Welcome to Engineering in the Kitchen!

Please find a seat and fill out a name tent with whatever you want us to call you.

EN 1: Engineering in the Kitchen

Steven Bell

6 September 2023

Tufts UNIVERSITY

About me

Bachelor's in Computer Engineering

Oklahoma Christian University

About me

Bachelor's in Computer Engineering

Oklahoma Christian University

MS/PhD in Electrical Engineering

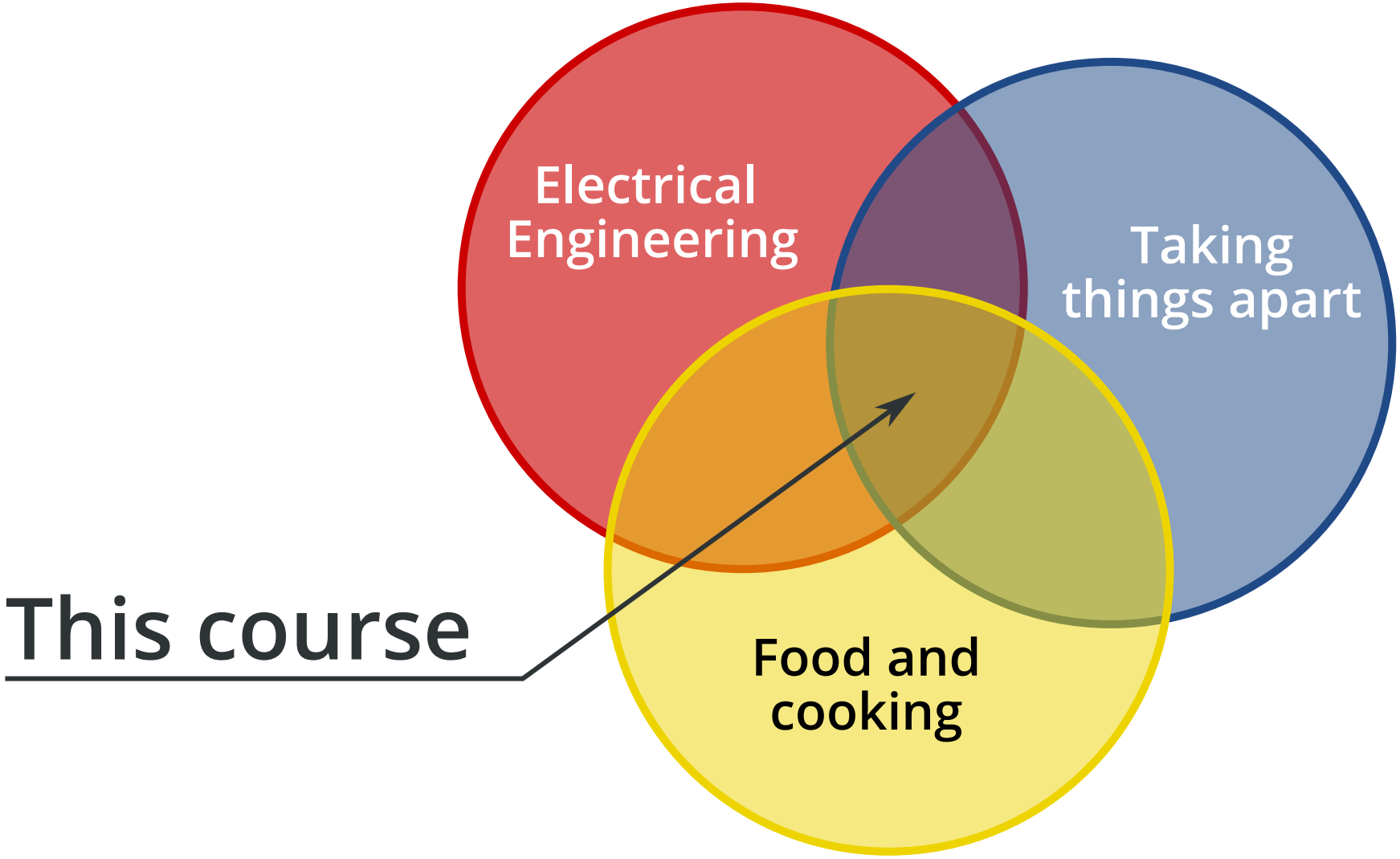
Stanford

Teaching assistant

Pushkar Jha

Why did you choose this EN-1?

Respond at **pollev.com/stevenbell**


Electrical Engineering
Taking things apart
Food and cooking
This course

What is something (related to this course) that you're nervous about?

Respond at **pollev.com/stevenbell**

I want everyone to succeed in this class!

And to have fun.

We'll evaluate your learning based on what you can do,
not on a curve against each other.

If you're falling behind, please reach out and get help!

Rarely does "working harder" solve the problem.

From the 2020 course evaluations:

8. What suggestions do you have for improving this course?

Comments
I did not have any prior experience with circuits and stuff like that so I always felt behind. I didn't feel like the professor did a good enough job of explaining the basics of the course.
I felt like I knew most of the material coming into it. I still enjoyed the course and learned from it, but there were occasional times when I was a bit bored.

A word on stereotypes

There are lots of mental images
and actual barriers
related to who can be an engineer
(and who should be in the kitchen).

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There are lots of mental images
and actual barriers
related to who can be an engineer
(and who should be in the kitchen).

I believe that everyone in this room can succeed as an engineer -
and make tasty food!

Office hours

OH are for many things:

- Getting help when your project doesn't work
- Talking through concepts that don't make sense yet
- Chatting about what is going well in the course
- Discussing different major and career options

Office hours are for everyone!

Some more logistics

Go read the learning guide!

Sign up for Piazza if you haven't yet - you should have an email invite

Intermission: Interview your partner

I'll be coming around to take pictures

Intermission: Interview your partner

Who is from the furthest away?

Who has the largest / most interesting pet?

Who has the most siblings?

Who has an interesting hobby?

Roadmap of the course

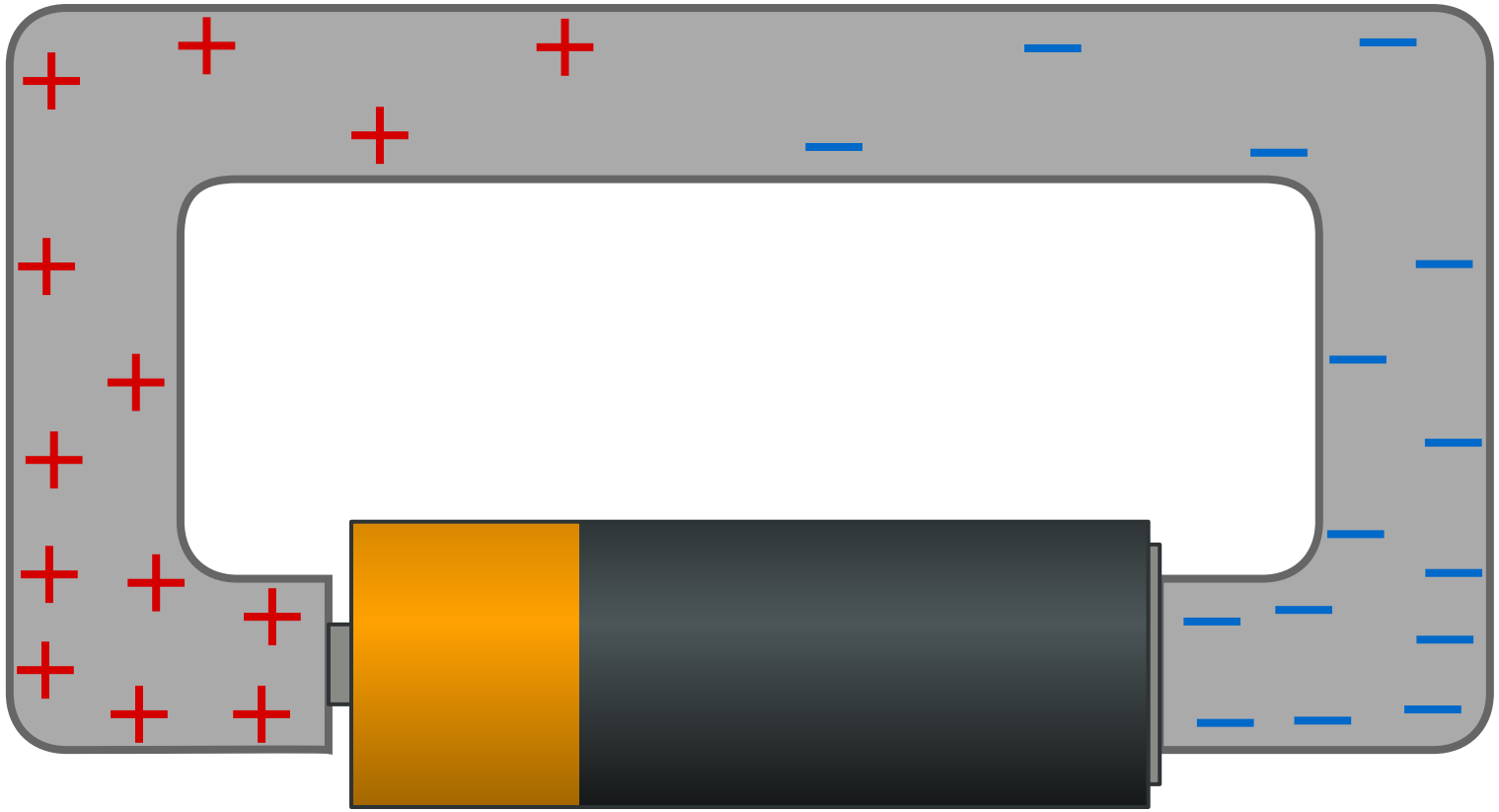
Circuit basics	→	Appliance disassembly
Python and microcontrollers	→	Microwave control panel
Sensing and controlling stuff with a microcontroller	→	Interactive pumpkins
Networking / IoT	→	Datalogging investigation
Other areas of ECE		Final project

By the end of class today, you should be able to:

- Explain what voltage and current are, and how they are different
- Explain what resistance is
- Use a digital multimeter (DMM) to measure voltage and resistance

What is voltage?

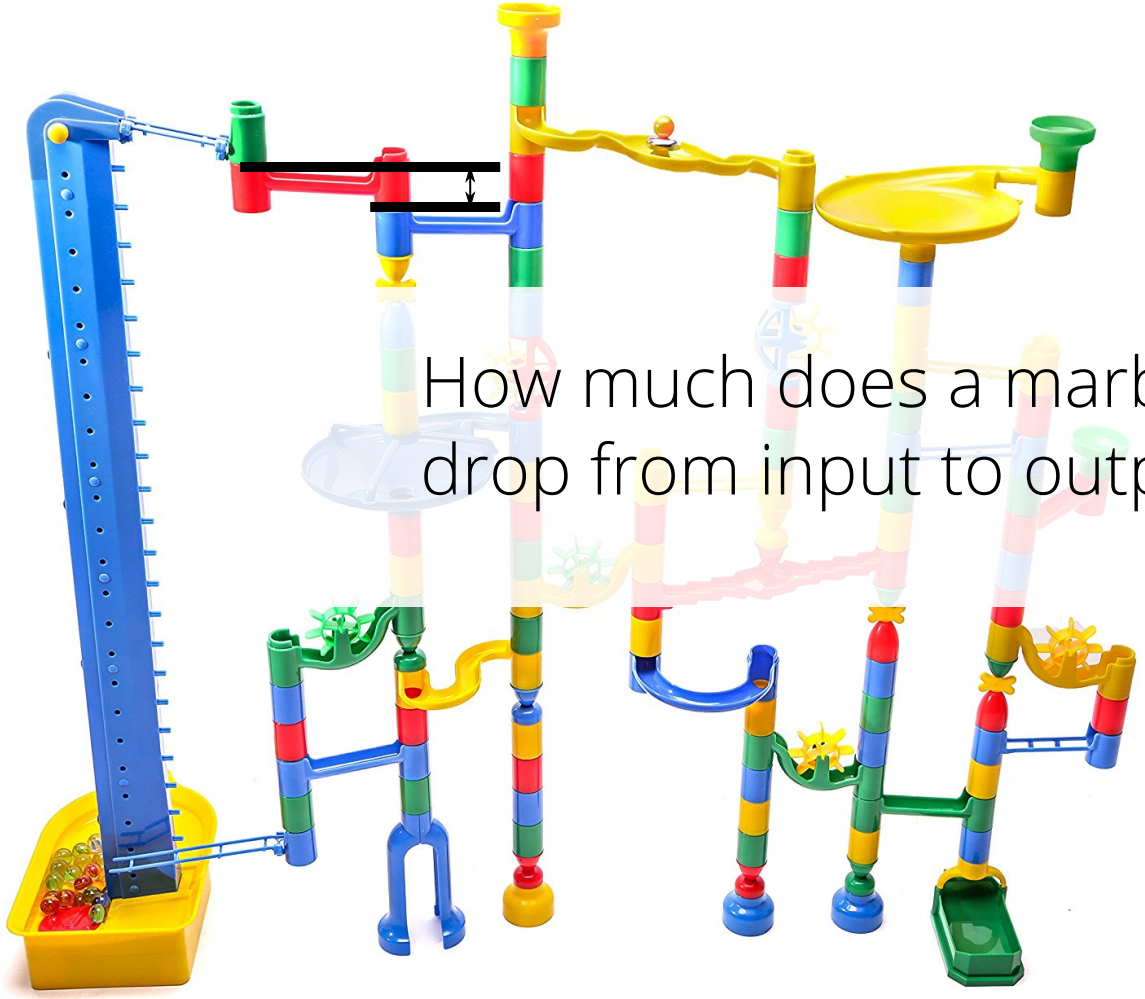
The amount of "push" electrons receive through a circuit



One way to think about a circuit:

Marbulous - amazon.com

Voltage in the marble machine



How much does a marble drop from input to output?

Marbulous - amazon.com

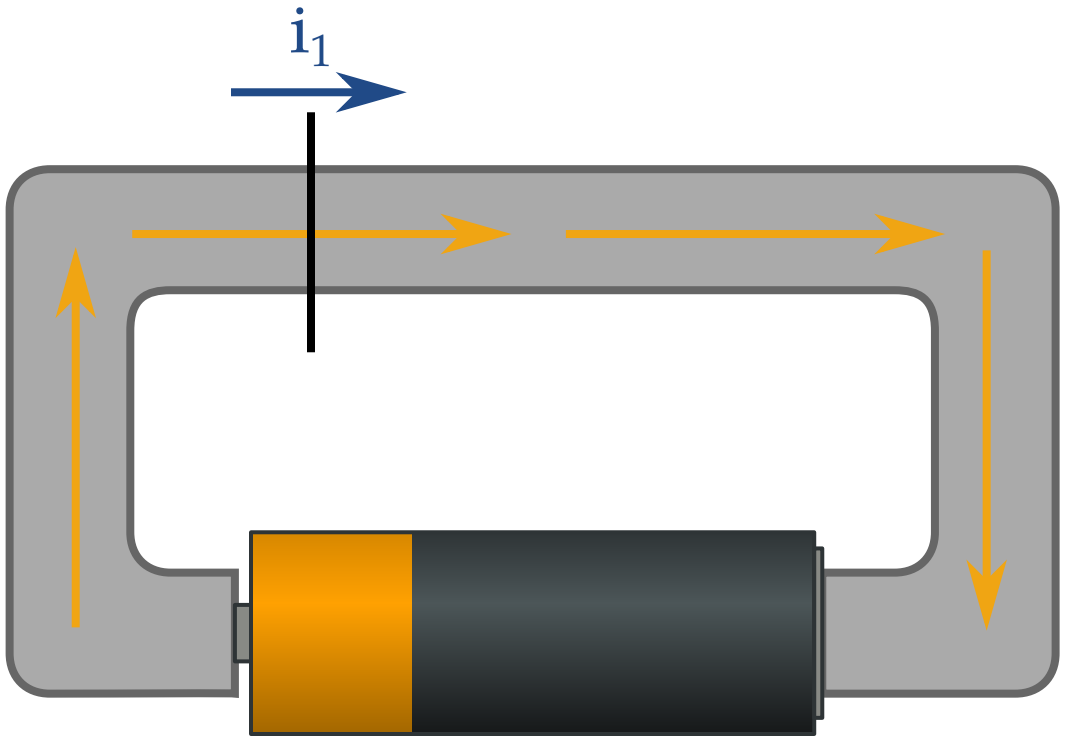
Another way to think about voltage

How hard the chain is being pulled through the circuit

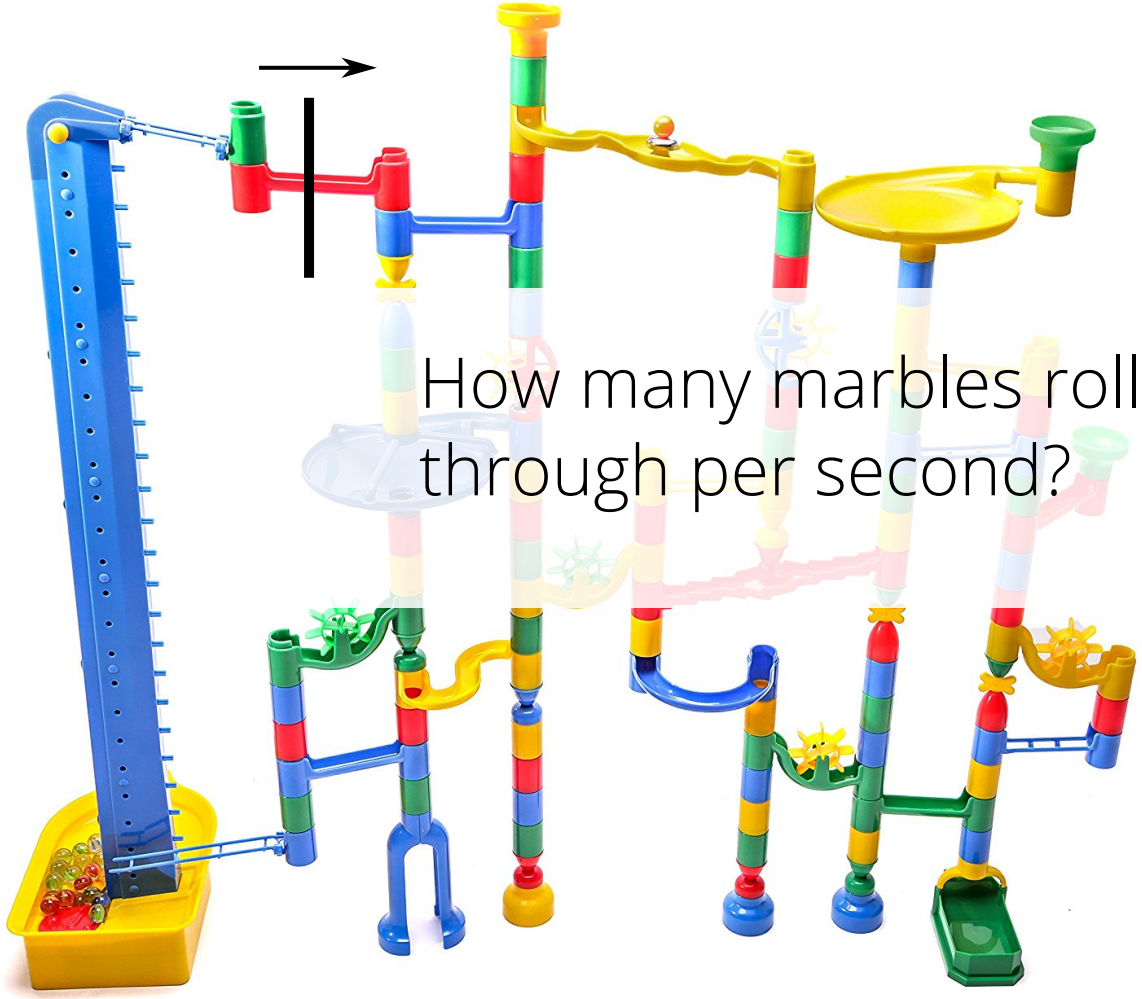
Current

Current is charge per second past a point

Measured in Coloumbs /second = **Amps**



Current in the marble machine



How many marbles roll through per second?

Marbulous - amazon.com

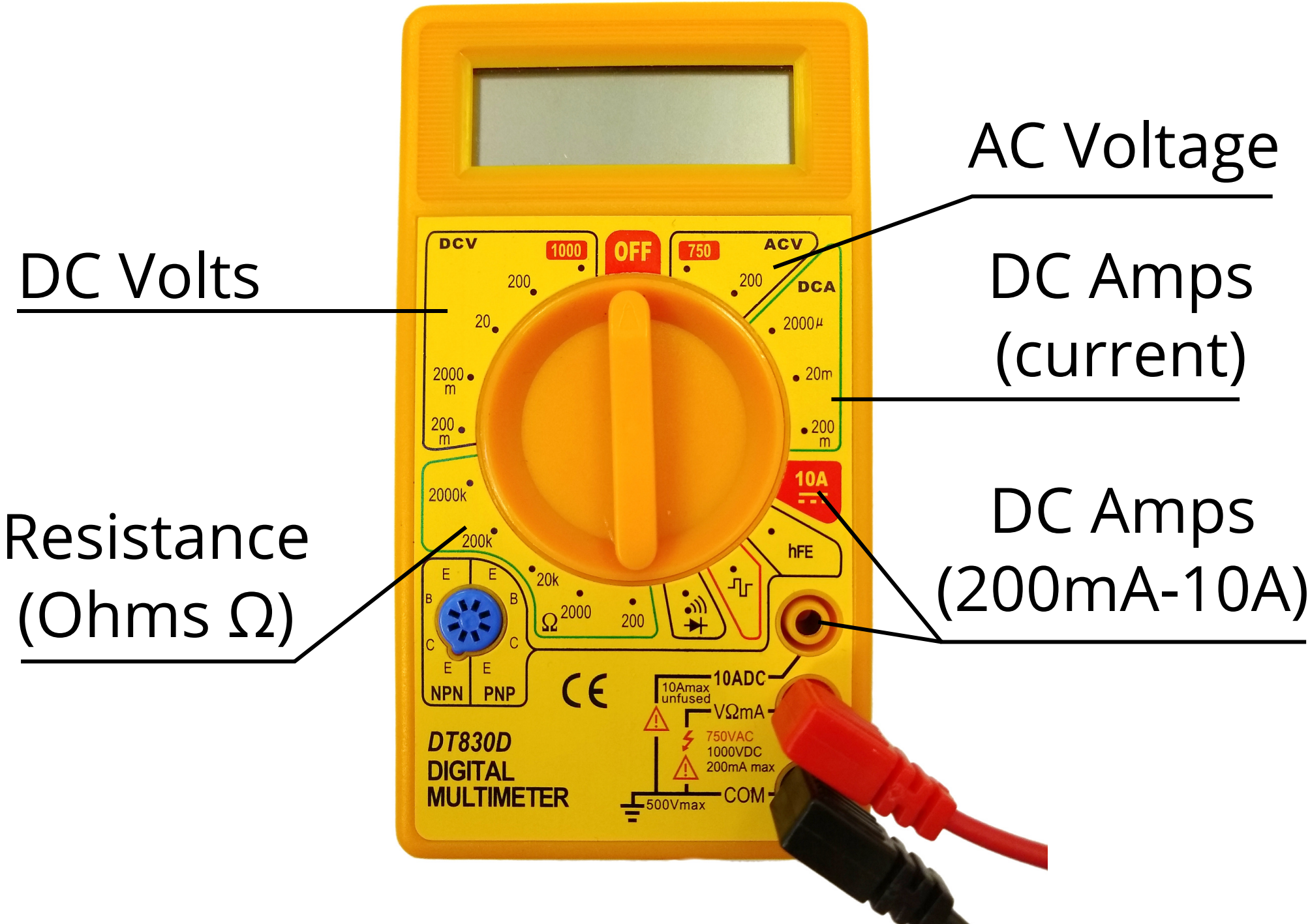
Current in Spintronics

How fast the chain is moving (i.e., links per second past a point)

In your own words...

Pair up with someone next to you, and describe the difference between voltage and current in your own words.

Respond at **pollev.com/stevenbell**


DC Volts
AC Voltage
DC Amps
(current)
Resistance
(Ohms Ω)
DC Amps
(200mA-10A)
DCV
1000
OFF
750
ACV
DCA
200
20
2000 m
200 m
2000μ
20m
200 m
2000k
200k
20k
2000
200
10A
hFE
NPN
PNP
10ADC
10Amax unfused
VΩmA
750VAC
1000VDC
200mA max
COM
500Vmax
DT830D
DIGITAL
MULTIMETER

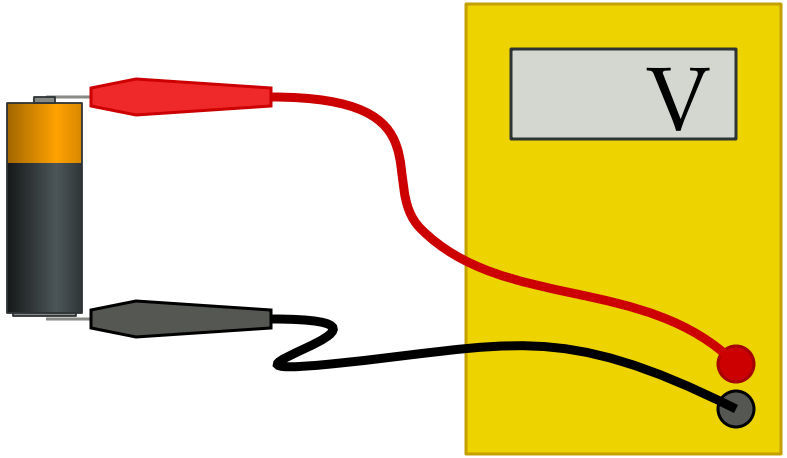
Measuring voltage

1) Pick an appropriate voltage scale

2) Put the **black** lead on the "**lower**" side

3) Put the **red** lead on the "**higher**" side

4) Read the result!



What happens if you use the wrong scale?

What happens if you swap the leads?

Why do you need two leads, anyway?

Marble-track resistor

From the fantastic engineering/woodworking site woodgears.ca

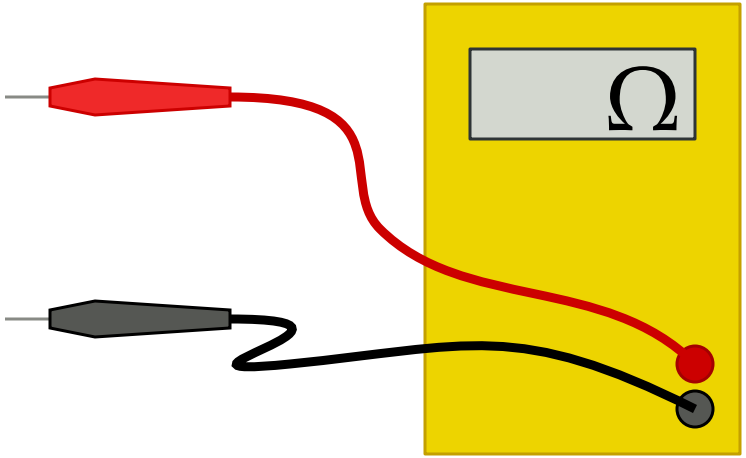
Measuring resistance

1) Pick an appropriate resistance scale

2) Put the **black** lead on one side

3) Put the **red** lead on the other side

4) Read the result!



What happens if you use the wrong scale?

What happens if you swap the leads?

Why do you need two leads, anyway?

What is one question you have after today's class?

Respond at **pollev.com/stevenbell**

For next Monday

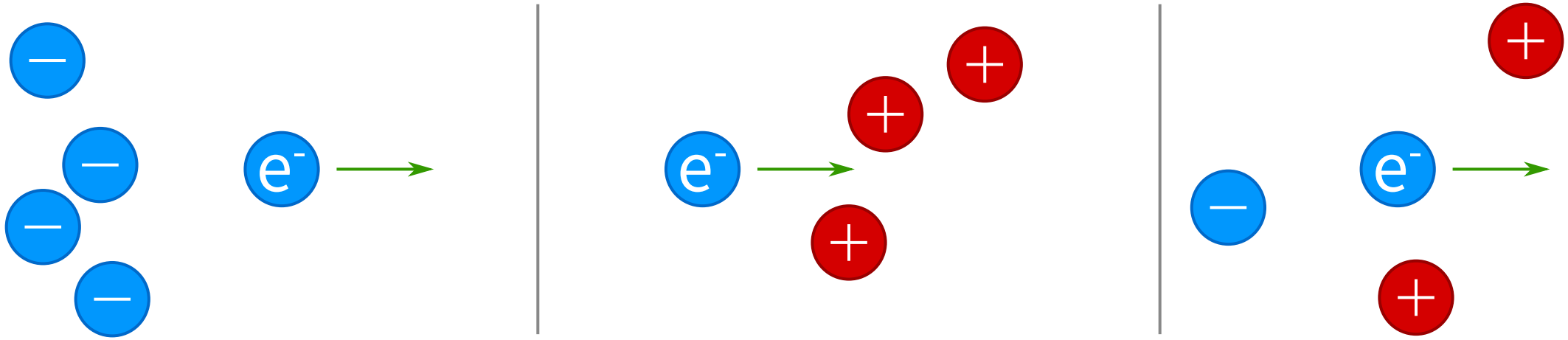
Read the learning guide

Complete the welcome survey (posted by Friday)

Bring your DMMs

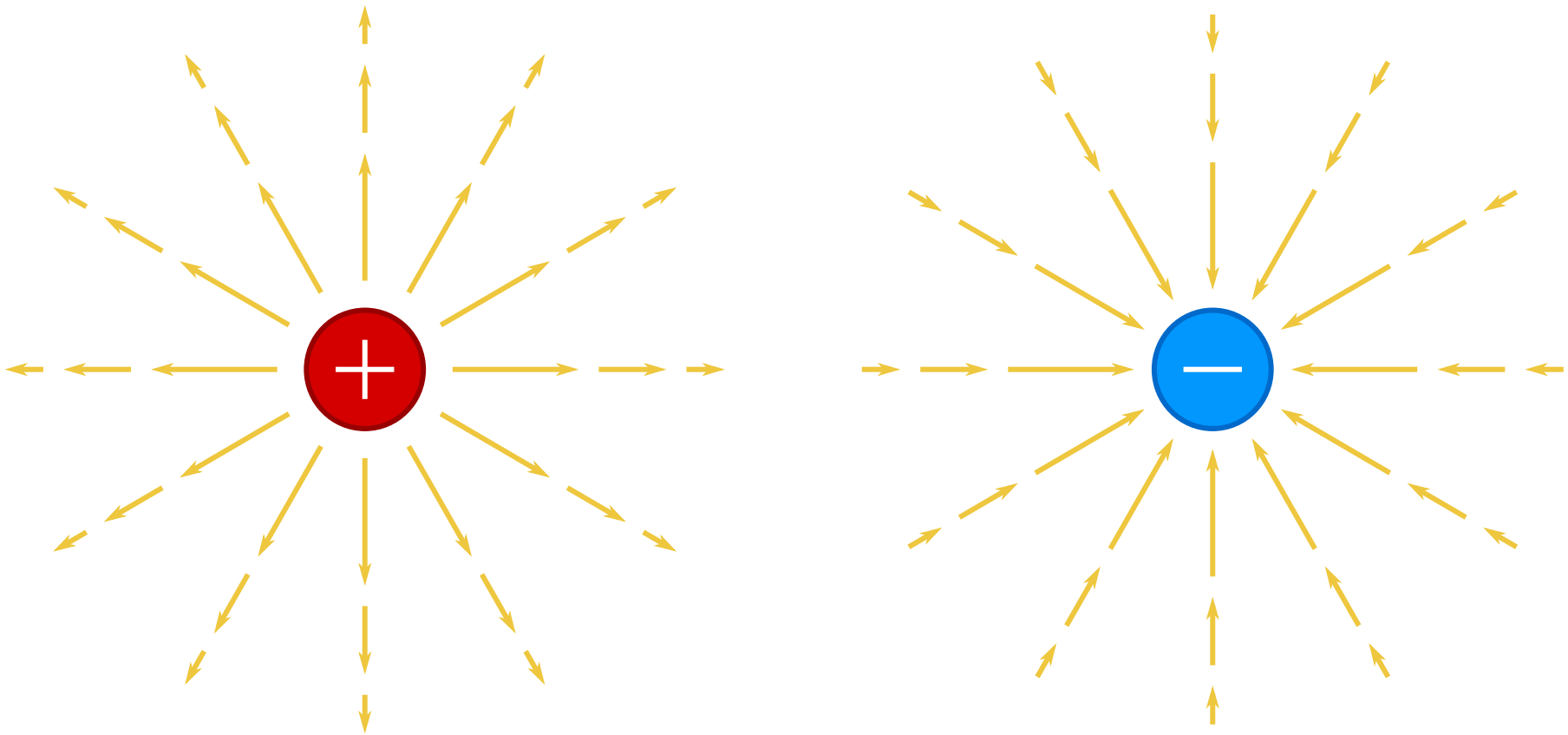
Bonus slides

Opposites attract



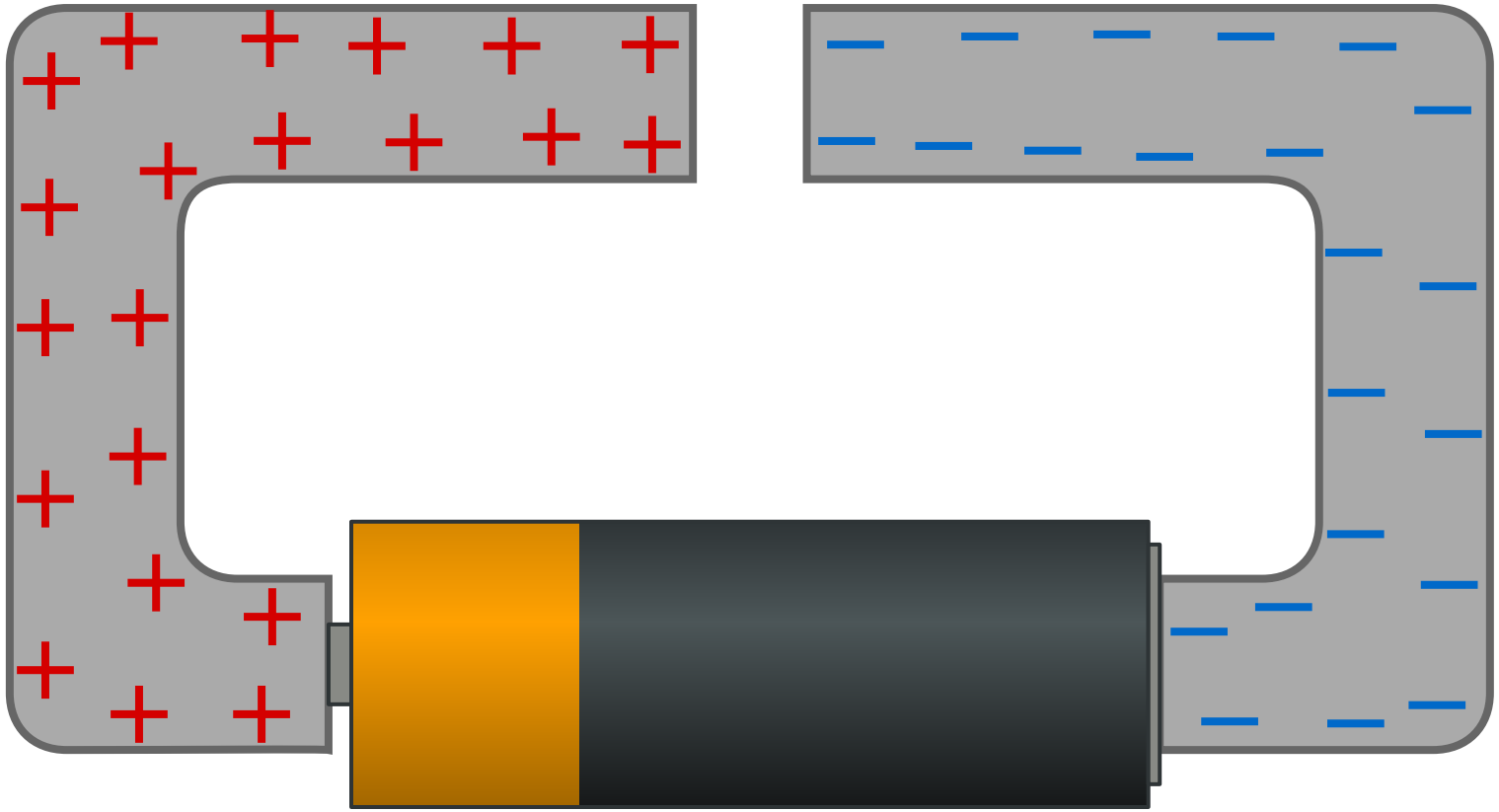
Electric field

Describes the force a *positive* charge will experience



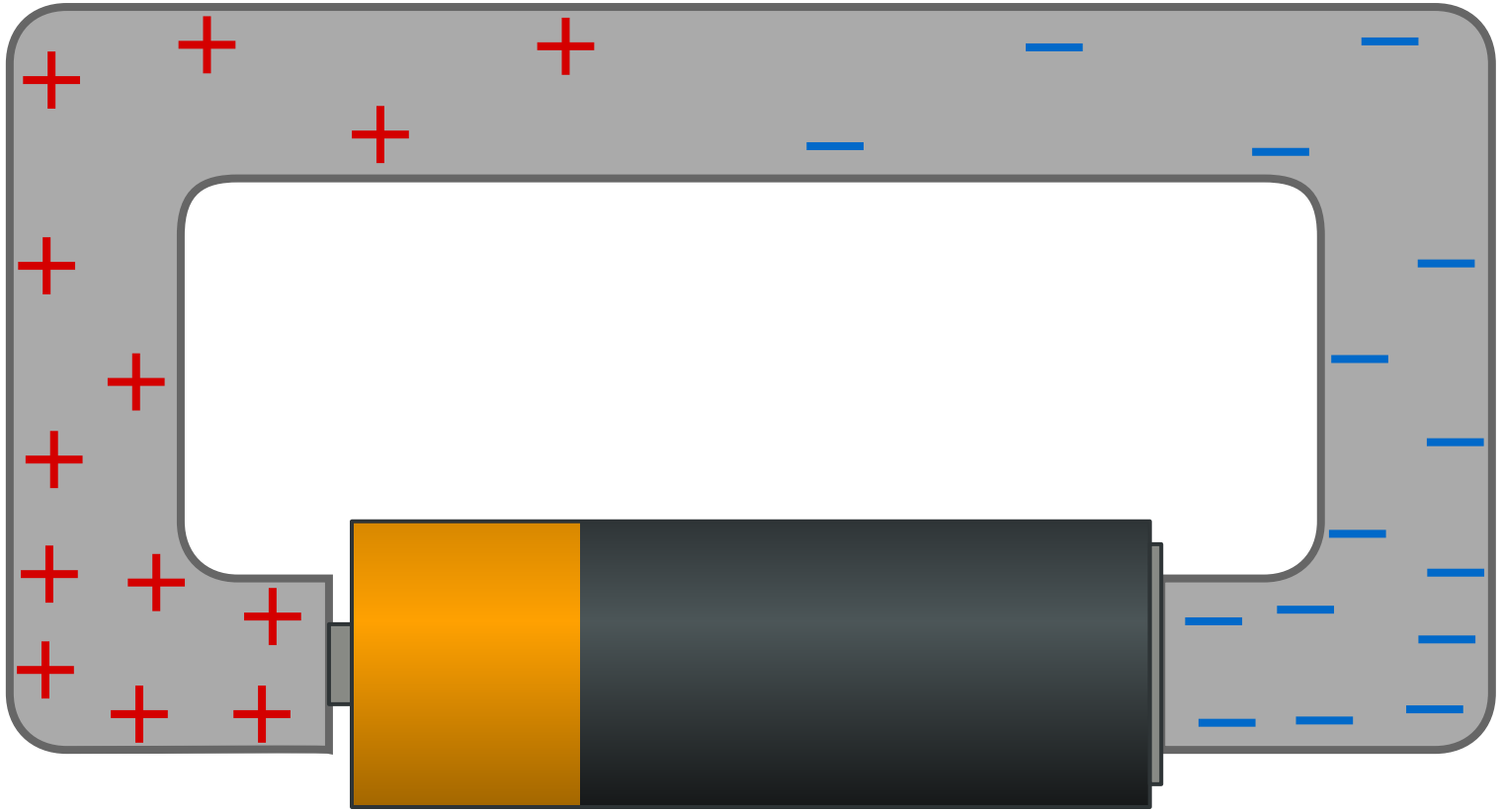
Batteries and wire

A chemical reaction produces charges, until it reaches equilibrium.



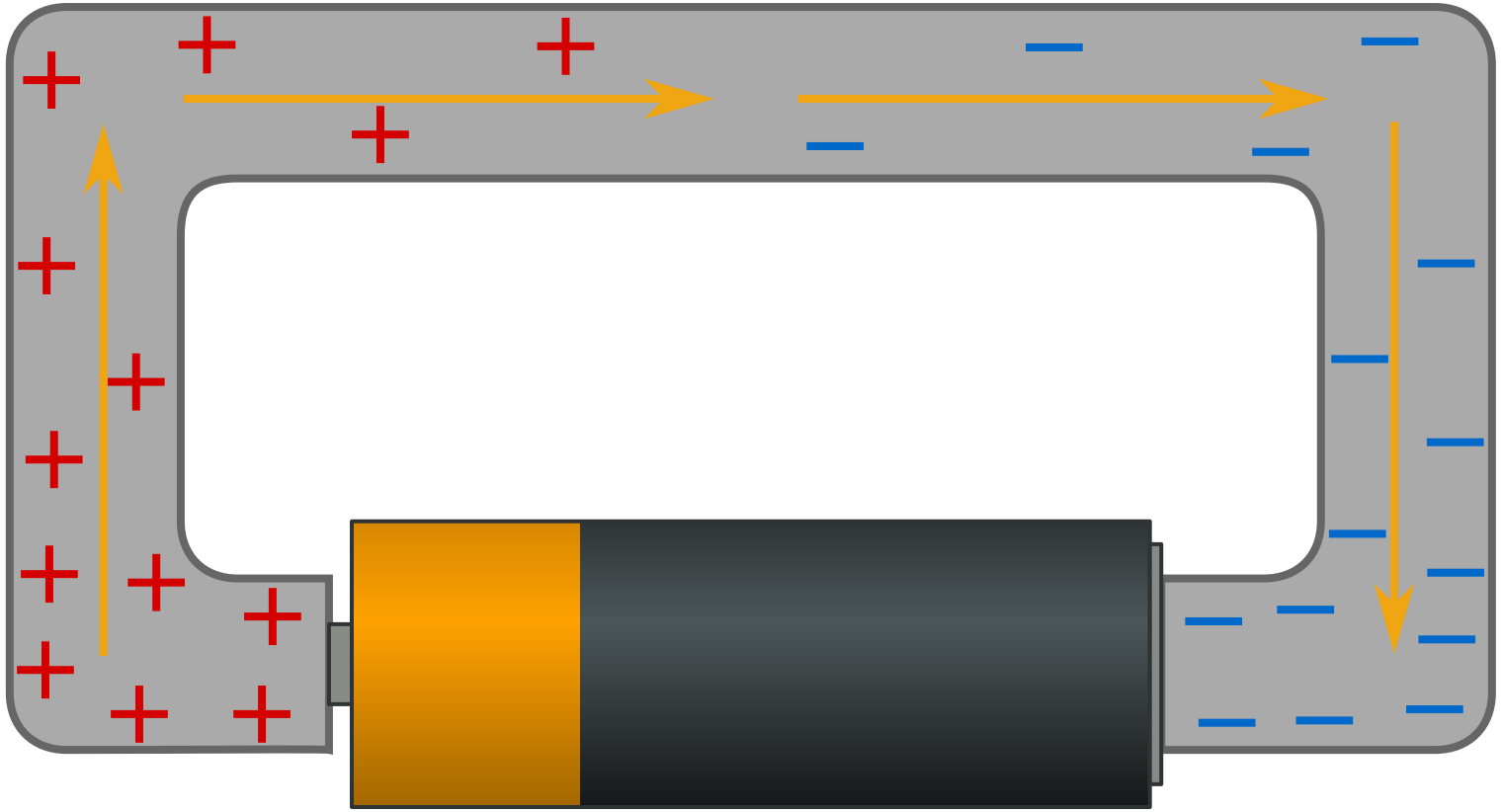
Connecting the wire

Charges cancel, but the battery produces more, setting up a new equilibrium.

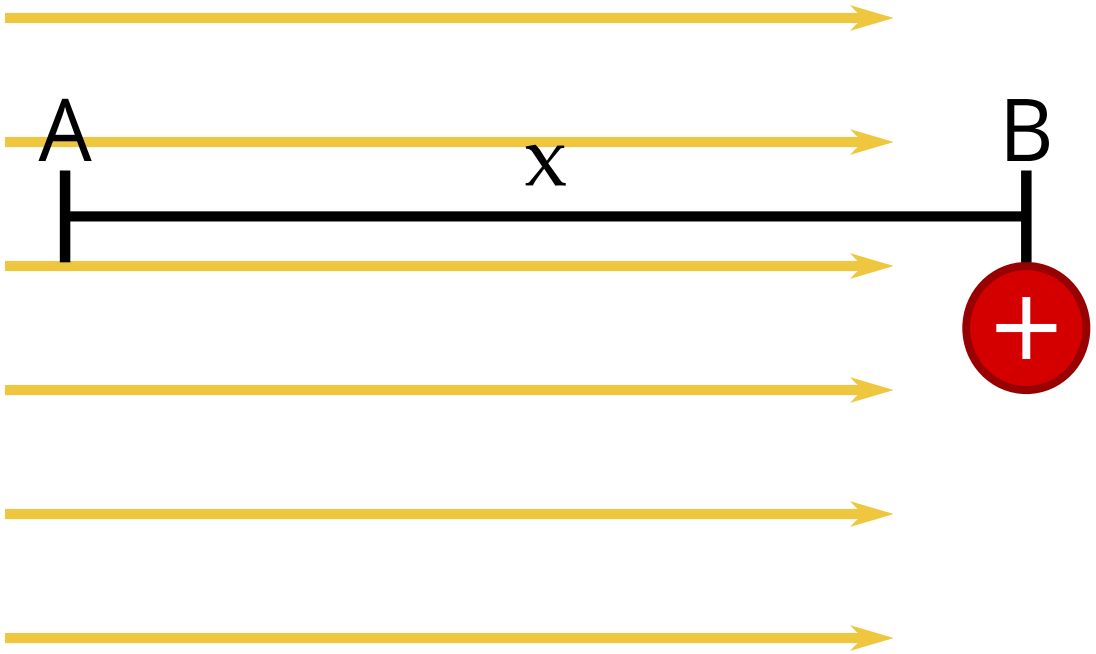


A field in the wire

The charge gradient produces an electric field,
which pushes current down the wire!



Work in an electric field



We say that A has **higher potential** than B,
because a positive charge will "fall" from A to B.
(and something would have to push it from B to A.)

Work in a wire

Voltage is difference in electrical potential

Measured in Joules/Coulomb = **Volts**