Department for Education

Design and technology

GCSE subject content

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Contents

The content for design and technology GCSE

Introduction

1. The GCSE subject content sets out the knowledge, understanding, skills and educational 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 prototypes[1] (together with evidence of modelling to develop and prove product concept and function) that solve real and relevant problems, considering their own and others' needs, wants and values. GCSE 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, with confidence, prototypes in response to issues, needs, problems and opportunities. 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] In the context of this document, the term 'prototype' refers to a functioning design outcome. A final prototype could be a highly finished product, made as proof of concept prior to manufacture, or working scale models of a system where a full-size product would be impractical.

Aims and objectives

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 apply 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 combine ideas 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, including the planning and organisation of time and resources when managing their own project work
- develop a broad knowledge of materials, components and technologies and practical skills to develop high quality, imaginative and functional prototypes
- 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 technology[2] must require students to demonstrate the necessary knowledge, understanding and skills required to undertake iterative design processes of exploring, creating 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 principles
- designing and making principles

7. Specifications must require students to produce at least one final made prototype based on a design brief they develop in response to a contextual challenge set by Awarding Organisations. When completing their project students will apply designing and making principles and their knowledge and understanding of technical principles.

8. Specifications should provide a range of broad and contemporary contextual challenges, which provide a basis from which students can undertake a design, make and evaluate project. Contextual challenges must:

- offer a broad range of real-world contexts, representing contemporary issues and concerns
- be open-ended, avoiding predetermining the materials or processes to be used to achieve a design solution
- focus on needs, wants and values of individuals and groups, leading students to address problems and/or opportunities
- be accessible and relevant to the full range of design and technology materials and components outlined in section 9

Technical principles

9. 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:

- the impact of new and emerging technologies on industry, enterprise, sustainability, people, culture, society and the environment, production techniques and systems

[2] 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.

- how the critical evaluation of new and emerging technologies informs design decisions; considering contemporary and potential future scenarios from different perspectives, such as ethics and the environment
- how energy is generated and stored in order to choose and use appropriate sources to make products and to power systems
- developments in modern and smart materials, composite materials and technical textiles
- how electronic systems provide functionality to products and processes, including sensors and control devices to respond to a variety of inputs, and devices to produce a range of outputs
- the use of programmable components 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 categorisation of the types and properties of the following materials:

    - papers and boards
    - natural and manufactured timber
    - ferrous and non-ferrous metals
    - thermoforming and thermosetting polymers
    - natural, synthetic, blended and mixed fibres, and woven, non-woven and knitted textiles

In addition, when designing and making[3] (in relation to at least one of the material categories outlined in bullet 8 or the components and systems outlined in bullets 5-7, above) students should develop an in-depth knowledge and understanding of:

- the sources, origins, physical and working properties of the material categories or the components and systems, and their ecological and social footprint
- the way in which the selection of materials or components is influenced by a range of factors, such as functional, aesthetic, environmental, availability, cost, social, cultural and ethical
- the impact of forces and stresses on materials and objects and the ways in which materials can be reinforced and stiffened
- stock forms, types and sizes in order to calculate and determine the quantity of materials or components required
- alternative processes that can be used to manufacture products to different scales of production
- specialist techniques and processes that can be used to shape, fabricate, construct and assemble a high quality prototype, including techniques such as wastage, addition, deforming and reforming, as appropriate to the materials and/or components being used

[3] Including prototypes that are products or systems.

- appropriate surface treatments and finishes that can be applied for functional and aesthetic purposes

Designing and making principles

10. GCSE specifications in design and technology must require students to:

- understand that all design and technological practice takes place within contexts which inform outcomes
- identify and understand client and user needs through the collection of primary and secondary data
- demonstrate an ability to write a design brief and specifications from their own and others' considerations of human needs, wants and interests
- investigate factors, such as environmental, social and economic challenges, in order to identify opportunities and constraints that influence the processes of designing and making
- explore and develop their ideas, testing, critically analysing and evaluating their work in order to inform and refine their design decisions thus achieving improved outcomes.
- 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
- 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 prototype that responds to needs and/or wants and is fit for purpose, demonstrating functionality, aesthetics, marketability and consideration of innovation[4]
- make informed and reasoned decisions, respond to feedback about their own prototypes (and existing products and systems) to identify the potential for further development and suggest how modifications could be made

In relation to at least one of the material categories listed in paragraph 9 (above), students are required to develop and apply in-depth knowledge by:

- selecting and working with appropriate materials and components in order to produce a prototype

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[4] Innovation in this context refers to students considering new methods or ideas to improve and refine their design solutions and meet the needs of their intended market and/or primary user.

- using appropriate and accurate marking out methods including: measuring and use of reference points, lines and surfaces; use templates, jigs and/or patterns; work within tolerances; understand efficient cutting and how to minimise waste
- using specialist tools and equipment, appropriate to the materials or components used (including hand tools, machinery, digital design and manufacture), to create a specific outcome
- using specialist techniques and processes to shape, fabricate, construct and assemble a high quality prototype, including techniques such as wastage, addition, deforming and reforming, as appropriate to the materials and/or components being used
- using appropriate surface treatments and finishes for functional and aesthetic purposes

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.

Through the assessment of their knowledge and understanding of technical principles students must demonstrate an understanding of the mathematical and scientific requirements shown in tables 1 and 2. The examples in the tables below are illustrative of how the mathematical skills and scientific knowledge and skills identified could be applied in design and technology.

Links to mathematics

Students must be able to apply the following mathematical skills:

Table 1

Ref	Mathematical skills requirements	Examples of D&T applications
1	*Arithmetic and numerical computation*	
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	*Handling data*	
a	Presentation of data, diagrams, bar charts and histograms.	Construct and interpret frequency tables; present information on design decisions
3	*Graphs*	
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	*Geometry and trigonometry*	
a	Use angular measures in degrees	Measurement and marking out, creating tessellated patterns
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

Students must know and apply the following scientific knowledge and skills:

Table 2

Ref	Scientific knowledge and skills requirements	Examples of D&T application
1	*Use scientific vocabulary, terminology and definitions*	
a	quantities, units and symbols	Appropriate use of scientific terms when developing a design brief and specifications
b	SI units (e.g. kg, g, mg; km, m, mm; kJ, J), 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	metals and non-metals and 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	*Life cycle assessment and recycling*	
a	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	*Using materials*	
a	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	the composition of some important alloys in relation to their properties and uses	Selecting appropriate materials
c	the physical properties of [materials], how the properties of materials are selected related to their uses	Knowledge of properties of materials to be applied when designing and making
d	the main energy sources available for use on Earth (including fossil fuels, nuclear fuel, bio-fuel, wind, hydro-	Understanding of how to choose appropriate energy sources

	electricity, the tides and the Sun), the ways in which they are used and the distinction between renewable and non-renewable sources	
e	the action of forces and how levers and gears transmit and transform the effects of forces	Knowledge of the function of mechanical devices to produce different sorts of movement, changing the magnitude and direction of forces

Appendix 2

Contextual challenges

A defining feature of design and technological activity is that it is context dependent, as are the outcomes of such activities. The role of the contextual challenges is to provide an external stimulus for students, from which they will explore and clarify design problems and opportunities, leading to the development of their own design briefs, which will inform and direct their designing and making. Students will be assessed on their ability to analyse and respond to contexts, rather than their knowledge of specific contextual areas.

Contextual challenges that have been suggested and could meet the criteria above include areas such as:

- extending human capacity
- responding to the unexpected
- improving living and working spaces (environments and objects)
- securing a sustainable future
- protecting people and products
- promoting health and wellbeing
- developing and communicating personal, social, and corporate identity
- developing communities

The above list is not intended to be definitive.

Department for Education

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