Digital Technologies – 7 and 8_ Digital Systems

Strand			Digital Systems		Data and Information				Creating Digital Solutions									
Content Description			Investigate how data is transmitted and secured in wired, wireless and mobile networks, and how the specifications affect performance (ACTDIK023)		Investigate how digital systems represent text, image and audio data in binary (ACTDIK024)		Acquire data from a range of sources and evaluate authenticity, accuracy and timeliness (ACTDIP025)		Analyse and visualise data using a range of software to create information, and use structured data to model objects or events (ACTDIP026)		Define and decompose real-world problems taking into account functional requirements and economic, environmental, social, technical and usability constraints (ACTDIP027)		Design the user experience of a digital system, generating, evaluating and communicating alternative designs (ACTDIP028)		Design algorithms represented diagrammatically and in English, and trace algorithms to predict output for a given input and to identify errors (ACTDIP029)		Implement and modify programs with user interfaces involving branching, iteration and functions in a general-purpose programming language (ACTDIP030)		Evaluate how student solutions and existing information systems meet needs, are innovative, and take account of future risks and sustainability (ACTDIP031)		Plan and manage projects that create and communicate ideas and information collaboratively online, taking safety and social contexts into account (ACTDIP032)
Sequence of Lessons / Unit	Approx. time rq'd	Year A or B	CD	Achievement standard #	CD	Achievement standard #	CD	Achievement standard #	CD	Achievement standard #	CD	Achievement standard #	CD	Achievement standard #	CD	Achievement standard d #	CD	Achievement standard #	CD	Achievement standard #	CD	Achievement standard #	CD	Achievement standard #
Get connected	12	7	☑	1	☐		☐		☐		☐		☐		☐		☐		☐		☐	

Years 5 and 6 Achievement Standard	Years 7 and 8 Achievement Standard	Years 9 and 10 Achievement Standard
By the end of Year 6: • Students explain the fundamentals of digital system components (hardware, software and networks) and how digital systems are connected to form networks. (1) • They explain how digital systems use whole numbers as a basis for representing a variety of data types. (2) • Students define problems in terms of data and functional requirements and design solutions by developing algorithms to address the problems. (3) • They incorporate decision-making, repetition and user interface design into their designs and implement their digital solutions, including a visual program. (4) • They explain how information systems and their solutions meet needs and consider sustainability. (5) • Students manage the creation and communication of ideas and information in collaborative digital projects using validated data and agreed protocols. (6)	By the end of Year 8 • Students distinguish between different types of networks and defined purposes. (1) • They explain how text, image and audio data can be represented, secured and presented in digital systems. (2) • Students plan and manage digital projects to create interactive information. (3) • They define and decompose problems in terms of functional requirements and constraints. (4) • Students design user experiences and algorithms incorporating branching and iterations, and test, modify and implement digital solutions. (5) • They evaluate information systems and their solutions in terms of meeting needs, innovation and sustainability. (6) • They analyse and evaluate data from a range of sources to model and create solutions. (7) • They use appropriate protocols when communicating and collaborating online. (8)	By the end of Year 10 • Students explain the control and management of networked digital systems and the security implications of the interaction between hardware, software and users. (1) • They explain simple data compression, and why content data are separated from presentation. (2) • Students plan and manage digital projects using an iterative approach. (3) • They define and decompose complex problems in terms of functional and non-functional requirements. (4) • Students design and evaluate user experiences and algorithms. (5) • They design and implement modular programs, including an object-oriented program, using algorithms and data structures involving modular functions that reflect the relationships of real-world data and data entities. (6) • They take account of privacy and security requirements when selecting and validating data. Students test and predict results and implement digital solutions. (7) • They evaluate information systems and their solutions in terms of risk, sustainability and potential for innovation and enterprise. (8) • They share and collaborate online, establishing protocols for the use, transmission and maintenance of data and projects. (9)

Topic: Digital systems

Units

Year 7   **Year 8**

Get connected 12 hours Discuss types of networks, simulate a network and discuss security requirements	**Networks and performance** 10 hours Develop a basic understanding of network performance and ways to connect wirelessly or by wired connections

Get connected

A basic computer network consists of a collection of computers, printers and other equipment that is connected together so that they can communicate with each other. The internet is a network of networks connecting devices all around the world, which is based on a set of rules (protocols) governing its use. Choose a familiar network system, such as a transport system, as a way of comparing and contrasting another system with the computer networking system. Computer networks require security measures to protect against threats. Use a practical activity to simulate a basic network. Problem solve a way to send data from program board to program board to represent an image.

Flow of activities				
Short text	Network types Discuss types of networks and simulate a network through role play or by sending data using program boards	Network protocols Explore network protocols that define rules and processes for communication between network devices	Protect against cybercrime Explore and use security measures that can protect computer networks against cybercrimes	Send data via a network Simulate the sending of data that can be used to represent a simple image made up of pixels
Questions to guide exploration	*How do computers send data via a network?*	*How does data travel via the internet?*	*In what ways is a computer network similar to other types of networks?*	*How do you send data (in the form of an image) via a network?*
What's this about?	A basic computer network consists of a collection of computers, printers and other equipment that is connected together so that they can communicate with each other. The school network provides an opportunity to describe a basic local area network (LAN) connecting computers with each other, the internet, and various servers. The school may also incorporate wireless technology via wireless local area network (WLAN). Typically, networks are made up of: • switches – a network switch is a computer networking device that connects devices together on a computer network. Software on the switch manages the packets it receives, then processes the packets and forwards the packets to the destination device • routers – connect computers from one network to another and to the internet. They dispatch information and ensure that the right packets of information end up at the correct destination (includes firewall functionality) • hardware devices – such as computers, printers and laptops.	The internet is a network of networks connecting devices all around the world. Internet Protocol (IP) is a set of rules governing the format of data sent over the internet or other network. It describes how data packets move through a network based on their IP address (a unique address identifying a machine on a network). Transmission control protocol/internet protocol (TCP/IP) is used for controlling file transfers over the internet. TCP/IP makes sure that the packets reach the end destination and are reassembled correctly. The IP address is similar to the mailing address of a person. It is known as a logical address because it is logically assigned based on the host location. Data sent across the internet is divided into packets to reduce the file's size. For example, downloading a 3 MB song is likely to be split up into over 20,000 packets of 1,500 bytes each.	The internet provides opportunity for cybercrime. Examples of security measures that can protect computer networks include: passwords, security settings on routers, firewalls, security certificates, and anti-virus and anti-malware tools.	In electronic communication, data is represented as 1s and 0s. These separate elements are known as bits (or binary digits). All electronic data is stored in this digital binary format. People interpret words and pictures; however, computers interpret bit patterns. The advantage of using digital coding is that data can be stored more efficiently and can be transmitted over long distances without the quality becoming degraded.
The focus of the learning (in simple terms)	Describe familiar networks and the way students interact with their devices at home, at school or at a local library. What does a network allow them to do? Find out how the school network fits together, and the various components involved that enable data to be transmitted through the network. Network topology refers to the layout of a network. How different nodes in a network are connected to each other and how they communicate is determined by the network's topology. Identify the types of network topology (bus, ring, star etc) and the advantages and disadvantages of each type. Collaboratively, discuss the advantages of networking computers, which may include speed, flexible and ready access to files and storage, licensing costs and centralised software management. What would happen if devices were not networked? Use a practical activity to simulate a basic network. Simulate a network using a programming board such as a BBC micro:bit or similar that has at least one button, at least two pins and is low voltage (~3V). In	Pose the question: 'How does information travel via the internet?' For example, you request a song from Spotify, how does that song reach your computer? A misconception is that it travels from the source in one path directly to your computer. Ask students to share what they know about IP addresses, IP packets of information, fibre optics and cables, switches and routing that all play a role in information being sent via the internet. Create a flow chart to demonstrate how these work. Compare initial ideas with those developed after referencing relevant videos or other resources. Run a traceroute to show students how data travels via the internet divided into packets of information of smaller file size. Use an unplugged activity to role-play the sending of information via packets. Use the BBC micro:bit to simulate the sending of packets of information, for example, four words, by sending these encoded as Morse code. Set up a network of connected microbits to send the words	Choose a familiar network system such as a transport system as a way of comparing and contrasting another system with the computer networking system. Like a computer network ,the transport system may include security measures to protect users. Create a flow chart to describe how this might work. Use the BBC micro:bit to simulate the sending of packets of information. Introduce a 'hacker' (a microbit that connects to the network and reads the messages). Explain the use of encryption to protect information being sent via the internet. A simple encryption can be the letter +1, for example, 'A' is represented by 'B'.	Use the BBC micro:bit to simulate the sending of data that can be used to represent a simple image made up of pixels. Building on what students have learnt in previous sessions using the microbit to simulate a network, pose the problem: 'How can we send data to create an image made up of pixels?' Students define the width and height of their image, code the image using an agreed representation, such as, B is black, W is white. They then send the message encoded as Morse code to the second microbit to be decoded and drawn. Compare images and discuss any differences and reasons why these might have occurred. Discuss the limitations of Morse code (human error) and reasons why the computer uses binary to encode images.

	pairs, connect two microbits to send a Morse code message and decode it. Show how the microbits can be connected in a linear configuration to represent a bus. Next compare that to a star network with one central microbit connected to other microbits to send messages.	to a final destination (microbit). Each word represents one packet and each word can be sent on a different route in the network to the final destination. Introduce IP by using a number for each microbit in the network and TCP as a way of ensuring the entire message was received and how to reassemble the message in the correct order.		
Supporting resources and tools and purpose/context for use.	**Learn about** What is a computer network? A simple view of what is a network and how it operates. BBC Bitesize: Network types and topologies Explore three main types of network topology: Star, bus, ring. Provides advantages and disadvantages of each configuration. Types of Network Topology A comprehensive guide to network topology (the schematic description of a network arrangement). Provides advantages and disadvantages of each configuration. Computer networks Take a closer look at how a network operates. 'How computer networks connect and work' This video created by Netgear explains the role routers and switches play in a network. **Lesson ideas** The orange game This game can be used to represent the way in which computer networks pass messages from computer to computer. Morse Code Alphabet Morse code network: Lesson One Use a practical activity to simulate a basic network. Make Your Own Message Use Arduino programming board to send a Morse code message.	**Learn about** 'There and Back Again: A Packet's Tale. How Does the Internet Work?' This video follows a packet of data as it flows from your fingertips, through circuits, wires, and cables, to a host server, and then back again. 'The Internet: Packets, Routing & Reliability' This video can be used to explain what keeps the internet running and how information is broken down into packets. The Internet Students model the flow through the internet to learn about internet connections, URLs, IP addresses, and the DNS. BBC Bitesize: The internet Learn about the internet How to Read a Traceroute Use this document as a guide to do a traceroute. Note: some school's networks will not allow Ping and traceroute. Introduction to Internet of Things CISCO FREE Online Courses: create a login to register for free. Packet Tracer – Packet Switching Simulation Explore how Packet Tracer serves as a modelling tool for network representations. Use the simulation to explore how packets are created and sent across the network, travelling from source device to destination device. Requires sign up for free log-in. **Lesson ideas** Tablets of Stone Use this unplugged activity student to explore communication protocols. Morse code network: Lesson Two Use a practical activity to simulate a basic network.	**Lesson ideas** Computer chatter 1: Networks and data transmission Use the concept of transportation systems as a comparison to develop an understanding of networked systems. Network Security This lesson plan for Network Security focuses on authentication, encryption, firewalls and Mac address filtering. Morse code network: Lesson three Use a practical activity to simulate a basic network.	**Lesson ideas** Morse code network: Lesson four Use a practical activity to simulate a basic network.
Assessment	**Suggested approaches may include:** Labelling diagram **Achievement standard** Distinguish between different types of networks and defined purposes.	**Suggested approaches may include:** Labelling diagram **Achievement standard** Distinguish between different types of networks and defined purposes. **Explain** how digital systems use whole numbers as a basis for representing a variety of data types.	**Suggested approaches may include:** Adapted worksheet **Achievement standard** Distinguish between different types of networks and defined purposes. **Explain** how digital systems use whole numbers as a basis for representing a variety of data types.	**Suggested approaches may include:** Presentation or demonstration Artefact analysis **Achievement standard** Distinguish between different types of networks and defined purposes. **Explain** how digital systems use whole numbers as a basis for representing a variety of data types.