Design and technology

Programme of study for key stage 3 and attainment target

(This is an extract from The National Curriculum 2007)
Curriculum aims

Learning and undertaking activities in design and technology contribute to achievement of the curriculum aims for all young people to become:

- successful learners who enjoy learning, make progress and achieve
- confident individuals who are able to live safe, healthy and fulfilling lives
- responsible citizens who make a positive contribution to society.

The importance of design and technology

In design and technology pupils combine practical and technological skills with creative thinking to design and make products and systems that meet human needs. They learn to use current technologies and consider the impact of future technological developments. They learn to think creatively and intervene to improve the quality of life, solving problems as individuals and members of a team.

Working in stimulating contexts that provide a range of opportunities and draw on the local ethos, community and wider world, pupils identify needs and opportunities. They respond with ideas, products and systems, challenging expectations where appropriate. They combine practical and intellectual skills with an understanding of aesthetic, technical, cultural, health, social, emotional, economic, industrial and environmental issues. As they do so, they evaluate present and past design and technology, and its uses and effects. Through design and technology pupils develop confidence in using practical skills and become discriminating users of products. They apply their creative thinking and learn to innovate.
Key concepts

There are a number of key concepts that underpin the study of design and technology. Pupils need to understand these concepts in order to deepen and broaden their knowledge, skills and understanding.

1.1 Designing and making

a. Understanding that designing and making has aesthetic, environmental, technical, economic, ethical and social dimensions and impacts on the world.

b. Applying knowledge of materials and production processes to design products and produce practical solutions that are relevant and fit for purpose.

c. Understanding that products and systems have an impact on quality of life.

d. Exploring how products have been designed and made in the past, how they are currently designed and made, and how they may develop in the future.

1.2 Cultural understanding

a. Understanding how products evolve according to users’ and designers’ needs, beliefs, ethics and values and how they are influenced by local customs and traditions and available materials.

b. Exploring how products contribute to lifestyle and consumer choices.

EXPLANATORY NOTES

Environmental: This includes opportunities to explore issues relating to sustainability.

Economic: This includes understanding the patenting process.
1.3 Creativity

a Making links between principles of good design, existing solutions and technological knowledge to develop innovative products and processes.
b Reinterpreting and applying learning in new design contexts and communicating ideas in new or unexpected ways.
c Exploring and experimenting with ideas, materials, technologies and techniques.

1.4 Critical evaluation

a Analysing existing products and solutions to inform designing and making.
b Evaluating the needs of users and the context in which products are used to inform designing and making.
c Exploring the impact of ideas, design decisions and technological advances and how these provide opportunities for new design solutions.

EXPLANATORY NOTES

Making links: This includes seeing possibilities, problems and challenges, and visualising alternatives.

Analysing existing products and solutions: This includes sharing and negotiating success criteria that lead to successful practical solutions.
2 Key processes

These are the essential skills and processes in design and technology that pupils need to learn to make progress.

Pupils should be able to:

a. generate, develop, model and communicate ideas in a range of ways, using appropriate strategies
b. respond creatively to briefs, developing their own proposals and producing specifications for products
c. apply their knowledge and understanding of a range of materials, ingredients and technologies to design and make their products
d. use their understanding of others’ designing to inform their own

e. plan and organise activities and then shape, form, mix, assemble and finish materials, components or ingredients
f. evaluate which hand and machine tools, equipment and computer-aided design/manufacture (CAD/CAM) facilities are the most appropriate to use
g. solve technical problems
h. reflect critically when evaluating and modifying their ideas and proposals to improve products throughout their development and manufacture.
3 Range and content

This section outlines the breadth of the subject on which teachers should draw when teaching the key concepts and key processes.

a The curriculum should include resistant materials, systems and control and at least one of food or textiles product areas.

In each product area the study of designing should include understanding of:

b users’ needs and the problems arising from them
c the criteria used to judge the quality of products, including fitness for purpose, the extent to which they meet a clear need and whether resources have been used appropriately
d the impact of products beyond meeting their original purpose and how to assess products in terms of sustainability
e aesthetic, technical, constructional and relevant wider issues that may influence designing, selection of materials, making and product development.

The study of making in food should include:

f a broad range of practical skills, techniques, equipment and standard recipes, and how to use them to develop, plan and cook meals and single or multiple products
g how to plan and carry out a broad range of practical cooking tasks safely and hygienically
h healthy eating models relating to a balanced diet, the nutritional needs of different groups in society and the factors affecting food choice and how to take these into account when planning, preparing and cooking meals and products
i the characteristics of a broad range of ingredients, including their nutritional, functional and sensory properties.

EXPLANATORY NOTES

At least one of food or textiles product areas: When selecting product areas, consideration should be given to equality of opportunity and progression from key stage 3 to key stage 4 and beyond. Product areas may be combined where appropriate.

Users’ needs and the problems arising from them: This should include an analysis of where human values may conflict, for example benefits for a minority or the majority, for the present or the future.

The criteria used to judge the quality of products: This should include criteria for users’ likes and dislikes and for overall benefit and user satisfaction. Pupils should be able to develop and use criteria.

Assess products in terms of sustainability: This includes researching and thinking about the use of renewable sources or exploring alternatives to less sustainable materials.

Constructional: This includes considering the feasibility of solving practical problems, such as whether essential resources are available or whether constructional forces are being properly transferred from one body to another.

Safely and hygienically: This includes understanding the principles of food safety and knowing the hygienic procedures to follow when preparing, cooking and storing food.

Balanced diet: This includes learning about the components of a healthy diet by classifying food into groups. Pupils should also understand the relationship between food, good health, growth and energy balance throughout life.

Nutritional, functional properties: This includes how the characteristics of ingredients help achieve a balanced and varied diet.

Sensory properties: This includes appreciating different flavours and using appropriate vocabulary to describe tastes that have been experienced.
The study of making in **resistant materials** and **textiles** should include:

- a broad range of techniques, including handcraft skills and CAD/CAM, and how to use them to ensure consistency and precision when making single and multiple products
- the behaviour of **structural elements** in a variety of materials
- how to use materials, smart materials, technology and aesthetic qualities to design and make products of worth
- how to prepare and assemble components to achieve functional results.

The study of making in **systems and control** should include:

- the practical application of systems and control in design proposals
- **electrical**, electronic, mechanical, microprocessor and computer control systems and how to use them effectively
- using systems and control to assemble subsystems into more complex systems
- feedback and how a variety of inputs can give rise to a variety of outputs.

EXPLANATORY NOTES

**CAD/CAM:** For example, using a computer-operated cutter/plotter, lathe, milling machine, rapid prototyping equipment, sewing-machine.

**Structural elements:** This includes understanding loads and other forces, resistance to loads without deforming, and the connection and transfer of forces within a structure.

**Materials, smart materials, technology and aesthetic qualities:** This includes recognising that new materials are being developed all the time and understanding the tension between cost, the demands of the product and sustainability issues, such as minimising waste and reusing materials.

**The practical application of systems and control:** This includes managing the sequence of operations in mechanical, electrical, electronic, pneumatic or combined systems.

**Assemble subsystems into more complex systems:** This includes integrating subsystems to manage particular events in a larger designed and made product, for example to control the location of objects using light.

**Feedback:** For example, using feedback from a heat sensor to trigger a mechanical action.
**4 Curriculum opportunities**

During the key stage pupils should be offered the following opportunities that are integral to their learning and enhance their engagement with the concepts, processes and content of the subject.

In ways appropriate to the product area, the curriculum should provide opportunities for pupils to:

a. analyse products to learn how they function
b. undertake focused tasks that develop knowledge, skills and understanding in relation to design and make assignments
c. engage in design and make assignments in different and progressively more complex contexts, including for purposes and uses beyond the classroom
d. work individually and in teams, taking on different roles and responsibilities
e. work with designers and makers where possible to develop an understanding of the product design process
f. use ICT as appropriate for image capture and generation; data acquisition, capture and handling; controlling; and product realisation
g. make links between design and technology and other subjects and areas of the curriculum.

EXPLANATORY NOTES

Analyse: This includes observing what is happening and linking causes with effects when a product is used.

Products: This includes their own, other pupils’ and professionally designed products.

Design and make assignments: These should build on ideas developed and information acquired during product analysis, and experience gained during focused tasks.

Designers and makers: These include electronic, mechanical and structural engineers, product designers, fashion designers, chefs, architects and others.

Use ICT as appropriate: This could include: image capture with scanners and digital cameras; image generation through computer-aided design (CAD); data acquisition through CD-ROMs and internet-based resources; data capture through sensors; data handling through the use of databases and spreadsheets; controlling through the use of control programme software; and product realisation through the use of computer-aided manufacture (CAM).

Other subjects and areas of the curriculum: This includes using knowledge and understanding from other subjects and from outside school when designing and making. It also includes using design and technology to give context and meaning to the application of other programmes of study, for example ‘using ICT to make things happen’ (ICT) and ‘planning and carrying out practical and investigative activities both individually and in groups’ (science). The study of food could be linked with human processes in science and healthy lifestyles in personal wellbeing.
Attainment target

Level 4
Pupils generate ideas by collecting and using information. They take users’ views about aesthetic and technical issues into account as they respond to briefs. They communicate alternative ideas using words, labelled sketches and models, showing that they are aware of constraints. They apply their knowledge and understanding of materials, ingredients and components, and work with them with some accuracy, paying attention to quality of finish and to function. They use some ideas from others’ designing to inform their own work. They produce step-by-step plans and then select and work with a range of tools and equipment. They identify what is working well and what could be improved to overcome technical problems. They reflect on their designs as they develop, recognising the significance of knowledge and previous experience.

Level 5
Pupils develop ideas by drawing on and using various sources of information. They clarify their ideas through discussion, drawing and modelling, showing understanding of aesthetic and economic dimensions. They respond to briefs showing understanding of how culture and society are reflected in familiar products when developing and communicating their own ideas. They show that they are aware of constraints as they apply knowledge and understanding of materials, ingredients and techniques. They use understanding of others’ designing as they develop their work. They work from their own detailed plans, modifying them where appropriate. They work with a range of tools, materials, ingredients, equipment, components and processes with some precision. They check their work as it develops, solve technical problems and show some evidence of creativity as they modify their approach in the light of progress. They test and evaluate their products, showing that they understand the situations in which the products will function.

Level 7
Pupils use a wide range of appropriate sources of information when developing and modelling ideas. They investigate form, function and production processes as they respond creatively to briefs. They apply their knowledge and understanding, recognising the different needs of a range of users, and search for trends and patterns in existing solutions as they develop fully realistic products. They use their understanding of others’ designing to inform their own as they communicate creative ideas. They produce plans that predict the time needed to carry out the main stages of making products. They work with a range of tools, materials, ingredients, equipment, components and processes, taking full account of their characteristics. They adapt their methods of manufacture to changing circumstances as they solve technical problems, providing a sound explanation for any change from the design proposal. They select appropriate techniques to evaluate how their products would perform when used and modify their products in the light of this evaluation to improve their performance.

Level 8
Pupils use a range of strategies to fully develop and model appropriate ideas, responding to information they have identified. They identify conflicting demands on a product and respond creatively to briefs, suggesting ways forward and explaining how their ideas address these demands. When applying knowledge they make decisions on materials, ingredients and techniques based on their understanding of physical properties and working characteristics. They use their understanding of others’ designing by reinterpreting and applying learning in new contexts. They organise their work so that they can carry out processes accurately and consistently, and use tools, equipment, materials, ingredients and components with precision. They use accurate testing to inform their judgements when solving technical problems. They identify a broad range of criteria for evaluating their products, clearly relating their findings to environmental, ethical, and social and cultural dimensions.
Level 6

Pupils draw on and use a range of sources of information, and show that they understand the form and function of familiar products as they develop and model ideas. They respond creatively to briefs, exploring and testing their design thinking. They develop detailed criteria for their products and use these to explore proposals. They apply their knowledge and understanding by responding to several aspects of the problem. They recognise the significance of others’ designing and modify their approaches accordingly. They produce plans that outline alternative methods of making progress. They work with a range of tools, materials, ingredients, equipment, components and processes, showing that they understand their characteristics. They check their work as it develops and solve technical problems by modifying their approach in the light of progress. They evaluate how effectively they have used information sources, using the results of their research to inform their judgements when developing products. They evaluate their products as they are being used, and identify ways of improving them.

Exceptional performance

Pupils seek out information to help their design thinking. They recognise how products contribute to lifestyle and choices of a variety of client groups as they develop and model ideas in an innovative way. Responding creatively to briefs, they are discriminating in their selection and use of information sources to support their work. They interpret and apply knowledge and understanding creatively in new design contexts and communicate ideas in new or unexpected ways. They use understanding of others’ designing in innovative ways. They work with tools, equipment, materials, ingredients and components to a high degree of precision. They make products that are reliable and robust and that fully meet the quality requirements given in the design proposal. They reflect critically and effectively throughout designing and making processes.

Pupils combine practical and technological skills with creative thinking to design and make products and systems that meet human needs.