Linear Circuits and Systems

Resistance and Current flow

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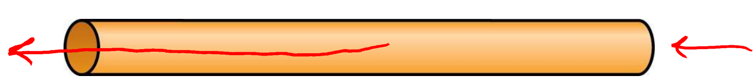
Resistance

- Every object has a resistance to the flow of current
  - Conductors have small resistance
  - Insulators have large resistance

Drinking straws

What's inside a straw? What is it doing?

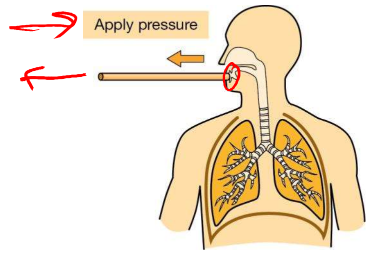


q ≡ air molecules

(Air. The molecules move randomly, but there is no net movement!)

A current ≡ air flow

Can you make the air flow?



Pressure ≡ Voltage (V)

(A force is needed to make anything start moving and,
if there are resistive forces, to keep it moving.)

What if the pressure is bigger?

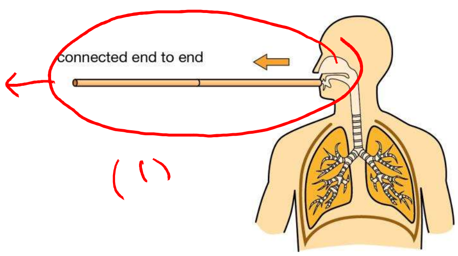
Voltage → Current

V ↑ → I ↑

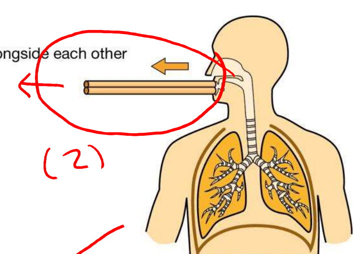
Straw ≡ Conductor

What if there are two straws?

Same pressure ~ "fixed voltage"



(1)

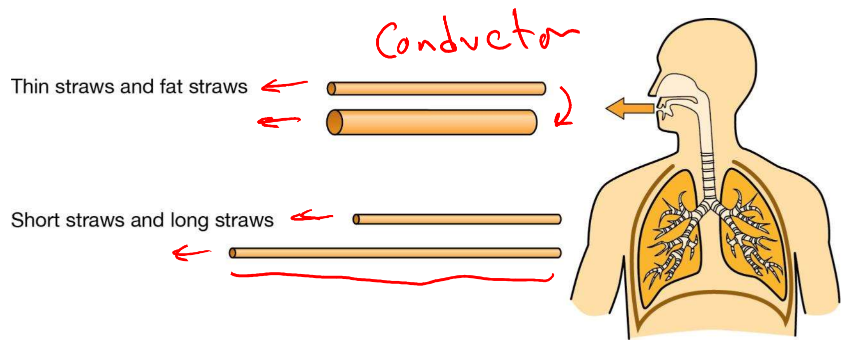


(2)

Length ↑ → I ↓

Area ↑ → I ↑

Straws of different shapes?



Current, voltage and resistance

Current in a simple circuit will be larger if

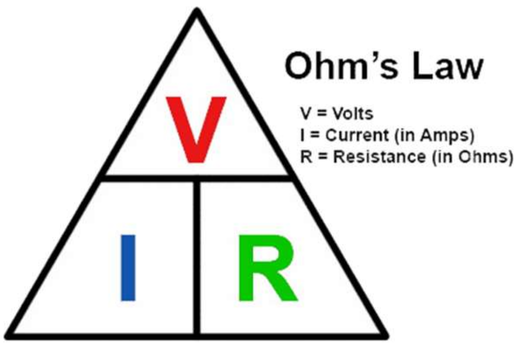
- voltage of the supply is larger
- resistance in the circuit is smaller

$$R = \frac{\rho l}{A}$$

where R is resistance, ρ is resistivity of the material, l is its length and A is its cross-sectional area.

The same relationships apply in networks of identical resistors.

Ohm's Law



$V = I \cdot R$ $$V = I \cdot R$$ (volts = amps times ohms)

$I = \frac{V}{R}$ $$I = \frac{V}{R}$$ (amps = volts divided by ohms)

$\frac{V}{I} = R$ $$R = \frac{V}{I}$$ (ohms = volts divided by amps)

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