could be used to produce electricity. Draw out that a water wheel is a good way of doing as it changes the direction into rotation.

Ask pupils to design, construct and test simple water wheels. This can be done in various ways but one of the easiest is using *activity sheet 2*

Each group will need a plastic cotton reel and an axle (knitting needles are good but plastic rod is safer). They will also need plastic card and plasticine. The idea is for the plastic card to be cut up to make the paddles and attached to the cotton reel using plasticine. Corrugated plastic (often known as corriflute) is good for this.

This activity can be made more challenging if pupils can decide how large to make the paddles, though thought needs to be given as to how cutting can be achieved safely. The activity is even better if each group has a set area of plastic and has to decide how to divide it. Water wheels should then be tested in the stream of water.



3. Show image of turbine linked to generator and explain that this can produce electricity.

Then ask for ideas about how a steady flow of water, large enough to turn a big water wheel and power a large generator, might be achieved. Show picture of Craggside, point out the raised lake and explain that this was the first place ever to be powered using falling water, turning a wheel and driving a generator.

Outcomes

- To explain the advantages of a water wheel to power a generator
- To have tested and evaluated a model water wheel
- To understand how this was applied practically

Episode 3

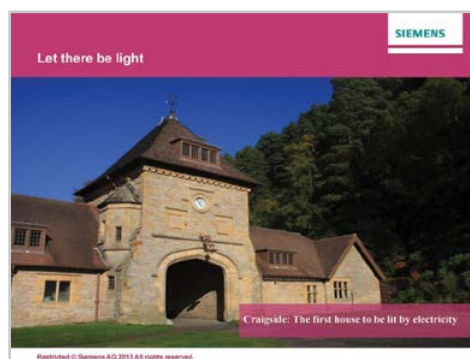
Not one house but a whole town

Resources required:

- ☐ Image of Cragside
- ☐ Cardboard box (or similar container style)
- ☐ Bulbs
- ☐ Battery
- ☐ Wire

Learning objectives

- To understand the advantages of electric lighting over gas lighting
- To understand about the use of parallel circuits
- To apply and test these ideas



Learning activities

1. Show a picture of Cragside and say that this was possible because the owner of the house was wealthy and also knew how to use scientific and technical ideas (Sir William Armstrong was a major shipbuilder on the River Tyne). The next step was to make electric lighting available to ordinary people.

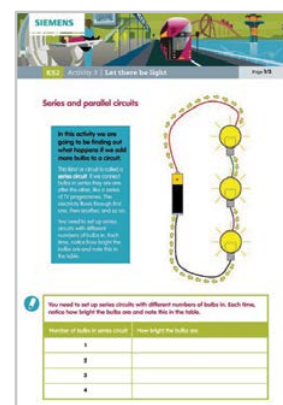
Say that in the 1870s street lighting consisted of gas lights. These had to be lit as it went dark, turned out at the end of the night and needed cleaning. Electricity didn't need any of these. In 1881 Godalming became the first town to have electric street lighting, using water wheels and a Siemens alternator.

However, when lots of bulbs are joined to one supply, something rather odd can happen. Either demonstrate or (preferably) ask pupils to investigate what happens if more and more bulbs are linked to one power supply. Ask pupils to put more bulbs in a series circuit and see what happens. As more are added, they all become dimmer.

Now introduce the idea of parallel circuits and show how bulbs connected in parallel are all 'fully bright', irrespective of how many are connected. Pupils can now work in table groups to set up circuits and see how a parallel arrangement enables several bulbs to be lit at once. This activity can be developed (equipment allowing) by asking pupils to bring in cardboard boxes (or other such container) and decorate them to represent houses. Each house can then be fitted with a light and several houses powered from one source.

Use activity sheet 3

Pupils should record the arrangement using circuit diagram conventions, including symbols.



Outcomes

- To explain the advantages of electric lighting
- To test and evaluate a parallel circuit compared to a series circuit
- To explain the practical application of this.

Introduction

This topic uses the context of rail travel to provide a range of learning activities. The first part starts with the historical setting and asks pupils to imagine what different types of travel were like. It then goes on to look at uses that electric motors are put to, presenting ideas about how technology affects people's lives. Finally it looks at the challenges of running a good service using limited resources; pupils use mathematical understanding and logical thinking to develop and evaluate solutions

Overall learning objectives

- To learn how scientific and technological developments have been used to improve the quality of life
- To identify the advantages and disadvantages of different technologies
- To understand how electrical systems can be used to reduce pollution in areas of high population density
- To understand how rail systems are designed and managed to provide a service whilst maximising the use of resources

Overall learning outcomes

- To explain how electric traction offered an attractive option in terms of travel
- To explain the use of electric motors in a range of contexts
- To evaluate alternative solutions to the provision of an effective service

Curriculum learning objectives:

Clean silent trains will support the following national curriculum learning objectives at KS2.

Maths:

- Teachers should develop pupils' numeracy and mathematical reasoning in all subjects so that they understand and appreciate the importance of mathematics.
- Pupils should be taught to apply arithmetic fluently to problems, understand and use measures, make estimates and sense check their work. They should be taught to apply their mathematics to both routine and non-routine problems, including breaking down more complex problems into a series of simpler steps.

Science:

- Pupils should be taught to identify common appliances that run on electricity

Technology:

- Pupils should be taught to understand how key events and individuals in design and technology have helped shape the world

Geography:

- Pupils should describe and understand key aspects of human geography, including the distribution of natural resources including energy, food, minerals and water

Links to Curriculum for Excellence and Northern Ireland Curriculum are also available at: www.siemens.co.uk/education/curriculum

Episode 1 The power of steam

Resources required:

- Picture of Volks Electric Railway
- Picture of Brighton Belle

Learning objectives

- To use evidence to understand how people travelled in the late 19th century
- To evaluate the advantages and disadvantages of technology used in transport systems

Learning activities

1. Show pupils a picture of a steam train headed for Brighton in the 1880s. Explain that:
 - At this time the railways were still fairly new and new lines were still being opened. There were no cars – the nearest anyone had to that was a horse drawn carriage. The only buses were horse drawn as well. Powered flight was yet to be invented.
 - Railways were exciting. They offered people the chance to travel the country and opened up areas that only the wealthy could previously have visited. Cheap excursions were offered and people flocked to take them up. Thousands of people would travel from the cities to the coast for days out and holidays. Coastal towns grew if they were on the railway system.
 - Yet railway travel wasn't always a happy experience. The engines that pulled the trains were steam engines and though they were exciting to watch they produced large amounts of smoke, soot and ash. If you lived by a railway line, it wasn't a good idea to hang washing out to dry – if you did you found that white sheets or shirts were no longer white. The first underground trains were steam powered – imagine that.
 - Steam wasn't the only way of powering trains though. It was powerful and lots of staff knew how to make the engines work well. However some people were starting to experiment with other ways of moving people.
2. Show a picture of Volks Electric Railway. Explain that:
 - This is the world's oldest electric railway. It runs along the seafront at Brighton.
 - Each coach has an electric motor which powers it along.

Ask pupils to compare this with the steam train; they should suggest similarities and differences.

Their responses might include:

Similarities:	Differences:
- Run on rails - Carry people - Takes them to a destination - Passengers sit in carriages	- Electric train is smaller, lighter and slower - Electric train can carry fewer people at once - Electric train gives off no smoke, ash or soot (though the electricity has to be generated somewhere)

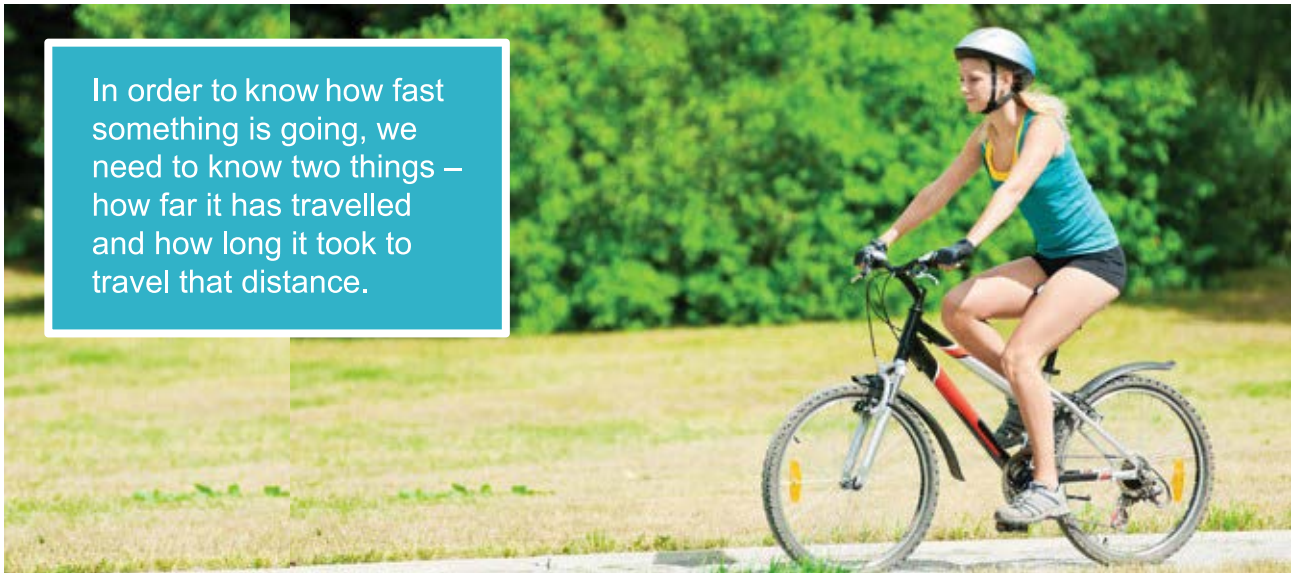
3. Ask pupils to produce a poster, divided into two parts. One side is to present the advantages of the steam trains that took people to places like Brighton; the other explains the advantages of having a seafront railway powered by electricity.
4. Afterwards show pupils a picture of the Brighton Belle (an electric train) and explain that forty years later, many of the trains from London to Brighton were electric.

Outcomes

- To be able to explain the role of steam and electric power
- To identify advantages of each
- To present ideas about technological change effectively.

The speed of a train

In order to know how fast something is going, we need to know two things – how far it has travelled and how long it took to travel that distance.



For example, Jemima is riding her bike along the road. She travels 10 metres along and does that in 2 seconds.

We know that distance = 10m

We know that time = 2s

We can work out the speed she was travelling at by dividing the distance by the time.

$10\text{m}/2\text{s} = 5 \text{ metres per second}$

She was travelling at a speed of 5m/s. Every second she travelled another 5 metres. In 2 seconds she would have travelled 10 metres.

For example, Horace the class snail travels 16 millimetres in 4 seconds.

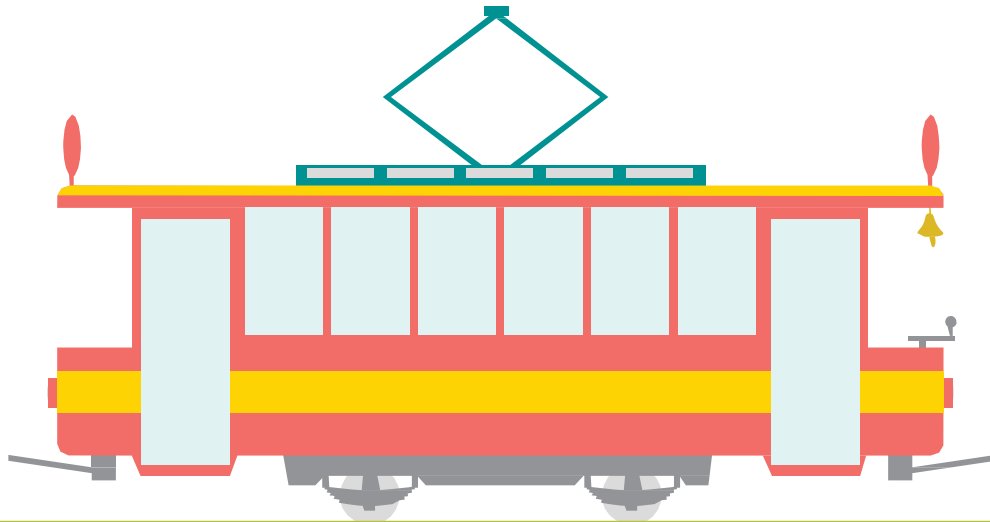
We know that distance = 16mm

We know that time = 4s

$16\text{mm}/4\text{s} = 4\text{mm/s}$

He's travelling at 4mm every second.





Now let's think about the trains on Volk's Electric Railway. The manager wants to know how fast they are going (and they don't have speedometers).

- What do we need to know to work out the speed?
- What measurements should be taken?
- What equipment might be useful?

The manager gets the measurements and finds out that:

- From one end of the line to the other is 1620m
- A train takes 12 minutes to get from one end to the other

See if you can work out the speed:

- In metres per minute*

- In metres per second** (think about how many seconds in a minute)

- In the wet the trains slow down – they take 15 minutes to get from one end to the other

- What will their speed be now?

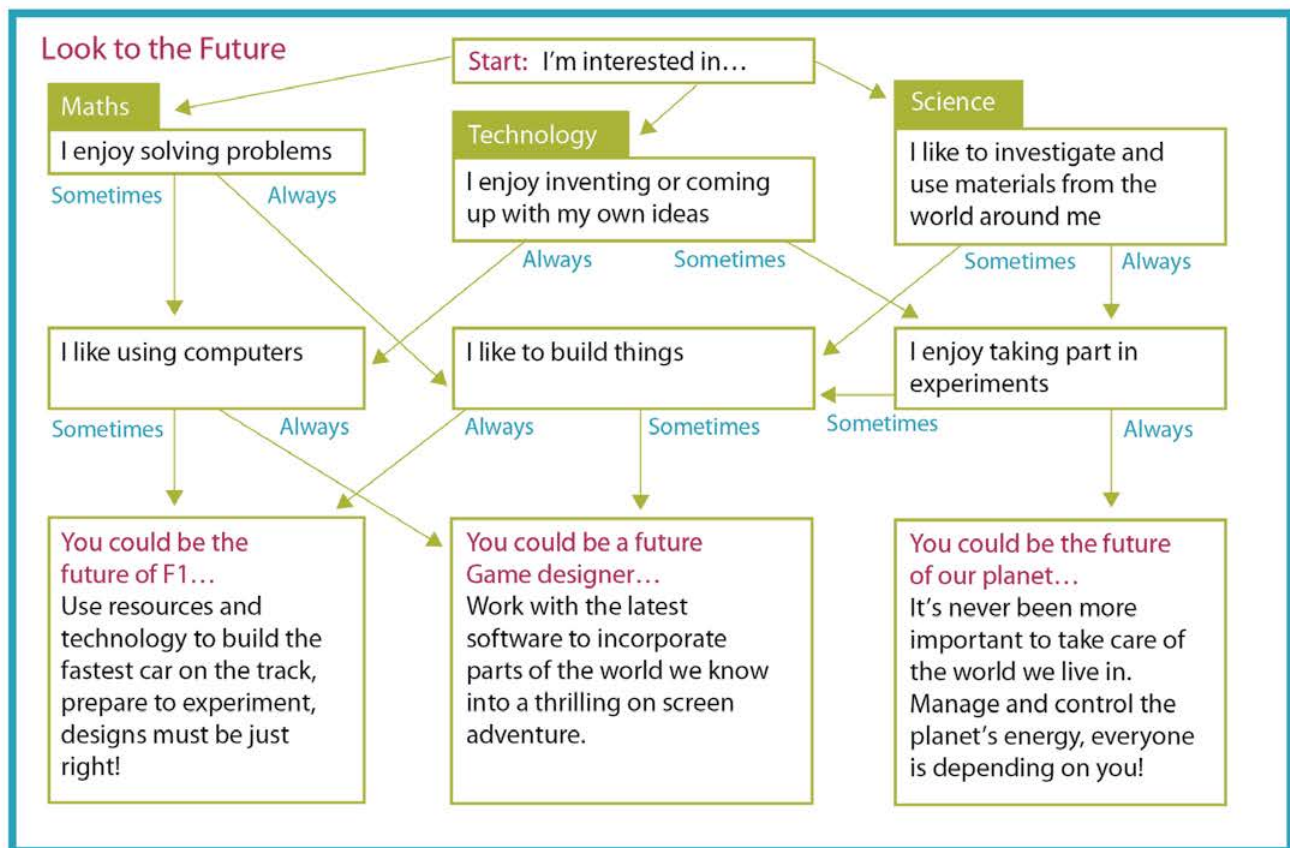
* You might want to use a calculator

** This one's a bit trickier

- Reducing traffic pollution is an important factor in designing buses for the future. How are hybrid buses the first step towards totally emission-free transport?
- A bus can be powered by three different sources. Can you name them and their key features?

- There are already 1700 hybrid buses in London and 300 on the road in Manchester!
- By 2020 Transport for London want ALL new vehicles to be either Hybrid or full Electric Vehicles.

www.siemens.co.uk/education



Explore an interactive world of engineering questions and fascinating facts, discover cool careers and meet inspiring engineers. Visit [siemens.co.uk/curiosity-project/youngpeople](https://www.siemens.co.uk/curiosity-project/youngpeople)

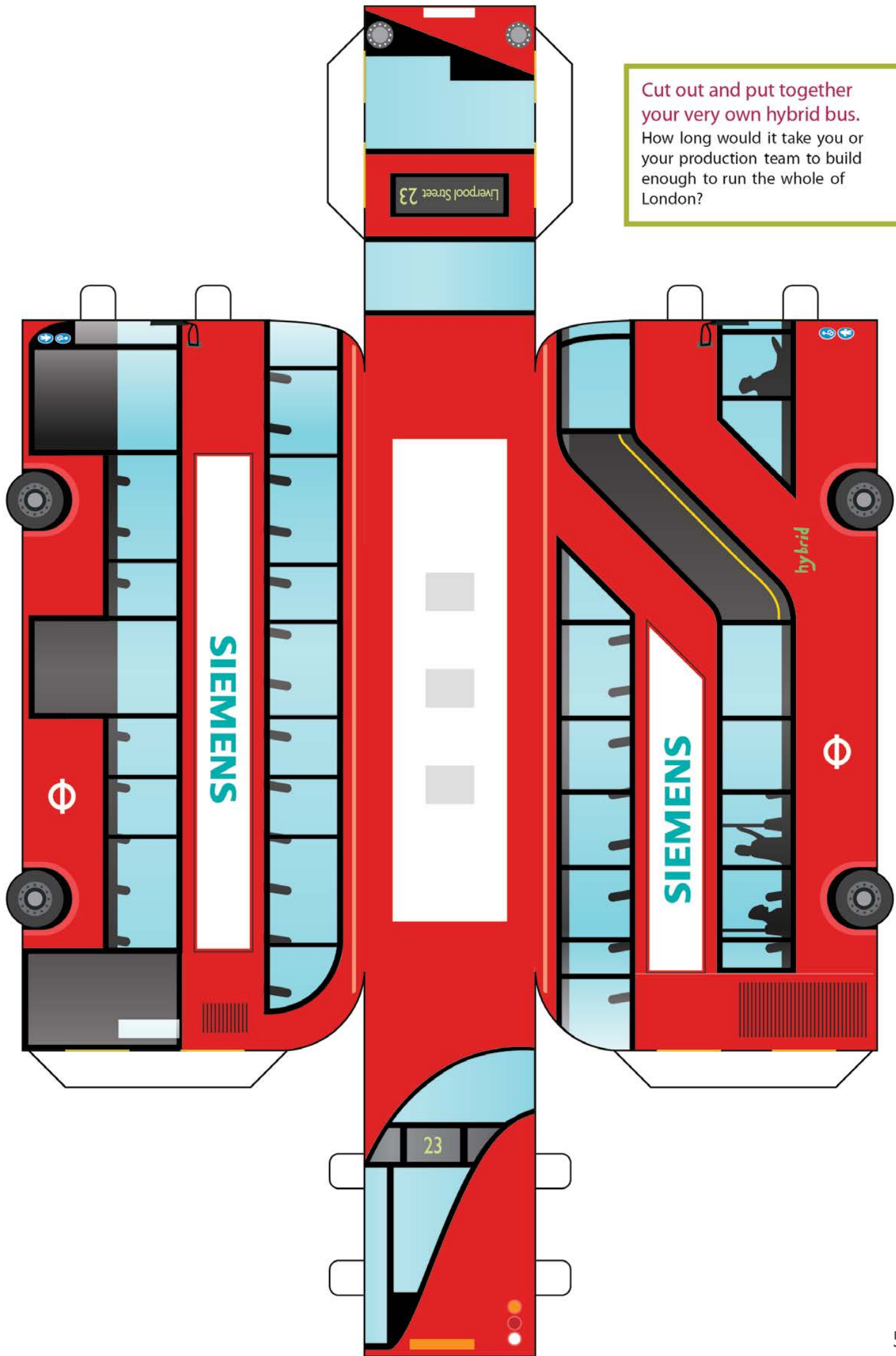
- Rearrange the letters to unlock the answer to the question...
- What is the name of the London bus using Siemens hybrid technology?

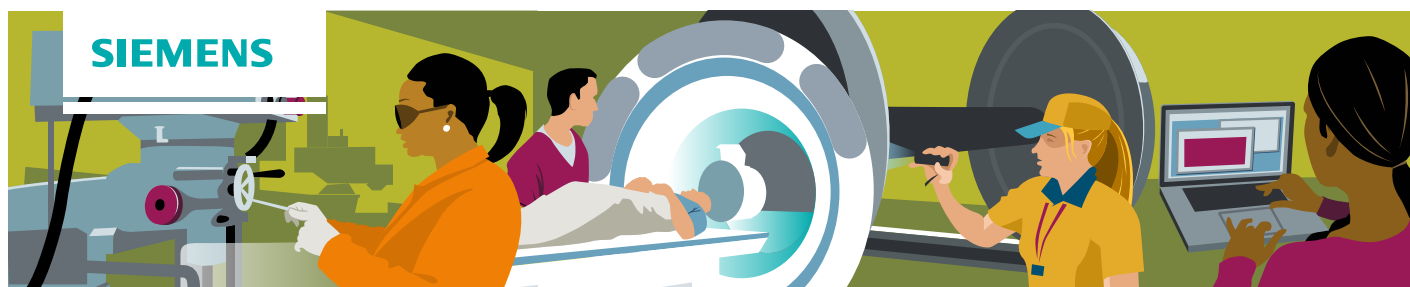
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Answer:





Margaret Onifade

Age 24

Project Engineer

Siemens Manchester

I was in year 6 and studying for **exams**. I was very **unsure of the career path** I wanted to pursue! I was just **focussed on doing well in my exams**. My favourite subjects were **maths and science**. I was also a **member of the Junior Science Club** at school.

Age 11



I completed my **A-levels in physics, maths and chemistry**. I had decided to **complete my A-levels more quickly so I did both AS and A2 levels in 13 months!** That was the most challenging period of my life academically as **I needed to learn a lot in a short space of time**. I also **began to apply to universities in the UK to study Electronics Engineering** - I had settled on this as my preferred career choice.

Age 17

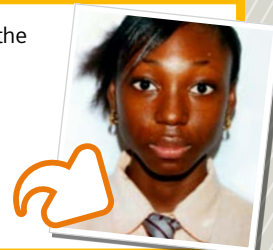
A-levels

I now **work in project management** within the **electrical and electronic engineering industry** and I am very **happy** in my role. I get to work with a **wide range of people** on varying **projects** that are used in different industries. Each day brings its own challenges and I get to **learn something new every day**.



Project management

I **grew up in Lagos** which is the second largest city in **Africa**. I started my education there and stayed until just before university. My friends and family call me by my middle name, **Funmi**.



Age 8

Lagos



I completed my **WASSCE exams**, the equivalent of **GCSEs**. I **thoroughly enjoyed studying the sciences** and my **favourite subjects** were **physics and maths**. Because I enjoyed the subjects, I did very well in them. I **knew I wanted to go to university** to study either physics or engineering so I began looking at universities to find out what **A-level subjects** I needed.



Age 16

By the time I'm 30 I'd like to be a **chartered engineer** and go into engineering management. I'd like to be on track to **leading a department** and to keep working with people to help **deliver amazing engineering accomplishments**.

I've had a lot of help to get to where I am. I had **inspiring teachers** who **encouraged me to pursue engineering as a girl**. I've also made sure to be involved in groups related to my interests which enabled me to meet my peers and discuss issues and ideas with them. I'm **currently a member of the Institute of Engineering (IET)**. I also have **mentors** who have a lot of experience so I go to them for advice when needed.



The future

CLASSROOM ACTIVITY POWERWISE - SCOTTISH POWER

TEACHER'S
GUIDE



POWERWISE

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Welcome to PowerWise, the outstanding new educational website from ScottishPower that teaches children and young adults all about electricity and how to stay safe around it - inside and outside the home.

Through a combination of interactive activities, animations, creative missions and innovative lesson ideas, children and young adults will be drawn into today's and tomorrow's world of electricity.

Our aim is to help young people to stay safe, be responsible and to generate an interest in the future of electricity. We hope that by the time they've worked through PowerWise, what they don't know about staying safe, generation and efficiency could be written on an electron!

Take a look at these exciting classroom activities!

 WWW.POWERWISE.ORG.UK



WORKING IN LEISURE & TOURISM



What? How? Why?

Leisure & Tourism are all the places and businesses people go to for enjoyment, whether they live locally or are on holiday. Leisure & Tourism is one of the UK's oldest industries and has changed a lot over the years. There are new sites and attractions being built all the time, each with their own unique job opportunities.



**Show this video to
pupils to set the scene**
www.actonstem.co.uk

Skills Needed:

- Ability to follow important rules & guidelines.
- Listening & understanding.
- Good communication - talking, explaining, directing, advising.
- Being bilingual, if you work in Wales and additional foreign languages.
- Able to work well in a team – team work.
- Basic computer skills.
- Interest in people and helping them.
- Basic knowledge of Health & Safety regulations.
- Excellent Customer Service.

Operating across Wales, leisure and tourism offers an amazing career path full of opportunities to grow and develop your skills.

Chwarae Teg



LEISURE & TOURISM JOB EXAMPLES

Tourist Guide | Average Salary: £18,000 (Oct15)

Guides are available for different activities and places. Tour Guides & Mountain Guides use their local knowledge to help and show people around exciting locations. Places like Wales are not only filled with history but with lots of places that people want to explore.

Up-to-date full information:



www.careerswales.com/en/career-search/search?jobTitleId=10212

Aromatherapist | Average Salary: £25,000 (Oct15)

Aromatherapist use special oils & lotions (taken from plants) to provide customers/guests with relaxing therapies.

The therapies take time to learn and help with healing and calming the body & mind. Understanding how the body works is an important part of this job.

Up-to-date full information:



www.careerswales.com/en/career-search/search?jobTitleId=10048

Hotel Manager | Average Salary: £25,000 (Oct15)

Hotel Managers are key to ensuring the smooth running of a hotel on a 24 hour basis.

A Hotel Manager has to make sure everything happens smoothly at the hotel, they have the responsibility of hotel staff, the business and making sure guests have a great time and would like to stay there again in future.

Up-to-date full information:



www.careerswales.com/en/career-search/search?jobTitleId=10127



Leisure & Tourism Resources....



www.careerswales.com/en/tools-and-resources/job-trends/tourism-hospitality/



nwef.infobase.cymru.net/IAS/Custom/Resources/Infographics/Active_Tourism_Infographic_FINAL.pdf



www.youtube.com/watch?v=0nz85SKLoGk

Produced in association with thanks to:



CLASSROOM ACTIVITY

BOYS & GIRLS AT WORK

TEACHER'S
GUIDE

All kinds of jobs are available to both men AND women. In this exercise pupils must think of professions that are traditionally seen as male or female roles. Once a shortlist has been created- pupils must draw a poster depicting both men AND women working together in a particular profession e.g. male and female builders, male and female beauty therapists etc.

KEY SKILLS (NATIONAL CURRICULUM)

**SOCIAL
LEARNING**

**GLOBAL
CITIZENSHIP**

**CREATIVE
INVESTIGATION**

**SPEAKING
& LISTENING**

PREPARATIONS & MATERIALS:

- Whiteboard/Smartboard
- Coloured pencils
- Exercise paper
- LOTS OF FUN!!

METHOD

1. Ask the pupils to list the names of familiar jobs/industries and write them on the whiteboard, cards, post it notes or flip chart.
2. Using the list of professions ask pupils what kind of person they may expect to see in those particular roles. Pupils may remark on male firefighters or female hairstylist.
3. Now using the **STEM video** – highlight to the pupils the gender diversity depicted on screen.
4. Ask the pupils to select one of the professions listed/discussed to create a poster depicting men and women working together in the same roles or 'reverse' roles.
5. There are no gender specific jobs. Boys and girls can aspire to enter any job role of their choosing.



LEARNING OUTCOMES

- Highlights important social issues: gender equality, equal opportunity and career freedom.
- Allows pupils to engage, discuss and deconstruct important issues.
- Provides pupils with a creative and fun task.
- Addresses the working world and their potential role within it.
- This exercise would benefit from being repeated again later on in the school year to help produce a greater variety of results and reinforce learning.



FURTHER INVESTIGATION & RESOURCES

 www.wisecampaign.org.uk//resources/2015/09/people-like-me-resource-pack

 nwef.infobasecymru.net/IAS/launch

Parent & Teacher Guide (article)

 www.theguardian.com/education/2015/feb/27/guide-parents-help-girls-into-male-dominated-careers

Chwarae Teg

 www.cteg.org.uk

• Tre-Ysgawen Hall

 www.treysgawen-hall.co.uk

Produced in association with thanks to:

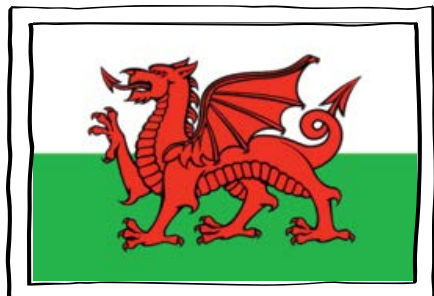


CLASSROOM ACTIVITY

LEISURE & OUTDOOR TOURISM

IN NORTH WALES

TEACHER'S
GUIDE



Leisure & Tourism is one of the largest industries in North Wales, supporting approximately 37,500 jobs!

Read attached 'infographic' sheet on Outdoor Tourism in North Wales.

 http://nwef.infobasecymru.net/IAS/Custom/Resources/Infographics/Active_Tourism_Infographic_FINAL.pdf

There is everything from hotels, activity parks, outdoor centres, food, castles, zoos, sailing and many more!

Can you create your very own tourist attraction?

Using the box below – create your own leisure or tourism business name and 'logo' or advert.

Remember – there are lots of different business to choose from, maybe you would like to create something completely new to the area?!



CAN YOU THINK LIKE A BUSINESS OWNER?



What's your business name?

Is it a 'catchy' name? Will people remember it? Is it Welsh or English? Can you get it on a logo or poster and leaflets?



Where is it located?

Is it indoors, outdoors, or both? Do you have to build something new or buy a building? Is it in a busy village or town? Can you get there easily by car, rail, bike or bus?



How many people does the business need to employ?

If you have to employ lots of staff to do different things you will have to pay them wages and this will come out of the business profits.



What jobs do these people do?

Will your staff need special training, skills and qualifications? People with higher skills are usually paid more than unskilled jobs.



How much will you charge people to take part in your activity / attraction? Are you making enough profit to pay your staff?

Do you know how much it costs to get into some tourist attractions locally? Is the price of your attraction similar? You need to be competitive to make sure people will visit and use it and you need to make a profit!



Will you be open all year round?

The weather in North Wales can sometimes 'spoil' some activities. Can you offer something 'whatever the weather'? If your business is closed because you can't use it in heavy rain, snow or ice you won't be making any money.



What's great about your tourist attraction and why should people visit or use it?

Perhaps the most important question to get right at the start! Would you ask your parents to take you there?

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CLASSROOM ACTIVITY

ICE CREAM VAN

TEACHER'S
GUIDE

INTRODUCTION

The Ice Cream Van's map shows a Tourist Town (reverse side). The lines are streets and the dots are street corners (junctions/crossings). The town lies close to the seafront, and in the summer season, ice-cream vans park at street corners and sell ice-creams to tourists.

The vans need to be in locations so that anyone can reach one by walking to the end of their street or at most, one block further.

Imagine people living at the junctions or crossings, rather than along the streets; they must be able to get to the ice-cream van by only walking at the most one block.

The question is, what is the least number of vans needed, and on which junction or crossing should they be placed?

PREPARATIONS & MATERIALS:

- Activity Time: 20 Minutes
- Plastic counters (2 colours)
- Materials Needed:
- Ice Cream Van Town Map
- Whiteboard / Smartboard

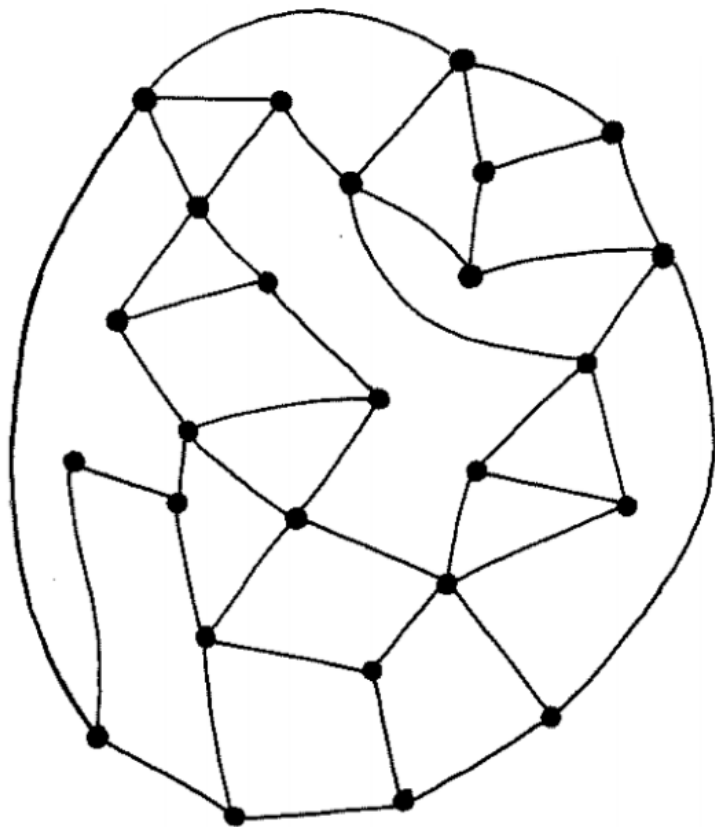


METHOD

1. Divide the pupils into small groups, give each group the Tourist Town map and some counters, and explain the story.
2. Show the pupils how to place a counter on a dot representing a junction/crossing to mark an ice-cream van, and then place counters of another colour on the junction one street away. People living at those junctions (or along the streets that come into them) are served by this ice-cream van.
3. Have the children experiment with different positions for the vans. As they find configurations that serve all houses, remind them that vans are expensive and the idea is to have as few of them as possible. It is obvious that the conditions can be met if there are enough vans to place on all junctions—the interesting question is how few you can get away with?
4. The minimum number of vans for Tourist Town is six, and a solution is shown (bottom of the page). But it is very difficult to find this solution! After some time, tell the class that six vans is the least number possible and challenge them to find a way to place them. This is still quite a hard problem: many groups will eventually give up. Even a solution using eight or nine vans can be difficult to find and should be praised!



5. The map of Tourist Town was made by starting with the six map pieces at the bottom of the Ice Cream Vans worksheet, each of which requires only one ice-cream van, and connecting them together with lots of streets to disguise the solution. The main thing is not to put any links between the solution junctions (the open dots), but only between the extra ones (the solid dots). Show the class this using an overhead projector, or by drawing it on the board.



SOLUTION



Further information & templates available at:

 www.nationalstemcentre.org.uk

The leisure industry in Wales covers everything from holidays, sports and games to cinemas, theatre television and live music, to name but a few

Activity courtesy of Computer Science Unplugged and National STEM Centre UK © 2009

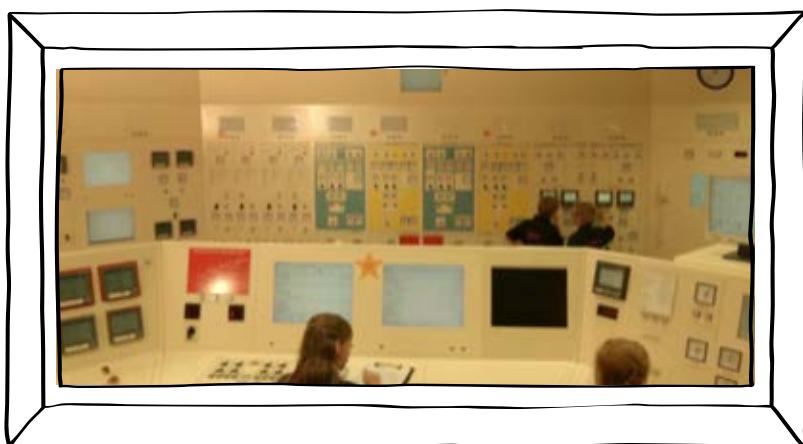


WORKING IN THE NUCLEAR SECTOR



What? How? Why?

Nuclear Power is a clean and highly controlled way of making electricity by using the nuclear energy found in atoms. Nuclear Power Stations like on Anglesey have large teams of people to make sure that everything goes safely in each of their different job roles. The Nuclear Sector has many interesting opportunities from designing to chemical experiments.



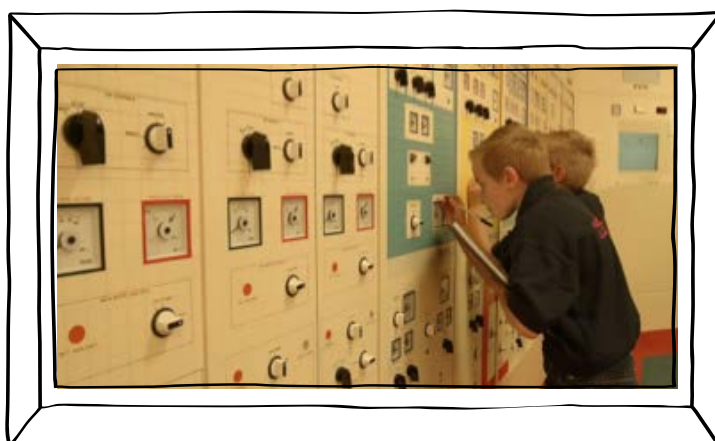
Show this video to pupils to set the scene
www.actonstem.co.uk

Skills Needed:

- Ability to follow important rules & guidelines.
- Listening & understanding.
- Able to adapt to regular improvements and changes.
- Attention to detail.
- Basic knowledge of Health & Safety regulations.
- Successfully completed a variety of work experience.
- Ability to assess & understand individual performance and situation awareness.
- Minimum of A* - C grade A-levels in 3 subjects (one of which should be in chosen area).
- Advanced/Higher Apprenticeships available with large support organisations and networks in place for further advancement.

A truly high tech industry with highly rewarding long term career prospects.

Chwarae Teg



NUCLEAR SECTOR JOB EXAMPLES

Operations Manager | Average Salary: £35,000 (Oct15)

Operational activities are essential to the day-to-day running of a nuclear plant facility. Operations-staff help run the reactors, steam turbines and general support machines; this team of skilled experts needs to be managed by an Operations Manager.

Alongside managing a strong team, Operation Managers must lead the way in areas such as staff development and strategic analysis.

Up-to-date full information:

 www.careerswales.com/en/career-search/search?jobTitleId=55538

Business Support | Average Salary: £35,000 (Oct15)

The work is typically varied requiring strong communication and organisational skills. The Business Support team are a select team of individuals who deal with matters both internally and externally.

Business Support is responsible for shaping the future of the company through finance & budgets, negotiations and community presence.

Up-to-date full information:

 www.careerswales.com/en/career-search/search?jobTitleId=5000115

Chemist | Average Salary: £40,000 (Oct15)

A Chemist on a power station collects and analyses samples from plant systems and interprets the data to ensure that all health & safety standards are met.

The aim of the Chemist is to understand the nature of substances and how they behave under different conditions.

Up-to-date full information:

 www.careerswales.com/en/career-search/search?jobTitleId=10355



Nuclear Resources....

 www.careerswales.com/en/tools-and-resources/job-trends/the-energy-sector/

 nwef.infobasecymru.net/IAS/Custom/Resources/Infographics/Energy_and_Environment_FINAL.pdf

Produced in association with thanks to:

POWER NIWCLEAR
HORIZON
NUCLEAR POWER



CLASSROOM ACTIVITY CODEBREAKERS

TEACHER'S
GUIDE

In groups- pupils must identify the number of shapes found in a variety of patterns. The resulting numbers will help to solve a series of maths equations based on the subject area currently under classroom discussion e.g. subtraction or division etc. The final number will correspond to a key; press the correct sequence of coloured buttons to break the code!

KEY SKILLS (NATIONAL CURRICULUM)

PROBLEM
SOLVING

WORKING
WITH OTHERS

UNDERSTANDING
NUMBERS

SHAPES &
PATTERNS

PREPARATIONS & MATERIALS:

- Pattern shapes – triangle and square (examples included – Activity Sheet (a))
- Whiteboard / Smartboard
- Keypad + key (included – Activity Sheet (b))

METHOD

1. Draw the patterns shown in Activity Sheet (a) on the whiteboard and/or hand out copies of the activity sheet (making sure to hide the solutions!).
2. Ask pupils to identify the correct number of triangles or squares possible within each pattern. They should have 7 different answers, one for each pattern. The answers are noted on the activity sheet and below.

3. Pupils need to use the 7 resulting numbers to form part of seven different numerical tasks, below. Which one of the 7 answers fit into these blank spaces? An answer is only used once.

The answers are: 5, 14, 24, 1, 5, 13, 25

Use the white board or print the activity sheet (b)

$(2 \times 2) + 1 = \underline{\hspace{2cm}}$	$\underline{\hspace{2cm}} + (3 \times 3) = 23$	$16 + (4 \times 4) - 8 = \underline{\hspace{2cm}}$
$(0 \times 0) \times 0 + 1 = \underline{\hspace{2cm}}$	$(5 \times 5) - 20 = \underline{\hspace{2cm}}$	$3 \times 4 + 1 = \underline{\hspace{2cm}}$
$(100 - 50) - \underline{\hspace{2cm}} = 25$		

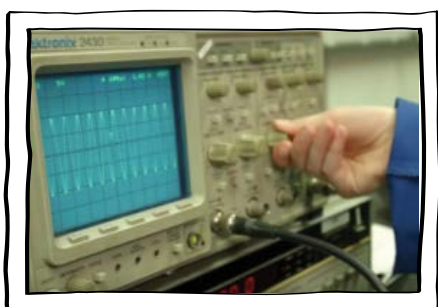
4. The possible maths equations are limitless and can be changed and altered depending on classroom ability and the mathematic subject currently under discussion.
5. The final answers can be then placed alongside the key in Activity Sheet (c) to provide the sequence of coloured buttons necessary to break the code.



6. Role-play is an important element in engaging pupils. Ask the pupils to imagine that the code is for the benefit of a power reactor or some other important piece of technology.

LEARNING OUTCOMES

- Understanding the relationship between STEM subjects and the world of work - Problem solving, team work and a clear consensus of opinion.
- Learn that these are the skills required in the current and emerging local energy sector.
- Using maths in a fun way that is adaptable to classroom needs.
- Role-play designed to simulate the critical thinking and responsibilities required within the energy sector at an accessible level to Key Stage 2.



FURTHER INVESTIGATION & RESOURCES

- This exercise could be further expanded on by creating a multiple sequence of maths equations to discover the colour code rather than one singular maths problem.

 nwef.infobasecymru.net/IAS/launch

The Dot and the Line: A Romance in Lower Mathematics (1965)

 [10.00 minute animation] – available on YouTube

- Online help guide on how to solve the large pattern from Activity Sheet (a)

 majortwister.com/answer-to-the-square-picture/

- Further facts & information Nuclear Industry Association (NIA)

 www.niauk.org

- BBC Bitesize

 www.bbc.co.uk

- Horizon Nuclear

 www.horizonnuclearpower.com

- National Skills Academy for Nuclear

 www.nsan.co.uk

Produced in association with thanks to:

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HORIZON
NUCLEAR POWER

CLASSROOM ACTIVITY: CODEBREAKERS

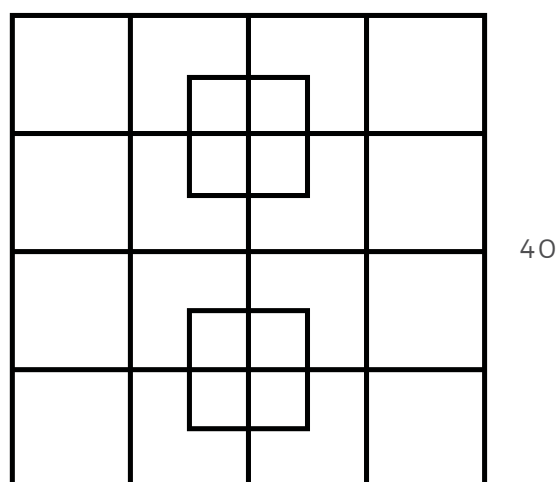
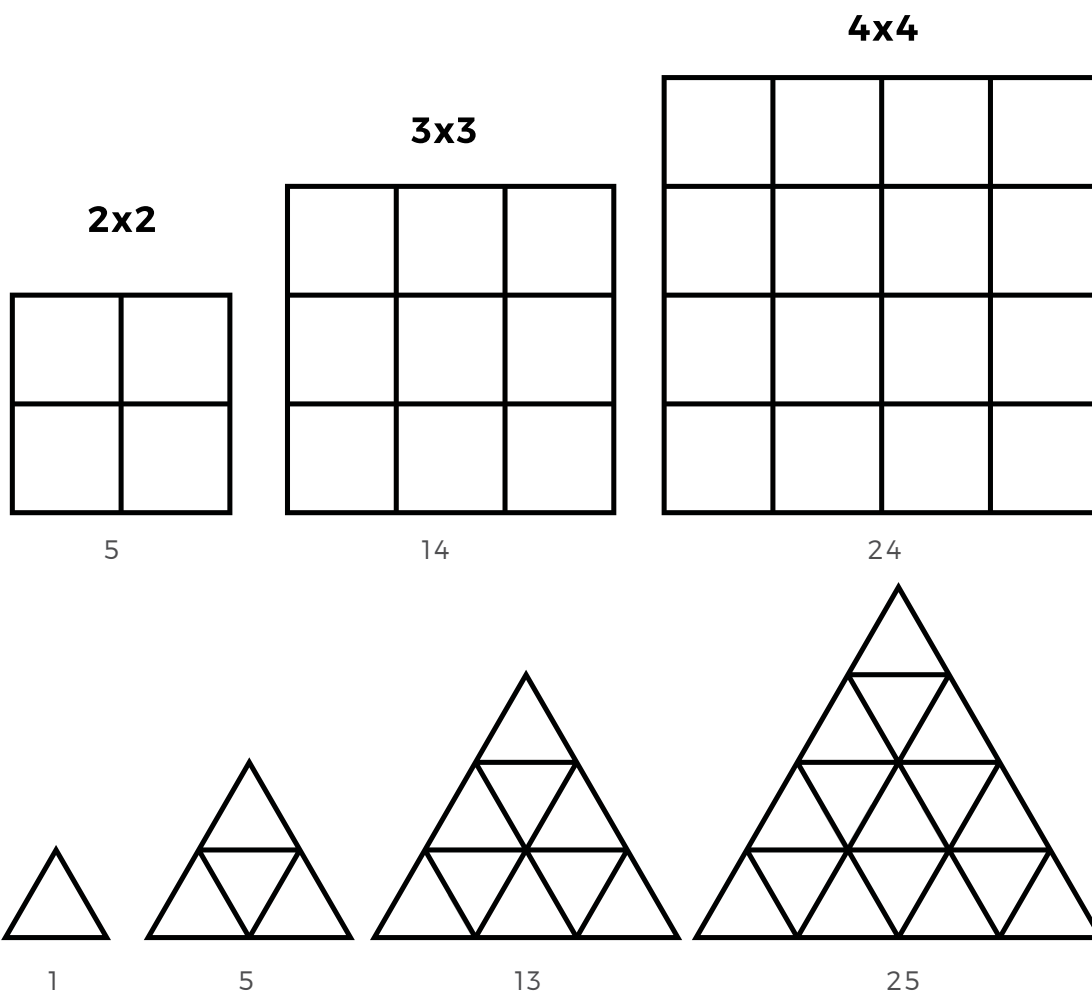


ACTIVITY SHEET A

PATTERNS & SHAPES

TEACHER'S
GUIDE

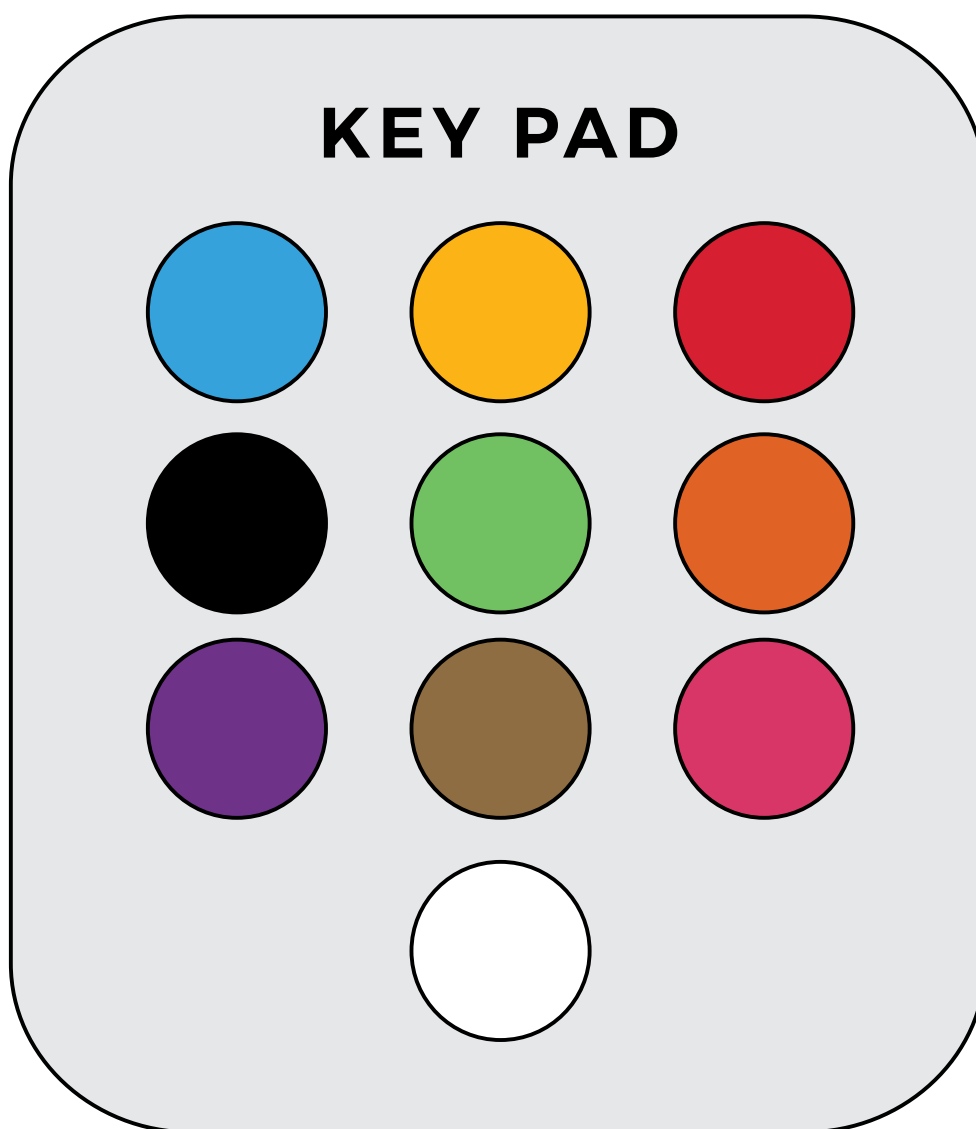
WHAT IS THE NUMBER OF POSSIBLE SQUARES OR TRIANGLES IN THE PATTERNS BELOW?



ACTIVITY SHEET B

KEY PAD

TEACHER'S
GUIDE



KEY:

1 - BLUE	4 - BLACK	7 - PURPLE	0 - WHITE
2 - YELLOW	5 - GREEN	8 - BROWN	
3 - RED	6 - ORANGE	9 - PINK	

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POWER GENERATION

HOW IS ELECTRICAL POWER GENERATED?

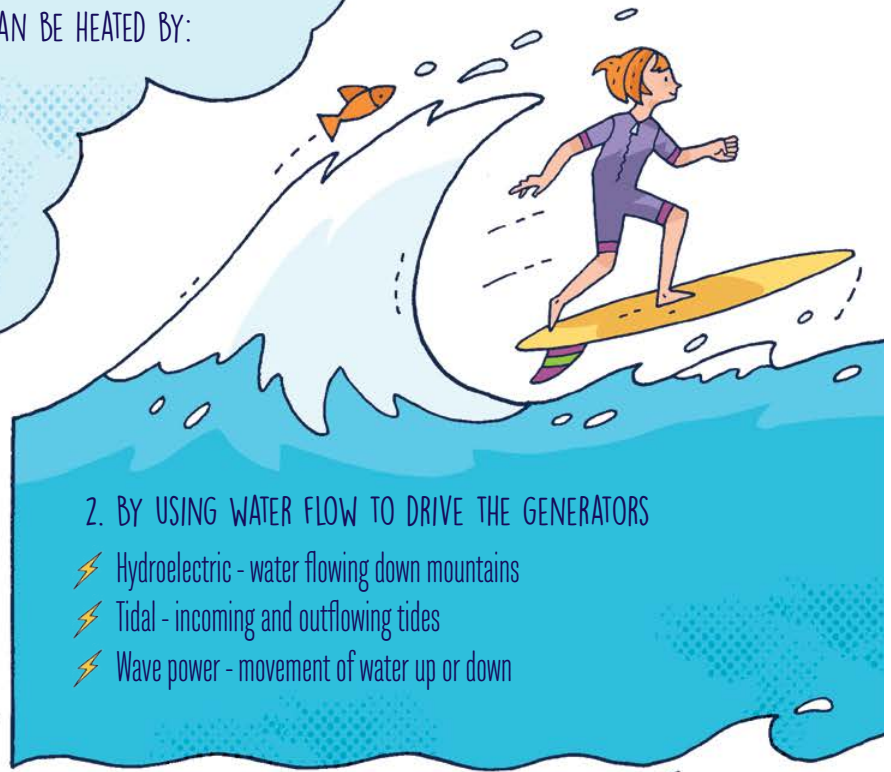
1. BY HEATING WATER AND USING THE STEAM TO DRIVE TURBINE GENERATORS. THE WATER CAN BE HEATED BY:

- ⚡ Burning coal
- ⚡ Burning gas
- ⚡ Nuclear reaction
- ⚡ Underground thermal heat
- ⚡ Solar furnace



2. BY USING WATER FLOW TO DRIVE THE GENERATORS

- ⚡ Hydroelectric - water flowing down mountains
- ⚡ Tidal - incoming and outflowing tides
- ⚡ Wave power - movement of water up or down

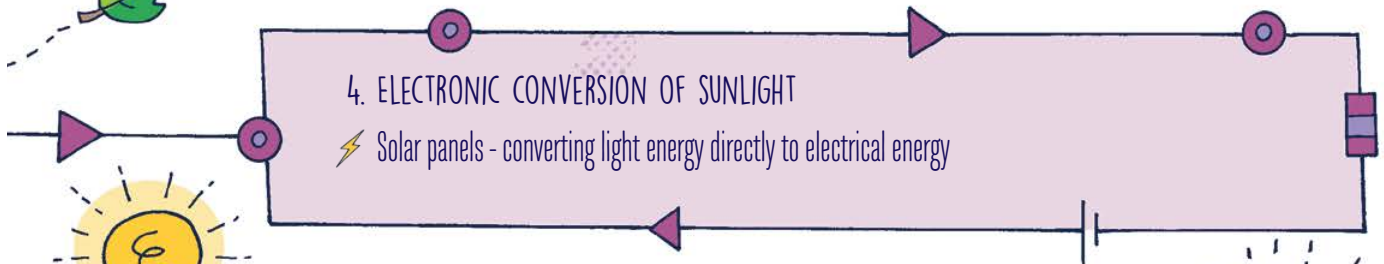


3. BY USING AIR TO DRIVE THE GENERATOR

- ⚡ Wind turbines

4. ELECTRONIC CONVERSION OF SUNLIGHT

- ⚡ Solar panels - converting light energy directly to electrical energy



5. BY CHEMICAL REACTION

- ⚡ Batteries - reaction between metals or metals and acids

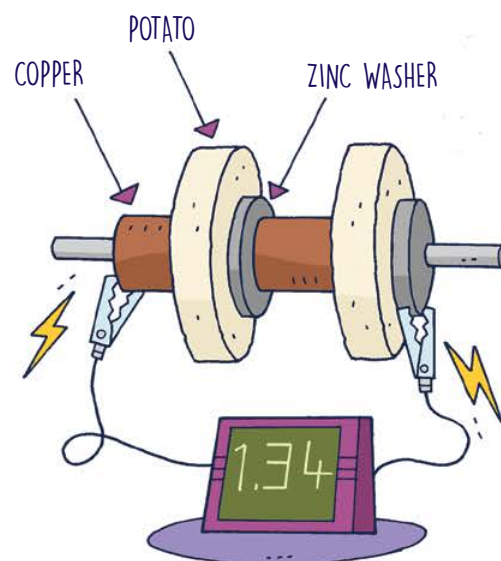


MAKING A POTATO BATTERY

MAKING A POTATO BATTERY

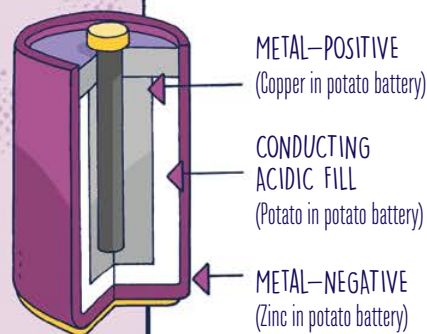
- ⚡ Slide one zinc washer, then one piece of potato then one piece of copper onto the kebab skewer
- ⚡ Connect one lead from the Digital Volt Meter onto the copper, and one onto the zinc washer
- ⚡ Press the sandwich of copper, potato and zinc together
- ⚡ Record the voltage

Add a second sandwich of zinc, potato and copper and record the voltage, repeat with three...



HOW DOES IT WORK?

- ⚡ Potatoes (and other fruit and vegetables) contain acids and conduct electricity
- ⚡ The acid reacts with the copper and zinc causing a chemical reaction called corrosion, which releases electrons ($\text{Metal} + \text{acid} \rightarrow \text{metal salt} + \text{hydrogen}$)
- ⚡ This creates a potential difference (voltage) between the copper and the zinc causing electrons in the wire to flow, creating an electrical current
- ⚡ The electrical current provides the power to run electrical equipment

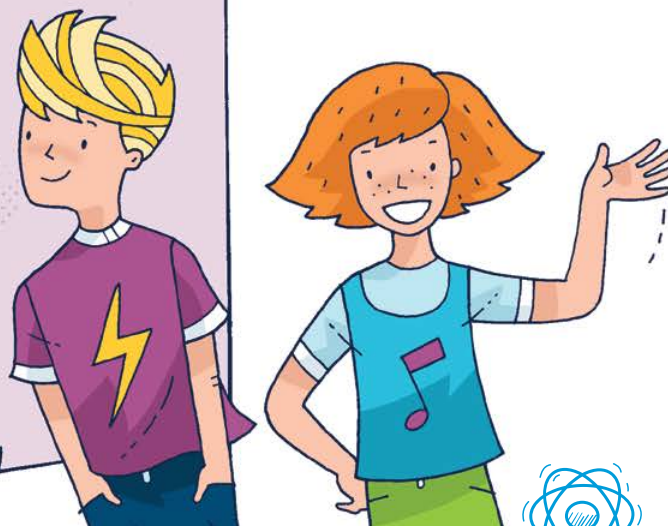


EXTENSION ACTIVITIES

Observe and record what happens when you use:

- ⚡ Different numbers of copper/potato/zinc units
- ⚡ Different vegetables and fruits - what happens to the voltage
- ⚡ Different thicknesses of potato
- ⚡ Different metals - iron instead of zinc

Can you use the power to light an LED, or LCD Clock?

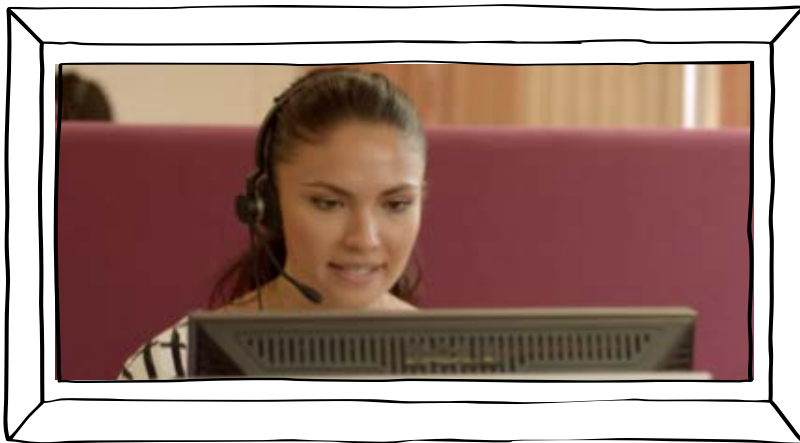


WORKING IN TELECOMMUNICATIONS



What? How? Why?

Call-centres answer thousands of calls a day from customers from all over the UK; those who answer the phones are known as agents. Agents work in large teams and help solve people's queries. A call-centre is usually a business that helps the customers of other businesses.



**Show this video to
pupils to set the scene**

www.actonstem.co.uk

Skills Needed:

- Strong reading, writing and communication skills.
- Helpful & friendly personality.
- Strong listening skills.
- Basic computer skills.
- Attention to detail.
- Able to work well in a team – team work.
- Interest in people and helping them.
- Minimum of A* - C grade GCSEs.
- Introductory courses available for Customer Service.

With technologies rapidly
converging this truly is an exciting
time to enter the world of telecoms!

Chwarae Teg



TELECOMMUNICATIONS JOB EXAMPLES

Customer Service Agent | Average Salary: £18,000 (Oct15)

Customer Service Agents work in the call-centre and handle large numbers of telephone calls from people from all over the country and sometimes beyond.

The team of Agents are skilled in solving customers' requests or problems. It is a level of communication that requires a lot of listening and understanding.

Up-to-date full information:

 www.careerswales.com/en/career-search/search?jobTitleId=10016

PA (Personal Assistant) | Average Salary: £30,000 (Oct15)

Personal Assistants (PA) help managers and other key staff organise their work. PAs play an important role in making sure important work is handled properly.

PAs have many roles and make great future managers.

Up-to-date full information:

 www.careerswales.com/en/career-search/search?jobTitleId=45592

Customer Services Manager | Average Salary: £35,000 (Oct15)

Customer Service Managers listen to customer needs and make sure they are happy with the product or service the company is supplying.

The Customer Service Manager brings the team together, understanding their strengths, abilities and organising how everything should work.

Up-to-date full information:

 www.careerswales.com/en/career-search/search?jobTitleId=10017



Telecommunications Resources....

 www.careerswales.com/en/tools-and-resources/job-trends/it-telecommunications/



CLASSROOM ACTIVITY SHIFT SUCCESS

TEACHER'S
GUIDE

Pupils must pretend as a classroom that they are managers of a 24 hour call centre. Using a time chart the classroom must decide the staff shifts for one complete day. The total results of the shifts will then be presented in a pie chart.

KEY SKILLS (NATIONAL CURRICULUM)

PROBLEM
SOLVING

TIME

GRAPHS
& CHARTS

DATA
HANDLING

PREPARATIONS & MATERIALS:

- Whiteboard/Smartboard
- Coloured pencils
- Exercise paper
- Attention of the Classroom

METHOD

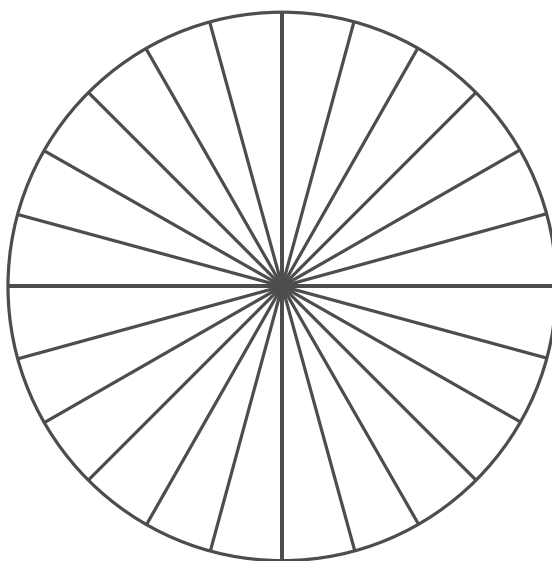
1. Ask the pupils to imagine, that they as a classroom, are managers of a busy 24 hour call centre responsible for a team of Customer Service Agents.
2. Once this concept has been established – draw up a time chart on the whiteboard covering a complete 24 hour period (example below):

TIME	STAFF MEMBER
00.00 - 01.00	
01.00 - 02.00	
02.00 - 03.00	
03.00 - 04.00	
04.00 - 05.00	
05.00 - 06.00	
06.00 - 07.00	

3. The next stage is deciding on the number of staff and giving them each names. Every staff member will work different shifts depending on whether they are full-time/part-time or work daytime/evening. Each staff member will have their own unique working hours, meaning that for this exercise only one staff member can populate each hour time slot.



4. Division of labour and breaks are important considerations before finalising on the various staff shifts.
5. The final results will then be presented in a pie chart. The number of sections, 24, is equal to that of the number of hours. Filling in the pie chart can be done by assigning each staff member a colour or alternatively by writing in their initials:



LEARNING OUTCOMES

- Understanding of the 24 hour clock.
- Plot input/output in a graph format.
- Role-play designed to simulate the critical thinking and responsibilities required within a managerial role at an accessible level to Key Stage 2

FURTHER INVESTIGATION & RESOURCES

• Useful templates

 www.nationalstemcentre.org.uk/elibrary/resource/10557/presenting-data-graphically

• Graphs, Charts & Tables

 www.bbc.co.uk/bitesize/ks2/maths/data/frequency_diagrams/read/1/

• Moneypenny

 www.moneypenny.com/uk

Produced in association with thanks to: 



CLASSROOM ACTIVITY

WHAT'S CAROL'S BUDGET?

TEACHER'S
GUIDE

Imagine building a Call Centre business from scratch.

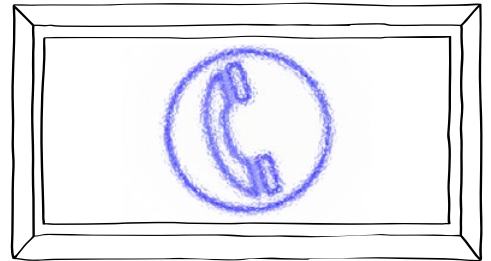
Carol decides to start her own Call Centre business with a fixed budget:

Carol spends $\frac{1}{2}$ of her budget on construction - building the call centre.

Carol then spends a $\frac{1}{4}$ of what she has left on equipment.

She then splits the final amount equally between branding & company logos and 12 months advertising and launch.

Carol then spends her last £20,000 on advertising which is the same amount as the branding and company logos



HOW MUCH WAS CAROL'S BUDGET?

£

ANSWER: £160,000

Produced in association with thanks to:



CLASSROOM ACTIVITY: CAROLS BUDGET



CLASSROOM ACTIVITY MYSTERY CALLER

TEACHER'S
GUIDE

Mystery Caller is a game very similar to Twenty Questions. One person must pretend to be the receiver and the other must be the caller! If the receiver can guess the caller in 20 guesses or less they win!

Remember this is a “phone call” so the players must be back to back so there are no possible clues or signals.

What country
are you from?

Are you male
or female?

Are you a
famous
person?

Are you someone
from history?



People employed as telephone ‘agents’, such as those working for Moneypenny, are very skilful in the way they deal with people over the phone.

When you can’t see people’s faces it’s difficult to know how they feel to help you judge whether they understand what you’re saying.

They might be rolling their eyes or opening their mouth in shock!

In this task called ‘Mystery Caller’ pupils will sit back to back with another pupil to guess the identity of the caller. This is a fun way to introduce a message about workplace skills.

WHAT CAN PUPILS LEARN IN THIS TASK?

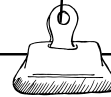
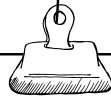
- How to describe things accurately
- How to project their voice clearly
- Speaking slower than usual
- Avoid distractions
- Listening very intently
- Asking the right questions
- Giving good information



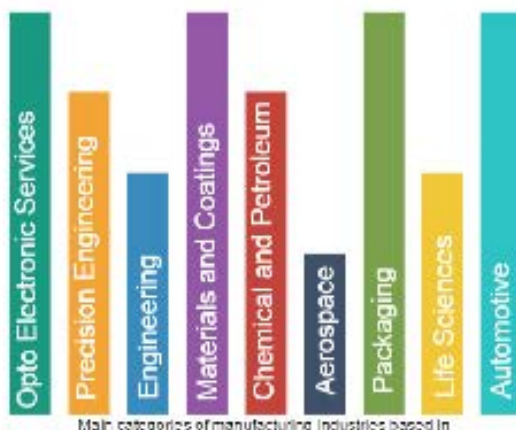
These are essential skills that telephone agents certainly use and need for their day to day job, however these are also ‘transferrable’ skills that any employer would value in all jobs.

Produced in association with thanks to:





Electrical Fitters & Technicians
Production Managers
2015
Main Occupations
in demand
Electricians



North Wales

30% of the Welsh National Manufacturing Output comes from North Wales

9000 JOBS Large concentration of manufacturing jobs are in the Deeside Enterprise Zone

37% of manufacturing industries in North Wales are in Flintshire and Wrexham with other opportunities across the region.

6000 people are employed in

In 2014 there were
10,370
Learning & Training Opportunities
in
Manufacturing & Engineering in
North Wales



STEM

Science, Technology, Engineering & Mathematics
manufacturing offers a wide range of diverse and sub divisions requiring generic 'STEM skills' from maths, science and technology subjects

north wales development foundation
helping businesses make the most of the region



Watch the animation here

www.actonstem.co.uk



CONSTRUCTION INDUSTRY IN NORTH WALES



8,500
potential
construction
employees
needed for
Wylfa Newydd



6,000
people studied
construction
related courses
across North
Wales in 2013



1.5
billion pounds
worth of projects
for construction
in next 10 yrs
(excluding Wylfa Newydd)

100 apprentices per year offered for construction phase of new North Wales Prison at Wrexham

Increased employment across the sector likely to exceed Welsh average projection of +2.4%

Commercial based construction to be one of the main growth areas for the sector

FUTURE DEMAND FOR SKILLS



Bricklayers
Civil Engineers
Surveyors
Wood trades

57%

regional construction
workforce aged 25-49

34%

regional construction
workforce aged 50 plus

9%

regional construction
workforce aged 16-24



north wales economic ambition board
bwrdd uchelgais economaidd gogledd cymru



Watch the animation here

www.actonstem.co.uk



Energy & Environment



£12 billion+

the value of this sector to the Anglesey and North Wales economy over the next 15 years

NORTH WALES CONTINUES TO DEVELOP KEY PROJECTS IN THESE SECTORS:



SOLAR



WIND



BIOMASS



WAVE



ELECTRICITY



NUCLEAR



Around 700 apprentices are expected to be taken on for Wylfa Newydd



£20m

proposed expansion of Coleg Menai's Technology and Energy Centre



Between 8,000-10,000 jobs

will be created at the peak of construction at Wylfa



Plasterers
Welders
Decorators
Carpenters
Plumbers
Engineers
Specialist Technical
Electricians
Scaffolders
Bricklaying
Apprentices
Supervisors
Professional
Plant Machinery Operators

OPPORTUNITIES WHICH WILL BE CREATED



STEM SKILLS

are high value for this sector in North Wales

EMPLOYERS VALUE ADDITIONAL SKILLS SUCH AS:



POSITIVE ATTITUDE



ENERGETIC



INSIGHTFUL



FLEXIBLE



WILLINGNESS TO LEARN



north wales economic ambition board
bwrdd uchelgais economaidd gogledd cymru



Watch the animation here

www.actonstem.co.uk



Active Tourism



Welsh Government have plans to make

North Wales

the leading area for outdoor activity tourism in the UK

VOLUNTEERING

is a great way into employment in this sector

28%

of all volunteering carried out in the UK is from the

SPORTS SECTOR



The tourism industry generates



£1.8 BILLION

each year for the **NORTH WALES ECONOMY**

North Wales

will see an increase of

3,000

additional jobs in this sector during the next 5-10 years



In 2014



825 TOURISM & LEISURE RELATED APPRENTICESHIPS were available in **NORTH WALES**

Main skills prioritised for the sector are:

Welsh Language

Teamwork

Customer Handling

Communication



north wales economic ambition board
bwrdd uchelgais economaidd gogledd cymru



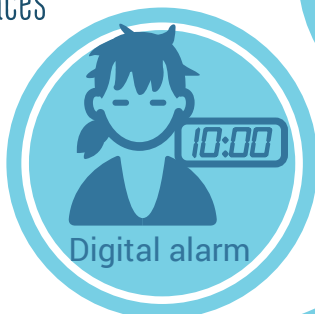
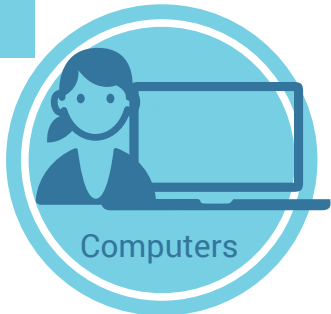
Watch the animation here

www.actonstem.com

QUALIFIED FOR LIFE: FOCUS ON SCIENCE

Science takes you places

Science, technology, engineering and maths (STEM) affects us all, every day of the year, from the moment we wake up, all day long, and through



Science is all around us

Question: What has your digital alarm clock, the weather forecast, your computer, your family car, your kitchen utensils and your mobile phone all got in common?

Answer: They were all brought to you courtesy of science.

Tell your children a career in science can be fun, financially rewarding and can make a difference.

There are excellent opportunities for those who pursue a science career.

www.facebook.com/beginsathome

Science takes you places



72%

? Where
www.careerswales.gov.uk/en/spe

Some of the financial
enjoy if you are STEM
www.careerswales.gov.uk/games-and-activities

Aerospace industry
Agriculture
Animals
Biological sciences
Chemistry careers
Computers
Construction
Engineering
Environment
Film, TV and radio
Finance
Food and drink



Llywodraeth Cymru
Welsh Government

www.gov.wales

1 in 5
new jobs
in the UK by 2022,
will be a STEM job

of all UK businesses
rely on people with
STEM skills

Can STEM take me?
[careerswales.com/
spotlight-on-stem/](http://careerswales.com/spotlight-on-stem/)

Especially rewarding careers you could
be STEM skilled! Find out more:
[careerswales.com/en/tools-and-resources/
subjects-and-jobs/](http://careerswales.com/en/tools-and-resources/subjects-and-jobs/)

Health and beauty
Health, medicine and dentistry
Mechanical engineering
Nursing and midwifery
Oil and gas production
Physics careers
Plastics and polymers
Science careers
Teaching
Textile industry
Vehicles
Water industry

Why not try these fun science
experiments at home:

- Seven fun science experiments with this link:
[www.buzzfeed.com/lewismorgan/
british-science-week-listicle-1erlv](http://www.buzzfeed.com/lewismorgan/british-science-week-listicle-1erlv)
- Make your home a science lab with this link:
www.rigb.org/experimental

Useful links

BBC Bitesize can help you
with your child's science education.

Ages

- 5–7 www.bbc.co.uk/education/levels/z3g4d2p
- 7–11 www.bbc.co.uk/education/levels/zbr9wmn
- 11–14 www.bbc.co.uk/education/levels/z4kw2hv
- 14–16 www.bbc.co.uk/education/levels/z98jmp3

SPECIAL THANKS

BANGOR UNIVERSITY

Bangor University has an international reputation for teaching and research, fostering the intellectual and personal development of its students & staff, it provides a supportive multicultural environment, and supports the economic, social and cultural well-being of Wales and the wider community it serves.



BEACON CUBED

Beacon Cubed support the development of skills and attitudes of the current and future workforce communities. They are keen to deliver an enhanced route to employment.



CAREERS WALES

Careers Wales is a pan-Wales service that provides people of all ages free impartial careers advice and guidance across a variety of delivery methods and platforms.



CHWARAE TEG

As a charity, since 1992 we've been working to help ensure that women in Wales can enter the workplace, develop their skills and build rewarding careers. We work closely with the government, academics and industry to influence the development of policies. Thank you for providing additional funding for the project.



COMTEK

Comtek is the UK's fastest growing multi-vendor IT and telecoms repair service, and is committed to extending the working life of legacy IT and telecoms equipment – irrespective of its age or manufacturer.



GwE

GwE is the Regional School Effectiveness Service for North Wales and works in partnership with the six Local Authorities to improve standards of education and improve outcomes for pupils by ensuring effective leadership at all levels and quality teaching and learning in all classrooms.



HORIZON

Horizon Nuclear Power is a UK energy company developing a new generation of nuclear power stations - enough to power around 10 million homes. Thank you for providing additional funding for the project



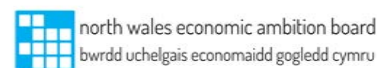
MONEYPENNY

Money Penny, the leading UK Telephone Answering Service and Outsourced Switchboard market with respect to our size, quality of service & technology, looking after more calls for more businesses than any other company.



NORTH WALES ECONOMIC AMBITION BOARD – COORDINATING, FACILITATING AND FUNDING

The North Wales Economic Ambition Board (NWEAB) is a collaborative group of private and public organisations in North Wales committed to promoting economic growth in Anglesey, Conwy, Denbighshire, Flintshire, Gwynedd and Wrexham. With a clear suite of priority work areas, the Skills & Employment workstream of the Board has been officially recognised by Welsh Government as one of the three Regional Skills Partnerships within Wales.



REACHING WIDER

Reaching Wider Partnership offers a range of learning and aspiration raising activities, working with under-represented groups in higher education and students studying through the medium of Welsh. Thank you for providing additional funding for the project.



SANTANDER

Through its Santander Universities, Banco Santander has collaborated with universities for 18 years on a unique global initiative investing Corporate Social Responsibility in connection with education. Santander Universities maintain 1,208 universities and research institutes from all over the world, 78 in the UK.



SIEMENS

The company is active in more than 200 countries, focusing on areas of electrification, automation and digitalisation. One of the world's largest producers of energy-efficient, resource-saving technologies.



SP ENERGY NETWORKS

Provides power on behalf of supply companies through a network of cables and power lines that we own and maintain. Respect, safety and environment.



THE NATIONAL SKILLS ACADEMY NUCLEAR

The leading, not-for-profit, organisation for the sourcing and provision of skills solutions consistently exceeding the expectations of our members.



TRE-YSGAWEN HALL – COUNTRY HOUSE HOTEL & SPA

Tre-Ysgawen Hall, originally a grand mansion built in 1882. Now a hotel with a high reputation as one of the finest country house hotels in Wales.



WATKIN JONES GROUP

The Watkin Jones Group is one of the UK's leading construction and development companies. Highly experienced in delivering new developments, ranging from homes to commercial and industrial.





ACT ON STEM

To access all web links, please see online version of this document
www.actonstem.co.uk

We value your feedback, please let us know your thoughts by going to
www.northwaleseab.co.uk/get-in-touch



north wales economic ambition board
bwrdd uchelgais economaidd gogledd cymru

Designed by Daydream Designs. www.daydreamdesigns.co.uk