# Lesson 4 – Binary Numbers and LEDs

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| The Big Picture – Why is this Relevant? | Learning Objectives |
| * Learners have used the LED screen on the micro:bit during a number of lessons. They will learn how this works in this lesson. * Learners will gain their first insight into the binary number system which is a base 2 system which computers use. | * Understand the reason why computers use binary numbers * Understand how to convert numbers between the denary (base 10) and binary (base 2) number systems * Understand how LEDs work * Understand that inputs can be stored in variables |
| Engagement – How Can I Engage Learners? | Assessment for Learning |
| * Learners will enjoy discovering a new number system and learning why computers use this system * They will enjoy the practical exercise where they will be able to dim and brighten the LED screen on the micro:bit | **Expected Progress:**   * Learners will understand how to convert numbers between binary and denary * Learners will be able to write a program which controls the brightness of the screen on the micro:bit   **Good Progress:**   * Learners will understand why computers use the binary number system * Learners will be able to convert numbers between the binary and denary number systems * Learners will understand how LEDs work and be able to write a program for the micro:bit to control the brightness of the screen   **Exceptional Progress:**   * Learners will understand that electrical circuits can only have 2 states – on and off * Learners will be able to recognise that the CPU contains a large number of circuits, all of which only have two states * Learners will understand how LEDs work and be able to write programs for the micro:bit which control them |
| Links to Program of Study | |
| * Understand how numbers can be represented in binary, and be able to carry out simple operations on binary numbers (for example, binary addition and conversion between binary and decimal) | |
| Key Concepts | Key Words |
| * Computers use the binary number system * Each circuit on the computer has two states, on and off * LEDs are light emitting diodes which are semiconductors which light up when a current is passed through * The higher the current that is passed through, the brighter the LED will light up | * LED * Light emitting diode * Semiconductor * Binary * Denary * Base 2 * Variables |
| Differentiation | Resources |
| More able learners could explore how to add further controls to the micro:bit to control the brightness of the screen. They could work to develop a program which acts as a dimmer switch. | * 1 micro:bit per learner * 1 USB cable to connect the micro:bit to a PC * A PC * Access to <https://makecode.microbit.org> * Lesson 4 ppt * Lesson 4 Number conversions worksheet |
| Lesson Flow | |
| * Discuss the concept of the denary number system. This will be the system that they are used to. Discuss how many different digits are available until you need to use two numbers. The digits are 0-9, which are 10 different numbers. For this reason, it is called a base 10 number system * Discuss the fact that computers are made up of electrical circuits. They only two different states, on and off. For this reason, it makes sense to have a base 2 number system. We call this system binary, a base 2 number system. The digits in binary are represented with 1s and 0s * Using the ppt as support discuss how learners can convert numbers between the two systems * Learners should then complete the number systems worksheet * Learners will then explore the use of LEDs. The screen on the micro:bit is made up of LEDs. They are light emitting diodes. They are semiconductors which light up when an electrical current is passed over them. The higher the electrical current, the brighter they will light up * Using the code on the ppt discuss how learners can create a program to control the brightness of the LED. Note that the highest number is 255. Discuss why this may be the case – 255 is the highest number that can be represented with 8 bits. We call 8 bits a byte * Learners can then write the program. More able learners may wish to develop the core program to create a dimmer switch. This will involve creating a variable to store the value. Once more able learners have explored how to implement this discuss the solution with the class as a whole. If there is time, they should then implement this solution. If time is short issue learners with the sample solution to upload onto their micro:bit so that they can see it in operation. | |
| Making | |
| There are no making activities in this lesson. | |