Class 2 Agenda

- Open Q&A - how was Week 1?
- Review/Workshop Week 1 Labs
    - Components, basic breadboard setup, multimeter
- Electricity Notes
- Preview Week 2 Labs
    - Install Arduino IDE, Upload first program
- Tools for System Diagrams and Schematics
- Discuss reading (time allowing)

Electricity

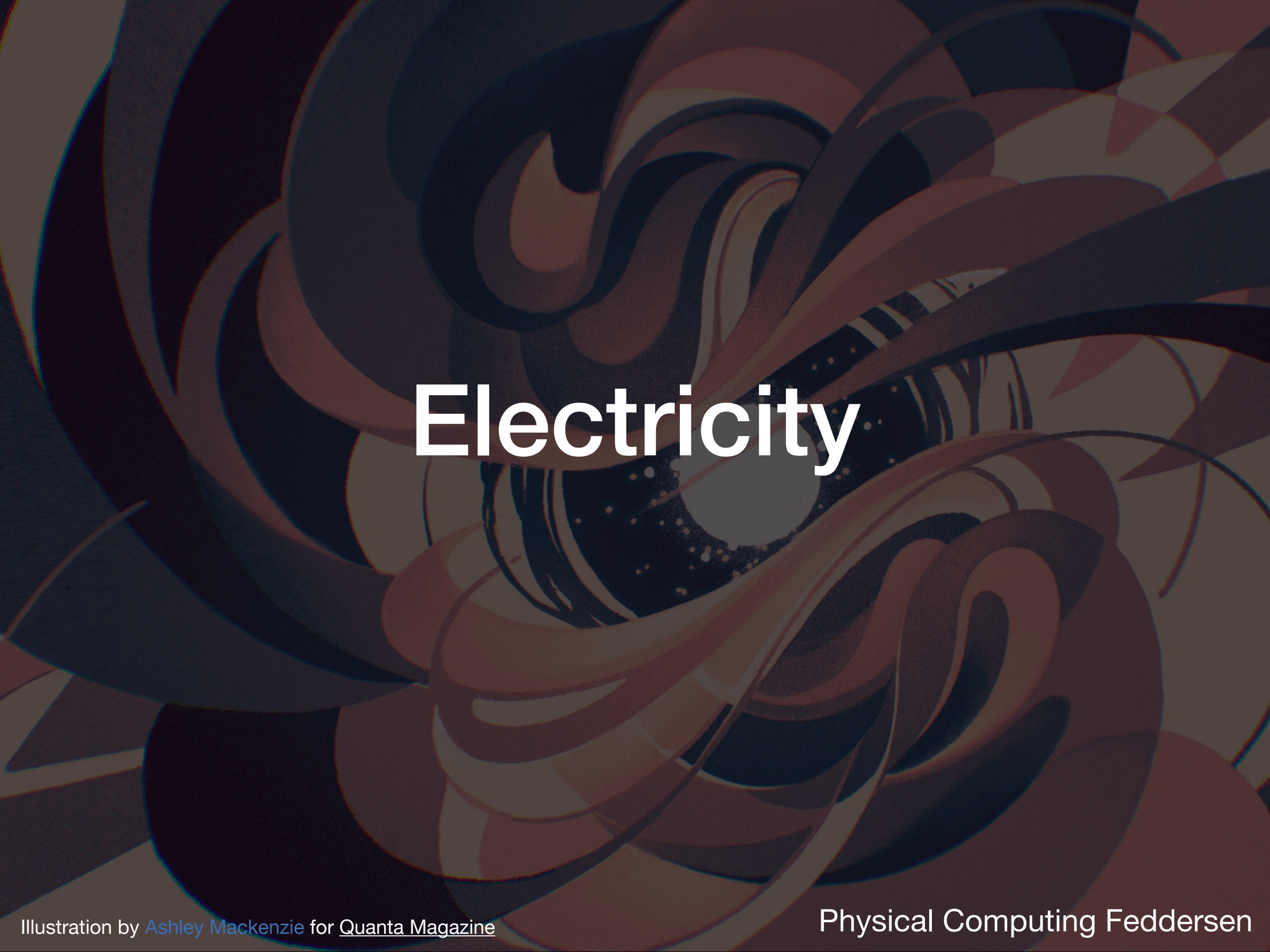


Illustration by Ashley Mackenzie for Quanta Magazine

Everything is electricity!*

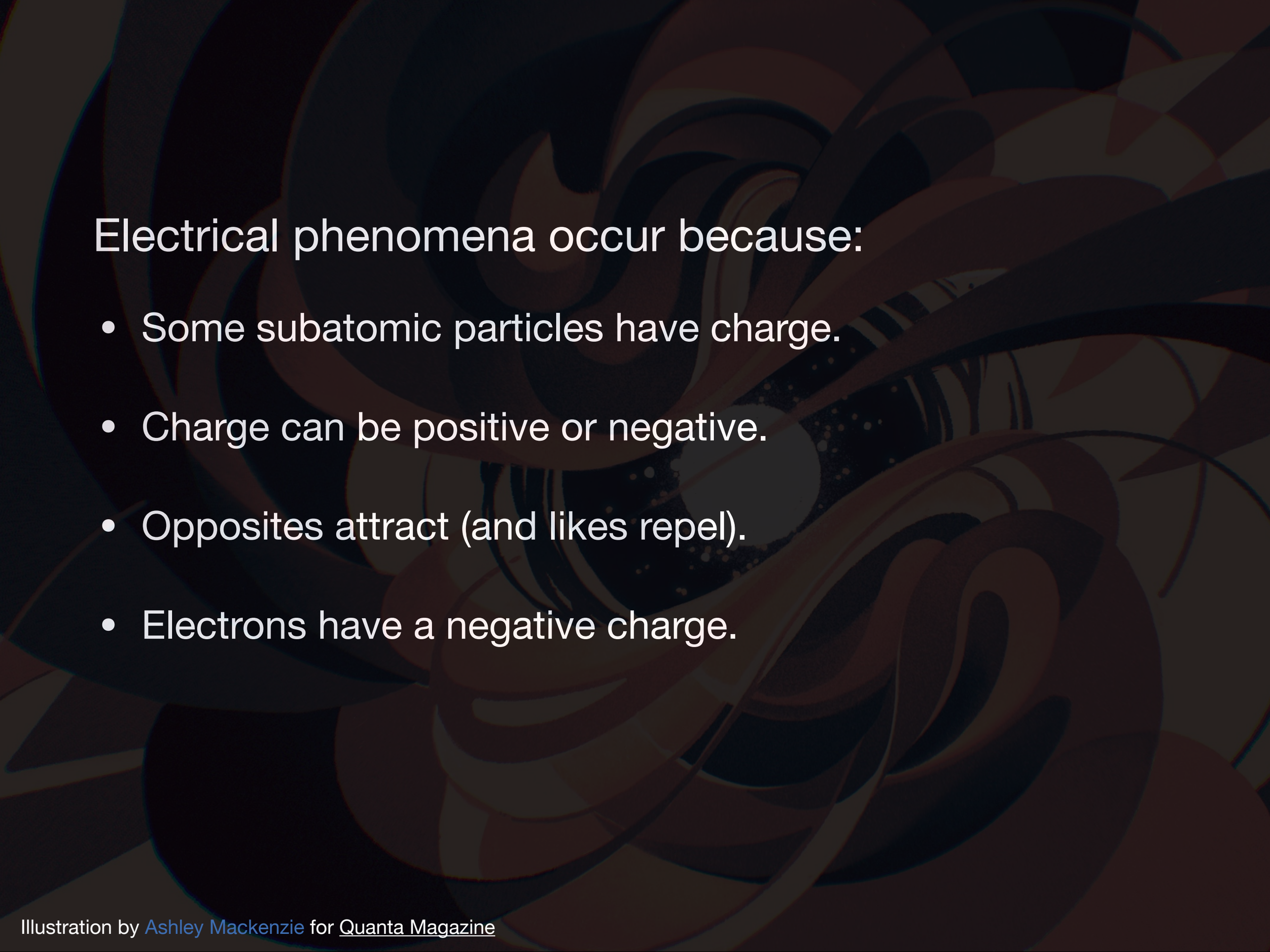
- Electromagnetism is a fundamental force in the universe, and the only one we experience directly.
- Electricity is powerful, subtle, strange, useful, but ultimately predictable.
- We've only had any idea about electrons for about 100 years! Our current understanding of them is really weird!

Illustration by Ashley Mackenzie for Quanta Magazine

* and magnetism

- Electricity is a huge subject, but…
- We only scratch the surface to get started in Physical Computing

Illustration by Ashley Mackenzie for Quanta Magazine



Electrical phenomena occur because:

- Some subatomic particles have charge.
- Charge can be positive or negative.
- Opposites attract (and likes repel).
- Electrons have a negative charge.

Illustration by Ashley Mackenzie for Quanta Magazine

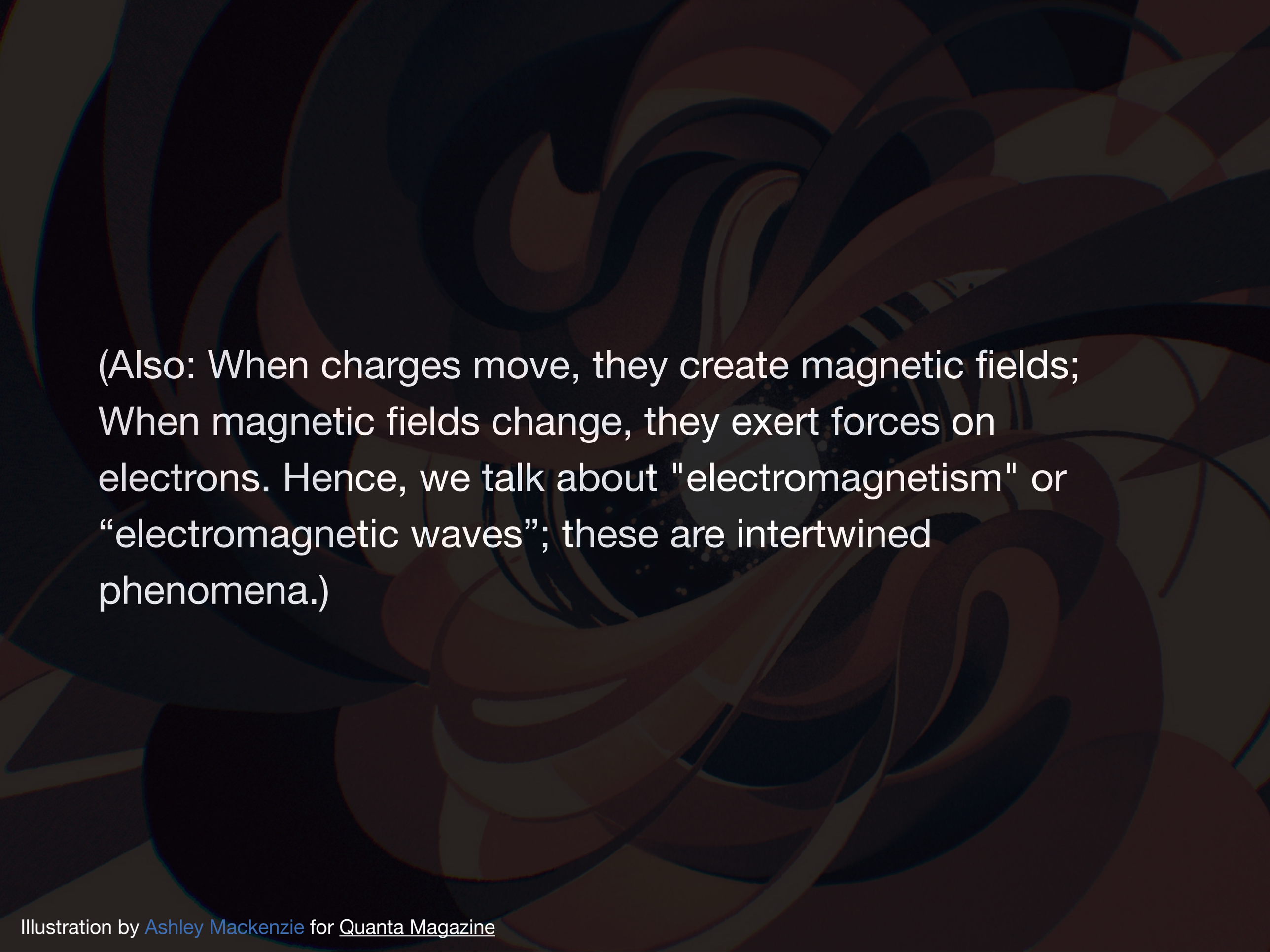
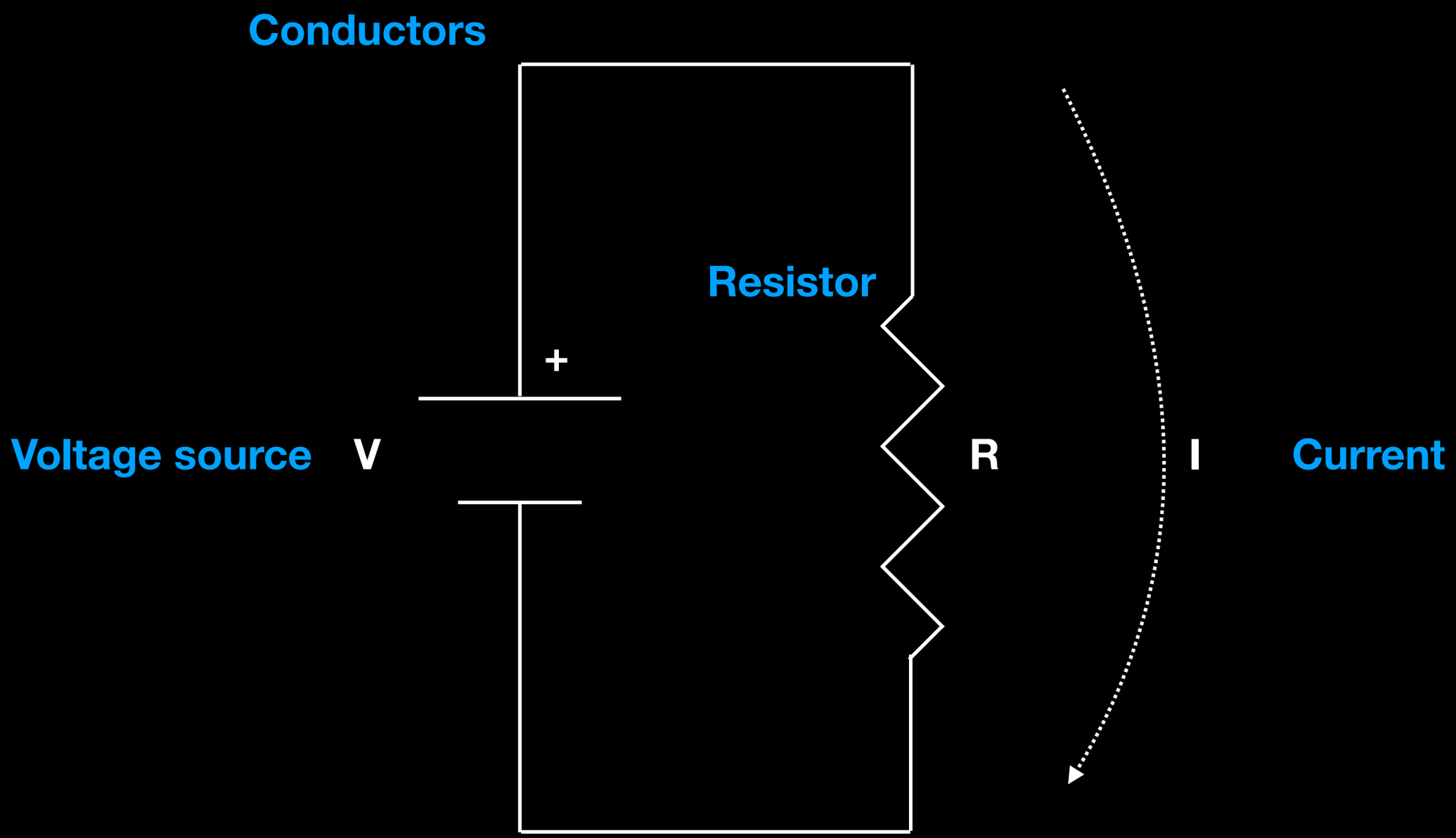


Illustration by Ashley Mackenzie for Quanta Magazine

We’re going to figure this out:



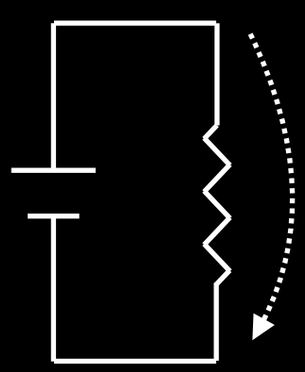
- We can consider any two points in regards to how charges would flow between them if they could.

image: https://www.javelin-tech.com/

- We measure that potential for charge to flow as a "VOLTAGE" with the unit Volts, V.

- Voltage is always a measurement between two points.

V



- In this class, we don't care (much) about shocks, we care about situations where charge flows for a long time.
- This is the job of batteries and power supplies.
- The first characteristic of any power supply is its Voltage.
- Consider a battery - 1.5V, 9V, 12V, etc.
- Or a “wall wart”: 12V, 16V. Or AC (what that means comes later) 120V, 220V

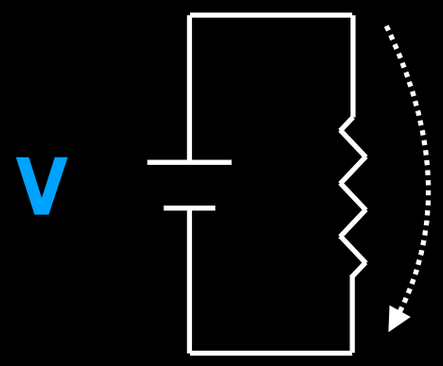


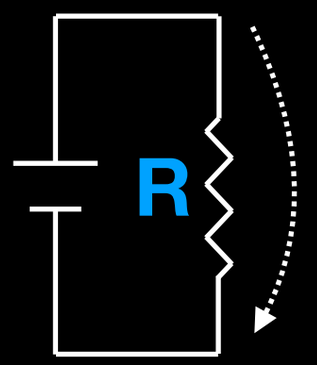
image: duracell

- Every material has an ability to allow electrons to flow through it.

- Some things are good at it, like most metals. These are called “conductors.”

- Some things are bad, like wood, plastic, or air. These are “insulators.” They have a low conductivity, or conversely, a HIGH RESISTANCE.

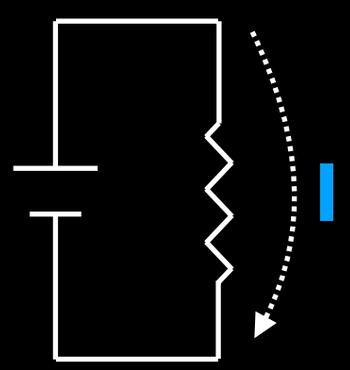
- RESISTANCE is the second property we care about. It's unit is Ohms, Ω.



- Voltage is measured between two points, and every (DC) power supply has a positive and negative (or positive and "GROUND") side.

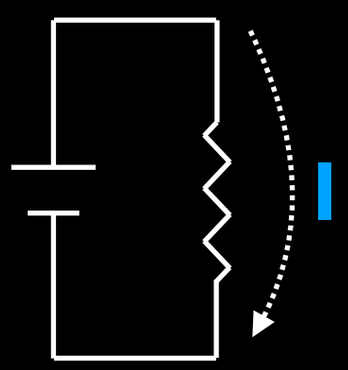
- The path from positive to negative, through some stuff, is called a CIRCUIT.

- Flowing charge is called CURRENT, measured in Amps (A) and noted in circuits as "I"



- If a Voltage source is connected in a circuit by a HIGH RESISTANCE path, virtually no charge will flow (LOW CURRENT).

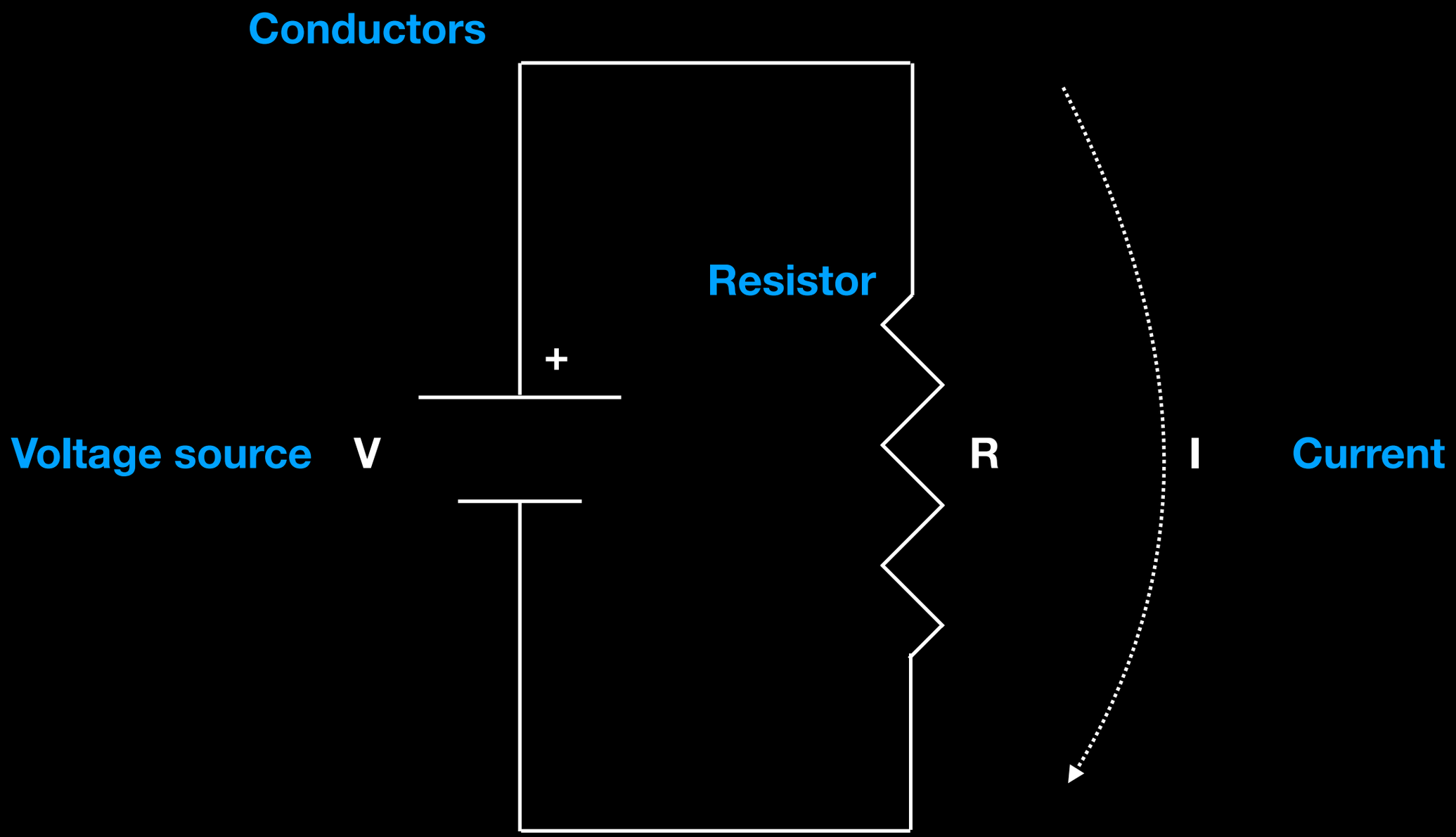
- If a Voltage source is connected in a circuit by a LOW RESISTANCE path, a lot of charge will flow (HIGH CURRENT).



We can say this with math:

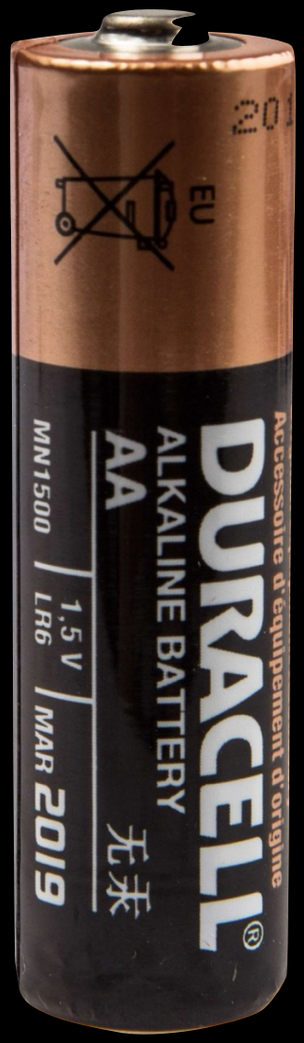
$$I = V/R$$

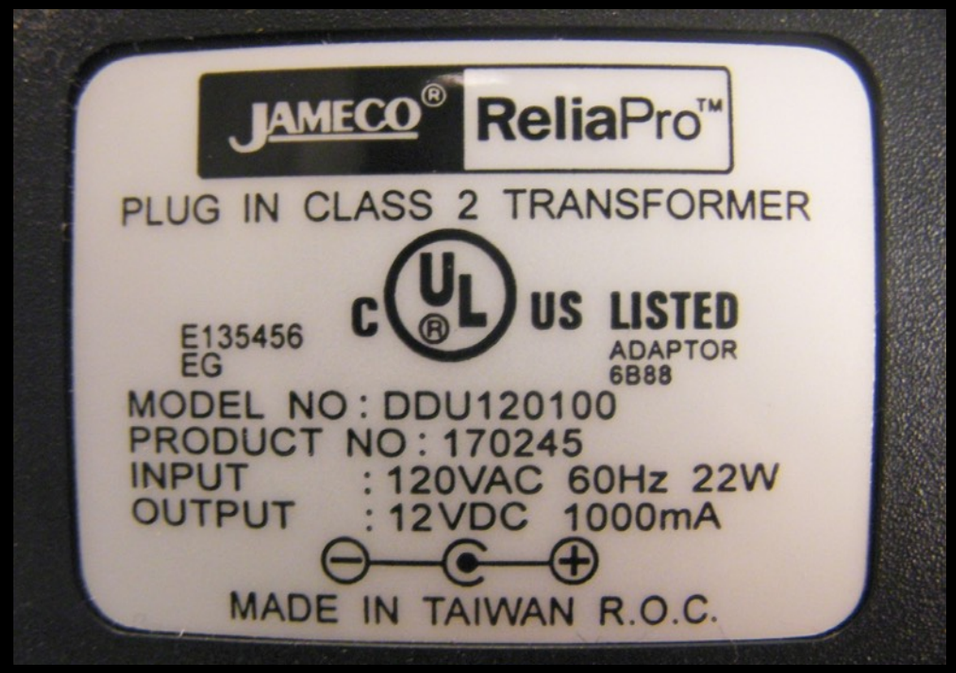
Here’s our schematic again:



Our goal this week was to build the foundation for the Labs you will do in the coming weeks. We will:

- Use a power supply to get 5V for prototyping circuits
- Set up a breadboard
- Use a multimeter to make measurements of Voltage and Resistance (bonus points for Current!)
- See some basic components and their schematic symbols





For any electrical power supply ask:

- What voltage is it?
- How much current *could* it source?

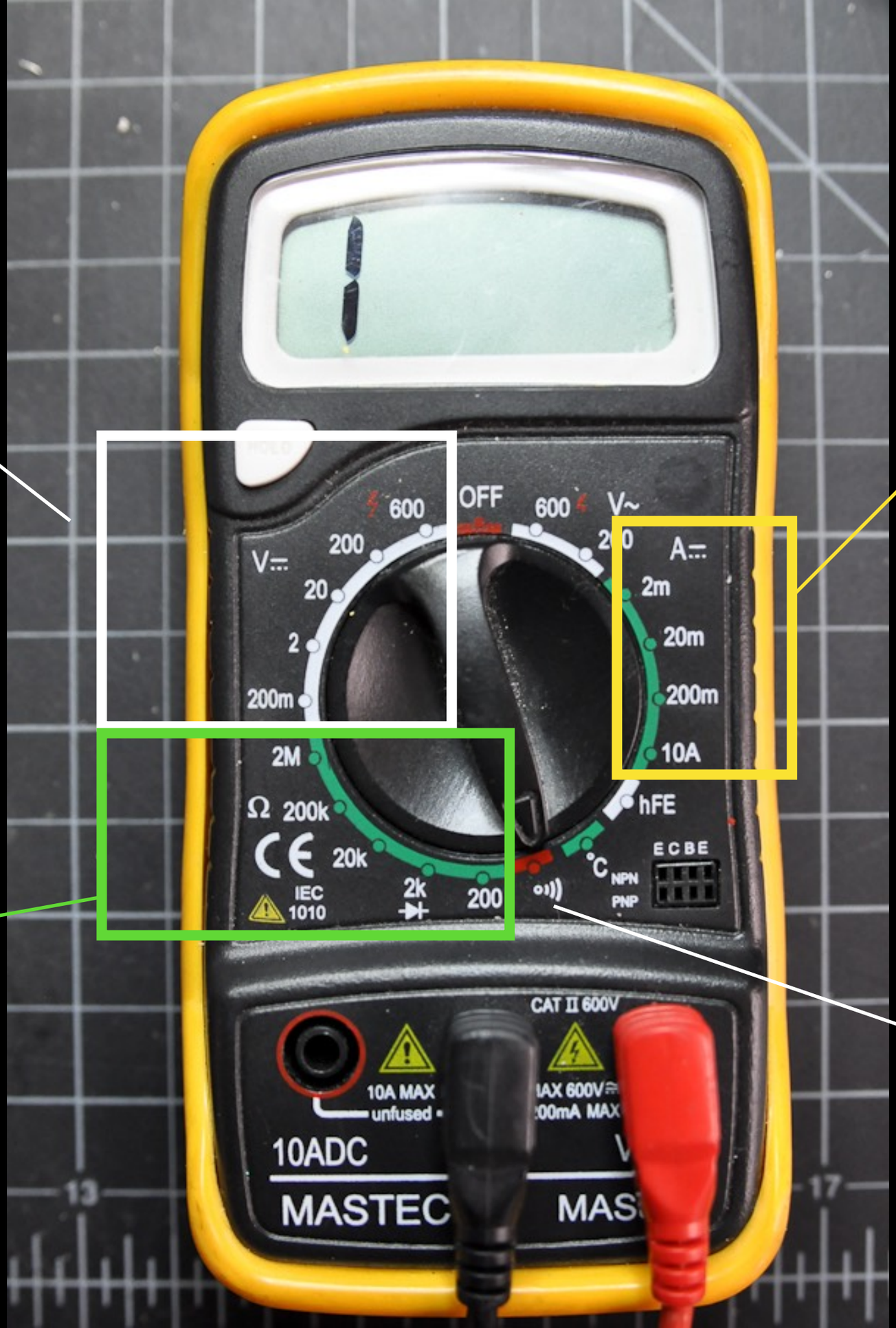
image: https://www.circuitspecialists.com/

DC Volts

DC Current

Resistance

Continuity

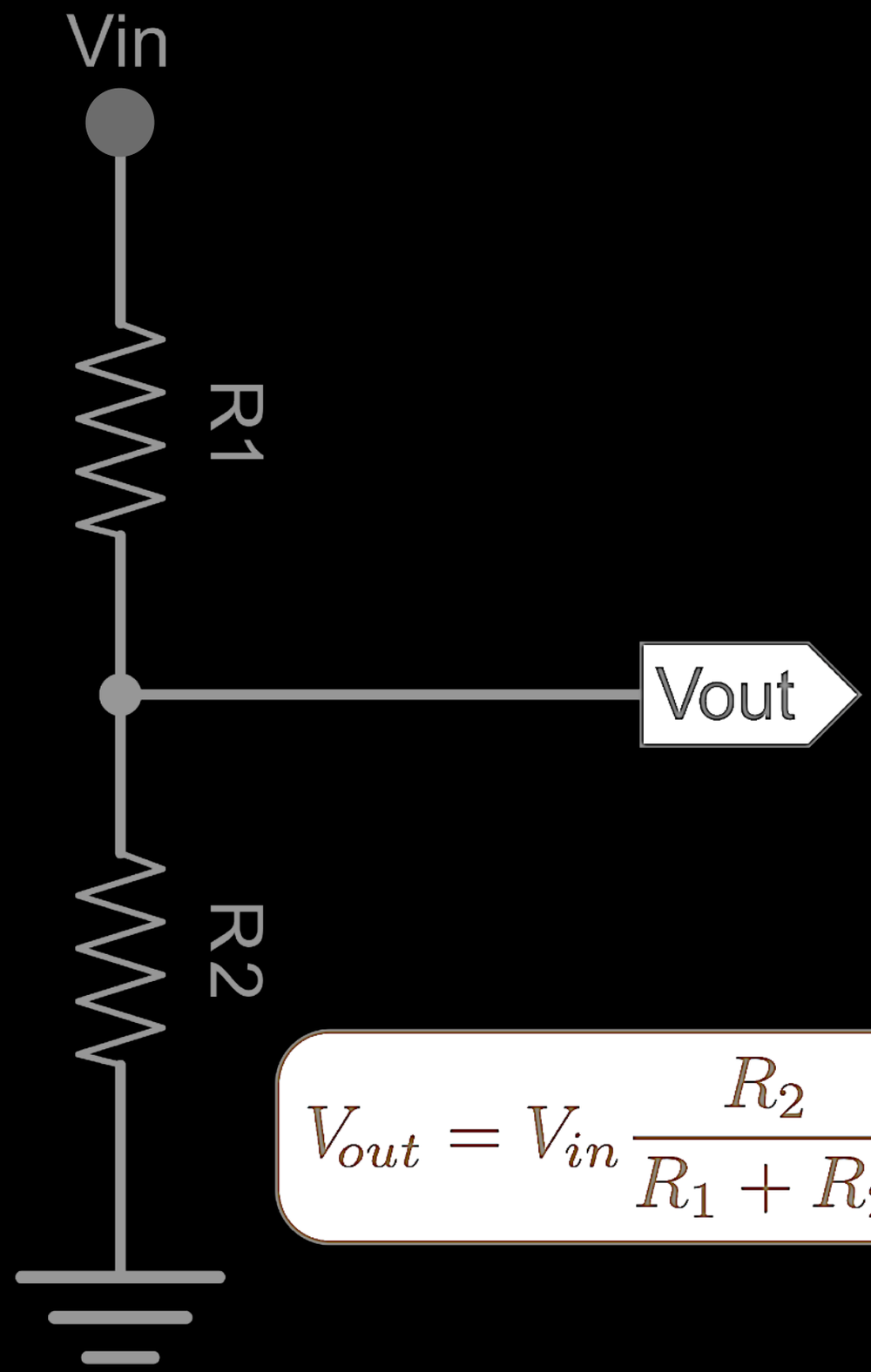


Everything important about electricity*

- Volts, Resistance, Current, related as I=V/R
- Circuits are circles made up of components.
- Components include power supplies, wires, resistors, diodes (& LEDs)
- Switches and buttons and breadboards are just fancy wire (conductors and insulators in useful configurations)
- Potentiometers are fancy resistors
- Variable resistors - resistance changes because of something else (light, force)
- Diodes let electricity flow one way, we especially care about the ones that light (LEDs)
- Some components are polarized, some aren’t
- Memorize the schematic symbols for each components (they generally look like what they are)
- Get used to translating from schematic layout to breadboard layout (just takes practice). Look for things in series or in parallel
- Memorize the voltage divider circuit

*as far as intro pcomp is concerned

Voltage divider circuit



$$V_{out} = V_{in} \frac{R_2}{R_1 + R_2}$$

image: openclipart.org

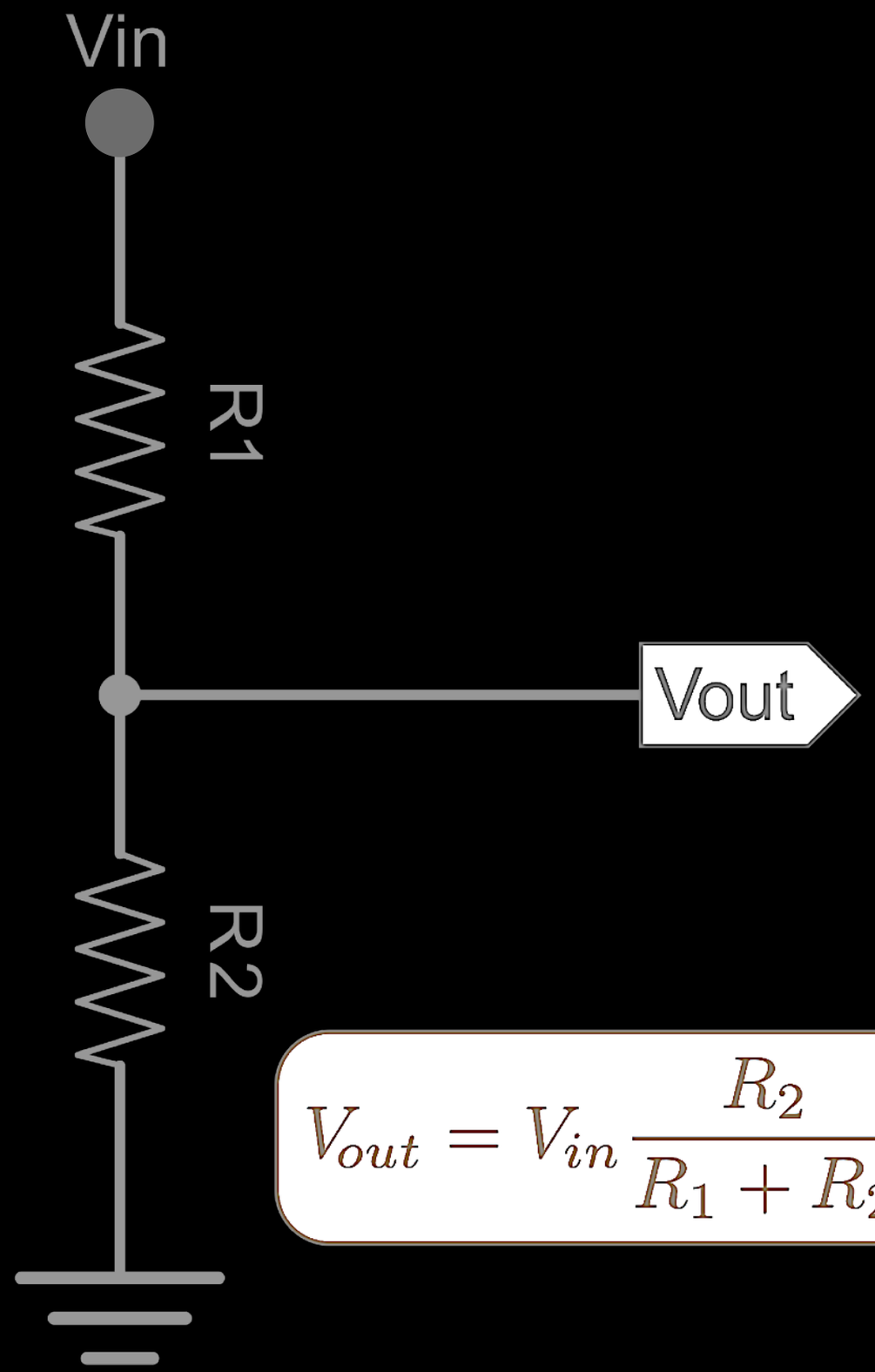
Voltage divider circuit

Dot, squiggle, squiggle, bar

Each squiggle is an R

The ratio R1 to 2

Determines what Vout will do



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