



Department
for Education

Design and Technology

Draft GCSE subject content

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Contents

The content for design and technology GCSE	3
Introduction	3
Subject aims and learning outcomes	4
Subject content	5
Designing and making principles	6
Appendix 1	8
Links to mathematics and science	8
Links to mathematics	8
Links to science	9
Appendix 2	11
Contextual challenges	11

The content for design and technology GCSE

Introduction

1. The GCSE subject content sets out the knowledge, understanding, skills and learning outcomes common to all specifications in design and technology.
2. The GCSE specifications in design and technology should enable students to understand and apply iterative design processes through which they explore, create and evaluate a range of outcomes. They should enable students to use creativity and imagination to design and make prototypes¹ or products² that solve real and relevant problems, considering their own and others' needs, wants and values. Specifications should also provide opportunities for students to apply knowledge from other disciplines, including mathematics, science, art and design, computing and the humanities.
3. Students should acquire subject knowledge in design and technology that builds on key stage 3, incorporating knowledge and understanding of different materials and manufacturing processes in order to design and make prototypes or products in response to issues, needs, problems and opportunities with confidence. Students should learn how to take design risks, helping them to become resourceful, innovative and enterprising citizens. They should develop an awareness of practices from the creative, engineering and manufacturing industries. Through the critique of the outcomes of design and technology activity, both historic and present day, students should develop an understanding of its impact on daily life and the wider world and understand that high-quality design and technology is important to the creativity, culture, sustainability, wealth and well-being of the nation and the global community.

¹ The word 'prototype' is understood throughout to be a generic term for outcomes of design practice that are not final products, instead they could be scaled down products or products made using alternative materials/systems in order to allow a design to be realized. A 'prototype' gives a true indication of a final product's functions, characteristics and quality, but will need further development.

² The word 'product' is understood throughout to be a generic term for all final outcomes of design practice including systems and objects.

Subject aims and learning outcomes

4. The study of design and technology seeks to prepare students to participate confidently and successfully in an increasingly technological world; and be aware of, and learn from, wider influences on design and technology, including historical, social/cultural, environmental and economic factors. GCSE design and technology specifications must enable students to work creatively when designing and making and applying technical and practical expertise, in order to:

- demonstrate their understanding that all design and technological activity takes place within contexts that influence the outcomes of design practice
- develop realistic design proposals as a result of the exploration of design opportunities and users' needs, wants and values
- use imagination, experimentation and synthesis when designing
- develop the skills to critique and refine their own ideas whilst designing and making
- communicate their design ideas and decisions using different media and techniques, as appropriate for different audiences at key points in their designing
- develop decision making skills
- develop a broad knowledge of materials, components and technologies and practical skills to develop high quality, imaginative and functional prototypes and/or products
- be ambitious and open to explore and take design risks in order to stretch the development of design proposals, avoiding clichéd or stereotypical responses
- consider the costs, commercial viability and marketing of products
- demonstrate safe working practices in design and technology
- use key design and technology terminology including those related to: designing, innovation and communication; materials and technologies; making, manufacture and production; critiquing, values and ethics

Subject content

5. GCSE specifications in design and technology³ must require students to demonstrate the necessary knowledge, understanding and skills required to undertake iterative design processes of exploring, creating⁴ and evaluating. Specifications must require students to demonstrate the mathematical and scientific knowledge, understanding and skills set out in Appendix 1.
6. The knowledge, understanding and skills that all students must develop have been separated into:
- technical knowledge and understanding
 - designing and making principles
7. Specifications must require students to produce at least one prototype and at least one product by undertaking an iterative design, make and evaluate project based on a brief they develop in response to a contextual challenge set by Awarding Organisations. When completing their project students will apply the **designing and making principles** and their **technical knowledge and understanding**. Specifications should provide a range of three broad and contemporary contextual challenges which provide a basis from which students can work. Exemplars of suitable contextual challenges are provided at Appendix 2.

Technical knowledge and understanding

8. In order to make effective design choices in relation to which materials, components and systems to utilise, students will need a breadth of technical knowledge and understanding that includes:
- categorisation of the types and properties of a range of materials, including: papers and boards; natural and manufactured timber; ferrous and non-ferrous metals; thermoforming and thermosetting polymers; natural, synthetic, blended and mixed fibres; woven, non-woven and knitted fabrics; composite materials; modern and smart materials, including e-textiles and technical textiles

In relation to all of the above materials, students must know and understand:

- the way in which the selection of materials is influenced by functional, aesthetic, availability, cost and ethical factors

³ It should be noted that there are no endorsed routes with this qualification. All qualification certificates will be titled GCSE design and technology; i.e. the range of titles that are currently offered, such as electronic products, graphic products, resistant materials, textiles technology and systems and control technology, will be removed.

⁴ In this context creating refers the creative process of generating, developing, and communicating ideas and the realisation of design proposals

- the impact of forces and stresses on materials and objects and the ways in which materials can be reinforced and stiffened.
- how to calculate and determine the quantity of materials required including a knowledge of stock forms, types and sizes

Students must also know and understand:

- how mechanical and electrical power is stored in order to choose and use appropriate sources of power to make products and systems work.
- the key elements of open and closed systems, including subsystems, and systems thinking
- how electronic systems provide functionality to products, including: switches and sensors to respond to a variety of input signals; process/control devices to switch, time and amplify; and devices to produce a range of outputs including light, sound and motion
- the use of programmable components, including microcontrollers and coding, to embed functionality into products in order to enhance and customise their operation
- the functions of mechanical devices, to produce different sorts of movement, changing the magnitude and direction of forces
- the impact on industry, enterprise, sustainability, people, culture, society and the environment of new and emerging technologies, production techniques and systems
- how the critical evaluation of new and emerging technologies, in contemporary and potential future scenarios, from different perspectives, such as ethics and the environment, informs design decisions
- that alternative processes can be used to manufacture products to different scales of production and require critical evaluation

Designing and making principles

9. GCSE specifications in design and technology must require students to:
- understand that all design and technological practice takes place within contexts which inform outcomes
 - demonstrate an ability to write at least one design brief and at least one specification from their own consideration of human needs, wants and interests, and from those identified by others
 - explore and develop their ideas, test, critically analyse and evaluate their work in order to inform their decision making
 - investigate factors, such as social and economic challenges, in order to identify opportunities and constraints that influence the processes of designing and making

- investigate and analyse the work of past and present professionals and companies in the area of design and technology in order to help inform their own ideas
- make informed and reasoned decisions, respond to feedback about their own prototypes and/or products (and those of others) to identify the potential for further development and suggest how modifications could be made
- identify and understand client and user needs through the collection of primary and secondary data
- use different design strategies, such as collaboration, user-centred design and systems thinking, to generate initial ideas and avoid design fixation
- develop, communicate, record and justify design ideas, applying suitable techniques, for example: formal and informal 2D and 3D drawing; system and schematic diagrams; annotated sketches; exploded diagrams; models; presentations; written notes; working drawings; schedules; audio and visual recordings; mathematical modelling; computer-based tools
- design and develop at least one product that respond to needs and/or wants and is fit for purpose, demonstrating functionality, aesthetics, innovation⁵ and marketability
- select and work with appropriate materials and components in order to produce at least one prototype and at least one product. In doing so, demonstrate an understanding of the physical and working properties of materials; the source and origin of materials; and the ecological and social footprint of materials
- use appropriate and accurate marking out methods including: measuring and use of reference (and datum) points, lines and surfaces; use templates, jigs and/or patterns; work within tolerances; understand efficient cutting and how to minimise waste
- use specialist tools and equipment appropriate to the materials used (including hand tools, machinery, digital design and manufacture) to create a specific effect.
- understand and use specialist techniques and processes to shape, fabricate, construct and assemble high quality prototypes and/or products⁶, including techniques such as wastage/subtraction; addition; moulding (deforming and reforming) and combination as appropriate
- understand and use appropriate surface treatments and finishes for functional and aesthetic purposes

⁵ Innovation in this context means that students should develop consideration of new, novel and/or bespoke approaches in the design and development of their product.

⁶ Appropriate to the material(s) and/or components being used.

Appendix 1

Links to mathematics and science

Through their work in design and technology students must apply relevant knowledge, skills and understanding from key stage 3 and 4 courses in the sciences and mathematics. They should use the metric and International System of Units (SI) system but also be aware that some materials and components retain the use of imperial units.

Links to mathematics

Ref	Mathematical skills requirements	Examples of D&T applications
1	<i>Arithmetic and numerical computation</i>	
a	Recognise and use expressions in decimal and standard form	Calculation of quantities of materials, costs and sizes
b	Use ratios, fractions and percentages	Scaling drawings, analysing responses to user questionnaires
c	Calculate surface area and volume	Determining quantities of materials
2	<i>Handling data</i>	
a	Presentation of data, diagrams, bar charts and histograms.	Construct and interpret frequency tables; present information on design decisions
3	<i>Graphs</i>	
a	Plot, draw and interpret appropriate graphs	Analysis and presentation of performance data and client survey responses
b	Translate information between graphical and numeric form	Extracting information from technical specifications
4	<i>Geometry and trigonometry</i>	
a	Use angular measures in degrees	Measurement and marking out
b	Visualise and represent 2D and 3D forms including two dimensional representations of 3D objects	Graphic presentation of design ideas and communicating intentions to others
c	Calculate areas of triangles and rectangles, surface areas and volumes of cubes	Determining the quantity of materials required

Links to science

Ref	Scientific knowledge and skills requirements	Examples of D&T application
1	Use scientific vocabulary, terminology and definitions	
a	<i>quantities, units and symbols</i>	Appropriate use of scientific terms when developing design briefs and specifications
b	use SI units (e.g. kg, g, mg; km, m, mm; kJ, J) and use prefixes and powers of ten for orders of magnitude (e.g. tera, giga, mega, kilo, centi, milli, micro and nano)	Calculation of quantities, measurement of materials and selection of components
c	describe metals and non-metals and explain the differences between them on the basis of their characteristic physical and chemical properties	Classification of the types and properties of a range of materials
2	<i>Life cycle assessment and recycling</i>	
a	describe the basic principles in carrying out a life-cycle assessment of a material or product	Selection of materials and components based on ethical factors, taking into consideration the ecological and social footprint of materials
3	<i>Using materials</i>	
a	describe the conditions which cause corrosion and the process of corrosion and oxidisation	Understanding of properties of materials and how they need to be protected from corrosion through surface treatments and finishes. Appreciate how oxidisation can be used when dyeing materials.
b	describe the composition of some important alloys in relation to their properties and uses	Selecting appropriate materials
c	compare quantitatively the physical properties of glass and clay ceramics, polymers, composites and metals, explain how the properties of materials are related to their uses and select appropriate materials given details of the usage required	Knowledge of properties of materials to be applied when designing and making
d	describe the main energy sources available for use on Earth (including fossil fuels, nuclear fuel, bio-fuel, wind, hydro-electricity, the tides and the Sun), compare the ways in which they are used and distinguish between renewable and non-renewable sources	Understanding of how to choose appropriate energy sources

Ref	Scientific knowledge and skills requirements	Examples of D&T application
e	describe examples in which forces cause rotation; define and calculate the moment of the force in such examples and explain how levers and gears transmit the rotational effects of forces	Knowledge of the function of mechanical devices to produce different sorts of movement, changing the magnitude and direction of forces
f	recall that current (I) depends on both resistance (R) and potential difference (V) and the units in which these are measured; recall and apply the relationship between I, R and V, and that for some resistors the value of R remains constant but that in others it can change as the current changes; explain the design and use of circuits to explore such effects – including for lamps, diodes, thermistors and LDRs.	Understanding the functions of electronic components and applying formulae where appropriate
g	calculate the currents, potential differences and resistances in DC series circuits; represent them with the conventions of positive and negative terminals, and the symbols that represent common circuit elements, including diodes, LDRs and thermistors.	Representation of electronic components in circuit diagrams. Use of formulae as appropriate.
4	<i>Different kinds of chemical bonds</i>	
a	describe and compare the nature and arrangement of chemical bonds in ionic compounds, simple molecules, giant covalent structures, polymers and metals	Understand that man-made fibres are engineered from polymers and the link of covalent bonding to the dyeing of materials

Appendix 2

Contextual challenges

A defining feature of design and technological activities is that they are context dependent, as are the outcomes of such activities. The following challenges are provided as exemplars to illustrate the range of issues, needs and wants that should be provided to schools:

- Extending human capacity
- Responding to the unexpected
- Improving living and working spaces (environments and objects)
- Securing the future
- Protecting people and products
- Promoting health and wellbeing
- Developing and communicating personal, social, and corporate identity
- Developing communities



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