# Sketching with Hardware

02: Current, Voltage, Resistance

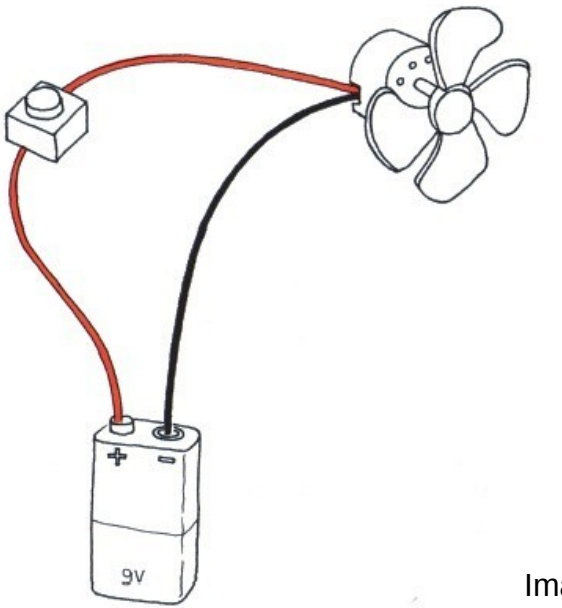
# What do you already know about electricity?

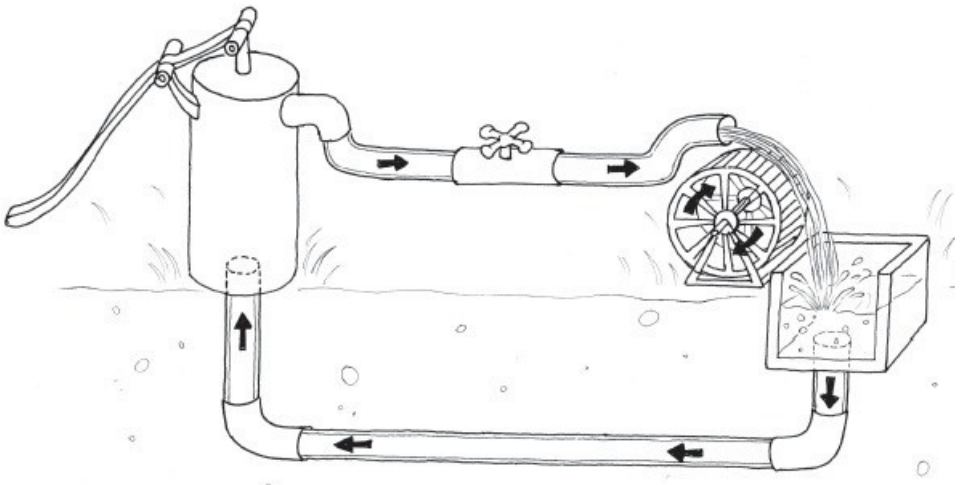
# Analogy: Water circuit

Voltage (in Volt, V): ~ Water Pressure

Current (in Ampere, A): ~ Water Amount

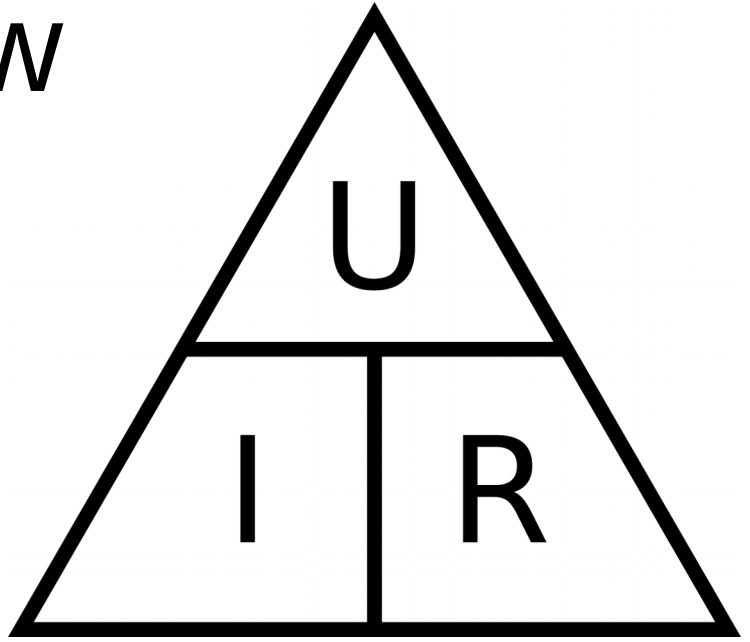
Resistance (in Ohm, Ω): ~ Bottleneck in a Tube



# Ohm’s Law

Relationship between:
Current (I), Voltage (U) and Resistance (R)




- Higher voltage results in more current
- Higher resistance results in less current

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R = U / I
U = R * I
I = U / R
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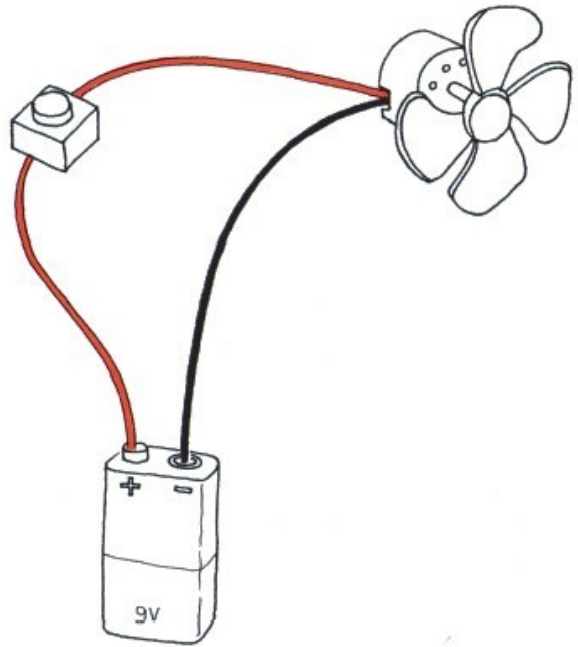
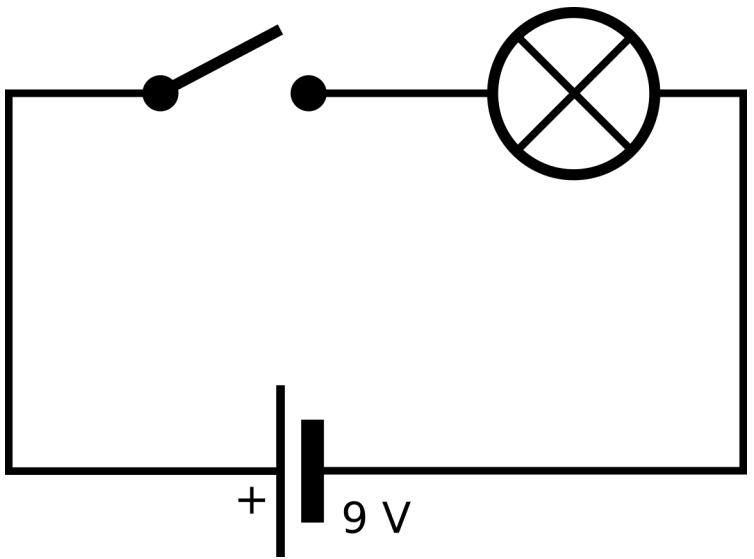
# Circuit Diagrams

- Formal representation of a circuit
- Independent from actual components, cables, etc



# Safety Instructions: Electronics

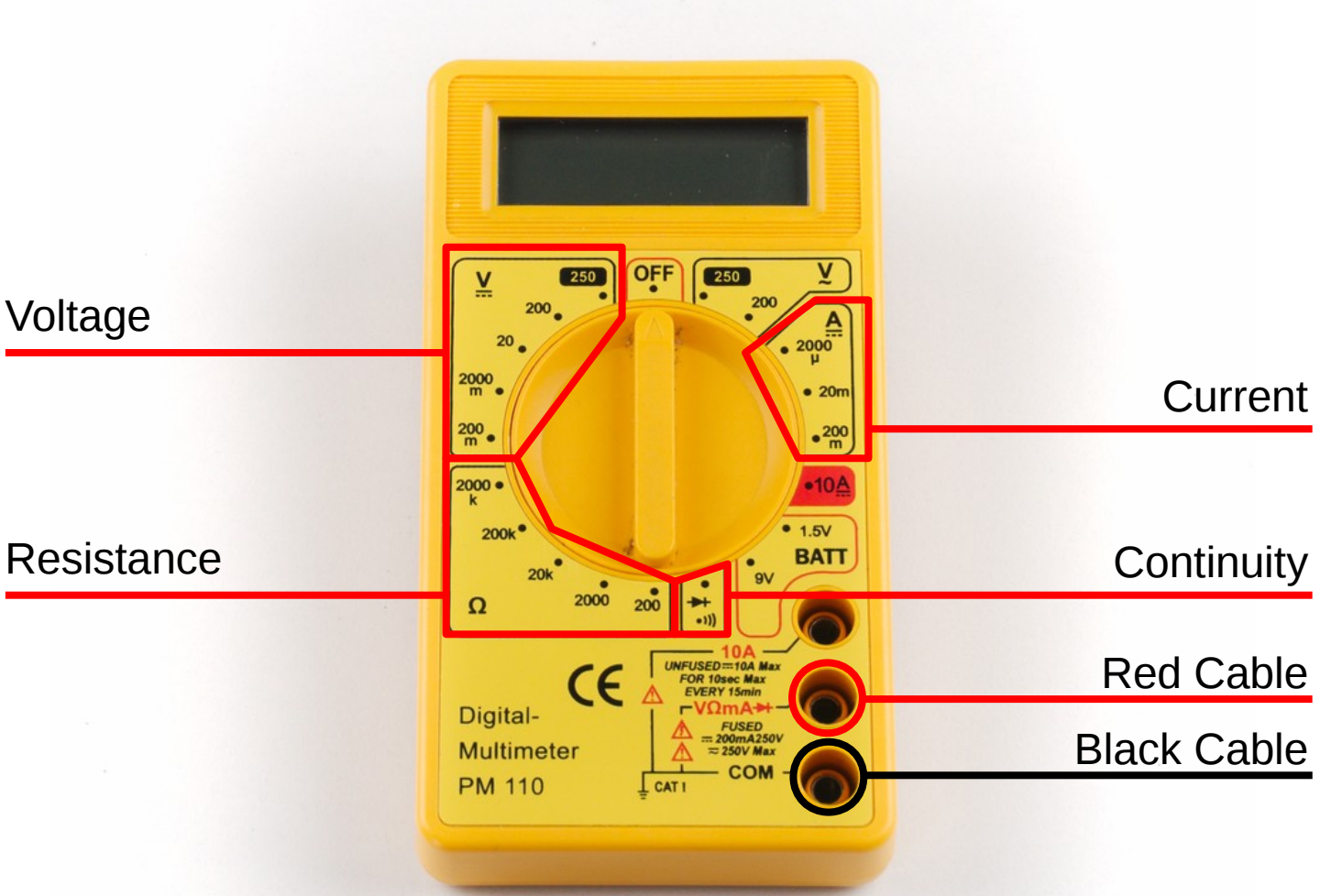
- Voltages below 20 V are generally harmless (e.g. USB: 5 V)
- **BUT:** Mains voltage (~ 220 V, AC) can be deadly!

  → no experiments with AC power

  → work exclusively with 5 V from the USB port
- Fuses prevent fires but do not protect against injuries
- Components can be damaged by too high voltages

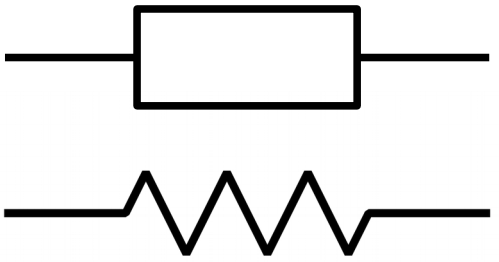
  → follow the data sheet!

# The Multimeter



# Resistors

- Resistance (in Ohm, Ω)
- Water circuit analogy: Bottleneck
- Can be measured with the multimeter
- Color code represents resistance



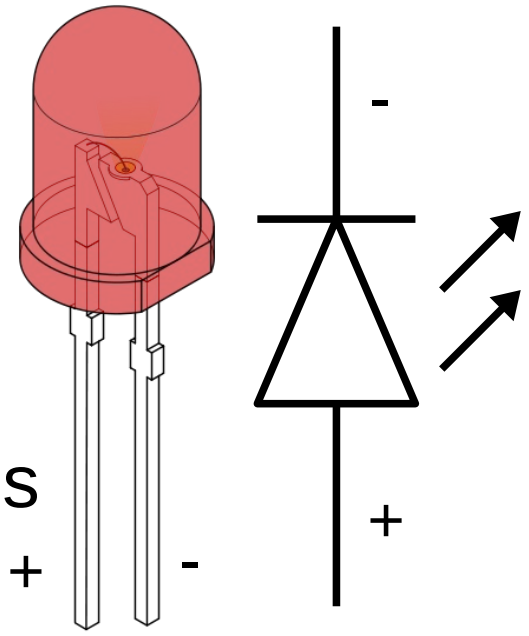
# Continuity Test

- Acoustic signal if a circuit is closed
- Quick test of connections
  - Beep: Resistance is below ~ 10 Ω
- Can be used to check if there are **short circuits**

# Light Emitting Diode (LED)

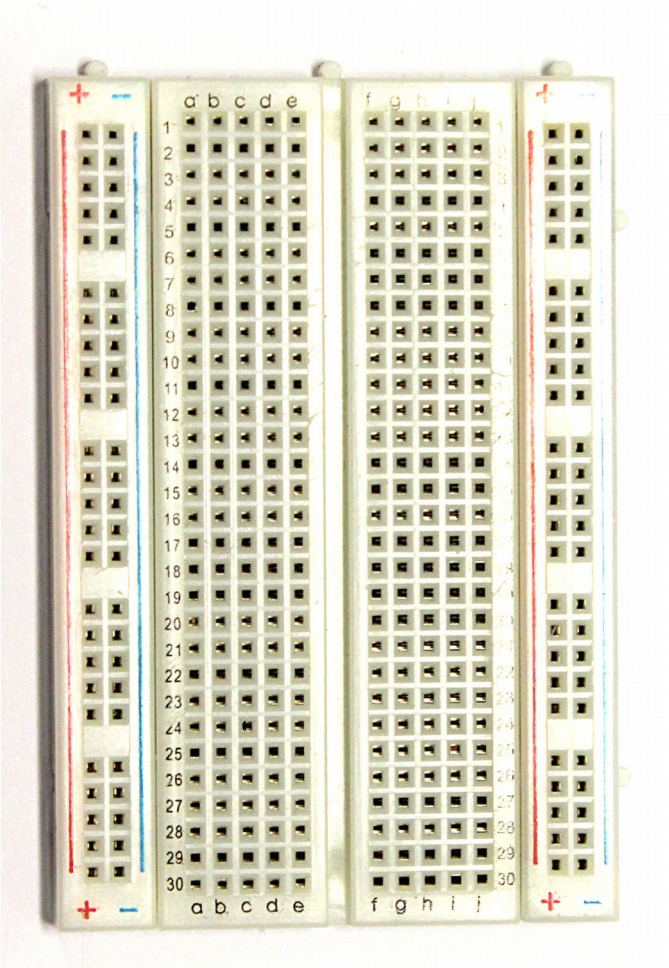
- “Valve” for current
- Current can only flow in one direction
- Typical current: 20 mA
- typical voltage: 2 – 4 V
- Slightly too high voltage can destroy LEDs

  → *dropping resistor* is needed




https://commons.wikimedia.org/wiki/File:LED,_5mm,_red_%28unlabelled,_full%29.svg

# Breadboard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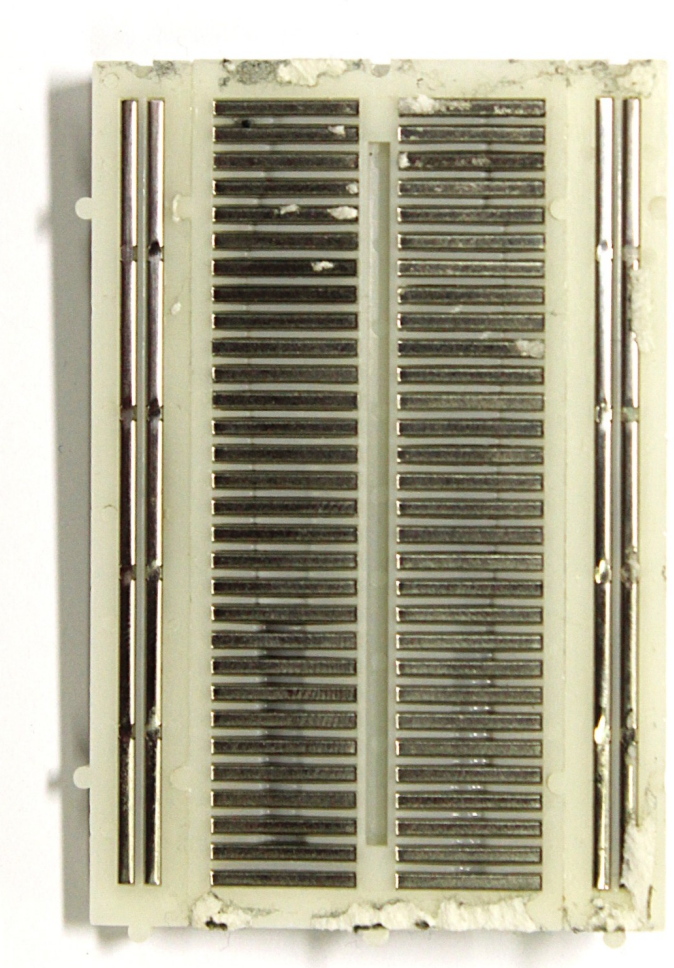

# Tutorial 01 - Electronics