

STEM Education
Learning Activity Exemplar
St. Francis Xavier's College

Learning Activity: Decimal to Binary Converter Level/ Key Stage: S2

<input checked="" type="checkbox"/> Based on topics of a KLA	<input type="checkbox"/> Project learning
KLA : <input checked="" type="checkbox"/> SE <input type="checkbox"/> ME <input type="checkbox"/> TE	

Major L&T mode/ strategies (more than 1 could be chosen) :

- Enquiry learning Problem-based learning e-Learning Cooperative learning
 Design & make Direct teaching Others : _____

Learning objectives (include generic skills, e.g. creativity, collaborative and problem-solving skills):

Students should be able to:

1. integrate and apply knowledge and skills of SE KLA (electric circuit, current) and MEKLA (number system) to make a decimal to binary converter; and
2. develop problem solving skills through the design and make process of electric circuits.

Prerequisite knowledge:

1. Number system
2. Series and parallel circuits

Learning difficulties:

1. Integrate the knowledge of the closed circuit and binary numbers.
2. Understand the direction of current flow.
3. Apply the knowledge of the diode function to design the electric circuit for converting larger decimal numbers (e.g. 5 and 6) to the corresponding binary numbers. (Extended learning)

	Learning focus	Curriculum content/ elements involved	KLA		
			SE	ME	TE
1.	Electric circuits <ul style="list-style-type: none"> • Series and parallel circuits 	Unit 8 Making Use of Electricity 8.1 Simple circuit 8.2 Current, voltage and resistance 8.3 Electric circuits	✓		
2.	<ul style="list-style-type: none"> • Laws of Integral Indices <ul style="list-style-type: none"> ▪ Inter-convert between simple binary numbers to decimal numbers 	Number and Algebra Dimension <ul style="list-style-type: none"> • Observing Patterns and Expressing Generality 		✓	

Remarks: The school joined the STEM Education support service provided by the SBCDS Section of the EDB. This exemplar is one of the school-based learning and teaching materials developed by the school in collaboration with the Section.

Assessment:

Assessment	Assessor
<ul style="list-style-type: none"> • Students' performance in learning worksheets to show their mastery of knowledge and skills <ul style="list-style-type: none"> ▪ Use short division to convert decimal numbers to the corresponding binary representations ▪ Draw the circuit diagrams with current direction for the binary representations 	<ul style="list-style-type: none"> • Teachers
<ul style="list-style-type: none"> • Final Product <ul style="list-style-type: none"> ▪ Electric circuit to show the design ideas 	<ul style="list-style-type: none"> • Teachers

<p>Brief:</p>	<p>Students design and make an electric circuit with switches and light bulbs for converting decimal numbers (1, 2 and 3) to the corresponding binary representations.</p> <p>Tasks:</p> <ol style="list-style-type: none"> 1. Design and make an electric circuit for converting the decimal number 1 to its binary representation. 2. Design and make an electric circuit for converting the decimal number 2 to its binary representation. 3. Design and make an electric circuit for converting the decimal number 3 to its binary representation with the use of diodes.
<p>Linkage with other Major Renewed Emphases (if applicable):</p>	<p><input type="checkbox"/> RaC <input type="checkbox"/> Values education</p> <p><input type="checkbox"/> Entrepreneurial spirit <input type="checkbox"/> Catering for LD/ Gifted education</p>
<p>Extended learning (if applicable):</p>	<p>Design and make the converter for converting decimal numbers (e.g. 4-8) to their corresponding binary representations.</p>
<p>School's reflection:</p>	<p>The STEM learning activity enhanced students' learning interest through the integration and application of knowledge and skills of Science Education KLA (electric circuit, current) and Mathematics Education KLA (number system) to make a decimal to binary converter. Students showed a better understanding of the direction of current flow. It was good to show how the product (showing the switches and light bulbs only) worked before students designed the circuits. In addition, the more able students should be encouraged to attempt the extended learning task.</p>
<p>Reference/ Annex</p>	<p>/</p>

<p>Lesson Flow:</p>	<ol style="list-style-type: none"> 1. Revision Revise the conversion of decimal numbers to the corresponding binary numbers (Revision Worksheet). 2. Demonstration Teacher introduces the learning activity. 3. Teacher shows how the product (showing the switches and light bulbs only) works, i.e. when the switch representing the decimal number (1, 2 or 3) is closed, the light bulb(s) will turn on showing the corresponding binary representation. 4. Activity 1 (Converting the decimal number 1 to its binary representation) (Worksheet 1) <ol style="list-style-type: none"> (a) Design an electric circuit. (Only Switch 1 is closed) (b) Indicate the flow of conventional current. (c) Make the electric circuit. 5. Activity 2 (Converting the decimal number 2 to its binary representation) (Worksheet 2) <ol style="list-style-type: none"> (a) Design an electric circuit. (Only Switch 2 is closed) (b) Indicate the flow of conventional current. (c) Make the electric circuit. 6. Activity 3 (Converting the decimal number 3 to its binary representation) (Worksheet 3) <ol style="list-style-type: none"> (a) Design an electric circuit. (Only Switch 3 is closed) (b) Indicate the flow of conventional current. (c) Make the electric circuit. 7. Activity 4 (Checking the correctness of the electric circuit) (Worksheet 4) <ol style="list-style-type: none"> (a) Indicate the flow of conventional current when only Switch 1 is closed. (Students find that both the light bulbs (2^0 and 2^1) will turn on when only Switch 1 is closed.) (b) A diode is introduced to allow current to flow in one direction only (to turn the light bulb 2^1 off). (c) Make the electric circuit. 8. Activity 5 (Checking the correctness of the electric circuit) (Worksheet 5) <ol style="list-style-type: none"> (a) Indicate the flow of conventional current when only Switch 2 is closed. (Students find that both light bulbs (2^0 and 2^1) will turn on when only Switch 2 is closed.) (b) Add a diode to allow current flow in one direction only (to turn the light bulb 2^0 off). (c) Make the electric circuit.
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Learning
Materials:

Revision Worksheet

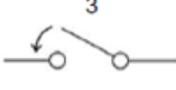
Decimal	Binary		
	2^2	2^1	2^0
0			
1			
2			
3			
4			
5			
6			
7			

Design a circuit to convert a decimal number into a binary one

1. Each button (a switch) represents a decimal number
2. Each light bulb represents a binary digit

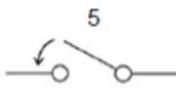
Example:

Decimal number 3:

	Binary	2^2 0	2^1 1	2^0 1
	on/ off			
		off	on	on

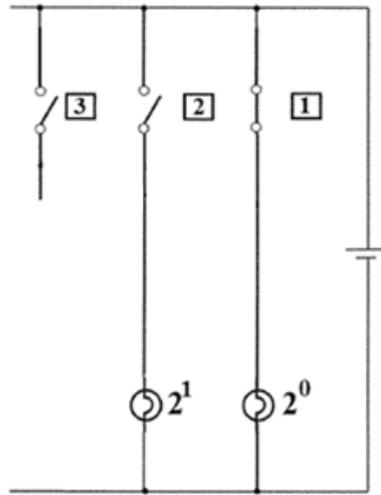
Question:

Decimal number 5:

	Binary	2^2	2^1	2^0
	on/ off			

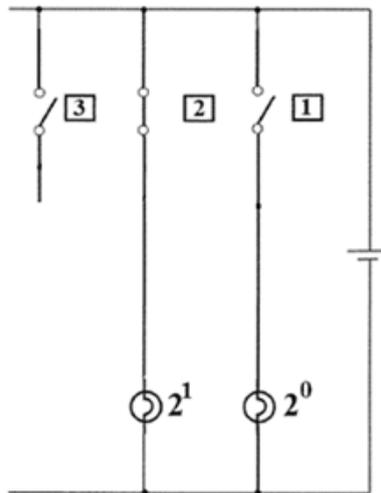
Worksheet 1

Indicate flow of conventional current



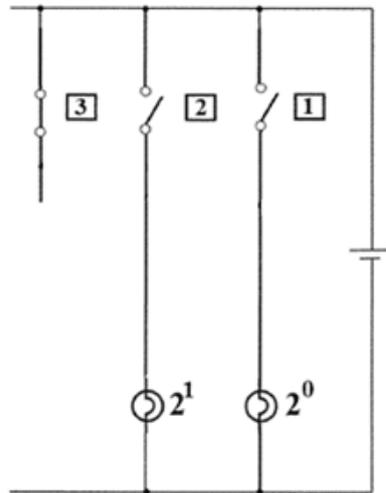
Worksheet 2

Indicate flow of conventional current



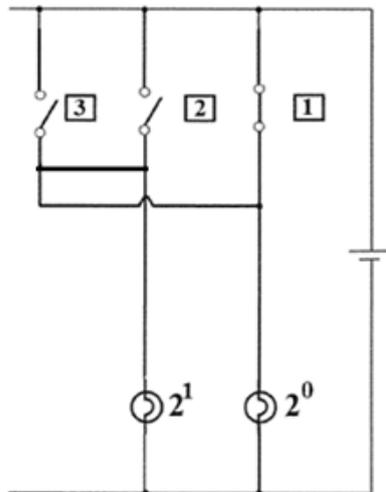
Worksheet 3

Indicate flow of conventional current



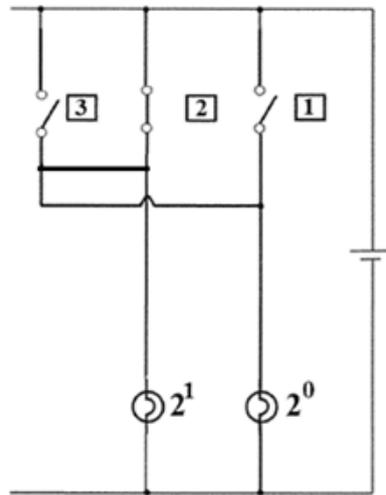
Worksheet 4

Indicate flow of conventional current

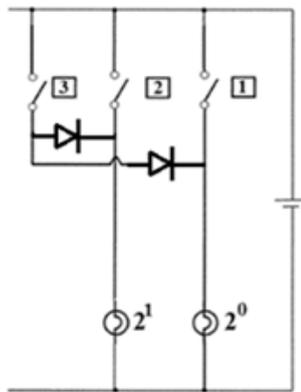


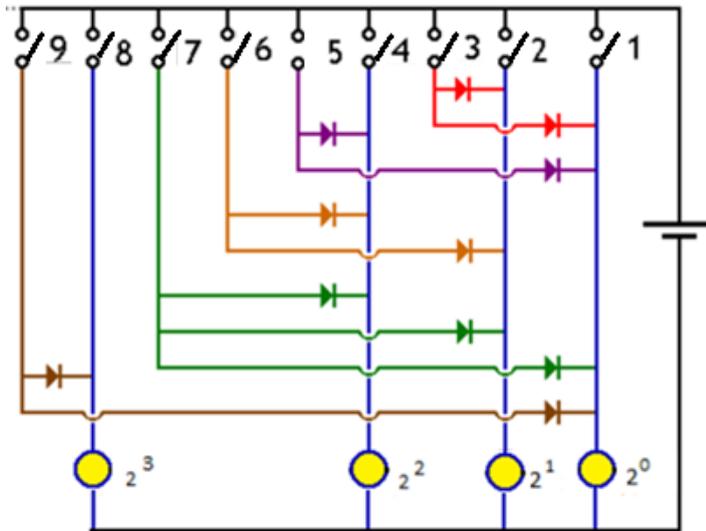
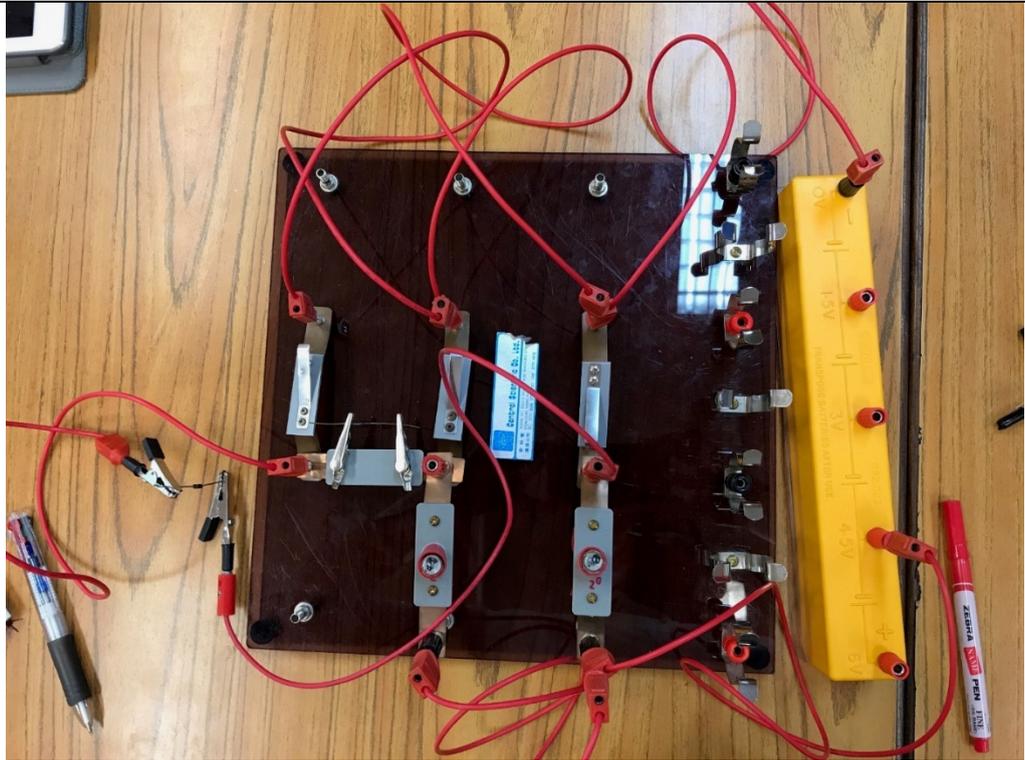
Worksheet 5

Indicate flow of conventional current



Expected Learning Outcome





(Extended learning)

Student work

