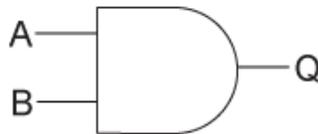


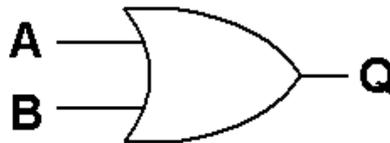
BASIC LOGIC CONTROL

Logic circuits process data signals to create new desired signals and information. This is commonly done in binary. These logic circuits often use operations through gates, which have inputs and outputs in form of 1's and 0's. There are two essential gates, AND and OR.

- **AND Gate:** A single bit AND gate will only produce a 1 as an output if **both** inputs are 1. The symbol for AND is '&'.



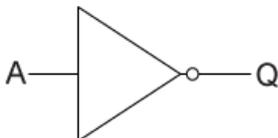
- **OR Gate:** A single bit OR gate will produce a 1 as an output if **either** of the inputs are 1. The symbol for OR is '|'.



This **truth table** shows all outcomes of AND and OR gates with two inputs:

A	B	A&B	A B
0	0	0	0
0	1	0	1
1	0	0	1
1	1	1	1

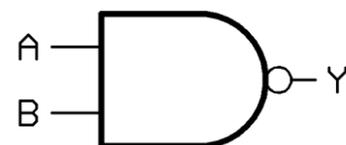
The **NOT gate** takes the input and inverts it. For example, if a 1 is inputted, a 0 is outputted.



The **XOR gate** is an **exclusive OR gate**. The output is a 1 only when the two inputs are different, that is, when one input is 1 and the other is 0.



The **NAND gate** is a combination of an AND gate and a NOT gate. The inputs first go through an AND gate, then the result is inverted. For example, inputting two 1's will output a 0.



Now, design your own logic circuit!

Car Safety Buzzer Design (PLTW):

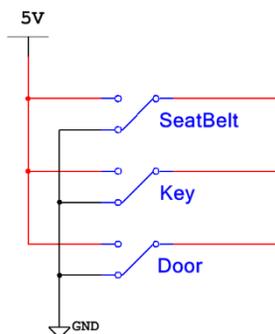
The buzzer is on whenever the door is open or when the key is in the ignition and the seat belt is not buckled.

Seat Belt	0 = Active (1) Not buckled
	1 = Not Active (0) Buckled
Key	0 = Not Active (0) Not in ignition
	1 = Active (1) In ignition
Door	0 = Active (1) Open
	1 = Not Active (0) Close
Buzzer	0 = BUZZER is OFF
	1 = BUZZER is ON

What input combinations make the output 1? Fill out the truth table below.

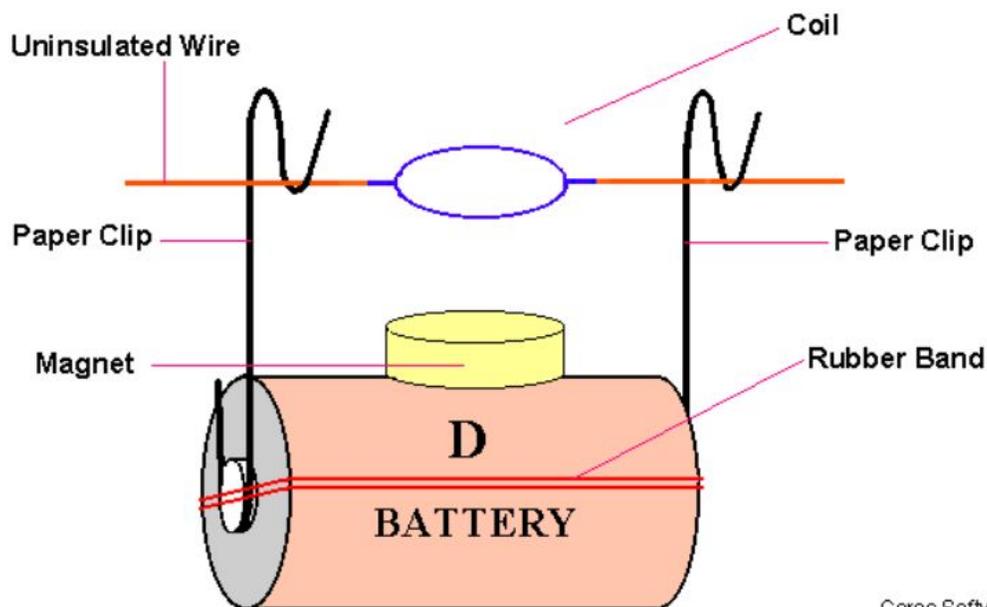
Seat Belt	Inputs Key	Door	Buzzer Output
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

What does this circuit look like? Complete the circuit using logic gates.



Build A Magic Motor!

This activity: We can create a basic motor just using paper clips, a rubber band, battery, copper wire, and a magnet. The magnetic field from the magnet interacts with the electric field in the coil of wire, which is being produced by the current of electricity provided from the battery, and makes the coil of wire spin, like magic!



Ceres Software
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Another motor activity:

http://pbskids.org/designsquad/parentseducators/resources/motorized_car.html

Application: There are literally hundreds of motors hidden around us every day in cars, clocks, hair dryers, refrigerators, vacuums, appliances, and computers, just to name a few places! Motors are a key piece of technology that is an incredibly important in our society. Without motors modern manufacturing, transportation, construction, heating and cooling would be nearly impossible. With hybrid and electric cars becoming ever more popular, large, high power motors will be more important than ever in the near future.

Riding the Waves: Analyzing Wave Signals

Application:

Whenever you are listening to music on the radio, waves are being produced. Waves are signals that transfer energy from one location to another by traveling through a medium, such as air. Audio engineers utilize the properties of waves such as amplitude, wavelength, and frequency to produce music and sound. Just by talking, you are producing waves that carry sound.

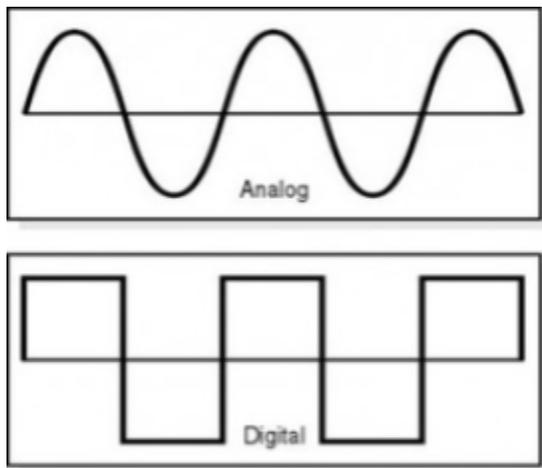


Figure 1: SEQ Figure * ARABIC 1 Analog and Digital Waves

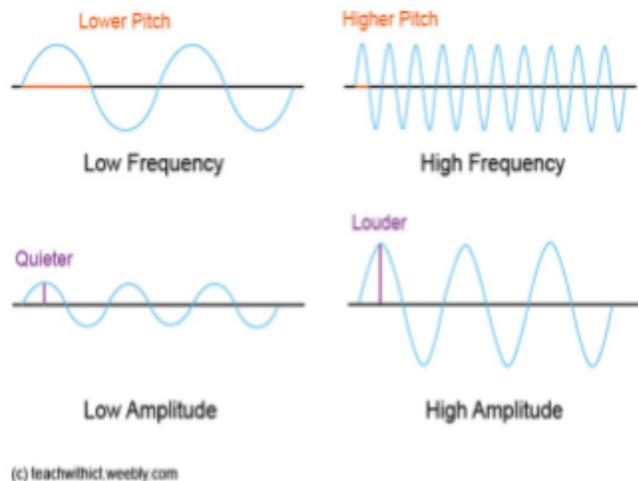


Figure 2: Analog Waves & Wave Properties

This Activity:

By using the Audacity software, we can take a popular song on the radio and analyze their wave properties. There are two types of waves that we focus on in electrical engineering which are analog and digital waves. Analog waves report continuous signals whereas digital waves only produce step values (see figures 1 and 2). The greater the amplitude (height), the louder the sound will be. Therefore, a digital wave will produce only two volumes, silent or loud (ie an alarm) whereas an analog wave can produce a variety of sounds. Another wave property known as wavelength is the distance from start to end of a single wave. The time it takes a wave to travel in one cycle is called the period. Frequency relates to the wavelength and determines the pitch of a sound. For example, when you talk in a high squeaky voice, your vocal cords vibrate quickly to produce high frequency waves.

Resources:

- <https://www.audacityteam.org/>
- <https://www.slideshare.net/rofldork/analog-digitalsignals>
- <https://www.mediacollege.com/audio/01/wave-properties.html>

Electrical Engineering: The Wigglebot Robot

Activity:

Create a simple robot that can draw its own designs! We will hook up a simple DC motor battery in order to make a simple fun robot that wiggles around on a piece of paper and makes its own unique art.

Applications:

All robots need a power source and one or more motors. Robots includes drones, manufacturing robots and self-driving cars. Engineers make motors for all kinds of machines includes toys and washing machines. Robots are very important as they can do many tasks for disabled people, search radiation rooms, make coffee and go in places humans can't go such as space exploration.



Further Information:

Lego Mindstorm Information:

<http://www.lego.com/en-us/mindstorms/?domainredir=mindstorms.lego.com> – This demo utilizes a LEGO NXT Mindstorms robot. These robots are made out of LEGOs and can do many different types of tasks.

FIRST Robotics:

<https://www.firstinspires.org/> – FIRST Robotics, an organization that hosts robotics competitions for all ages.