Basic Electronics

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2 Group Electronic Kits

3 Electronics
   - Electricity
   - Circuit
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1 Safety Guideline

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SCIENCE TECTECH Challenge Guideline

- Disconnect the power before making any connections!
- Do NOT short circuit the battery.
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Parts List

- Breadboard
- GPIO and Resistor Colors Quick Reference Cards
- Breadboard
- one RGB LED
- Jumper Wires
- Several resistors (100Ω, 10K), one diode
- Battery holder and 2xAA battery
about Parts

- Polarized vs non-polarized
- Physics and chemistry in a tiny package
- Explain Data Sheets
- Sparkfun online tutorial
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What is electricity?

- What kinds are there?
- What can it do?
- What are the dangers?
- What is DC vs AC?
- What are some power sources?
- What is analog vs digital?
Breadboard

A breadboard allows us to neatly wire circuits without the need for soldering. It is good for prototyping a circuit. Literally started out as a bread board with nails.
Electric Circuit

Combination of electronic parts, wires connected between power sources. It’s like a physical program. It’s also like setting up dominoes in sequence.
Electricity vs water

Electricity is like water.

- Voltage is the height, measured in Volts (V).
- Current is the amount of water, measured in Amps (A).
- Resistance is any obstacle that slows down the water, measured in Ohms Ω.
Electric Power Source

Electricity is most often generated at a power station by electromechanical generators, primarily driven by heat engines fueled by chemical combustion or nuclear fission but also by other means such as the kinetic energy of flowing water and wind. Other energy sources include solar photovoltaics and geothermal power.

2014 US energy source

- Coal = 39%
- Natural Gas = 27%
- Hydropower = 6%
- Other renewables = 7%
  - Biomass = 1.7%
  - Geothermal = 0.4%
  - Solar = 0.4%
  - Wind = 4.4%
- Petroleum = 1%
- Other gases < 1%
Battery

- A battery converts chemical energy into electrical energy.
- Some batteries are rechargable and can do the reverse as well.
Ohm’s Law

\[ V = I \times R \]

Voltage = Current * Resistance
Some Terminology

- **Voltage:**
- **Current:**
- **Power:** Voltage $\times$ current
- **Energy:** Power $\times$ time
Resistors provide a specific amount of resistance to a path in a circuit or wire. Ohm’s law is used to calculate the properties related to resistance. Resistors are color coded.
2700000 ohm resistor? How can I read resistor’s value?

To distinguish left from right there is a gap between C and D bands.

- band A is the first significant figure of component value (left side)
- band B is the second significant figure (Some precision may have a 3rd significant figure)
- band C is the decimal multiplier
- band D if present, indicates tolerance of value in percent (no band means 20% tolerance)
# Resistor Codes in Table

<table>
<thead>
<tr>
<th>Color</th>
<th>Significant figures</th>
<th>Multiplier</th>
<th>Tolerance</th>
<th>Temp. Coefficient (ppm/K)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black</td>
<td>0</td>
<td>$\times 10^0$</td>
<td>--</td>
<td>250</td>
</tr>
<tr>
<td>Brown</td>
<td>1</td>
<td>$\times 10^1$</td>
<td>±1%</td>
<td>100</td>
</tr>
<tr>
<td>Red</td>
<td>2</td>
<td>$\times 10^2$</td>
<td>±2%</td>
<td>50</td>
</tr>
<tr>
<td>Orange</td>
<td>3</td>
<td>$\times 10^3$</td>
<td>--</td>
<td>15</td>
</tr>
<tr>
<td>Yellow</td>
<td>4</td>
<td>$\times 10^4$</td>
<td>(±5%)</td>
<td>25</td>
</tr>
<tr>
<td>Green</td>
<td>5</td>
<td>$\times 10^5$</td>
<td>±0.5%</td>
<td>20</td>
</tr>
<tr>
<td>Blue</td>
<td>6</td>
<td>$\times 10^6$</td>
<td>±0.25%</td>
<td>10</td>
</tr>
<tr>
<td>Violet</td>
<td>7</td>
<td>$\times 10^7$</td>
<td>±0.1%</td>
<td>5</td>
</tr>
<tr>
<td>Gray</td>
<td>8</td>
<td>$\times 10^8$</td>
<td>±0.05% (±10%)</td>
<td>1</td>
</tr>
<tr>
<td>White</td>
<td>9</td>
<td>$\times 10^9$</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Gold</td>
<td>--</td>
<td>$\times 10^{-1}$</td>
<td>±5%</td>
<td>J</td>
</tr>
<tr>
<td>Silver</td>
<td>--</td>
<td>$\times 10^{-2}$</td>
<td>±10%</td>
<td>K</td>
</tr>
<tr>
<td>None</td>
<td>--</td>
<td>--</td>
<td>±20%</td>
<td>M</td>
</tr>
</tbody>
</table>
LEDs

Light Emitting Diodes (LED)
Diode Symbol $+$ Arrows for light
Points to Ground

[Diagram of LED parts: Epoxy lens/case, Wire bond, Reflective cavity, Semiconductor die, Anvil Post, Leadframe, Flat spot, Anode, Cathode]

[Diagram of LED circuit: Positive, Negative, LED symbol, Breadboard with LED connection]
LED-RGB Clear Common Anode

LED - Common Anode, Datasheet and product information at: RGB- Common Anode LED
LED-RGB Clear Common Cathode

LED - Common Cathode, Datasheet and product information at:
RGB- Common Cathode LED
Serial vs Parallel

Circuits in serial
- Share the same current
- Have different voltages

Circuits in parallel
- Have different currents
- Share the same voltage
Voltage and Current Measurement

- Digital or Analog multimeter (Volts, Amps)
- Small unit: mV, mA, uV, uA, kV,
- Voltage: Parallel to the circuit, Current: Serial in the Circuit
Power Energy

Assume your smartphone battery is charged with 5V, charge current = 1A, it needs two hours to get fully charged. IMP will charge you 0.20$ for 1kW, how much will you pay to fully charge a battery?
Battery Capacity

mAh is used to describe the energy charge that a battery will hold and how long a device will run before it needs recharging. One mAh is the amount of capacity needed to let one mA of electrical current flow for one hour.
DC vs AC

- Direct Current (DC): the electric charge (current) only flows in one direction.
- Alternating Current (AC): Electric current changes direction.