Computing

National Curriculum

Purpose of study

A high-quality computing education equips pupils 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. The core of computing is computer science, in which pupils are taught the principles of information and computation, how digital systems work, and how to put this knowledge to use through programming. Building on this knowledge and understanding, pupils are equipped to use information technology to create programs, systems and a range of content. Computing also ensures that pupils become digitally literate – able to use, and express themselves and develop their ideas through, information and communication technology – at a level suitable for the future workplace and as active participants in a digital world.

Aims

The national curriculum for computing aims to ensure that all pupils:

- can understand and apply the fundamental principles and concepts of computer science, including abstraction, logic, algorithms and data representation
- can analyse problems in computational terms, and have repeated practical experience of writing computer programs in order to solve such problems
- can evaluate and apply information technology, including new or unfamiliar technologies, analytically to solve problems
- are responsible, competent, confident and creative users of information and communication technology.

Key Stage 1

Pupils should be taught to:

- Understand what algorithms are; how they are implemented as programs on digital devices; and that programs execute by following precise and unambiguous instructions
- Create and debug simple programs
- Use logical reasoning to predict the behaviour of simple programs
- Use technology purposefully to create, organise, store, manipulate and retrieve digital content
- Recognise common uses of information technology beyond school
- Use technology safely and respectfully, keeping personal information private; identify where to go for help and support when they have concerns about content or contact on the internet or other online technologies.

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Computing Progression of Knowledge and Skills			
Foundation stage expected	**Technology:** Children recognise that a range of technology is used in places such as homes and schools. They select and use technology for particular purposes.		
Key Stage 1	Year 1 Expected	Year 2 Expected	Year 2 Greater Depth/End of Key Stage
Algorithms	Understands what an algorithm is. Writes a set of instructions for a purpose using symbols, numbers and words. Understands that computes need precise instructions. Shows care and precision to avoid errors.	Understands what an algorithm is and is able to express simple linear (non-branching) algorithms as symbols. Understands that computers need precise instructions. Demonstrates care and precision to avoid errors. Understand that algorithms are used on digital devices as programs. Simple algorithms using loops and selection (as statements). Uses logical reasoning to predict outcomes. Detects and corrects errors (debugging) in algorithms.	Understands what an algorithm is and is able to express simple linear (non-branching) algorithms as symbols. Understands that computers need precise instructions. Demonstrates care and precision to avoid errors. Understand that algorithms are used on digital devices as programs. Designs simple algorithms using loops and selection (as statements). Uses logical reasoning to predict outcomes. Detects and corrects errors (debugging) in algorithms. Begins to use design solutions e.g. repetition to improve algorithms.
Programming and Development	Knows that users can develop their own programs. Demonstrates this by creating simple programs e.g. on programmable robots,. Executes, checks and changes programs. Understands that programs execute by following precise instructions. Begins to use logical reasoning to predict the behaviour of programs.	Develops their own programs e.g. robots. Uses arithmetic operators and what if statements and loops within programs. Uses logical reasoning to predict the behaviour of programs and detects and corrects simple semantic errors i.e. debugging.	Develops their own programs e.g. robots. Uses arithmetic operators and what if statements and loops within programs. Uses logical reasoning to predict the behaviour of programs and detects and corrects simple semantic errors i.e. debugging. ams that implement algorithms to achieve given goals.
Data and Data Representation	Recognises that digital content can be represented in many forms. Begins to distinguish between some of these forms and can explain the different ways that they communicate information. Organises, stores, edits and manipulates data in different digital formats.	Recognises the different types of data e.g. text and number. Appreciates that programs can work with different types of data. Recognises that data can be structured in tables to make it useful. Confidently organises, stores, edits and manipulates data in a range of digital formats.	Recognises the different types of data e.g. text and number. Appreciates that programs can work with different types of data. Recognises that data can be structured in tables to make it useful. Confidently organises, stores, edits and manipulates data in a range of digital formats.

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		Begins to recognise the difference between data and information .	Recognises the difference between data and information.
Hardware and Processing	Understands that computers have no intelligence and can do nothing unless a program is used. Recognises that all software executed (used) on digital devices is programmed (look at examples) Begin to recognise and use a range of input and output devices e.g robotics. Starts to understand how programs specify the function of a general purpose computer.	Recognises that a range of digital devices can be considered a computer (look at examples). Recognises and uses a range of input and output devices (e.g. robotics) Understands how programs specify the function of a general purpose computer.	Recognises that a range of digital devices can be considered a computer (look at examples). Recognises and uses a range of input and output devices (e.g. robotics) Understands how programs specify the function of a general purpose computer. Begins to recognise that computers collect data from various input devices e.g. sensors.
Communication and Networks	Obtains content from the world wide web using a web browser. Understand the importance of communicating safely and respectfully on line (e-safety) and the need for keeping personal information private. Knows what to do when concerned about content or being contacted. Begins to carry out simple web searches to collect digital content.	Navigates the web and can carry out simple web searches to collect digital content. Demonstrates use of computers safely and responsibly, knowing a range of ways to report unacceptable content and contact when online.	Navigates the web and can carry out simple web searches to collect digital content. Demonstrates use of computers safely and responsibly, knowing a range of ways to report unacceptable content and contact when online. Begins to understand the difference between the internet and internet services e.g. world wide web.
Information Technology	Uses technology with increasing independence to purposely organise digital content. Shows awareness of the quality of digital content collected. Uses software to manipulate and present digital content: data and information. Shares their experiences of technology in school and outside school. Talks about their work and makes some improvements to solutions based on feedback received.	Uses technology with increasing independence to purposely organise digital content. Shows awareness of the quality of digital content collected. Uses software to manipulate and present digital content: data and information. Shares their experiences of technology in school and outside school. Talks about their work and makes some improvements to solutions based on feedback received.	Uses technology with increasing independence to purposely organise digital content. Shows awareness of the quality of digital content collected. Uses software to manipulate and present digital content: data and information. Shares their experiences of technology in school and outside school. Talks about their work and makes some improvements to solutions based on feedback received. Begins to create digital content to achieve a given goal through combining software e.g. blogs.

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Key Stage 2
Pupils should be taught to: • Design, write and debug programs that accomplish specific goals, including controlling or simulating physical systems; solve problems by decomposing them into smaller parts • Use sequence, selection, and repetition in programs; work with variables and various forms of input and output • Use logical reasoning to explain how some simple algorithms work and to detect and correct errors in algorithms and programs • Understand computer networks including the internet; how they can provide multiple services, such as the world wide web; and the opportunities they offer for communication and collaboration • Use search technologies effectively, appreciate how results are selected and ranked, and be discerning in evaluating digital content • Select, use and combine a variety of software (including internet services) on a range of digital devices to design and create a range of programs, systems and content that accomplish given goals, including collecting, analysing, evaluating and presenting data and information • Use technology safely, respectfully and responsibly; recognise acceptable/unacceptable behaviour; identify a range of ways to report concerns about content and contact.

Computing Progression of Knowledge and Skills - Key Stage 2			
	Year 3 Working towards	**Year 3 Expected**	**Year 3 Greater Depth**
Algorithms	Designs some solutions (algorithms) that use repetition and two way selection (i.e if, then, else.) Uses diagrams to express solutions. Starts to use logical reasoning to predict outputs, showing some awareness of inputs.	Designs solutions (algorithms) that use repetition and two way selection (i.e if, then, else.) Uses diagrams to express solutions. Uses logical reasoning to predict outputs, showing some awareness of inputs.	Designs solutions (algorithms) that use repetition and two way selection (i.e if, then, else.) Uses diagrams to express solutions. Uses logical reasoning to predict outputs, showing some awareness of inputs. Begins to show an awareness of tasks best completed by humans or computers.
Programming and Development	Begins to create programs that implement algorithms to achieve given goals. Identifies and assigns variables in programs. Uses loop commands “until” and sequences of selection statements in programs, including if, then, else statements.	Create programs that implement algorithms to achieve given goals. Identifies and assigns variables in programs. Uses loop commands “until” and sequences of selection statements in programs, including if, then, else statements.	Create programs that implement algorithms to achieve given goals. Identifies and assigns variables in programs. Uses loop commands “until” and sequences of selection statements in programs, including if, then, else statements. Begins to understand the difference between ‘if’ and ‘if’, then and else statements.
Data and Data Representation	Understands the difference between data and information.	Understands and can explain the difference between data and information.	Understands and can clearly explain the difference between data and information.

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	Knows why sorting data in a 'flat file' can improve searching for information. Begins to use filters or can perform single criteria searches for information.	Knows why sorting data in a 'flat file' can improve searching for information. Uses filters or can perform single criteria searches for information.	Knows why sorting data in a 'flat file' can improve searching for information. Uses filters and can perform single criteria searches for information. Starts to perform more complex searches for information e.g. relational operators.
Hardware and Processing	Begins to recognise that computers collect data from various input devices e.g. sensors and application software. Begins to understand the difference between hardware and application software and their roles within a computer system.	Recognise that computers collect data from various input devices e.g. sensors and application software. Understand the difference between hardware and application software and their roles within a computer system.	Recognise that computers collect data from various input devices e.g. sensors and application software. Understand the difference between hardware and application software and their roles within a computer system. Begins to understand why and when computers are used.
Communication and Networks	Understands the difference between the internet and internet services e.g. world wide web. Shows some awareness of, and can use some internet services such as VOIP. Recognises what is acceptable and unacceptable behaviour when using technologies and online services.	Understands the difference between the internet and internet services e.g. world wide web. Shows awareness of, and can use some internet services such as VOIP. Recognises what is acceptable and unacceptable behaviour when using technologies and online services.	Understands the difference between the internet and internet services e.g. world wide web. Shows awareness of, and can use some internet services such as VOIP. Recognises what is acceptable and unacceptable behaviour when using technologies and online services. Produces safety guidance on viruses, cyber bullying and stranger danger.
Information Technology	Collects, organises and presents data and information in digital content. Creates digital content to achieve a given goal through combining software, packages and internet services to communicate with a wider audience e.g blogging. Makes some appropriate improvements to solutions based on feedback received and can comment on the success of the solution.	Confidently collects, organises and presents data and information in digital content. Creates digital content to achieve a given goal through combining software, packages and internet services to communicate with a wider audience e.g blogging. Makes effective improvements to solutions based on feedback received and can comment on the success of the solution.	Collects, organises and presents data and information in digital content. Creates digital content to achieve a given goal through combining software packages and internet services to communicate with a wider audience e.g blogging. Makes effective improvements to solutions based on feedback received and can comment on the success of the solution. Makes judgements about the effectiveness and suitability of the digital content for the targeted audience.

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	Year 4 Working towards	Year 4 Expected	Year 4 Greater Depth
Algorithms	Shows an awareness of tasks best completed by human or computers. Begins to design solutions by decomposing a problem. Begins to recognise that there is more than one solution to a problem.	Knows which tasks best completed by human or computers. Designs solutions by decomposing a problem and creates a sub-solution for each part of the problem (decomposition) Recognises that there is more than one solution to a problem.	Knows which tasks are best completed by human or computers, giving examples. Designs solutions by decomposing a problem and creates a sub-solution for each part of the problem (decomposition). Recognises that there are several solutions to the same problem and various algorithms exist for different purposes.
Programming and Development	Begin to understand differences between 'if' and 'if', then and else statements. Uses some variable and relational operators within a loop to control 'endings' in programs. Designs, writes and debugs (modular) programs using procedures (algorithms). Begins to know that a procedure can be used to hide details in programs.	Understands differences between and appropriately uses 'if' and 'if', then and else statements. Uses variable and relational operators within a loop to control 'endings' in programs. Designs, writes and debugs (modular) programs using procedures (algorithms). Knows that a procedure can be used to hide details in programs.	Understands differences between and appropriately uses 'if' and 'if', then and else statements. Uses variable and relational operators within a loop to control 'endings' in programs. Designs, writes and debugs (modular) programs using procedures (algorithms). Knows that a procedure can be used to hide details in programs. Begins to recognise that programming bridges the gap between algorithms and computers.
Data and Data Representation	Understands and can clearly explain the difference between data and information. Knows why sorting data in a 'flat file' can improve searching for information. Uses filters and can perform single criteria searches for information. Starts to perform more complex searches for information e.g. relational operators. Begins to analyse and evaluate data and information and recognises that poor quality data leads to unreliable results.	Understands and can clearly explain the difference between data and information. Knows why sorting data in a 'flat file' can improve searching for information. Performs more complex searches for information e.g. using Booleam and relational operators. Analyses and evaluates data and information and recognises that poor quality data leads to unreliable results and inaccurate conclusions.	Clearly explain the difference between data and information, giving examples. Knows why sorting data in a 'flat file' can improve searching for information. Performs more complex searches for information e.g. using Booleam and relational operators. Analyses and evaluates data and information and recognises that poor quality data leads to unreliable results and inaccurate conclusions. Starts to understand key vocabulary e.g. binary and bit patterns.

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Hardware and Processing	Begins to understand why and when computers are used. Understands the main functions of the operating systems. Begins to know the difference between physical, wireless and mobile networks. Look at examples e.g. internet: how they provide multiple services such as the world wide web.	Understands why and when computers are used. Understands the main functions of the operating systems. Knows the difference between physical, wireless and mobile networks. Look at examples e.g. internet: how they provide multiple services such as the world wide web.	Understands why and when computers are used. Understands the main functions of the operating systems. Knows the difference between physical, wireless and mobile networks. Look at examples e.g. internet: how they provide multiple services such as the world wide web. Begins to recognise the function of the main internal parts of basic computer designs (architecture.)
Communication and Networks	Understands how to effectively use search engines and knows how search results are selecting including that search engines are 'web crawler programs' Selects, combines and uses some internet services. Demonstrates responsible use of technologies and online services and knows how to report concerns.	Understands how to effectively use search engines and knows how search results are selecting including that search engines are 'web crawler programs' Selects, combines and uses internet services. Demonstrates responsible use of technologies and online services and knows a range of ways to report concerns.	Understands how to effectively use search engines and knows how search results are selecting including that search engines are 'web crawler programs' Selects, combines and uses internet services. Demonstrates responsible use of technologies and online services and knows a range of ways to report concerns. Begins to understand how search engines rank results.
Information Technology	Begins to make judgements about digital content when evaluating and assigning it for a given audience. Recognises the audience when designing and creating digital content. Understands the potential of information technology for collaboration when computers are networked. Uses criteria to evaluate the quality of solutions.	Makes judgements about digital content when evaluating and assigning it for a given audience. Recognises the audience when designing and creating digital content. Understands the potential of information technology for collaboration when computers are networked. Uses criteria to evaluate the quality of solutions. Can identify improvements, making some refinements to the solution and future solutions.	Makes sound judgements about digital content when evaluating and assigning it for a given audience. Recognises the audience when designing and creating digital content. Understands the potential of information technology for collaboration when computers are networked. Uses criteria to evaluate the quality of solutions. Can confidently identify improvements, making some refinements to the solution and future solutions.

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	Year 5 Working towards	**Year 5 Expected**	**Year 5 Greater Depth**
Algorithms	Knows which tasks are best completed by human or computers. Designs solutions by decomposing a problem and creates a sub-solution for each part of the problem (decomposition). Recognises that there are several solutions to the same problem. Understands that various algorithms exist for different functions.	Knows and can explain which tasks are best completed by human or computers. Designs solutions by decomposing a problem and creates a sub-solution for each part of the problem (decomposition). Recognises that there are several solutions to the same problem. Understands that various algorithms exist for different functions. Begins to identify patterns in algorithms that help to solve specific problems.	Explains confidently which tasks are best completed by human or computers. Designs solutions by decomposing a problem and creates a sub-solution for each part of the problem (decomposition). Recognises that there are several solutions to the same problem. Understands that various algorithms exist for different functions. Identifies patterns in algorithms that help to solve specific problems.
Programming and Development	Begins to recognise that programming bridges the gap between algorithms and computers. Has some practical experience of high level textural languages e.g. standard libraries when programming. Uses some operators and expressions e.g. Booleam.	Understands that programming bridges the gap between algorithmic solutions and computers. Has practical experience of high level textural languages e.g. standard libraries when programming. Uses some operators and expressions e.g. Booleam. Starts to apply these in the context of program control (e.g. input/process/output.)	Understands that programming bridges the gap between algorithmic solutions and computers. Has practical experience of high level textural languages e.g. standard libraries when programming. Uses a range of operators and expressions e.g. Booleam. Starts to apply these in the context of program control (e.g. input/process/output.)
Data and Data Representation	Knows why sorting data in a ‘flat file’ can improve searching for information. Performs more complex searches for information e.g. using Booleam and relational operators. Analyses and evaluates data and information and recognises that poor quality data leads to unreliable results and inaccurate conclusions.	Knows why sorting data in a ‘flat file’ can improve searching for information. Performs more complex searches for information e.g. using Booleam and relational operators. Analyses and evaluates data and information and recognises that poor quality data leads to unreliable results and inaccurate conclusions.	Knows why sorting data in a ‘flat file’ can improve searching for information. Performs more complex searches for information e.g. using Booleam and relational operators. Analyses and evaluates data and information and recognises that poor quality data leads to unreliable results and inaccurate conclusions.

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	Starts to understand key vocabulary e.g. binary and bit patterns. Begins to understand that digital computers are binary to represent all data.	Begins to understand that digital computers are binary to represent all data. Begins to understand how bit patterns represent numbers and images.	Knows that digital computers use binary to represent all data. Understands how bit patterns represent numbers and images.
Hardware and Processing	Understands why and when computers are used. Understands the main functions of the operating system. Knows the difference between physical, wireless and mobile networks. Look at examples e.g. internet: how they provide multiple services such as the world wide web. Recognise the function of the main internal parts of basic computer designs (architecture.)	Recognise the function of the main internal parts of basic computer designs (architecture.) Begins to understand the concept behind the fetch-execute cycle. Starts to appreciate that there is a range of operating systems and application software for the same hardware.	Recognises and understands the function of the main internal parts of basic computer designs (architecture.) Understands the concepts behind the fetch-execute cycle. Starts to appreciate that there is a range of operating systems and application software for the same hardware.
Communication and Networks	Begins to understand how search engines rank search results. Understands how to construct static web pages using HTML and CSS. Begins to understand data transmission between digital computers over networks including the internet i.e. IP addresses and packet switching.	Understands how search engines rank search results and test some of these systems. Understands how to construct static web pages using HTML and CSS. Understands data transmission between digital computers over networks including the internet i.e. IP addresses and packet switching.	Understands how search engines rank search results and test and evaluate some of these systems. Understands how to construct static web pages using HTML and CSS. Understands data transmission between digital computers over networks including the internet i.e. IP addresses and packet switching.
Information Technology	Makes sound judgements about digital content when evaluating and assigning it for a given audience. Recognises the audience when designing and creating digital content, (makes examples and tests them). Understands the potential of information technology for collaboration when computers are networked. Uses criteria to evaluate the quality of solutions. Confidently identify improvements, making some refinements to the solution and future solutions.	Evaluates the appropriateness of digital services, internet services and application software to achieve given goals. Recognises ethical issues surrounding the application of information technology beyond school. Designs criteria to critically evaluate the quality of solutions. Uses the criteria to identify improvements, and can make appropriate some refinements to the solution.	Evaluates the appropriateness of digital services, internet services and application software to achieve given goals. Recognises ethical issues surrounding the application of information technology beyond school. Designs criteria to critically evaluate the quality of solutions. Uses the criteria to identify effective improvements, and can make appropriate some refinements to the solution.

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	Year 6 working towards	**Year 6 expected**	**Year 6 working at greater depth**
Algorithms	Begins to understand that iteration is the repetition of a process such as a loop. Recognises that different algorithms exist for the same problem. Detects errors in algorithms. Rewrites own tests and sequences. Is able to identify some similarities and differences in situations and can use these to solve problems (pattern recognition.)	Understand that iteration is the repetition of a process such as a loop. Recognises that different algorithms exist for the same problem. Detects errors in algorithms. Rewrites and tests own tests and sequences. Is able to identify similarities and differences in situations and can use these to solve problems (pattern recognition.)	Understands that iteration is the repetition of a process such as a loop. Recognises that different algorithms exist for the same problem. Detects errors in algorithms. Rewrites and tests own sequences. Is able to identify similarities and differences in situations and can use these to solve problems (pattern recognition.) Begins to recognise that some problems share the same characteristics and use the same algorithms to solve both (generalisation)
Programming and Development	Understands that programming bridges the gap between algorithmic solutions and computers. Has practical experience of high level textural languages e.g. standard libraries when programming. Uses a range of operators and expressions e.g. Booleam. Starts to apply these in the context of program control (e.g. input/process/output.) Starts to select the appropriate data types.	Understands that programming bridges the gap between algorithmic solutions and computers. Has practical experience of high level textural languages e.g. standard libraries when programming. Uses a range of operators and expressions e.g. Booleam and applies them in the context of program control (e.g. input/process/output.) Starts to select the appropriate data types.	Understands that programming bridges the gap between algorithmic solutions and computers. Has practical experience of high level textural languages e.g. standard libraries when programming. Uses a range of operators and expressions e.g. Booleam and applies them in the context of program control (e.g. input/process/output.) Starts to select the appropriate data types. Starts to appreciate the need for and writes their own “custom” functions to improve programs. Starts to detect and correct syntactical errors.

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Data and Data Representation	Knows that digital computers use binary to represent all data. Understands how bit patterns represent numbers and images. Begins to know that computers transfer data in binary (code). Starts to recognise the relationship between binary and file size (uncompressed) Defines data types: real numbers and booleam. Queries data on one table using typical query language.	Knows that digital computers use binary to represent all data. Understands how bit patterns represent numbers and images. Knows that computers transfer data in binary (code). Recognises the relationship between binary and file size (uncompressed) Defines data types: real numbers and Booleam. Queries data on one table using typical query language.	Knows that digital computers use binary to represent all data. Understands how bit patterns represent numbers and images. Knows that computers transfer data in binary (code). Recognises the relationship between binary and file size (uncompressed) Defines data types: real numbers and Booleam. Queries data on one table using typical query language. Begins to understand how numbers, images, sounds and character sets use the same bit patterns.
Hardware and Processing	Recognises and understands the function of the main internal parts of basic computer designs (architecture.) Understands the concepts behind the fetch-execute cycle. Knows that there is a range of operating systems and application software for the same hardware. Tests, compares and contrasts the effectiveness of operating systems (eg. Windows android)	Recognises and understands the function of the main internal parts of basic computer designs (architecture.) Understands the concepts behind the fetch-execute cycle. Knows that there is a range of operating systems and application software for the same hardware. Tests, contrasts and evaluates the effectiveness of operating systems (eg. Windows android)	Recognises and understands the function of the main internal parts of basic computer designs (architecture.) Understands the concepts behind the fetch-execute cycle. Tests, contrasts and evaluates a range of operating systems and application software that is often used for the same hardware. Begins to understand the Von Neuman architecture in relation to the fetch-execute cycle, including how data is stored in memory. Understand the basic function and operation of location addressable memory.
Communication and Networks	Understands how search engines rank search results and test and evaluate some of these systems. Understands how to construct static web pages using HTML and CSS. Understands data transmission between digital computers over networks including the internet i.e. IP addresses and packet switching.	Understands how search engines rank search results. Clearly evaluates these systems. Understands how to construct static web pages using HTML and CSS. Designs and creates own web pages for a purpose. Understands data transmission between digital computers over	Understands how search engines rank search results. Clearly evaluates these systems. Understands how to construct static web pages using HTML and CSS. Designs and creates own web pages for a purpose. Understands data transmission between digital computers over

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	Begins to know the names of hardware e.g hubs and routers.	networks including the internet i.e. IP addresses and packet switching.	networks including the internet i.e. IP addresses and packet switching. Knows key names of hardware e.g. hubs, routers, switches and the names of protocols e.g.SMTP, IMAP, POP, FTP, TCP/IP associated with computer systems.
Information Technology	Begins to justify the choice of, combines and uses multiple digital devices, internet services and application software to achieve given goals. Starts to evaluate the trustworthiness of digital content. Begins to consider how the use of technology can impact on society.	Justifies the choice of, combines and uses multiple digital devices, internet services and application software to achieve given goals. Evaluates the trustworthiness of digital content. Knows how the use of technology can impact on society. Begins to design criteria for users to evaluate the quality of solutions and uses the feedback to identify some improvements.	Justifies the choice of, and independently combines and uses multiple digital devices, internet services and application software to achieve given goals. Evaluates the trustworthiness of digital content and considers the usability of visual design features when designing and creating digital artefacts for a known audience. Identifies and explains how the use of technology can impact on society. Designs criteria for users to evaluate the quality of solutions and uses the feedback to identify some improvements and can make appropriate refinements to the solution.