Today we will be covering:

Voltage (V)

Current (I)

Fundamental electronics components

- batteries
- resistors
- diodes
- LEDs
- buttons
- potentiometers
- capacitors

Circuit diagrams

Simple circuit designs
ELECTRICITY = presence and flow of electric charge

ELECTRIC CURRENT (I): measured in Amperes

ELECTRIC POTENTIAL (V): measured in Volts
CURRENT (I)

rate of flow of electric charge

1 Ampere = 1 coulomb/second

quantity of charge passing a given point per unit of time
Voltage (V)

energy per unit charge

1 Volt = 1 joule/coulomb

difference in electric potential between two points in a circuit
Power (W)

1 Watt = 1 Volt X 1 Ampere

Watt = joules/sec

Watt = \( \frac{\text{Joule}}{\text{Coulomb}} \times \frac{\text{Coulomb}}{\text{Second}} \)
Resistance (Ω)

measurement of the ease with which electric current flows through a circuit
Ohm’s Law

\[ V = I \times R \]

\[ R = \frac{V}{I} \]

\[ I = \frac{V}{R} \]
Kirchhoff’s Laws

Voltage Law
The sum of the voltage drops around a closed loop is always zero
\[ v_1 - v_2 - v_3 = 0 \]

Current Law
Current into a circuit node is equal to current out of the same circuit node
\[ i_1 = i_2 + i_3 \]
Series and Parallel Circuit Construction

Series
- voltage divides across components
- current remains the same along the entire loop

Parallel
- voltage stays the same for each parallel loop
- current divides between the loops
Multimeters

electronics measuring tool:
- voltage
- current
- resistance
- capacitance
- and more!

current: place in series
voltage: place in parallel
Voltage Sources

Battery: Direct Current

Supplies constant voltage
Current can vary
Resistors

used to control the current in a circuit

non-directional
<table>
<thead>
<tr>
<th>COLOR</th>
<th>1st BAND</th>
<th>2nd BAND</th>
<th>3rd BAND</th>
<th>MULTIPLIER</th>
<th>TOLERANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1Ω</td>
<td>± 1% (F)</td>
</tr>
<tr>
<td>Brown</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>10Ω</td>
<td>± 1% (G)</td>
</tr>
<tr>
<td>Red</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>100Ω</td>
<td>± 2% (H)</td>
</tr>
<tr>
<td>Orange</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>1KΩ</td>
<td>± 0.5% (I)</td>
</tr>
<tr>
<td>Yellow</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>10KΩ</td>
<td>± 0.25% (J)</td>
</tr>
<tr>
<td>Green</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>100KΩ</td>
<td>± 0.10% (K)</td>
</tr>
<tr>
<td>Blue</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>1MΩ</td>
<td>± 0.05%</td>
</tr>
<tr>
<td>Violet</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>10MΩ</td>
<td>± 0.02%</td>
</tr>
<tr>
<td>Grey</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>0.1</td>
<td>± 5% (L)</td>
</tr>
<tr>
<td>White</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>0.01</td>
<td>± 10% (M)</td>
</tr>
<tr>
<td>Gold</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Silver</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Electronix Express / RSR
http://www.elexp.com

1-800-972-2225
In NJ 732-381-8020
Series and Parallel Behaviors

**Series**

\[ R_t = R_1 + R_2 \]

**Parallel**

\[ R_t = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2}} \]
Diodes

used to maintain current directionality

directional: low resistance in one direction, high resistance in the other
Light Emitting Diodes (LEDs)

special type of diode where the light emitted is directly proportional to the current flowing through
Breadboards

great circuit prototyping tool

not connected

not connected
Let there be Light!
Potentiometers

variable resistor
-constant resistance between A and B
-variable resistance on W (middle leg)
Mood Lighting
Buttons and Switches

provide a controlled break in the circuit loop

single pole

can control only one circuit

single throw

has only one position: either closed (on) or open (off)

only connected when button is pushed

always connected
Now you see it, Now you don’t
Capacitors smooth out power supply output by storing voltage and releasing it at a predictable rate.

- Electrolytic
  - Directional
  - Uses ionic conductive liquid

- Ceramic
  - Non-directional
  - Ceramic material as dielectric

Measured in Farads.
higher capacitance = higher power

charge and discharge rates depend on resistance
Series and Parallel Behaviors

Series:

\[ Ct = \frac{1}{\frac{1}{C_1} + \frac{1}{C_2}} \]

Parallel:

\[ Ct = C_1 + C_2 \]
Back up generator
Integrated Circuits: 555 Timer

- adjustable oscillator
- controlled by connecting resistors and capacitors to the pins
- datasheets: pin-outs, min/max values
Blinking an LED
It works!!!