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| **Design your own sustainable aircraft** |
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| Understand sustainability issues in engineering and how these are applied when designing a product |
| Subjects: Design and Technology, EngineeringApprox. time: 50 - 60 minutes |  | **Key words / Topics*** aircraft
* design brief
* design criteria
* drawing
* finite resource
* petrochemicals
* sketch
* sustainability
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| **Stay safe** Whether you are a scientist researching a new medicine or an engineer solving climate change, safety always comes first. An adult must always be around and supervising when doing this activity. You are responsible for: •        ensuring that any equipment used for this activity is in good working condition•        behaving sensibly and following any safety instructions so as not to hurt or injure yourself or others  Please note that in the absence of any negligence or other breach of duty by us, this activity is carried out at your own risk. It is important to take extra care at the stages marked with this symbol: ⚠ |
| **Suggested Learning Outcomes**  |  |  |
| * To know that oil is a non-renewable, finite resource.
* To understand and apply sustainable alternatives to petrochemicals for powering aircraft.
* To be able to communicate design ideas using sketches, notes and annotations.
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| **Introduction** |  |  |
| The resources are designed to support teaching of key engineering concepts at both key stage 3 and key stage 4, including the new GCSE in Engineering. This resource focusses on designing a sustainably powered aircraft for the future.Petrochemicals are likely to become more scarce in the future as the world’s oil resources are used up. Engineers and designers will need to consider alternative ways of powering aircraft. |
| **Purpose of this activity**In this activity, learners will design a sustainably powered aircraft of the future. They will learn about the alternatives to using petrochemicals to power aircraft. It will build understanding of sustainability issues in engineering and how these are applied when designing a product.This could be used as a one-off main lesson activity, as part of a wider unit of work focussing on sources of energy and sustainability issues in engineering or as part of a scheme on aircraft design using all of the resources developed in association with Arconic. |
| **Activity**  |  | **Teacher notes** |
| **1. Introduce the design brief and design criteria (10 mins)**Introduce and discuss the design brief and criteria for the product with the class. ***Situation****Petrochemicals are likely to become more scarce in the future as the world’s oil resources are used up. This will affect the design of aircraft and how they are powered.****Brief****Design a passenger aircraft that could operate without the use of petrochemicals.* ***Design criteria:****The aircraft must:** *Use a sustainable alternative to petrochemicals to provide the thrust needed for flight.*
* *Make use of appropriate new and/or modern materials.*
* *Be aesthetically appealing.*

**2. Design ideas for the aircraft (20 mins)**Learners to sketch three ideas for a future aircraft product that meets the needs of both the brief and the design criteria given. They should ensure that they show and fully explain how the aircraft is powered or able to fly. Designs can be produced on the handout provided or on blank A4/A3 paper.**3. Final design (20-30 mins)**Learners to select their best idea from the three that they have designed. They should produce an annotated and rendered drawing of the design chosen, using annotations to justify their choice and explain its main features. The drawing should be suitable for use on a poster to present their idea to the class. |  | It is intended that learners complete this activity as individuals.Some prior understanding of sustainability issues and energy generation methods may be advantageous.It should be noted that this activity refers to aircraft rather than airplanes. Depending upon the capabilities and creativity of the learners, the teacher could outline a wide range of flying machines for inspiration, such as helicopters, airplanes and gliders, airships and blimps, hot air balloons, hang gliders, rockets, mag-lev trains, levitating hoverboards etc.**Notes and annotations**Learners should use notes and detailed annotations to explain and describe how their design meets the needs of the brief and design criteria. They should especially focus on how the product would function and the underlying science that would enable this to happen.**Formal drawing techniques**Learners should select an appropriate drawing technique to communicate their chosen design idea. For example, an orthographic drawing or an isometric projection. The teacher may wish to instruct the learners to use a particular drawing technique depending on their ability and/or prior learning. This could also be a good opportunity to practice a technique that learners have previously found difficult to master.  |
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| **Differentiation** |  |  |
| **Basic** |  | **Extension** |
| Provide additional examples of different types of drawing techniques to aid understanding of the drawing process.Restrict the possible types of aircraft that could be considered, e.g. different designs of airship.Provide a list of annotations that must be included using sentence starters, such as ‘This aircraft is powered by … ‘, ‘It is made from …’ etc. |  | Learners initial designs must include three or more completely different types of aircraft, e.g gliders, airships and helicopters; this could also include hybrid vehicles combining features from different aircraft.Learners could produce a 3D CAD model of their chosen final design. |
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| **Resources** |  | **Required files** icon-docicon-pdficon-ppt |
| * Projector/Whiteboard
* Basic drawing equipment
* CAD software (if producing final design using CAD)
 |  | icon-ppt Design a sustainable aircraft presentationicon-pdf Design a sustainable aircraft handout |
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| **Additional websites** |  |  |
| The following websites can be used for additional background information or to aid with the activity: * **GCSE Bitesize – Working drawings:** Revision notes on the theory behind different drawing techniques and how to produce them. <https://www.bbc.com/bitesize/guides/z6jkw6f/revision/6>
* **Guardian – Solar impulse:** News article about a solar powered aircraft capable of flying around the world. <https://www.theguardian.com/environment/2016/jul/26/solar-impulse-plane-makes-history-completing-round-the-world-trip>
* **CNN travel – Future aircraft:** Article exploring what air travel might look like in 2068. <https://edition.cnn.com/travel/article/passenger-planes-future-look/index.html>
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| **Related activities (to build a full lesson)** |  |  |
| **Starters*** Discuss the problems that might be created by a shortage of petrochemicals in the future.

**Main*** ACTIVITY: Design a sustainable aircraft
* Create a CAD model of a future aircraft design.
 | **Plenary*** Evaluations of designs produced.
* Reflection on Objectives and PLT skills used.
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| **The Engineering Context** film |
| Sustainable design and the use of finite and non-finite resources is required learning as part of both the new Design and Technology and Engineering 9-1 GCSE courses.The knowledge gained can also be used when selecting sources of energy for future product and system designs. |

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| **Curriculum links**  |
| **England: National Curriculum**Design & Technology * KS3 1d, 1e, 3d
 | **Northern Ireland: Curriculum**Technology & Design* KS3 Knowledge, understanding and skills: Design – identifying problems; investigating, generating, developing, modelling and evaluating design proposals.
* Communication – use of free-hand sketching and formal drawing techniques and ICT tools (including
* 3D modelling).
* Learning Outcomes - demonstrate creativity and initiative when developing ideas and following them through.
* communicate effectively in oral, visual (including graphic), written, mathematical and ICT formats showing clear awareness of audience and purpose.
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| **Scotland: Curriculum for Excellence**Technologies* TCH 4-06a, 4-07a, 3-11a, 3-12a
 | **Wales: National Curriculum**Design and Technology* KS3 Range: Designing: 1, 3, 4, 6,
* Resistant Materials: 10, 15
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| **GCSE D&T**AQA D&T* 3.1.1, 3.1.2, 3.1.3, 3.2.1, 3.2.3, 3.3.2, 3.3.4, 3.3.5

Edexcel D&T* 1.1.3, 1.1.7, 1.2.2c, 1.2.4, 1.3, 1.4, 1.14.3, 1.17

Eduqas D&T* 2.1 Core: 1, 2, 3, 4
* 2.2 Core:4, 8

OCR D&T* 1.1a iii, 1.2a iv, 2.1a vi, 2.2a, 3.1a, 3.2, 3.3a, 4.1a, 5.2c
 | **GCSE Engineering**AQA Engineering* 3.1.3, 3.4.3, 3.5, 3.6
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| **Assessment opportunities** |
| Regular questioning throughout the activity, formal teacher assessment of completed work. |
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| **Personal, learning & thinking skills (PLTS)** |
| * Independent enquirer
* Creative thinker
* Self-manager
* Effective participator
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