

Liquids Mean life

KEY STAGE 3 and 4 (11-16 YEARS) PROGRAMMES OF STUDY

Teacher Support notes regarding the teaching areas of study covered by this pack.

Design and Technology KS3

KNOWLEDGE, SKILLS AND UNDERSTANDING

Developing, planning and communicating ideas

1. Pupils should be taught to:
 - a) identify relevant sources of information, using a range of resources including ICT
 - b) respond to design briefs and produce their own design specifications for products
 - c) develop criteria for their designs to guide their thinking and to form a basis for evaluation
 - d) generate design proposals that match the criteria
 - e) consider aesthetics and other issues that influence their planning (for example, the needs and values of intended users, function, hygiene, safety, reliability, cost)
 - f) suggest outline plans for designing and making, and change them if necessary
 - g) prioritise actions and reconcile decisions as a project develops, taking into account the use of time and costs when selecting materials, components, tools, equipment and production methods
 - h) use graphic techniques and ICT, including computer-aided design (CAD), to explore, develop, model and communicate design proposals (for example, using CAD software or clip-art libraries, CD-ROM and internet-based resources, or scanners and digital cameras).

Evaluating processes and products

3. Pupils should be taught to:
 - a) evaluate their design ideas as these develop, and modify their proposals to ensure that their product meets the design specification
 - b) test how well their products work, then evaluate them
 - c) identify and use criteria to judge the quality of other people's products, including the extent to which they meet a clear need, their fitness for purpose, whether resources have been used appropriately, and their impact beyond the purpose for which they were designed (for example, the global, environmental impact of products and assessment for sustainability).

KNOWLEDGE AND UNDERSTANDING OF MATERIALS AND COMPONENTS

4. Pupils should be taught:
 - a) to consider physical and chemical properties and working characteristics of a range of common and modern materials
 - b) that materials and components can be classified according to their properties and working characteristics
 - c) that materials and components can be combined, processed and finished to create more useful properties and particular aesthetic effects (for example, combining different ingredients to create products with different sensory characteristics)
 - d) how multiple copies can be made of the same product.

Liquids Mean life

KNOWLEDGE AND UNDERSTANDING OF SYSTEMS AND CONTROL

5. Pupils should be taught:
- a) to recognise inputs, processes and outputs in their own and existing products
 - c) the importance of feedback in control systems.

BREADTH OF STUDY

7. During the key stage, pupils should be taught the Knowledge, Skills and Understanding through:
- a) product analysis
 - b) focused practical tasks that develop a range of techniques, skills, processes and knowledge
 - c) design and make assignments in different contexts. The assignments should include control systems, and work using a range of contrasting materials, including resistant materials, compliant materials and/or food.

Design and Technology KS4

KNOWLEDGE, SKILLS AND UNDERSTANDING

Developing, planning and communicating ideas

1. Pupils should be taught to:
- a) develop and use design briefs, detailed specifications and criteria
 - b) consider issues that affect their planning (for example, the needs and values of a range of users; moral, economic, social, cultural and environmental considerations; product maintenance; safety; the degree of accuracy needed in production)

- c) design for manufacturing in quantity
- d) produce and use detailed working schedules, setting realistic deadlines and identifying critical points
- e) match materials and components with tools, equipment and processes, taking account of critical dimensions and tolerances when deciding how to manufacture the product
- f) be flexible and adaptable in responding to changing circumstances and new opportunities
- g) use graphic techniques and ICT, including computer-aided design (CAD), to generate, develop, model and communicate design proposals (for example, using CAD software to generate accurate drawings and part drawings to help with manufacturing).

Working with tools, equipment, materials and components to produce quality products

2. Pupils should be taught to:
- a) select and use tools, equipment and processes effectively and safely to make products that match a specification.

Evaluating processes and products

3. Pupils should be taught to:
- a) check design proposals against design criteria, and review and modify them if necessary as they develop their product
 - b) devise and apply tests to check the quality of their work at critical points during development
 - c) ensure that their products are of a suitable quality for intended users (for example, how well products meet a range of considerations such as moral, cultural and environmental) and suggest modifications that would improve their performance if necessary

Liquids Mean life

- d) recognise the difference between quality of design and quality of manufacture, and use essential criteria to judge the quality of other people's products.

- f) use spoken standard English fluently in different contexts

- g) evaluate the effectiveness of their speech and consider how to adapt it to a range of situations.

BREADTH OF STUDY

- 6. During the key stage, pupils should be taught the Knowledge, Skills and Understanding through:

- a) product analysis
- b) focused practical tasks that develop a range of techniques, skills, processes and knowledge
- c) design and make assignments, which include activities related to industrial practices and the application of systems and control.

Group discussion and interaction

- 3. To participate effectively as members of different groups, pupils should be taught to:

- c) sift, summarise and use the most important points
- d) take different roles in the organisation, planning and sustaining of groups
- e) help the group to complete its tasks by varying contributions appropriately, clarifying and synthesising others' ideas, taking them forward and building on them to reach conclusions, negotiating consensus or agreeing to differ.

English KS3 & 4

KNOWLEDGE, SKILLS AND UNDERSTANDING: EN1 Speaking and Listening

Speaking

- 1. To speak fluently and appropriately in different contexts, adapting their talk for a range of purposes and audiences, including the more formal, pupils should be taught to:
 - a) structure their talk clearly, using markers so that their listeners can follow the line of thought
 - b) use illustrations, evidence and anecdote to enrich and explain their ideas
 - c) use gesture, tone, pace and rhetorical devices for emphasis
 - d) use visual aids and images to enhance communication
 - e) vary word choices, including technical vocabulary, and sentence structure for different audiences

Standard English

- 5. Pupils should be taught to use the vocabulary, structures and grammar of spoken standard English fluently and accurately in informal and formal situations.

Language variation

- 6. Pupils should be taught about how language varies, including:
 - a) the importance of standard English as the language of public communication nationally and often internationally
 - c) attitudes to language use.

BREADTH OF STUDY

- 7. During the key stage, pupils should be taught the Knowledge, Skills and Understanding through the following range of activities, contexts and purposes.

Liquids Mean life

Speaking

8. The range of purposes should include:

- a) describing, narrating, explaining, arguing, persuading, entertaining and pupils should be given opportunities to make:
- b) extended contributions to talk in different contexts and groups
- c) presentations to different audiences.

Listening

9. The range should include listening to and watching:

- a) live talks and presentations.

KNOWLEDGE, SKILLS AND UNDERSTANDING: EN2 Reading

Understanding texts

1. To develop understanding and appreciation of texts, pupils should be taught:

Understanding the author's craft

- j) how techniques, structure, forms and styles vary.

Printed and ICT-based information texts

4. To develop their reading of print and ICT-based information texts, pupils should be taught to:

- a) select, compare and synthesise information from different texts
- b) evaluate how information is presented.

BREADTH OF STUDY

7. During the key stage, pupils should be taught the Knowledge, Skills and Understanding

through the following ranges of literature and non-fiction and non-literary texts.

Non-fiction and non-literary texts

9. The range should include:

- b) print and ICT-based information and reference texts.

KNOWLEDGE, SKILLS AND UNDERSTANDING: EN3 Writing

Writing to inform, explain, describe

- e) form sentences and paragraphs that express connections between information and ideas precisely (for example, cause and effect, comparison)
- f) use formal and impersonal language and concise expression
- g) consider what the reader needs to know and include relevant details
- h) present material clearly, using appropriate layout, illustrations and organisation.

Writing to analyse, review, comment

- l) reflect on the nature and significance of the subject matter
- m) form their own view, taking into account a range of evidence and opinions
- n) organise their ideas and information, distinguishing between analysis and comment
- o) take account of how well the reader knows the topic.

Planning and drafting

2. To improve and sustain their writing, pupils should be taught to:

Liquids Mean life

- a) plan, draft, redraft and proofread their work on paper and on screen.

Punctuation

3. Pupils should be taught to use the full range of punctuation marks correctly to signal sentence structure, and to help the reader.

Spelling

4. Pupils should be taught to:
 - d) check their spelling for errors and use a dictionary when necessary
 - e) use different kinds of dictionary, thesaurus and spellchecker.

Handwriting and presentation

5. Pupils should be taught to write with fluency and, when required, speed.

In presenting final polished work, pupils should be taught to:

 - a) ensure that work is neat and clear
 - b) write legibly, if their work is hand-written
 - c) make full use of different presentational devices where appropriate.

BREADTH OF STUDY

8. During the key stage, pupils should be taught the Knowledge, Skills and Understanding through addressing the following range of purposes, readers and forms of writing.
9. The range of purposes for writing should include:
 - b) to inform, explain and describe, focusing on conveying information and ideas clearly. The forms for such writing should be drawn from memos, minutes, accounts, information leaflets, prospectuses, plans, records, summaries.

Mathematics KS3

KNOWLEDGE, SKILLS AND UNDERSTANDING: MA2 Number and Algebra

Using and applying number and algebra

1. Pupils should be taught to:

Problem solving

- b) break down a complex calculation into simpler steps before attempting to solve it
- d) select efficient techniques for numerical calculation and algebraic manipulation
- e) make mental estimates of the answers to calculations; use checking procedures to monitor the accuracy of their results.

Reasoning

- j) show step-by-step deduction in solving a problem; explain and justify how they arrived at a conclusion.

Calculations

3. Pupils should be taught to:

Number operations and the relationships between them

- a) add, subtract, multiply and divide integers and then any number; multiply or divide any number by powers of 10, and any positive number by a number between 0 and 1; find the prime factor decomposition of positive integers (for example, ITEM 6).

Written methods

- j) use standard column procedures for addition and subtraction of integers and decimals

Liquids Mean life

- l) use efficient methods to calculate with fractions, including cancelling common factors before carrying out the calculation, recognising that, in many cases, only a fraction can express the exact answer
- m) solve simple percentage problems, including increase and decrease (for example, simple interest, VAT, discounts, pay rises, annual rate of inflation, income tax, discounts).

Calculator methods

- o) use calculators effectively and efficiently
- q) understand the calculator display, interpreting it correctly (for example, in money calculations, and when the display has been rounded by the calculator), and knowing not to round during the intermediate steps of a calculation.

Solving numerical problems

- 4. Pupils should be taught to:
 - a) draw on their knowledge of the operations and the relationships between them, ...to solve problems involving... a range of measures and compound measures, metric units, and conversion between metric and common imperial units, set in a variety of contexts
 - c) use a variety of checking procedures, including working the problem backwards, and considering whether a result is of the right order of magnitude
 - d) give solutions in the context of the problem to an appropriate degree of accuracy, recognising limitations on the accuracy of data and measurements.

KNOWLEDGE, SKILLS & UNDERSTANDING: MA3 Shape, space and measures

Measures and construction

- 4. Pupils should be taught to:

Measures

- a) interpret scales on a range of measuring instruments, including those for time and mass; know that measurements using real numbers depend on the choice of unit; recognise that measurements given to the nearest whole unit may be inaccurate by up to one half in either direction; convert measurements from one unit to another; know rough metric equivalents of pounds, feet, miles, pints and gallons; make sensible estimates of a range of measures in everyday settings.

KNOWLEDGE, SKILLS AND UNDERSTANDING: MA4 Handling data

Collecting data

- 3. Pupils should be taught to:
 - a) design and use data-collection sheets for grouped discrete and continuous data; collect data using various methods including observation, controlled experiment, data logging, questionnaires and surveys
 - b) gather data from secondary sources, including printed tables and lists from ICT-based sources
 - c) design and use two-way tables for discrete and grouped data.

Processing and representing data

- 4. Pupils should be taught to:
 - a) draw and produce, using paper and ICT, pie charts for categorical data.

Interpreting and discussing results

- 5. Pupils should be taught to:
 - a) relate summarised data to the initial questions
 - b) interpret a wide range of graphs and diagrams and draw conclusions

Liquids Mean life

- c) look at data to find patterns and exceptions.

BREADTH OF STUDY

1. During the key stage, pupils should be taught the Knowledge, Skills and Understanding through:
 - f) practical work in which they draw inferences from data and consider how statistics are used in real life to make informed decisions
 - h) tasks focused on using appropriate ICT (for example, spreadsheets, databases, geometry or graphic packages), using calculators correctly and efficiently, and knowing when it is not appropriate to use a particular form of technology.

Mathematics Foundation KS4

KNOWLEDGE, SKILLS AND UNDERSTANDING: MA2 Number and algebra

Using and applying number and algebra

1. Pupils should be taught to:

Problem solving

- b) break down a complex calculation into simpler steps before attempting to solve it
- d) make mental estimates of the answers to calculations; use checking procedures, including use of inverse operations; work to stated levels of accuracy.

Reasoning

- k) show step-by-step deduction in solving a problem.

Calculations

3. Pupils should be taught to:

Number operations and the relationships between them

- a) add, subtract, multiply and divide integers and then any number; multiply or divide any number by powers of 10, and any positive number by a number between 0 and 1
- b) use brackets and the hierarchy of operations
- c) calculate a given fraction of a given quantity (for example, for scale drawings and construction of models, down payments, discounts), expressing the answer as a fraction; express a given number as a fraction of another; add and subtract fractions by writing them with a common denominator; perform short division to convert a simple fraction to a decimal.

Written methods

- j) use standard column procedures for addition and subtraction of integers and decimals
- l) use efficient methods to calculate with fractions, including cancelling common factors before carrying out the calculation, recognising that, in many cases, only a fraction can express the exact answer
- m) solve simple percentage problems, including increase and decrease (for example, VAT, annual rate of inflation, income tax, discounts).

Calculator methods

- o) use calculators effectively and efficiently
- q) understand the calculator display, interpreting it correctly (for example, in money calculations, or when the display has been rounded by the calculator), and knowing not to round during the intermediate steps of a calculation.

Liquids Mean life

Solving numerical problems

4. Pupils should be taught to:
- a) draw on their knowledge of the operations and the relationships between them, ... to solve problems involving... a range of measures and compound measures, metric units, and conversion between metric and common imperial units, set in a variety of contexts
 - c) use a variety of checking procedures, including working the problem backwards, and considering whether a result is of the right order of magnitude
 - d) give solutions in the context of the problem to an appropriate degree of accuracy, interpreting the solution shown on a calculator display, and recognising limitations on the accuracy of data and measurements.

KNOWLEDGE, SKILLS AND UNDERSTANDING: Ma3 Shape, space and measures

Measures and construction

4. Pupils should be taught to:

Measures

- a) interpret scales on a range of measuring instruments, including those for time and mass; know that measurements using real numbers depend on the choice of unit; recognise that measurements given to the nearest whole unit may be inaccurate by up to one half in either direction; convert measurements from one unit to another; know rough metric equivalents of pounds, feet, miles, pints and gallons; make sensible estimates of a range of measures in everyday settings.

KNOWLEDGE, SKILLS AND UNDERSTANDING: Ma4 Handling data

Using and applying handling data

1. Pupils should be taught to:

Problem solving

- a) carry out each of the four aspects of the handling data cycle to solve problems:
- i) specify the problem and plan: formulate questions in terms of the data needed, and consider what inferences can be drawn from the data; decide what data to collect (including sample size and data format) and what statistical analysis is needed
 - ii) collect data from a variety of suitable sources, including experiments and surveys, and primary and secondary sources
 - iii) process and represent the data: turn the raw data into usable information that gives insight into the problem
 - iv) interpret and discuss: answer the initial question by drawing conclusions from the data
- b) identify what further information is needed to pursue a particular line of enquiry.

Communicating

- e) interpret, discuss and synthesise information presented in a variety of forms
- f) communicate mathematically, including using ICT, making use of diagrams and related explanatory text
- g) examine critically, and justify, their choices of mathematical presentation of problems involving data.

Specifying the problem and planning

2. Pupils should be taught to:
- d) identify which primary data they need to collect and in what format, including grouped data, considering appropriate equal class intervals
 - e) design an experiment or survey; decide what secondary data to use.

Liquids Mean life

Collecting data

3. Pupils should be taught to:
 - a) design and use data-collection sheets for grouped discrete and continuous data; collect data using various methods, including observation, controlled experiment, data logging, questionnaires and surveys
 - b) gather data from secondary sources, including printed tables and lists from ICT-based sources
 - c) design and use two-way tables for discrete and grouped data.

Processing and representing data

4. Pupils should be taught to:
 - a) draw and produce, using paper and ICT, pie charts for categorical data, and diagrams for continuous data, including line graphs for time series, scatter graphs, frequency diagrams and stem-and-leaf diagrams
 - g) find the median for large data sets and calculate an estimate of the mean for large data.

Interpreting and discussing results

5. Pupils should be taught to:
 - a) relate summarised data to the initial questions
 - b) interpret a wide range of graphs and diagrams and draw conclusions
 - c) look at data to find patterns and exceptions
 - i) understand that if they repeat an experiment, they may - and usually will - get different outcomes, and that increasing sample size generally leads to better estimates of probability and population characteristics.

BREADTH OF STUDY

1. During the key stage, pupils should be taught the Knowledge, Skills and Understanding through:
 - f) practical work in which they draw inferences from data, consider how statistics are used in real life to make informed decisions, and recognise the difference between meaningful and misleading representations of data
 - h) substantial use of tasks focused on using appropriate ICT (for example, spreadsheets, databases, geometry or graphic packages), using calculators correctly and efficiently, and knowing when not to use a calculator.

Science KS3

KNOWLEDGE, SKILLS AND UNDERSTANDING: SC1 Scientific enquiry

Investigative skills

2. Pupils should be taught to:

Planning

- c) carry out preliminary work and to make predictions, where appropriate
- e) decide the extent and range of data to be collected and the techniques, equipment and materials to use (for example, appropriate sample size for biological work)

Obtaining and presenting evidence

- g) make observations and measurements, including the use of ICT for datalogging (for example, variables changing over time) to an appropriate degree of precision

Liquids Mean life

- i) use a wide range of methods, including diagrams, tables, charts, graphs and ICT, to represent and communicate qualitative and quantitative data.

the differences in solubility of solutes in different solvents

- c) to relate changes of state to energy transfers.

Considering evidence

- j) use diagrams, tables, charts and graphs, including lines of best fit, to identify and describe patterns or relationships in data
- k) use observations, measurements and other data to draw conclusions
- l) decide to what extent these conclusions support a prediction or enable further predictions to be made
- m) use their scientific knowledge and understanding to explain and interpret observations, measurements or other data, and conclusions.

Geological changes

- e) about the formation of rocks by processes that take place over different timescales, and that the mode of formation determines their texture and the minerals they contain.

Chemical reactions

- g) how mass is conserved when chemical reactions take place because the same atoms are present, although combined in different ways.

Evaluating

- n) consider anomalies in observations or measurements and try to explain them
- o) consider whether the evidence is sufficient to support any conclusions or interpretations made
- p) suggest improvements to the methods used, where appropriate.

Patterns of behaviour

- 3. Pupils should be taught:

Acids and bases

- d) to use indicators to classify solutions as acidic, neutral or alkaline, and to use the pH scale as a measure of the acidity of a solution.

KNOWLEDGE, SKILLS AND UNDERSTANDING: SC3 Materials and their properties

Changing materials

- 2. Pupils should be taught:

Physical changes

- a) that when physical changes (for example, changes of state, formation of solutions) take place, mass is conserved
- b) about the variation of solubility with temperature, the formation of saturated solutions, and

BREADTH OF STUDY

- 1. During the key stage, pupils should be taught the Knowledge, Skills and Understanding through:
 - a) a range of domestic, industrial and environmental contexts
 - b) considering ways in which science is applied in technological developments
 - c) considering the benefits and drawbacks of scientific and technological developments, including those related to the environment, health and quality of life
 - d) using a range of sources of information, including ICT-based sources

Liquids Mean life

- e) using first-hand and secondary data to carry out a range of scientific investigations, including complete investigations.
- n) explain to what extent these conclusions support any prediction made, and enable further predictions to be made

Single Science KS4

KNOWLEDGE, SKILLS AND UNDERSTANDING: SC1 Scientific enquiry

Investigative skills

2. Pupils should be taught to:

Planning

- c) carry out preliminary work and make predictions, where appropriate
- e) decide the extent and range of data to be collected (for example, appropriate sample size for biological work) and the techniques, equipment and materials to use.

Obtaining and presenting evidence

- g) make observations and measurements, including the use of ICT for datalogging (for example, to monitor several variables at the same time) to a degree of precision appropriate to the context
- j) represent and communicate qualitative and quantitative data using diagrams, tables, charts, graphs and ICT.

Considering evidence

- k) use diagrams, tables, charts and graphs, and identify and explain patterns or relationships in data
- l) present the results of calculations to an appropriate degree of accuracy
- m) use observations, measurements or other data to draw conclusions

- o) use scientific knowledge and understanding to explain and interpret observations, measurements or other data, and conclusions.

Evaluating

- p) consider anomalous data giving reasons for rejecting or accepting them, and consider the reliability of data in terms of the uncertainty of measurements and observations
- q) consider whether the evidence collected is sufficient to support any conclusions or interpretations made
- r) suggest improvements to the methods used
- s) suggest further investigations.

BREADTH OF STUDY

1. During the key stage, pupils should be taught the Knowledge, Skills and Understanding through:
- a) a range of domestic, industrial and environmental contexts
- b) considering ways in which science is applied in technological developments
- c) considering and evaluating the benefits and drawbacks of scientific and technological developments, including those related to the environment, personal health and quality of life, and those raising ethical issues
- d) using a range of sources of information, including ICT-based sources
- e) using first-hand and secondary data to carry out a range of scientific investigations, including complete investigations.