Curriculum Grid for Design Engineering Projects

Computing programmes of study: Key Stage 3 National Curriculum in England ● = addresses standard ◐ = partially addresses standard	Make It Move						Make It Smarter						Make a System					
	Video	With Wheels	And Display Speed	Without Wheels	Up an Incline	In a Pattern	Video	With a Sensor	And Faster	And Adaptable	With Communication	And Healthier	Video	That Moves a Ball	That Picks and Places	That Manufactures	That Sorts Colours	That Communicates
Subject content: Key Stage 3																		
Pupils should be taught to:																		
design, use and evaluate computational abstractions that model the state and behaviour of real-world problems and physical systems		●	●	●	●	●		●	●	●	●	●		●	●	●	●	●
understand several key algorithms that reflect computational thinking [for example, ones for sorting and searching]; use logical reasoning to compare the utility of alternative algorithms for the same problem		●	●	●	●	●		●	●	●	●	●		●	●	●	●	●
use two or more programming languages, at least one of which is textual, to solve a variety of computational problems; make appropriate use of data structures [for example, lists, tables or arrays]; design and develop modular programs that use procedures or functions		◐	◐	◐	◐	◐		◐	◐	◐	◐	◐		◐	◐	◐	◐	◐
understand simple Boolean logic [for example, AND, OR and NOT] and some of its uses in circuits and programming; understand how numbers can be represented in binary, and be able to carry out simple operations on binary numbers [for example, binary addition, and conversion between binary and decimal]								●				●					●	●
understand the hardware and software components that make up computer systems, and how they communicate with one another and with other systems		●	●	●	●	●		●	●	●	●	●		●	●	●	●	●
understand how instructions are stored and executed within a computer system; understand how data of various types (including text, sounds and pictures) can be represented and manipulated digitally, in the form of binary digits		◐	◐	◐	◐	◐		◐	◐	◐	◐	◐		◐	◐	◐	◐	◐
undertake creative projects that involve selecting, using, and combining multiple applications, preferably across a range of devices, to achieve challenging goals, including collecting and analysing data and meeting the needs of known users		●	●	●	●	●		●	●	●	●	●		●	●	●	●	●
create, re-use, revise and re-purpose digital artefacts for a given audience, with attention to trustworthiness, design and usability		●	●	●	●	●		●	●	●	●	●		●	●	●	●	●
understand a range of ways to use technology safely, respectfully, responsibly and securely, including protecting their online identity and privacy; recognise inappropriate content, contact and conduct and know how to report concerns.		◐	◐	◐	◐	◐		◐	◐	◐	◐	◐		◐	◐	◐	◐	◐

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Subject content: Key Stage 3																		
Pupils should be taught to:																		
Working scientifically																		
Scientific attitudes																		
pay attention to objectivity and concern for accuracy, precision, repeatability and reproducibility	◐	●	●	●	●	●	◐	●	●	●	●	●	◐	●	●	●	●	●
understand that scientific methods and theories develop as earlier explanations are modified to take account of new evidence and ideas, together with the importance of publishing results and peer review	◐	●	●	●	●	●	◐	●	●	●	●	●	◐	●	●	●	●	●
evaluate risks.	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐
Experimental skills and investigations																		
ask questions and develop a line of enquiry based on observations of the real world, alongside prior knowledge and experience	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
make predictions using scientific knowledge and understanding	◐	●	●	●	●	●	◐	●	●	●	●	●	◐	●	●	●	●	●
select, plan and carry out the most appropriate types of scientific enquiries to test predictions, including identifying independent, dependent and control variables, where appropriate		●	●	●	●	●		●	●	●	●	●		●	●	●	●	●
use appropriate techniques, apparatus, and materials during fieldwork and laboratory work, paying attention to health and safety		◐	◐	◐	◐	◐		◐	◐	◐	◐	◐		◐	◐	◐	◐	◐
make and record observations and measurements using a range of methods for different investigations; and evaluate the reliability of methods and suggest possible improvements		●	●	●	●	●		●	●	●	●	●		●	●	●	●	●
apply sampling techniques.																		
Analysis and evaluation																		
apply mathematical concepts and calculate results		●	●	●	●	●		◐	◐	●	◐	●		●	●	●	◐	●
present observations and data using appropriate methods, including tables and graphs		●	●	●	●	●		●	●	●	●	●		●	●	●	●	●
interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions		●	●	●	●	●		●	●	●	●	●		●	●	●	●	●
present reasoned explanations, including explaining data in relation to predictions and hypotheses		●	●	●	●	●		●	●	●	●	●		●	●	●	●	●
evaluate data, showing awareness of potential sources of random and systematic error		●	●	●	●	●		●	●	●	●	●		●	●	●	●	●
identify further questions arising from their results.		●	●	●	●	●		●	●	●	●	●		●	●	●	●	●
Measurement																		
use and derive simple equations and carry out appropriate calculations		●	●	●	●	●				●		●		●	●	●	●	●
undertake basic data analysis including simple statistical techniques.		●	●	●	●	●				●		●		●	●	●	●	●

Science programmes of study: Key Stage 3 National Curriculum in England

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Subject Content: Physics																		
Energy																		
Energy changes and transfers																		
simple machines give bigger force but at the expense of smaller movement (and vice versa): product of force and displacement unchanged					●													
other processes that involve energy transfer: changing motion, dropping an object, completing an electrical circuit, stretching a spring, metabolism of food, burning fuels.		◐	◐	◐	◐	◐		◐	◐	◐	◐	◐		◐	◐	◐	◐	◐
Motion and forces																		
Describing motion																		
speed and the quantitative relationship between average speed, distance and time (speed = distance ÷ time)		●	●	●														
the representation of a journey on a distance-time graph.			◐									◐						
Forces																		
forces as pushes or pulls, arising from the interaction between two objects	◐	●	●	●	●	●			◐					◐				
using force arrows in diagrams, adding forces in one dimension, balanced and unbalanced forces.		◐	◐	◐	◐	◐			◐					◐				
Forces and Motion																		
change depending on direction of force and its size.					●													
Waves																		
Light waves																		
the transmission of light through materials: absorption, diffuse scattering and specular reflection at a surface								◐		◐	◐						◐	◐
colours and the different frequencies of light, white light and prisms (qualitative only); differential colour effects in absorption and diffuse reflection.								◐		◐	◐						◐	◐

Design and Technology programmes of study: Key Stage 3 National Curriculum in England

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Subject content: Key Stage 3																		
When designing and making, pupils should be taught to:																		
Designing																		
use research and exploration, such as the study of different 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, components and ingredients, taking into account their properties		◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐
Evaluating																		
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]	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
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].	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●

Mathematics programmes of study: Key Stage 3 National Curriculum in England

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Subject content: Key Stage 3																		
Through the mathematics content, pupils should be taught to:																		
Working Mathematically																		
Develop fluency																		
select and use appropriate calculation strategies to solve increasingly complex problems		●	●	●		●								●				
use algebra to generalise the structure of arithmetic, including to formulate mathematical relationships		●	●	●		●												
move freely between different numerical, algebraic, graphical and diagrammatic representations [for example, equivalent fractions, fractions and decimals, and equations and graphs]										◐								
develop algebraic and graphical fluency, including understanding linear and simple quadratic functions										◐								
Reason mathematically																		
extend and formalise their knowledge of ratio and proportion in working with measures and geometry, and in formulating proportional relations algebraically					◐													
Solve problems																		
develop their mathematical knowledge, in part through solving problems and evaluating the outcomes, including multi-step problems		●	●	●		●								●				
develop their use of formal mathematical knowledge to interpret and solve problems, including in financial mathematics		◐	◐	◐		◐								◐				
begin to model situations mathematically and express the results using a range of formal mathematical representations																		
select appropriate concepts, methods and techniques to apply to unfamiliar and non-routine problems.		●	●	●		●								●				
Subject content																		
Number																		
Pupils should be taught to:																		
order positive and negative integers, decimals and fractions; use the number line as a model for ordering of the real numbers; use the symbols =, ≠, <, >, ≤, ≥								◐	◐	◐	◐	◐		◐	◐	◐	◐	◐
use a calculator and other technologies to calculate results accurately and then interpret them appropriately		◐	◐	◐		◐								◐				
Algebra																		
Pupils should be taught to:																		
understand and use standard mathematical formulae; rearrange formulae to change the subject		◐	◐	◐	◐	◐		◐	◐	◐	◐	◐		◐	◐	◐	◐	◐
model situations or procedures by translating them into algebraic expressions or formulae and by using graphs		◐	◐	◐	◐	◐		◐	◐	◐	◐	◐		◐	◐	◐	◐	◐
interpret mathematical relationships both algebraically and graphically		◐	◐	◐	◐	◐		◐	◐	◐	◐	◐		◐	◐	◐	◐	◐
recognise geometric sequences and appreciate other sequences that arise.						●												

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Ratio, proportion and rates of change																		
Pupils should be taught to:																		
use ratio notation, including reduction to simplest form					◐													
Geometry and measures																		
Pupils should be taught to:																		
derive and apply formulae to calculate and solve problems involving: perimeter and area of triangles, parallelograms, trapezia, volume of cuboids (including cubes) and other prisms (including cylinders)						◐												
calculate and solve problems involving: perimeters of 2-D shapes (including circles), areas of circles and composite shapes						●												
derive and illustrate properties of triangles, quadrilaterals, circles, and other plane figures [for example, equal lengths and angles] using appropriate language and technologies		◐	◐	◐	◐	◐		◐	◐	◐	◐	◐		◐	◐	◐	◐	◐
identify properties of, and describe the results of, translations, rotations and reflections applied to given figures		◐	◐	◐	◐	◐		◐	◐	◐	◐	◐		◐	◐	◐	◐	◐
interpret mathematical relationships both algebraically and geometrically.		◐	◐	◐	◐	◐		◐	◐	◐	◐	◐		◐	◐	◐	◐	◐
Statistics																		
Pupils should be taught to:																		
construct and interpret appropriate tables, charts, and diagrams, including frequency tables, bar charts, pie charts, and pictograms for categorical data, and vertical line (or bar) charts for ungrouped and grouped numerical data.		◐	◐	◐	◐	◐		◐	◐	◐	◐	◐		◐	◐	◐	◐	◐

Computing programmes of study: Key Stage 4 National Curriculum in England ● = addresses standard ◐ = partially addresses standard	Make It Move						Make It Smarter						Make a System					
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Pupils should be taught to:																		
develop their capability, creativity and knowledge in computer science, digital media and information technology		●	●	●	●	●		●	●	●	●	●		●	●	●	●	●
develop and apply their analytic, problem-solving, design, and computational thinking skills.		●	●	●	●	●		●	●	●	●	●		●	●	●	●	●

Science programmes of study: Key Stage 4 National Curriculum in England

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Working scientifically																		
The Development of Scientific Thinking																		
using a variety of concepts and models to develop scientific explanations and understanding	◐	●	●	●	●	●	◐	●	●	●	●	●	◐	●	●	●	●	●
explaining everyday and technological applications of science; evaluating associated personal, social, economic and environmental implications; and making decisions based on the evaluation of evidence and arguments	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐
evaluating risks both in practical science and the wider societal context, including perception of risk	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐
recognising the importance of peer review of results and of communication of results to a range of audiences.		●	●	●	●	●		●	●	●	●	●		●	●	●	●	●
Experimental skills and Strategies																		
using scientific theories and explanations to develop hypotheses	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
planning experiments to make observations, test hypotheses or explore phenomena		●	●	●	●	●		●	●	●	●	●		●	●	●	●	●
applying a knowledge of a range of techniques, apparatus, and materials to select those appropriate both for fieldwork and for experiments		◐	◐	◐	◐	◐		◐	◐	◐	◐	◐		◐	◐	◐	◐	◐
carrying out experiments appropriately, having due regard to the correct manipulation of apparatus, the accuracy of measurements and health and safety considerations		●	●	●	●	●		●	●	●	●	●		●	●	●	●	●
making and recording observations and measurements using a range of apparatus and methods		◐	◐	◐	◐	◐		◐	◐	◐	◐	◐		◐	◐	◐	◐	◐
evaluating methods and suggesting possible improvements and further investigations.		●	●	●	●	●		●	●	●	●	●		●	●	●	●	●
Analysis and evaluation																		
presenting observations and other data using appropriate methods		●	●	●	●	●		●	●	●	●	●		●	●	●	●	●
carrying out and representing mathematical and statistical analysis										●		●						
interpreting observations and other data, including identifying patterns and trends, making inferences and drawing conclusions										●		●						
presenting reasoned explanations, including relating data to hypotheses.										●		●						
Vocabulary, units, symbols and nomenclature																		
developing their use of scientific vocabulary and nomenclature.	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐	◐

Mathematics programmes of study: Key Stage 4 National Curriculum in England

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Through the mathematics content, pupils should be taught to:																		
Working Mathematically																		
Develop fluency																		
select and use appropriate calculation strategies to solve increasingly complex problems, including exact calculations involving multiples of ϖ {and surds}, use of standard form and application and interpretation of limits of accuracy		◐	◐	◐		◐								◐				
consolidate their algebraic capability from key stage 3 and extend their understanding of algebraic simplification and manipulation to include quadratic expressions, {and expressions involving surds and algebraic fractions}		◐	◐	◐		◐												
move freely between different numerical, algebraic, graphical and diagrammatic representations, including of linear, quadratic, reciprocal, {exponential and trigonometric} functions										◐		◐						
use mathematical language and properties precisely		●	●	●	●	●				●		●		●	●	●	●	●
Reason mathematically																		
extend and formalise their knowledge of ratio and proportion, including trigonometric ratios, in working with measures and geometry, and in working with proportional relations algebraically and graphically					◐	◐												
Solve problems																		
develop their mathematical knowledge, in part through solving problems and evaluating the outcomes, including multi-step problems		●	●	●		●								●				
develop their use of formal mathematical knowledge to interpret and solve problems, including in financial contexts		◐	◐	◐		◐								◐				
Ratio, proportion and rates of change																		
interpret the gradient of a straight line graph as a rate of change; recognise and interpret graphs that illustrate direct and inverse proportion					◐													
Geometry and measures																		
construct and interpret plans and elevations of 3D shapes.		●	●	●	●	●		●	●	●	●	●		●	●	●	●	●