Overview

Pupils become aware of some of the issues facing the advanced engineering (transport) sector (namely passenger safety and security, and sustainability). They develop practical skills through the scenario provided and follow the design process to manufacture a product.

Curriculum Links

<table>
<thead>
<tr>
<th>These activities allow pupils to:</th>
<th>In the context of the following Key Elements:</th>
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<tr>
<td>Develop skills in creative thinking and problem-solving through:</td>
<td>Abide by health and safety rules when using tools, machines and equipment (Personal Health).</td>
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<tr>
<td>• Design – identifying problems; generating, developing, modelling and evaluating design proposals; giving consideration to form, function and safety; and</td>
<td>• Investigate how the skills developed through technology and design will be useful to a wide range of careers (Employability);</td>
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<tr>
<td>• Manufacture – selecting and using materials fit for purpose; safe use of a range of tools and processes appropriate to materials, demonstrating accuracy and quality of outcome.</td>
<td>• Identify product needs and pursue sustainable harmonious design solutions in the local outdoor context (Education for Sustainable Development); and</td>
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<td>• Explore the technology behind products with potential economic importance (Economic Awareness).</td>
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Health and Safety Warning

CCEA has assessed the health and safety risks associated with these activities. However, we strongly recommend that all teachers leading these activities carry out their own health and safety assessment, taking into account the ability of the students, the school’s resources and its quality of equipment, etc.
Key Questions

- How important is a client brief?
- One of the largest costs to individuals associated with transport is injury and death caused by accidents. What does this mean for passenger safety and advances in technology?
- Some feel that security procedures take the joy out of travelling. Why do you think they feel this way? Do you agree?
- Why is sustainable transport a priority?
- Why are composite materials important to the transport industry?

Prior Learning

- the design process
- research techniques
- 2D and 3D sketching
### Learning Intentions

**Pupils are learning:**
- ways in which they can experiment with ideas, materials, technologies and techniques;
- about the use of materials and production processes used to design products;
- about client briefs and constraints within them;
- how products are currently designed and how they may develop in the future based on advances in technology; and
- that technological advances have an impact on the environment and the economy.

### Success Criteria

**Pupils will:**
- respond creatively to design briefs;
- produce specifications for products;
- work in groups to address all aspects of a design brief;
- prepare and assemble materials safely to achieve results;
- understand the impact of ideas and advances in technology; and
- know the impact of products in terms of sustainability, including the use of smart materials.

### Thinking Skills and Personal Capabilities

**Working with Others:**
- respond to each other in constructive and respectful ways;
- review progress and evaluate outcomes; and
- use explanation and reasoning to reach an acceptable outcome.

### Cross-Curricular Skills

**Communication:**
- listen attentively;
- make relevant contributions to discussion;
- articulate and explain information, ideas and opinions clearly;
- use an appropriate vocabulary; and
- use non-verbal methods to engage the listener.

### Cross Curricular Skills Assessment Tasks available

**Using ICT:** Next Stop: Safety (3D CAD)
Activity 1

The Project Brief

Divide the class into groups of three or four pupils, and explain that they will be working as engineers. Ask them to research the following questions:

- What is engineering?
- What qualifications does a person need to become an engineer?
- What are some of the different types of engineers (structural, chemical, software, etc.)?
- Why is engineering important (economy, jobs)?
- What engineering firms make transportation products (Ford, VW, Honda, etc.)?
- What are the local transport engineering firms called (Bombardier, Wrightbus, Datum Design, Munster Simms, etc.)?

Share with the class the Advanced Engineering (Transport) sector profile which is available in the Sector Profiles section of the STEM Futures folder and online at: www.nicurriculum.org.uk/stem

Ask each group to discuss the sector and record the following:

- one thing they already knew about the sector;
- two things they have learned; and
- one thing that has surprised them about the sector.

Next, use the whiteboard to present the scenario in Resource 1 to the class. In it, the local council is looking for engineers who can offer design solutions for a sustainable public transport system. Give your pupils a copy of the design brief in Resource 2, and explain that each group’s challenge is to develop an innovative long-term solution and present their proposals at the end of the project.

Then, discuss what they already know about forms of transport as well as local and global transport systems.

In the scenario provided for the pupils, the brief is not limiting but the emphasis is on Innovation and Sustainability. In addition, budget restrictions have not been dictated. The purpose of this is to allow pupils to be as creative and innovative as possible with their designs. However, explain that in the world of work:

- engineers are often limited by a client’s brief; and
- constraints are often connected to considerations relating to cost.

Activity 2

Smarter Solutions

Draw the class’s attention to the design brief requesting a proposal for a long-term, innovative solution for a sustainable public transport system. Together, discuss what sustainable transport is.

Responses should include:

- socially sustainable, such as safety and security;
- economically sustainable, such as transport manufactured with cost-effective materials; and
- environmentally sustainable, such as transport that relies on alternative materials and fuels and reuse of parts.

Discuss the importance of sustainability in public transport. Include discussion about safety and security in the context of well-known incidents, such as the London Underground bomb in 2005 or the World Trade Centre air disaster in 2001, if appropriate.

Invite individual members of each group to select an area or areas of research as defined in the original design brief and outlined below.

Select innovation in terms of:

- public transport systems;
- passenger safety and transport security solutions;
- alternative fuel usage and materials – introduce the term composite materials to the pupils and explain that composite materials are:
  - a combination of two or more dissimilar materials;
  - stronger than the individual component materials;
  - used in a range of industries, such as transport, construction and sporting goods; and
- advantages and disadvantages of types of chassis or frames, for example ladder chassis, backbone chassis and the monocoque chassis (French for ‘single shell’ – currently the most sought-after chassis because it is economical, efficient and suits assembly line manufacture)
Activity 3

Concept Design

Next, give the groups time to come together to discuss their research findings and agree ideas that will fulfil the design brief. Ask each group to sketch and annotate their prototype design, including specifications for a sustainable transport solution on sheets of A3 paper. Encourage them to think creatively. Examples could include an elevated sky train, electric bicycles/scooters or hybrid/electric buses.

Afterwards, invite a reporter from each group to present their sketches and design ideas for classroom discussion. For example, responses for passenger safety and transport security might include:

- airbags;
- sensing devices;
- technology that supports passenger identity recognition; and/or
- an automated passenger recognition tunnel.

The final design with annotated drawings/specifications could also be carried out using Computer-Aided Design (CAD).

NOTE: A Pre-approved (Exemplar) assessment task for Using ICT (3D CAD) has been developed and is available at www.nicurriculum.org.uk

Activity 4

Manufacture and Production

Determine which manufacturing process the pupils will use based on resources available. Processes could include, for example the:

- vacuum forming process; or
- Computer Numerical Control process (CNC).

Demonstrate to your class the chosen manufacturing process, highlighting health and safety rules. Emphasise the importance of adhering to specifications during the manufacturing process and relate to a real-world situation, for example on an assembly line production.

Allow each group/pupil to manufacture their prototype and provide time for them to add features that are unique to their design.

Finally use Resource 3 to invite each group to use the Two Stars and a Wish* strategy to assess their prototypes using their original design specification and the design brief as success criteria. Then ask groups to carry out peer assessment based on the same success criteria.

- Two Stars and a Wish
  Two things we really like about our prototype and one thing we could improve upon.

Activity 5

The Pitch

By this stage, all groups should have:

- designed their product; and
- manufactured their product.

Allow them time to create their presentation materials, which might include a:

- poster;
- brochure; or
- presentation.

Afterwards, ask each group present their design solutions, preferably to a real and relevant audience. You could request a link with a relevant STEM ambassador through the STEMNET initiative which is co-ordinated by W5. STEM ambassadors can act as role models and help inspire and engage young people about the value of STEM in their daily lives. For further information, please contact Mary Carson at W5 (marycarson@w5online.co.uk) or visit their website at www.w5online.co.uk/stemnet.

The pupils could make their pitch to their STEM Ambassador via video conferencing using the Elluminate software available through C2K. For advice and support to get started please contact the C2K Service Desk.

You may want to watch an episode of Dragons’ Den as a class to provide them with an example of how to conduct a pitch, or, if possible, work in collaboration with the English Department to develop pupils’ presentation pitches.

Provide time for pupils to research STEM career opportunities, including in Advanced Engineering (Transport). Resources are available within the ‘Futures − Skills & Employability/CEIAG’ section of the STEMWorks website at www.nicurriculum.org.uk/stem
Resource 1

Scenario
Members of the community don't feel safe or secure at night on public transport. The council tenders to seek solutions by employing engineers to propose new designs for a sustainable public transport system.
Resource 2
Design Brief

Overview
The local council has invited tender applications for engineering solutions. The Council is keen to receive proposals for a long-term innovative solution that will help ensure the future of a sustainable public transport system.

General Guidelines
Design and manufacture a model for a solution that:
• incorporates new designs to ensure increased passenger safety;
• demonstrates a new and improved solution to passenger security; and
• includes economic and environmental solutions in the proposal.

Target Audience
Passengers on the local public transport system.

Research Requirements
Innovation in terms of:
• public transport systems;
• passenger safety and transport security solutions;
• alternative fuel usage and the use of smart materials; and
• types of chassis or frames.

Budget
To be determined.
### Manufacture Self/Peer Assessment

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<td>Finished Product Title:</td>
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<td><img src="image1.png" alt="Medal" /></td>
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<td><img src="image2.png" alt="Medal" /></td>
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<th>With reference to the design brief one area that could be improved on</th>
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<td><img src="image3.png" alt="Lightbulb" /></td>
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Useful Websites

These links were active at the time of publishing.

CCEA accepts no responsibility or liability for any material supplied by or contained in any of the linked websites and does not necessarily endorse the views expressed within them. We cannot guarantee that these links will work all of the time and we have no control over availability of the linked pages.

Indian Autos Blog – article outlining a British designed concept vehicle which is a cross between a bus, train and truck
http://indianautosblog.com/2008/09/introducing-the-blade-runner

The Design Blog – article outlining the design concept for a new sustainable bus
www.thedesignblog.org/entry/matthew-heywood-s-new-bus-for-london-is-functionally-sustainable

The Bus World News Site
www.busworld.org/news/article/288

Car Body Design – article on a freight-bus concept
www.carbodydesign.com/archive/2008/12/11-freight-bus-concept

Design East – article on a bus design in Central and Eastern Europe
http://designeast.eu/2008/04/29/ikarus-bus-concept

Eco-Design – futuristic buses for public transport
www.ecofriend.org/entry/10-futuristic-buses-to-drive-public-transport-green

Shado Design Consultancy – European bus design concept
www.shado.co.uk/portfolio/design.php?id=212

Car Body Design – article about a bus design concept
www.carbodydesign.com/archive/2006/12/02-honda-step-bus-concept

Trends Updates – futuristic slim bus concept designed by student in India
http://trendsupdates.com/slimbus-might-just-slim-down-transportation-needs

The Auto Channel – article about the Mercedes-Benz high capacity bus concept
www.theautochannel.com/news/2006/06/30/013380.html

Indian Autos Blog – article outlining a British designed concept vehicle which is a cross between a bus, train and truck
http://indianautosblog.com/2008/09/introducing-the-blade-runner
Useful Websites (continued)

The Design Blog – article outlining the design concept for a new sustainable bus

The Bus World News Site
www.busworld.org/news/article/288

Car Body Design – article on a freight-bus concept
www.carbodydesign.com/archive/2008/12/11-freight-bus-concept

Design East – article on a bus design in Central and Eastern Europe
http://designeast.eu/2008/04/29/ikarus-bus-concept

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www.theautochannel.com/news/2006/06/30/013380.html

ULTRA – example of innovative ‘personal sustainable transit’
www.ultraprt.com

Airport International – articles about potential increased security using advances in technology and a new trial based on alternative fuel at Stanstead Airport