Planning learning and teaching BGE Craft, Design, Engineering and Graphics

Midlothian exemplar

This is an example of how one local authority has planned their craft, design, engineering and graphics curriculum using the refreshed experience and outcomes in the Technologies.

This document is accompanied with a short video of teacher disussing their experience of working together on this plan.

Overall planning of outcomes from S1 to Nat 5 CDEG			
S1	**S2**	**S3**	**S4**
Graphics I can explore and use the features of a range of digital technologies, integrated software and online resources to determine the most appropriate to solve problems. **TCH 3-01a** I can create solutions in 3D and 2D and can justify the construction/graphic methods and the design features. **TCH 3-09a** I can apply a range of graphic techniques and standards when producing images using sketching, drawing and software. **TCH 3-11a**		**Graphics** I can select and use digital technologies to access, select relevant information and solve real world problems. **TCH 4-01a** I can use digital technologies to process and manage information responsibly and can reference sources accordingly. **TCH 4-02a** I can extend my use of manual and digital graphic techniques to realise ideas, concepts and products and recognise the importance of real world standards. **TCH 4-11a**	**Graphic Communication** Candidates develop: • skills in graphic communication techniques, including the use of equipment, graphics materials and software • the ability to extend and apply knowledge and understanding of graphic communication standards, protocols and conventions • an understanding of the impact of graphic communication technologies on our environment and society
Design I understand how scientific and technological developments have contributed to changes in everyday products. **TCH 3-05a** I can evaluate the implications for individuals and societies of the ethical issues arising from technological developments. **TCH 3-06a** I can create solutions in 3D and 2D and can justify the construction/graphic methods and the design features. **TCH 3-09a** I can apply a range of graphic techniques and standards when producing images using sketching, drawing and software. **TCH 3-11a**		**Design** I can use digital technologies to process and manage information responsibly and can reference sources accordingly. **TCH 4-02a** I can analyse products taking into consideration sustainability, scientific and technological developments. **TCH 4-05a** I can examine a range of materials, processes or designs in my local community to consider their environmental, social and economic impact. **TCH 4-06a** I can present conclusions about the impact of technologies on the economy, politics and the environment. **TCH 4-07a** I can apply design thinking skills when designing and manufacturing models/products which satisfy the user or client. **TCH 4-09a** I consider the material performance as well as sustainability of materials and apply these to real world tasks. **TCH 4-10a** I can extend my use of manual and digital graphic techniques to realise ideas, concepts and products and recognise the importance of real world standards. **TCH 4-11a**	**Design and manufacture** The course enables candidates to develop: • skills in designing and manufacturing models, prototypes and products • knowledge and understanding of manufacturing processes and materials • an understanding of the impact of design and manufacturing technologies on our environment and society

Manufacture I can evaluate the implications for individuals and societies of the ethical issues arising from technological developments. **TCH 3-06a** I can identify the costs and benefits of using technologies to reduce the impact of our activities on the environment and business. **TCH 3-07a** I can create solutions in 3D and 2D and can justify the construction/graphic methods and the design features. **TCH 3-09a** I can explore the properties and performance of materials before justifying the most appropriate material for a task. **TCH 3-10a** I can apply a range of graphic techniques and standards when producing images using sketching, drawing and software. **TCH 3-11a**	**Manufacture** I can examine a range of materials, processes or designs in my local community to consider their environmental, social and economic impact. **TCH 4-06a** I consider the material performance as well as sustainability of materials and apply these to real world tasks. **TCH 4-10a** I can extend my use of manual and digital graphic techniques to realise ideas, concepts and products and recognise the importance of real world standards. **TCH 4-11a**	
Engineering Science I understand how scientific and technological developments have contributed to changes in everyday products. **TCH 3-05a** I can evaluate the implications for individuals and societies of the ethical issues arising from technological developments. **TCH 3-06a** I can create solutions in 3D and 2D and can justify the construction/graphic methods and the design features. **TCH 3-09a** I can explore the properties and performance of materials before justifying the most appropriate material for a task. **TCH 3-10a** I can apply my knowledge and understanding of engineering disciplines and can develop/build solutions to given tasks. **TCH 3-12a**	**Engineering Science** I can analyse products taking into consideration sustainability, scientific and technological developments. **TCH 4-05a** I can examine a range of materials, processes or designs in my local community to consider their environmental, social and economic impact. **TCH 4-06a** I can apply design thinking skills when designing and manufacturing models/products which satisfy the user or client. **TCH 4-09a** I consider the material performance as well as sustainability of materials and apply these to real world tasks. **TCH 4-10a** I can solve problems through the application of engineering principles and can discuss the impact engineering has on the world around me. **TCH 4-12a**	**Engineering Science** Candidates develop the ability to: • apply knowledge and understanding of key engineering facts and ideas • understand the relationships between engineering, mathematics and science • apply skills in analysis, design, construction and evaluation to a range of engineering problems • communicate engineering concepts clearly and concisely, using appropriate terminology • develop an understanding of the role and impact of engineering in changing and influencing our environment and society

Overall planning of content from S1 to Nat 5 CDEG			
S1	**S2**	**S3**	**S4**
Graphic **Sketching –** 2D (proportion), 3D (1pt/2pt perspective, isometric, oblique), orthographic, drawing standards, line types, dimensioning, rendering (materials), tone. **DTP –** software, layers, cropping, elements and principles (depth, unity, colour, contrast, harmony), thumbnails. **3D CAD –** software, extrude, revolve, shell, subtractions, fillet, chamfer, rendering. **2D CAD –** software, drawing sheet, line types, dimensions, offset, fillet.		**Graphic** Geometric drawings • squares • rectangles • circles • hexagons • octagons • right prisms • pyramids • cones • cylinders partial or single cuts to these forms components based on geometric forms combinations of two components. True lengths true shapes surface developments sectional views assembly drawings	**N5 Graphic Communication** • Graphic types • Manual and computer-aided techniques • Skills in applying drawing standards, protocols and conventions - • Geometric shapes and forms and everyday objects • Views and techniques • Layout elements and principles • Computer-aided design • Desktop publishing Graphic communication technology: impact on society and the environment

Design	Design	N5 Design and Manufacture
Design Factors – MESCAFE (Materials, Ergonomics, Safety, Cost, Aesthetics, Function, Environment) **Research** – Desk Research **Shape Generation** – Pencil for a walk, SAM (Subtract and Manipulate), Biomorphic. **Initial Ideas** – Types of graphics used to communicate ideas. Annotation. **Development** – Function, Aesthetics, Manufacture and Assembly. **Modelling -** to inform design decisions. **Materials** – Wood (softwood/hardwood/ pine), plastic (thermoplastic/thermosetting plastic/acrylic), metal (brass, copper, steel, aluminium), sustainability **3D CAD** – to visualise ideas. Usually done retrospectively. **Analysis -** of design briefs/ products **Design Briefs / Specification** **Planning Manufacture –** Sequence of operations (usually done retrospectively) **Evaluation** – Survey / questionnaires	More independence and enhanced complexity of product. More emphasis on planning for manufacture – cutting lists/parts lists, exploded diagrams, orthographic (working drawings)	• Analysis of a brief - • Idea-generation techniques • Modelling in the design process • Graphics in the design process • Performance • Market • Aesthetics • Ergonomics • Uses of common materials • People who influence design • Commercial manufacture • Impact of design and manufacturing technologies • Planning for manufacture • Evaluation of products • Tools for measuring and marking out • Machine and hand tools for cutting and forming materials • Assembling • Surface finishing
Manufacture Pupils reading sizes from orthographic drawings Joints – Butt, Lap, Dowelled, Through Housing, Mortice and Tenon, Single dovetails, double dovetail Finishing wood – Raising the grain, sandpaper (various grades), varnish, painting Finishing edge of acrylic – Cross file, Draw filing, Wet or Dry, Polish Finishing Metal – Draw filing, emery cloth, wet or dry, polish Hand tools – Tenon saw, Steel rule, Try Square, Bevelled edge chisel, Marking Gauge, Files (Flat/Half-rounded/Square, Round), Rasps, Tin snips, rivet set, Ball-pein hammer, Warrington Hammer, Soldiering Irons Machine Tools – Pillar Drill, Sanding machine (belt sander), Cordless Drill, polishing machine, forge, strip heater, oven, Fluidiser, Spot Welder, mortise machine, vacuum former Processes- annealing, polishing, drilling, riveting, Box and Pan folder, forming of plastic, dip coating, Soldiering, Brazing, Spot welding	**Manufacture** As S1/S2 but with the following included: Turning on Wood Lathe Centre Lathe Taps and dies Hot/ cold metal forming Heat treatment of metal Wood Joints – Corner / T halving, Stopped Housing, Finger, Bridle	**Woodworking skills/ Metal working skills / Design and Manufacture / Construction Crafts**

Engineering Science	Engineering Science	N5 Engineering Science
Ability to use 2D/3D software packages Forces Types of movement Modelling Structures CAMs, gears and Levers Systems diagrams Simple circuits Structures Generators Wind turbines Types of energy Renewable energy/Fossil Fuels Model making	electronics pneumatic	• analysing engineering problems • designing, developing, simulating, building, testing and evaluating solutions to engineering problems in a range of contexts • investigating and evaluating existing and emerging technologies • communicating engineering concepts clearly and concisely, using appropriate terminology • knowledge of the many types of engineering • knowledge of the wide role and impact of engineering on society and the environment • knowledge of the workings of a range of engineered objects • knowledge and understanding of key concepts related to electronic and microcontroller-based systems and their application • knowledge and understanding of key concepts related to mechanical, structural and pneumatic systems and their application • knowledge of the relevance of energy, efficiency and sustainability to engineering problems and solutions • applying engineering knowledge and skills in a range of contexts

One example of the bundles of experiences and outcomes will become learning experiences.

CONTEXT FOR LEARNING

Project based learning which focuses on **Scientific and Technological Developments** but in *a Midlothian context* as a theme to a range of projects. Midlothian has had associations presently or in the past with the following industries:

- Mining (Drills, Lifts, Steam Powered Pump, etc.)
- Saw Mills (Sustainabilty, Automation)
- Paper Mills (Sustainabilty, Automation)
- Railways (Steam Engines, Lothian Bridge (Thomas Telford 1831))
- Pentland Science Park (Moredun Foundation/Group – Specialists in livestock health and welfare)
- Edinburgh Technopole (Scottish Agricultural College, Roslin Institute – Dolly the sheep)
- Flour Mills (Dalkeith once held the title as the biggest grain market in Scotland)
- Carpet Factory; MacTaggart Scott (Naval) (Pneumatic lifts)
- Nairn Oatcakes (Gluten free oatcakes)
- Edinburgh Crystal (Penicuik); IKEA (Sustainability)
- Roslin Gunpowder Mills at Roslin Glen

These industries and related technologies would form a theme for a range of graphics projects across the year.

The class teacher would be free to choose an industry / related technology each year and apply it to pre-described projects. These projects would cover a large part of the course content for BGE.

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<tr><th>EXPERIENCES AND OUTCOMES</th><th>LEARNING INTENTIONS</th><th>ASSESSMENT EVIDENCE</th></tr>
<tr>
<td>I can apply a range of graphic techniques and standards when producing images using sketching, drawing and software.
TCH 3-11a
I understand how scientific and technological developments have contributed to changes in everyday products.
TCH 3-05a</td>
<td>▪ Introduce the pupils to the selected scientific and technological development and to develop curiosity (who/ what/ why)
▪ To further develop researching skills which would have been initially developed at Primary school
▪ To introduce the pupils to pictorial sketching techniques
▪ To introduce the pupils to 3D CAD terms and processes and to build up confidence using the software
▪ To recognise design principles and DTP terms in the making of a graphical publication</td>
<td>Produce a portfolio consisting of evidence from class tasks:
• research on technology
• timeline
• visit task
• graphical study sketches
• 3D CAD model renders
• Orthographic drawings
• DTP Poster</td>
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<tr><th>BENCHMARKS/SUCCESS CRITERIA</th><th colspan="2">LEARNING AND TEACHING ACTIVITIES/TASKS</th></tr>
<tr>
<td>Learners can :
• produce sketches which show an understanding of proportion.
• produce 2D and 3D sketches using a range of techniques.
• produces rendered drawings which may include colour, surface, texture, tonal change
• use computer aided design (CAD) commands, techniques and practices required to create a model.
• produce 3D rendered CAD models
• produce a range of 2D and 3D CAD drawings
• justify the choice of colours, layout in a promotional graphics.
• recognise design principles and DTP terms.
• gathers and combines data and information from a range of sources to create a publication, presentation or information resource.
• demonstrate efficient searching techniques for example using ‘and’, ‘or’, ’not’.</td>
<td colspan="2">• Teacher to select theme
• Research Task - Teach the pupils how to research
○ Research the history behind the theme
○ Research the scientific and technological developments associated with the theme and produce a timeline to show how the technology has advanced
• Visit to local industry
• Graphical study and physical investigation (if possible) into the selected technology.
○ Teach the pupils how to do freehand lines, 2D sketching, isometric, 2pt perspective and rendering of materials
○ Sketch the technology in 2D and pictorial form (try exploded views)
○ Render using appropriate colour, texture and tonal change
• Model the technology using CAD
○ Teach the pupils basic 3D CAD processes
○ Produce 3D rendered CAD model
○ Produce orthographic drawings from 3D CAD model
• Produce a poster detailing how the technology works
○ DTP exercise - design principles and DTP terms
• Justify the choice of colours and layout in the promotional graphic</td>
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