Introduction

The Royal Academy of Engineering and STEMNET have worked together to produce a suite of high quality activities and support resources for use by STEM Clubs Leaders.

Tried and tested by and with schools, they offer a range of ideas for activities, accompanied by support resources that enable STEM Clubs and STEM Ambassadors to enhance their engagement with students aged 11–14 years old.

We want to give STEM Clubs the greatest chance of inspiring all young people, regardless of their background, and show that engineering and technology are positively beneficial to their present and future lives.

Visit The Royal Academy of Engineering’s website for more information: www.raeng.org.uk/eenp

Alternatively visit the STEM Clubs website: www.stemclubs.net

Engineering Engagement Project

In brief this project will:

- Provide engineering activity ideas to use in your club.
- Provide support information on careers, diversity and engineering.
- Support and guide new and existing STEM Clubs.
- Provide ‘Engineering in STEM Clubs CPD’ (Winter 2011).
We currently have the following resources available:

**Teacher Resources** (Support Resources)
- Engineering Engagement Project Introduction
- The Engineering Message
- Diversity
- Routes Into Engineering

**Activity Resources**
- Creating Captivating Cornflour
- Perfect Pylons
- In Control
- The Right Switch
- Moving House
- The Whole Package
- Milking It
- Smart Muscle
- Take Off
- The Engineers Brain
- Keeping It Cool
- Rescue Rail
- Making Music
- Water Power (in development)
- Manipulating Moods (in development)

21st Century Living

**Having somewhere to live is important for all of us.** However, where and how we live is constantly changing. Aspects such as having enough space, the design of a building, area or city, integration with local communities and infrastructure become increasingly important.

Our well-being in high density living relies on the suitable engineering of our security, energy and environment. Do we build high rise developments, new towns or do we follow the lead of countries such as Japan and opt for minimalist pod accommodation?

How do we integrate modern technology and the digital era into our everyday lives?

**Whatever the solutions, the engineer is essential.**

**Themes**

Within the concept of 21st Century Living, many engineering themes occur; providing great opportunities to draw upon your own experiences or relevant news items. Remember you can tailor the sessions and activities in the resources to make them suitable for your interests and the groups you are working with.

Our ‘Mind Map’ gives examples of these important themes and the relevant resources you could use.

**Transferable Skills**

The resources can also be used to help highlight the transferable skills that are helpful in being an engineer, including creativity, team work, problem solving and communication skills.

All the resources are available on the STEM Clubs website www.stemclubs.net or TES Connect (www.tes.co.uk/teaching-resources).

Keep checking the Engineering Engagement Project website for new resources and announcements (www.raeng.org.uk/eenp). You can also watch ‘How to’ videos for some of these resources at www.youtube.com/user/RAEngTV.

Our resources are intended to help support Engineering and Technology in your STEM Club. These resources are starting points. Use the activity ideas as one off or short term projects; follow the extensions or add your own ideas for longer project ideas.

The teacher resources offer you the user guidance on how to cover some difficult topics such as careers and the ‘Engineering Message’. These resources have been made so that you can mix and match. Use as little or as much as you like and tailor to your own interests and expertise.

Remember we also have ‘Engineering in STEM Clubs CPD’ available to complement the resources. See your latest Engineering Engagement Project newsletter for more details. If you are not part of The Engineering Engagement Project you can email eenp@raeng.org.uk for more information.
What is a STEM Club?

STEM Clubs are a place where creativity and exploration can flourish because, although they can enrich the curriculum, clubs are not tied to it.

Pupils of all abilities and interest can come together to investigate a variety of topics and projects, building confidence and interest in STEM subjects.

The aims of STEM clubs are:

- to enrich, enhance and extend the 11–14 yrs curriculum
- improve attainment in, interactions with, and experiences of, the STEM subjects among pupils
- improve collaboration between schools and also between schools and industry
- encourage pupils to continue their education in STEM beyond GCSE and Diploma (or equivalent qualification) level

Need help starting a club? Read through First Steps at www.stemclubs.net/about-stem-clubs/starting-a-club/first-steps-how-to,12,ART.html

The website will also give you tips on finding funding.

It can sometimes be hard to sustain a club, so try to timetable sessions so that they do not clash with other activities and use a variety of projects (one off, short and long term) to keep students interested. There are lots of activities among these resources to help get you started.

Remember there is no ‘one size fits all’ when it comes to STEM Clubs. Clubs are all different sizes, with a variety of interests.

Visit the STEM Clubs website to register online www.stemclubs.net/register

Action Plan

We recommend that you take some time looking through the resources to find the information, tasks and activities suitable for your club.

You may find it useful to complete an action plan of how you are going to use them. We have provided a blank template for you to follow (adapted from the Science Learning Centre www.sciencelearningcentres.org.uk).
<table>
<thead>
<tr>
<th>1 – Action point (What you want to achieve)</th>
<th>4 – How you are going to get to it</th>
<th>5 – Timings and key Dates</th>
<th>6 – Resources and sources of support</th>
</tr>
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**2 – Success criteria**

**3 – Longer term benefits**

**7 – Monitoring (finding out how it’s going)**

**8 – Evaluation**

**Action Plan Template**
Manufacturing
Important to our economy and engineering; the manufacturing and processes used can have a major impact on the final product, local environment and communities.

How has manufacturing changed in the 21st century?

Try THE WHOLE PACKAGE activity

Materials
Materials are essential for all types of engineering. Is the material strong enough? How do we know it won’t fail?

Engineers look at improving existing and developing new types of materials to ensure that our structures, products and future are sustainable.

Ensuring the correct choice of materials is vital for the way we live, for example we need our buildings to be strong and weatherproof.

Sustainability and the Environment
Recent concerns of being ‘green’, reducing our carbon footprint and ensuring the world is here for future generations needs the vital input of engineers.

Whether manufacturing steel girders for Olympic structures, silicon wafers for games consoles or food for supermarket shelves, manufacturing is an essential part of engineering and touches all of our lives.

Try THE RIGHT SWITCH activity

Discuss the latest developments in materials. How can they affect the way we live?

21st Century Living

Construction
This traditional engineering area is still just as relevant today as it has always been. An essential part of 21st Century living, construction can relate to public or private, corporate or personal concerns.

What gets built and how it is constructed can have a huge impact on local communities and the environment.

Try the MOVING HOUSE activity

Energy
Energy and related ideas are essential in engineering. How do we power our towns, cities and manufacturing? How do we ensure that this is sustainable?

What alternatives are there in the 21st century?

Try the PERFECT PYLONS activity

Discuss where raw materials come from and whether they will last

How does manufacturing impact on communities and the environment?

Try the MILKING IT activity

How GREEN is the school?

Can you relate to your town/city/home?
We would like you to mix and match these resources, tailoring them to your own interests and expertise. However, we have developed a 12 week programme for you if you need some inspiration. Why not dedicate a whole term of your STEM Club to engineering?

You can always extend the activities by following the extras suggested, by looking at the Mind Map or by adding your own ideas.

<table>
<thead>
<tr>
<th>Week number</th>
<th>Activities</th>
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</thead>
<tbody>
<tr>
<td>One</td>
<td>Try the ‘What does it mean to you?’ task from The Engineering Message resource. This will help you discover what your group thinks of Engineering. Follow this task by starting the ‘Milking It’ activity. Leave your plastic to dry for the following week.</td>
</tr>
<tr>
<td>Two</td>
<td>Finish the ‘Milking It’ activity; why not design a board game? Do not forget to highlight the STEM Ambassador profile. You can then find out what ‘other’ things the Club think have been engineered following the ‘A Diverse Job’ task from the Diversity resource.</td>
</tr>
<tr>
<td>Three</td>
<td>Start ‘The Whole Package’ activity</td>
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<tr>
<td>Four</td>
<td>Finish ‘The Whole Package’ activity; ask the club members to present their ideas. You could end this session by following the Role Model – Mix and Match activity highlighting the different people that become engineers, from the Diversity resource</td>
</tr>
<tr>
<td>Five</td>
<td>Why not invite a STEM Ambassador to deliver an activity or talk? Use STEMNetworking to request a STEM Ambassador: <a href="http://networking.stemnet.org.uk">http://networking.stemnet.org.uk</a></td>
</tr>
<tr>
<td>Six</td>
<td>Have a careers session. Start with the first activity on the Routes Into Engineering resource and see where the discussion takes you. Allow internet access for researching careers and following the links given.</td>
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<tr>
<td>Seven</td>
<td>Start the ‘Moving House’ activity; make your jellies and leave them to set for a week.</td>
</tr>
<tr>
<td>Eight</td>
<td>Finish the ‘Moving House’ activity; making your jitterbugs and testing your jellies. Your club has been working on and thinking about engineering for a while now; can they make an engineering word cloud display? (Getting the Message Across from The Engineering Message resource). Perhaps this could be developed into a podcast for the school website?</td>
</tr>
<tr>
<td>Nine</td>
<td>Follow ‘The Right Switch’ activity.</td>
</tr>
<tr>
<td>Ten</td>
<td>There is a resource pack for STEM Ambassadors too. Invite an Ambassador to your club to deliver one of their sessions.</td>
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<tr>
<td>Eleven</td>
<td>Start the ‘Smart Muscle’ activity, investigating the properties of the smart ‘niti’ spring.</td>
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<tr>
<td>Twelve</td>
<td>Finish the ‘Smart Muscle’ activity by developing your own robot muscle.</td>
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Why not request a STEM Ambassador?

Visit http://networking.stemnet.org.uk for more information or contact your local STEM Ambassador contract holder www.stemnet.org.uk/regions

There are many activities a STEM Ambassador could do:

- Leading Practical Activities.
- Helping Practical Activities.
- Careers Presentations (with power point/lecture style).
- Speed Networking.
- Interview Skills.
- Engineering/Technology talk (lecture style/assembly with or without demonstrations).
- Curriculum Support.
- Judging (perhaps a STEM Ambassador can start off a project and come back to judge later).
- Facilitating Industry visits.
- Help to support the activities in the Engineering Engagement Project.

It is always useful to the STEM Ambassador to give clear guidance on what you want them to do or provide; discuss the activity with the STEM Ambassador in advance of the session. Most STEM Ambassadors are not trained teachers and as so a member of school staff should always be present when they are working with students. However, the engineering expertise of STEM Ambassadors can add value to your club, bringing expert knowledge, skills and ideas.

Please do allow a STEM Ambassador time, even if it is only five minutes, to introduce themselves and explain how/why they got into engineering.

There are lots of STEM Ambassadors who have done some great work with schools.

“[I was] working with a small group of Year 7’s, talking to them about my job and answering their questions about what working was like. The fact I was a woman running my own business struck a cord with some of the girls! Also the fact that I generally worked from home was something that most of the pupils had not come across before.”

Ruth Martin,
RE Martin Consultancy,
Managing Director

“We are currently struggling to recruit engineers, and with a huge programme of work in future decades to connect renewable energy there is an ongoing need to encourage young people to take an interest in Science related subjects. This was an opportunity to create excitement and interest in schools about Science. My team of 7 are all involved. During term time 2 of us run a Science Club weekly for 1 hour. We also do a full school assembly once a term and support the school wherever else we can.”

John Wilson,
National Grid, System Development Manager
Finding Contacts

There are many ways to find useful contacts for your STEM Club:

- Local STEM Club Advisors (British Science Association www.britishscienceassociation.org/web/_Contactus/HeadOffice.htm).
- You can contact your local Contract Holder for advice (www.stemnet.org.uk/regions).
- Your STEM Ambassador may be able to get their workplace involved.
- Check your local universities or industries websites e.g. EON, Rolls Royce and Transport for London all have outreach programmes for schools.
- Do not forget your local museums or Engineering Centres e.g. The Hethel Engineering Centre in Norfolk (www.hethelcentre.com).
- The STEM Directories also provide useful contact information: www.stemdirectories.org.uk.
- Perhaps parents or siblings of club members will be able to provide support through their universities and work?

Other Resources

See what other clubs are doing on the STEM Clubs website www.stemclubs.net and view all of the Engineering Engagement Project Resources at www.raeng.org.uk/eenp including the Athlete or Machine? Which is more important in the bob skeleton event? Resource: (www.raeng.org.uk/bobresource).

The London Engineering Project www.thelep.org.uk is also a good place to start, as is the Tomorrow’s Engineers website (www.tomorrowengineers.org.uk), but there are many other resources available which will help enhance your STEM Club. Here are just a few:

- CREST Awards (www.britishscienceassociation.org/web/ccaf/CREST).
- Visit the Discover Engineering website, which brings together many different links including different sectors and careers http://www.discoverengineering.co.uk.
- Enginuity (www.enginuity.org.uk). These resources provide a clear approach to some unusual ideas.
- E.ON (www.eon-uk.com/about/education.aspx). E.ON have created a variety of educational resources to use.
- European Space Education Resources can be found at www.esero.org.uk.
- IET Faraday (http://faraday.theiet.org/teachers/index.cfm). These resources give good contextual ideas for Technology and Engineering e.g. Urban Evolution and Real Stars of Sport.
- National STEM Centre (www.nationalstemcentre.org.uk) House the UK’s largest collection of STEM teaching and learning resources, many of which are now available online.
- Practical Action (http://practicalaction.org/education/education?utm_campaign=education) There are a variety of Design and Technology and Sustainable Engineering resources available.
- SEP (www.sep.org.uk). The Science Enhancement Programme (SEP), like the TEP have many good, comprehensive resources available (online and to buy) covering a wide range of topics.
- STEM Challenges (www.stemchallenges.net) The STEM Challenges are ten activities that have been inspired by London 2012, providing a contextual and cross-curricular approach to studying the STEM subjects at 11–14 (KS3/S1-S3). Even after the competitions have finished the resource materials will be available online – why not try these with your Club?
- STEM Networking (http://networking.stemnet.org.uk) contains a resource bank with activities uploaded by a variety of people. Why not add some of your own?
- TEP (www.tep.org.uk). The Technology Enhancement Programme (TEP) offers a wide variety of resources including traditional publications which may be a useful source of facts as well as ideas.
- Visit Upd8 (www.upd8.org.uk) for a variety of interesting science resources across different key stages, each providing context for science ideas.
- Visit WISE (www.wisecampaign.org.uk/girls/fun_stuff/mind_maps.cfm) for some visually engaging and colourfully designed Mind Maps outlining the breadth of opportunities and careers you can follow within Engineering, Mobile Technology, the Natural World, and Physics.

There are a large number of other websites which offer interesting science and engineering practical ideas or career paths:

- www.data.org.uk/index.php
- www.iom3.org/content/school-and-college-pupils
- www.stemgirls.co.uk/
- www.thenakedscientists.com
- www.tryengineering.org/home.php

If you are interested in computer programming try processing.org – this website offers free software and tutorials which can be used to help explain computer programming through visual processes. Also visit The Computer Science for Fun (www.cs4fn.org) from Queen Mary University London which also provides lots of activities and useful information.

Thank You

Thank you to everyone who has helped with these resources.

Generously supported by

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www.baesystems.com/education

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