DISCOVERY AWARD

CREST AWARDS

ENRICH MY CLASSROOM

Student pack

TEAM PROJECT

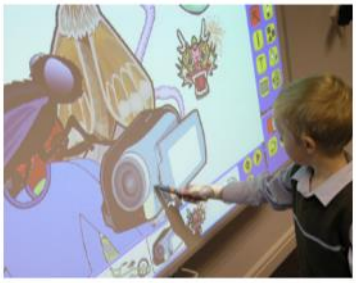
Working in teams, students are challenged to design the classroom of the future using new materials and digital tools to improve the learning environment.

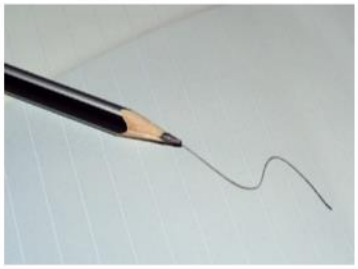
#coding
#nanotechnology
#ergonomics
#magnetism
#electricity

IN PARTNERSHIP WITH

urenco
The Energy to Succeed

30 years of classroom changes





Team roles

REMEMBER: *Your job title shows which part of the project you will lead. You are in charge of making sure that each thing gets done, but everyone on your team should contribute to all the tasks. If you have more than five members you can have multiple designers and engineers.*

Project Manager

Makes sure that the whole team and the project is on track.

Communications Manager

This person is responsible for ensuring that the team communicates its ideas effectively when presenting to the other teams. They are responsible for coordinating the presentation.

Market Research Manager

The person in this role will gather evidence, data and other resources to support the development of ideas for the classroom.

Research Manager

This person will help other members of the team to gather examples and evidence using various resources, including the workshops, and report back on this as part of the presentation.

Designer

This person is responsible for taking the knowledge and information gained from the workshops and developing it into ideas that will provide new solutions in the classroom.

Engineer

The role of the engineer is to ensure that the implications of the design ideas are thought through. They should work with the designer to sketch ideas and question how they will work. This person will also be responsible for researching the materials and technology required to make the design ideas work.

Research workshop: Coding

Instructions

The use of computer programs has changed the way we live our lives. One of the greatest impacts has been through the development of the World Wide Web. It was designed by British Physicist Sir Tim Berners-Lee to allow researchers to share data easily. The result was a set of protocols that have been adopted more widely and have transformed the way we access and share information.

Working in pairs, the aim of the workshop is to investigate what we use computer programs for and how they are designed. By the end you will have investigated apps and why we use them.

You should make notes as you go through this workshop as you will need to share your findings with your teammates.

Part 1: Writing a program

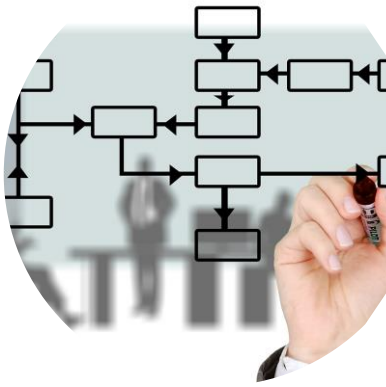
1. Working in pairs, write down the steps for how to make a jam sandwich.
2. Swap the instructions with another pair and use them to make a jam sandwich. Are the instructions accurate? Are any changes needed?
3. When writing a program for a computer or app, logic statements or flow charts can be used to replace the sentences used to describe a task. Review your steps and try to replace the sentences used with logic statements or flow charts. You can look at the examples in the **Logic statements** and customise them for your task.

Part 2: How do programs and apps enrich our lives?

1. Investigate different apps that you use regularly. Begin by reading about the different types of apps available in the **App fact file.** What types of apps do you use and what categories are they in?
2. Summarise what you like and dislike about a selection of apps and describe how they might be used in the classroom.

Research workshop: Coding

Logic statements



A task can be broken down into different steps. To begin thinking about transforming your description into a program, you can re-write the steps using logic statements.

There are different actions that a program will perform that depend on what is happening. By using logic statements, we can think about how a program will work.

Statement	Description
AND	To move onto the next step, both conditions must exist.
OR	One or the other condition must be satisfied to move on.
IF THEN ELSE	This tests whether a condition exists and tells us what to do if it does.
END	Finish.

For example, you want to make enough jam sandwiches for two people and then stop. This could be written as:

IF the number of jam sandwiches <2 **THEN**
Choose two pieces of bread
Butter one side of one piece of the bread
Add jam on top of the butter
Put both pieces of bread together with the jam layer in the middle
OR IF the number of jam sandwiches = 2 **THEN END**
END

Now rewrite your task using the logic statements. Try to keep it simple.

Research workshop: Coding

App fact file

There are millions of apps available for use on smartphones and tablets. In general, they can be sorted into one of the five categories below.

As you read through the information, write down the names of apps you can think of that haven't already been mentioned.

Fitness

Using GPS trackers and other sensors, fitness apps often gather data about the exercise you are doing. They track the distance you cover and the time you've taken to calculate your speed. Using this information alongside maps means that apps can see how you've improved. Other types of fitness apps provide you with a training programme to follow. Your activity is then used by the app to determine prompts.

Example apps: Fitbit Coach, My Fitness Pal, Couch to 5k, Run 5k

Lifestyle

We all have different hobbies that we enjoy. These could include exploring the outdoors, reading or cooking. Whatever your interest, there are a broad range of apps that help you to enjoy your leisure time and, in general, they all aim to make some aspect of your life easier. This could mean having access to your books as an eReader, having detailed maps to hand, storing recipes or having quick access to price comparisons for a piece of clothing you want to buy. Lifestyle apps also include apps for ordering takeaways, arranging a delivery or buying items online.

Example apps: Pinterest, Kindle, OS Mapfinder, Deliveroo, eBay

Education

These apps are designed to support learning. Some education apps provide content, including interactive graphs and demonstrations, and reduce the need for textbooks. Other education apps help to organise your classwork by allowing you to add details of homework assignments, deadlines and so on. There are also apps that allow you to carry out analysis on scientific experiments and to interact with lessons, for example through quizzes or polls.

Example apps: ClassDojo, Instructables, Google Classroom, Duolingo

Communication

With high-speed 4G mobile connections and readily available WiFi, it is easy to stay connected with friends and family. Most message apps available now do not charge per message and will only require a WiFi connection or other mobile signal to send. We are not just restricted to sending text, either – photos, videos, emojis and GIFs are popular ways of communicating.

Example apps: SnapChat, WhatsApp, Facebook Messenger

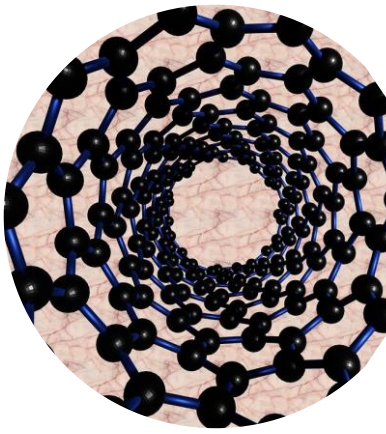
Gaming

Many of us now choose to entertain ourselves through some form of gaming. Various consoles have been developed and smartphones and tablets are also offering a more sophisticated selection of games. While some are free and others must be purchased, a huge variety of games are now available.

Example apps: Angry Birds, Farmville, Candy Crush

Research workshop: Nanotechnology

Instructions



Nanotechnology has allowed the creation of a large range of different products with applications in healthcare, technology, communication and many other areas. Nanotechnology refers to items which are very small in size and will often require the manipulation of atoms and molecules.

Working in pairs, the aim is to investigate what nanotechnology is and to find some specific examples. Can nanotechnology be used to enrich your school? You should make notes as you go through this workshop as you will need to share your findings with your teammates.

Part 1: What is nanotechnology?

1. Read the **Magic Sand and Ferrofluid fact file**. If you have some, explore the nanotechnology materials available.
2. To get an idea of the difficulties of controlling items on a small scale, each team member should work with their partner to lay out the letters of a word (e.g. your name) using counters or beans whilst wearing large gloves.
3. Research some more examples and applications using the **Nanotechnology fact files** provided and your own internet research.
4. Share your findings with the rest of the group.

Part 2: Nanotechnology in school

1. Using the knowledge that you have gained about nanotechnology, think about what products are available that help with the following challenges at school? Pick at least two to research.
    a. Graffiti
    b. Stains on clothes
    c. Waterproofing of technology, e.g. phones
    d. Heat loss
    e. Electricity generation
2. How would using these impact on your school environment?

Research workshop: Nanotechnology

Fact file: Magic sand and Ferrofluid

Magic sand

Also known as hydrophobic sand, this is just ordinary sand that has been coated with a special compound that repels water. This means that when the sand is submerged in water and removed it stays completely dry.

It is now commonly found as a toy, but it was originally developed to trap oil spills that occur near the shoreline. The hydrophobic sand would be poured on top of the oil to mix with it and sink, and the oil would then be removed. However, it turned out that this was too expensive to produce.

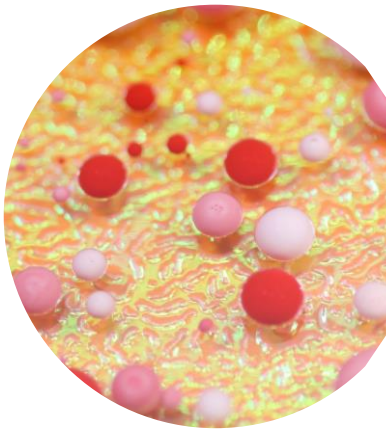
Ferrofluid

This dark fluid consists of a large number of iron oxide particles in oil. The particles move and react when in the presence of a magnet, and this produces some exciting patterns. To prevent the particles being pulled out of the oil when near a magnet they are coated with a surfactant.

The fluid was developed in the 1960s by NASA as a potential basis for a rocket fuel that worked in zero gravity. Today it is found in a wide range of fields, including engineering, medicine and materials science.

Research workshop: Nanotechnology

Fact file: Medicine



The potential for using in nanotechnology in medicine is very broad. Many of the examples below are at an early stage of research and have not been approved for use yet.

Medical sensors

During diagnosis or treatment, patients are monitored in all sorts of different ways. This can include checking heart rate and blood pressure and often the monitoring has to be carried out by a doctor or nurse. Nanotechnology could mean that hospitals can gather information about a patient without having to use lots of uncomfortable procedures. Instead of taking blood samples from patients or asking them to wear a heart rate monitor, for example, a very small implant could be used to monitor a patient.

Cancer treatment

When it comes to the treatment of cancer, nanotechnology can be used to make molecules (groups of atoms) that directly attack the cancerous cells. These types of molecules are called peptides and are used along with radioisotopes produced by companies like URENCO. Radiation is commonly used to treat cancer, but this type of treatment is on a very small scale, which means that healthy tissue surrounding the cancer cells is less likely to be damaged.

Imaging

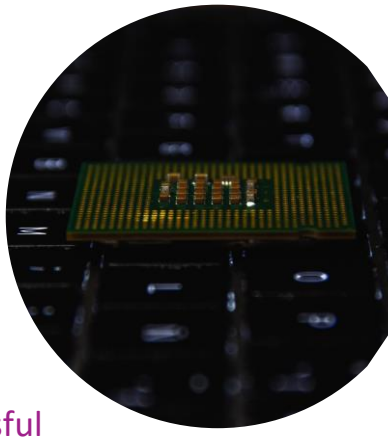
Visits to a hospital can often mean an X-ray, ultrasound or MRI scan. These give general pictures of the bone, brain or another part of your body. The details in these pictures can be interpreted by radiographers, doctors and nurses. However, nanotechnology could be used to highlight specific molecules or cancerous tissue in these scans and could speed up and increase detection rates of cancer. This would be achieved by injecting specially designed nanoparticles into the body before a scan. These would then search out and attach themselves to a tumour.

Tissue engineering

It is very common for people to have a knee or a hip transplant. Often these are made of strengthened metals such as titanium. However, nanotechnology could be used to repair bones, joints, and it could even find a role in organ transplants. Nanoparticles could be used as the basis of a new organ or bone tissue, with growth taking place on top of the nanostructure. The types of materials suitable for this application, particularly when it comes to bones, include graphene and carbon nanotubes. These are very strong but also very light materials.

Research workshop: Nanotechnology

Fact file: Computing



Many of the leaps forward in computing have been through the successful miniaturisation of a part of a computer. With the increased use of nanotechnology there are improvements being made that in the not-too-distant future will mean faster computers that are able to store lots more information than the average desktop computer available today.

Computer processors

The materials traditionally used to make many components within a computer, in particular the processor, can heat up. This is because there are so many powerful components in such a small space. This heat can limit the number of components that can be used, and this restricts the processor speed. However, if nanomaterials such as carbon nanotubes were used, then the processors could be lighter weight and would not get as hot. This would allow for the processors to become even faster. It would also have the effect that the computer would need less power to run, extending the battery life of lots of different computing devices.

Computer memory

The typical ways of storing information are being challenged as computer companies, such as Hewlett Packard and IBM, search for ways to store more information on a smaller scale, including researching ways that nanotechnology might help. Specifically, they are building networks using nanowires. These are tiny, tiny (nano) wires made of iron and nickel, with different sections being magnetic and non-magnetic. You can store information on these tubes coded in magnetic and non-magnetic parts, which is small-scale and low cost.

Quantum computing

Small-scale manufacturing has improved over time to mean that we have been able to build better and faster computer microchips. However, the ways in which these components work has not changed much.

One area of research that could change all of this is called quantum computing. This uses theories from quantum physics (the study of how matter behaves at a very small scale) to build a new type of computer microchip. URENCO's Stable Isotopes division will soon begin enriching Silicon-28 for use in this new type of computer. One example being worked on by Google could operate 100 million times faster than an ordinary computer, with the potential to revolutionise the way we work and live.

Research workshop: Nanotechnology

Fact file: Electricity generation

The impact of nanotechnology in this sector generally means more electricity being produced at a lower cost and with reduced losses of energy.

Solar power

The most common way to generate electricity from the sun is to install large solar panels on the roofs of buildings, or on a wide flat piece of land. The light from the sun is then used to generate electricity for that building or area. Any surplus electricity can be sold to the National Grid to be used elsewhere.

Nanotechnology can be used to create solar panels that are much thinner and smaller than those currently being made. This could mean that individual devices, such as phones, have their own power source as this smaller type of solar panel could be incorporated into the existing technology. Solar panels could also be put onto the surface of windows using a film made from nanoparticles.

Wind power

Wind turbines are gathered in locations called wind farms, usually situated on a hillside where there is a high average wind speed. The wind turns the blades of the turbine because, as the air moves past the blades, they interact via the force of friction. The design of the wind turbine blades means that they turn as a result of this force.

The wind turbine structures are tall and have long blades because wind speed increases with height and the higher the speed, the more electricity generated. However, with some wind turbines over 100m high this can mean the structure is very heavy. To generate as much electricity as possible, the blades of the turbine should be light and easy to turn. Nanomaterials using carbon are lightweight and strong. These could be used as part of the structure of the wind turbines and would increase the total electricity output.

Research workshop: Nanotechnology

Fact file: Clothing

Clothing designers and manufacturers are now thinking more about the ways in which the environment around us affects us, and how this might influence what we wear.

Waterproofing and stain proofing

Silicon dioxide, also known as silica, is added to many different types of clothing. The properties of silica mean that it repels water and other liquids. The liquid will stay on the surface and can either be brushed off or will roll off by itself.

Not all nanotechnologies are new – silica has in fact been used for hundreds of years, but the process of being able to add it to textiles is a more recent development.

UV protection

UV radiation from the sun can damage the skin, causing sunburn. With extensive exposure there is also the potential for skin cancer.

Your clothing doesn't always protect your skin because the UV radiation might be able to pass through the material. Nanoparticles such as titanium oxide or zinc oxide can be added to clothes that will protect you from UV rays. They prevent the UV from getting to your skin as they reflect it away.

Antibacterial

Silver nanoparticles have been found to be able to control the spread of fungus and bacteria by interrupting their growth. When added to clothing (such as socks) this can prevent a smell from developing!

Research workshop: Ergonomics
Instructions

Ergonomics is an area of science that designs products and systems with the needs of the user in mind, by combining fields such as human biology and engineering.

People who work in ergonomics study a place, such as a school or classroom, and make it better by designing new products or ways of doing things. For example, in school you spend a lot of time sitting and writing, so we can use ergonomics to design things like the chairs that you sit on and the things you write with.

In this workshop you will work in pairs to investigate the design of tools for seating and writing. You should make notes as you go through this workshop as you will need to share your findings with your teammates.

Part 1: Seating solutions

1. Use the **Seating risk assessment** to assess how your partner is sitting. These assessments are carried out in workplaces on a regular basis to ensure that the equipment and furniture provided is suitable for each member of staff.
2. There are many types of seating now available, including yoga balls and chairs with different arm or back rests. In some cases, seating has been replaced by standing desks. Using internet research, make a list of the types of seating available and why they may be used.
3. Is there a type of seating that you would recommend for your partner?

Part 2: Writing tools

1. There are lots of different writing tools available. Get your partner to try out the different pens and writing tools. Ask them questions about what they like and dislike in different pens, what they find more comfortable, and what they would like in a writing tool.
2. Using the materials provided, design a new grip for a pen for your partner. Start with a sketch and then make a model. You can do this using an existing pen as a base.

Seating risk assessment

Name	
Assessed by	
Date	
Average time seated (hours per day)	

Question	Yes / No	Comments
Is the desk at a satisfactory height? For example, can you sit comfortably and write?		
Is there adequate leg room under the desk to sit comfortably?		
Is your chair fully adjustable (seat height, back height and back tilt)?		

Further comments

Research workshop: Magnetism

Instructions

Information can be stored by adding a magnetic property to a material. For example, credit cards store information on a magnetic strip and hard drives work by adding a magnetic property to a metal disc. This magnetism allows us to store information as a 1 or 0. A string of eight 1s and 0s can then be used to represent letters, numbers and other characters. This is known as binary code. Using this, you can write ‘a’ as 01100001 and ‘A’ as 01000001.

Through this use of magnetism, miniaturisation of computer hard drives has been made possible. This has meant the development of technologies such as phones, tablets and cloud storage, where your data is stored remotely and accessible on multiple devices.

Working in pairs, the aim of this workshop is to investigate how magnetic force is used to store information and how it has affected the development of technology.

Part 1: Magnetic storage

1. Using the table provided write your first name in binary, using the metal object to represent a 1 and the plastic object to represent a 0.
2. Choose another word to write in binary, but keep it secret from your partner.
3. Fix the items to the table so that they don’t move. You can use Blu Tack or something similar for this. Cover your word using the card provided.
4. Swap with your partner and ‘read’ their word using a magnet.
5. Our devices store large amounts of information. If a book containing 500,000 characters is to be stored on a device, how many 1s and 0s are needed in total? How much physical space would you need to lay out the 500,000-character book on grids as you have just done for your name?

Part 2: Magnetic memory

1. Using the internet, research the different devices that use a hard drive. Make a list based on what you find. Looking back 10, 20 or 30 years, were any of these devices originally bigger? If they have become smaller, has this changed the way they have been used?
2. What is cloud computing? Is this used in your school? Are there ways in which this could enrich the classroom?

Research workshop: Magnetism

Binary table

Character	Binary	Character	Binary
A	0100 0001	a	0110 0001
B	0100 0010	b	0110 0010
C	0100 0011	c	0110 0011
D	0100 0100	d	0110 0100
E	0100 0101	e	0110 0101
F	0100 0110	f	0110 0110
G	0100 0111	g	0110 0111
H	0100 1000	h	0110 1000
I	0100 1001	i	0110 1001
J	0100 1010	j	0110 1010
K	0100 1011	k	0110 1011
L	0100 1100	l	0110 1100
M	0100 1101	m	0110 1101
N	0100 1110	n	0110 1110
O	0100 1111	o	0110 1111
P	0101 0000	p	0111 0000
Q	0101 0001	q	0111 0001
R	0101 0010	r	0111 0010
S	0101 0011	s	0111 0011
T	0101 0100	t	0111 0100
U	0101 0101	u	0111 0101
V	0101 0110	v	0111 0110
W	0101 0111	w	0111 0111
X	0101 1000	x	0111 1000
Y	0101 1001	y	0111 1001
Z	0101 1010	z	0111 1010

Research workshop: Electricity

Instructions

There are many way that we generate electricity for use in our homes, businesses and schools. We are currently aiming to use fewer sources that produce large amounts of CO2 emissions, such as coal-fired power stations.

The sources that have little or no CO2 emissions during operation are nuclear power stations or renewable energies such as wind, solar and hydro-power. It is also useful for electricity to be generated locally to where it is used.

In this workshop you will work in pairs to investigate ways of meeting your school electricity needs using local sources. You should make notes as you go through this workshop as you will need to share your findings with your teammates.

Part 1: How is electricity produced

1. Write down a list of the different ways you can think of to generate electricity. For each item on your list, add a description of how you think it works.
2. Most forms of electricity generation, except for solar panels, require some kind of movement. Using the materials provided, investigate how moving a magnet near a coil of wire can produce electricity.

Part 2: Electricity in school

1. Make a list of the items in your classroom that are used to help you learn. How many of these require electricity? Are there alternatives that would use less electricity?
2. Do you think that in the future there will be more or fewer items in the classroom that will require electricity?
3. How much electricity do you need to run a classroom for a whole school day? You can estimate this using the **Power usage fact file** and your own internet research.
4. Are there ways you could reduce this? How could you generate energy at school? You can use the **Movement fact file** to begin your research.

Research workshop: Electricity

Fact file: Power usage

When power companies measure electricity usage for bills, they will write this down in terms of a kilowatt hour. This is a measure of energy.

However, appliances are generally described in terms of the power they use, and this is measured in watts or kilowatts. The power needed to run a variety of items found in the classroom can be found in the table below.

Item	Power (kilowatts)
Desktop computer	0.2
Laptop	0.65
Lighting	1.0
Interactive whiteboard	0.0025
Digital projector	0.2

To find the total energy in kilowatt hours for each item you should multiply the power by the number of hours the item is used for (this could be a fraction of an hour):

Energy (kilowatt hours) = Power (kilowatts) x Time (hours)

To get the total electricity used in the classroom for one day, you should perform this calculation for each item based on how many hours it is used for, and then add up the energy used by all the items. Don't forget that there may be multiple computers or laptops in the one classroom.

Feedback

Use the worksheet below to make notes about the feedback from the different workshops and start making links between them.

Coding

Nanotechnology

Ergonomics

Magnetism

Electricity

Links

Planning guide

Your challenge: Come up with a way to enrich your classroom using ideas from at least two of the workshops.

Get started

Start by thinking about some different things that you think could be improved in your school or classroom. Could any of the technologies you explored in the research workshops help with these?

Things that could be improved in your classroom or school

Brainstorm ideas

In the previous session you identified links and connections between the workshop topics. These might provide inspiration for a new idea or product for you to develop.

This could mean designing an app, finding a new way to use technology in your school, or designing a new type of classroom.

- **Design an app:** What kind of app could be useful at school?
- **Classroom ergonomics:** How could you make the classroom more comfortable? How could you make it more efficient for learning?
- **Energy generation:** How could you make electricity at school? Is there a way you could use a new technology to do this?

TIP!

*You should aim to combine ideas from **at least two** of the different workshops.*

Idea development

Research and develop your concept

Start by researching your ideas. Look into what similar products already exist and how they work.

- Would your tool work? What kind of technology would it use?
- How would you test your idea to see if people would use it?

Design your product

You will need to make decisions about the physical designs of your product.

- Who is your product be aimed at? How will it be useful for them?
- What is the physical format of your product?
- What will you do to ensure that your tool will be safe?
- How will you make your design both fit for purpose **and** attractive to consumers?
- What is the reasoning behind your design?

Prepare your presentation

In the final session your team will present your ideas. In your presentations you should include:

- An overview of what you are enriching in the classroom
- Information on how you came up with the idea
- Discussion of your idea in more detail, including sketches, drawings or images to illustrate how your solution works

Every team member must contribute to the presentation. It should last no longer than 5 minutes. If there is time available, the other teams will be able to ask you questions.

Idea development

Use the worksheet below to develop your idea further. You might like to draw a diagram.

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email: crest@britishscienceassociation.org