

Objective: Be a Sensor, Logic Gate or Data Decoder – The team decodes the binary codes to find letters associated with the weather scenario. Then the letters are re-arranged to find the word for that game.

Summary: Groups of students (minimum 11 students) take part in a role-playing activity to process data output from 'weather scenarios' using Boolean AND, OR and NOT gates. The output from the logic gates provide a binary sequence which is decoded using the given binary-to-alphabetic decoder sheet. Each 'game' involves decoding the weather scenarios to find a word.

If there is more than 1 group, it could be arranged for different groups to compete to find the word in the fastest time.

The students are arranged as in figure 1. The students will either sit or stand so seats are needed.

6 students are needed to become sensors and 4 are needed to become logic gates. At least 1 student is needed (more is better, especially for more difficult words) to decode the binary sequence made from the logic gates.

**** Note that it is important that the arrangement shown in figure 1. must be adhered to.**

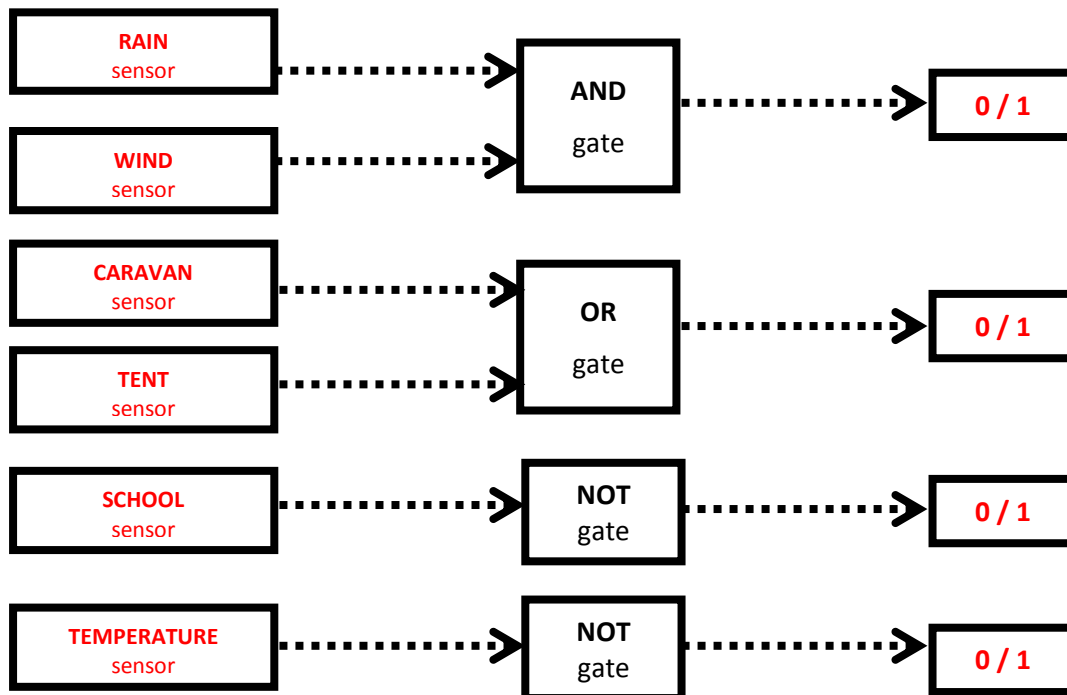
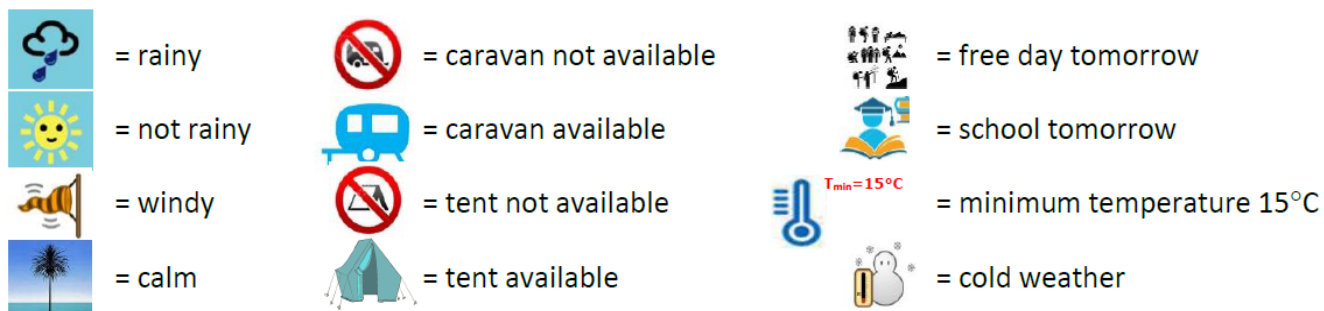


Figure 1. Arrangement of students as sensors & logic gates.

Sensor students

The Sensor students will see symbols as shown here. It is more important that the students know what they should do (i.e. sit or stand) when they see these symbols below, rather than the actual meaning of the symbols themselves. Nevertheless, here is an explanation of the symbols.



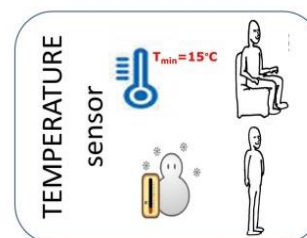
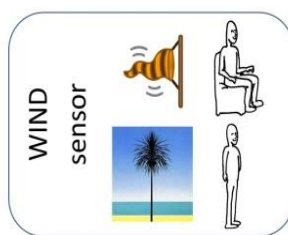
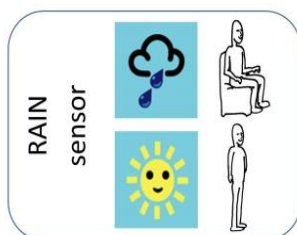
The Sensors are shown a weather scene such as on the right hand side here. Each Sensor must identify which symbols are relevant to them and take the correct position.

Depending on the class group, it might be necessary to not allow the Data Decoders to be able to see the weather scene as they might be able to decode the letter directly from the scene!



The Sensor students must be sitting in the order shown in figure 1.

Each Sensor will either **sit or stand** depending on the information in the weather scene. The response of each Sensor to their weather scene icon is as shown in the following **Sensor Cards**:



Depending on the group of students, at the beginning it is recommended that each Sensor be **given** their relevant card to remind them of their response.

Increasing difficulty could be achieved by Sensors having to memorise their response instead!

The **Sensor Cards** in the accompanying document 'Bo01ean Game Cards', can be printed out and laminated if possible.

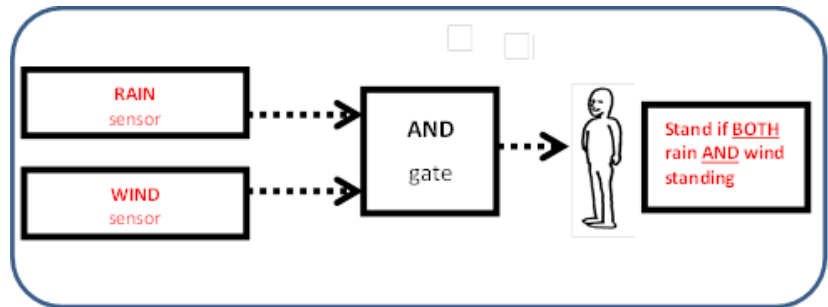
Logic Gate students

The Logic Gate students must also be sitting in the order shown in figure 1.

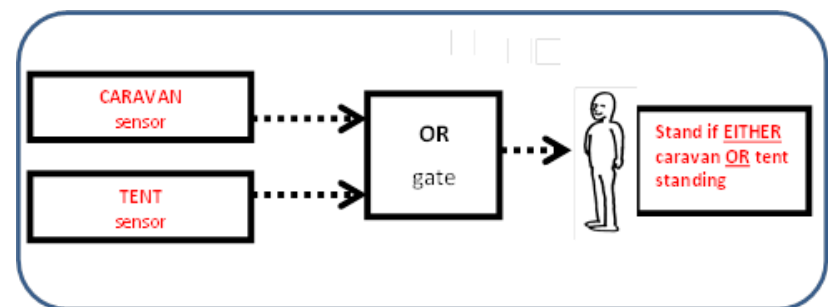
Each Logic Gate will either **sit or stand** depending on the information they get from the sensors.

The response of each Logic Gate to their sensor input is as shown in the following **Logic Gate Cards**:

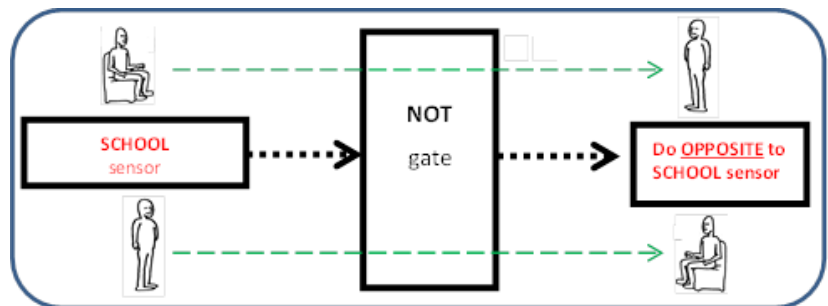
The AND Logic Gate stands if BOTH Rain AND Wind Sensors are standing.



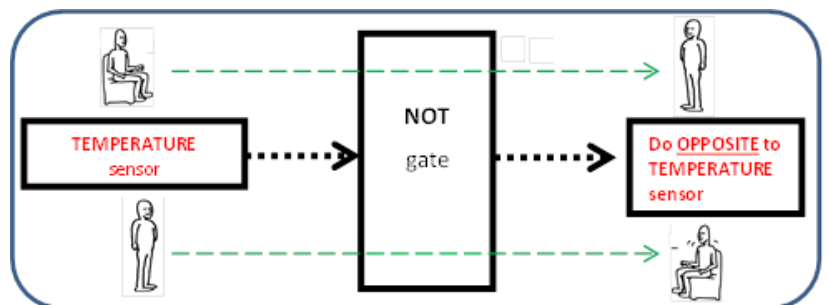
The OR Logic Gate stands if EITHER Caravan OR Wind Sensor is standing.



The School NOT Logic Gate does the OPPOSITE to the School Sensor; if the School Sensor is sitting, the NOT Logic Gate stands.



The Temperature NOT Logic Gate does the OPPOSITE to the Temperature Sensor; if the Temperature Sensor is sitting, the NOT Logic Gate stands.



As with the Sensor Cards, depending on the group of students, each Logic Gate could be given their relevant card to remind them of their response, or difficulty could be increased if they had to memorise it instead.

The **Logic Gate Cards** are also in the accompanying pdf file '**Bo01ean Game Cards**', and can be printed out and laminated if necessary.

Data Decoder students

There must be at least 1 Data Decoder student – more is better, especially with more difficult words.

With the Sensors and Logic Gates sitting as in figure 1, the Data Decoder students must **read the status of the Logic Gates from left to right**.

If a Logic Gate is sitting down that means it is at **LOGIC 0**. If a Logic Gate is standing, then that means **LOGIC 1**.

Using the binary to alphabetical decoder sheet shown below, a letter is obtained for that weather scene.

Binary code				Letter
—	—	—	→	
0	0	0	0	A
0	0	0	1	B
0	0	1	0	C
0	0	1	1	D
0	1	0	0	E
0	1	0	1	F
0	1	1	0	G
0	1	1	1	H
1	0	0	0	I
1	0	0	1	J
1	0	1	0	K
1	0	1	1	L
1	1	0	0	M
1	1	0	1	N
1	1	1	0	O
1	1	1	1	P

Example

This weather scenario is shown (or passed around) to the Sensors.



In this example, the Rain Sensor would sit, the Wind Sensor would sit, the Caravan Sensor would sit, the Tent Sensor would sit, the School Sensor would sit and the Temperature Sensor would stand.

After 'reading' the Rain and Wind Sensors, the	AND Logic Gate would sit	= Logic 0
After 'reading' the Caravan and Tent Sensors, the	OR Logic Gate would sit	= Logic 0
After 'reading' the School Sensor, the School	NOT Logic Gate would stand	= Logic 1
After 'reading' the Temperature Sensor, the Temp.	NOT Logic Gate would sit	= Logic 0

The Data Decoders would then obtain a binary code (reading the Logic Gates from left to right):

0 1 0 0

which corresponds to the letter

E

The next weather scenario is shown to the Sensors and the process is repeated to obtain the next letter. This process is repeated to obtain all the letters of a word.

Depending on the group of students, the weather scenarios could be given (shown to the Sensors) so that the letters obtained by the Data Decoders are in the correct order to form the word, or difficulty could be increased by using a random order to show the weather scenarios (so that the word has to be found by re-arranging the letters).

The Data Decoders sheet is page 3 in the accompanying pdf file '**Bo01ean Game Cards**'. It is recommended that this page be printed out and laminated.

Games

Several games are provided and are ready to play. New games can be made easily by using the '**Bo01ean LETTERS**' document to obtain the weather scenarios for required letters to make words.

The weather scenarios could be either passed around to the Sensors or shown to them using a data projector.

Again, difficulty could be increased by randomising the sequence the scenarios are shown, and/or by using longer words (more letters).

Rules

No talking allowed between Sensors, Logic Gates and Data Decoders.

Data Decoders are allowed to discuss between themselves only.

Linking Boolean Logic to Education

Links

<http://computer.howstuffworks.com/boolean2.htm>

<http://www.doc.ic.ac.uk/~dfg/hardware/HardwareLecture01.pdf>

Syllabus References

The main syllabus references for the lesson are:

Leaving Certificate Physics (p. 44) ([LC Physics curriculum link](#))

Logic Gates: AND, OR and NOT gates.

Establish truth tables for AND, OR and NOT gates. Use of IC in demonstrating circuits.

STS: Relate NOT to transistor (the transistor as a voltage inverter). Boole.

Leaving Certificate Technology (p. 27) ([LC Technology curriculum link](#))

Logic Circuits

basic logic gates: AND, OR, NOT, NAND and NOR;

truth tables combinations of gates;

the main logic families (TTL and CMOS);

the use of logic gates with sensors and output devices

Junior Certificate Technology (p.8) ([JC Technology curriculum link](#))

Electronic Systems

Simple electronic systems are to be treated as in the following diagram,

input sensors to include switches. light, sound, heat. Etc.

process units to include decision making (digital logic), amplification, switching, time delay;

assembly and use of simple systems.

CEIA Boolean Role-Playing Game devised by:

Eamon Connolly & Brian English

as part of the GB 200 celebrations