Design Technology & Engineering Year 9

Our Subject Vision

Design and Technology is a subject which prepares pupils for work and life in the 21st century by allowing them to participate confidently and successfully in an increasingly technological world. Fast paced changes in the economy make predictions about future job market difficult. Giving students a range of transferable skills, up to date subject knowledge, and creative thinking will make them adaptable in the face of change.

Design and Technology can do this by empowering them to independently research, plan, implement and reflect and ensure they are equipped with the practical skills and technical knowledge to participate in modern society, giving them the option to pursue a career in STEM.

Design and technology programmes of study: key stage 3 National curriculum in England

Purpose of study

Design and technology are an inspiring, rigorous, and practical subject. Using creativity and imagination, pupils design and make products that solve real and relevant problems within a variety of contexts, considering their own and others' needs, wants and values. They acquire a broad range of subject knowledge and draw on disciplines such as mathematics, science, engineering, computing, and art. Pupils learn how to take risks, becoming resourceful, innovative, enterprising, and capable citizens. Through the evaluation of past and present design and technology, they develop a critical understanding of its impact on daily life and the wider world. High-quality design and technology education makes an essential contribution to the creativity, culture, wealth, and well-being of the nation.

Aims

The national curriculum for design and technology aims to ensure that all pupils:

- develop the creative, technical, and practical expertise needed to perform everyday tasks confidently and to participate successfully in an increasingly technological world
- build and apply a repertoire of knowledge, understanding and skills to design and make high-quality prototypes and products for a wide range of users
- critique, evaluate and test their ideas and products and the work of others

Attainment targets

By the end of key stage 3, pupils are expected to know, apply, and understand the matters, skills and processes specified in the programme of study. Schools are not required by law to teach the example content in [square brackets].

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Subject content Key stage 3
Through a variety of creative and practical activities, pupils should be taught the knowledge, understanding and skills needed to engage in an iterative process of designing and making. They should work in a range of domestic and local contexts [for example, the home, health, leisure, and culture], and industrial contexts [for example, engineering, manufacturing, construction, energy].

When designing and making, pupils should be taught to:

Design

- use research and exploration, such as the study of diverse cultures, to identify and understand user needs
- identify and solve their own design problems and understand how to reformulate problems given to them
- develop specifications to inform the design of innovative, functional, appealing products that respond to needs in a variety of situations
- use a variety of approaches [for example, biomimicry and user-centred design], to generate creative ideas and avoid stereotypical responses
- develop and communicate design ideas using annotated sketches, detailed plans, 3-D and mathematical modelling, oral and digital presentations and computer-based tools

Make

- select from and use specialist tools, techniques, processes, equipment, and machinery precisely, including computer-aided manufacture
- select from and use a wider, more complex range of materials and components, taking into account their properties

Evaluate

- analyse the work of past and present professionals and others to develop and broaden their understanding
- investigate new and emerging technologies
- test, evaluate and refine their ideas and products against a specification, taking into account the views of intended users and other interested groups
- understand developments in design and technology, its impact on individuals, society and the environment, and the responsibilities of designers, engineers, and technologists

Technical knowledge

- understand and use the properties of materials and the performance of structural elements to achieve functioning solutions
- understand how more advanced mechanical systems used in their products enable changes in movement and force
- understand how more advanced electrical and electronic systems can be powered and used in their products [for example, circuits with heat, light, sound and movement as inputs and outputs]

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- apply computing and use electronics to embed intelligence in products that respond to inputs [for example, sensors], and control outputs [for example, actuators], using programmable components [for example, microcontrollers]

End Points – GCSE DT

EP1.To innovate and take risks, to be resourceful, to be an enterprising and capable citizen.
EP2.To be a participant in advances in manufacturing, to be able utilise CAD (Computer Aided Design) CAM.
EP3.To be able to conduct primary and secondary research relating - aesthetic, technical, cultural, social, economic, industrial, and environmental issues. To understand and apply findings to inform design decisions.
EP4.To Design products that solve real world and relevant problems within a variety of contexts, considering their own and other's needs, wants and values
EP5.To combine practical and technological skills with creative thinking and problem solving to make products and systems to meet human needs
EP6.To have and apply an understanding of a wide range of materials, being able to choose and justify their use in relation to their aesthetic, technical, economic, cultural, and physical properties.

End Points – OCR National Engineering Design

R038: Principles of engineering design - EP1 - Designing processes, EP2 - Designing requirements, EP3 - Communicating design outcomes, EP4 - Evaluating design ideas

R039: Communicating designs - EP5 - Manual production of freehand sketches, EP6 - Manual production of engineering drawings, EP7 - Use of Computer Aided Design (CAD)
R040: Design, evaluation, and modelling - EP8 - Product evaluation, EP9 - Modelling design ideas

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Subject Domains of Knowledge – GCSE DT

- D1. Industry and enterprise
- D2. Critical evaluation and disruptive technologies
- D3. Investigation with primary and secondary data
- D4. Prototype development
- D5. Specialist tools and equipment
- D6. Materials and their properties

Subject Domains of Knowledge – OCR National Engineering Design

R038: Principles of engineering design -

EP1 - Designing processes

- The stages involved in design strategies
- Stages of the iterative design process, and the activities carried out within each stage of this cyclic approach

EP2 - Designing requirements

- Types of criteria included in an engineering design specification
- How manufacturing considerations affect design
- Influences on engineering product design

EP3 - communicating design outcomes

- Types of drawing used in engineering
- Working drawings

Subject Key Concepts GCSE DT

Industry and enterprise

- **C1. Organisation of the workplace**
- **C2. Business models**
- **C3. Automation**
- **C4. Scale of production**

Critical evaluation and disruptive technologies

- **C5. Global warming**
- **C6. Finite/non-finite**
- **C7. CAD/CAM**
- **C8. Planned obsolescence**
- **C9. Ethical considerations**

Investigation with primary and secondary data

- **C10. Primary and secondary data**
- **C11. Representation of data**
- **C12. Responding to data**
- **C.13 The work of others**

Prototype development

- **C.14 Design strategies**
- **C.15 Exploring design ideas**
- **C.16 Communicating design ideas**

Specialist tools and equipment

Subject Key Concepts OCR National Engineering Design

R038: Principles of engineering design

EP1 - Designing processes

Linear design, Iterative design, Inclusive design, User-centred design, Sustainable design, Ergonomic design, Analysis of the design brief, Methods of researching the product requirements,
Production of an engineering design specification, Generation of design ideas by sketching and modelling, The reasons for the use of modelling, Virtual modelling of the design idea, Physical modelling of the design idea, Manufacture, or modification of the prototype

EP2 - Designing requirements

Needs and wants, Quantitative and qualitative criteria, Reasons for the product criteria included in the design specification (ACCESS FM), Scale of manufacture, Material availability and form, Types of manufacturing processes, Production costs, Market pull and technology push, British and International Standards, Legislation, Planned obsolescence, Sustainable design (6Rs), Design for the circular economy

EP3 - Communicating design outcomes

Freehand sketching, Isometric, Oblique, Orthographic drawings, Exploded views, Assembly drawings, Block diagrams,

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• Using CAD drawing software EP4 - Evaluating design ideas • Methods of evaluating design ideas • Modelling methods • Methods of evaluating a design outcome ***R039: Communicating designs -*** EP5 - Manual production of freehand sketches • Sketches for a design idea EP6 - Manual production of engineering drawings • Drawings for a design idea EP7 - Use of computer aided design (CAD) • Produce a 3D CAD model of a design proposal to include compound 3D shapes ***R040: Design, evaluation, and modelling -*** EP8 - Product evaluation • Product analysis • Carry out product disassembly EP9 - Modelling design ideas • Methods of modelling	• **C.17 Marking out** • **C.18 Addition process** • **C19.Wasting processes** • **C.20.Deforming processes** • **C.21.Finishing processes** • **C.22Commercial processes** **Materials and their properties** • **C.23 Sources and origin of plastic** • **C.24 Thermoforming plastic** • **C.25 Thermosetting plastic** • **C.26 Density** • **C.27 Conductivity** • **C.28 Strength** • **C.29 Hardness** • **C.30 Toughness** • **C.31 Malleability** • **C.32 Elasticity** • **C.33 Stock forms** • **C.34 Reinforcing**	Flowcharts, Circuit diagrams, Wiring diagrams 2D engineering drawings using third angle orthographic projection, Standard conventions, Meaning of line types, Abbreviations, Representations of mechanical features, Advantages, and limitations of using CAD drawing software compared to manual drawing techniques ***EP4 - Evaluating design ideas*** Production of models, Qualitative comparison with the design brief and specification, Ranking matrices, Quality Function Deployment (QFD), Virtual (3D CAD), Card, Block, Breadboarding, 3D printing, Methods of measuring the dimensions and functionality of the product, Quantitative comparison with the design brief and specification, User testing, Reasons for identifying potential modifications and improvements to the design, ***R039: Communicating designs*** ***EP5 - Manual production of freehand sketches*** 2D/3D sketches, Thick/thin lines, Texture, Tone Shading, Annotation, and labelling techniques, Produce an isometric sketch for a design proposal,

		EP6 - Manual production of engineering drawings Produce a 3rd angle orthographic projection drawing of a design proposal using standard conventions, Produce an assembly drawing for a design proposal. ***EP7 - Use of computer aided design (CAD)*** Produce a 3D CAD model of a design proposal to include compound 3D shapes, Produce 3D CAD assemblies of components ***R040: Design, evaluation, and modelling*** ***EP8 - Product evaluation*** Carry out product analysis using ACCESS FM, compare products using Ranking matrices, Quality Function Deployment (QFD), Use of manufacturers manuals or other published sources, use appropriate tools and instruments, Analyse the disassembled product ***EP9 - Modelling design ideas*** Virtual CAD 3D, Physical modelling,

Year 9: Design Technology

Units	**Unit 1 Train Project (18 lessons)**
Unit overview	This unit is to revisit all three main material groups. It will provide pupils with a clear application for materials based upon their individual properties and broaden their understanding of how materials are used. They will go into greater detail on Polymers, Woods, and Metals. They will learn how to draw the idea in Isometric and using CAD / SketchUp. They then go onto plan the production and quality assure their work as they go along.

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Lesson Sequence	1. Benchmark Assessment 2. Introduction to The Toy Train project – wood families 3. Isometric Drawing part one 4. Isometric Drawing part two 5. SketchUp 6. SketchUp	7. SketchUp 8. Polymers 9. Metals 10. Production plan 11. Measuring and Marking out 12. Drill holes into plywood	13. Drill, Cut and Shape 14. Vacuum form the HIPs, Bend the Aluminium 15. Cut and File edges of materials 16. Final assembly 17. Evaluation 18. Evaluation- and summative assessment
Key Domains taught in this Unit	D1. Industry and enterprise D2. Critical evaluation and disruptive technologies D3. Investigation with primary and secondary data D4. Prototype development D5. Specialist tools and equipment D6. Materials and their properties		
Key Concepts taught in this Unit	**Scale of production** **Finite/non-finite** **CAD/CAM** **Ethical considerations** **Primary and secondary data** **Representation of data** **Responding to data** **Design strategies** **Exploring design ideas** **Communicating design ideas** **Marking out** **Addition process** **Wasting processes** **Deforming processes** **Finishing processes** **Sources and origin of plastic**		

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	Thermoforming plastic **Thermosetting plastic** **Density** **Conductivity** **Strength** **Hardness** **Toughness** **Malleability** **Elasticity** **Stock forms** **Reinforcing**
KS4 End Points	EP1.To innovate and take risks, to be resourceful, to be an enterprising and capable citizen. EP2.To be a participant in advances in manufacturing, to be able utilise CAD (Computer Aided Design) CAM. EP3.To be able to conduct primary and secondary research relating - aesthetic, technical, cultural, social, economic, industrial, and environmental issues. To understand and apply findings to inform design decisions. EP4.To Design products that solve real world and relevant problems within a variety of contexts, considering their own and other's needs, wants and values EP5.To combine practical and technological skills with creative thinking and problem solving to make products and systems to meet human needs EP6.To have and apply an understanding of a wide range of materials, being able to choose and justify their use in relation to their aesthetic, technical, economic, cultural, and physical properties.
Declarative Knowledge (Students should know)	To know how a product is manufactured with traditional skills To understand that materials are sourced from material environment To know the original source of plastics, metals, and woods To be able to name a range of common workshop tools and explain their functions To know how to draw in 3D using SketchUp, in accurate detail To understand the variety of tools and what each of them can be used for To be able to name real world situations that 3D software is used to create products To know and recognise the three main hand drawing methods - Isometric

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Procedural Knowledge (Students should be able to do)	To be able to identify workshop hazards To be able to follow workshop safety rules To be able name and create and use a jig To be able to use the pillar drill To be able to use wet and dry paper To be able to name a range of common workshop tools, machinery and explain their functions To be able to apply the above knowledge in producing a train following on from demonstrations and tutorial access using hand drawing skills and CAD To be able to draw shapes in Isometric with a significant degree of accuracy
Developing T3 Literacy and Numeracy	Woods – Hardwoods (Deciduous), Softwoods (Coniferous), Manufactured, Manufactured boards, 30, 60 and 120 degrees, construction lines, parallel, Isosketch, Bump stops, oval, ellipse, Circle, Tone shading, Shadow, material texture. Annotation, Sketchup, OneDrive, Folder, File, Download, upload, Zoom, orbit / rotate, Exact / precise. X-y-z axis. 3d – three dimensional. CAD (computer aided design), Thermoplastics, Thermosetting, Smart Materials. Recycle, pollute, Environment, 6Rs rule, Ferrous, Non-Ferrous, Alloys, Iron, Magnetic, Oxidise, Rust, Aluminium, Steel, Copper, Precious metals, Step by step plan, Flowchart – Start / finish (terminator), action, decision, feedback, QC (quality control), QA quality assurance, Gannt chart, Time over action planning, Sequencing, Try square, steel rule, permanent marker, PVA (Poly Vinyl Acetate) adhesive – glue, Aluminium, Acrylic, MDF (medium density fibreboard), Twist drill bit, pillar drill, clamp, scrap wood, hand file, cross file, draw file, emery paper, wet and dry paper, goggles, apron, Health and safety, Line bender, strip heater, align, measure, soften, form, cool, Veneer, PVA – adhesive, Aluminium, Acrylic, Tenon saw, Coping saw. Fret saw. QC – Quality Control, QA – Quality Assurance, saw marks, cross file, draw file, abrade, emery paper, wet and dry paper, smooth, shiny, Accuracy, spacing, length, inaccurate/ accurate, asymmetrical/ symmetrical, weak/ strong, unattractive/ attractive, improve, modify, charge
Assessment (Summative and Formative)	An initial formative assessment at the start of the unit to see what pupils can recall from work done in year 7 and 8 (%). Summative assessment of practical outcome with written self-reflection evaluation, followed by formative feedback from the teacher. The whole project concludes with a final summative assessment in line with the initial formative test to gauge progress across the unit.
Links to Prior Learning	This unit builds upon all of year 7 and 8 units. Taking them into greater depth and application.

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Next steps in learning	IF pupils are progressing onto KS4 with Design Technology – they may do the OCR Engineering Design course or the planned GCSE Design and Technology course. (Please see below)
Common Barriers to learning in this unit	Pupils may have already chosen to not continue with the subject (particularly if they are doing this in the 2nd half of the year). They may as a result be by default less interested and engaged with the unit. A wide level of interest has been built in to encourage interest and engagement with all pupils.