Binary Format

Teacher's Notes

Lesson Plan

Length	60 mins	Specification Link	2.1.4/b	Representation of data in computer systems
Learning objective		Understand that data needs to be converted into a binary format to be processed by a computer Understand the way computers store and manipulate "data" Convert a decimal number into a binary one		

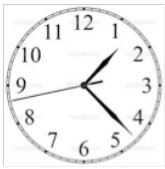
Time (min)	Activity	Further Notes
10	Show the students various analogue and digital devices e.g. an old vinyl record, tape cassette, DVD, analogue clock, digital clock, thermometer, hard disk drive. • Ask the students if they can state which are digital devices. • Ask the students why a DVD or hard disk drive is digital but an old vinyl record or cassette tape is not. • Tell the students that vinyl records and cassette tapes are analogue storage devices. Ask the students the difference between digital and analogue. • Tell the students that by the end of the lesson they should be able to answer that question. Show students the link to the specification. Explain the purpose and objectives of the lesson.	This will assess the students' prior knowledge and understanding of the terms 'analogue' and 'digital'. The students should obviously choose the digital clock (it's in the name), hard disk drive and DVD as they are associated with computers. They store data in a different way. Some students may have some ideas about the differences.
10	Watch the set of videos.	
10	**Activity1** The students complete Activity 1 individually.	
5	Briefly show the students an analogue clock and a digital clock and then ask the students what the exact time was. • Ask the students why they were able to get the time most accurately from the digital clock. • Tell that students that a recipe asks for 225g of sugar and two eggs. Ask the students which of the ingredients would be added most accurately, the sugar or the eggs. • Stress that computers must be very accurate and it is more accurate to **count** how many times the voltage is above zero than to **measure** it accurately each time. That is why they are digital.	The digital clock provides a readout in hours, minutes and seconds. With a quick glance at an analogue clock you could only get an approximate time e.g. somewhere between five past and ten past. The eggs as you would have to measure the sugar and you could never be 100% accurate but you have to count the eggs and so you would be 100% accurate (as long as you can count).
5	**Worksheet 1** Students to complete questions 1 to 3 of Worksheet 1 either on paper or on a computer. Ask individual students for their answers and discuss with the class so that all students will have the correct answers entered on their worksheets.	Answers provided. Ask students with the correct responses for Question 3 to explain to the class how they converted binary to decimal and vice versa.

Time (min)	Activity	Further Notes
10	**Activity 2** Students use Activity 2 and test it by converting some of their own decimal numbers into binary. • The students should now complete Question 4 on Worksheet 1.	Ask students for their answers so that all students will eventually have the correct answers entered on their worksheets.
	Extension Challenge/Homework Students to complete and submit Worksheet 2 for homework.	
5	**Plenary** Using a projector, display Activity 3 and ask selected students to enter the correct decimal numbers to score 5/5.	

WORKSHEET 1 ANSWERS

1 **Figure 1 shows some common devices. In the spaces provided, state whether they are analogue or digital devices.**

Figure 1



Analogue

Analogue

Digital

Digital

Analogue

2 **Explain why data needs to be converted into a binary format in order to be processed by computers.**

Computers are digital and do not measure the size of the voltage – only IF there is or isn't a voltage value.

Therefore there are only two states – on and off or true and false.

As there are only two states they represent data and instructions using the binary code which has two digits – 0 and 1.

3 **(a) Convert the following decimal numbers into binary ones.**

(i) 10110101 | 171

(ii 00101011 | 43

(iii) 11001001 | 201

(b) Convert the following digital numbers into binary ones.

(i) 213 | 1 1 0 1 0 1 0 1

(ii) 69 | 0 1 0 0 0 1 0 1

(iii) 130 | 1 0 0 0 0 0 1 0

WORKSHEET 1 ANSWERS

4 **When a programmer was creating a program in order to convert decimal numbers into binary ones, similar to the one in Activity 2, they firstly wrote some pseudocode to show the logical stages of the algorithm.**

Part of the pseudocode is shown below. Complete it by filling in the missing words in the spaces below.

Program ConvertDecimalToBinary

Declare variables

var numberEntered
var bitEight = 0
bitSeven = 0
bitSix = 0
etc to…
bitOne = 0

Test number entered

If (number entered [greater than (>)] 255) then
Alert (Number must not be greater than 255)
Exit
End if

Calculate bit eight

If (number entered [greater than or equal to (>=)] 128 then
bitEight = 1
numberEntered = numberEntered - [128]
end if

Calculate bit seven

If(numberEntered >= [64] then
bitSeven = [1]
numberEntered = [Number entered - 64]
end if

WORKSHEET 2 ANSWERS

1 **A computer contains data and instructions in binary. Explain why computers use binary. (2)**

So that computers can be based on logic circuits.

Each part of the circuit can be in one of two states – on/off or true/false

As there are only two states computers use the binary system which has two digits – 0 and 1.

2 **Calculate the denary value of the 8-bit binary number 10010111. (2)**

128 + 16 + 4 + 2 + 1

= 151

2 **Calculate the binary number from the denary number 213. (2)**

213/128 = 1 remainder 85	1
85/64 = 1 remainder 21	1
21 less than 32	0
21/16 = 1 remainder 5	1
5 less than 8	0
5/4 = 1 remainder 1	1
1 less than 2	0
1/1 =1	1

11010101