

Introduction to the computing curriculum in secondary schools

Key Stage 3 Years 7 to 9 – ages 11 to 13

Key Stage 4 Years 10 to 11 – ages 13 to 15

Schools in England are expected to follow the National Curriculum for computing. The opening statement shares the ambitious intention for all students:

‘A high-quality computing education equips students to use computational thinking and creativity to understand and change the world. Computing has deep links with mathematics, science and design and technology and provides insights into both natural and artificial systems.’

National Curriculum for computing, 2014

The purpose of this document is to help you as a STEM Ambassador align your expert knowledge to the computing curriculum. To aid matching activities to your expertise, we have divided the curriculum into 10 strands and each one shows the progression from Key Stage 3 to 4. It's worth noting that mental models maybe used to help deliver content to students, we highly recommend you discussing content with the classroom teacher to ensure your content is pitched at the correct level.

Digital skills amongst students:

It's important to consider what digital skills students will have experience of, the following information has been taken from the '[Digital literacy within the computing curriculum](#)' report – Jan 2021:

✓ Key stage 3 students:

Students will have experienced a range of hardware and software. They should be confident in using technology to create artefacts and present information and ideas.

✓ Key stage 4 students:

Students should be competent users of technology, tackling creative and data-focus tasks. During Years 10 and 11, learners focus their digital literacy development on using technology safely, effectively, and productively, particularly in the world of work.

Note: computing is a foundation subject, and the National Curriculum includes provision for all students at Key Stage 4. However, the offer to year 10 and Y11 students – other than GCSE Computer Science – is mixed; some non-GCSE students may study aspects of computing, but most currently do not.

The document has been split into two main areas, subject knowledge and computing skills. It is recommended that STEM Ambassadors discuss topic areas and expectations around the level of prior student knowledge, with the classroom teachers before planning activities.

1 Subject knowledge

Algorithms

An algorithm is a set of instructions that need to be followed in a particular order to solve a problem. At Key Stage 3, examples are:

- creating algorithms to solve problems, breaking problems into smaller, easier to solve parts (decomposing), and removing complexity (abstracting)
- explaining the purpose of the parts of the algorithms (tracing) and fixing faults (debugging)
- evaluating and comparing different algorithms
- key algorithms – there are particular searching and sorting algorithms that are taught as part of the curriculum. Students may know that web searches use algorithms to find their search results. They need to be able to compare algorithms, to explain which one is a better solution to a problem


Progressing to Key Stage 4, the students who are studying GCSE Computer Science need to be able to comprehend, design, create and evaluate algorithms. They build on their understanding of the examples from Key Stage 3 and develop to:

- represent algorithms using words (pseudocode) and flowcharts
- use data structures – ways of organising data, including lists, tables and simple arrays.
- use search and sort algorithms i.e. binary and linear searches, bubble, merge and insertion sorts

Programming

At Key Stage 3, the students learn that programs are created using common building blocks, known as programming constructs.

These programming constructs form the basis for all programs and are also used in algorithms. They need to understand how to create software to allow computers to solve problems.



The examples are similar to the requirements for algorithms, as it builds on the learning by:

- creating programming projects using suitable constructs i.e. sequencing, selection, iteration etc.
- tracing and debugging code
- modelling and simulating real-world objects
- inputting and outputting data from a program, focussing on data types and structure, such as, lists, tables and simple arrays
- using arithmetic logic using terms, AND, OR, NOT
- making their programs more efficient by combining sets of instructions into simple functions or procedures

Students should have experience using block-based software, such as, Scratch. Their expertise can vary across groups and schools. In addition, schools will have introduced a text-

based programming language, for example, Python or C#. The National Curriculum states that students should be taught two languages, one of which should be text-based. Therefore, it is useful to also continue with block-based languages, to support their learning of the computing constructs.

Progressing to Key Stage 4 at GCSE curriculum, the students develop their learning to:

- evaluate and compare their programs to check the robustness, readability and security
- input and output data to external files

At GCSE, students may be taught programming via an extended programming task, this is to allow students to develop skills in designing, writing, testing and refining a program. This aims to combine all the learning from Key Stage 3 and 4, to solve a particular problem whilst developing skills for their examinations.

Data and Information

The students learn how computers process data and how the resulting information can be used to form judgements and make predictions. They need to understand how data is stored, organised and used to represent real world scenarios. At Key Stage 3, the students are introduced to:

- how numbers, text, images and sound are represented in computer systems
- units of information from bits to petabytes
- number systems including binary and decimal
- using operators with data, such as, +, -, <, >, to perform calculations

This progresses at Key Stage 4 in GCSE by learning about:

- number systems including hexadecimal
- ways of compressing sound and images
- how encryption is used to secure data and information
- correcting errors in data
- databases, for storing and sharing data

Computer Systems

At Key Stage 3, students learn what a computer is and how the constituent parts function together as a whole. They recognise that a computer system is a combination of hardware (the physical parts of a computer) and software (the programs that run on a computer) working together. The areas introduced are:

- systems
- logic
- hardware – naming the main parts and introducing the architecture, for example, memory, processor

- software – naming familiar applications and their purpose, including the operating system
- communication and coordination between the computer's components and with other computers

Progressing to Key Stage 4, students develop their knowledge to evaluate and compare the performance of different components including the CPU. Students will learn about how the clock speed, total number of cores and cache size can impact upon the processors performance. This learning will progress to learning how instructions are stored and executed including common architectures such as Von Neumann.

Networks

The students learn that a network is two or more computers connected together and that networks can be connected using different topologies and architectures. At Key Stage 3, they learn about the Internet, the World Wide Web and different search technologies. They learn about services, for example, 'The Internet of Things' and how that can benefit their lives, coupled with the security risks.

At Key Stage 4, the students need to understand how networks can be used to retrieve and share information using protocols. Areas covered in the GCSE curriculum are:

- classification of networks - topology, type, model and the hardware - students will need to be able to compare the characteristics of different network topologies, including bus, ring, star and mesh topologies

- communication and coordination - this includes the basics of how data is transferred via wired and wireless network connections
- common protocols, such as TCP / IP, HTTP / HTTPS, FTP, POP, IMAP, SMTP
- security - students will learn about different threats including malware, brute force attacks, denial of service attacks, SQL injection etc. They will also consider the prevention methods and understand how to identify and prevent against vulnerabilities
- encryption and filtering - students will learn how encryption works and the importance of using it when transferring sensitive data over a network

Safety and Security

As important data is stored on computers, measures such as passwords and anti-virus software are needed to keep those devices secure. The students learn about risks, when using technology and how to protect individuals and systems. They build on their e-safety experience from primary school, with relevant examples, including using social media. They are introduced to threats to networks, digital systems and data, for example, malware attacks. They think about identifying vulnerabilities and protecting against these threats.

Progressing to Key Stage 4, there is a greater emphasis on prevention of attacks. Also, they learn more about social engineering, where people are tricked into sharing information or giving away access to their technology.

Not all students will undertake GCSE Computer Science covering the safety and security topics above. However, all students at this level should be taught to understand how changes in technology affect safety, including new ways to protect their online privacy and identity, and how to report a range of concerns.

2 Computing Skills



Creating Media

Students will select and create a range of media including text, images, sounds and video. They select, create, adapt and combine media to meet a specification and to meet a particular user's needs. This can involve generic software, such as, Microsoft Office or Google Suite for Education. It can include the students beginning to use industry-standard software, for example, Adobe Photoshop. Some students may have access to tablets and media apps, including augmented reality and virtual reality apps.

Design and Development

The students learn what is involved in planning, creating and evaluating computing objects. They begin to understand how writing the instructions, flowcharts and structure diagrams are used to design software and how modern design is used to develop software. This progresses through Key Stage 3 to cover: analysis, designing, implementation, evaluating and collaborating.

Effective use of tools

Students will use software tools to support their computing work. Students will develop confidence and efficiency with different software tools throughout their learning, including:

- locating and retrieving files, organising files
- using email
- using word processors, presentation tools and spreadsheets
- drawing tools, audio and video editing tools
- block-based programming software
- text-based programming software

At Key Stage 4, the students develop these areas to include a greater focus on testing and refining their solutions. They are introduced to project design methods used in industry, such as, agile and waterfall methodologies

Impact of Technology

The students learn how computers have brought about many environmental, ethical and legal issues and concerns that increasingly affect all of our daily lives. This involves evaluating content, for example, spam emails or webpages. They learn about responsible use of data, including privacy and copyright, with real-world, relevant examples. For example, crediting a photographer, when using an image.

At Key Stage 4 in GCSE, students are introduced how individuals, systems and society as a whole, interact with computer systems, including: legal implications, social issues and moral issues.

Further help

Follow this link to the **[National Curriculum for computing in England](#)**.

A range of Teach Computing lesson ideas are available:

for Key Stage 3: **<https://teachcomputing.org/curriculum/key-stage-3>**

for Key Stage 4: **<https://teachcomputing.org/curriculum/key-stage-4>**