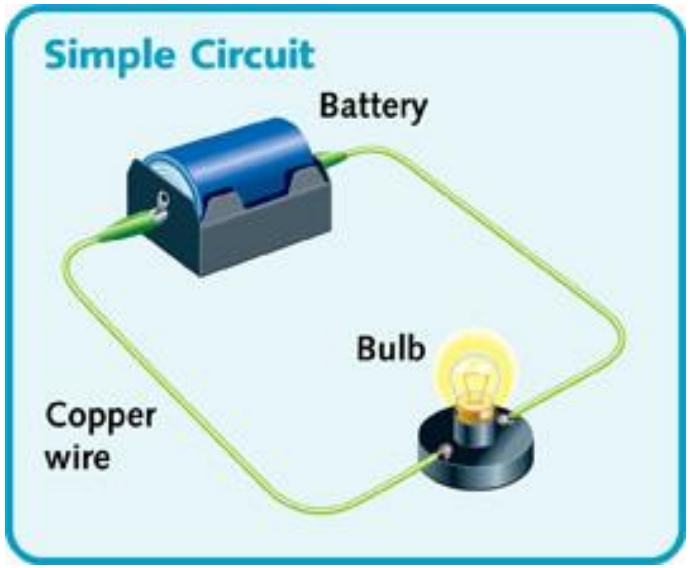
Measuring Electrical Resistance

Section 11.4

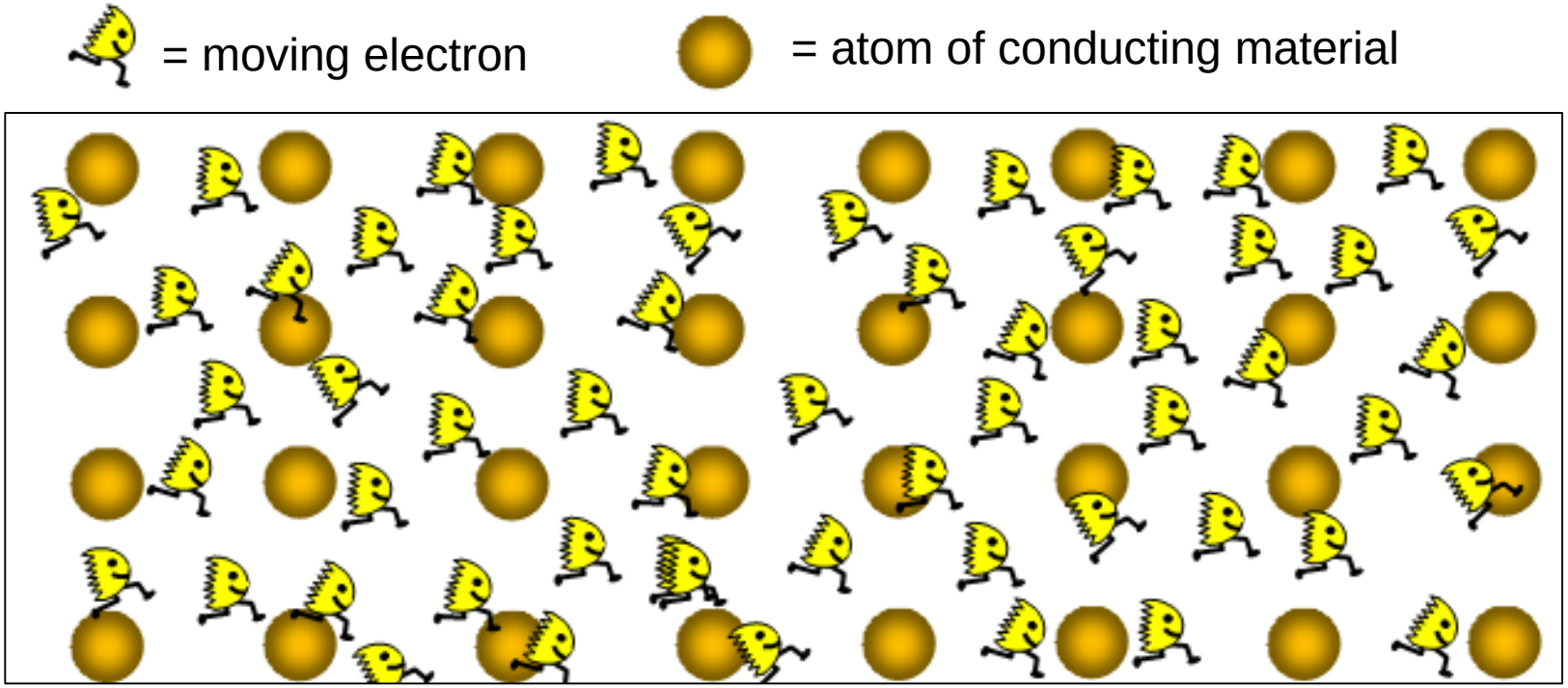
Electrical Resistance

1a. **Electrical resistance** - The ability of a substance to **slow down** the flow of electric current, and **convert** electrical energy into other forms of energy.

- All electrical loads have this property.

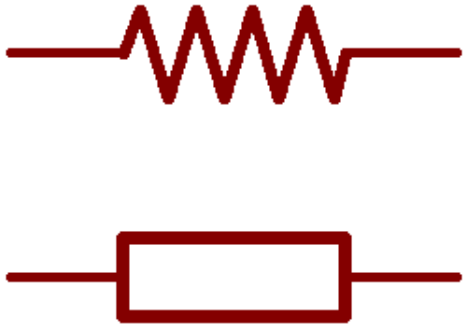


b. Resistance occurs because of **collisions** between the electrons in the current, and the atoms that make up the substance.



2. **Resistors** are devices used in electric circuits to decrease the current through a component in a circuit by a certain amount.
   - They don't convert electrical energy into anything usable, but they do produce **heat** as a result.

Different sizes = Different amounts of resistance



Two different circuit symbols for resistors.

- Metals are very good conductors, but they still provide some resistance to electrical current.

- The **best conductors** provide **very little resistance** - so little that it can be considered *negligible.*

(3) Factors Affecting Resistance of a Wire

A. Type of material - Resistance is different, depending on the identity of the material.

- For example, a piece of copper wire has **lower** resistance than the same length of iron wire.

Which material will be more suitable for producing wires?
copper

B. Length

The longer the wire, the **higher** the resistance.

A shorter wire has less resistance than a longer wire of the same diameter that is made from the same material.

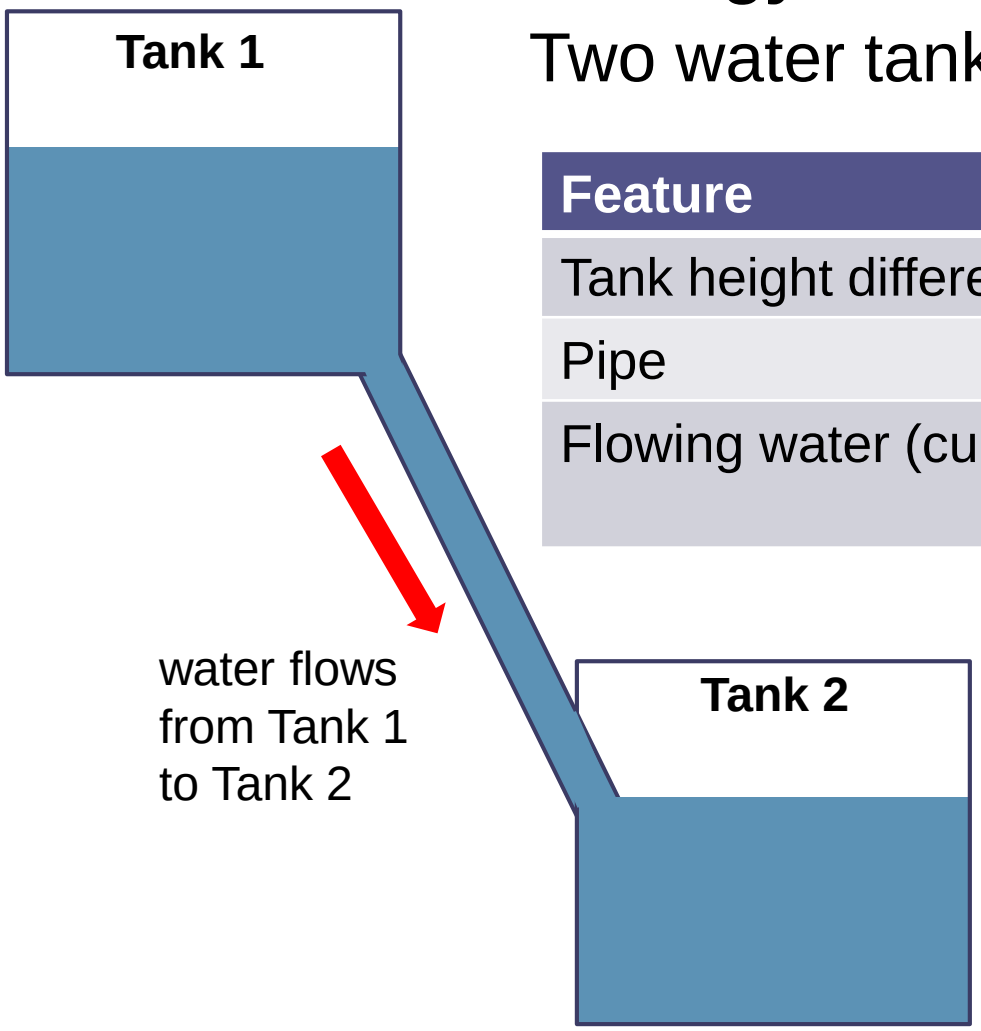
C. Diameter (thickness)

The thicker the wire, the **lower** the resistance.

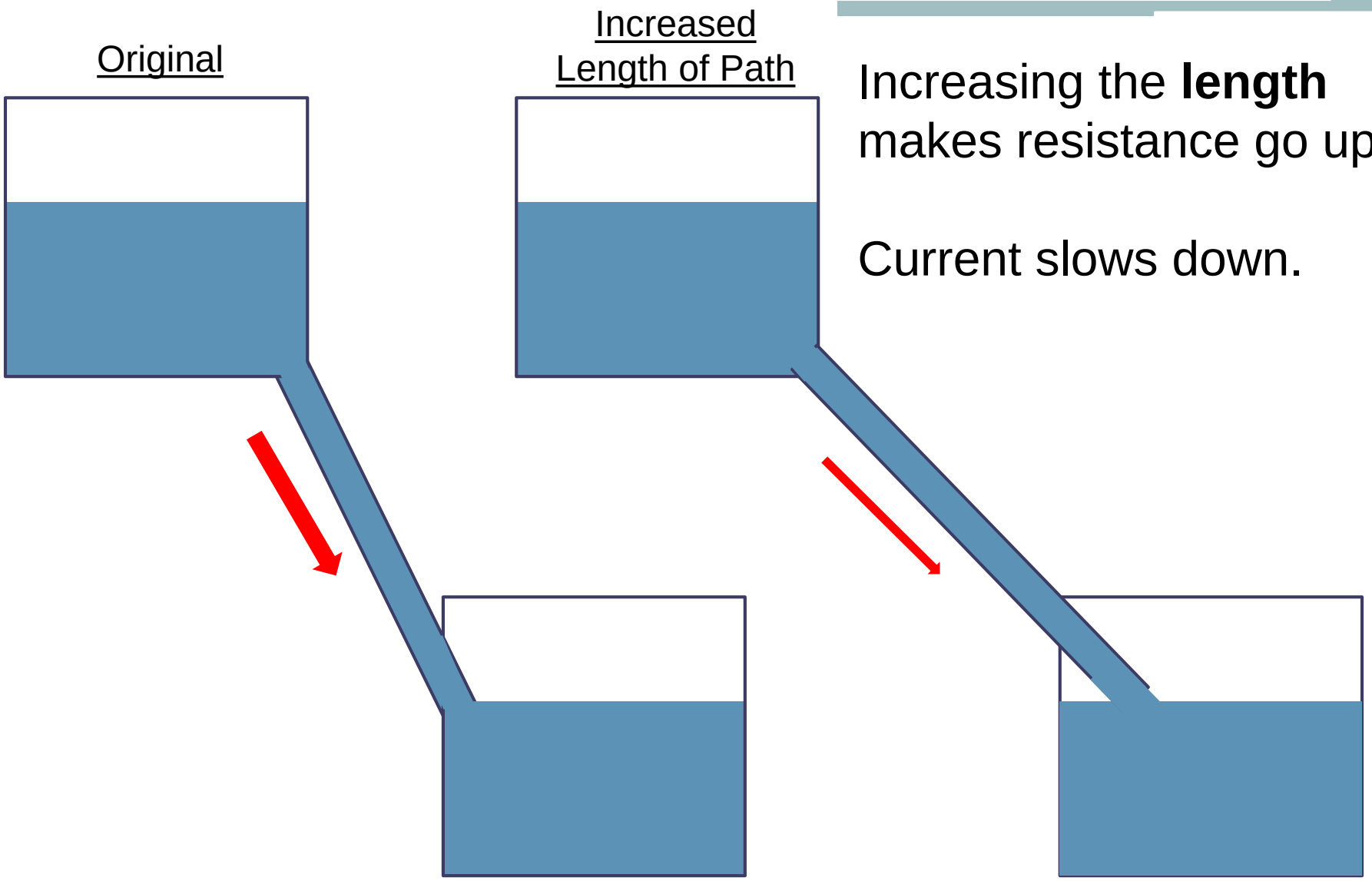
A thicker wire has less resistance than a wire of the same length that is made from the same material.

Analogy: Voltage, Current, Resistance

Two water tanks, connected by a pipe

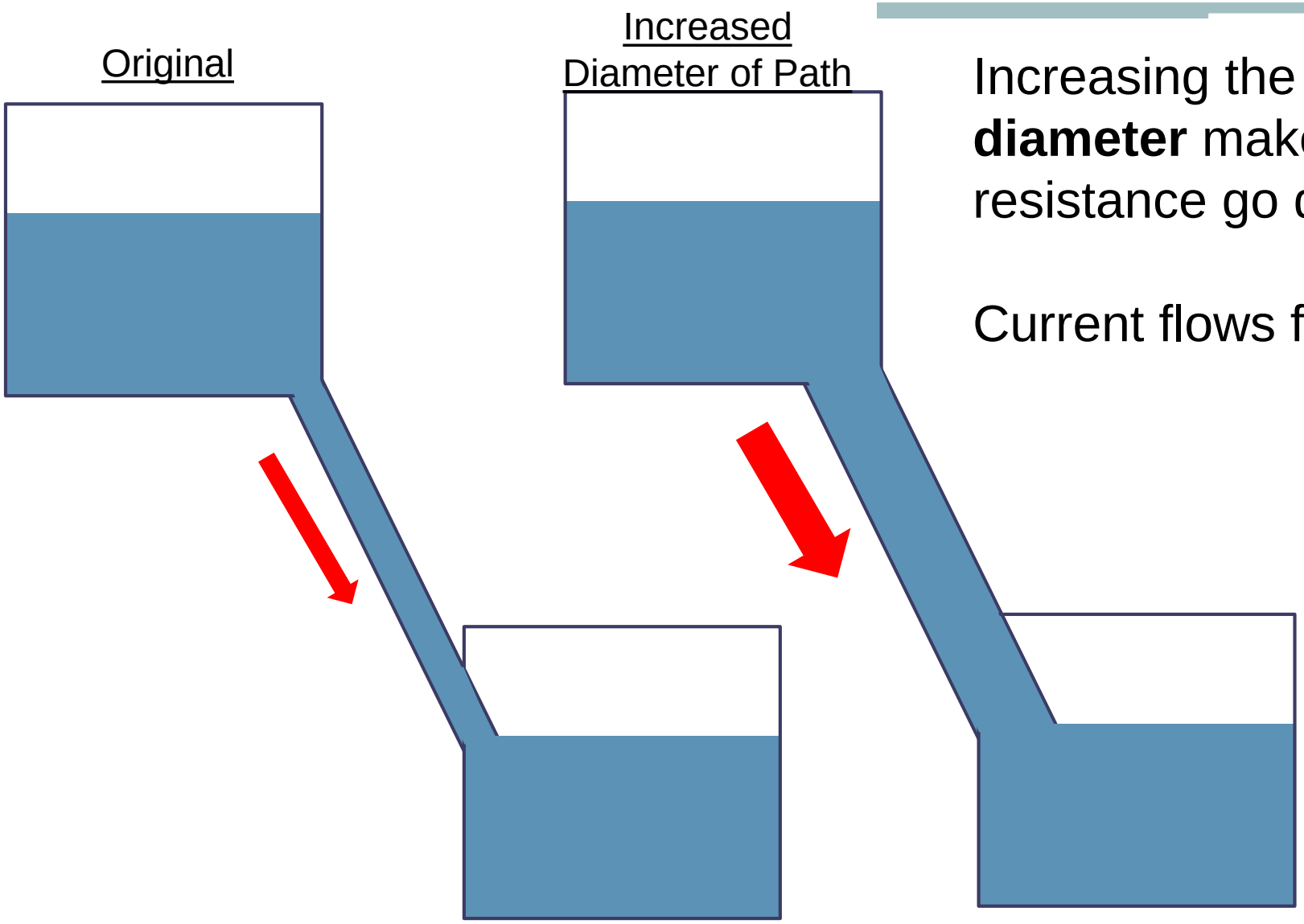


Feature	Compare to…
Tank height difference	Voltage
Pipe	Conducting path
Flowing water (current)	Flowing electrons (current)



Increasing the **length** makes resistance go up.

Current slows down.

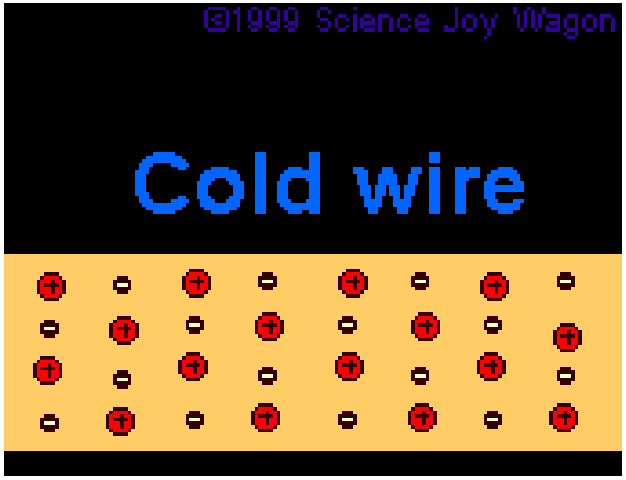


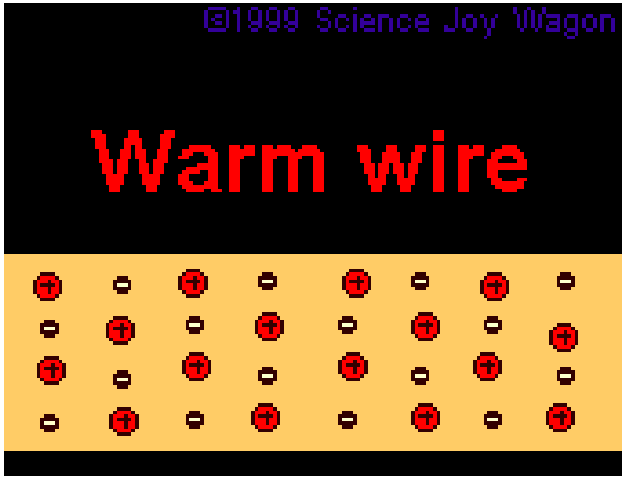
Increasing the **diameter** makes resistance go down.

Current flows faster.

D. Temperature

- The **hotter the temperature, the <u>higher</u> the resistance**.
  - Hotter temperatures cause the atoms in the wire to move faster, which increases the number of collisions.





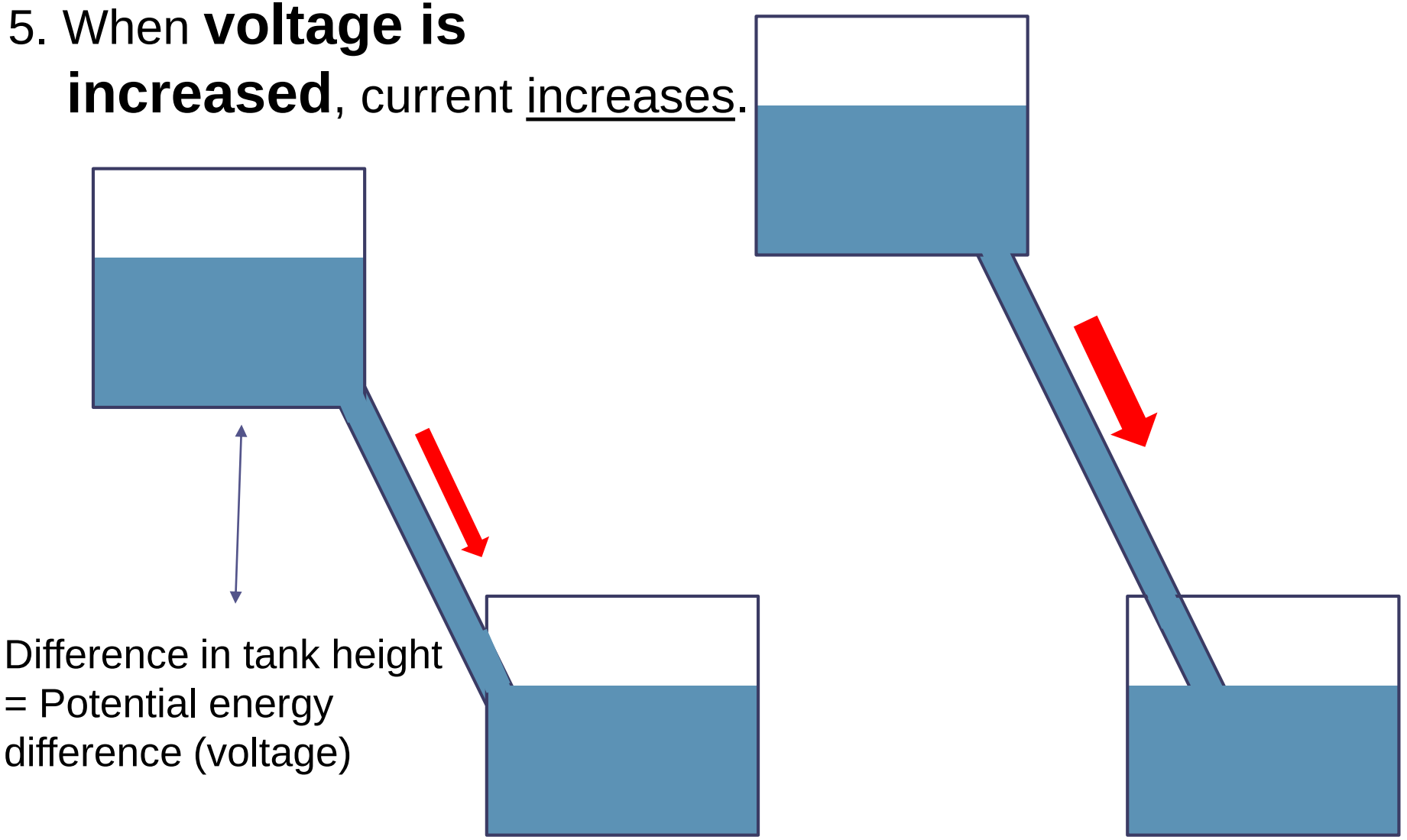
Relating Current to Resistance and Voltage

4. When **resistance is increased**, what happens to the **current**?
   (Think about the water analogy)

current **decreases**

What about voltage?

5. When **voltage is increased**, current <u>increases</u>.



Difference in tank height = Potential energy difference (voltage)

Ohm's Law

- describes the relationship between three quantities: **resistance** (R), **potential difference** (V), and **current** (I)

$$V = I \times R$$

voltage, measured in volts (V)

current, measured in amperes (A)

resistance, measured in ohms (Ω)

Symbol	Variable	Unit of measure
	voltage	
	current	
	resistance	

6. The formula can also be re-arranged to find **resistance**, or **current**.

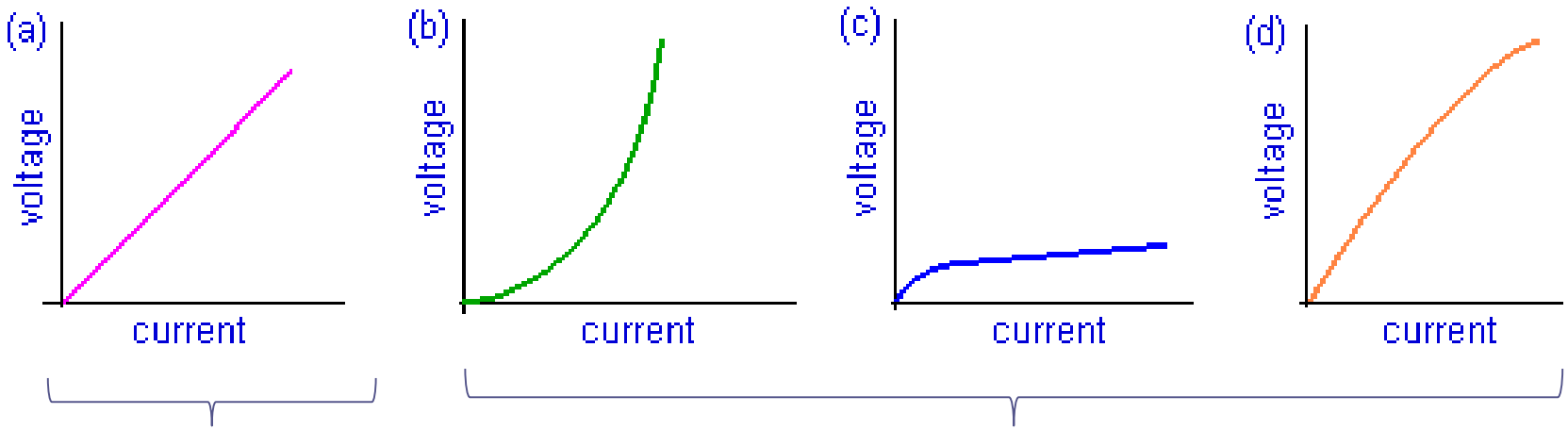
$$V = I \times R$$

Rising temperatures can raise a material's resistance.

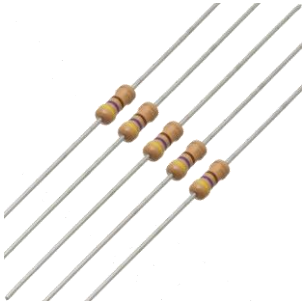
(7) **Ohmic resistors** always obey Ohm's Law:

- have a **constant resistance**, regardless of temperature

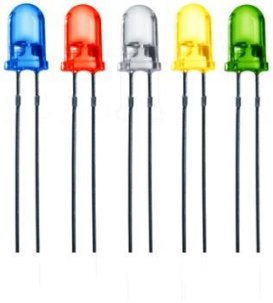
A graph of voltage vs. current will always show a straight line.



Ohmic resistor:
graph is a straight line



Non-ohmic resistor:
graph isn't a straight line



Ohm's Law: Sample Problem

A technician is checking the circuits on a vehicle. The technician measures the current entering a component as 0.75 A. The potential difference across the component is 12 V. What is its resistance?

GIVEN: *ANALYSIS & SOLUTION:* *STATEMENT:*

REQUIRED:

Homework

Resistance

1. Read 11.4
2. **Define** and give an **example** the following two terms: superconductor, non-ohmic conductor
3. pg. 465 #2, 3, 4
4. pg. 467 #4-7

Ohm's Law

1. Ohm's Law practice problems
2. Pg. 464 #1-6
3. Pg. 467 #1-7