Introduction to Digital Logic

Grades: 4-5

Objective: Students will learn how to employ simple logic in digital circuits and will be introduced to Boolean algebra.

Time: 30 minutes

Materials:

For each group of 4 students, have one set of:

- 1 Battery (AA, 9 Volt, etc, but low voltage so nobody gets hurt)
- Alligator clip wires
- 4 NPN based AND gates (found at Radio Shack)
- 4 NPN based OR gates (found at Radio Shack)
- 3 NOT gates (found at Radio Shack)
- 2-3 bulbs

Overview:

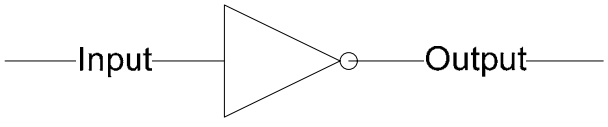
Your mentor will explain the operation of each type of logic gate. You will then attempt to configure the logic gates in such a manner as to achieve the output specifications your mentor gives you.

Scientific Background:

Digital Logic forms the foundations for all modern telecommunications systems and microprocessors. Logic gates are represented by Boolean truth tables, where a "1" represents some fixed voltage, and "0" represents a much lower fixed voltage. The truth tables for the logic gates are shown below:

NOT Gate

Input	Output
0	1
1	0



AND Gate

A	B	Out
0	0	0
1	0	0
0	1	0
1	1	1

OR Gate

A	B	Out
0	0	0
1	0	1
0	1	1
1	1	1

Procedure:

1. Hold up each type of logic gate, explain the truth table behind it, draw the preceding diagrams and demonstrate each ones functionality. Demonstrate how to build a 3-input AND gate by connecting together two AND gates.

2. Divide the kids into groups of 4. Give each group a set of components. Ask them to build 4 different circuits as they want, and then assist them in calculating the truth tables for each circuit. *This process will likely take 30-40 minutes.*

3. Each group should now come up with an application for their circuits and explain them to the other groups.

Additional Questions/Discussion Points:

Discuss with the kids how they felt in designing the circuits. Were there multiple ways to build the same truth table? What does this tell us about electrical engineering? *There are more than one ways to generate a solution but often times each method has its own advantages*.

Discuss how students could have improved previous experiments through the use of logic gates.