

Design Technology: Arconic Kitts Green

TEACHER Guide

Objectives

The virtual field trip to Arconic Kitts Green and the associated learning activities can be used to support the following learning objectives:

- ◇ Select from and use a wider, more complex range of materials, components and ingredients, taking into account their properties (Key Stage 3, National Curriculum for Design and Technology)
- ◇ Understand and use the properties of materials and the performance of structural elements to achieve functioning solutions (Key Stage 3, National Curriculum for Design and Technology)
- ◇ Consider health and safety in all of its aspects (GCSE Design & Technology)
- ◇ Be aware of current commercial/industrial processes (GCSE Design & Technology)
- ◇ Understand how metals are used, processed for use, and how they can be recycled (GCSE Resistant Materials, GCSE Product Design, GCSE Engineering)
- ◇ Recognise the working characteristics of common forms of metals, and know that they can be combined to form alloys (GCSE Resistant Materials, GCSE Engineering)
- ◇ Understand energy use in manufacturing (GCSE Engineering)

Learning activities

Students could:

- ◇ Carry out a risk assessment for either one section of the process (such as casting the ingots or rolling the plate) or for the full process:
 - ◇ What are the potential hazards?
 - ◇ What are the risks from these hazards?
 - ◇ What control measures are used to minimise these risks?

(Supporting resources: Risk Assessment PowerPoint and worksheet) [Download Here](#)

- ◇ Produce a flow chart showing how recycled aluminium becomes finished plate. This should detail all of the processes and equipment used.
- ◇ Carry out a product analysis of an aluminium product, such as a drinks can. This could use an approach that the learners are familiar with, such as ACCESS FM or CAFÉ QUE. What are the properties that make aluminium suitable for this product? How does it get these properties? What other products would these properties make it suitable for?

(Supporting resources: ACCESS FM PowerPoint and worksheet) [Download Here](#)

- ◇ Make a list of all the different resources that are used during the manufacture of the aluminium plate; this should include the material, water and energy. For each, describe how it is used (for example, energy is used in the plant ranging from melting the recycled aluminium and heating the ingots, to powering the rollers, computer screens and even the lighting) and any steps being taken to reduce the impact on the environment (for example, use of recycled aluminium, cleaning and recirculation of water etc.).
- ◇ Carry out a 1, 2, 3 review of the virtual field trip, detailing:
 - ◇ 1 thing you already knew
 - ◇ 2 questions that you need to ask
 - ◇ The 3 most important things that you learnt today.
 (*Supporting resources: 123 Review PowerPoint and worksheet*) [Download Here](#)
- ◇ Careers activity: Create a table with two columns. In the first column, list the job role of each of the people introduced during the virtual field trip. In the second column, list the education and training that supported each person in achieving their job role.

Key questions

- ◇ What control and safety measures are put in place at Arconic to minimise risk to workers?
- ◇ What are the potential hazards, risks and associated control measures in rolling sheet aluminium?
- ◇ Why is aluminium a suitable material for making a drinks can?
- ◇ What are the properties of aluminium? How does adding additional metal to aluminium affect its properties?
- ◇ What resources are used in the manufacture of aluminium plate?

Keywords

Keyword	Definition
aluminium	A non-ferrous metal extracted from bauxite clay via a smelting process.
alloy	A mixture of two or more metals, normally giving properties that are better than the pure metal.
ingot	A solid block of metal made by casting molten metal.
non-ferrous metal	Metals that do not contain iron. Examples are aluminium, copper, lead and tin. Have good resistance to corrosion.
plate mill	A manufacturing plant that uses rollers to reduce the thickness of a cast slab.
ultrasonic non-destructive testing	An inspection method that uses ultrasonic sound waves to detect defects in a material.



Geography: Arconic Kitts Green

Objectives

The virtual field trip to Arconic Kitts Green and the associated learning activities can be used to support the following learning objectives:

- ◇ To investigate the influence of site and location for manufacturing.
- ◇ To know about the production or supply chain from raw materials to customers and the production process.
- ◇ To understand how a multinational business adds value to products in an efficient way.
- ◇ To develop an understanding of a range of jobs related to manufacturing.
- ◇ To understand the different pathways to a career in manufacturing and to relate this to their own career choices.
- ◇ To explore the importance of corporate social responsibility to a range of stakeholders.

(GCSE Geography/Human Geography/Manufacturing processes and adding value; Behaviour and impact of transnationals or multinationals and global interdependence)

Learning activities

Students could:

- ◇ Work in pairs or small groups to list as many products as they can which are made from aluminium components. Share findings to produce a class list.
- ◇ Find the site and location of Arconic's Birmingham factory at Kitts Green using an online map. Mark it on the world map. Find another Arconic factory located somewhere else in the world and suggest reasons for that location. As a class, collect findings about other Arconic locations, marking these on the map. *(Supporting resources: Where does Arconic operate? worksheet)* [Download Here](#)
- ◇ Consider the different parts of the production and supply chain for turning bauxite into manufactured aluminium sheets for Airbus UK in Bristol, and complete the diagram on the Supply chain PowerPoint. Using the videos and further internet research, explain why turning bauxite into the ingots is a global process. Describe the process of hot milling and rolling a slab, and find out what Airbus UK do with the aluminium sheets. *(Supporting resources: Supply chain PowerPoint)* [Download Here](#)
- ◇ As a class, decide who the stakeholders are for Arconic in Kitts Green. Discuss why Arconic gives its employees time to support the local community, and identify the costs and benefits of the company's support in the community. Is corporate social responsibility worth it?
- ◇ Find out how Arconic, as a multinational, is working towards reducing its footprint in terms of environmental impact. Identify the stakeholders who would benefit from Arconic reducing its impact in these areas.
- ◇ Careers activity: Make a list of all the jobs mentioned in the virtual field trip, then add some of the skills required for each job and comment on the training needed in order to do it.
- ◇ Careers activity: Use the To be my future self cards, and identify nine cards they think fit themselves. They should organise these into a diamond with the most important at the top. They can then use the Job card questions sheet and answer each of the questions or explain the statements. Finally, they can share their answers with another student. *(Supporting resources: To be my future self cards; Job card questions)* [Download Here](#)

Key questions

- ◇ What makes Arconic a multinational or transnational company?
- ◇ Where does Arconic operate and why?
- ◇ What is the production or supply chain from raw material to finished aluminium product?
- ◇ How does Arconic Kitts Green add value to the aluminium ingots it is supplied with?
- ◇ Is corporate social responsibility worth it?

Keywords

Keyword	Definition
added value	The difference between the selling price of a product or service and the cost of inputs such as materials and components.
apprenticeship	A paid job with training. Apprentices earn while they learn and often gain a recognised qualification at the end of the apprenticeship.
competitive advantage	An advantage over competitors that is enjoyed by a firm or country, such as cheaper costs, more highly skilled workers or better technology.
career pathway	A chosen route through education into jobs. Following a particular pathway involves making key decisions about one's education and training. It is helpful to have an end goal or ambition in mind.
corporate social responsibility	The idea that companies should take responsibility for the impact their activities have on customers, suppliers, employees, communities and the environment.
economies of scale	The savings you can make when levels of output increase, thereby bringing down the cost of production per unit.
employability skills	Essential skills that are required by employees in order to perform their tasks well. They are often transferrable between jobs.
ingot	An oblong block of metal cast in a convenient form for shaping and storing.
interdependence	When people or countries depend on each other.
job description	A description of the purpose, tasks, duties and responsibilities of a job.

Keyword	Definition
job satisfaction	Describes how content or happy you are with your job.
mass-produced	When large numbers of a standard product are made using automated processes.
milling	A process by which metals can be shaped.
minerals	Minerals are chemicals in rock form that can be extracted and processed to create useful materials. Examples are gold, copper, nickel, cobalt and platinum ores, all of which can be crushed and heated to extract metal.
multinationals	Companies with business interests in several countries.
on the job training	Training that takes place while you are working. It is often skills based.
ore	Rocks that contain metals. The metals can be extracted by crushing the rock and heating (smelting) until the metal melts and separates from the other elements in the rock.
production chain	The steps or stages needed to transform raw materials into a finished saleable product. Each stage adds more value.
quality control	A series of processes and checks carried out to ensure that a product meets set standards.
recycling	The conversion of the component materials of rubbish into reusable materials to reduce waste.
specialisation	When a person or company focuses its activities on a narrow area in which they become expert.
stakeholders	People or organisations with an interest in the success of a business, or who are potentially affected by its actions.
sustainable manufacturing	The processing and manufacture of resources in a way that minimises the negative environmental impact.
waste management	What we do with waste products in order to minimise the damage to the environment.



Science: Arconic Kitts Green

Objectives

The virtual field trip to Arconic Kitts Green and the associated learning activities can be used to support the following learning objectives:

- ◇ Understand real-world techniques for testing material properties, and gain a greater knowledge of a range of scientific professions (Key Stage 3 and 4 National Curriculum for Science)
- ◇ Know that ultrasound waves are partially reflected at boundaries which allow them to be used for non-invasive imaging (GCSE Physics)
- ◇ Understand that metals such as aluminium, are derived from ore, and can be recycled (GCSE Chemistry)
- ◇ Understand the physical and chemical properties of aluminium, and the impact of creating alloys on the material properties (Key Stage 3 National Curriculum for Science, GCSE Chemistry)
- ◇ Know the force-extension relationship for materials, and the linear response for elastic deformation (Key Stage 3 National Curriculum for Science, GCSE Physics)

Learning activities

Students could:

- ◇ Conduct an experiment to investigate the relationship between load and extension for a variety of materials. Plot graphs of the results, identifying Young's Modulus for elastic deformation, the yield strength, and the ultimate strength of the materials. Fine gauge metal wires can be used where they respond sufficiently to load, and where suitably sensitive measurement devices are accessible.
(Supporting resources: *Load-extension graph PowerPoint*) [Download Here](#)
- ◇ Annotate a screenshot of the ultrasonic testing equipment to explain how ultrasound is used to detect defects in metal slabs. They could then answer the question: why is ultrasound used in these tests?
(Supporting resources: *Ultrasound worksheet and PowerPoint*) [Download Here](#)
- ◇ Use sample ultrasound data to determine the thickness of aluminium sheets and plot the results for a test scan.
(Supporting resources: *Ultrasound worksheet and PowerPoint*) [Download Here](#)
- ◇ Sort the stages of the aluminium recycling process into the correct order and match them to their descriptions.
(Supporting resources: *Aluminium recycling process cards*) [Download Here](#)
- ◇ Investigate the material and chemical properties of aluminium: magnetism, corrosion/oxidisation, strength, hardness, density. Students should then list as many aluminium products as they can think of. What are the properties of aluminium that make it a suitable material for each of these products?
- ◇ Careers activity: Create a table with two columns. In the first column, list the job role of each of the people introduced during the virtual field trip. In the second column, list the education and training that supported each person in achieving their job role.

Key questions

- ◇ How does the load placed on different materials affect their extension?
- ◇ What does elastic deformation mean? What does plastic deformation mean?
- ◇ How does ultrasonic non-destructive testing work and why is it used?
- ◇ How is the depth and position of a fault calculated from an ultrasound signal?
- ◇ What are the physical and chemical properties of aluminium? Which properties make aluminium suitable for different products?
- ◇ Describe how aluminium is recycled and turned into ingots. What role does recycled aluminium play in Arconic's business?

Keywords

Keyword	Definition
aluminium	A non-ferrous metal element extracted from bauxite clay through electrolysis.
alloy	A mixture of two or more metals, normally giving properties that are better than the pure metal.
corrosion	The process by which metals react with other elements in the environment to form stable compounds, either as oxides or hydroxides.
dross	Scum that forms on the surface of molten metal as a result of impurities.
eddy current separator	A device which uses magnetic fields to separate non-ferrous metals.
elastic deformation	A temporary, self-reversing change in the shape of an object caused by an applied force.
ingot	A solid block of metal made by casting molten metal.
load	An applied force.
metallurgist	A scientist specialising in the physical and chemical behaviours of metals, their compounds, and their alloys.

Keyword	Definition
non-ferrous metal	Metals that do not contain iron, and are not magnetic. Examples are aluminium, copper, lead and tin.
oxidise	Chemically react with oxygen to form compounds.
plastic deformation	A permanent change in the shape of an object caused when the applied load exceeds the yield strength.
strain	The amount an object is deformed, divided by the original length of the object.
stress	The force per unit area applied to an object.
ultrasonic non-destructive testing	An inspection method that uses ultrasonic sound waves to detect defects in a material.
ultrasound	High frequency sound waves used for imaging.
ultimate strength	The maximum stress a material can take without failing.
yield point	The stress at which a material begins to deform plastically, rather than elastically.
Young's modulus	A measure of the amount a material will deform (by extension) when a force is applied. It is also known as the modulus of elasticity.