EECS16A Imaging 1

Insert your names here

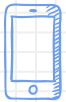
IMPORTANT: LAB CAPACITY

- Only students enrolled in this lab section should be present here

- If you **lie** about being enrolled in this section, you will be **REMOVED** from the course
  - Please be ready to show either CalCentral enrollment or an email confirming a switch.

Semester Outline

Imaging Module



Touchscreen Module

Locationing Module

Why Imaging?

- Use linear algebra techniques to capture real world images with limited sensors
- Today:
  - Finding a link between physical quantities and voltage
  - If you can digitize it, you can do anything (IOT devices, internet, code, processing)

Today's Lab: Imaging Part 1

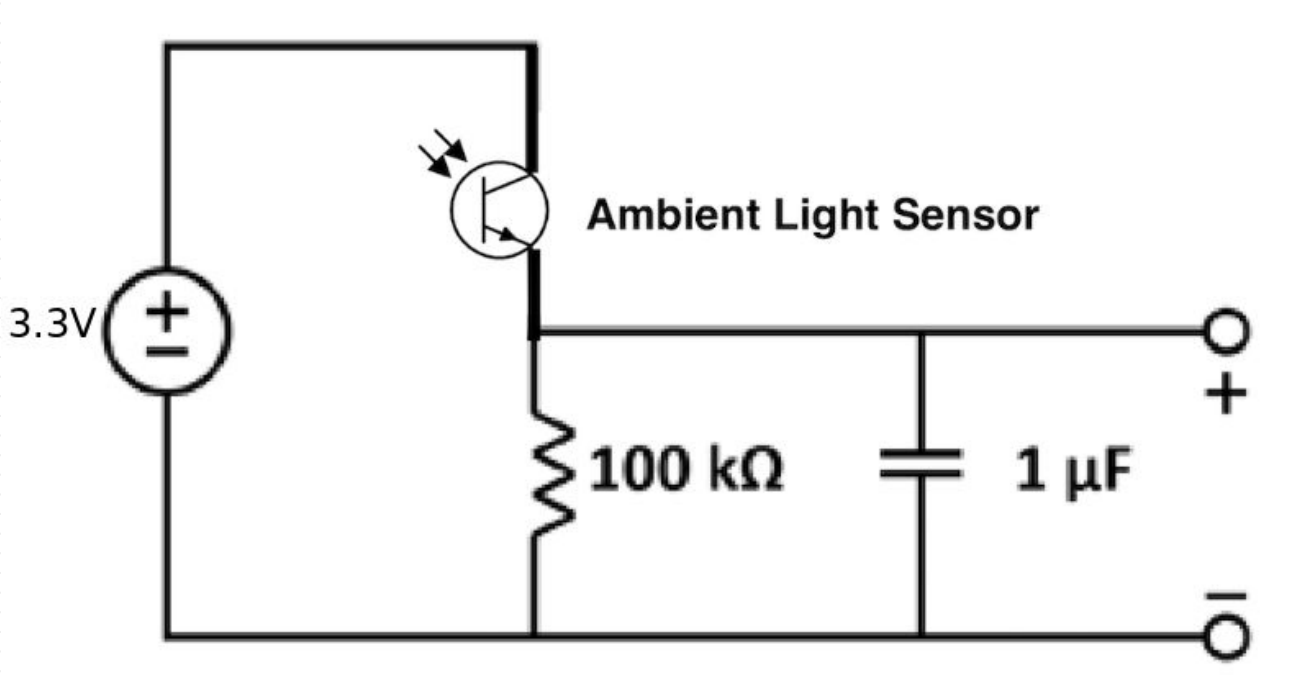
- You should have received lab materials (TI MSP430F5529 + lab kit)
- Circuits + Breadboarding 101
- Build circuit that reacts to light intensity
  - Use Launchpad/TinkerCAD to see how the circuit behaves
- Graded checkoff starts today!
- If you haven't received your lab kit yet, you can still do today's lab and get checked off

Today's Lab: Imaging Part 1

- Hardware lab
  - Uses physical Launchpad and breadboard
  - All students with kits should do this option

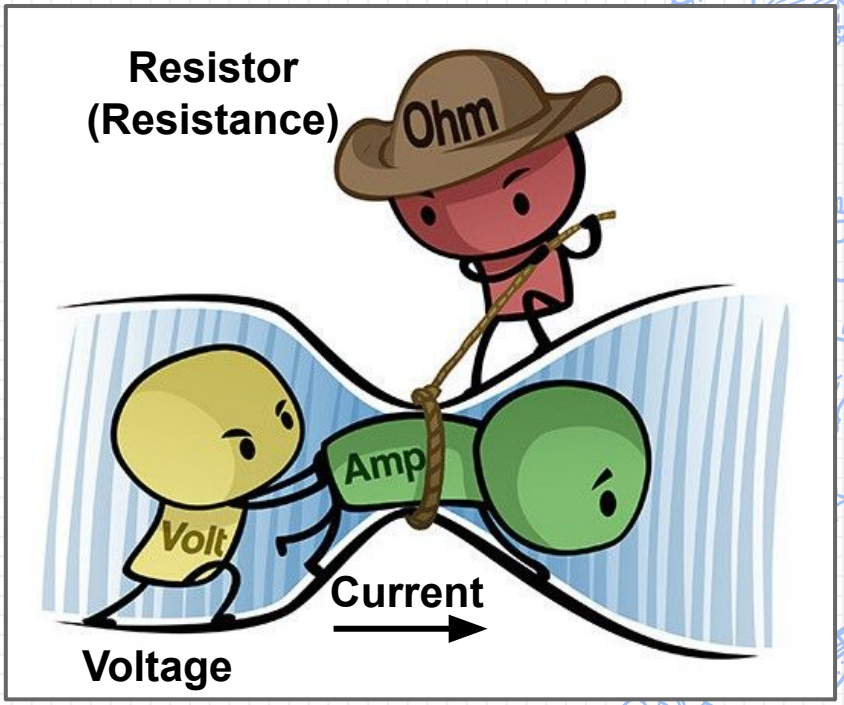
- Software lab
  - Uses online circuit simulations in TinkerCad
  - Look at other group members' physical setups and lab videos to get an idea of the hardware
  - All students without kits should do this option

Our circuit



A Little Physics: Voltage, Current, and Resistors

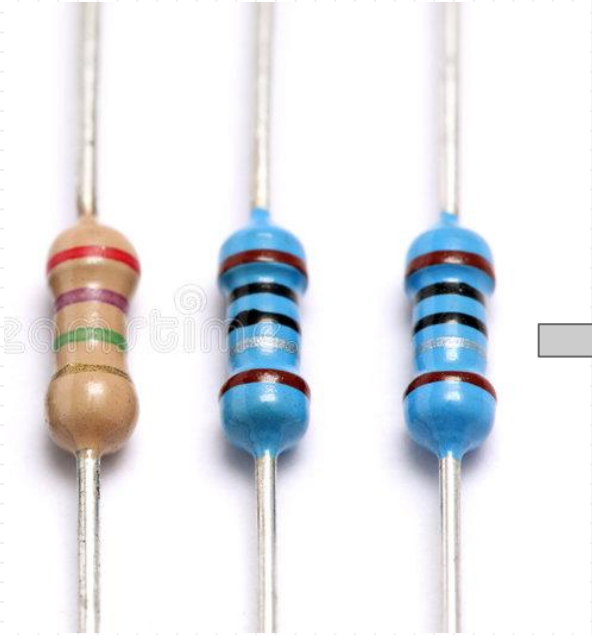
- **Voltage [Volts]** - pushes charge through circuit
- **Current [Amps]** - flow of charge through circuit
  - 1 Amp = 1 charge per second
- **Resistor [Ohms]** - circuit component that resists the flow of charge through circuit

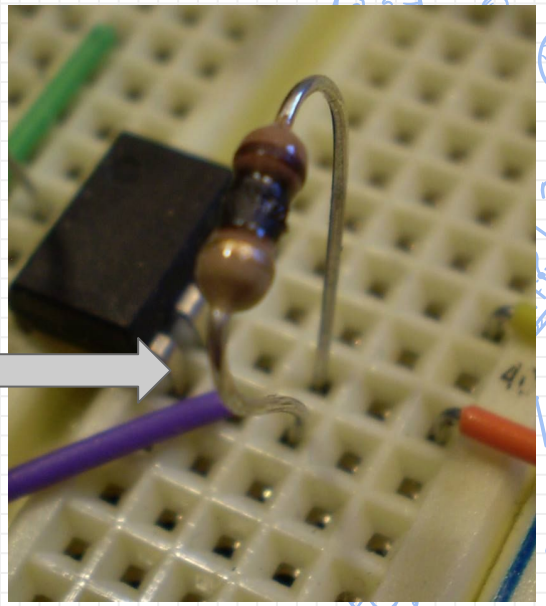


Simple Circuit: The Tools™

- Components
  - Resistors
  - Capacitors
  - Voltage Source
- Wires / Jumpers [male-to-male vs male-to-female]

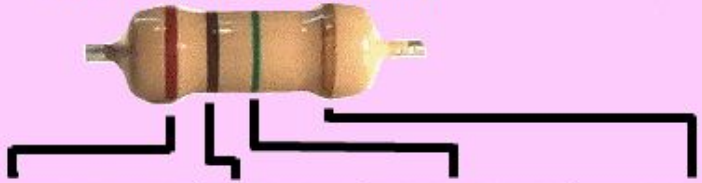
What's in your circuit? : Resistors





What's on your circuit? : Resistors

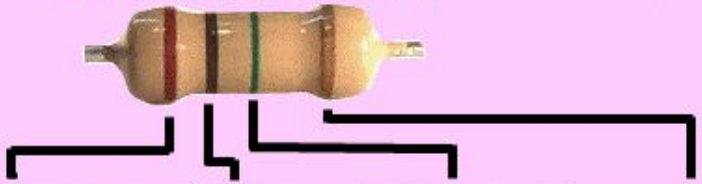
4 Band Resistor Color Coding



COLOR	1ST BAND	2ND BAND	MULTIPLIER	TOLERANCE
BLACK	0	0	x1Ω	
BROWN	1	1	x10Ω	±1%
RED	2	2	x100Ω	±2%
ORANGE	3	3	x1000Ω	
YELLOW	4	4	x10000Ω	
GREEN	5	5	x100000Ω	±0.5%
BLUE	6	6	x1000000Ω	±0.25
VIOLET	7	7	x10000000Ω	±0.10
GREY	8	8		±0.05
WHITE	9	9		
GOLD			0.1	±5%
SILVER			0.01	±10%

Poll Time! What color is a 100 ohm resistor?

4 Band Resistor Color Coding



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ORANGE	3	3	x1000Ω	
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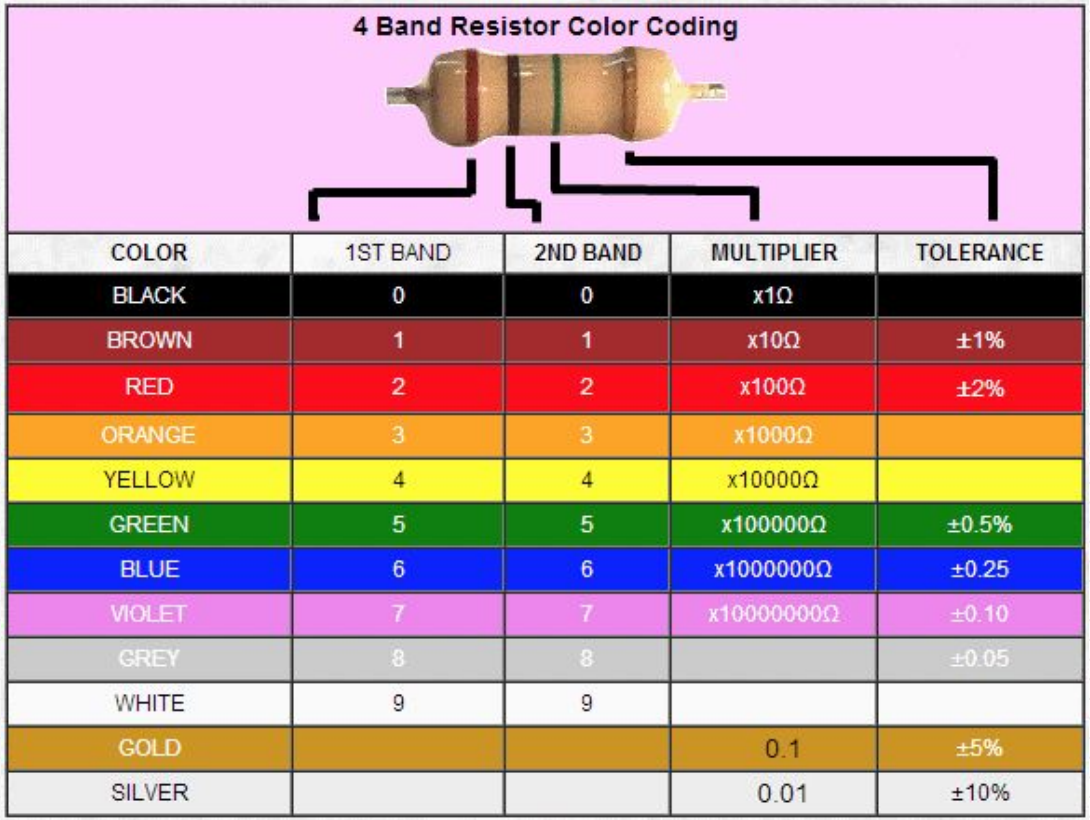
GREEN	5	5	x100000Ω	±0.5%
BLUE	6	6	x1000000Ω	±0.25
VIOLET	7	7	x10000000Ω	±0.10
GREY	8	8		±0.05
WHITE	9	9		
GOLD			0.1	±5%
SILVER			0.01	±10%

1. black-brown-red
2. brown-black-brown
3. brown-black-red
4. brown-black-black

Poll Time! What color is a 100 ohm resistor?



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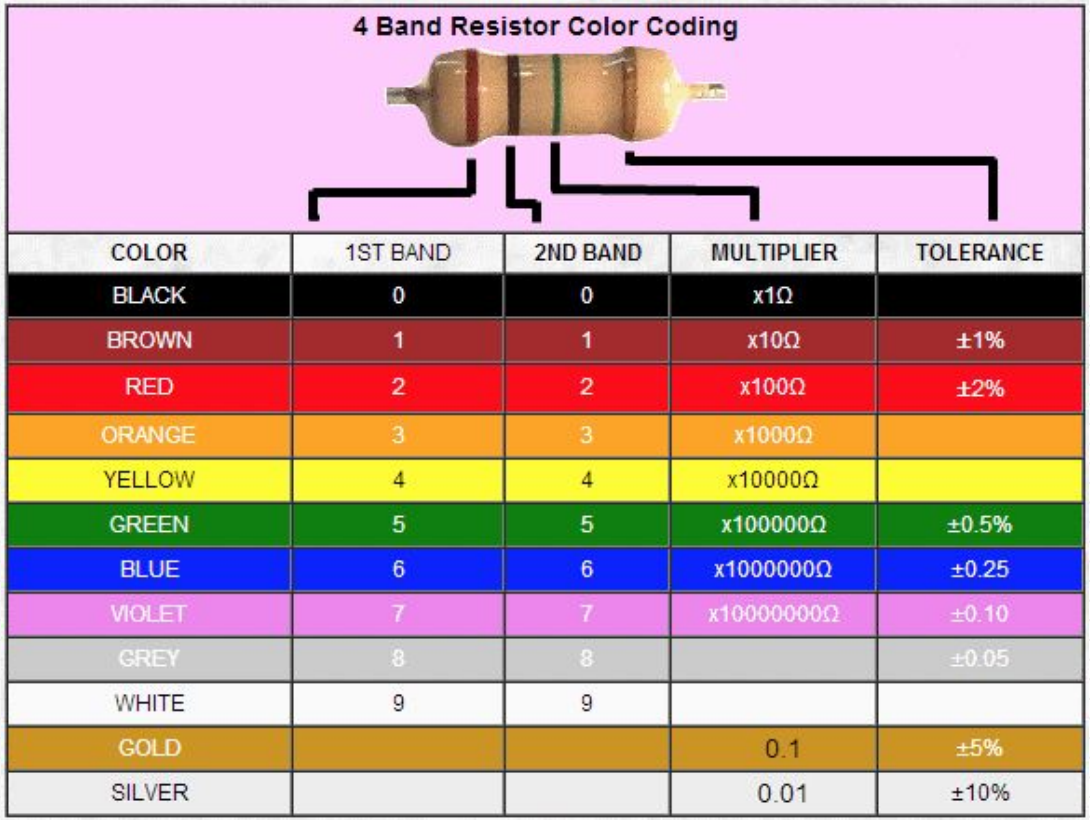
1. black-brown-red
2. **brown-black-brown**
3. brown-black-red
4. brown-black-black

Poll Time! What color is a 100K resistor? (100 kilo-ohms, so 100,000 ohms)



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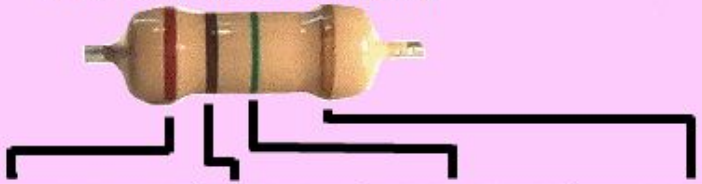
1. brown-black-red
2. brown-black-brown
3. brown-black-yellow
4. brown-black-white

Poll Time! What color is a 100K resistor? (100 kilo-ohms, so 100,000 ohms)

4 Band Resistor Color Coding



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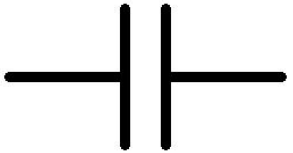
1. brown-black-red
2. brown-black-brown
3. **brown-black-yellow**
4. brown-black-white

Ambient Light Sensor

It’s a type of resistor and the current passing through it depends on how much light there is around it!

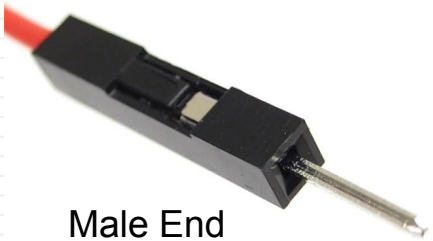
Direction matters!

Equipment for Today: Capacitors

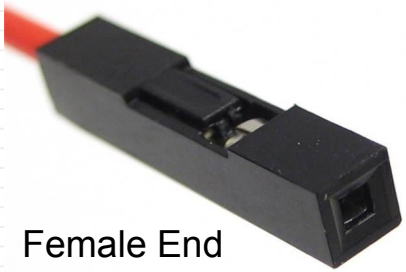


They store your charge!
Called capacitors because they have a set capacity (in Farads)

Equipment for Today: Wires/Jumpers



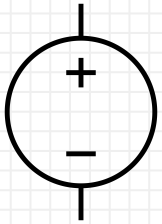
Male End

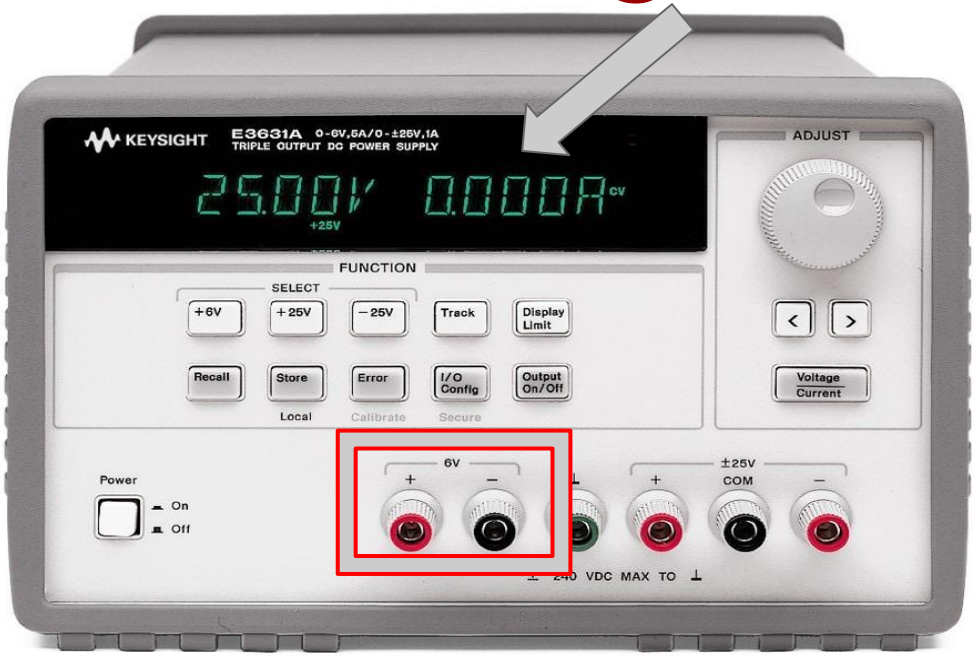


Female End

Equipment for Today: Voltage Source

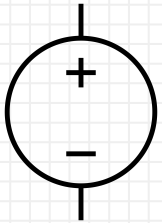
IMPORTANT: Always keep current limited @ 0.1 A limit

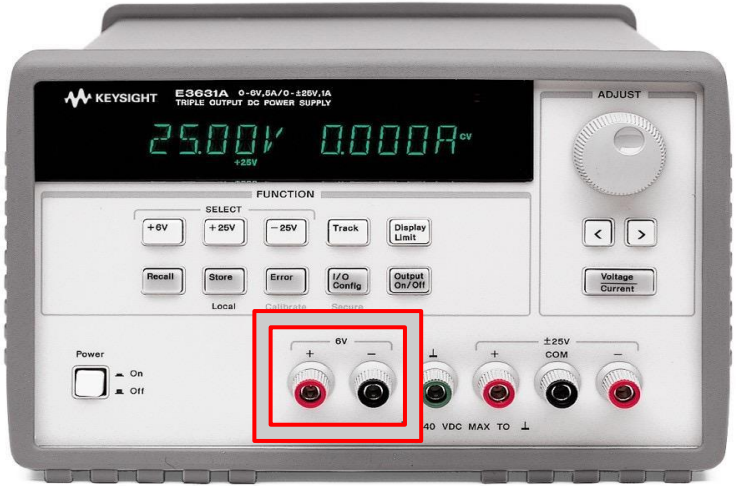




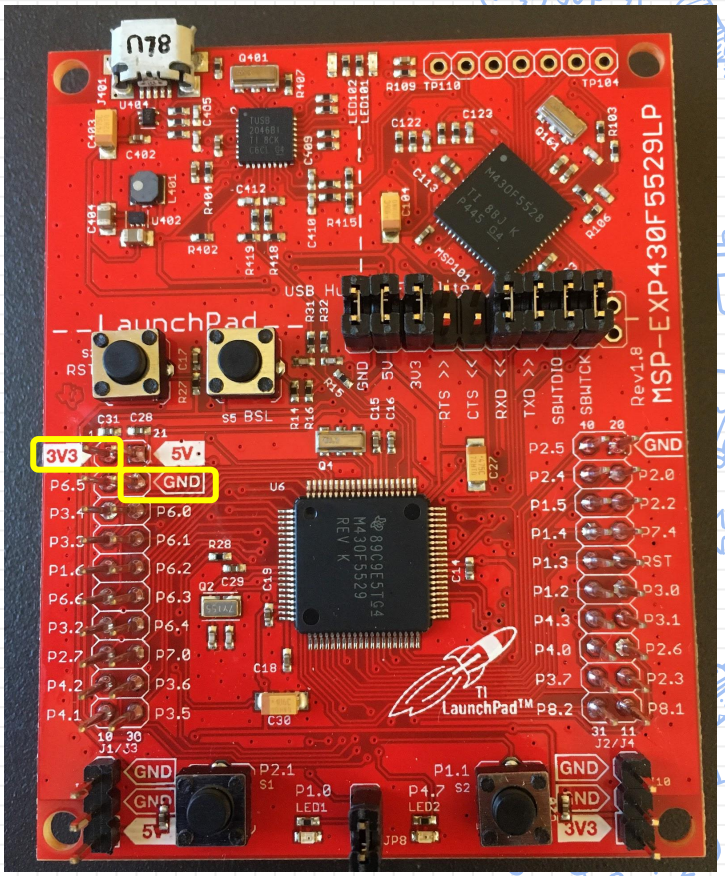
PSU cables are hanging on back wall

Equipment for Today: Voltage Source





Power Supply Unit (PSU)



We will be using the LaunchPad instead of the PSU as our voltage source. The 3V3 and GND pins on the LaunchPad are the + and - terminals of the voltage source respectively

Simple Circuit: The Theory

- Components
- Nodes
  - Point in circuit where circuit elements meet
  - Wire between components are considered part of one node
- We know you don’t know much about circuits yet; we’ve given you very detailed instructions on how to build the circuit in the lab

Simple Circuit: The Theory™

- Components (Resistors, LEDs, Capacitors)
- Nodes
  - Point in circuit where circuit elements meet
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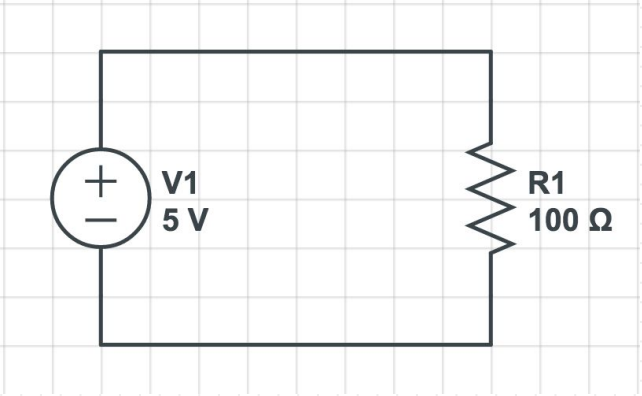

What components?

How many nodes?

Where are these nodes?

Simple Circuit: The Theory™

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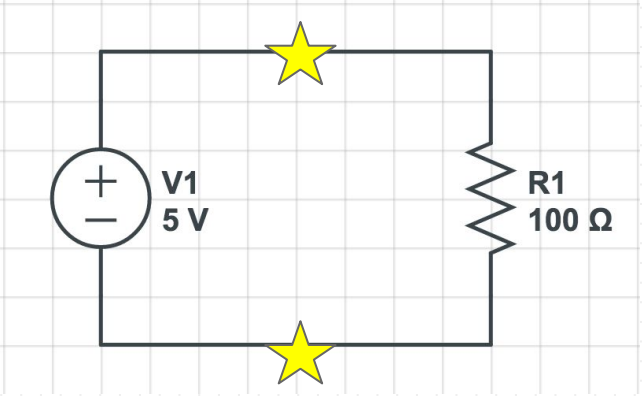

What components?

Voltage source, resistor

How many nodes? **2**

Where are these nodes?

Simple Circuit: The Theory™

- Components (Resistors, LEDs, Capacitors)
- Nodes
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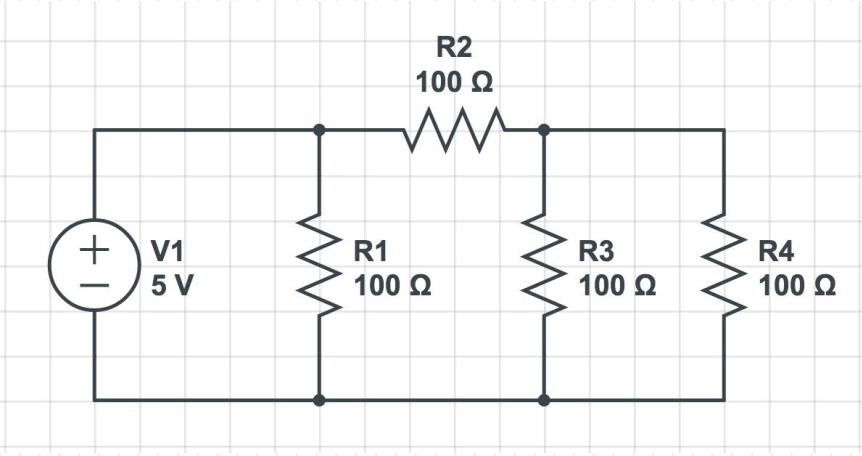


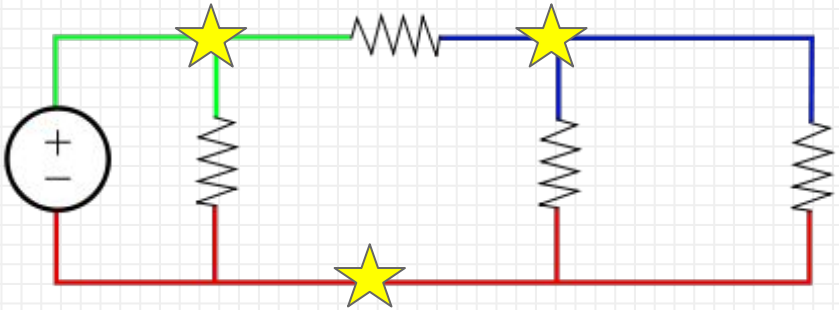
What components?

How many nodes?

Where are these nodes?

Simple Circuit: The Theory™

- Components (Resistors, LEDs, Capacitors)
- Nodes
  - Point in circuit where circuit elements meet
  - Wire between components are considered part of one node

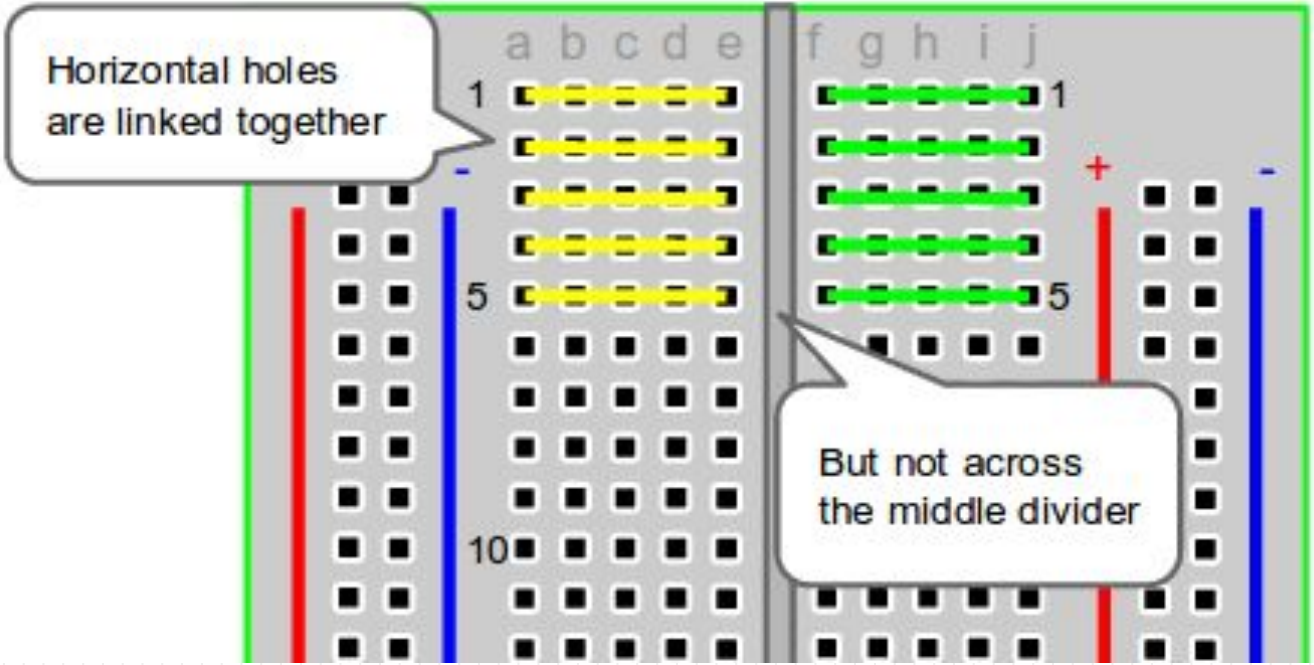


What components? **Same**

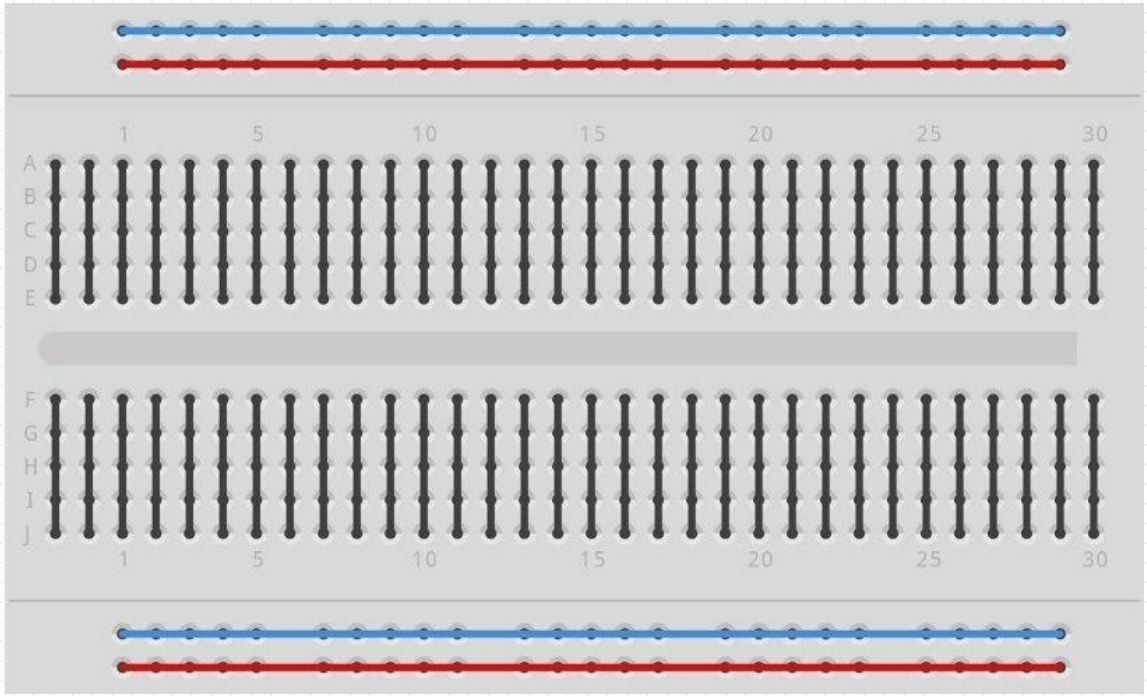
How many nodes? **3**

Where are these nodes?

Breadboard

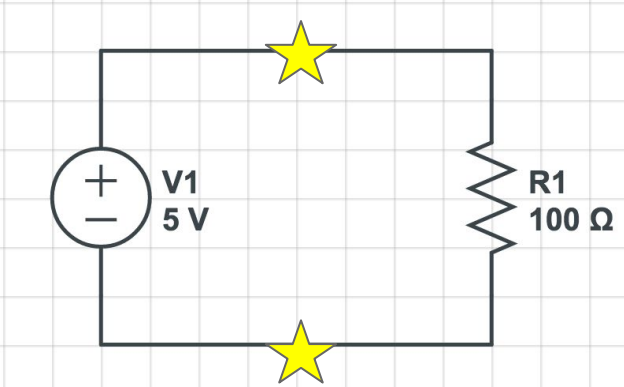

Horizontal holes
are linked together
a b c d e
f g h i j
1
5
10
1
5
+
-
-
But not across
the middle divider

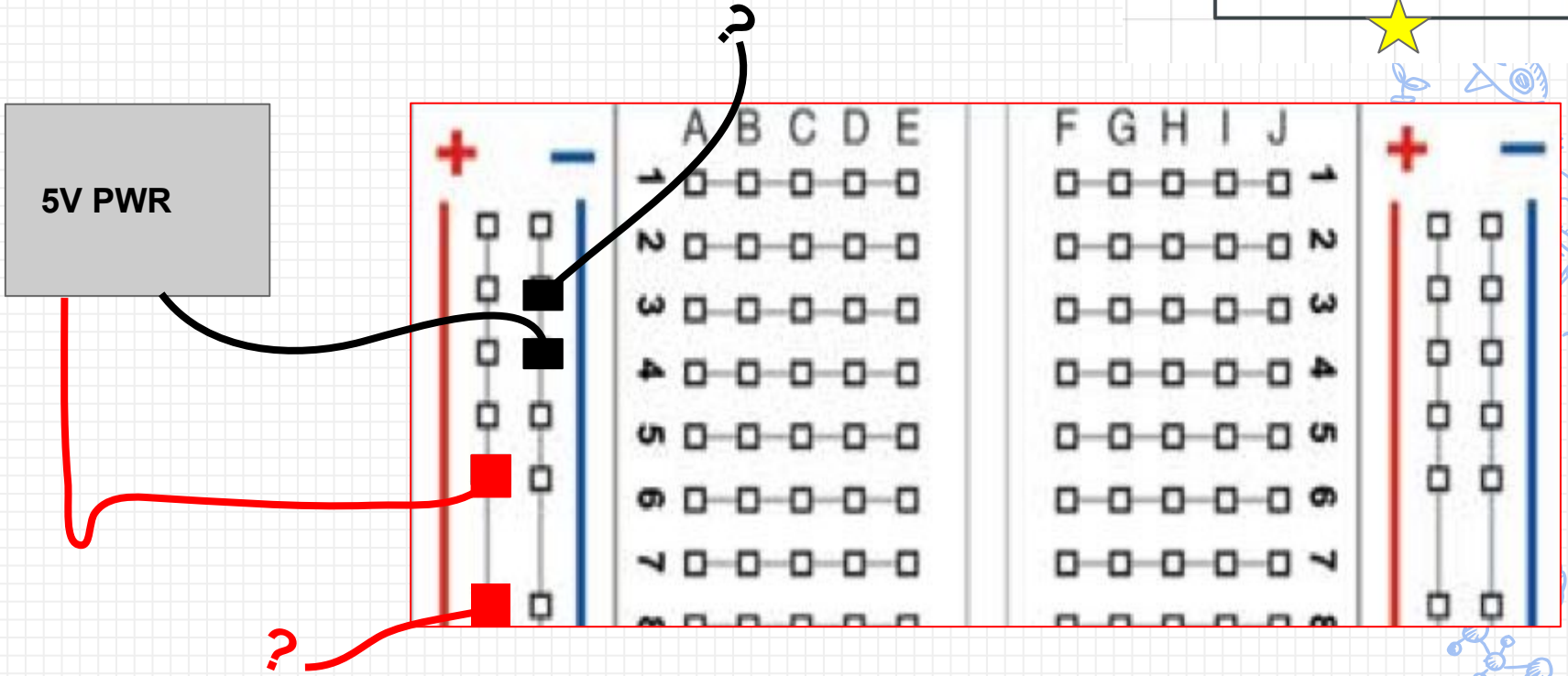
Breadboard



Breadboard Do's and Don't's

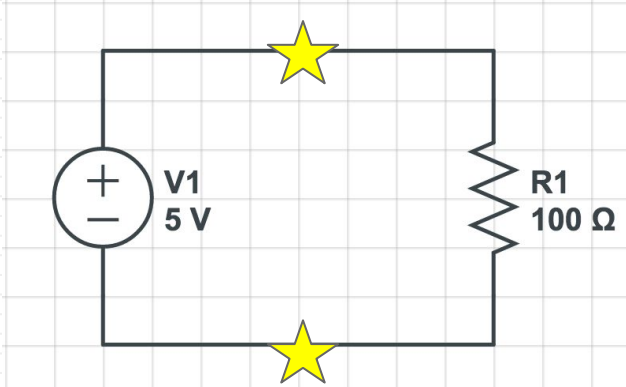
How do we make this circuit? →

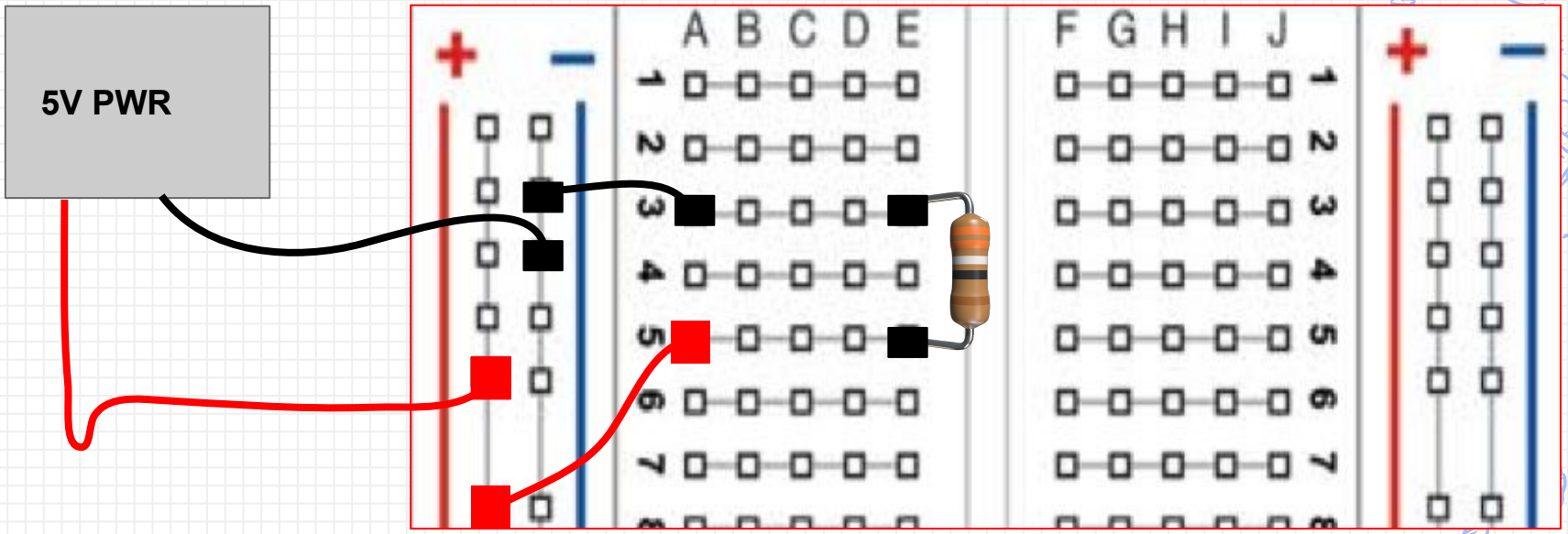




Breadboard Do's and Don't's

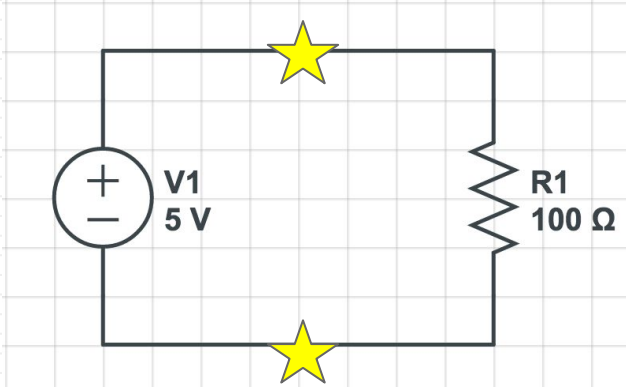
✓ **Do** plug component's ends into two different rows - separate nodes

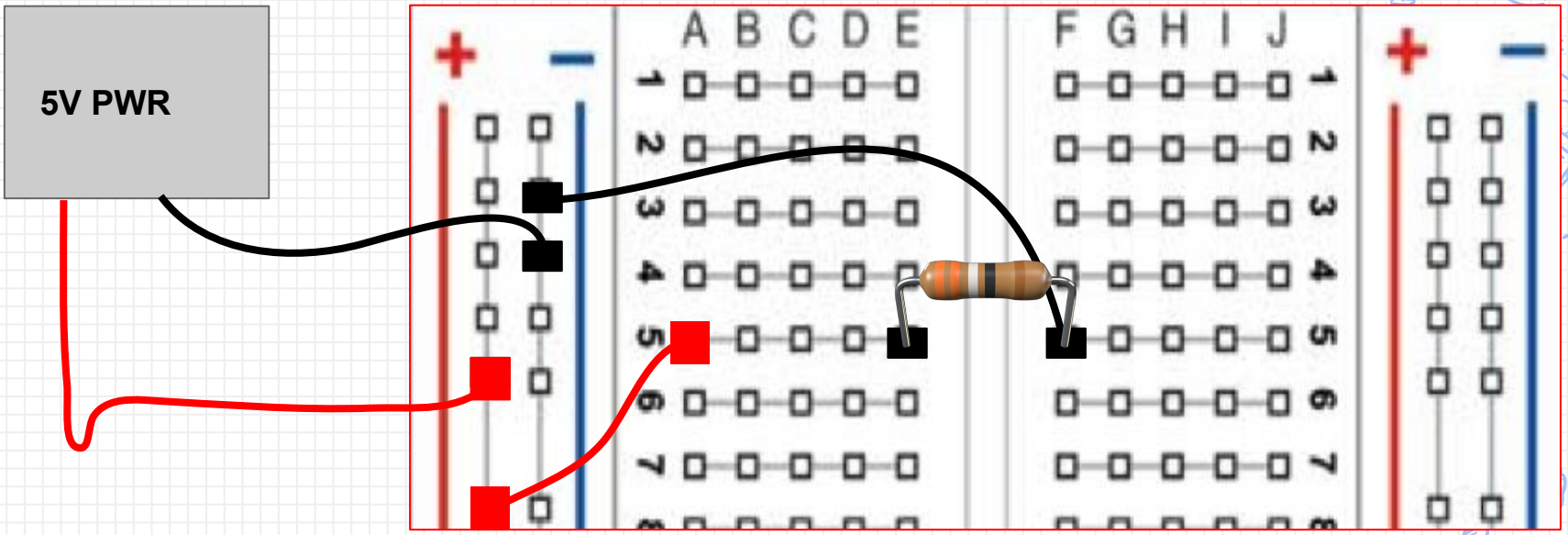




Breadboard Do's and Don't's

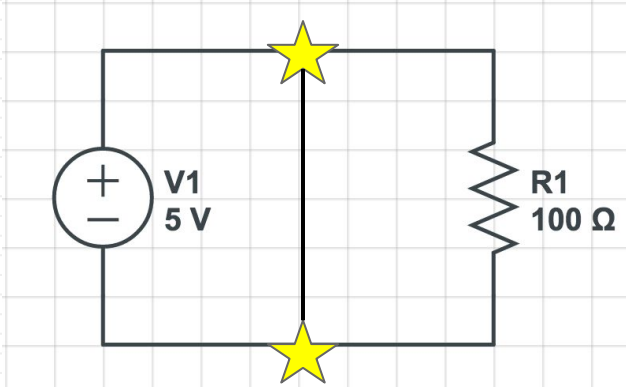
✓ **Do** plug components across the gap in your breadboard - A-E and F-J are separate

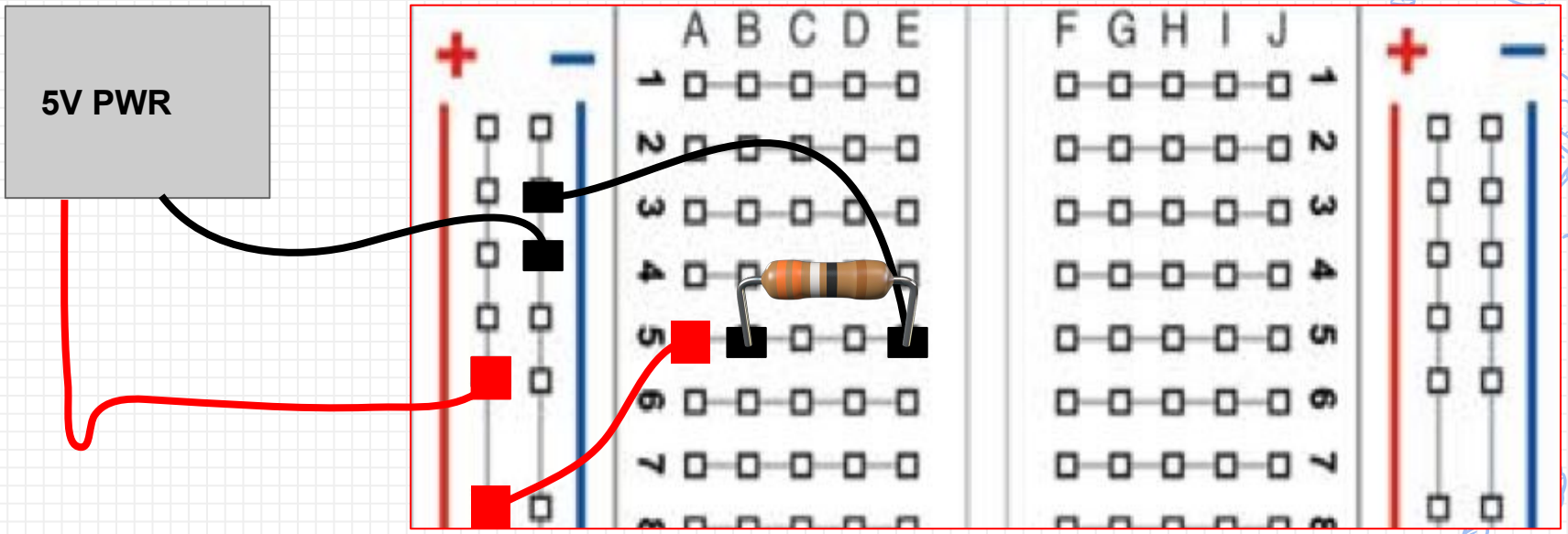




Breadboard Do's and Don't's

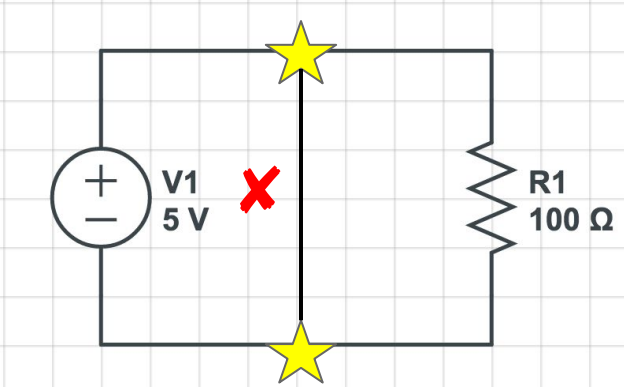
Is this okay? If there is an error, where?

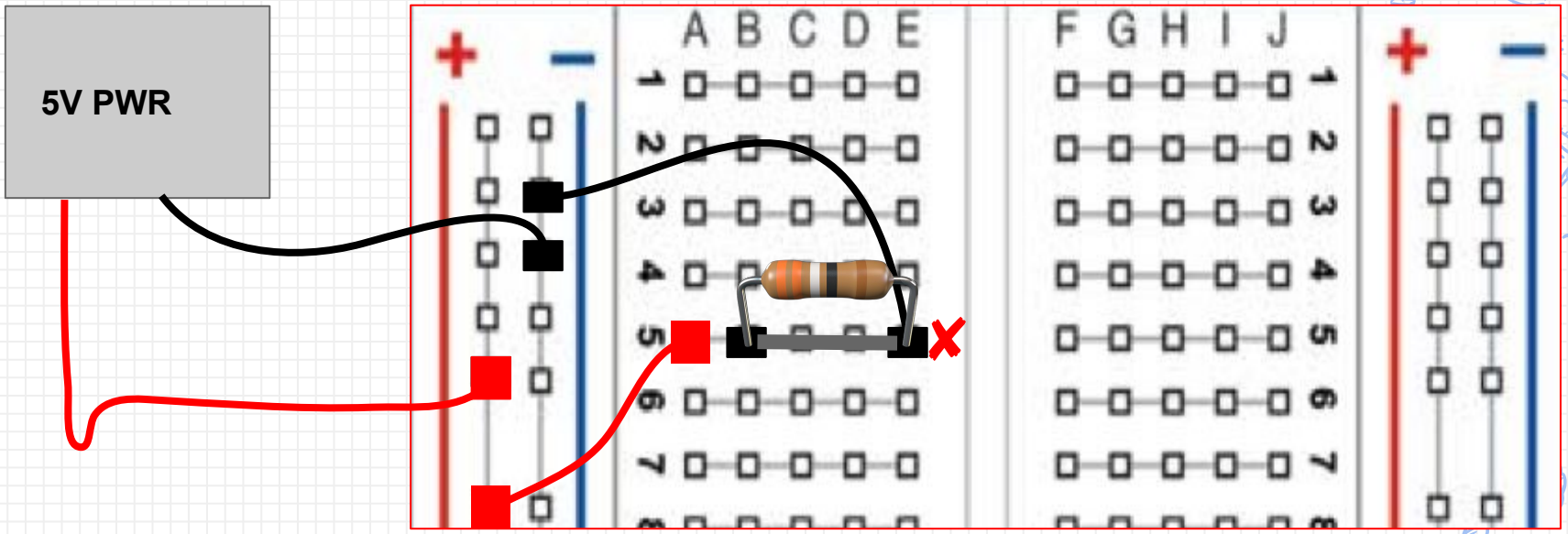




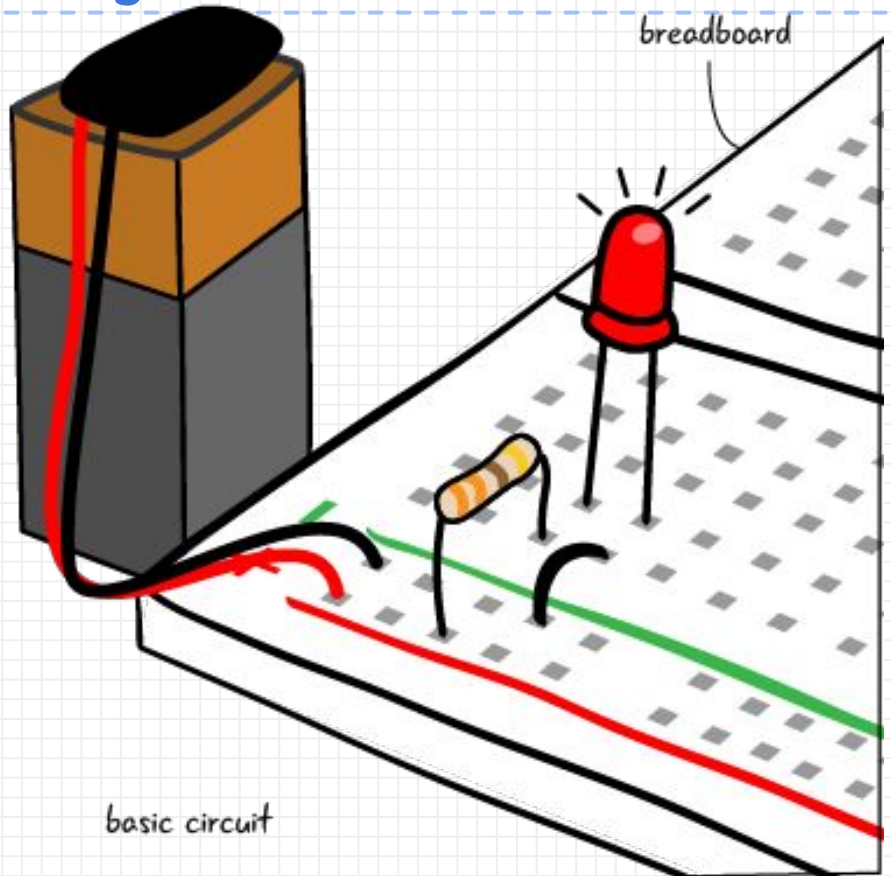
Breadboard Do's and Don't's

✗ **Do not** plug both ends of component into the same row! This creates a short

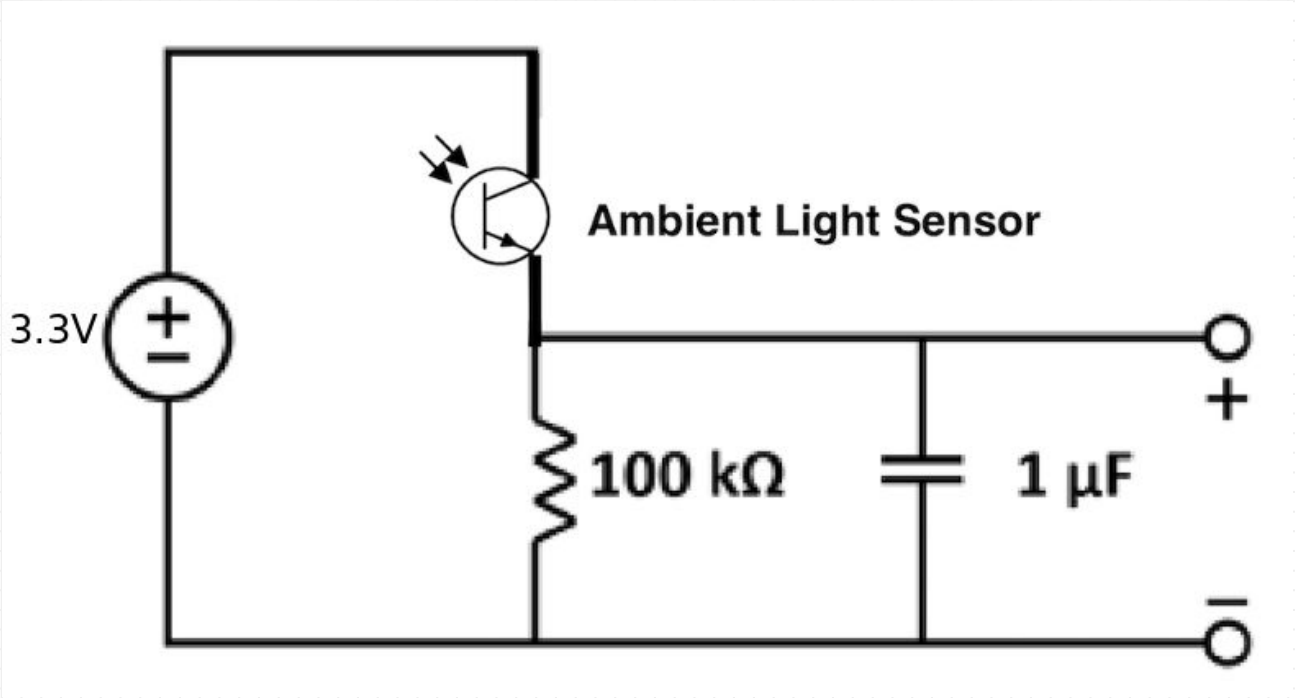




Breadboarding Color Convention

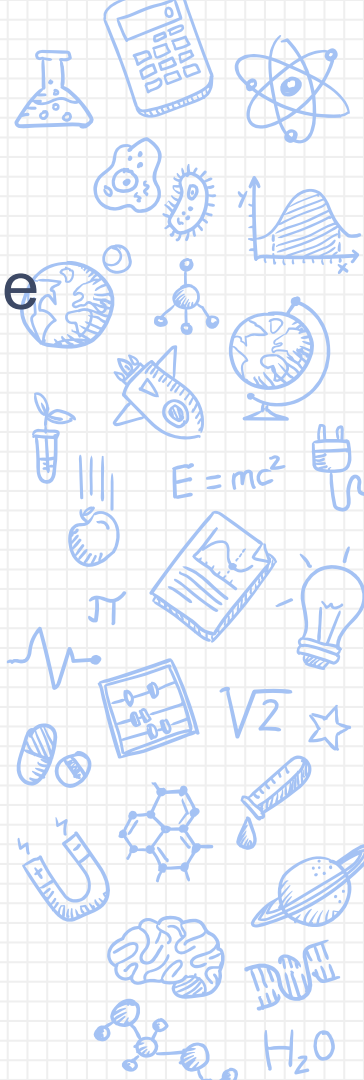


Light-detecting Circuit



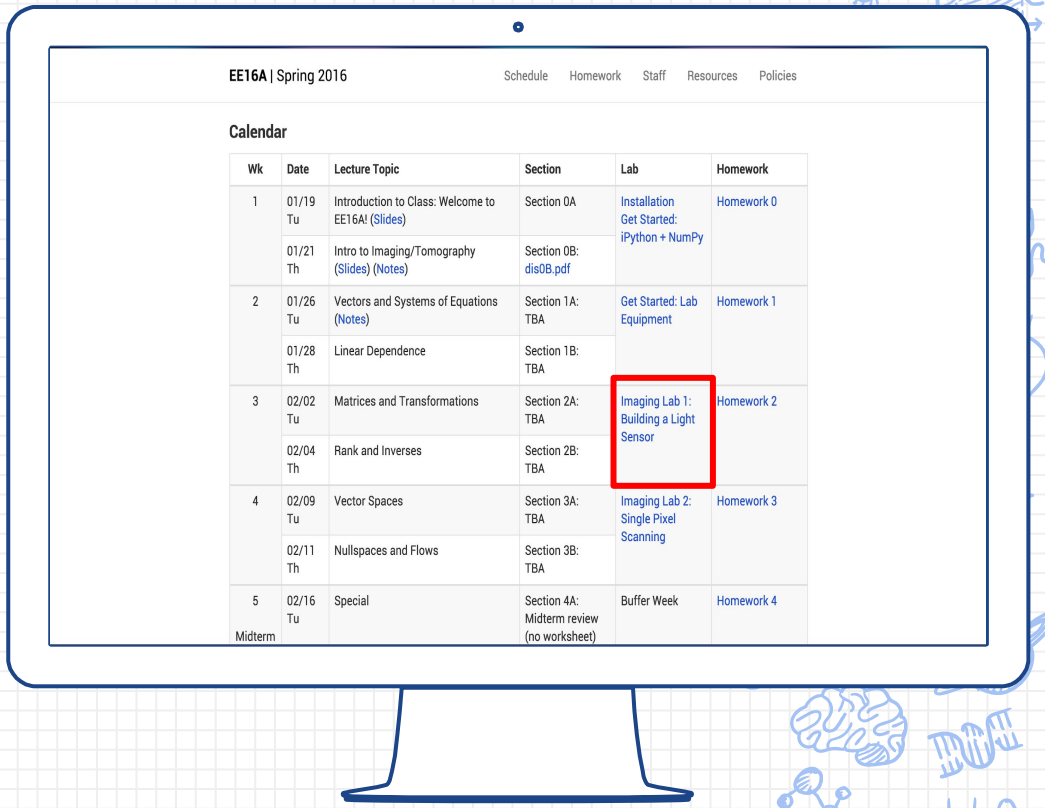
How to get your lab kit (1 per student)

- After finishing ~20% of the lab you will reach the end of the “Obtaining a Lab Kit” section
- Call over a lab staff member and: (also described in lab notebook)
  - Show answers to PSU, Oscilloscope, and lab kit questions
  - Demonstrate how to use the equipment
  - Be able to name components in the lab kit
- Everything in kit (bag+Launchpad) is yours to keep but EACH STUDENT HAS TO BRING THEM BACK TO EVERY LAB



How to start

- Please use the station desktops for this lab
- If you need an instructional account, let us know
- Work in pairs
- This week's lab is listed as **"Imaging Lab 1"**
- **Make sure website says Spring 2020**



Wk	Date	Lecture Topic	Section	Lab	Homework
1	01/19 Tu	Introduction to Class: Welcome to EE16A! (Slides)	Section 0A	Installation Get Started: iPython + NumPy	Homework 0
	01/21 Th	Intro to Imaging/Tomography (Slides) (Notes)	Section 0B: dis0B.pdf		
2	01/26 Tu	Vectors and Systems of Equations (Notes)	Section 1A: TBA	Get Started: Lab Equipment	Homework 1
	01/28 Th	Linear Dependence	Section 1B: TBA		
3	02/02 Tu	Matrices and Transformations	Section 2A: TBA	Imaging Lab 1: Building a Light Sensor	Homework 2
	02/04 Th	Rank and Inverses	Section 2B: TBA		
4	02/09 Tu	Vector Spaces	Section 3A: TBA	Imaging Lab 2: Single Pixel Scanning	Homework 3
	02/11 Th	Nullspaces and Flows	Section 3B: TBA		
5 Midterm	02/16 Tu	Special	Section 4A: Midterm review (no worksheet)	Buffer Week	Homework 4

FAQ

- Lab notebook link is on course website
- Check following slide for common Energia Install errors and possible fixes
- Keep voltage source leads from LaunchPad to breadboard disconnected whilst building your circuit
  - Female ends can stay connected to the LaunchPad
- **Make sure you are using the correct resistors (Brown Black Yellow Gold for light sensor)**
- **Make sure your ambient light sensor is in the right direction**
- Complete the lab in **GROUPS OF 4** in your assigned breakout room
  - You must each build your own setup and answer all questions in your own notebook
- DON'T LEAVE/PACK UP YOUR CIRCUIT WITHOUT BEING CHECKED OFF FIRST
- Use the help queue and google checkoff form (linked in the lab)
  - lab.eecs16a.org

Common Energia Install Errors

- ✘ **Error**: The system cannot find the file specified
  - ✗ Fix: Manually update your board from version 1.0.6 to 1.0.7 (Tools --> Board --> Boards Manager --> Energia MSP430 Boards --> Update)
- ✘ **Error**: Serial monitor not displaying anything
  - ✗ Fix: select correct Baud rate in the serial monitor window (refer to lab notebook); press RST (reset) button on LaunchPad
- ✘ **Error**: Serial monitor displaying strange symbols
  - ✗ Fix: close serial monitor; reupload the code to the other COM port and open serial monitor again.
- ✘ **Error**: not detecting the launchpad as a launchpad (something like COM3 and COM4 show up)
  - ✗ Fix: if on Windows, make sure to install drivers https://energia.nu/guide/install/windows/
- ✘ **Error**: If you have a space in your Windows username and you encounter an error when running the program, follow these instructions (courtesy of a 16B student's Piazza post)
  - ✗ Energia stores some important stuff in this directory C:\Users\First Last\AppData\Local\Energia15 - note: username has a space
  - ✗ Create the following directory structure: C:\Users\First\AppData\Local
  - ✗ Now copy the Energia15 folder from your actual home directory into the local folder in your firstname only user home directory.