
EECS 16A 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.

IMPORTANT: COVID Protocols

- Masks are always required
- Masks + Wipes + Sanitizers should be available at the TA desk
- Students will be required to wipe down their station before the start of every section
- Food and Drink are never allowed in the lab. This is especially true this semester. Students and staff should go outside (either Cory courtyard or out of the building) for food or water.
- Please DO NOT COME TO LAB if you're UNWELL!

Action Item: Instructional Accounts

- To use the computers at the lab stations, you will need to login using your instructional account
- Create an EE16A account by logging into [acropolis](#) with your CalNet ID.
- Click “Create an Account” for EE16A and wait for the page to create an account.
- You will be presented with an ee16a account and a password and prompted with an option to send the account information to an email. Please email this account information to yourself.

Action Item: Instructional Accounts

- On a Windows computer, you can change your password by hitting Control + Alt + Delete and selecting “Change Password”. Follow the prompt to permanently change your password.
- If you ever forget the password that you set, you can reset it by going to acropolis and resetting the password associated with that account.

Semester Outline



Imaging
Module



Touchscreen
Module



Acoustic
Positioning
Module

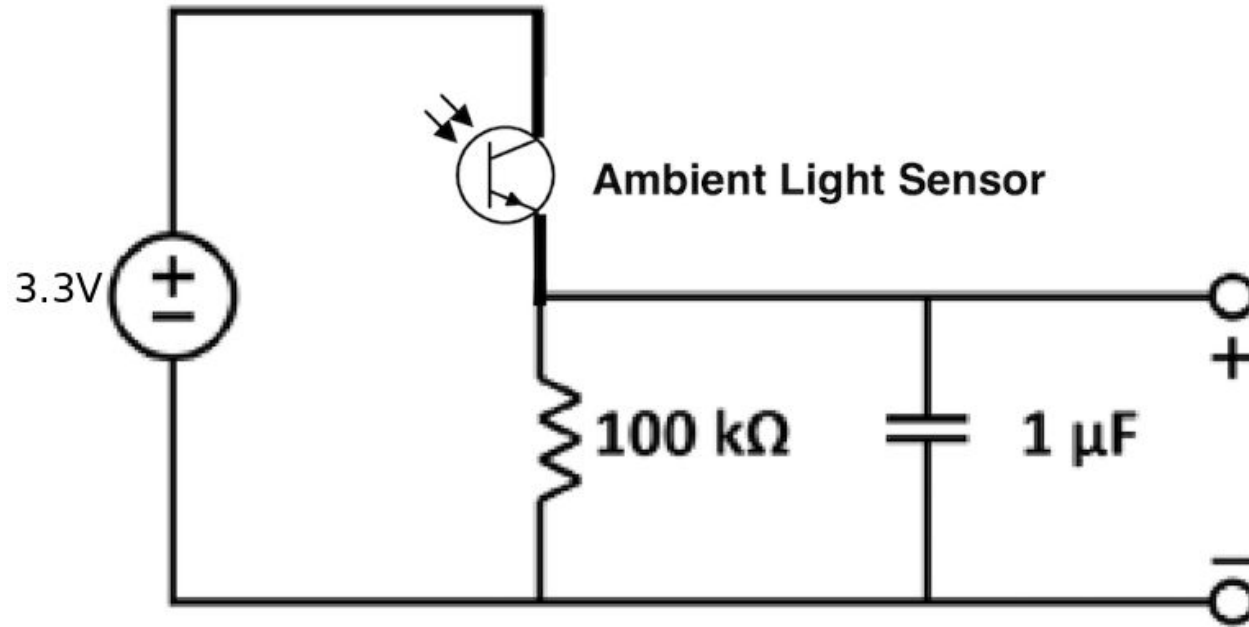
Why Imaging?

- 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

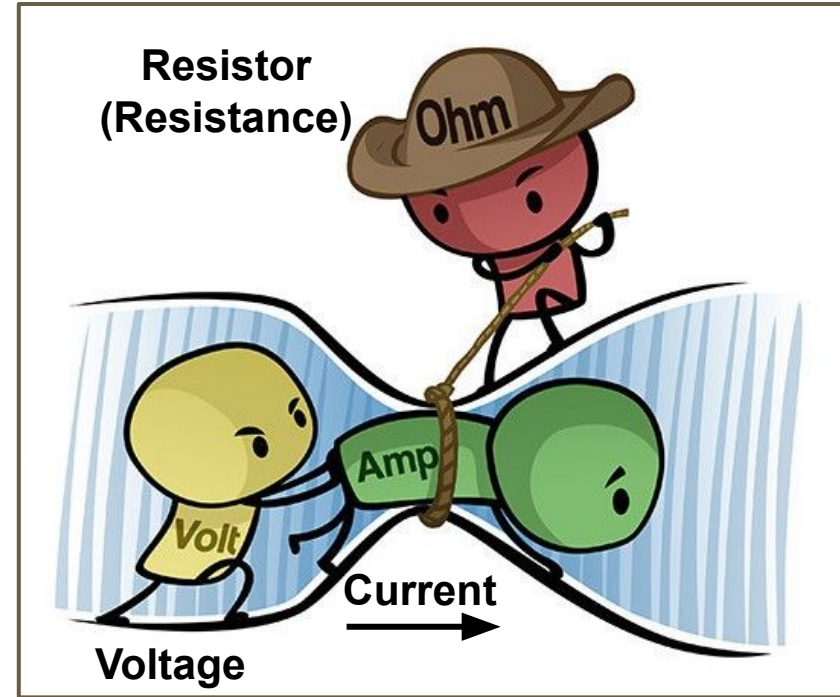
- You'll receive lab kit materials after completing part 1 of today's lab (TI MSP430F5529 + lab kit)
 - **You must bring your kit to each subsequent lab**
- Circuits + Breadboarding 101
- Build circuit that reacts to light intensity
 - Use Launchpad (+ Oscilloscope) to see how the circuit behaves
- Graded checkoff starts today!

Our circuit



A Little Physics: Voltage, Current, and Resistors

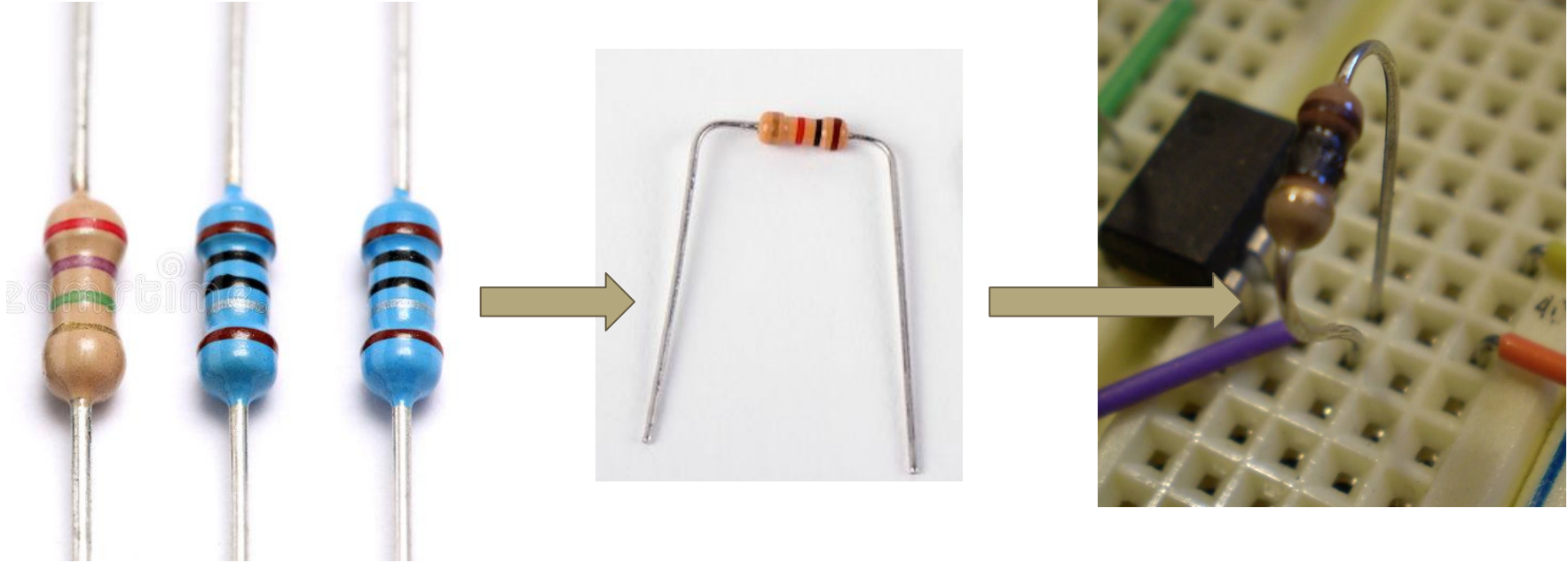
- **Voltage [Volts]** - pushes charge through circuit
- **Current [Amps]** - flow of charge through circuit
 - 1 Amp = 1 charge per second
- **Resistor [Ohms]** - circuit component that resists the flow of charge through circuit



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	$\times 1\Omega$	
BROWN	1	1	$\times 10\Omega$	$\pm 1\%$
RED	2	2	$\times 100\Omega$	$\pm 2\%$
ORANGE	3	3	$\times 1000\Omega$	
YELLOW	4	4	$\times 10000\Omega$	
GREEN	5	5	$\times 100000\Omega$	$\pm 0.5\%$
BLUE	6	6	$\times 1000000\Omega$	$\pm 0.25\%$
VIOLET	7	7	$\times 10000000\Omega$	$\pm 0.1\%$
GREY	8	8		$\pm 0.05\%$
WHITE	9	9		
GOLD			0.1	$\pm 5\%$
SILVER			0.01	$\pm 10\%$

Poll Time! What color is a 100 ohm resistor?

4 Band Resistor Color Coding




COLOR	1ST BAND	2ND BAND	MULTIPLIER	TOLERANCE
BLACK	0	0	x1 Ω	
BROWN	1	1	x10 Ω	$\pm 1\%$
RED	2	2	x100 Ω	$\pm 2\%$
ORANGE	3	3	x1000 Ω	
YELLOW	4	4	x10000 Ω	
GREEN	5	5	x100000 Ω	$\pm 0.5\%$
BLUE	6	6	x1000000 Ω	± 0.25
VIOLET	7	7	x10000000 Ω	± 0.10
GREY	8	8		± 0.05
WHITE	9	9		
GOLD			0.1	$\pm 5\%$
SILVER			0.01	$\pm 10\%$

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?

4 Band Resistor Color Coding



COLOR	1ST BAND	2ND BAND	MULTIPLIER	TOLERANCE
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SILVER			0.01	$\pm 10\%$

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)



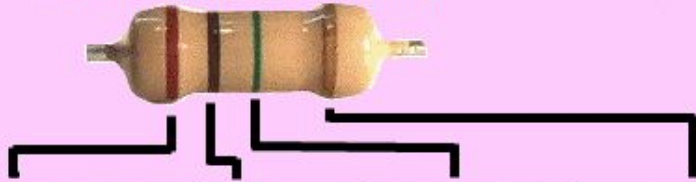
4 Band Resistor Color Coding				
COLOR	1ST BAND	2ND BAND	MULTIPLIER	TOLERANCE
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GREY	8	8		± 0.05
WHITE	9	9		
GOLD			0.1	$\pm 5\%$
SILVER			0.01	$\pm 10\%$

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



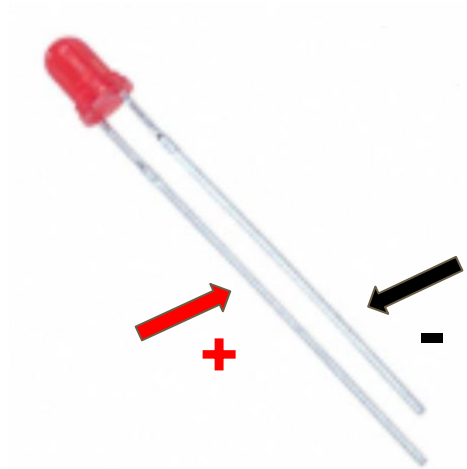
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GREY	8	8		± 0.05
WHITE	9	9		
GOLD			0.1	$\pm 5\%$
SILVER			0.01	$\pm 10\%$

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

Light Emitting Diode (LED)

When a sufficient potential difference is placed across its terminals, the LED emits light!

Direction matters!

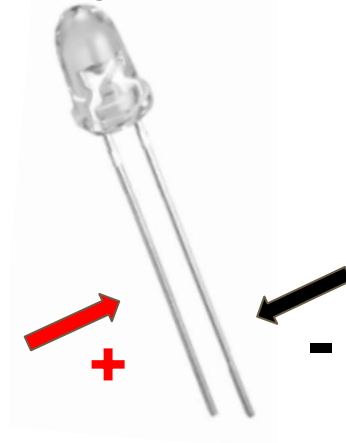


Ambient Light Sensor

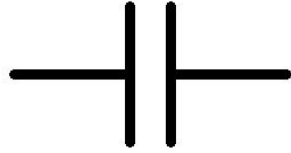


It behaves like a resistor and the current passing through it depends on how much light there is around it!

Direction matters! **Note: Polarity is opposite LED's**

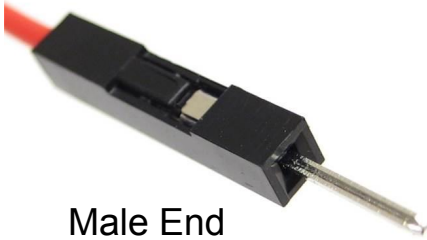


Capacitors

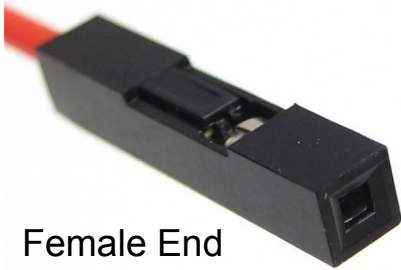


They store your charge!
Called capacitors because
they have a set capacity (in
Farads)

Wires/Jumpers



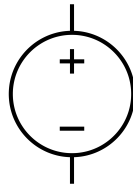
Male End



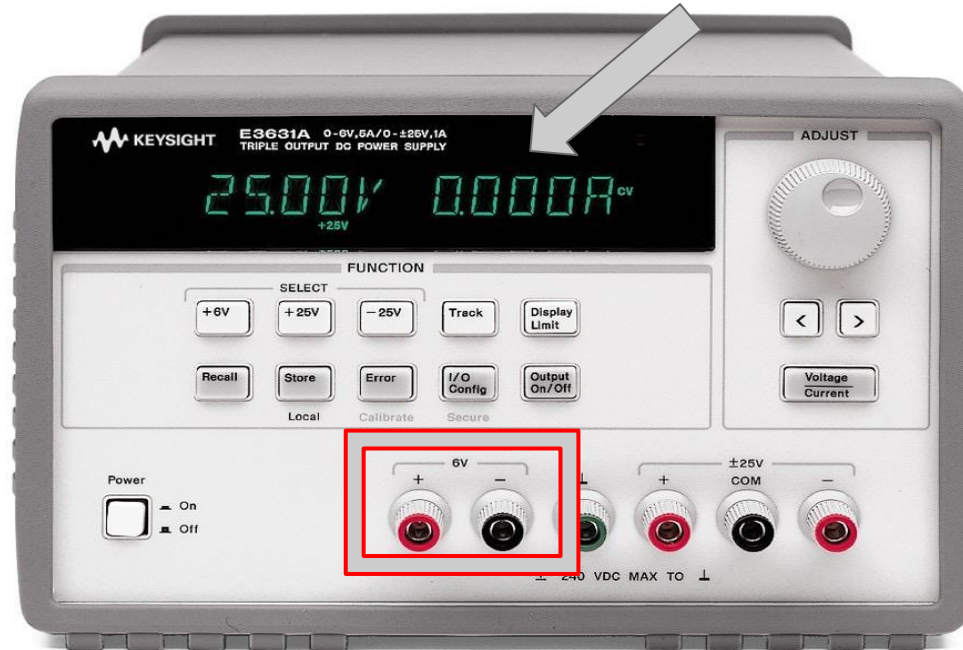
Female End



Voltage Source

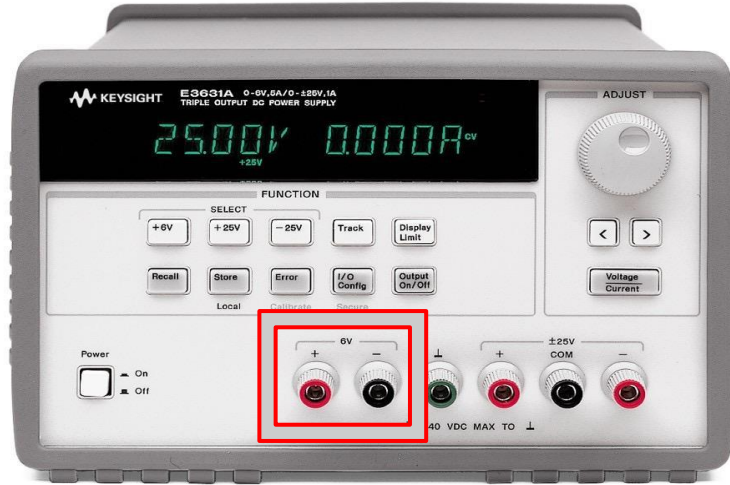
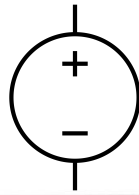


IMPORTANT: Always keep current limited @ 0.1 A limit



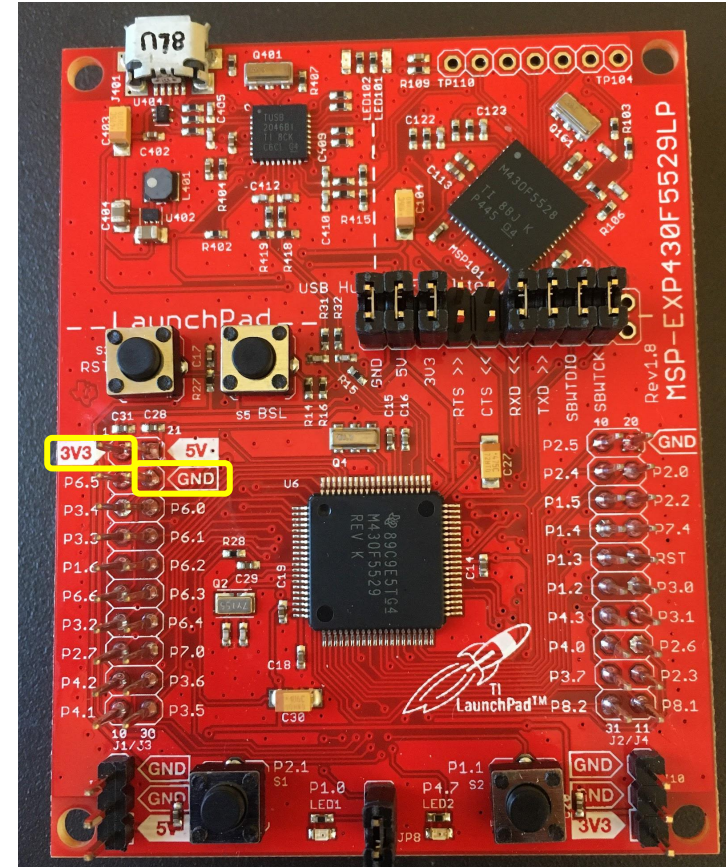
PSU cables
are hanging
on back wall

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
 - Wire between components are considered part of one node



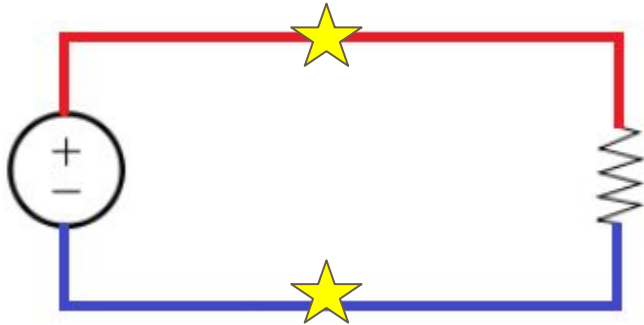
What components?

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?

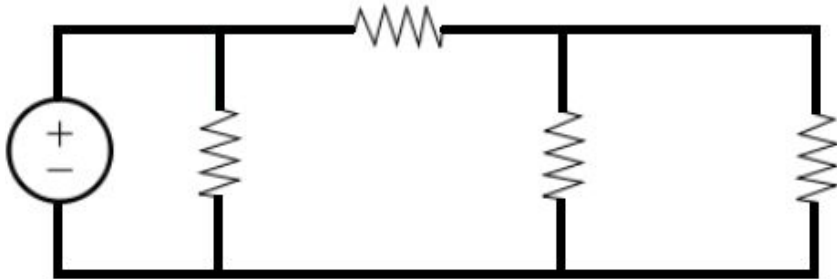
Voltage source, resistor

How many nodes? **2**

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



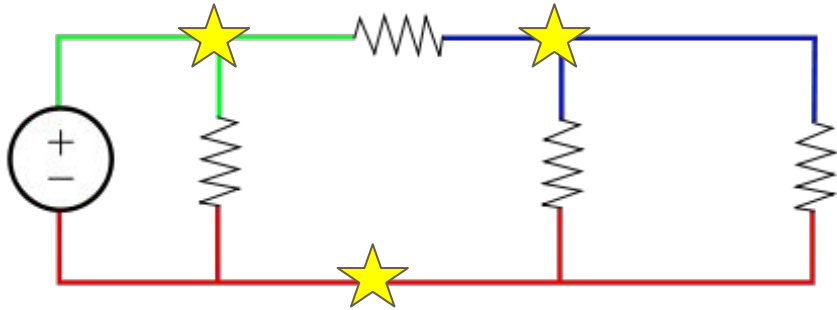
What components?

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

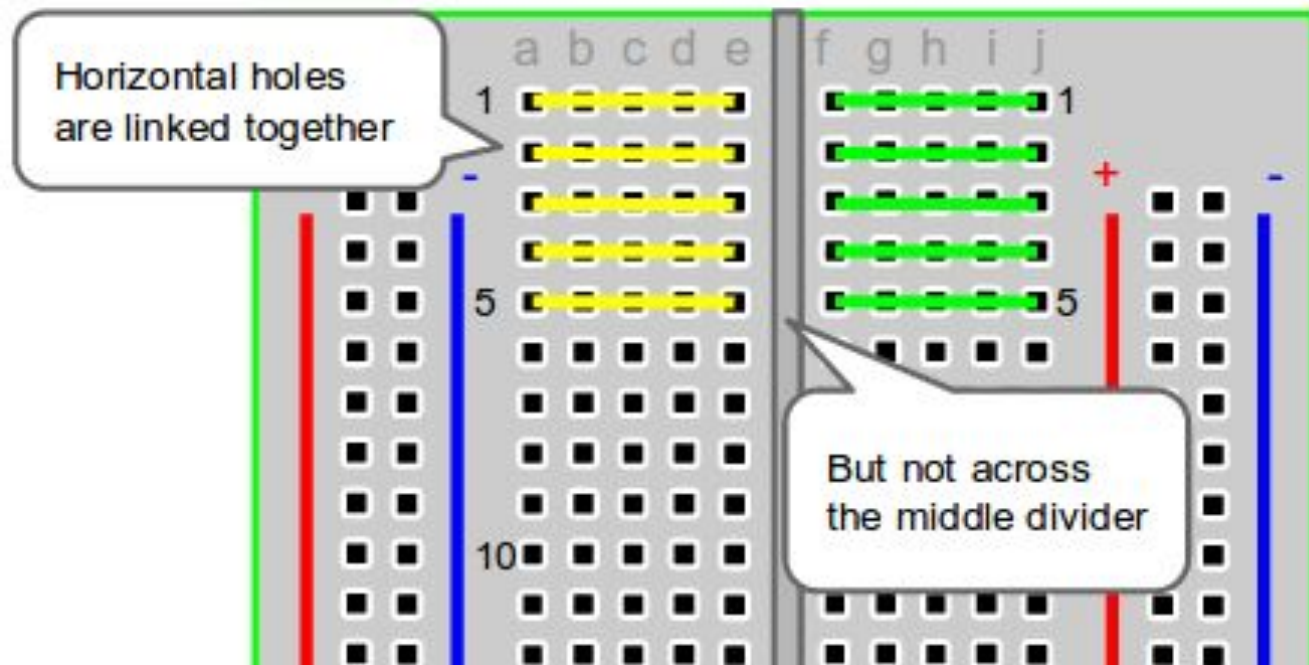


What components? **Same**

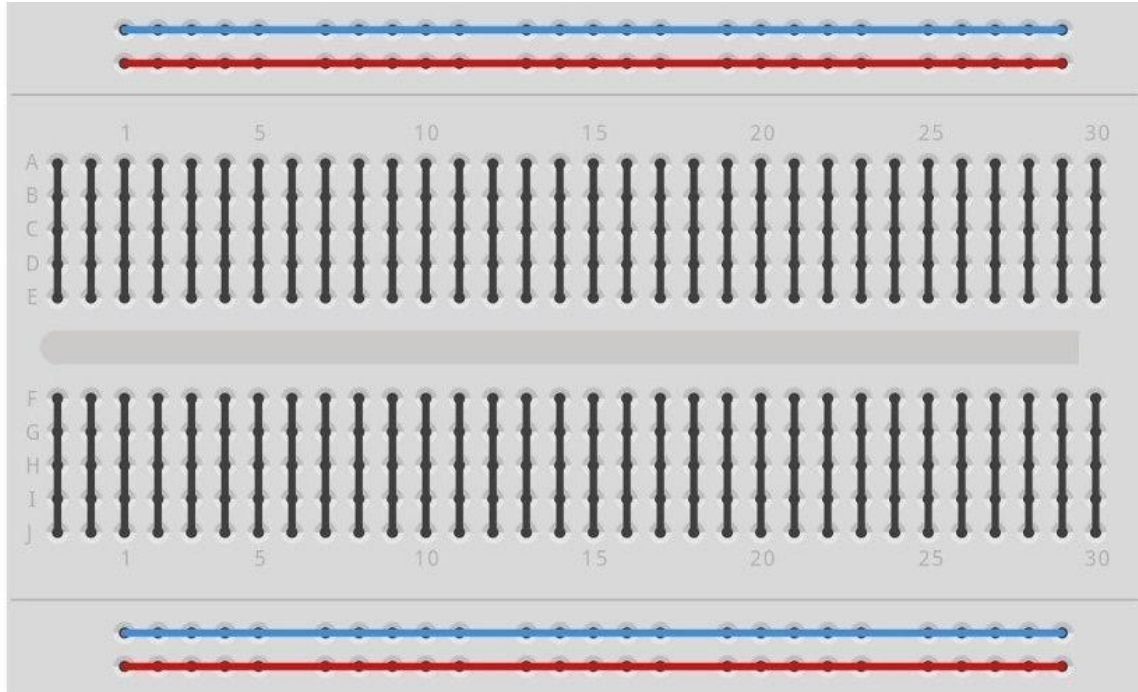
How many nodes? **3**

Where are these nodes?

Breadboard

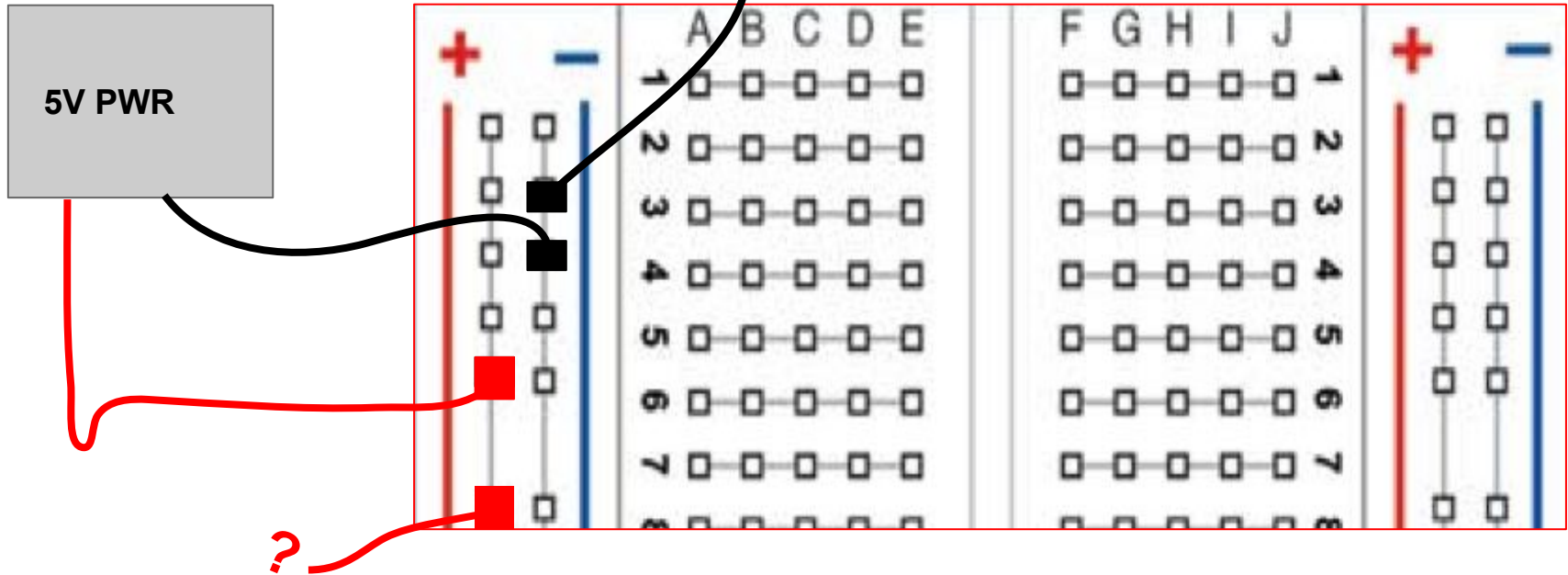
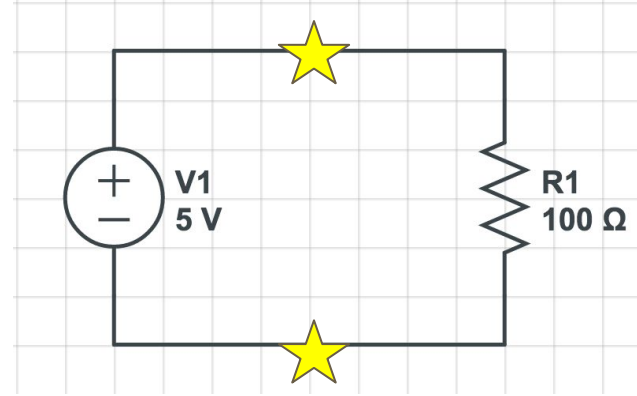


Breadboard



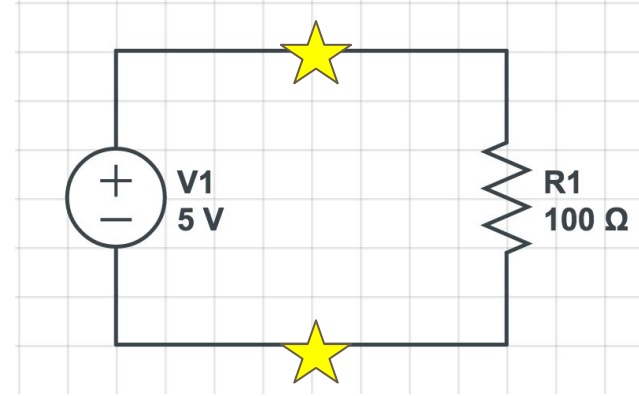
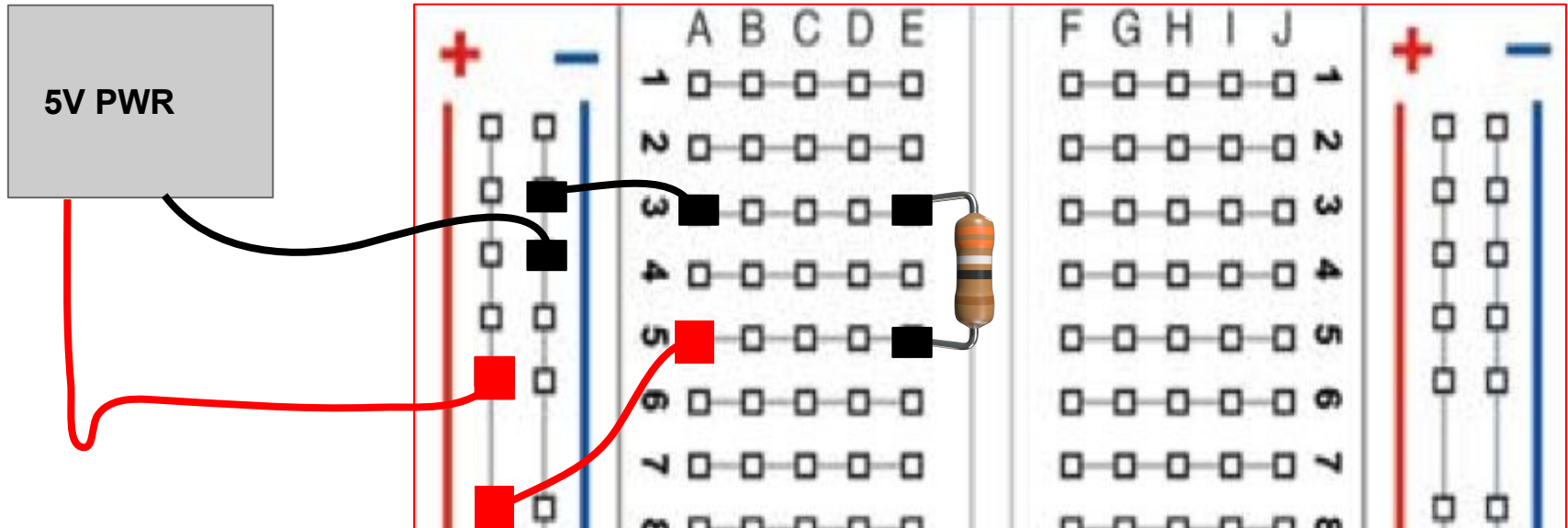
Breadboard Do's and Don't's

How do we make this circuit? →



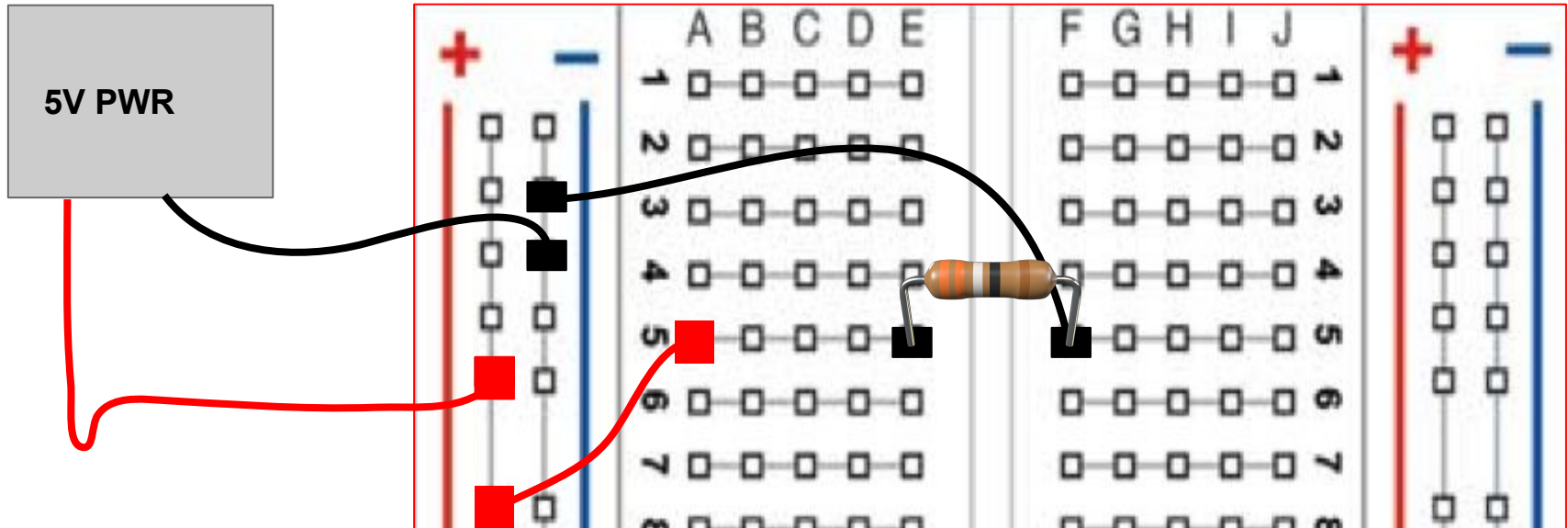
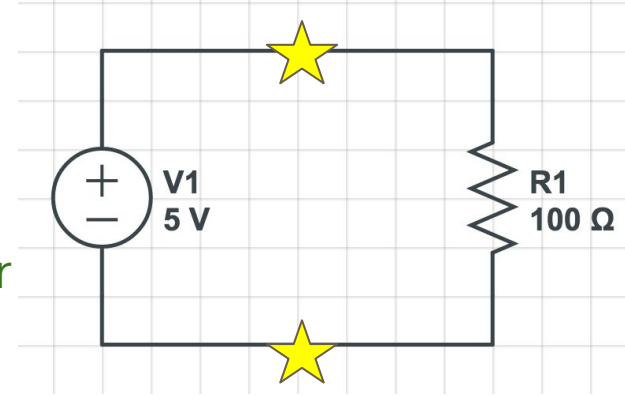
Breadboard Do's and Don't's

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



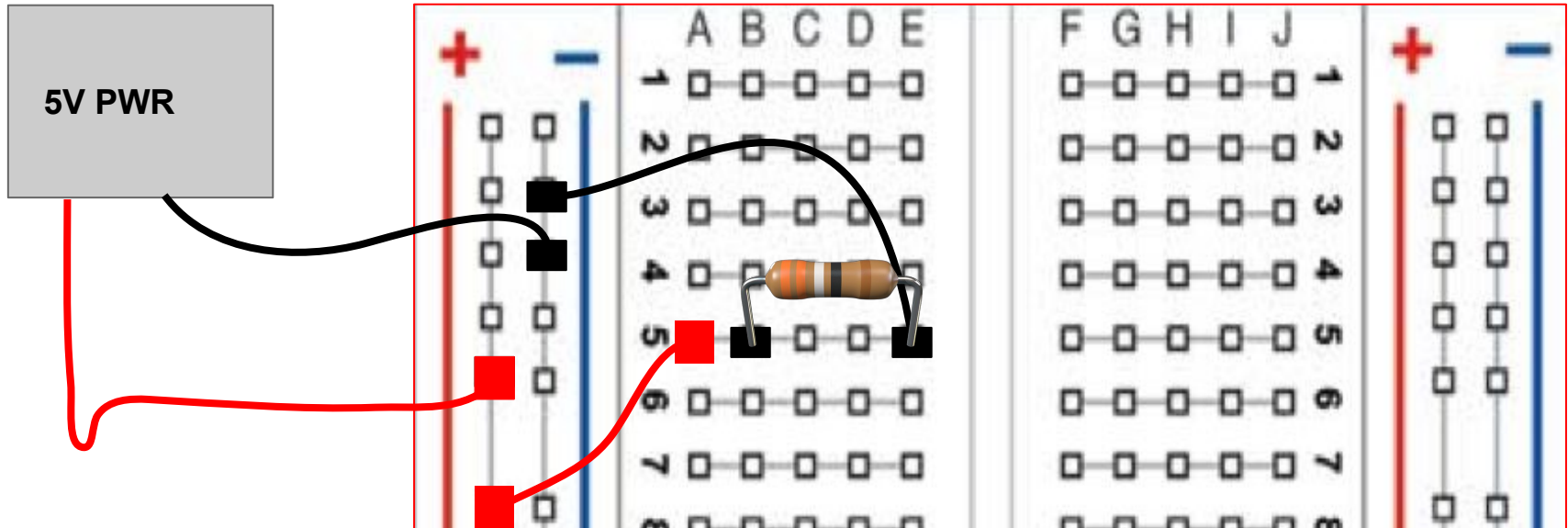
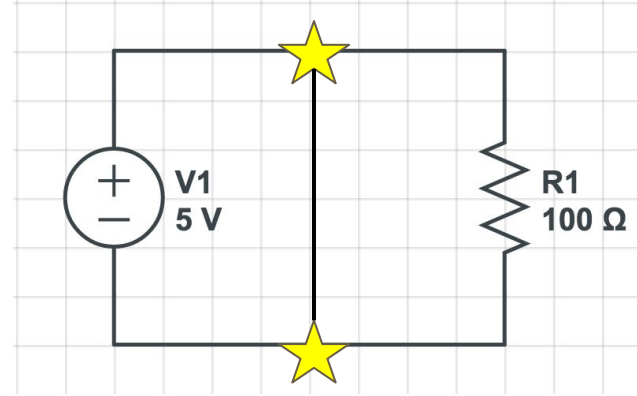
Breadboard Do's and Don't's

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



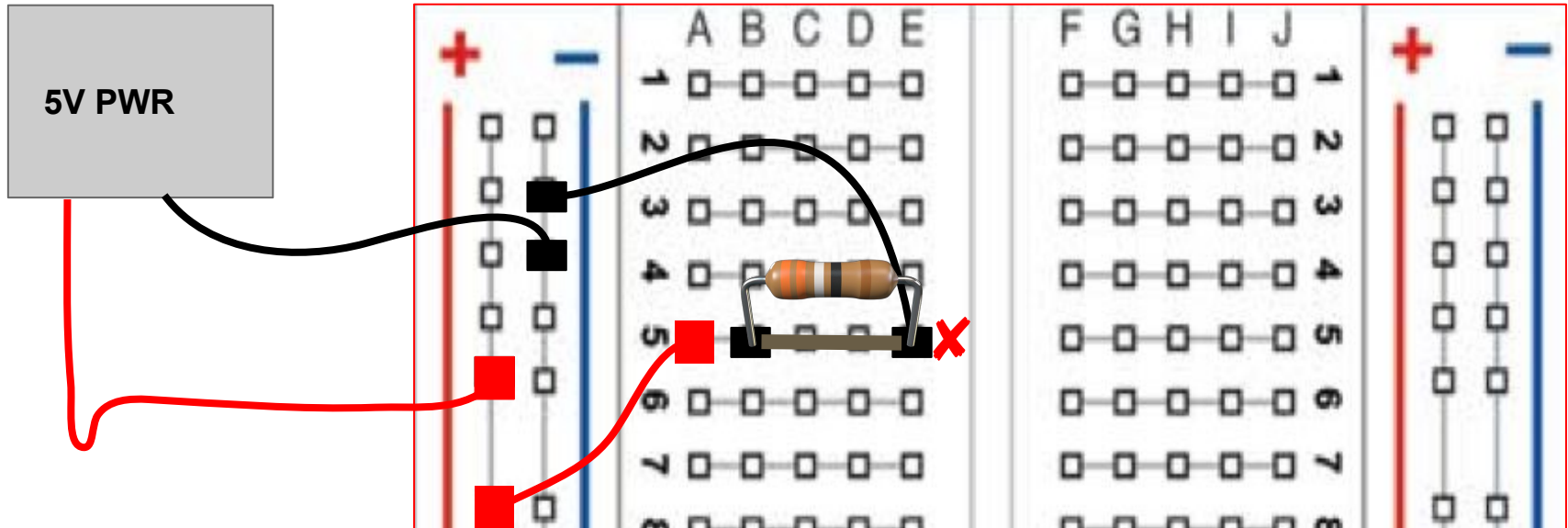
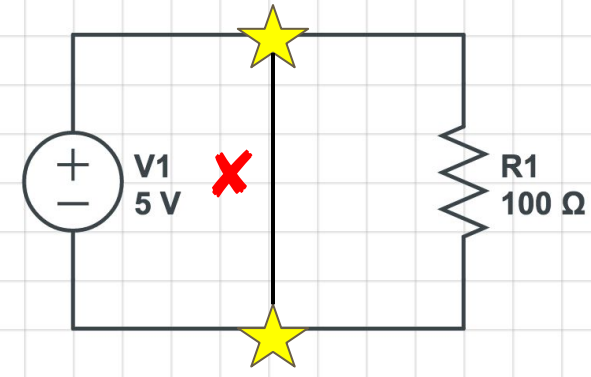
Breadboard Do's and Don't's

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

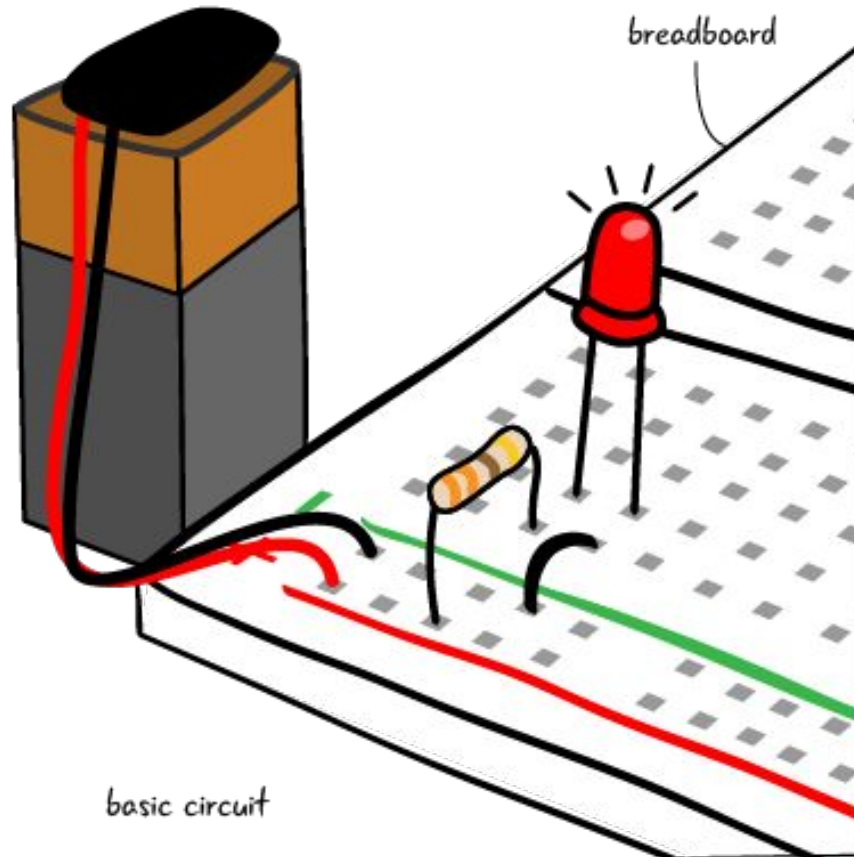


Breadboard Do's and Don't's

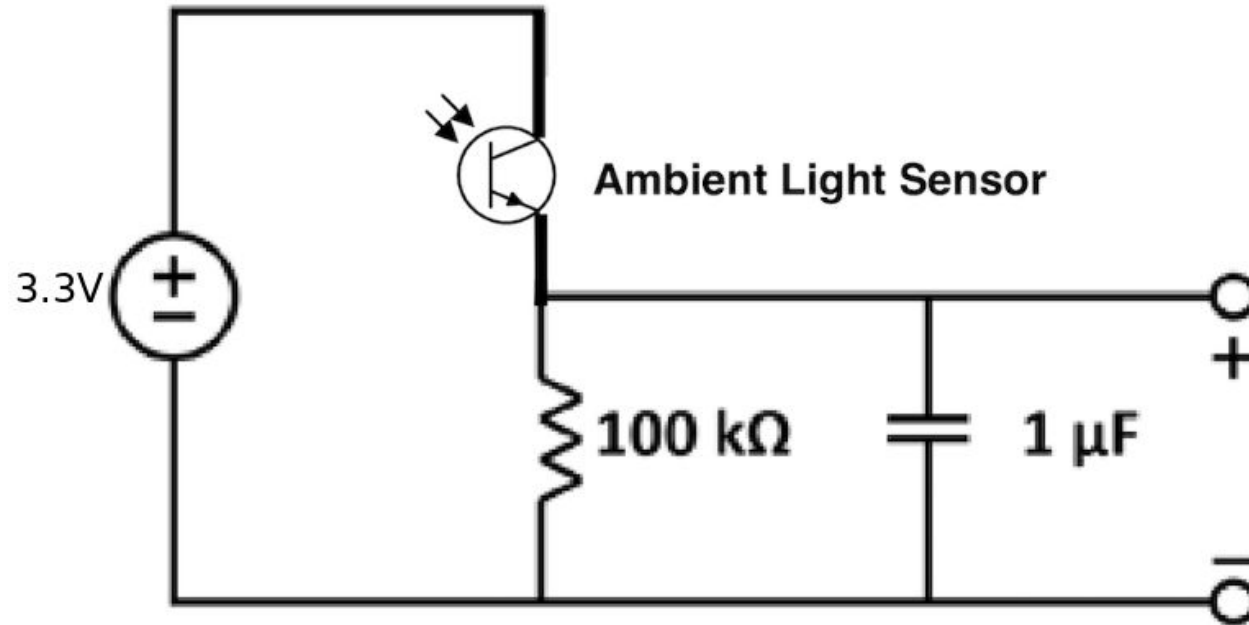
✗ **Do not** plug both ends of component into the same row! This creates a short



Breadboarding Color Convention

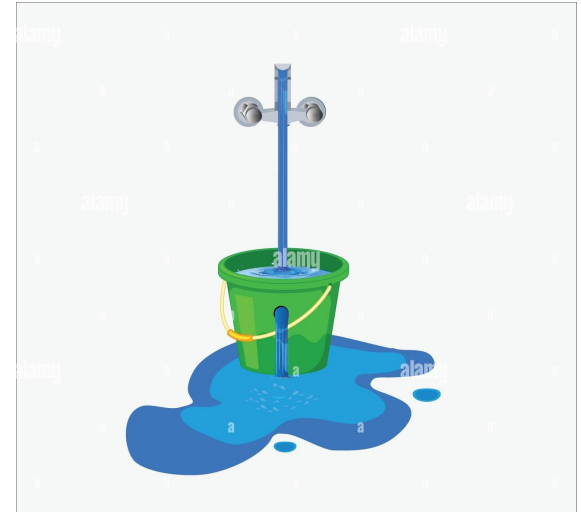
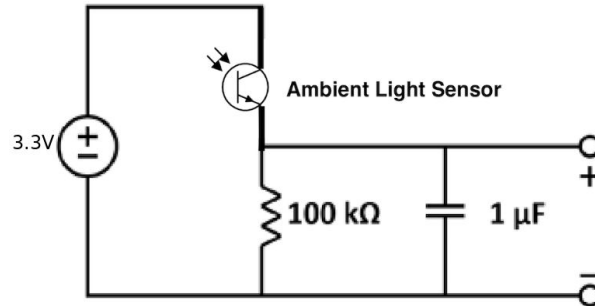
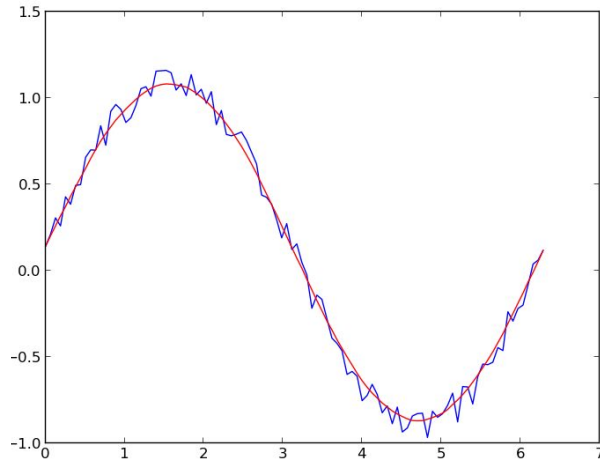


Light-detecting Circuit



Why the Capacitor?

- The capacitor acts like a bucket of charge – if the input instantaneously increases or decreases, it'll adjust the output flow to compensate
- This results in reducing noise and curve smoothing!



FAQ

- Complete the lab in **PAIRS**, do ONE setup and notebook per group
- Speak to the TA if you do not have a partner and would like one
- Use the help queue and google checkoff form (linked in the lab)
 - Lab.eecs16a.org
- DON'T LEAVE/PACK UP YOUR CIRCUIT WITHOUT BEING CHECKED OFF FIRST

FAQ

- Make sure current limit of power supply is set to 0.1A
- Turn PSU **output off** while building your circuit
- Keep voltage source leads from LaunchPad to breadboard disconnected while building your circuit
 - Female ends can stay connected to the LaunchPad
- Probes are on the back wall
- **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**
- Before leaving, please return the wires, power off your machines, and sign out of the computers
- If images in the notebook don't show up, save your work and reopen the notebook

30 minutes left

- BOTH partners need to fill out the checkoff form for credit!
- Only submit 1 checkoff request per pair.