

7-Segment Introduction and Scrabble Activity

Seven segment displays are commonly used in electrical applications, including alarm clocks, timers, and scales. In this activity, students will learn how to use 7-segment displays!

A 7-segment display is an electronic device that can be used for displaying numerals and some letters. Different letters/numbers can be represented by connecting different pins on the display to the battery, which turns on the LEDs in parallel.

Background on Diodes:

The 7-segment display is a device made up of seven bar shaped LEDs connected in parallel. There is also a round LED for displaying the decimal point (labelled DP in Figure 1), but we do not use it here. LED is an acronym for Light Emitting Diode. LEDs work very similarly to normal diodes, the difference is that normal diodes are designed to affect electrical circuits, while LEDs are designed to emit light. Below is a typical pin configuration and block diagram for a common anode 7-segment display, like the ones we use in this activity. Next to Figure 1 is a picture of the seven segment, and an LED light next to it (Figure 2).

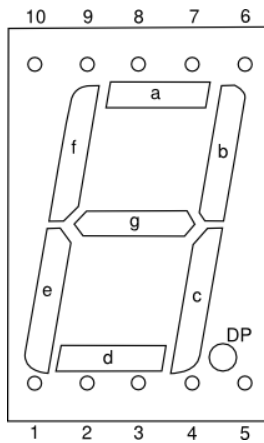


Figure 2

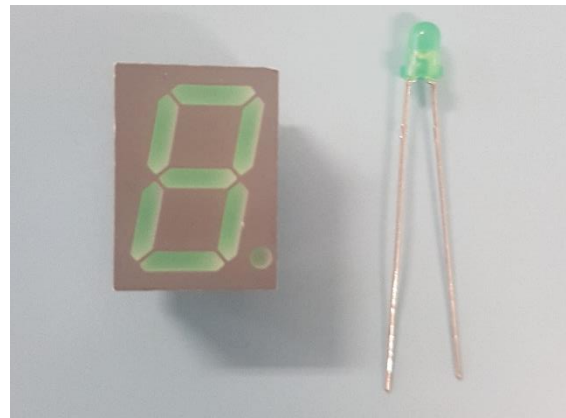
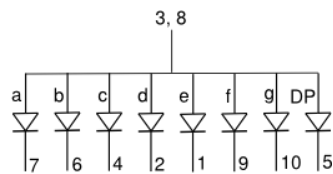


Figure 1

As you can see in the block diagram, a diode is shown as a triangle and a line. The direction in which the triangle is pointing indicates the direction of current when the diode is on. If we were to connect the positive end of the battery to the line labelled '3,8' through the resistor, and the negative end of the battery to the line labelled '7', the LED 'a' would turn on. However, if we reversed the battery connections, nothing would turn on. Why? Because the current will not flow through the diode! It is important to include a resistor as part of the circuit; a resistor limits the amount of current that flows through the circuit so the LED does not burn out. As long as the resistor is in series with the diode in the circuit it restricts the current.

To turn a diode on, you need to make sure current is flowing through the diode in the direction the triangle is pointing (called the *forward* direction). If current isn't flowing, then the diode is connected in the opposite (*reverse*) direction of the triangle, and the diode will be off. In the diode we consider, since the triangle of diode 'a' is pointing down, we can make the current flow down by connecting the positive end of the battery to '3,8' and the negative end of the battery to '7' through a series resistor.

Materials:

- 7-Segment Displays (5 per)
- Battery clip
- 9 V battery
- 360 Ω resistor
- Breadboard
- Jumper wires
- LED light

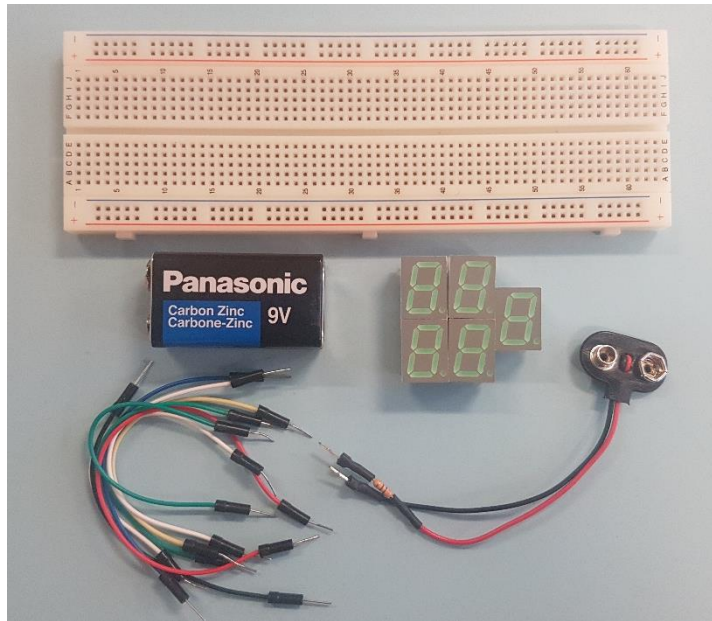


Figure 3

Prep Work: (If you borrow the materials from LEx program you can skip the prep)

1. Solder the resistor and a small segment of wire onto the battery clip- this makes it easier to slot into the breadboard
2. Know the location of the common pin on the IC. The ones in the outreach lab are common anode ICs, with the common pins located on pin 3 and pin 8. (note: common anode means the positive terminal - the red lead on the battery clip- must be connected to this pin)

Safety and Other Notes:

1. Do not touch the leads of the battery clip together. You will short your battery.
2. Shorted batteries get hot and discharge rapidly, some can even explode or start burning!
3. Show the students how to stick the wires into the breadboard (holding close to the end of the wire and slot it in without using force). If you don't, many will end up snapping the soldering connection.
 - bring a soldering iron just in case this happens
 - soldering irons get very hot: for adult use only

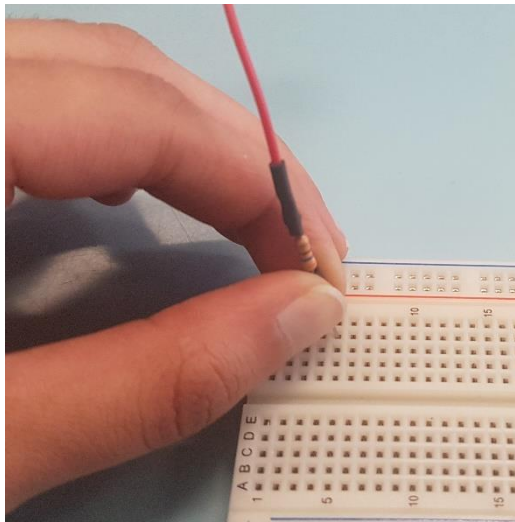


Figure 4 - How to insert a wire into the breadboard

Instructions:

1. Introduction to the breadboard: give a short talk about the breadboard. The yellow lines on the image below show the connections within the breadboard. Note that the two bottom and top rows are connected along the row. The middle columns are connected. Notice the break in the middle. For more information on the breadboard, visit this link <https://learn.sparkfun.com/tutorials/how-to-use-a-breadboard/all>

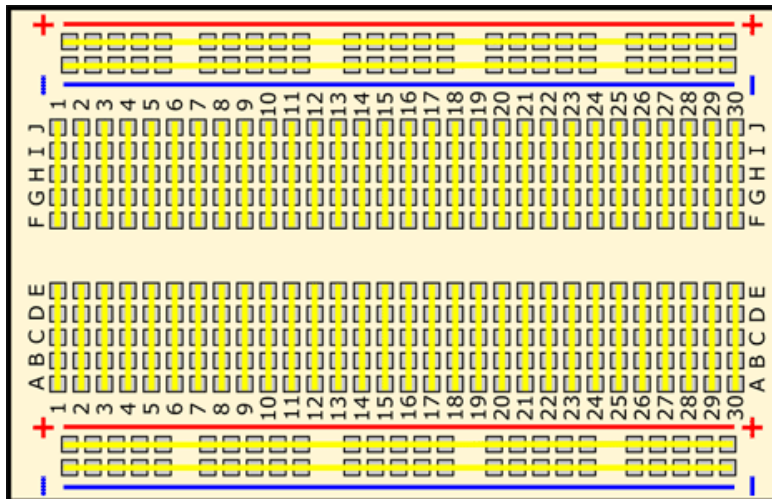


Figure 5

Note: Safety Note #3

2. Attach the battery clip to the battery. Insert the positive (red) end of the battery clip into the '+' rail of the breadboard, and the negative (black) end of the battery clip into the '-' rail.
3. Notice that the resistor is soldered in series with the battery between the battery and the positive wire to prevent burning the diodes.
4. Give students time to play with their LEDs on the breadboard to figure out how it is connected. Tell students about the diode aspect of the LED. Only the battery with the serial resistor can be used directly.

5. Ensure all students understand how to put the wires into the breadboard and how it works before moving on.
6. Introduce the 7-segment display IC. Talk about what an IC is and the similarities between the 7-segment and the LED light from earlier. Allow students to take only one of the 7-segments out of the kit to start with. Make sure all students connect the '+' rail with the common anode pin – this provides power to the device.

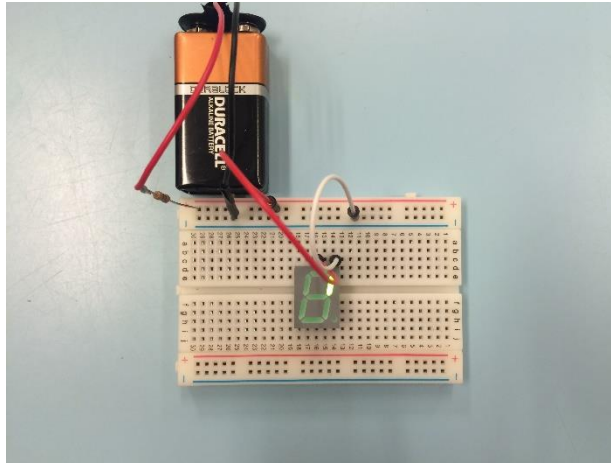


Figure 6 - Turning on the first segment

7. Give them their task: they need to create a few different letters and numbers. The difficulty will vary on the age of the group. For younger students, characters like “1”, “8”, “7”, and “U” are fine. For older students, characters like “A”, “7”, “6”, and “2” are more suitable.

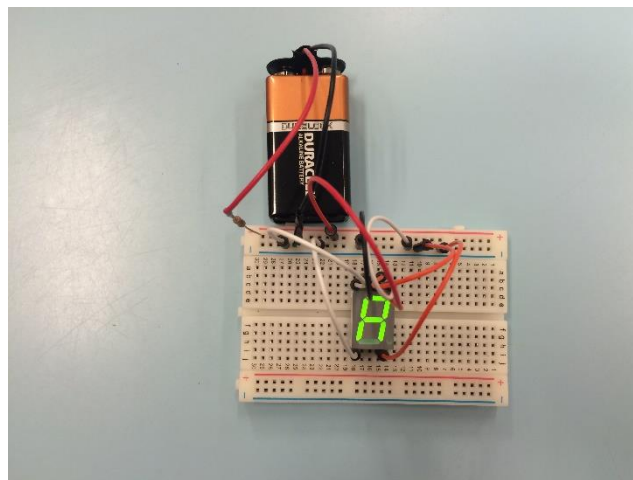




























Figure 7 - The letter A

8. Allow the students some time to play with one 7-segment before regrouping and explaining that they can hook together in parallel


Introduction to 7 Segment Display Scrabble

Allow students to take out the other four 7 segment displays and hand out the score sheet for 7 Segment Scrabble. The goal for this part of the activity is to connect the five 7 segment displays in parallel with each other to create a five letter word. The scoring system for each letter based on the value of the letter from the Scrabble board game and the amount of segments that will be needed to light up that letter. Remember that the more segments that are lit up, the less bright the segments will appear to be because less current will be running through that segment. The group that comes up with the five letter word with the highest score wins!

7 Segment Display Scrabble

Letter	7 Segment Display	Scrabble Score	Segment Score	Total Letter Score	Letter	7 Segment Display	Scrabble Score	Segment Score	Total Letter Score
A		1	2	3	N		1	4	5
B		3	10	13	O		1	2	3
C		3	8	11	P		3	10	13
D		2	10	12	Q		10	10	20
E		1	10	11	R		1	2	3
F		4	8	12	S		1	10	11
G		2	2	4	T		1	8	9
H		4	10	14	U		1	10	11
I		1	2	3	V		4	4	8
J		8	8	16	W		4	4	8
K		5	10	15	X		8	10	18
L		1	4	5	Y		4	10	14
M		3	4	7	Z		10	10	20

Scoring Sheet for : _____ (enter team name)

	Example					
Letter	t 					
Scrabble points for the letter	1					
7-segement display points for the letter	8					
Total points for the letter	9					

The word you are spelling is: _____

The total number of points you received is: _____ + _____ + _____ + _____ + _____ = _____