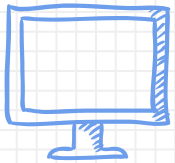
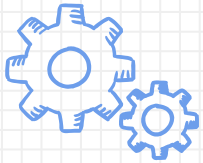
# Notes

- **Ask your questions:**
  - tinyurl.com/lab108-q
- This Presentation: tinyurl.com/lab108-python
- For checkoff: Type IP Address into URL and submit appropriate information. Double check your IDs.

# EE16A Lab
# Friday 11am-2pm

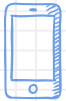
TA: Seiya Ono
LA: Cameron, Ed, Ryan


# Imaging – Part 1

# Semester Outline

Imaging Module



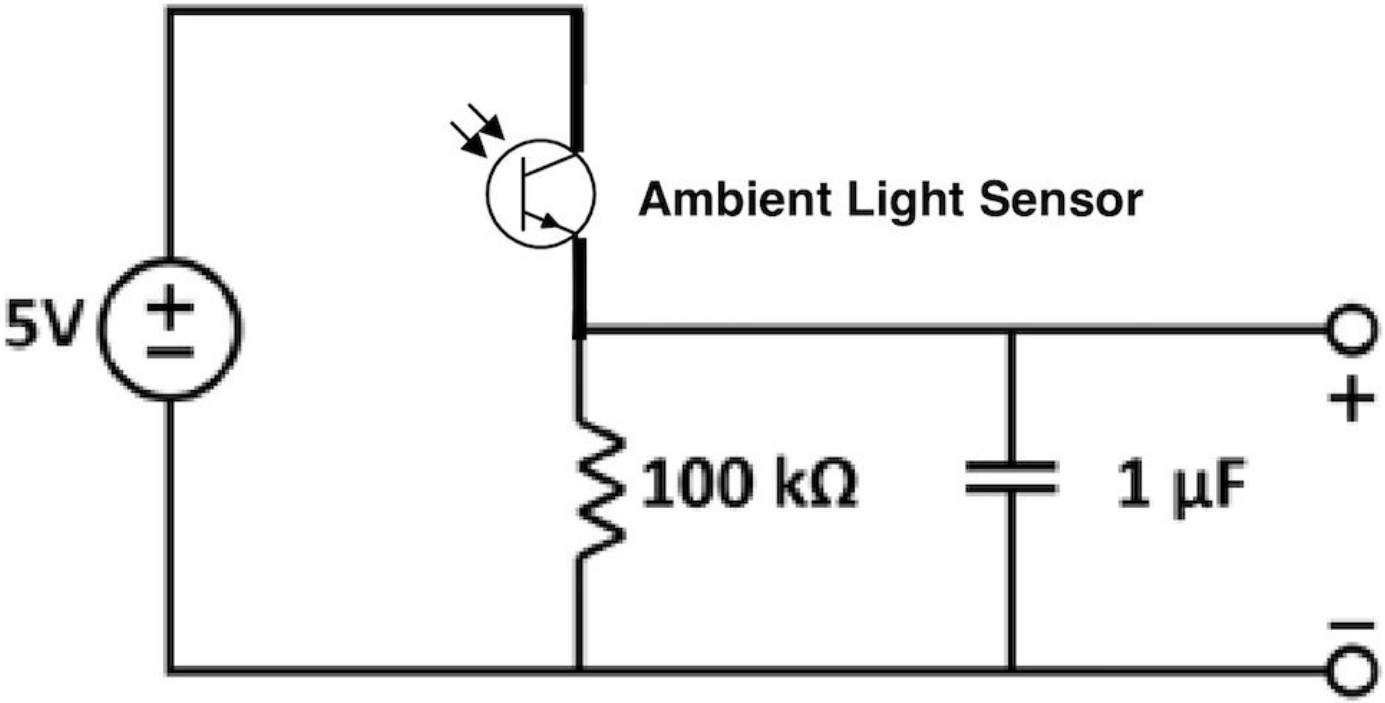
Touchscreen Module

Locationing Module

# Today's Lab: Imaging Part 1

- ✘ Distribute materials (Kit & TI Launchpad)
  - ✗ Write your name on the box and components bag
- ✘ Intro to Breadboarding
- ✘ Build circuit that reacts to light intensity
  - ✗ Use Oscilloscope and Launchpad to see how the circuit behaves

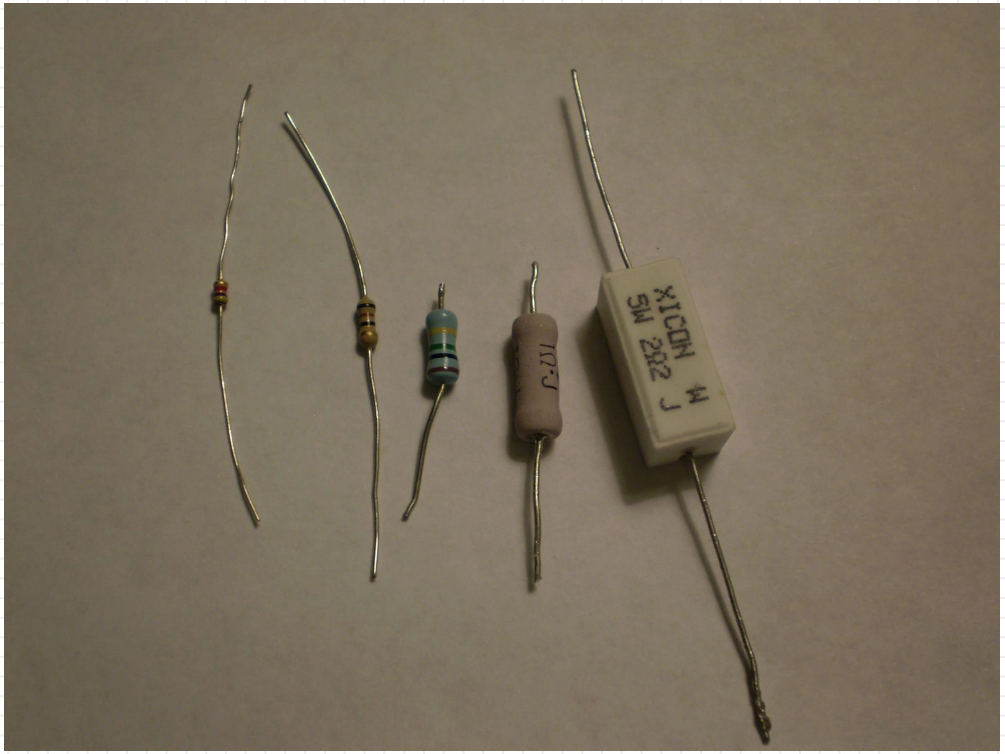
# Light-detecting Circuit



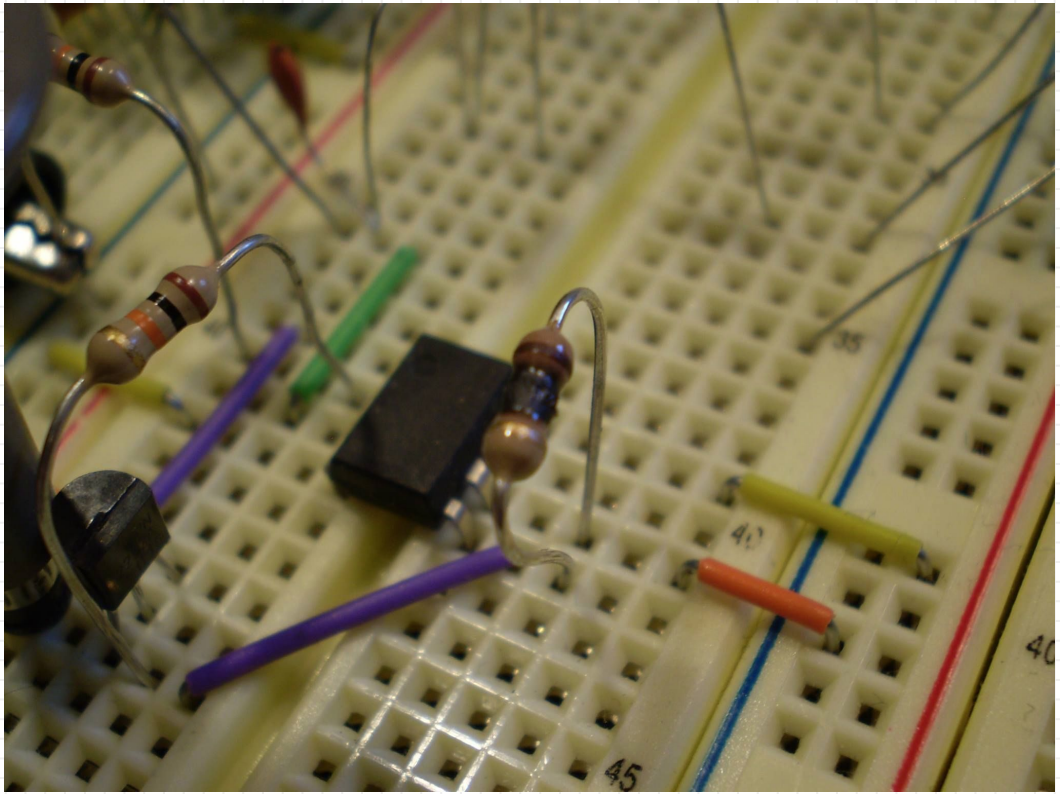
# What's a circuit?

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

# What's in your bag? : Resistors

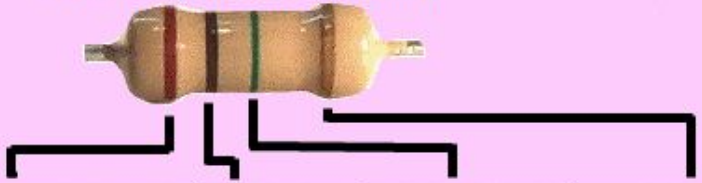


# What's in your bag? : Resistors



# What's in your bag? : Resistors

## 4 Band Resistor Color Coding

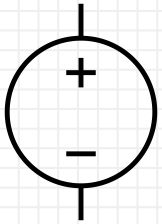


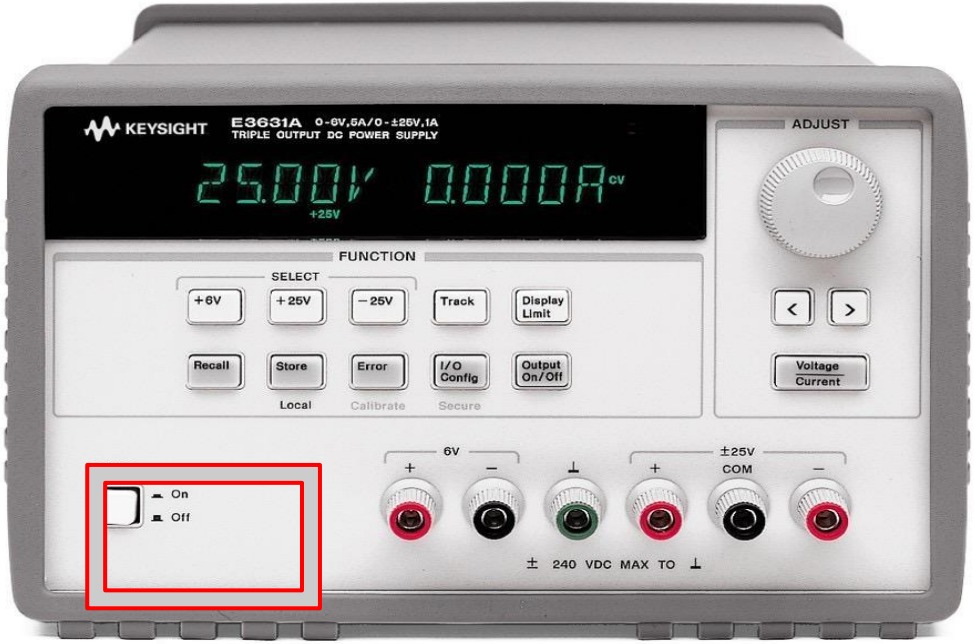
| COLOR | 1ST BAND | 2ND BAND | MULTIPLIER | TOLERANCE |
|---|---|---|---|---|
| BLACK | 0 | 0 | x1Ω | |
| BROWN | 1 | 1 | x10Ω | ±1% |
| RED | 2 | 2 | x100Ω | ±2% |
| ORANGE | 3 | 3 | x1000Ω | |
| YELLOW | 4 | 4 | x10000Ω | |
| GREEN | 5 | 5 | x100000Ω | ±0.5% |
| BLUE | 6 | 6 | x1000000Ω | ±0.25 |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

# Equipment for Today: Capacitors


# Equipment for Today: Wires/Jumpers

# Equipment for Today: Voltage Source (0.1 A Limit)



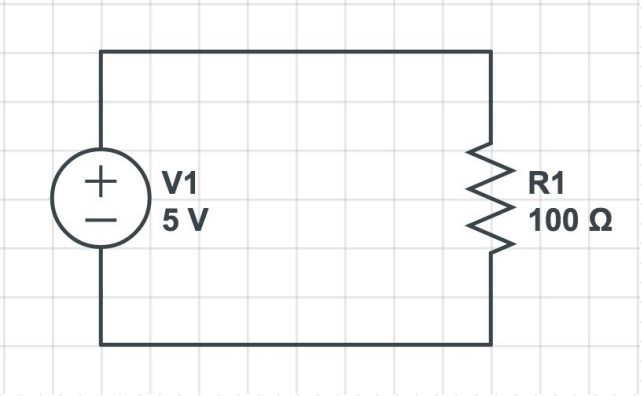



# What's a Circuit?

- ✘ Components
- ✘ Nodes
  - ✗ Point in circuit where 2 or more circuit elements meet
  - ✗ Wire between components are considered part of one node

# Simple Circuit

- ✘ Components (Resistors, LEDs, Capacitors)
- ✘ Nodes
  - ✗ Point in circuit where 2 or more circuit elements meet
  - ✗ Wire between components are considered part of one node




What components?

How many nodes?

Where are these nodes?

# Simple Circuit

- ✘ Components (Resistors, LEDs, Capacitors)
- ✘ Nodes
  - ✗ Point in circuit where 2 or more circuit elements meet
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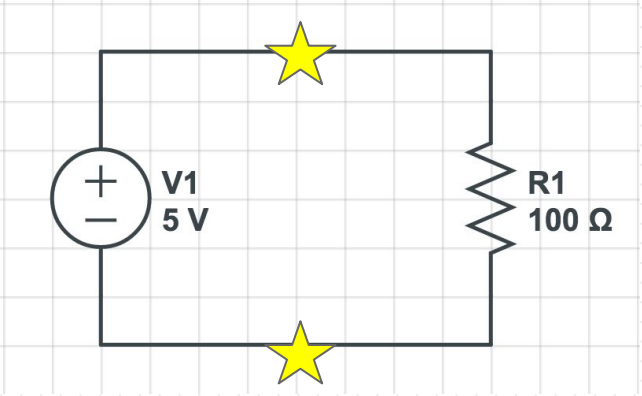



What components?

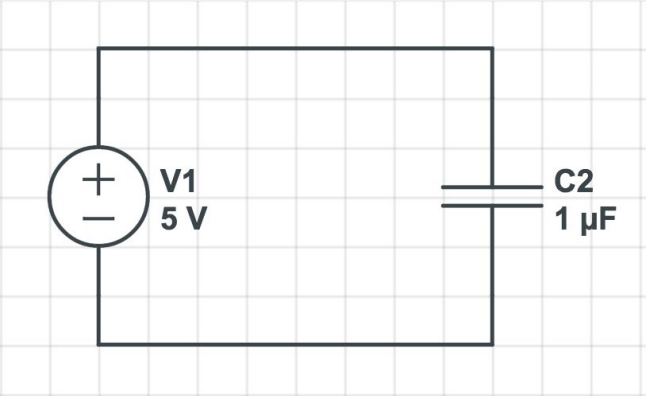
**Resistor, Voltage source**

How many nodes? **2**

Where are these nodes?

# Simple Circuit

- ✘ Components (Resistors, LEDs, Capacitors)
- ✘ Nodes
  - ✗ Point in circuit where 2 or more circuit elements meet
  - ✗ Wire between components are considered part of one node



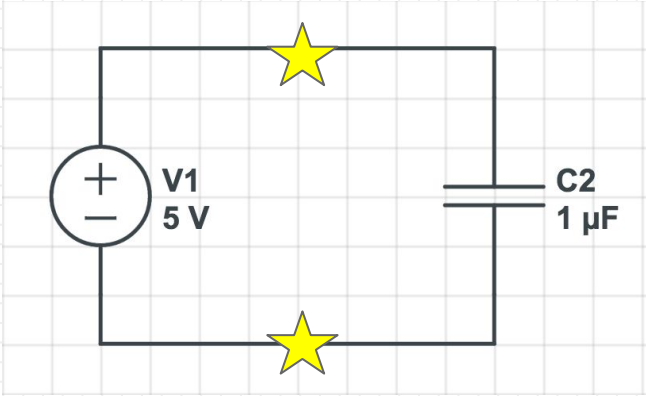

What components?

How many nodes?

Where are these nodes?

# Simple Circuit

- ✘ Components (Resistors, LEDs, Capacitors)
- ✘ Nodes
  - ✗ Point in circuit where 2 or more circuit elements meet
  - ✗ Wire between components are considered part of one node




What components?

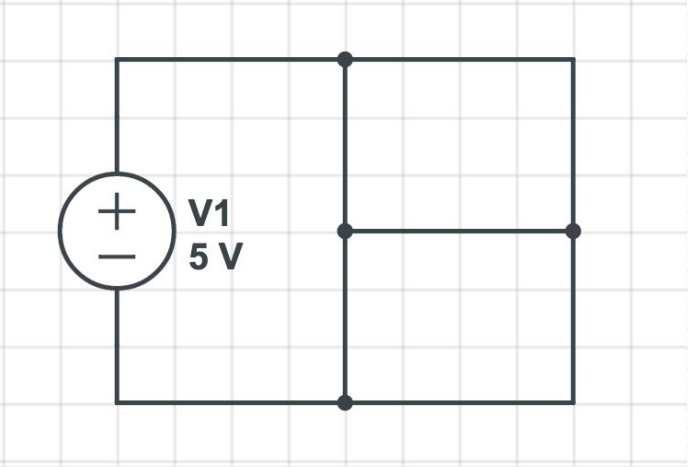
**Capacitor, Voltage source**

How many nodes? **2**

Where are these nodes?

# Simple Circuit

- ✘ Components (Resistors, LEDs, Capacitors)
- ✘ Nodes
  - ✗ Point in circuit where 2 or more circuit elements meet
  - ✗ Wire between components are considered part of one node



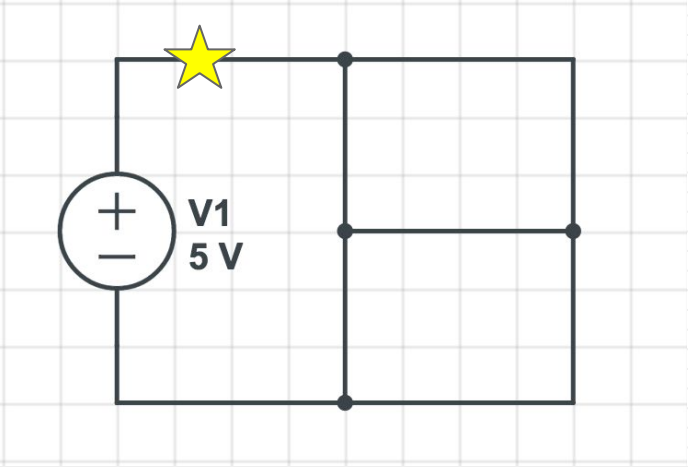

What components?

How many nodes?

Where are these nodes?

# Simple Circuit

- ✘ Components (Resistors, LEDs, Capacitors)
- ✘ Nodes
  - ✗ Point in circuit where 2 or more circuit elements meet
  - ✗ Wire between components are considered part of one node



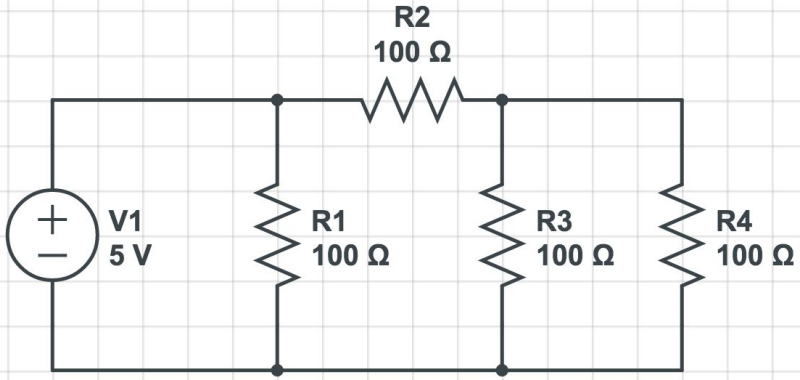

What components? **Vlt Src**

How many nodes? **1**

Where are these nodes?

# Simple Circuit

- ✘ Components (Resistors, LEDs, Capacitors)
- ✘ Nodes
  - ✗ Point in circuit where 2 or more circuit elements meet
  - ✗ Wire between components are considered part of one node



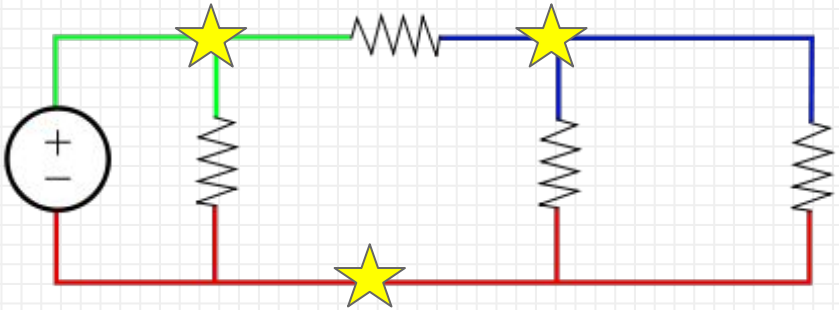

What components?

How many nodes?

Where are these nodes?

# Simple Circuit

- ✘ Components (Resistors, LEDs, Capacitors)
- ✘ Nodes
  - ✗ Point in circuit where 2 or more circuit elements meet
  - ✗ Wire between components are considered part of one node

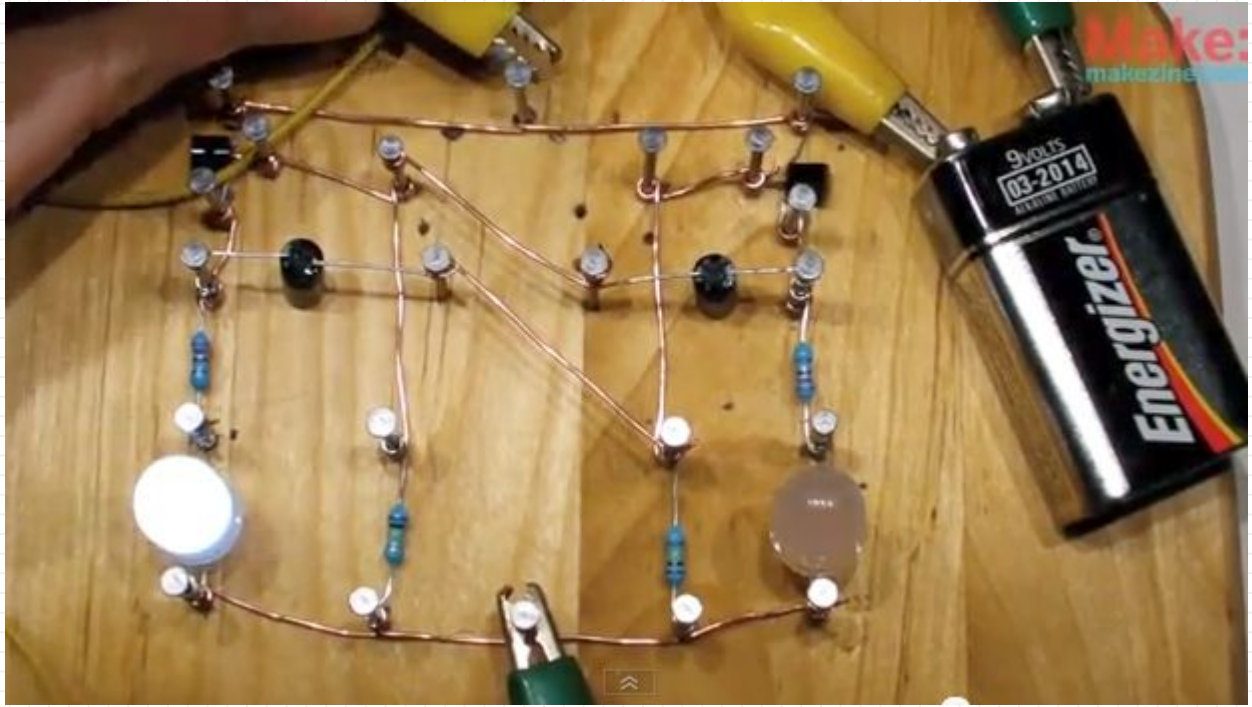


What components?

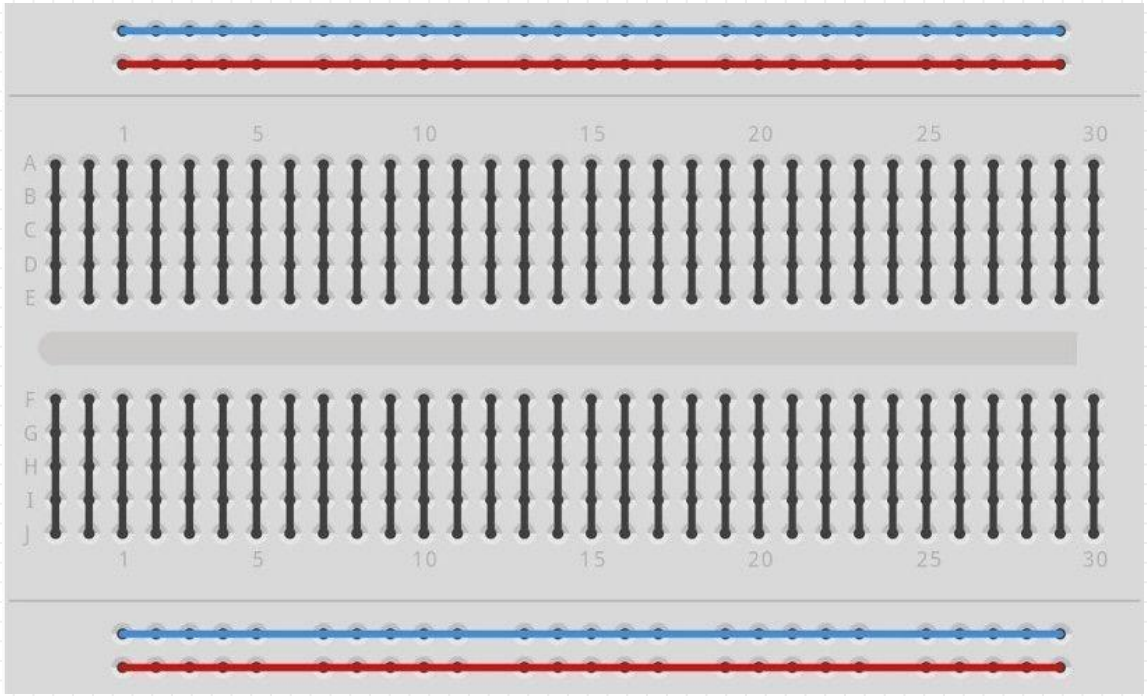
How many nodes? **3**

Where are these nodes?

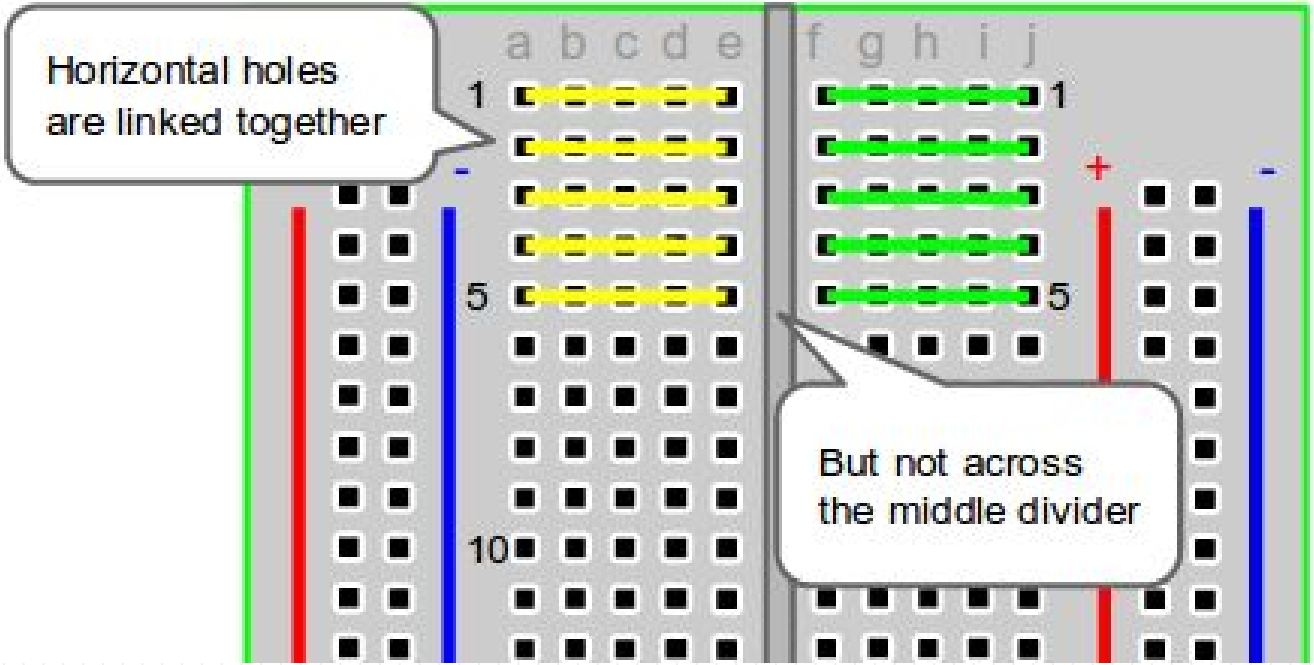
# Bread Board



# Breadboard

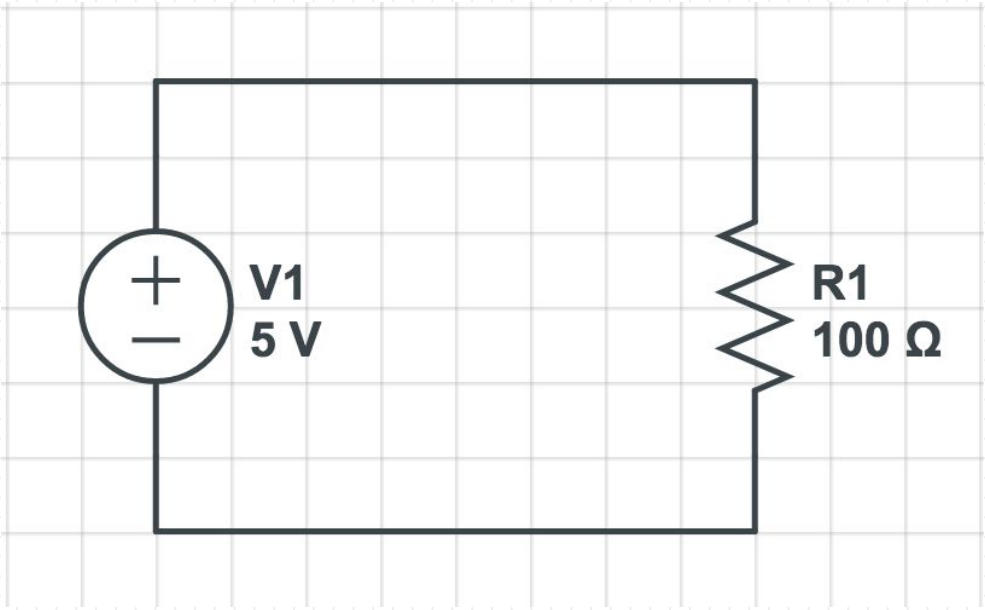


# Breadboard


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

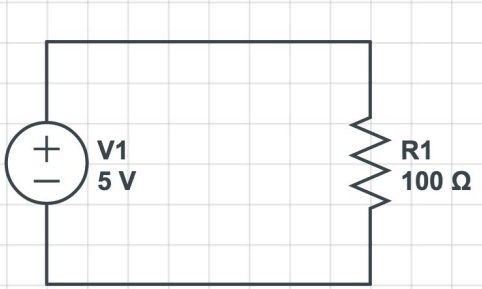
# Breadboard Exercise

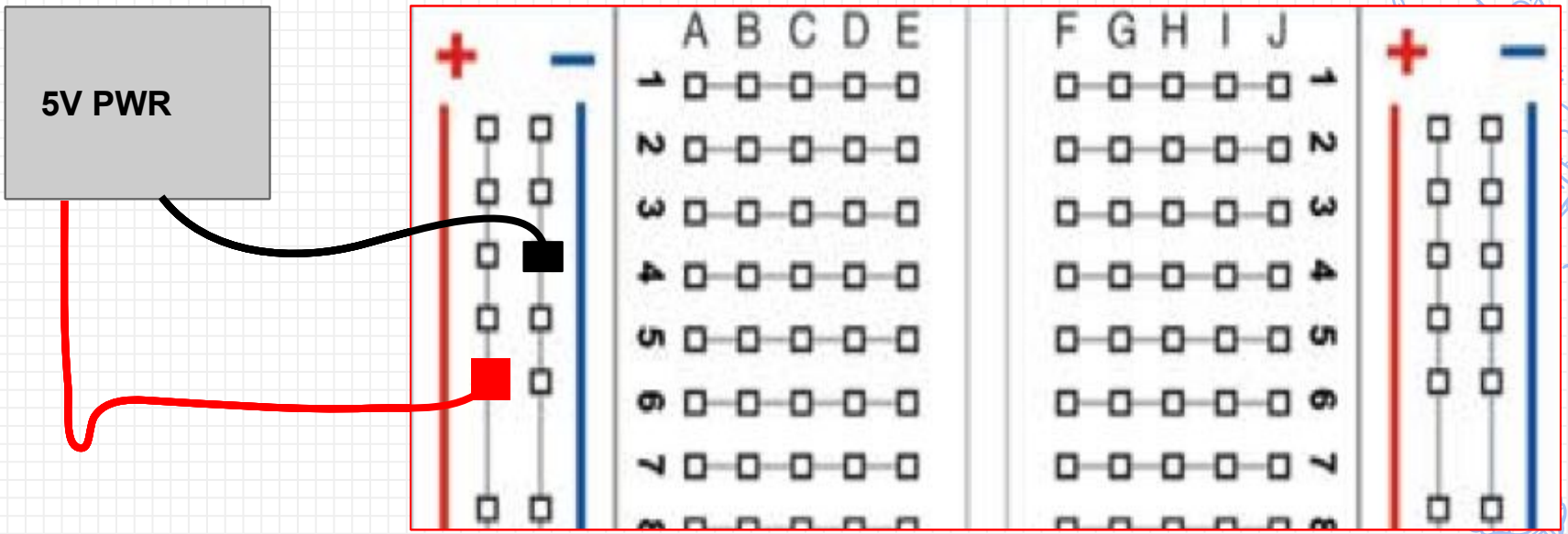
How do we translate from this to the physical world?



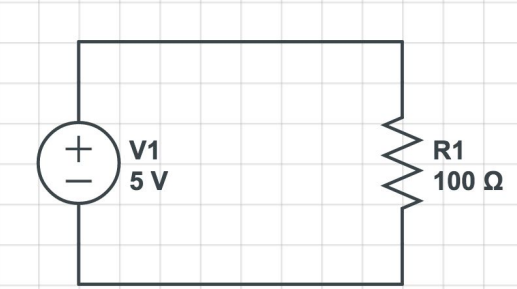
# Breadboard Exercise

Start with voltage source! [power rails]

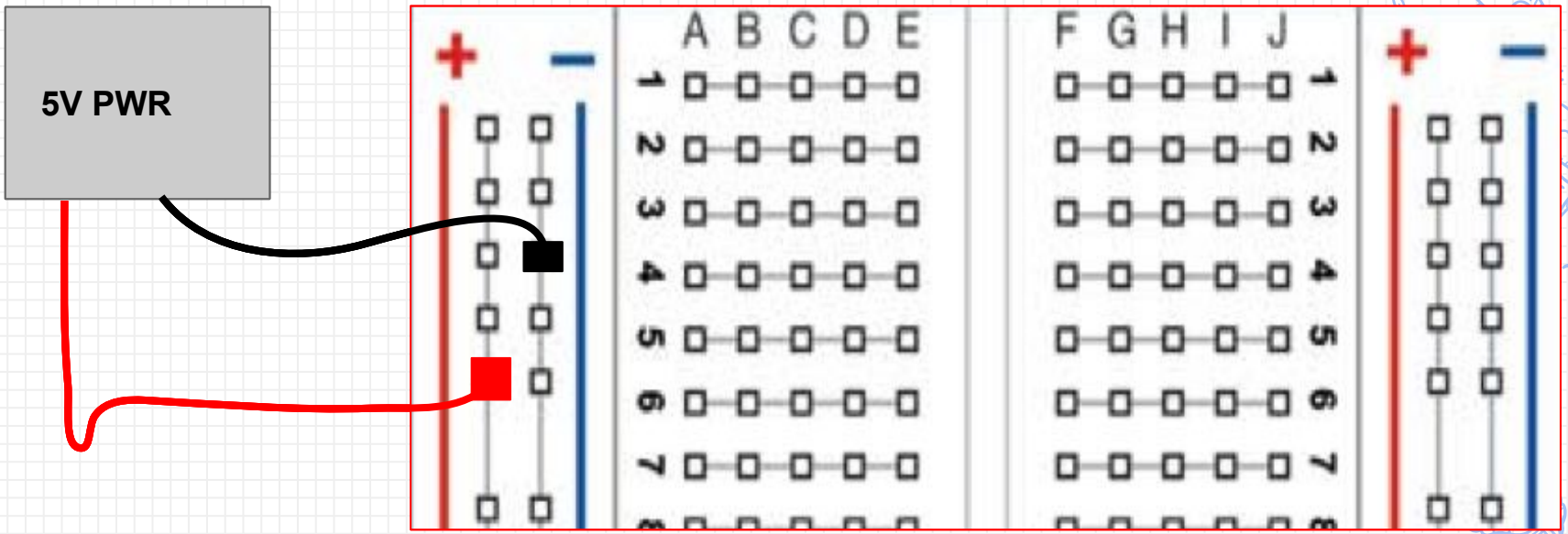


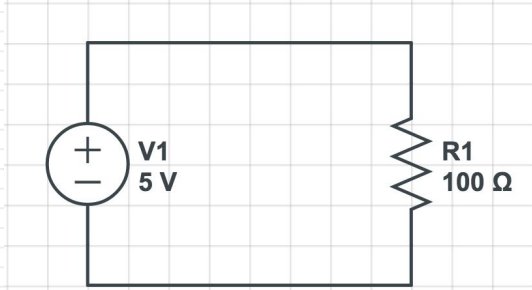
# Breadboard Exercise




Which holes are 0V and which are 5V?
(recall: horizontally linked VS vertically linked)



# Breadboard Exercise

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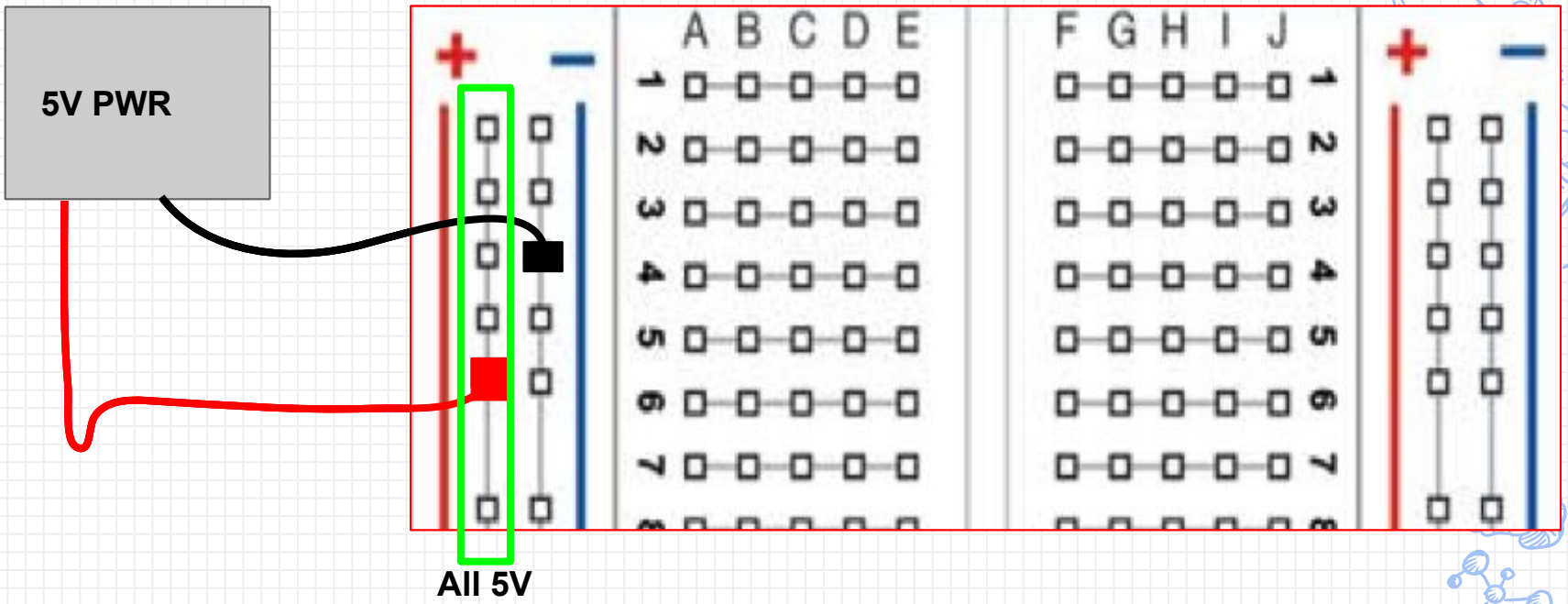
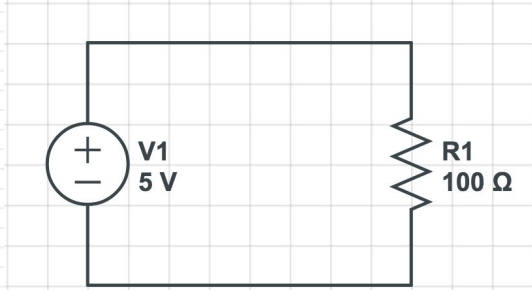


# Breadboard Exercise

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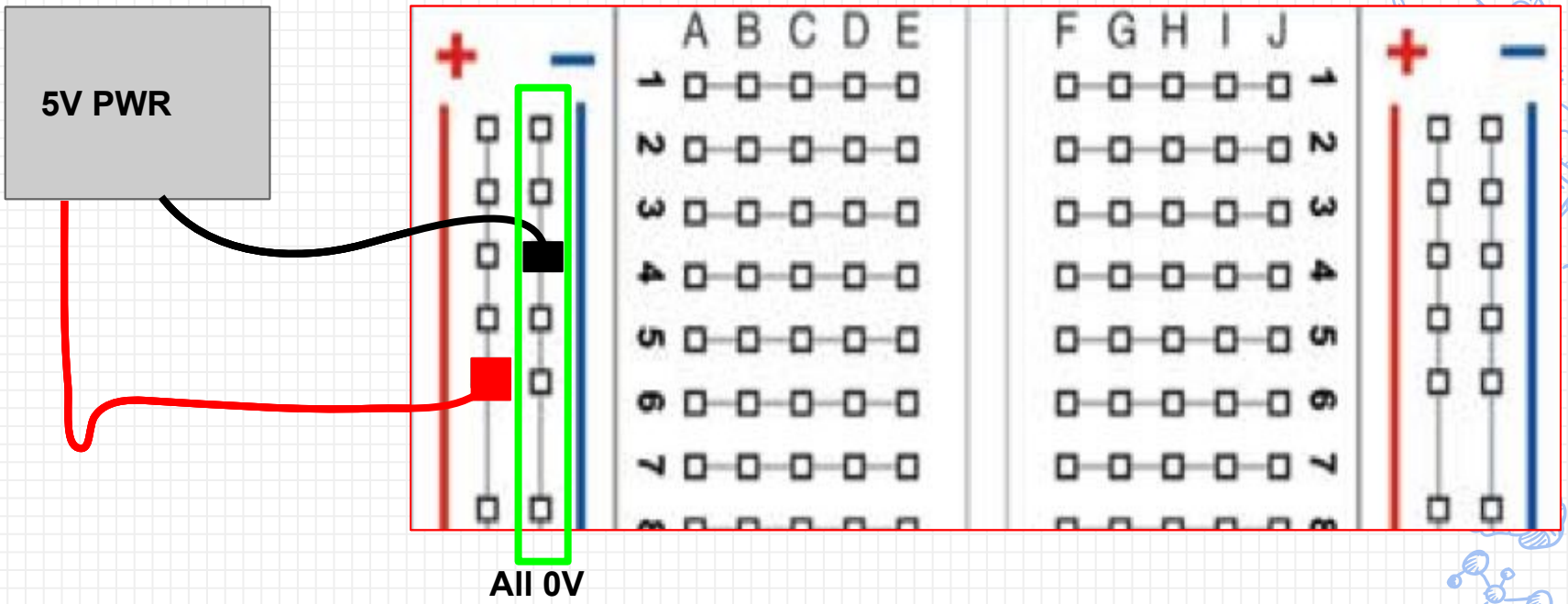
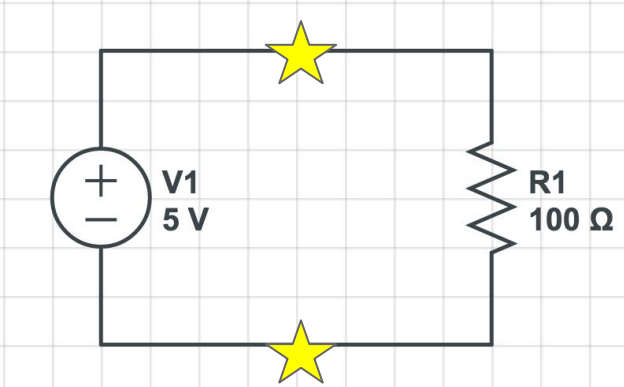
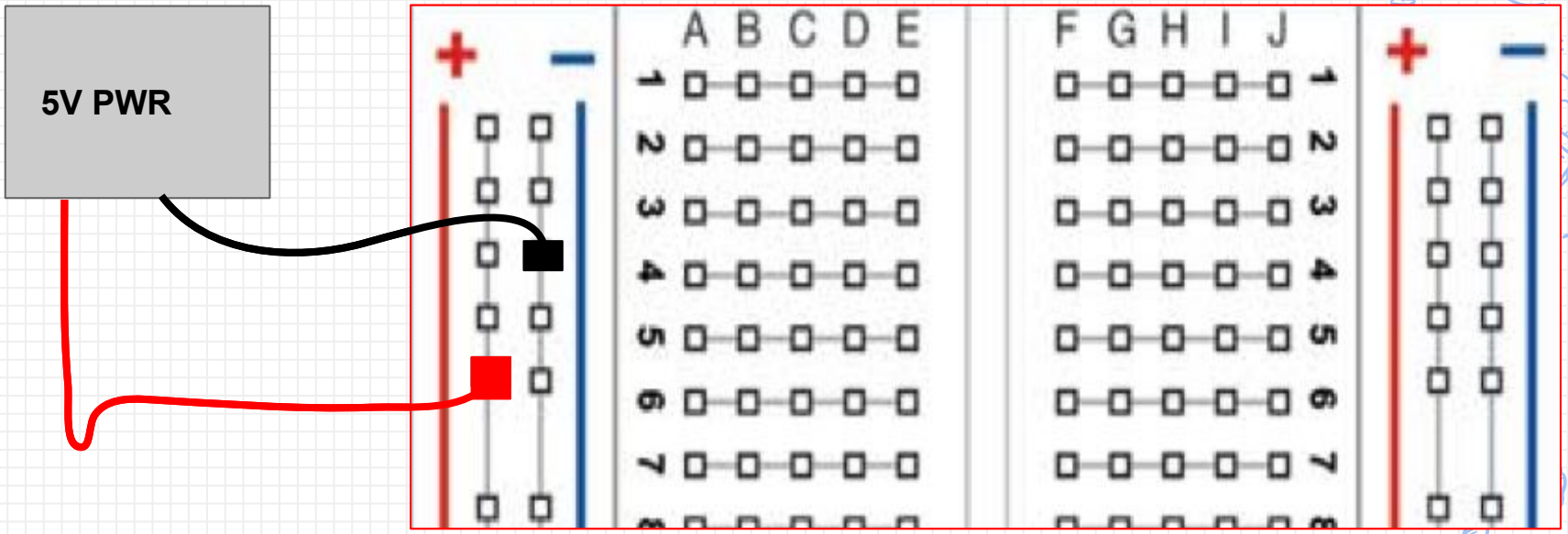


# Breadboard Exercise

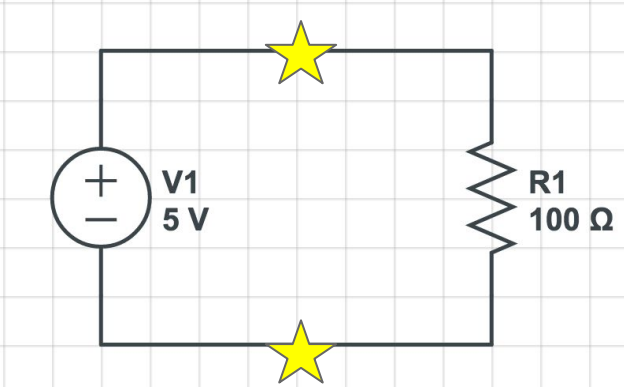
What are the different nodes? [different nodes = different rows]

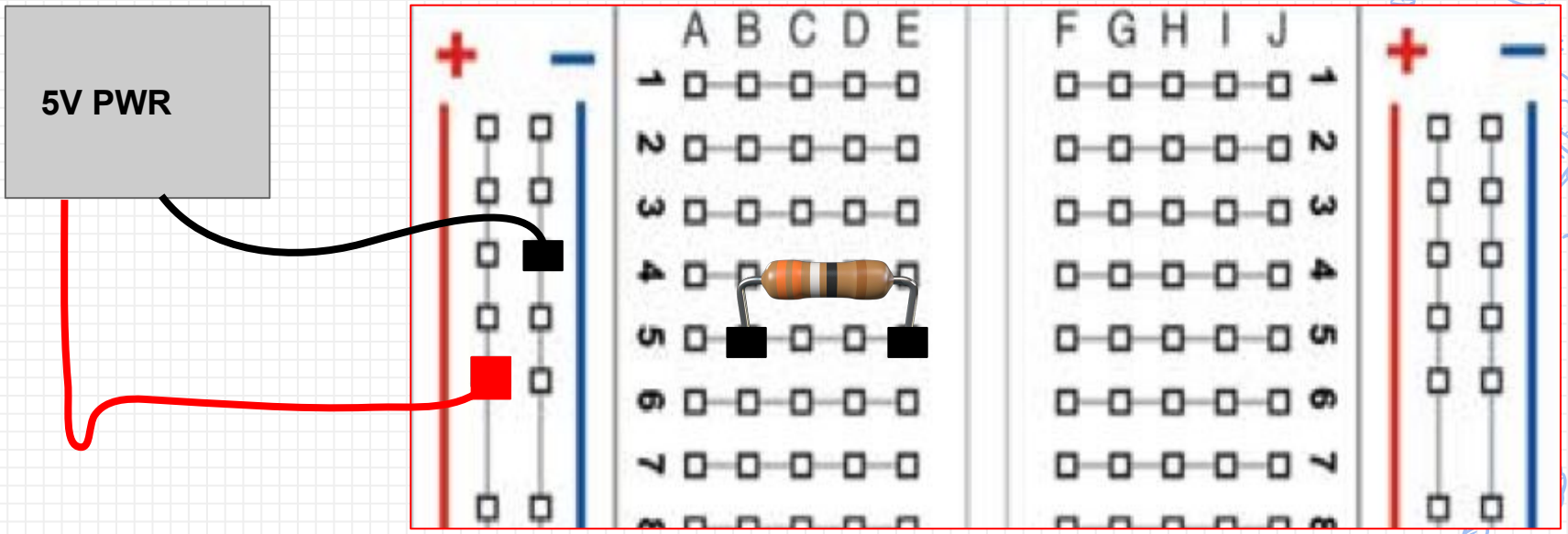


# Breadboard Exercise

Place the resistor!



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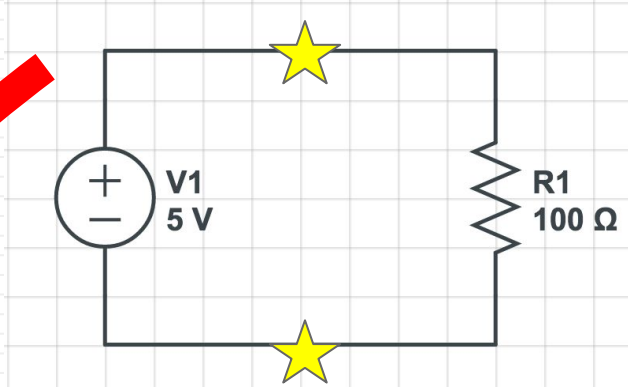
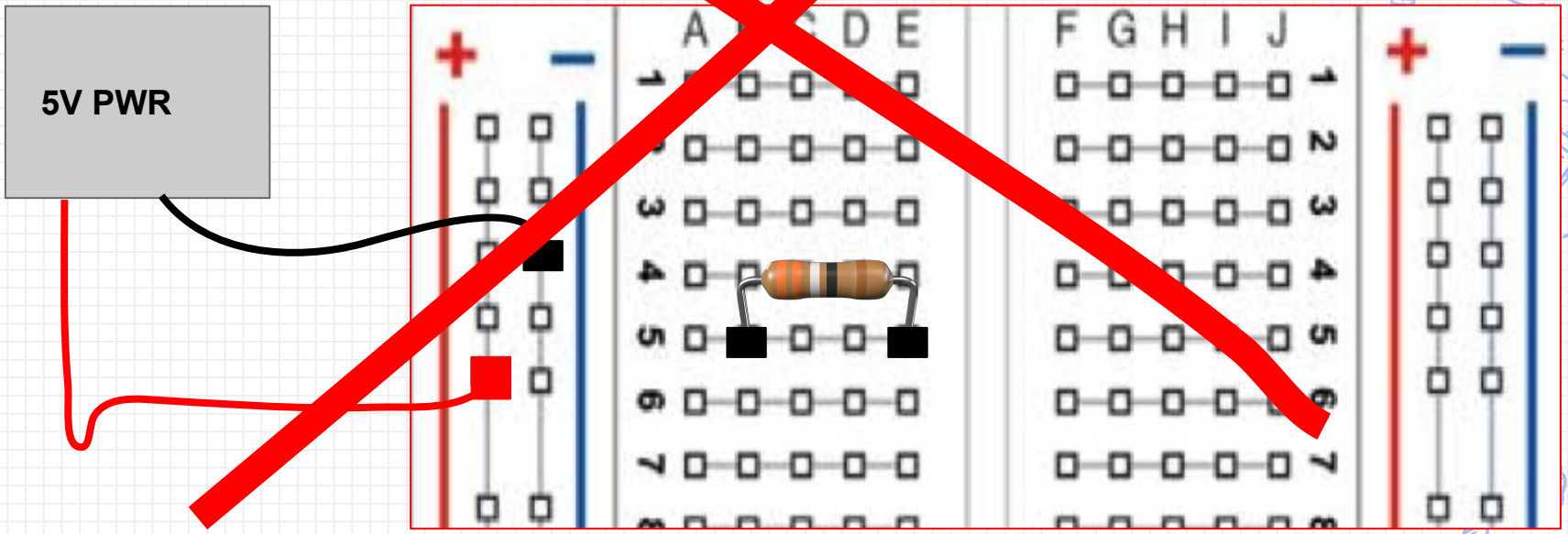
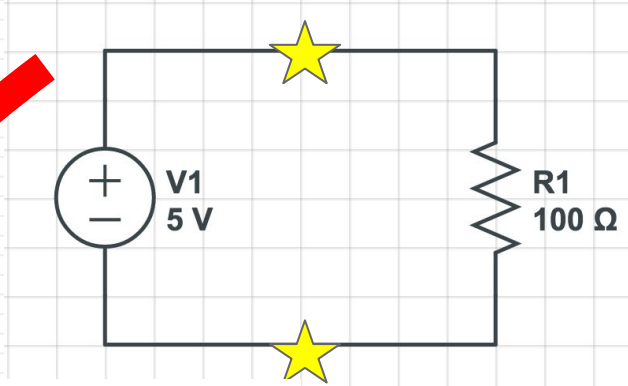


Graphic design is my passion

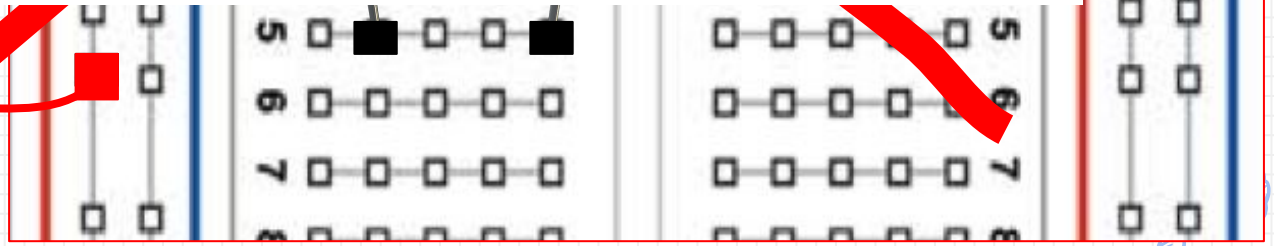
# Breadboard Exercise

Place the resistor!



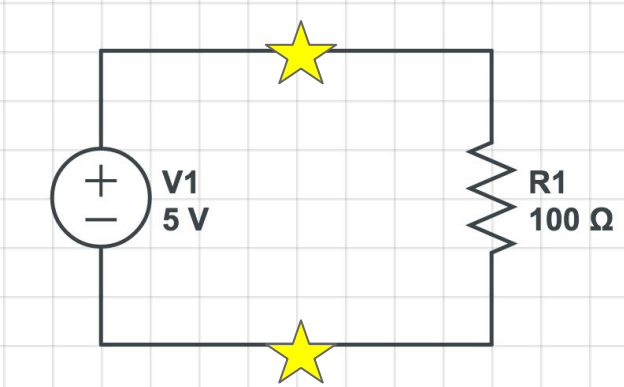

5V PWR

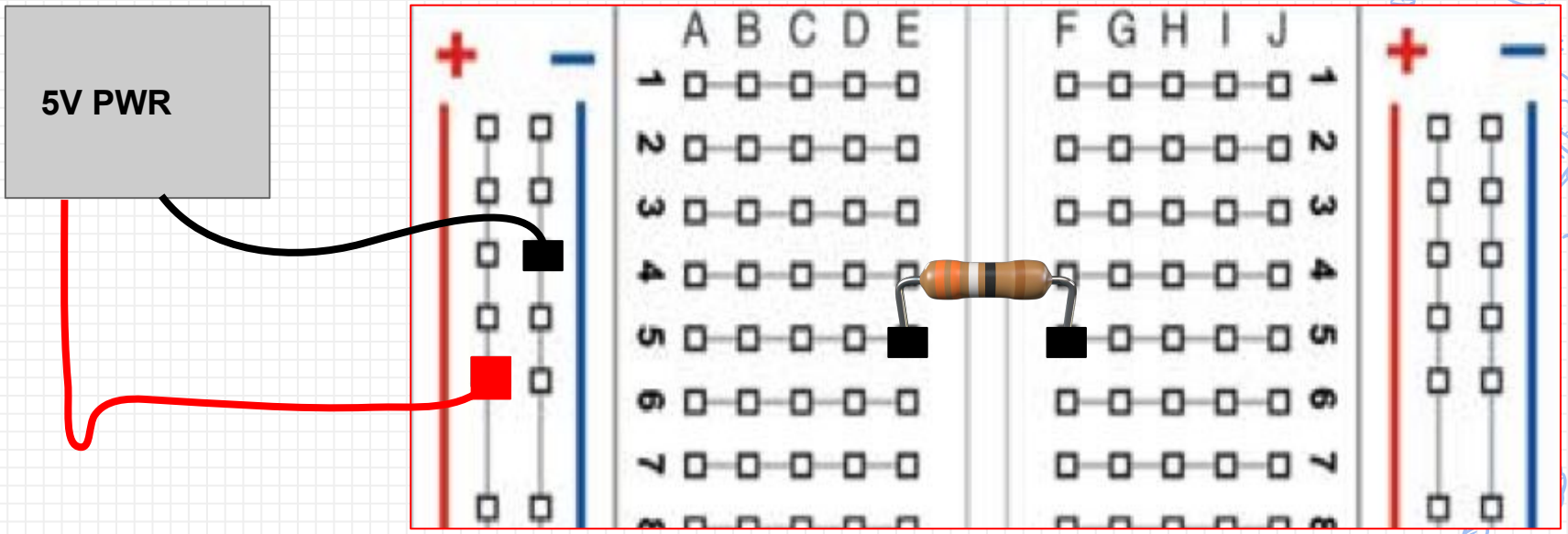
*** A component should NEVER have both ends in the same node**



# Breadboard Exercise

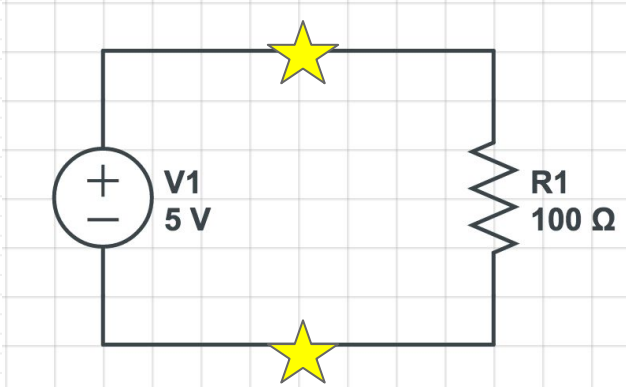
Place the resistor!

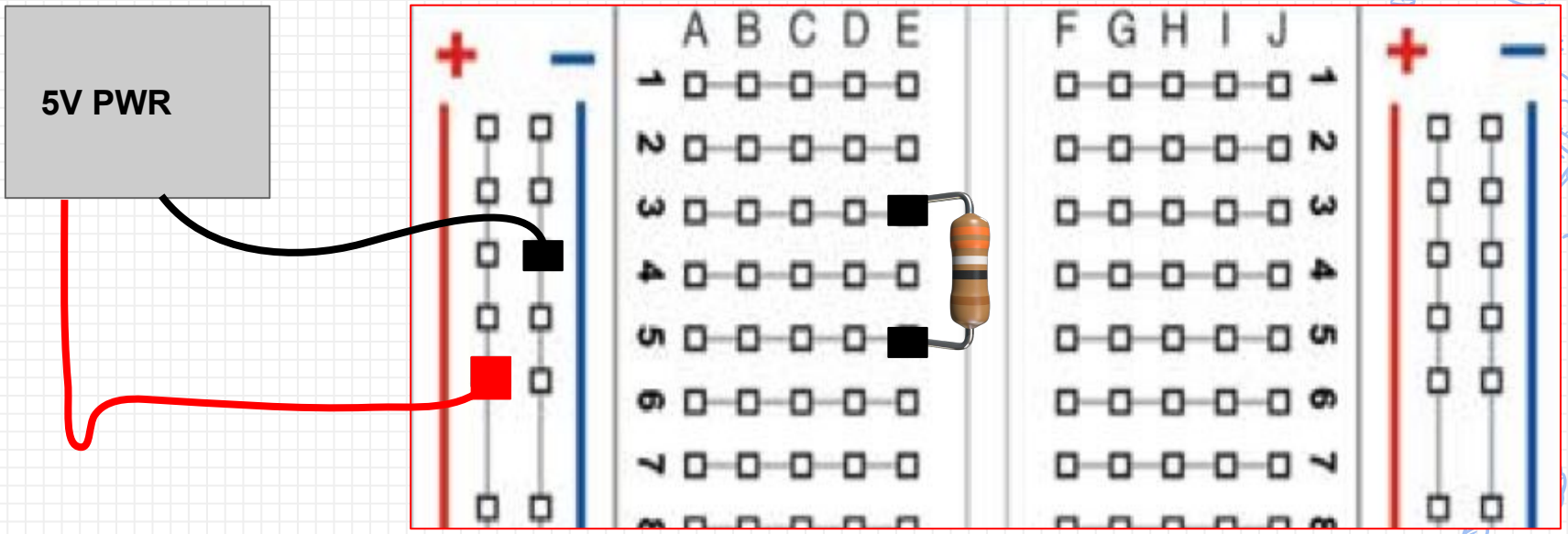


# Breadboard Exercise

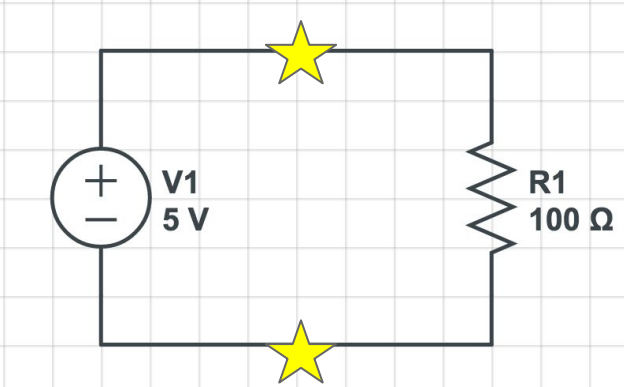
Place the resistor!

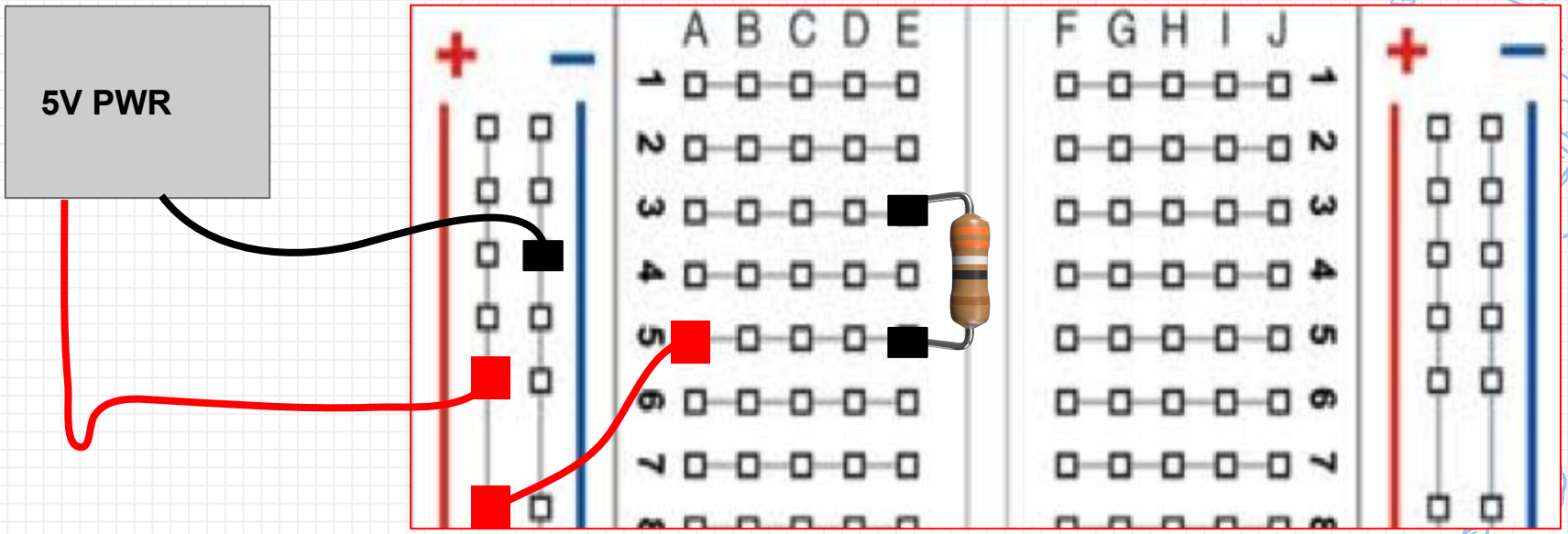


# Breadboard Exercise

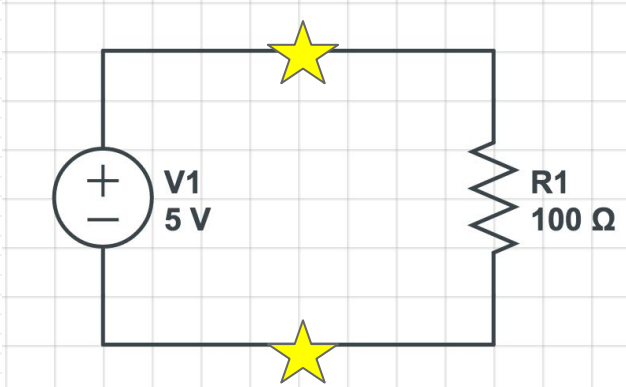
Connect the resistor to the power source

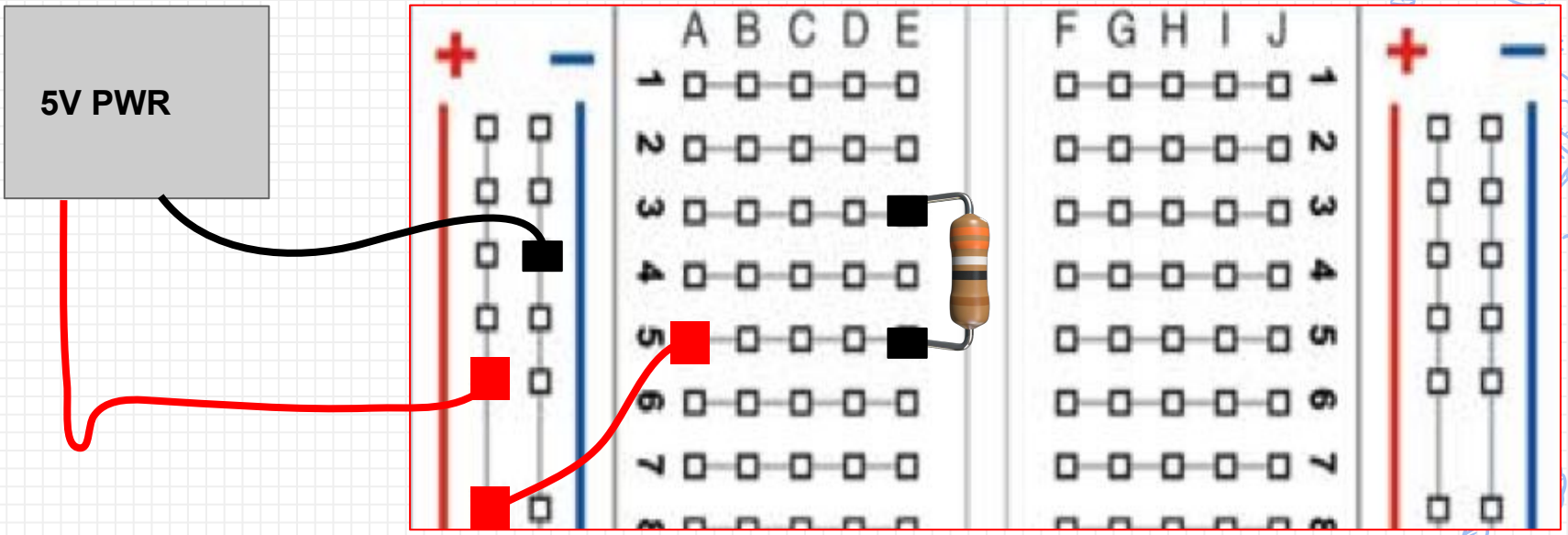


# Breadboard Exercise

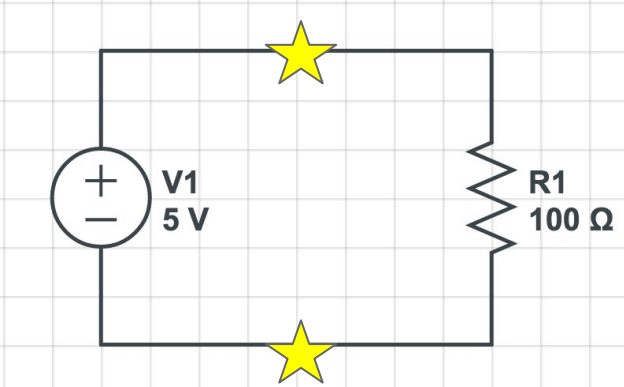
What's 5V? Are we done?

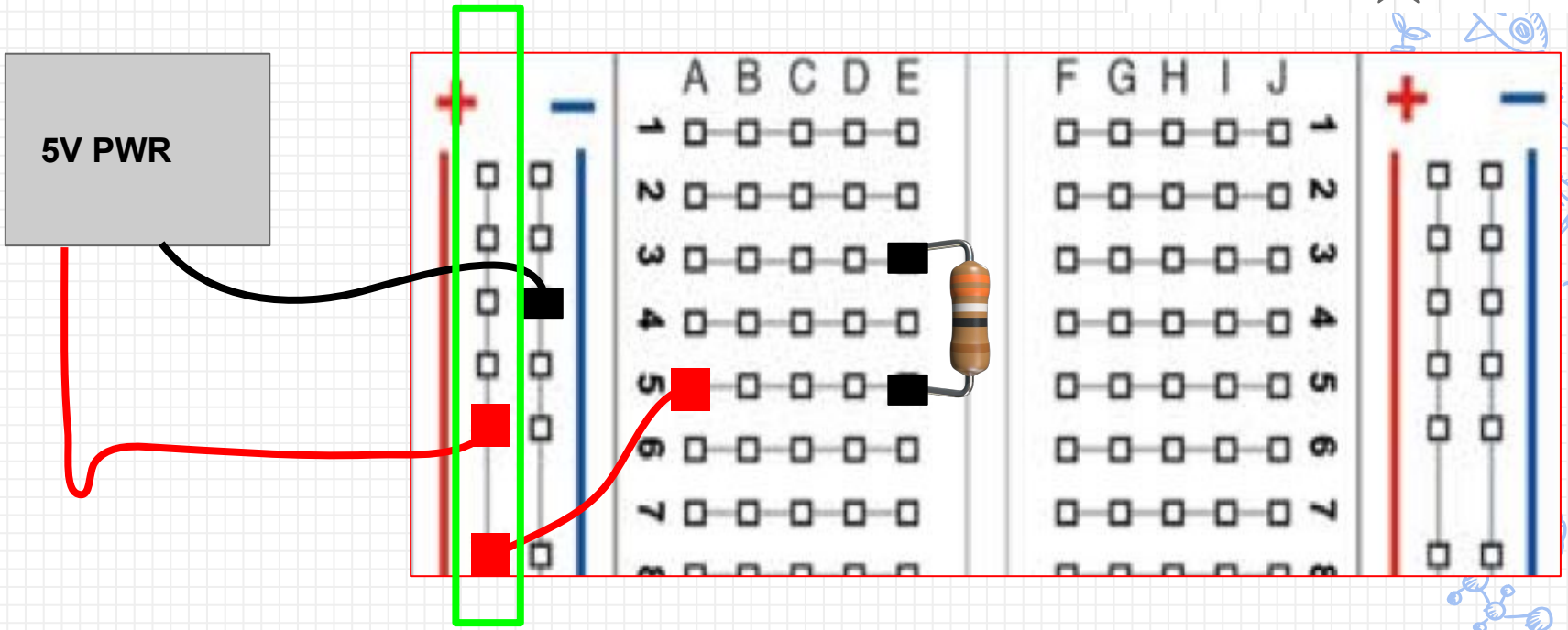


# Breadboard Exercise

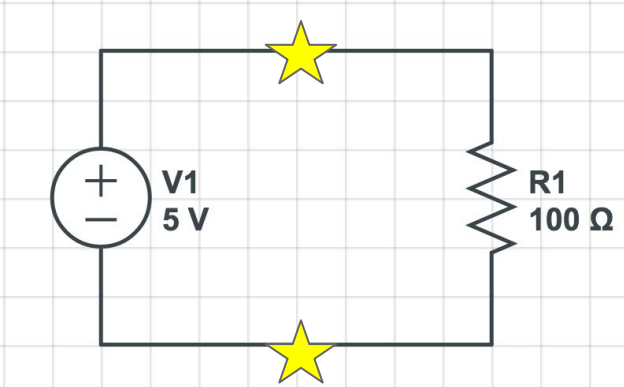
What's 5V? Are we done?

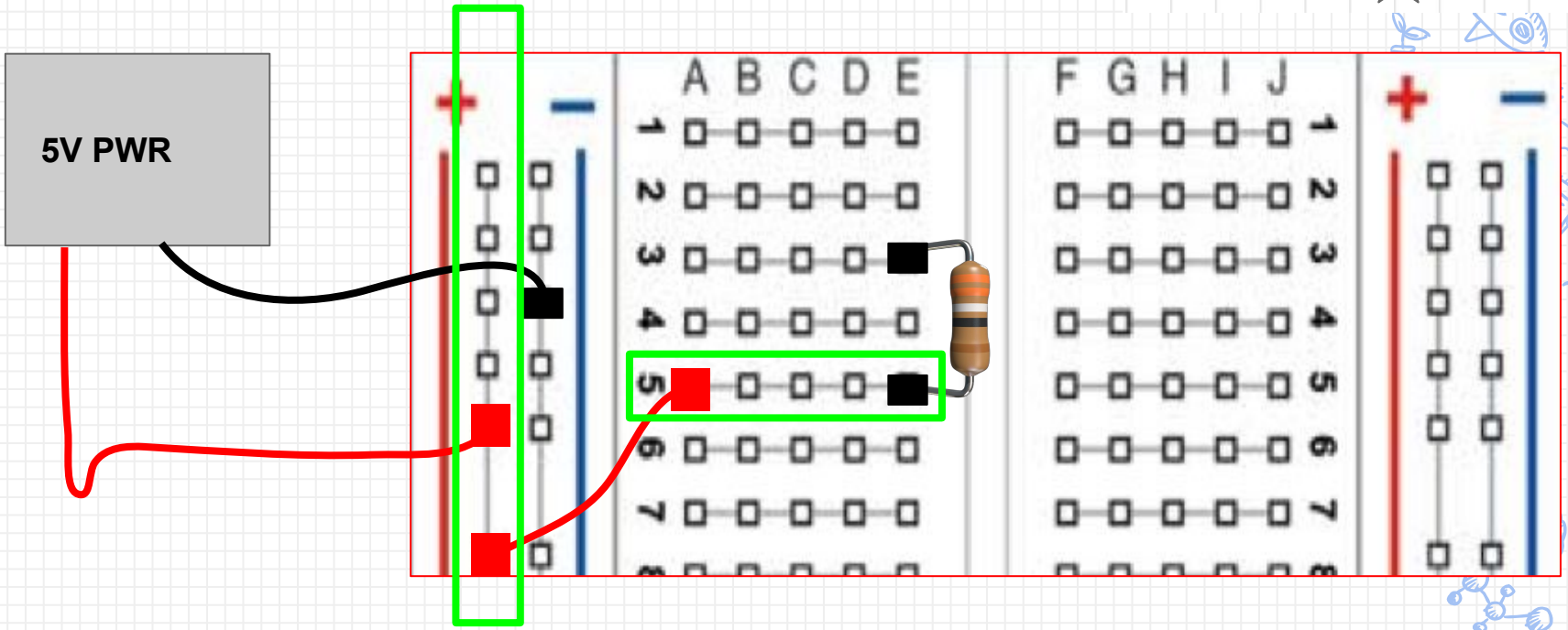


# Breadboard Exercise

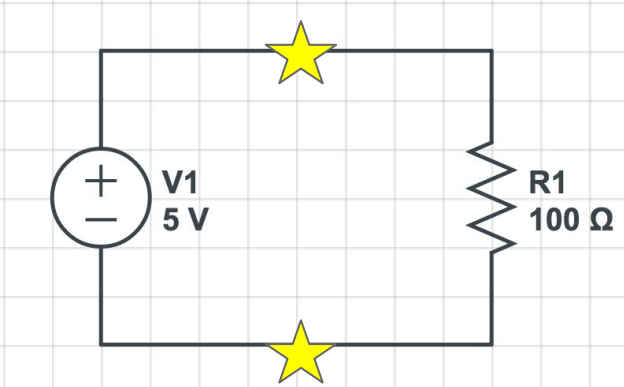
What's 5V? Are we done?

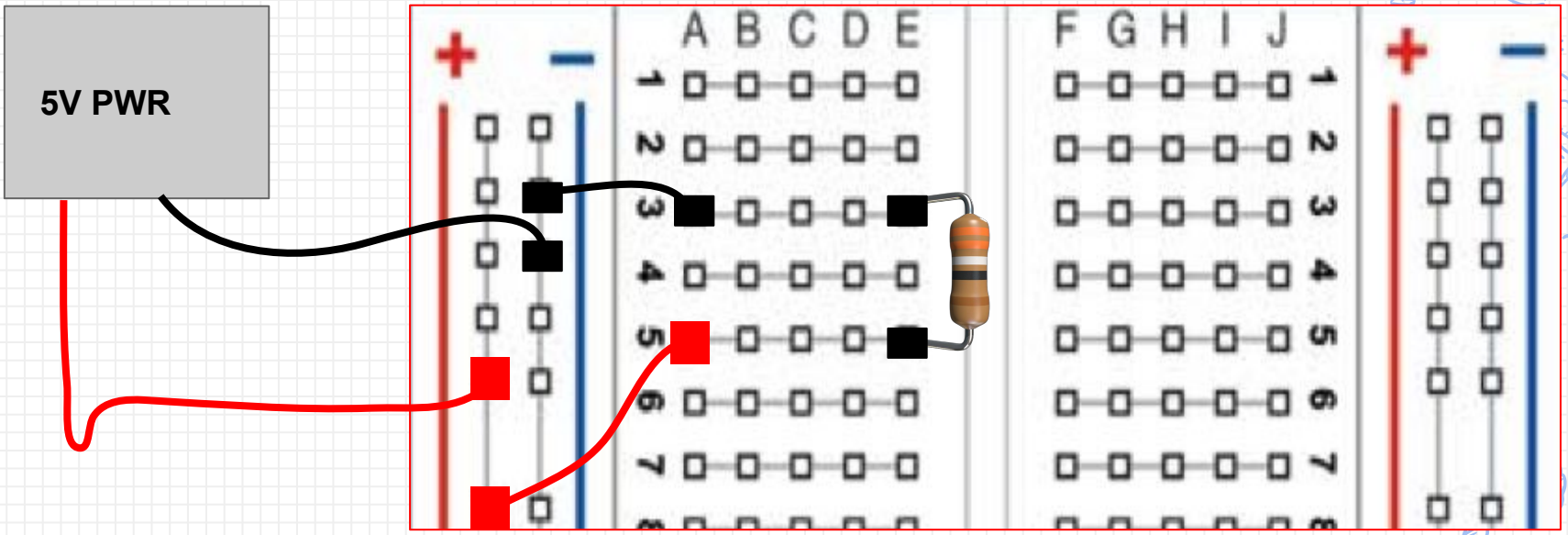


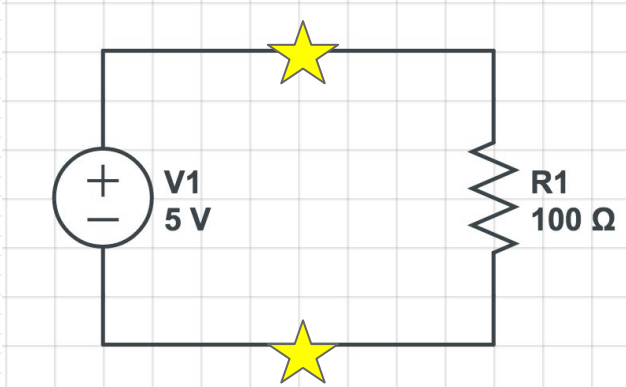
# Breadboard Exercise

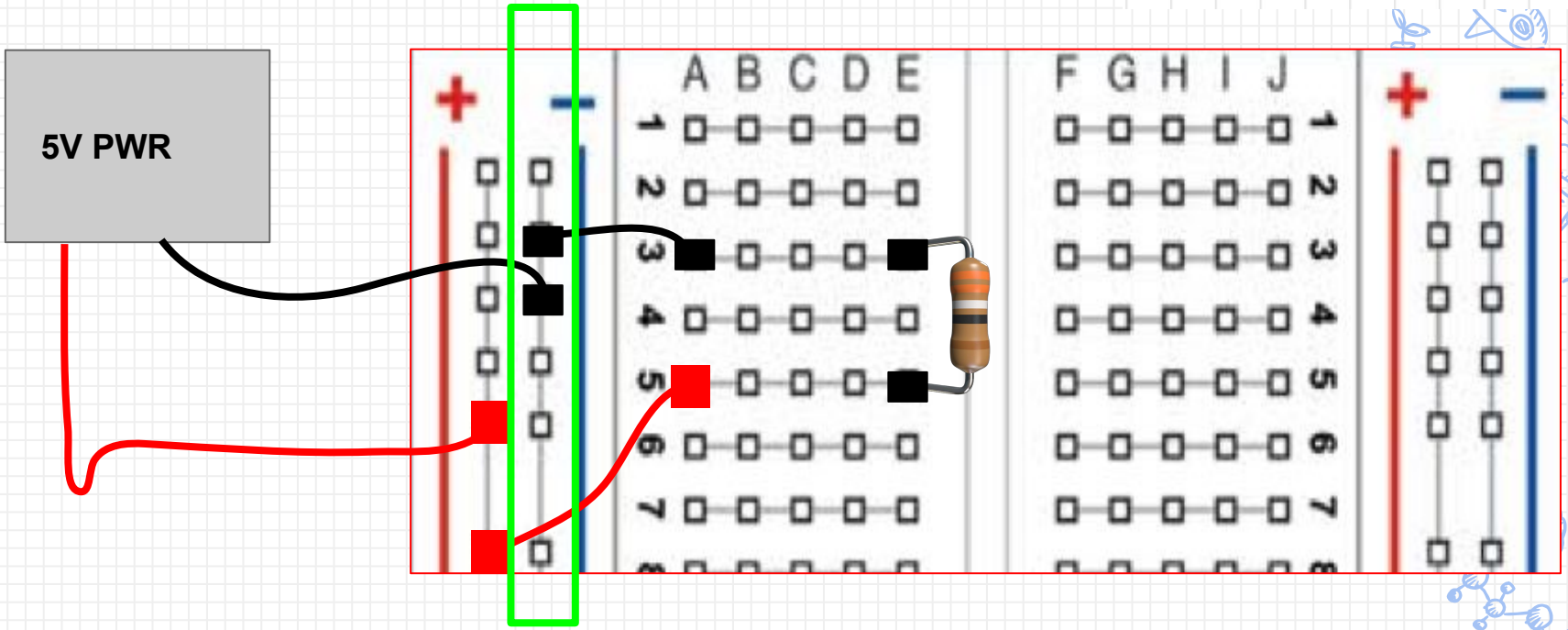
Need to connect the other end of the resistor
What's 0V?



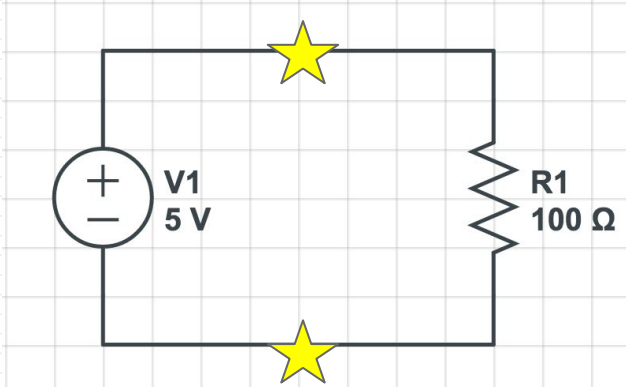



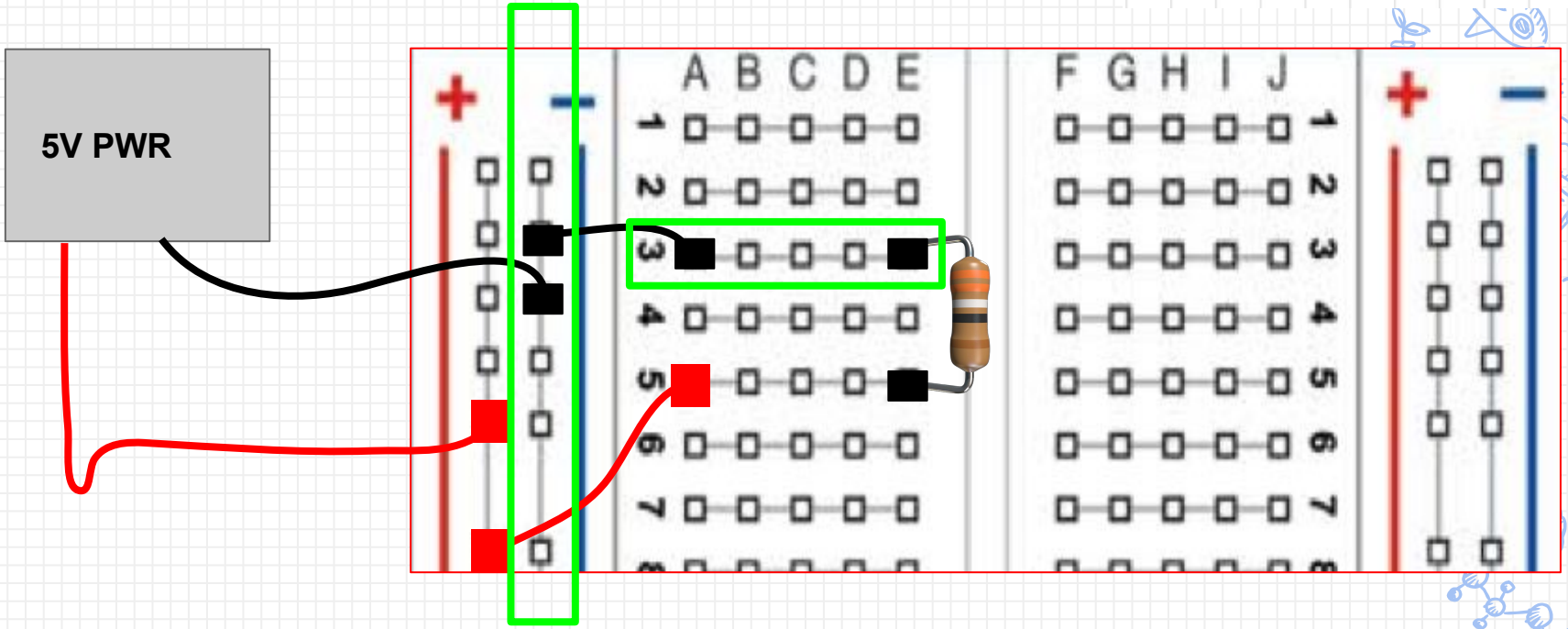
# Breadboard Exercise



# Breadboard Exercise

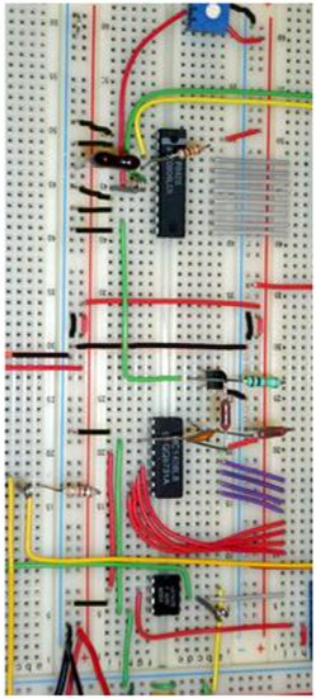


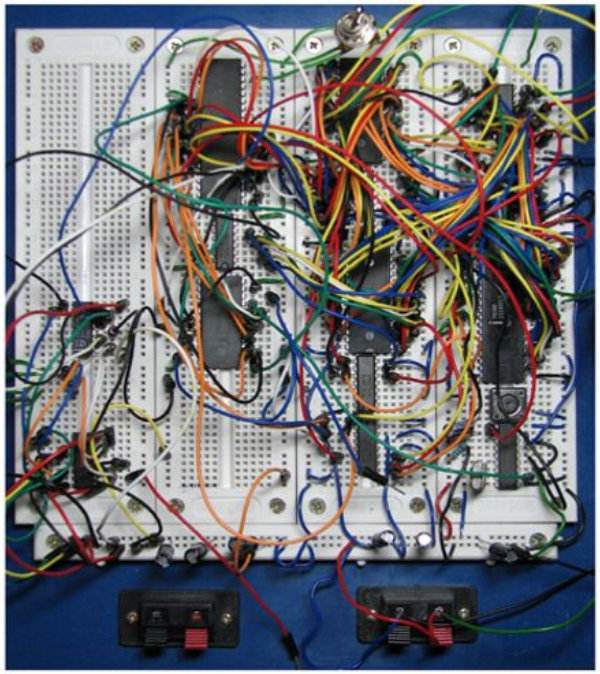
## Key Takeaway

- ✘ A component should **NEVER** have both ends in the same node
- ✘ Always **ground** your circuit!
- ✘ Wires **link** previously unconnected rows together to form **one node**

# Breadboard Best Practices

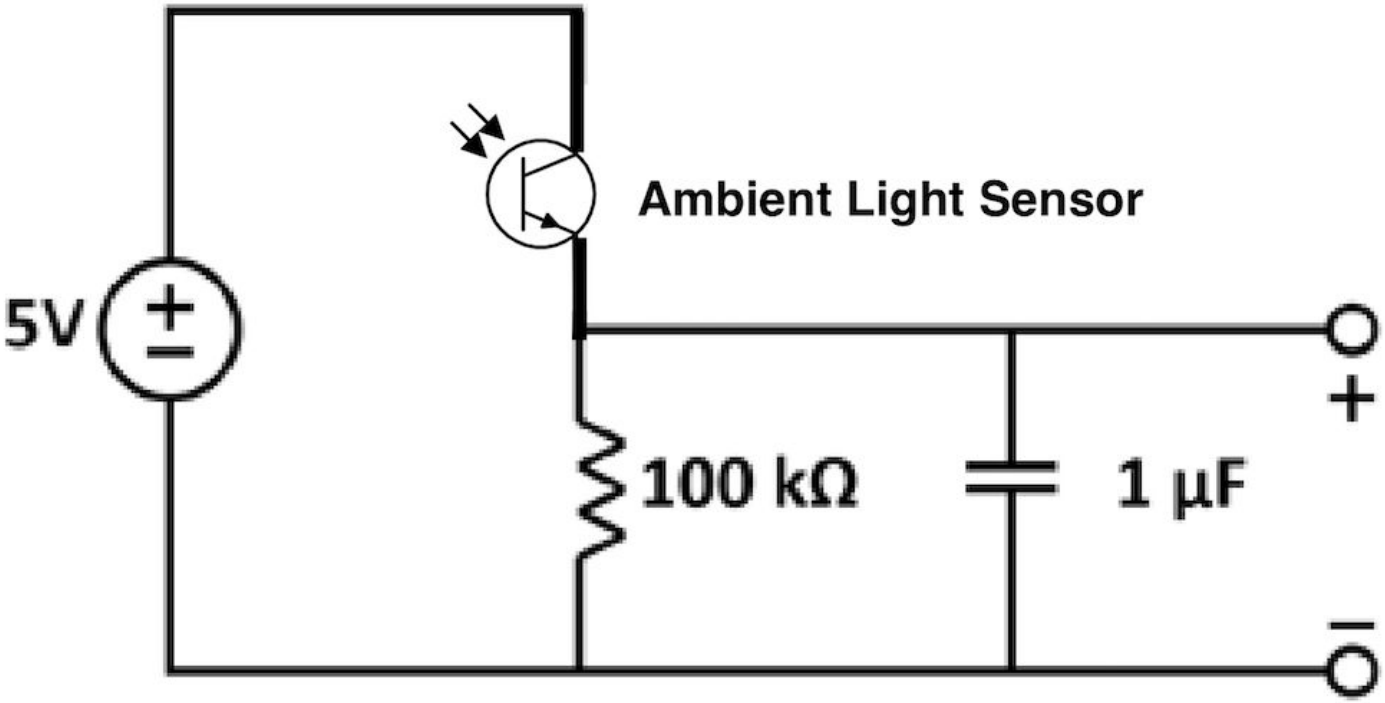


✘ Debuggable

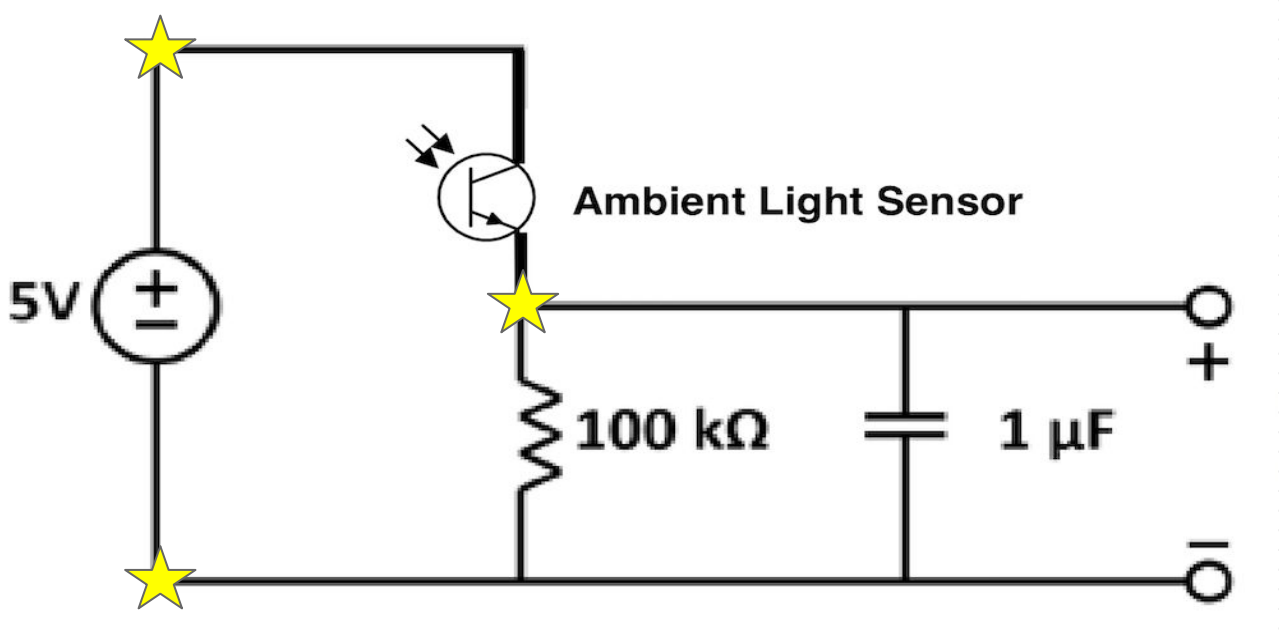


✘ Debugging nightmare

# Light-detecting Circuit

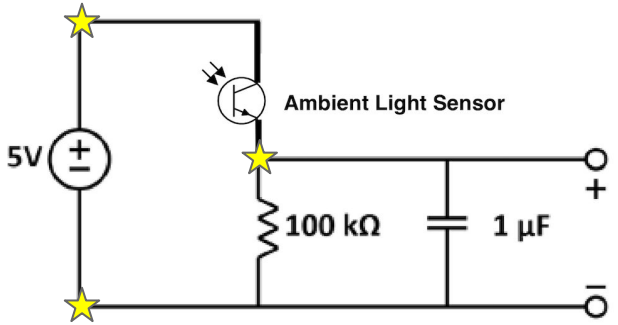


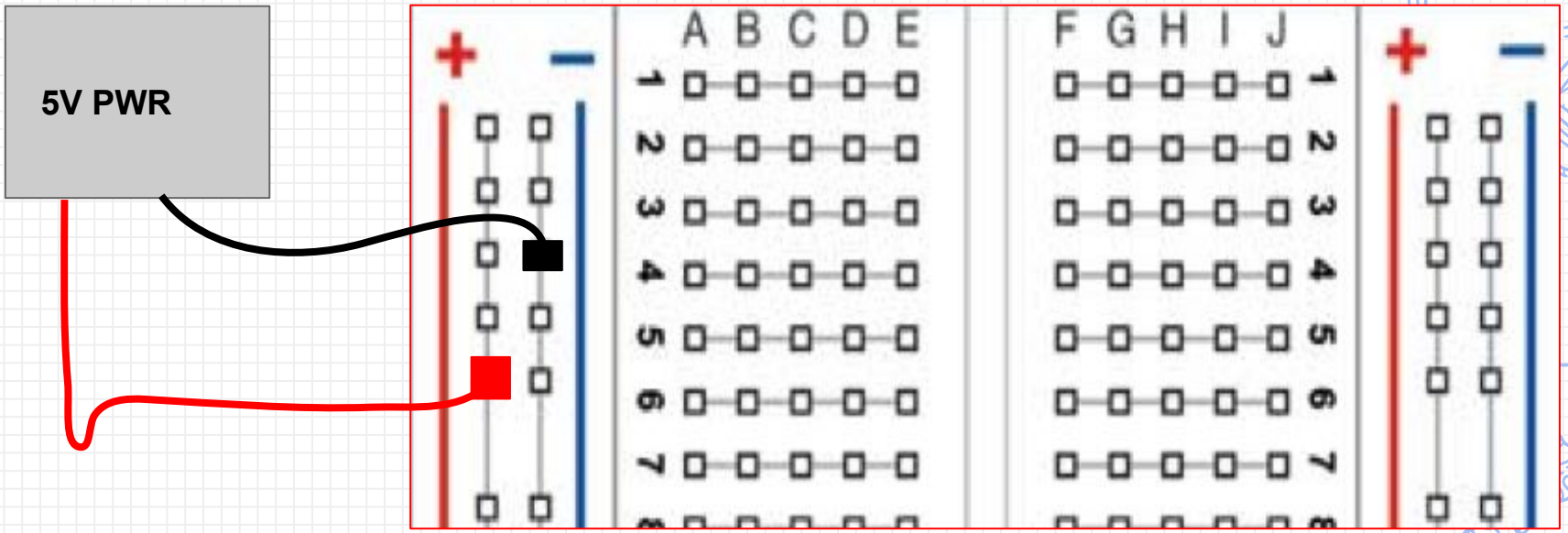
# Light-detecting Circuit



# Light-detecting Circuit

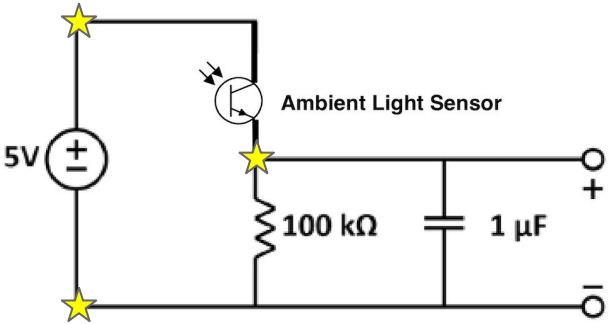
Start with voltage source! [power rails]

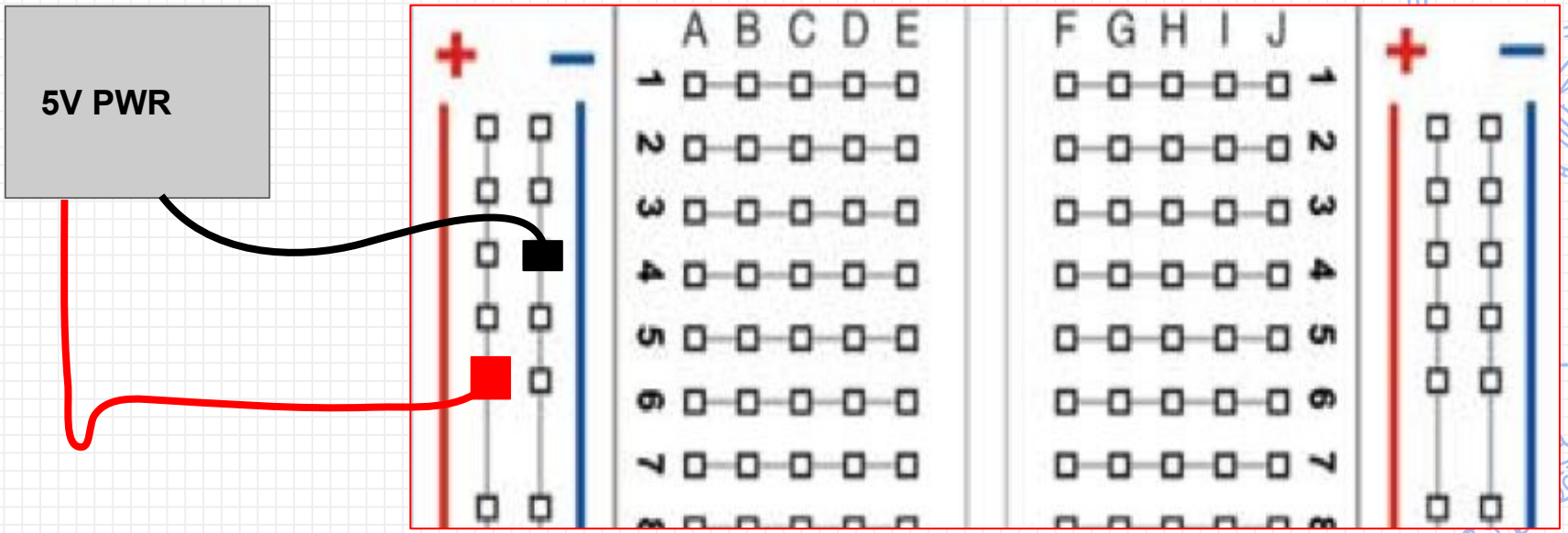


# Light-detecting Circuit

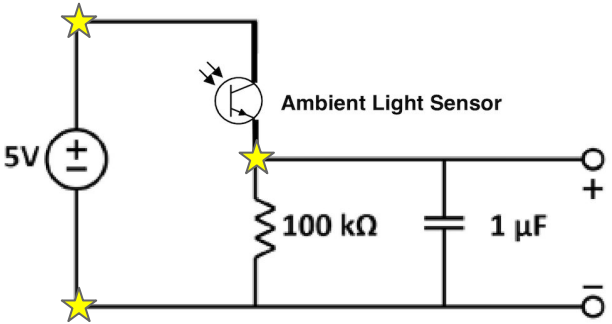
Place ambient light sensor [which nodes?]

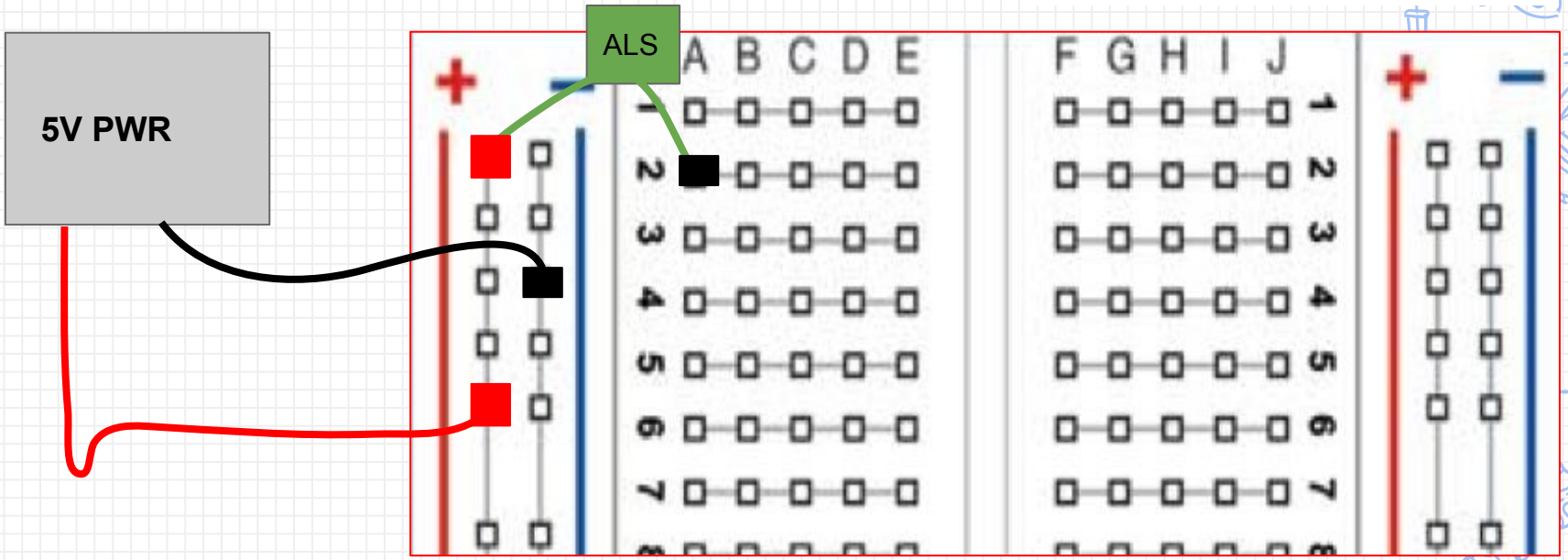


# Light-detecting Circuit

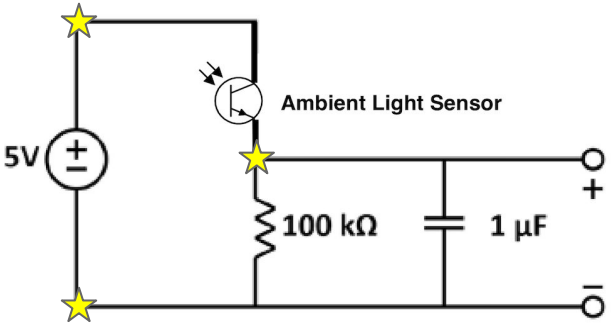
Place the ambient light sensor

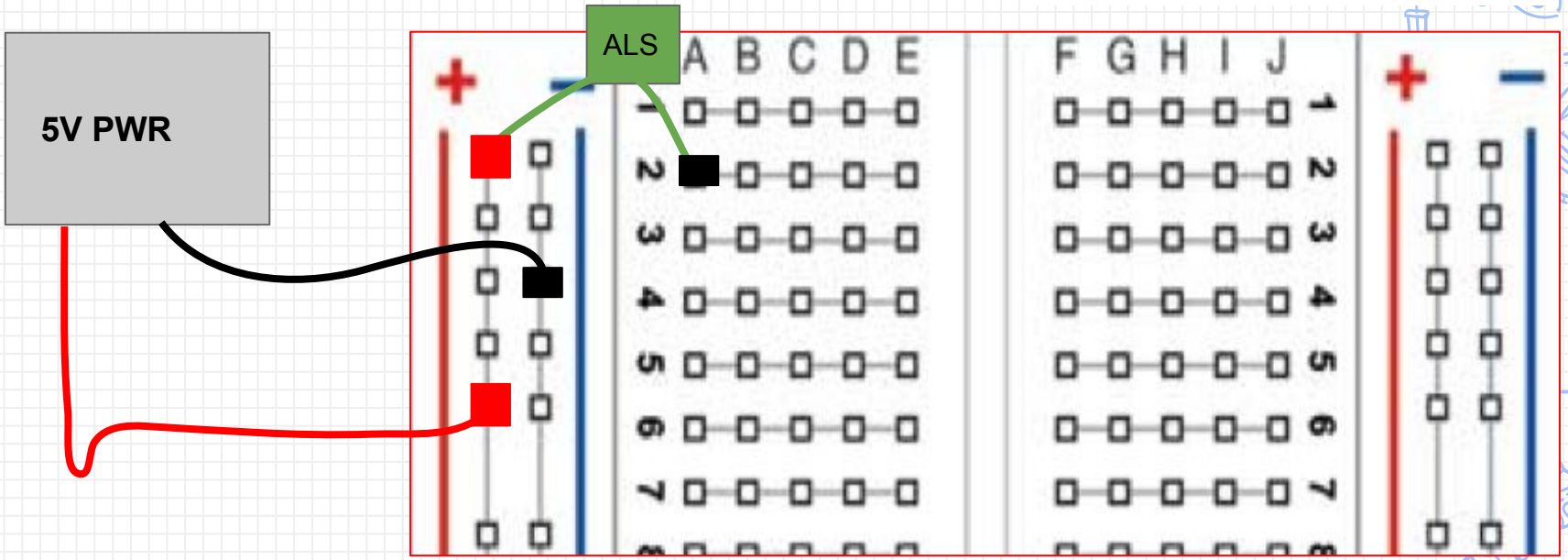


# Light-detecting Circuit

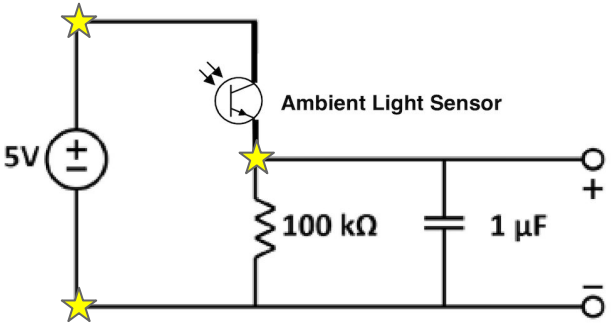
Place the resistor [which nodes?]

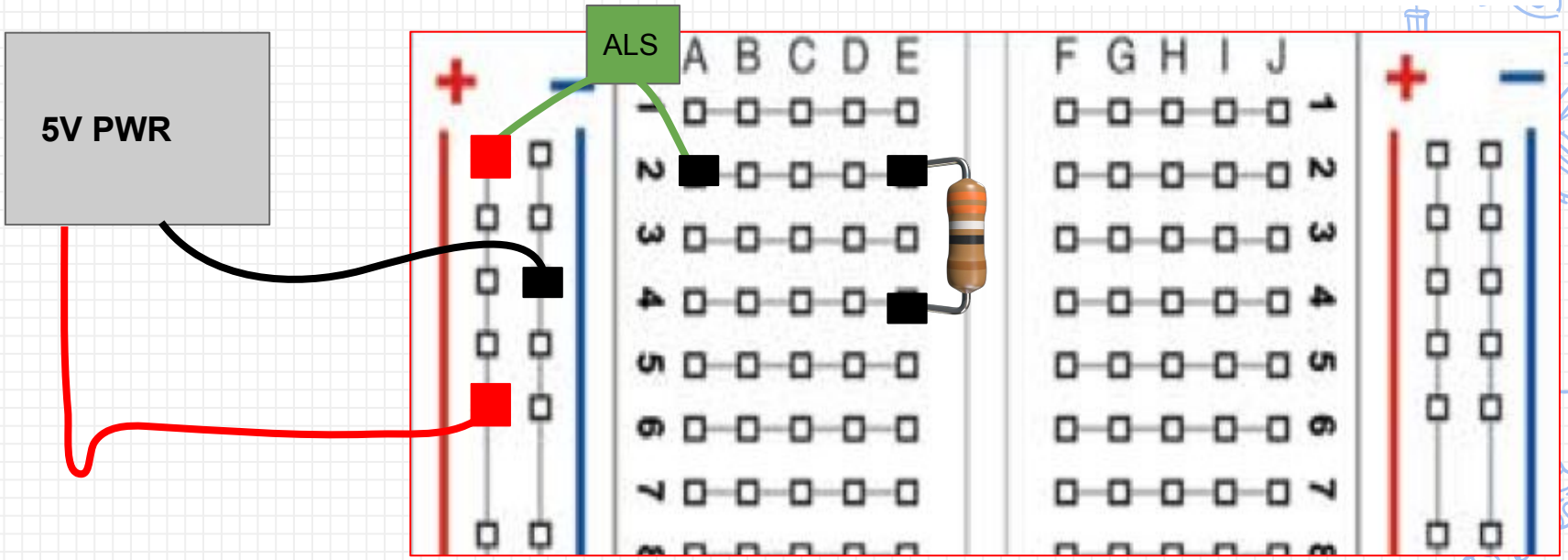


# Light-detecting Circuit

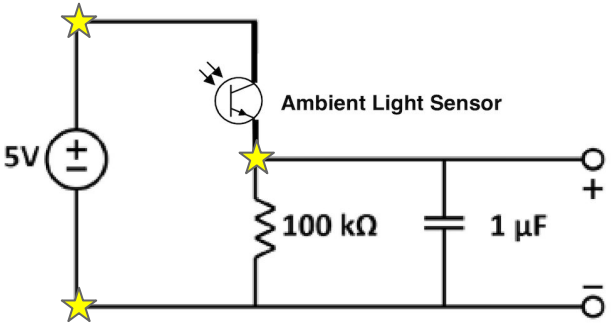
Place the resistor

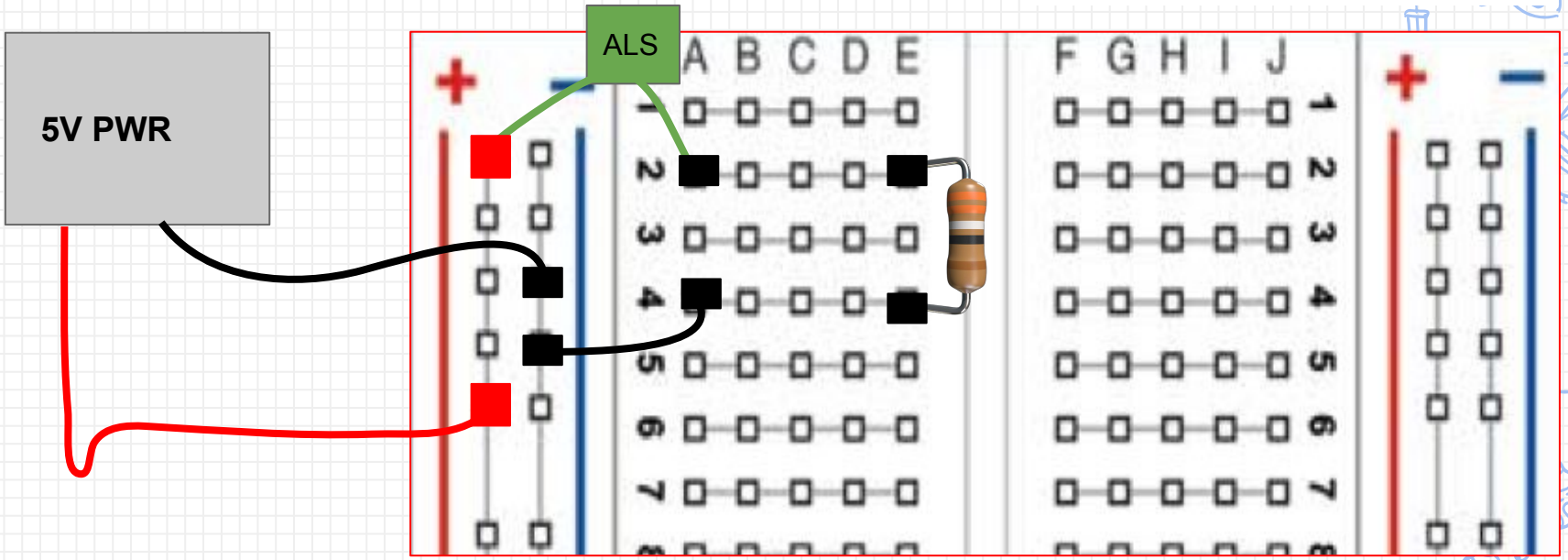


# Light-detecting Circuit

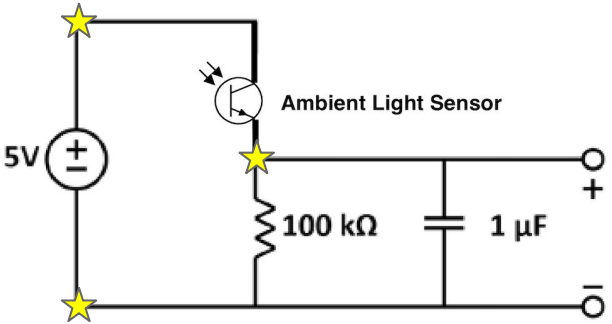
Place the capacitor [where?]

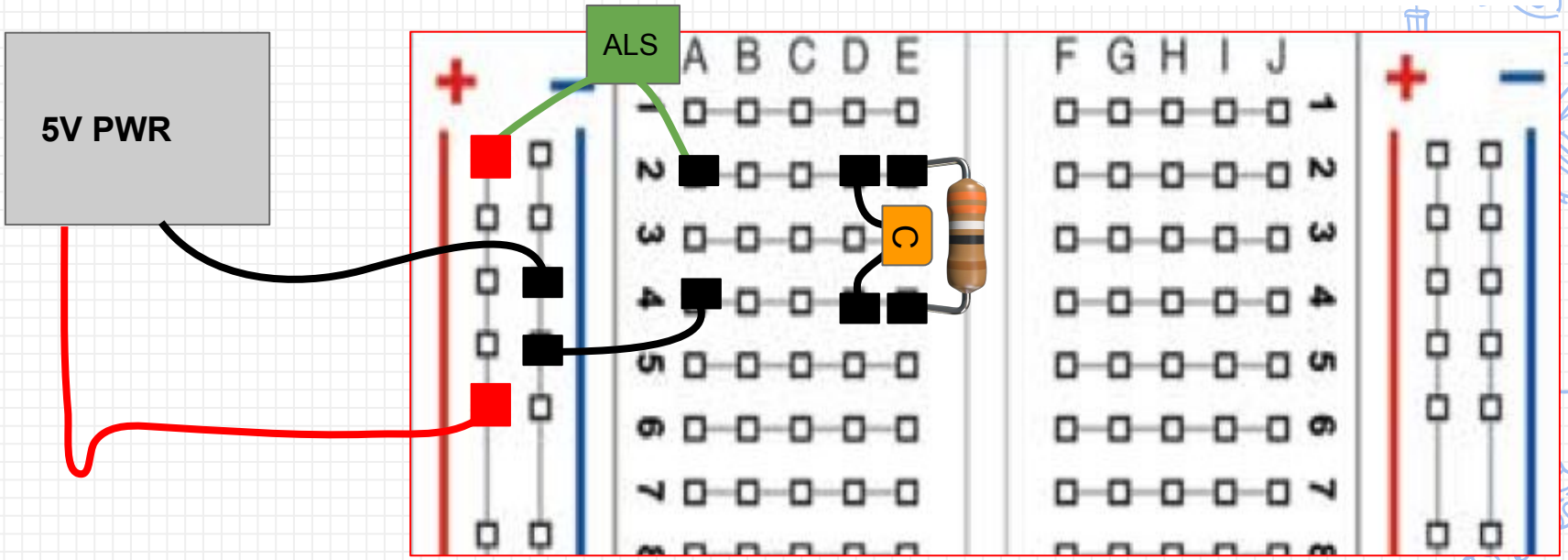


# Light-detecting Circuit

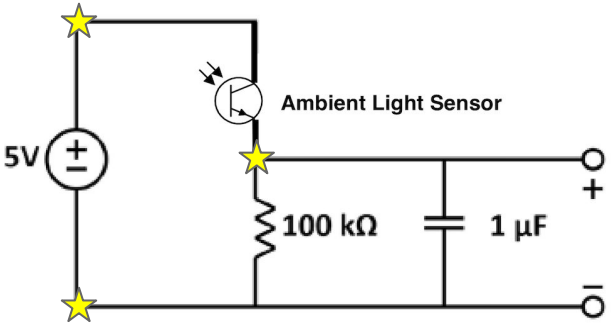
Place the capacitor

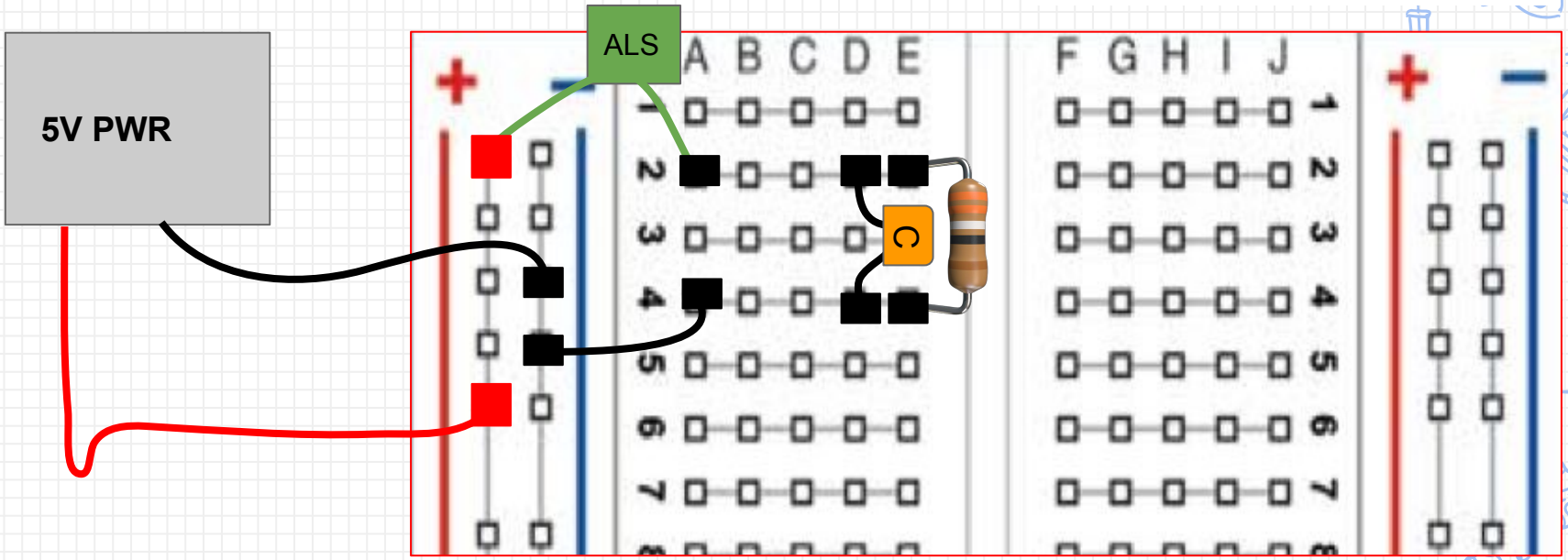


# Light-detecting Circuit

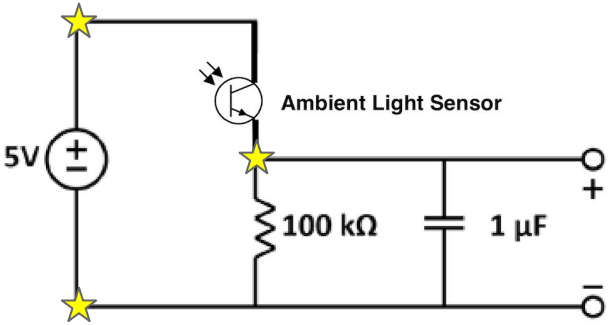
Probes! [which nodes?]

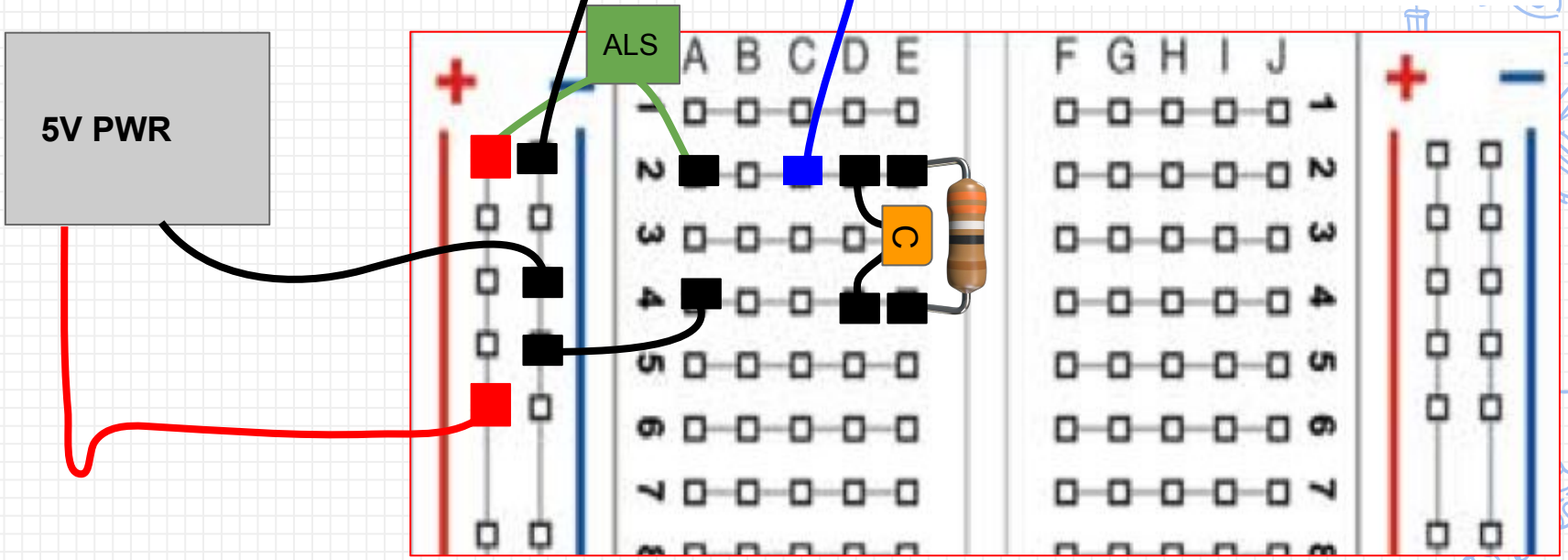


# Light-detecting Circuit

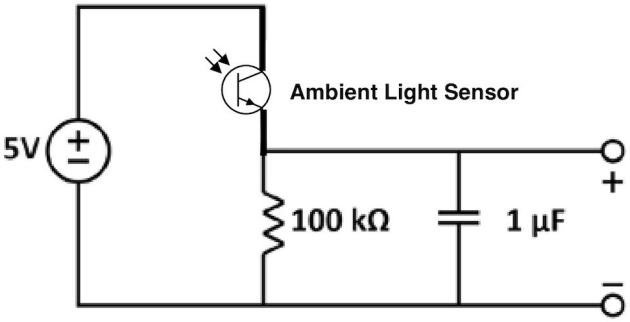
Probes!



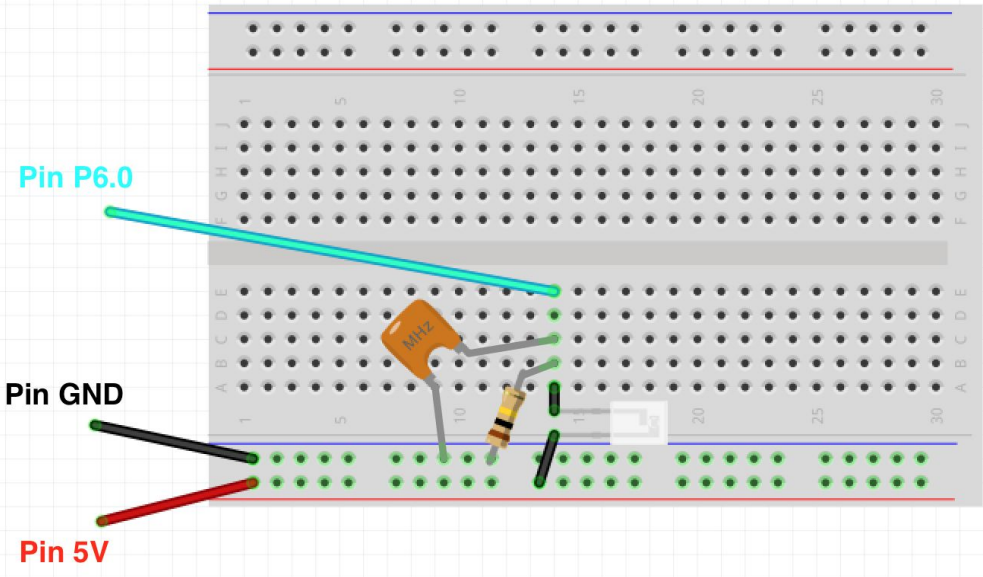



# What Your Circuit Will Look Like

## Circuit Diagram




## Breadboard Diagram



# Online Checkoffs

## EE16A checkoff request

Station number (example: 12):

Enter student id numbers (SID) separated WITH COMMA
(example: 123123,234234,345345):

Instructional accounts corresponding to student id numbers in order separated WITH COMMA
(example: aaa,aab,aac).
NOTE: If the order is wrong you will NOT be able to check off with your accounts.

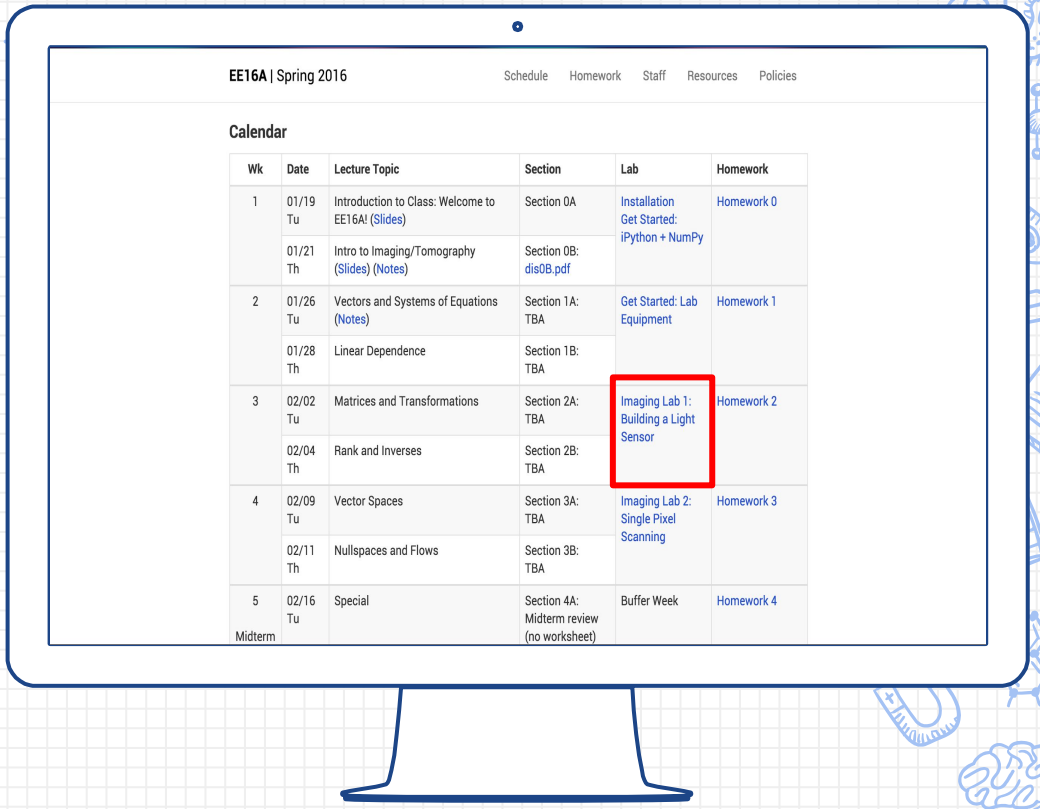
Select the lab part you want to check off.

imaging part 1

Submit

# Begin!

- ✘ Please use the station desktops for this lab.
- ✘ This week's lab is listed as **"Imaging Lab 1"** in the Week 3 row.



**EE16A** | Spring 2016 — Schedule | Homework | Staff | Resources | Policies

**Calendar**

| 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 |

# Folder Structure

- **ee16a_imaging_lab1:**
  - **ee16a_imaging _lab1.ipynb**
    - The lab file. Run this in iPython Notebook.
  - **virtual_oscope.py**
    - Python script to plot values read in via serial.
  - **LightSensor:**
    - **LightSensor.ino**
      - Launchpad code to read data from the solar cell and write to the serial port.

# Notes

- **Ask your questions:**
  - tinyurl.com/lab108-q
- For checkoff: Type IP Address into URL and submit appropriate information. Double check your IDs.