Kit’s Code-Cracking Challenge: Decoding Binary

Learning objective: To understand how computers represent data using binary digits (bits) and to convert between denary numbers and binary patterns.

Kit the Fox is building a secret message system for our woodland library. Computers only understand two states: ON (1) and OFF (0). Use the binary place value table (8, 4, 2, 1) to help Kit convert his secret codes into denary numbers, and vice versa. Remember, if a place value column has a '1', add that number to your total!

Word bank: Binary · Denary · Bit · Place value · On · Off · Base-two · Data

1. Kit has sent you the binary code 0101. Using the place values (8, 4, 2, 1), calculate the denary number. Show your working out. (2 marks)

2. Convert the denary number 12 into binary. Explain how you arrived at your answer by justifying your choice of bits. (3 marks)

3. If a computer uses a 4-bit system, what is the largest number it can represent? Explain your reasoning. (2 marks)

4. Compare and contrast: How is the binary system different from the denary (base-10) system we use in our daily maths lessons? (3 marks)

5. What might happen if a computer could only represent 0s and not 1s? Justify your answer based on what you know about how digital data is stored. (3 marks)

6. Kit wants to send the number 15. Write the 4-bit binary sequence for this number. (1 mark)

Draw: Draw a diagram showing four light bulbs in a row. Label them with their binary place values: 8, 4, 2, and 1. Colour the bulbs 'ON' (yellow) or 'OFF' (grey) to represent the binary number 1011.

Extension challenge: Design a 5-bit binary system. What is the new place value column you would need to add, and what is the new maximum number you could represent? Write a short explanation of why this 5-bit system is more powerful than a 4-bit system.