Teacher Notes

Six for Six features 6 sets of complementary resources and/or activity suggestions aligned to curriculum requirements for KS3 & 4 STEM subjects using real-world examples of Siemens technology, engineering or manufacturing principles as basis for learning.

Teachers are invited to select one or more suites of Six for Six materials to be used at their own discretion over the course of a half-term or term.

Each set of six includes:

- Comprehensive teacher notes
  - Introducing and providing an overview of key learning objectives for the six resources and/or activity suggestions
  - Curriculum matrix including learning outcomes
  - Recommendations for when and how to use the resources
  - Links to additional learning opportunities and events associated with the STEM learning framework and calendar
- Six, curated lesson plans, films, interactive learning tools, workshop or challenge event activity suggestions each linked to the other to repeat and reinforce learning opportunities

Download here

Module 1: Understanding the body and how it works – using and interpreting images to understand systems such as digestion and skeletal in the human body.

Module 2: Living in a world made by STEM – looking at the changes made to the world around us by developments in science and technology.

Module 3: Energy for thrills – seeing how the concept of energy transfer can help us make sense of everything from roller coasters to double deck buses.

Module 4: Power to the people – the quality of our lives depends upon a reliable and cheap supply of energy. This needs to be achieved without damaging the environment however.

Module 5: Getting around – transport systems are crucial to modern life but need careful planning and operation to be fit for purpose. Thought needs to be given to the technology used, organisation and energy sources.

Module 6: Building the things we need – manufacturing skills are crucial to providing the products we need but they also provide jobs and develop skills. Manufacturing uses scientific ideas, logical thinking and an understanding of the wider world.

Module 6: Building the things we need

Introduction

We are surrounded by things that people have built; the quality of our life depends upon it. They may be bespoke items that are constructed to order or designed to be manufactured on a production line. Many modern houses are built in factories and shipped to the location to be assembled.

This area of work involves many people with a wide range of occupations and drawing upon a huge set of skills. Between them they understand concepts such as the properties of materials, they call upon skills such as sequencing and troubleshooting, and they know how to work effectively as a team.

A key aspect of understanding how systems work is the concept of feedback; whether this is monitoring by humans or, increasingly, how systems themselves can be designed and run to self-regulate. Sometimes the solutions developed involve the use of particular concepts and technologies; often these are applications of ideas from science.

Manufacturing and operating systems are required to function not only in a reliable and effective way but also to minimise any negative impact on the environment. Sustainability is now built into systems from the outset and is seen as a fundamental requirement.

Educational context/curriculum links

This unit is designed to be run as a cross curricular activity, drawing together components of a number of STEM subjects as well as developing a broader agenda such as developing literacy and interpersonal skills. It could be used in a variety of ways including:

- A sequence of lessons delivered by one teacher but drawing upon a number of curriculum areas.
- A special 'STEM event', possibly using a STEM Ambassador to offer a different experience.
- A collapsed timetable session using teachers from different subject areas.

Subject references:

Maths

- Select appropriate mathematical tools and methods, including ICT.
- Use existing mathematical knowledge to create solutions to unfamiliar problems.
- Understand that mathematics is used as a tool in a wide range of contexts.
- Identify the mathematical aspects of the situation or problem.

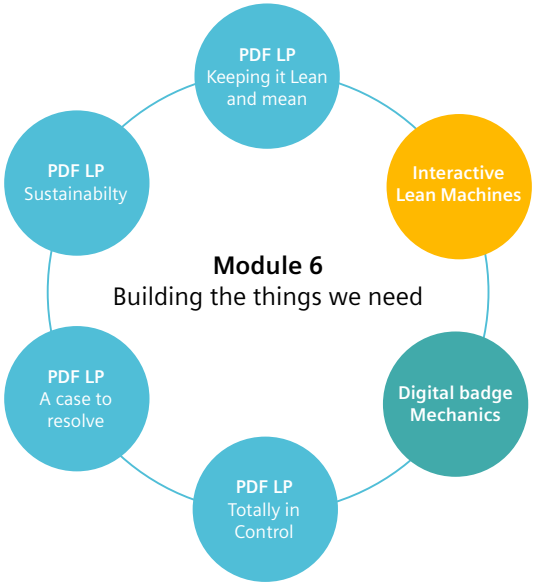
Science

- Recall, analyse, interpret, apply and question scientific information or ideas.
- Present information, develop an argument and draw a conclusion, using scientific, technical and mathematical language, conventions and symbols and ICT tools.
- Describe the use of contemporary scientific and technological developments and their benefits, drawbacks and risks.
- Consider how and why decisions about science and technology are made, including those that raise ethical issues, and about the social, economic and environmental effects of such decisions.

Technology

- Actively engaging in the processes of design and technology to develop as effective and independent learners;
- Making decisions, considering sustainability and combining skills with knowledge and understanding in order to design and make quality products;
- Analysing existing products and produce practical solutions to needs, wants and opportunities, recognising their impact on quality of life;
- Developing decision-making skills through individual and collaborative working;
- Developing skills of creativity and critical analysis through making links between the principles of good design, existing solutions and technological knowledge.

Overview of assets



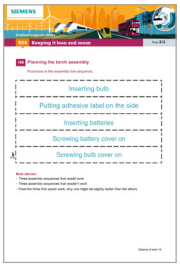
Rationale

The key idea with the activities is to get students thinking about efficient ways of doing things. This will start off with simple examples such as getting ready to come out of the house in the morning and then extending this to complex contexts such as how to organise the assembly of motor cars in response to orders.

1. Lesson plan: Keeping it lean and mean.
KS4 Scheme of work keeping it lean and mean

In this lesson plan students are challenged to understand and complete a range of activities in which they have to suggest the most logical and efficient way of organising activities. This starts with thinking about the best way of designing a kitchen so that it is easy to work in and then goes on to thinking about how the assembly of torches could best be managed. The lesson activities gradually bring in various factors such as trying to minimise the amount of stock that needs to be carried and making the process more environmentally friendly.

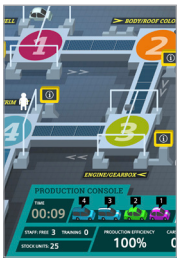
These ideas can be reinforced with home-based study following up on the theme of kitchen design.



KS4 Keeping it lean and mean student support sheet

This offers three different plans for a functional kitchen. This offers students the opportunity to study and reflect on these at home to work more independently and embed the skills of critiquing plans against considerations of efficient working. Students can reflect on these and quite possibly discuss them with other family members to broaden discussions out.

2. Interactive learning tool: Lean Machines
Students Interactives



In this resource, students are challenged to set up and manage a car production line. This introduces not only the idea that operations need to be sequenced but also that different orders need to be responded to and that assembly lines can be made more efficient by not keeping large stocks of parts.

The resource was developed in conjunction with BMW-Mini and is based on a much simplified version of their production line. There are video clips online that show how the real assembly line works and it may be useful to show a brief view of what this looks like (e.g. New Mini Production). The resource is designed to be challenging as well as accessible and it is worth trying it out beforehand to get a sense of how it works and what students may need to focus upon to succeed.

3. Digital Badge reward: Mechatronics Challenger
Siemens digital badges

This digital badge is based on the use of the Lean Machines interactive. The idea is that students would not only use the resource but also reflect upon the key points from it to reinforce the key outcomes. The second task involves describing and explaining the form and function of each stage and the third task is more open ended in that it requires an explanation of how a sudden surge in orders could be responded to effectively.

4. Lesson plan: Totally in control
KS4 Totally in control

This teaching sequence is focused on the notion of control and what it means to have a control system in place. The context of a fairground ride is used but then draws on a range of other examples such as pedestrian controlled road crossings. The sequence of sessions can then be extended into using a free programming language called Scratch, which students are likely to have met already, to set up a sequence of instructions. The context of the ride is then returned to, so that students can demonstrate their understanding of why a control system is useful.

5. Lesson plan: A case to resolve
KS4 A case to resolve scheme of work

This teaching sequence extends the idea of control in a system, using a baggage handling facility. In this, the challenge is to design a system which will read a simple code to direct items of baggage to different terminals in an airport. Students are asked to mock up and test a simple code reader and then to evaluate it against various criteria. It then goes on to explore other aspects of the context including using X-rays for security scanning.

6. Sustainability
KS4 Sustainability lesson plan PPT

Sustainability is an aspect of systems design which has recently and rapidly made a significant impact upon manufacturing and control systems. It is not always easy to retrofit such considerations and so this is now built in from the outset. The teaching sequence starts off with giving an overview as to what sustainability is and why it is important; it then goes on to challenge students to suggest how such considerations can be applied to a range of different enterprises.

Finally, there is a team challenge in which groups of students work together to present their ideas as to how such factors can be realised in a context.

Best teaching practice

There are various ways in which the resources can be used effectively but there are some key components that should be maintained.

Firstly, there is a need to support students in understanding that there are often different ways of organising manufacturing activities and control systems and that they need to be critically reflecting upon those. The idea of sequencing steps is fairly straightforward and can be developed by giving groups of students some fairly simple but multistage task to perform. If it was decided to try this out, then a net for a toy van is included; this can be downloaded and printed off. Teams of students can be given the task of assembling the largest number in a set time. However, they will soon see if they try this out then there are likely to be bottlenecks and sorting these out is the key to an efficient solution. Effective practice will involve skilful questioning to support reflection:

- How well did that work?
- How could it be improved?
- Is this the best use of manpower?
- What would be a better way of organising things?

Similarly, control systems involve not only the development of an idea but its testing and evaluation. This should include questions not only such as whether it can be made to work but also considering ways in which it might be abused or changed and reflecting on how well it would cope.

Secondly there is scope for reflection here, not only as to how things are best organised but also as to the personal skills needed. In a production team there may be a role for a manager but there may also be a need for all members to be able to make suggestions and contribute to the efficient running of the enterprise. This is an opportunity for recognition of personal traits and skills. Good production managers don't only understand processes and products but also people and how to get the best out of them. Control systems and the development of sustainability in a process similarly involve effective teamwork; this should be explicitly referred to and explored.

Thirdly there is scope for specific input upon approaches such as 'Just In Time' (JIT) production which is a much more recent development than assembly line working but which has resulted in more efficient working. It is unlikely to emerge from students' own experience of organising themselves in teams but is a major consideration in enterprises in which the components are often expensive and profit margins tight. This will need to be explained and can be reinforced using the interactive and the digital badges. Some of the teaching sequences use scientific concepts such as X-rays and ecosystems. Depending upon the age and curriculum structure students may have met these already but there is both a need to make sure that they are familiar with these and also an opportunity to provide them with examples as to how these are used commercially.

Links to careers and employment opportunities

A key point with this whole resource is, of course, that some students may feel that the skills and practices are ones that may want to develop further; it is appropriate to have further information about skills, training and employment opportunities.

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Further reference

There is an interesting comparison between a 1930s car assembly line at Fascinating 1936 Footage of Car Assembly Line and the current Mini line at: New Mini Production

There are useful summaries of the principles of Just In Time manufacturing at: What is just-in-time manufacturing JIT and JIT Just-in-Time manufacturing

To set up a simple production line with students the assembly of a cardboard cut out car can work well. Possibilities include and Papertoys and these can include thinking about the stages, allocating roles and allowing for functions such as colouring and quality control.

Scratch (scratch) is free to download and use. It commonly features in KS2 computing lessons so students may well have met it previously but if not it is relatively easy to pick up and use. The website includes tutorials, instruction cards and ideas for a wide range of applications.

Flowol (flowol) is also a way of developing programming and sequencing skills. It uses a range of mimics which represent applications such as fairground rides and enables the development of systems to be taken further.

For additional resources around these and other topics relevant to the KS4 STEM curriculum go to: KS4 Science, Maths, Technology

For additional modules, visit www.siemens.co.uk/education

Suite No.		1	2	3	4	5	6
Phase		Primary	Primary	Secondary	Secondary	Secondary	Secondary
Focus		STEM	STEM	Science	Design Technology	STEM	STEM
Module:		1	2	3	4	5	6
Title		Understanding the body and how it works	Living in a world made by STEM	Energy for thrills	Power to the people	Getting around	Building the things we need
Asset #1	Lesson plan and activity suggestions	The human body - skeletal muscular system	Clean silent trains	Formula for thrills	E-zero Island	Inspired bus company	Keeping it lean and mean
Asset #2	Lesson plan and activity suggestions	The human body – digestive system	Bus activity sheet	Monte Rosa Mountain Hut	Interactive learning tool. Energy Island	Green power challenge	Totally in control
Asset #3	Interactive learning tool	Inside the Human Body	Life without STEM	Formula for thrills	Siemens Farm	Self driving challenge	Lean machines
Asset #4	Digital Badge reward	Curiosity	Technology	Roller coaster challenge	Energy Challenger	On the move Challenger	Mechatronics Challenger
Asset #5	Lesson plan and activity suggestions	The human body – circulatory system	Words along wires	Here comes the Sun	Blowing in the Wind	Ringing true	A case to resolve
Asset #6	Lesson plan and activity suggestions	More than skin deep	Let there be light	Blowing in the Wind	Underwater Energy	A case to resolve	Sustainability