Digital Technologies – 5 and 6_ Data representation: Binary numbers

STRAND			Knowledge and understanding			Processes and production skills										
			Digital Systems	Representation of data	Collecting, managing and analysing data	*Creating Digital Solutions by:*										
						Investigating and defining	Generating and designing		Producing and implementing	Evaluating	Collaborating and managing					
	Content Description		Examine the main components of common digital systems and how they may connect together to form networks to transmit data (ACTDIK014)	Examine how whole numbers are used to represent all data in digital systems (ACTDIK015)	Acquire, store and validate different types of data, and use a range of software to interpret and visualise data to create information (ACTDIP016)	Define problems in terms of data and functional requirements drawing on previously solved problems (ACTDIP017)	Design a user interface for a digital system (ACTDIP018)	Design, modify and follow simple algorithms involving sequences of steps, branching, and iteration (repetition) (ACTDIP019)	Implement digital solutions as simple visual programs involving branching, iteration (repetition), and user input (ACTDIP020)	Explain how student solutions and existing information systems are sustainable and meet current and future local community needs (ACTDIP021)	Plan, create and communicate ideas and information, including collaboratively online, applying agreed ethical, social and technical protocols (ACTDIP022)					
Sequence of Lessons / Unit	Approx. time rq'd (hrs)	Year 5or6	CD / Achievement standard #	CD / Achievement standard #	CD / Achievement standard #	CD / Achievement standard #	CD / Achievement standard #	CD / Achievement standard #	CD / Achievement standard #	CD / Achievement standard #	CD / Achievement standard #
Binary numbers	2 hrs	5	☐	☑ 2	☑ 6	☐	☐	☐	☐	☐ 7	☐

Levels 3 and 4 Achievement Standard	Levels 5 and 6 Achievement Standard The numbering of the Achievement Standards below is reflected in the grid above to show coverage across the 8 units.	Levels 7 and 8 Achievement Standard
By the end of Year 4 • Students describe how a range of digital systems (hardware and software) and their peripheral devices can be used for different purposes • They explain how the same data sets can be represented in different ways. • Students define simple problems, design and implement digital solutions using algorithms that involve decision-making and user input. • They explain how the solutions meet their purposes. • They collect and manipulate different data when creating information and digital solutions. • They safely use and manage information systems for identified needs using agreed protocols and describe how information systems are used.	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. • They explain how text, image and audio data can be represented, secured and presented in digital systems. • Students plan and manage digital projects to create interactive information. • They define and decompose problems in terms of functional requirements and constraints. • Students design user experiences and algorithms incorporating branching and iterations, and test, modify and implement digital solutions. • They evaluate information systems and their solutions in terms of meeting needs, innovation and sustainability. • They analyse and evaluate data from a range of sources to model and create solutions. • They use appropriate protocols when communicating and collaborating online.

Binary numbers

Year Level 5   TOPIC Data representations   Time: 5 HOURS

The binary number system plays a central role in how information of all kinds is stored on computers. Understanding binary helps to unravel the mystery of computers, as students begin to understand that binary digits represent on and off. Binary cards can be used to introduce the binary number system. Students can see the connection between binary digits represented as dots and the corresponding decimal number. When cards are placed in sequence students can create a binary number displaying cards as on or off. Students explain how a standard system of encoding is used to represent numbers, text and other special characters.

Flow of activities				
Short text	Computers use binary Explore the way all data that is processed by a computer, is stored using binary.	The binary system uses 0s and 1s Examine how computer data is represented with binary, a number system that uses 0s and 1s.	Characters as binary Use the American Standard Code for Information Interchange (ASCII) to represent characters.	Standards of encoding characters Explore Unicode as an important character set that is used as standard worldwide.
Question to guide exploration	*Why do digital systems need to convert sound, text, images and numbers to process them?*	*How does the binary system work?*	*How are text characters represented?*	*What are standards of encoding characters?*
AC Alignment	*Representation of data (ACTDIK015)* *Collecting, managing and analysing data (ACTDIP016)*	*Representation of data (ACTDIK015)*	*Representation of data (ACTDIK015)* *Collecting, managing and analysing data (ACTDIP016)*	*Representation of data (ACTDIK015)* *Collecting, managing and analysing data (ACTDIP016)*
What's this about?	All software, music, documents, and any other information that is processed by a computer, is stored using binary.	Computer data is represented with binary, a number system that uses 0s and 1s. Binary digits can be grouped together into bytes (8 bits). The binary system is based on the power of 2, the progression being 1, 2, 4, 8, 16, 32, 64, etc. In contrast, the base 10 system progresses by multiples of 10: 1, 10, 100, etc.	American Standard Code for Information Interchange (ASCII) is a 7-bit character set containing 128 characters. The upper and lower case English letters from A to Z are represented by binary numbers (eg 01100001 is a, and 01000001 is A). ASCII is only used for the English language.	Hexadecimal is a shortcut for representing binary. ASCII and Unicode are important character sets that are used as standard.
Learning tasks	Explore audio, video, text and image files to examine standard encoding formats such as MP3 for audio files, ASCII or Unicode for text, JPEG for images and MOV, AVI and WMV for video. Make a chart of the different formats. Share ideas and decide on common file types and ones with which students are familiar. Explain that all these files use the binary system of encoding. Provide resources to explore the binary number system with the aim of finding interesting information about the binary system and to raise questions for inquiry. As students explore the fundamentals of the binary system, challenge them to find out and share three things they have learned and any questions that arise. Write a list about what the class knows about binary. Then view an informative video about binary numbers. Update the list with revisions and new ideas.	Students explore the binary number system. Brainstorm to find out what students already know about binary. View the video 'What are binary numbers?' Link with Mathematics and compare the base 10 system with base 2. Students explain what a binary number is, how to read it and identify the corresponding decimal number. Binary cards (cards with a dot for each 1, 2, 4, 8, 16 etc) enable us to see the connection between binary digits and the corresponding decimal number when placed in sequence. Students find out how to convert binary to decimal numbers. Use binary numbers in place of decimal numbers; for example, represent a calendar with months as binary numbers or a date of birth in binary.	Students can use a basic binary character table to encode and decode messages.	Students should be aware of other standards of encoding characters. Students create their own infographic about how text and numbers are encoded using patterns of binary digits. Provide a tool to create an infographic such as Canva or Piktochart.
Supporting resources and tools and purpose/ context for use	[Binary and data representation: Six learner guides and 11 class clips](#) This learner guide has background information presented visually in a clear and concise way. [What are binary numbers?](#) This video provides background information on the binary system and how computers encode using binary.	[Introduction to binary](#) This lesson idea can be used to introduce the binary number system using unplugged activities and online binary cards. [CS Unplugged: Binary numbers](#) Explore binary numbers. [Online binary cards](#)	[Binary character table](#) This basic binary character table can be used by students to encode and decode messages.	[Hexadecimal and character sets](#) Explore ASCII and Unicode using hexadecimal and character sets. [Piktochart](#) Piktochart is a useful, free infographic creator.

		These online binary cards show binary numbers as dots. Creating my own spreadsheet to convert binary to decimal Create a spreadsheet that converts a binary number to a decimal number.		
Assessment	Refer to the three things they have learned.	• Adapted worksheet with binary numbers to be matched with a decimal number • Explain using Think Aloud **Achievement standard** **Explain** how digital systems use whole numbers as a basis for representing a variety of data types. **Work Sample: Worksheet: Whole numbers** Annotated work samples on binary counting.	• Artefact analysis: Accuracy of message written in binary using ASCII encoding. **Achievement standard** **Explain** how digital systems use whole numbers as a basis for representing a variety of data types.	• Artefact: Infographic **Achievement standard** **Explain** how digital systems use whole numbers as a basis for representing a variety of data types. **Explain** how information systems and their solutions meet needs and consider sustainability.