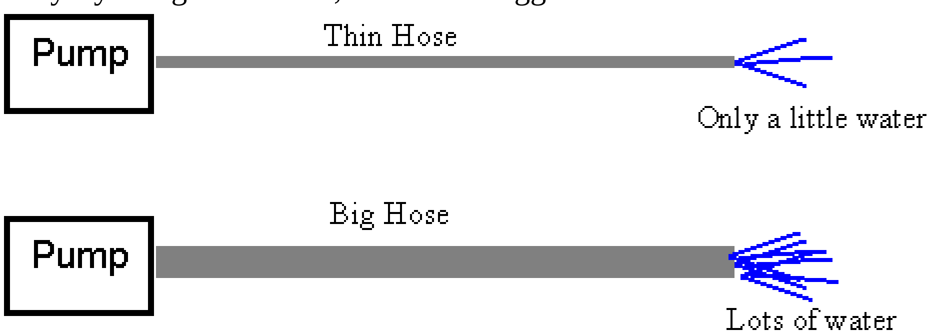
Note-A-Rific: Ohm

The amount of current flowing in a circuit depends, in part, on the voltage.

- It also depends on how the material of the conductor resistance the motion of its electrons.
    - Gold: an excellent conductor because its electrons are quite easily moved.
    - Aluminum: not a great conductor since its electrons don't move well.
- We would say that gold has a low resistance, and aluminum has a high resistance.

To understand the relationship between voltage, current, and resistance, look at the following analogy.

- Imagine a water pump that is being used to get some water out of the basement of a house.
- They try using a thin hose, and then a bigger hose.



- The big hose has a much lower resistance to the water flowing through it, so more water comes out the other end.
- This is how electricity works:
    1. The **Pump** is like **Voltage**: think of voltage (a potential difference) as the pumping power that is shoving electrons through the wire.
    2. The **Water** is like **Current**: a little water pouring out is like a little current running through a wire.
    3. The **Hose Thickness** is like the **Wire's Resistance**: a thin hose let's only a little water through, just like a poor conductor only lets a little current through.

Resistance of a wire depends on:

1. What material is used
    - It would be great to use gold wiring in our homes to reduce resistance, but the cost would be enormous.
    - Instead we use copper and some aluminum wire.
2. Diameter of the wire
    - A thicker diameter of wire offers less resistance than a thin wire.
    - It works out very much like the thin and big hose model drawn above… the thicker wire just has more room for the electrons to bump around in.

3. Length of wire
   - The longer the wire, the greater the resistance.
   - You can imagine that the further you are from the source of the electric current, the faster it will start to drop off.
4. Temperature
   - At **higher temperatures** atoms will be moving around more → more random movement bumps around free moving electrons → more bumping means they have a harder time moving around → **more resistance** (the only exception to this rule is carbon)
   - Electrical devices actually run more efficiently at lower temperatures.
   - It is also the reason why light bulbs *usually* burn out right when you turn them on.
     - When the bulb is turned off, the filament is at room temperature, so its resistance is quite low.
     - You turn it on and there's a sudden rush of electrons pushing through the filament at a very low resistance… this might cause the filament to snap.
     - If it can survive those first couple of seconds, the temperature of the filament quickly increases, which increases the resistance, so the electrons don't go ripping through the filament quite as fast anymore.

The physicist Georg Simon Ohm made a discovery about certain conductors.

- If a conductor's resistance stays constant even when different voltages are applied to it, the conductor is said to obey Ohm's Law.
- As far as we are concerned for our calculations in this course, all conductors obey Ohm's Law.
- The formula Ohm came up with is…

$$I = V / R$$

I = current (A)
V = voltage (V)
R = resistance measure in Ohms (Ω)

The symbol for Ohms, Ω, is the Greek letter "omega".
On your formula sheet Ohm's Law is written down as V = IR.

Example: A voltage of 220V goes through a wire. If the current is measured as 36A, what is the resistance of the wire?

$$V = IR$$

$$R = V / I = (220V) / (36A) = 6.1\Omega$$

Some Typical Resistances

Lamp Cord	Less than 1 Ω
Light Bulb	100 Ω
Clothes Iron	15 Ω