Computing Scheme of Work

Unit 6.8 – Understanding Binary

Contents

Year 6 – Medium Term Plan

Please note that all plans and resources can also be found within Purple Mash in the Teacher section at Computing Scheme of Work Year 6, unit 6.8 page.

Lesson	Title	Success Criteria
1	What is Binary?	• Children can explain how all data in a computer is saved in the computer memory in a binary format. • Children can explain that binary uses only the integers 0 and 1. • Children can relate 0 to an 'off' switch and 1 to and 'on' switch.
2	Counting in Binary	• Children can count up from 0 in binary using visual aids if needed. • Children can relate bits to computer storage.
3	Converting from Decimal to Binary	• Children can convert numbers to binary using the division by two method. • Children can check their own answers using the converter tool.
4	Game States	• Children can make use of a variable set to 0 or 1 to control game states.

Introduction

This unit is optional and not essential to meeting the requirements of the National Curriculum. The unit covers the binary system which involves the children writing digital data that involves just 0's and 1's.

For these sessions, it is advisable that the children have their own individual logins to Purple Mash. If you are currently using a single login per class or group and would like to set up individual logins yourself, then please see our guide to doing so at Create and Manage Users. Alternatively, please contact support at support@2simple.com or 0208 203 1781.

Differentiation

Understanding binary relates closely to mathematics concepts. Some of the learning aims do require mathematical operations. The emphasis in the unit is on Computing but children who struggle with understanding Mathematical concepts and performing mathematical operations are likely to find the work more challenging. Content is differentiated within lessons to use as required.
Several of the resources are 2Code files so experience of using 2Code is useful to understand the coding more deeply and develop their own adaptions to the code.

Lesson 1 - What is Binary?

Aims

- To examine how whole numbers are used as the basis for representing all types of data in digital systems.
- To recognise that digital systems represent all types of data using number codes that ultimately are patterns of 1s and 0s (called binary digits, which is why they are called digital systems).
- To understand that binary represents numbers using 1s and 0s and these represent the on and off electrical states respectively in hardware and robotics.

Success Criteria

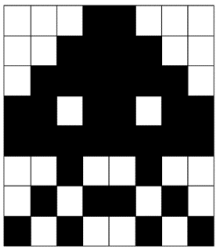
- Children can explain how all data in a computer is saved in the computer memory in a binary format.
- Children can explain that binary uses only the integers 0 and 1.
- Children can relate 0 to an 'off' switch and 1 to an 'on' switch.

Resources

Unless otherwise stated, all resources can be found on the main unit 6.8 page. From here, click on the icon to set a resource as a 2Do for your class. Use the links below to preview the resources; right-click on the link and 'open in new tab' so you don't lose this page.

- 2Connect could be used collaboratively (slide 4); see the user guide for more information about how to do this.
- 2Write could be used collaboratively (slide 6); see the user guide for more information about how to do this.
- Example 2Question branching (binary) database – set this as a 2Do for your class
- Database Puzzler - Print a question sheet for each child.
- If you have a technician in school, they could come and show the children the inside of a computer, so children can make a connection between the concepts of binary as a system and the physical storage in a machine.

Activities

Introduction	Display **slide 2** and outline the lesson aims. Display **slide 3** and outline the success criteria
Computer Input Devices	**Slide 4** provides guidance for an activity to be done in 2Connect; the link is clickable. To add a node, click on the blank page and then type. Nodes can be edited by clicking on them to select them and then clicking on the pencil button that appears. **Note:** 2Connect can be used collaboratively with all children opening the same file and adding their ideas – see the user guide.
	The example on **Slide 5** could be used to reflect upon what the children included.
	Slide 6 poses a question, do children have any ideas? These could be added to the 2Connect file or collected in a collaborative 2Write document. Some possible examples are given.
What is Binary?	**Slides 7-15** explain what binary is and relates this to computer processing. Clicking reveals more information. Children do not have to understand the connection between binary and transistors in detail, but it helps to explain how binary relates to computer processing. These slides might be useful to refer back to in future sessions.
Activity 1: Binary Puzzle	Use **slide 16** to introduce the activity. Children following the scheme of work will have completed a unit about branching databases in year 3 (unit 3.6). You can open the Branching database example and questions by clicking on the icon on the slideshow (children will open this from their 2Dos). Clicking on the slideshow will reveal the steps to solve the puzzle. Once they have solved the puzzle, there is space on the sheet for children to make up their own binary puzzle.
Activity 2: Extension	Use **slide 17** for an extension activity. The answer to the question is: 
Review Success Criteria	Display **slide 18.** Review the success criteria from **slide 3.** Children could rate how well they achieved this using a show of hands.

Lesson 2 - Counting in Binary

Aims

- To examine how whole numbers are used as the basis for representing all types of data in digital systems.
- To recognise that the numbers 0, 1, 2 and 3 could be represented by the patterns of two binary digits of 00, 01, 10 and 11
- To represent whole numbers in binary, for example counting in binary from zero to 15, or writing a friend's age in binary.

Success Criteria

- Children can count up from 0 in binary. Some may need visual aids to help them.
- Children can relate bits to computer storage.

Resources

Unless otherwise stated, all resources can be found on the main unit 6.8 page. From here, click on the icon to set a resource as a 2Do for your class. Use the links below to preview the resources; right-click on the link and 'open in new tab' so you don't lose this page.

- Binary Number cards – print on card if possible.
- Whiteboard to write on with pens.
- Counting in bits activity set as a 2Do for the class
- 2Code Convert from Binary program. In the resource area there are 2 copies of this program, one that opens in play mode to use and one that opens in code mode to see the code. Set the play mode version as a 2Do for children. If you wish children want to do the extension 1, set the code version as a 2Do as well.
  Link to play mode version
  https://www.purplemash.com/app/code/examples/2Code_binary_to_denary
  Link to code version
  https://www.purplemash.com/app/code/examples/2Code_binary_to_denary_code

Activities

<table>
<tr><td>Introduction</td><td>Display slide 2 and outline the lesson aims.
Display slide 3 and outline the success criteria
Recap the content from last week if you wish (slides 7-14 from the lesson 1 slideshow, explaining what binary is)</td></tr>
<tr><td></td><td>On slide 4, can children suggest the word to fill the gaps; clicking reveals the answer?</td></tr>
<tr><td>Activity 1: Binary Cards Role Play</td><td>Ask five children to stand at the front of the class and give each one a number card to hold up. The smallest number should be at the right-hand side.
Can children answer the questions on slide 5?
Clicking reveals the answer and teaching points.
For the rest of this activity use the children to model the actions shown by the slides.</td></tr>
<tr><td></td><td>Ask all the ‘switchers’ to turn their bits off. (slide 6).</td></tr>
<tr><td></td><td>Ask the number 1 switcher to turn ‘on’; (slide 7).</td></tr>
<tr><td></td><td>Next turn 1 off and turn 2 on. (slide 8)</td></tr>
<tr><td></td><td>Slide 9 - Turn 1 and 2 on.</td></tr>
<tr><td></td><td>Slide 10 - Turn 4 on and the others off</td></tr>
<tr><td></td><td>Slides 11- 15 repeat the number sequence from 0-5, this time showing how this is written in binary.</td></tr>
<tr><td></td><td>Slides 16 - 18 ask further questions to help children understand.</td></tr>
<tr><td>Activity 2: Binary Converter Program</td><td>Use the link on slide 19.
Open the program on the whiteboard initially, children will open from their 2Dos after this.
Ask some children to come and work out what it does by switching the switches.</td></tr>
<tr><td></td><td>On slide 20-21, children are directed to an activity in which they open the question file and use the program to answer the questions.
These are the answers:
<table>
<tr><th>Binary</th><th>Decimal</th></tr>
<tr><td>1010</td><td>10</td></tr>
<tr><td>1001101</td><td>77</td></tr>
<tr><td>11001101</td><td>205</td></tr>
<tr><td>1110101</td><td>117</td></tr>
<tr><td>11111111</td><td>255</td></tr>
</table></td></tr>
</table>

Number of bits	How many numbers can be made?	Highest number possible
1	2	1
2	4	3
3	8	7
4 (called a nibble)	16	15
5	32	31
6	64	63

Activity 3&4: Extensions	There are 2 extensions: Extension 1; **slides 22-24** considers the code and is suitable for proficient coders. Extension 2; **slides 25-26** applies binary to creating a binary clock. Click to reveal more questions and answers.
Review Success Criteria	Display **slide 27.** Review the success criteria from **slide 3.** Children could rate how well they achieved this using a show of hands.

Lesson 3 – Converting from Decimal to Binary

Aims

- To examine how whole numbers are used as the basis for representing all types of data in digital systems.
- To represent whole numbers in binary, for example counting in binary from zero to 15, or writing a friend's age in binary.
- To explore how division by two can be used as a technique to determine the binary representation of any whole number by collecting remainder terms.

Success Criteria

- Children can convert numbers to binary using the division by two method.
- Children can check their own answers using the converter tool.

Resources

Unless otherwise stated, all resources can be found on the main unit 6.8 page. From here, click on the icon to set a resource as a 2Do for your class. Use the links below to preview the resources; right-click on the link and 'open in new tab' so you don't lose this page.

- Converting to binary guide - can be used individually (online set as a 2Do or printed).
- Convert to binary quiz - set this as a 2Do for the class.
- Paper and pencils for children to use for calculations.
- 2Code Convert your age to binary program. In the resource (and in the computing section binary folder) folder there are 2 copies of this program, one that opens in play mode to use and one that opens in code mode to see the code.
  Link to play mode version
  https://www.purplemash.com/app/code/examples/2Code_denary_to_binary
  Link to code version
  https://www.purplemash.com/app/code/examples/2Code_denary_to_binary_code

Activities

Introduction	Display **slide 2** and outline the lesson aims. Display **slide 3** and outline the success criteria Review what the children did last week, converting numbers between binary and decimal using the switches program.
Converting a Decimal Number to Binary	Use **slides 4- 7** to demonstrate the method – this is repeated on the Converting to binary guide (link in Resources) if you wish to print it for children. Clicking progressively reveals the answers and next steps.
Activity 1: Quiz	**Slide 8 -** Children can now try the quiz. The icon is clickable for previewing on the whiteboard, but children should open the quiz from their 2Dos to records the results. Children should also jot down their answers as you will be checking them using a 2Code program afterwards.
Activity 2: Convert your Age to Binary Program	Use the link on **Slide 9** – the program is designed to convert any age to binary but can be used for any number up to the maximum. Open the program on the whiteboard initially, children will open from their 2Dos after this. Can they work out the answer; click to reveal this.
Check the Quiz	Use **slide 10** and the convert to binary program to check the answers to the previous quiz.
Activity 3: Extension	On **slide 11**, the extension relates to the one completed in lesson 1, children could do this instead if they did not complete it. Click to reveal the answers.
Review Success Criteria	Display **slide 12**. Review the success criteria from **slide 3.** Children could rate how well they achieved this using a show of hands.

Lesson 4 – Game States

Aims

- To examine how whole numbers are used as the basis for representing all types of data in digital systems.
- To represent the state of an object in a game as active or inactive using the respective binary values of 1 or 0.

Success Criteria

- Children can make use of a variable set to 0 or 1 to control game states.

Resources

Unless otherwise stated, all resources can be found on the main unit 6.8 page. From here, click on the icon to set a resource as a 2Do for your class. Use the links below to preview the resources; right-click on the link and 'open in new tab' so you don't lose this page.

- Binary Quiz – set this as a 2Do.
- Set the following Gibbon 2Code guided lessons as 2Dos. They can be found by going to Tools>Computing>2Code and scrolling to the Gibbon section.
  - Switching background
  - Night and Day (Gibbon)
- Print some storyboard frames if needed for designing in step 6. These can be found in the Program design section of the Computing page.

Activities

Introduction	Display **slide 2** and outline the lesson aims. Display **slide 3** and outline the success criteria
What are Game States?	Use **slide 4** to explain what game states are. Children will be familiar with variables which are first introduced in the coding units in year 3. In the image, the gift boxes and emoji represent three variables: Mia's gift, Jay's gift and Is Sam happy? The value of Mia's gift is currently 'roller skates'. What are the values of the other variables? What is the answer to the question, is Sam happy?

Activity 1: 2Code Guided Activity – Switching Background	Introduce the guided activities if children have not encountered them before. Use **slide 5** to introduce the first activity. The icon is a clickable link to open the activity in 2Code. If children have not had much experience with 2Code you might want to do this as a class coding activity. Otherwise, children could try completing the activity on their own devices.
Activity 2: 2Code Guided Activity – Night and Day	Use **slide 6** to introduce the activity. The icon is a clickable link to open the activity in 2Code. Can children answer the question?
Activity 3: Design and Make	Use **slide 7** to guide the task. Children should make the program using 2Code free code Gorilla.
Activity 4: Quiz	**Slide 8 -** Children can now try the quiz. The icon is clickable for previewing on the whiteboard, but children should open the quiz from their 2dos to records the results. Children should also jot down their answers as you will be checking them using a 2Code program afterwards.
Activity 5: Extension	On **slide 9**, introduce an extension activity which children can complete.
Review Success Criteria	Display **slide 10**. Review the success criteria from **slide 3.** Children could rate how well they achieved this using a show of hands.

Assessment Guidance

The following information is an exemplar of what a child at an expected level would be able to demonstrate when completing this unit with additional exemplars to demonstrate how this would vary for a child with emerging or exceeding achievements.

Assessment Guidance	
Emerging	With support throughout, children will begin to understand how within digital systems, whole numbers are used as the basis of representing all types of data and that this is known as a binary format. Children will begin to know that binary codes contain only the digits 0 and 1. When looking at binary, children will begin to be able to relate 0 to an 'off' switch and 1 to an 'on' switch (Lesson 1). Some children will show an understanding of the system in order to be able to count up from 0 in binary, as well as converting simple decimal numbers into binary, using visual aids and support (Lesson 2 &3).
Expected	Throughout the unit, children will examine and understand how within digital systems, whole numbers are used as the basis of representing all types of data and that this is known as a binary format. Children will know that binary codes contain only the digits 0 and 1. When looking at binary, children will be able to relate 0 to an 'off' switch and 1 to an 'on' switch and know that these represent the on and off electrical states respectively in hardware and robotics (Lesson 1). Most children will show an understanding of the system in order to be able to count up from 0 in binary, as well as converting decimal numbers into binary, using visual aids if necessary (Lessons 2&3). Children will understand the 'division by two' method as a way of converting numbers from decimal to binary (Lesson 3). Children will be able to use their knowledge of binary and of code to make their own program which represents the state of an object as active or inactive, using the respective binary values or 1 or 0 (Lesson 4).
Exceeding	Children demonstrating greater depth will understand and confidently explain how the binary system works within a wide variety of digital systems. Children will show a deep understanding of the system in order to be able to count up from 0 in binary, as well as converting decimal numbers into binary using the 'division by two' method. (Lesson 3). Children will be able to use their knowledge of binary and of code to design, make and evaluate their own programs which represents the state of an object as active or inactive, using the respective binary values or 1 or 0 (Lesson 4).