Unit 2: Smart cities

A future in STEM?

At Siemens we understand that it can be challenging for parents and carers to find ways of supporting the education of young people at home. We believe that all young people should be given the opportunity to explore their interests and discover their talents. This resource has been designed to support you in guiding your child through a range of STEM topics, to engage them and spark an interest in STEM subjects.

There are three of these in the set:

Medical Imaging

Showing how ideas about waves from Physics are used to produce stunning and exciting images of the inside of the human body.

Smart Cities

Exploring ways in which our cities are being redesigned to make them suitable for a low energy and sustainable future.

Climate Change

Showing how technologies are used to counter the causes of disastrous variations in conditions around the world.

Many people who work for Siemens are experts in STEM subjects.

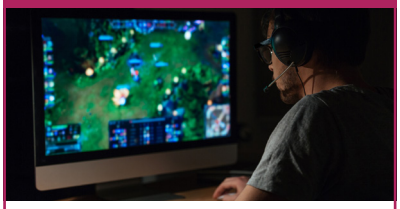
Science ↔ Technology ↔ Engineering ↔ Maths

There is a strong relationship between these subjects. Studying them enables students to follow a pathway that leads to a wide range of training and employment in STEM careers. These are often well paid, prestigious and secure.

One of the key skills for many STEM professionals is being able to draw upon a wide range of ideas. For example, large bridges are designed by civil engineers; these professionals are not scientists or mathematicians, but they use ideas and processes from those subjects and can only become qualified having studied those subjects extensively.

Young people often struggle to relate the topics they learn about in school to the real world and careers. Sometimes young people can formulate ideas in school but can't see their immediate relevance. Students in school spend a lot of time studying maths and science. In fact, many people who go on to use those subjects don't work as mathematicians or scientists but as engineers. Engineers are problem solvers; they use ideas and skills to come up with solutions. For example:

Programmer

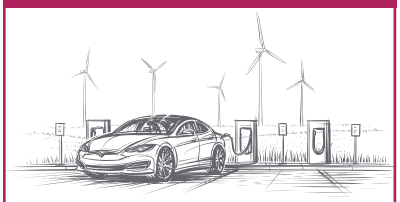


How can I use code to make a more exciting game?

Food Technologist

How can I design a cake with healthier ingredients?

Designer



How can I design an electric car with a greater range?

Smart cities

What do we mean by smart city? → How we use ideas from STEM subjects? → The challenges that are being faced → Supplying and using energy → Transportation around the city → Smart manufacturing → How to find out more

Cities as we know them present huge challenges to a sustainable future. In many cases, mass urbanisation is causing cities across the world to grow faster than infrastructure can be developed, resulting in traffic congestion, air pollution, and increasingly poor living conditions. These problems are set to get worse; by the year 2050, an extra 2.5 billion people will inhabit cities. Solving these infrastructural problems is imperative to averting social, economic and environmental catastrophe.

The engineering approach to solving this is the establishment of Smart Cities, where technological innovation and integration at an infrastructural level provide deep reaching solutions to living and working in urban environments. These innovations include smart streets, intelligent traffic systems, smart buildings and smart energy grids, all of which employ digital connectivity and sustainable energy solutions to leverage greater efficiency and sustainability from the systems by which we live.

Using ideas from STEM subjects and beyond

Smart Cities are a great example of a cross-curricular topic, taking STEM topics into the Humanities subject areas. Examining Smart Cities will introduce young people to the important 'joined-up thinking' needed to solve real-world problems and encourage them to find unexpected connections in their learning, such as how algorithms in Computing could solve global warming in Geography.

Fostering these connections is doubly important as the young people of today will be the ones to build and expand upon these smart innovations; as the civil engineers and computer scientists building and living in the cities of tomorrow.

Challenges to face

The question of how we build the cities of tomorrow seems rather huge but it can be broken down into more digestible questions:

Energy

- How can we generate the electricity needed to run the city?
- Can this generation avoid adding to dangerous emissions?

Transport

- How can we get around?
- How can this be made clean and safe?

Manufacturing

- How can factories be organised to be more efficient?
- What is a 'just in time' supply system and how is it used?

Energy

Energy can be produced in many different ways to power our cities, from renewables such as wind and solar power to storable energy such as biodiesel and green ammonia. Whilst wind and sun are free and clean, the key to providing clean energy to a Smart City lies in combining many different sources to ensure continuous energy. This can be achieved with a smart grid, which uses digital systems to switch between energy supplies to meet demand.

Your child can try the challenge of designing a smart power grid with Energy Island, a Siemens Education interactive game. Playing Energy Island, your child will apply many of the ideas about energy and power generation that they will have covered in KS3 Science, but now they must use their understanding to keep the lights on, avoid damaging the environment and balance the books for a small island.

Your child can play Energy Island at:
http://siemens.zincmediadev.com/energy/island/index.html

In Smart Cities, some consumers will also become providers as part of localised microgrids. This will form part of the 'distributed' power network which are already happening with smaller scale solar farms. City dwellers will become part of the same energy revolution, sharing excess clean electricity with their local neighbourhood from solar panels on their buildings.

Using Energy Farm, a Siemens Education interactive game, your child can build their own green energy solution, where they can decide whether to buy more energy storage or sell excess electricity to the National Grid.

Play your part in generating green electricity for the grid with Energy Farm, at:
http://siemens.zincmediadev.com/energy/farm/index.html

Transport

Transport plays a big part in the life of a city. If people and goods can move easily and without causing environmental problems, then the city will function better and be more sustainable. There are a number of ideas that are being used to improve transportation and Siemens are playing a lead role in several of them.

This video (https://www.youtube.com/watch?v=S9XyFX4FRuc&t) shows how transport plays a fundamental role in a city, touching many people's lives in different ways.

The bus featured in this is powered by (Siemens') hybrid technology; this has had a significant impact in reducing the negative impact of environmental pollution. Such developments play a key role in making cities more sustainable.

If they would like to build a model of such a vehicle the resources are at: https://new.siemens.com/uk/en/company/education/teachers/key-stage-2.html#BusActivityWorksheet

Buses, however, are not always the answer. There has been a lot of interest in recent years in self-driving vehicles. Much development has gone into these and there is a significant role here for STEM professionals.

Your child can find out more about driverless cars and have a go at programming one at: http://siemens.zincmediadev.com/selfdrivingchallenge

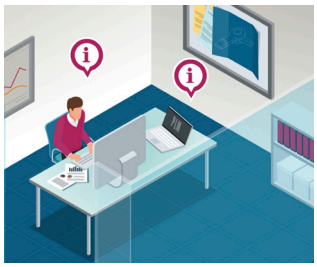
As well as control systems, the future of transportation also lies with the energy sources used. Siemens have recently installed 'Electric Avenue' the first city street to be completely updated with smart lampposts which incorporate electric charging points for cars, vans and lorries. Electric vehicles are the future of transportation, and Siemens is encouraging young people to design their own with the Greenpower Challenge. Here students use their Design & Technology skills to design, build and race their own electric car!

Inspired by the Greenpower Challenge? Watch a video here to find out what it involves:
https://www.youtube.com/watch?v=bC-7Wrp5pSw

The Greenpower Challenge also highlights that designing and building clean energy solutions involves more than subject knowledge; teamwork and communication skills are important too, not to mention fun to practice!

Manufacturing

Manufacturing zones are part of many cities' urban environments, and as such they are also due for a smart upgrade to form part of a Smart City. Smart factories will be doing their bit to make manufacturing sustainable, employing digital connectivity and intelligence to reduce waste and increase efficiency.



Visit a virtual factory and see how digital technologies are changing the way that products are manufactured at:
http://siemens.zincmediadev.com/PLM/SiemensPLM.html

Everyday products will now be manufactured using the latest digital technologies. Products can now be simulated and tested in virtual reality before they are made, whilst manufacturing machines can learn and use artificial intelligence to increase the efficiency of manufacture and the quality of products.

Working in a factory requires many different skills including managing the supply chain. Anyone who has ever ordered a new car will know that there is a range of options available; all of which have to be catered for on the assembly line. You might imagine that this is done by having large stores of parts, but that's not the way it's done in the 21st century. Managers have to plan ahead. As soon as the orders come in they have to source the components but costs are kept down by having the parts arrive just as they're needed. Could your daughter or son manage this?

They can have a go with the interactive Mini assembly line at:
http://www.tenalpscommunicate.com/clients/siemens/lean/

How to find out more

Apprenticeships

STEM careers can be approached at a range of different levels. Siemens offer a range of high-quality apprenticeships; these can be a great way into a rewarding career. They have an established apprenticeship scheme helping to support the industry of tomorrow. Find out more about the opportunities available at: https://new.siemens.com/uk/en/company/jobs/search-careers/apprenticeships.html