

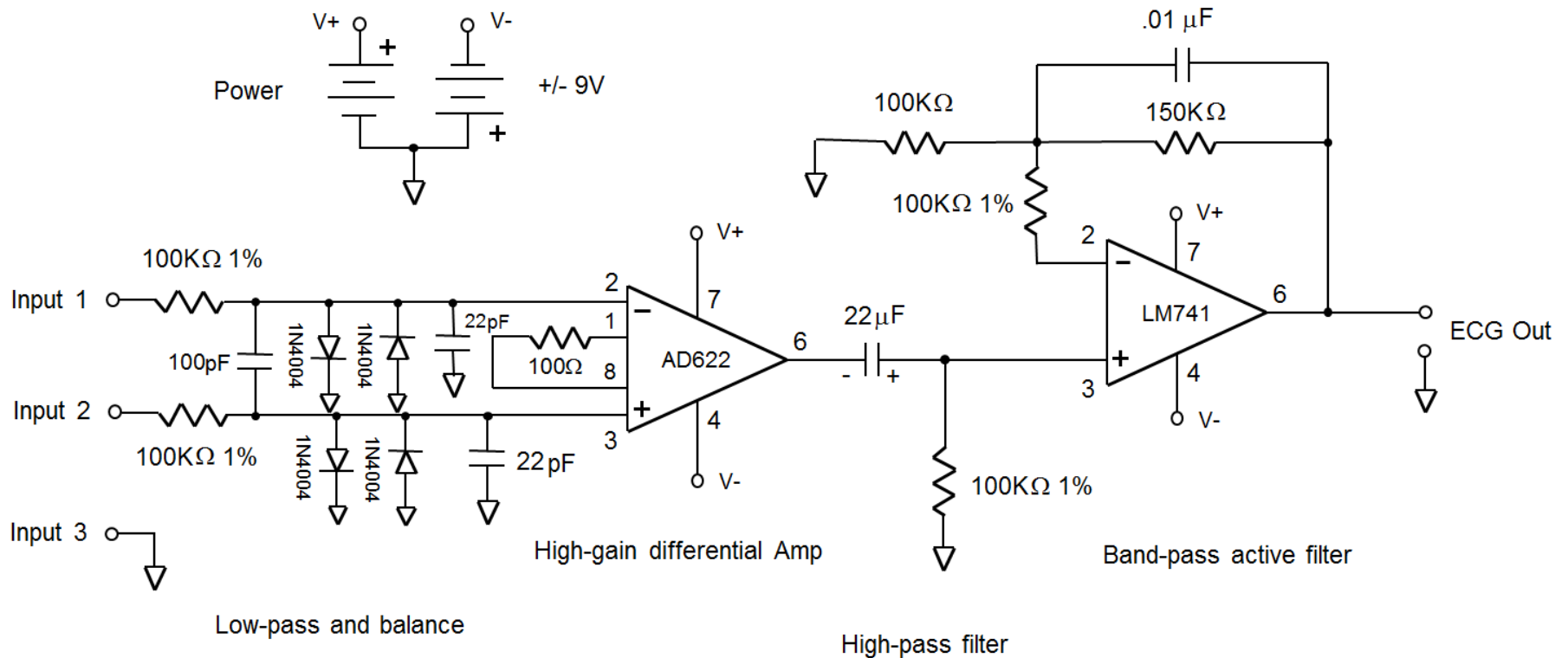
WEEK 4: BREADBOARDING FROM A SCHEMATIC

- Use schematic and parts list to breadboard a prototype circuit
- Double check connections and wiring

GOALS FOR THIS LAB

- Find your tool box with parts from last week
 - Review bread boarding technique slides [here](#)
 - Build your prototype circuit on the breadboard
 - Use schematic to guide your circuit connections
 - Store circuit in your tool box for next week!
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ECG AMPLIFIER SCHEMATIC DESIGN



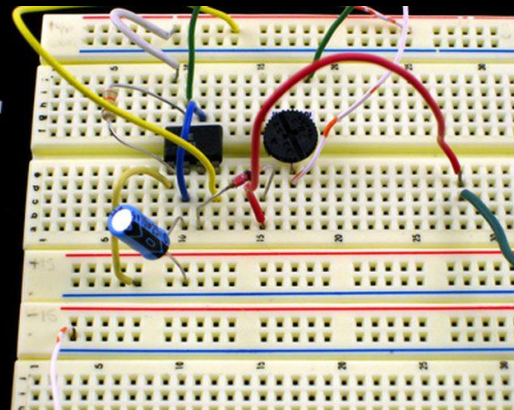
Note: the triangles  connected to components denote a connection to "ground" or a common wire.

BREADBOARDING

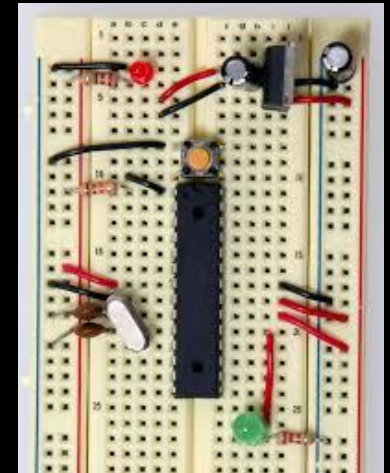
- Prototyping system for electronic circuits
- Easily change components and layout
- Use jumper wires as needed
- Use color-coding on supply/GND wires when possible
- Easy to pull apart!



Jumper wire kit

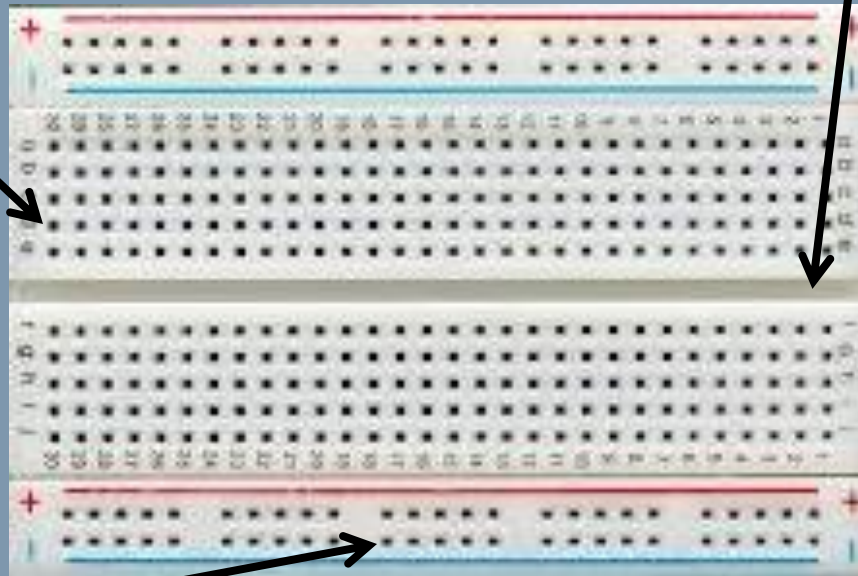


Wires can be curved or flat



BREADBOARDING

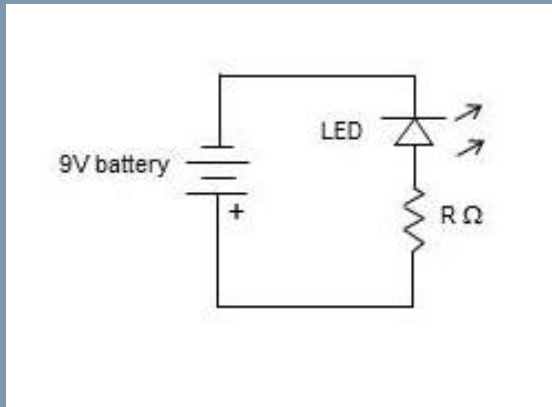
5 sockets in these columns are internally connected (not across the gutter)



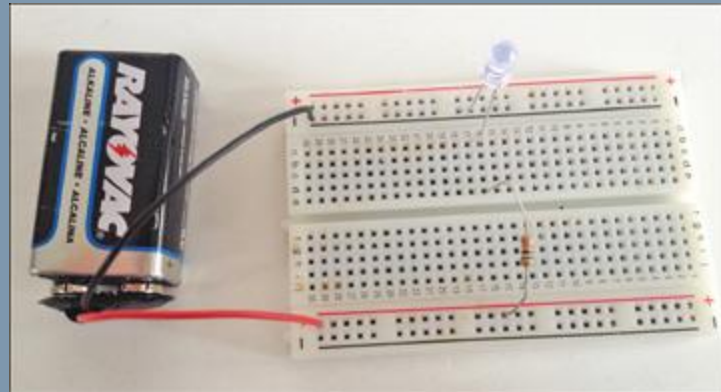
Typical long "rows" are connected (here $5 \times 5 = 25$ sockets) and used for power supplies

SIMPLE EXAMPLE

Schematic



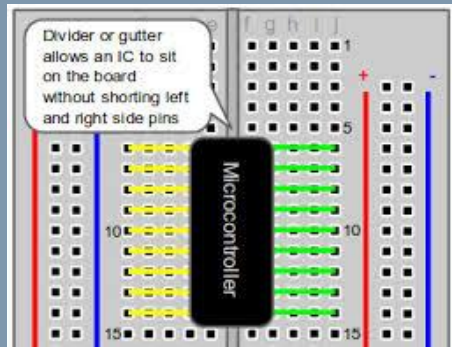
Breadboard



Advice: color-code power wires:
Red = V+, Black = Ground

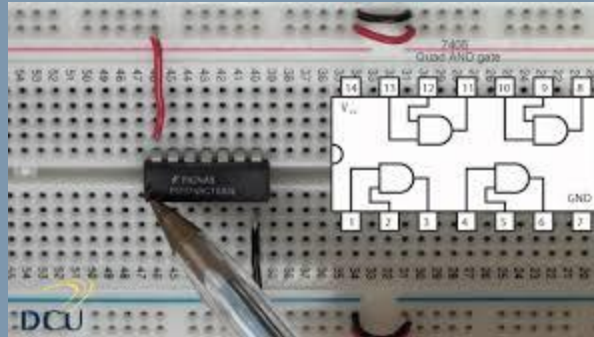
BREAD BOARDING INTEGRATED CIRCUITS

Span the “gutter”



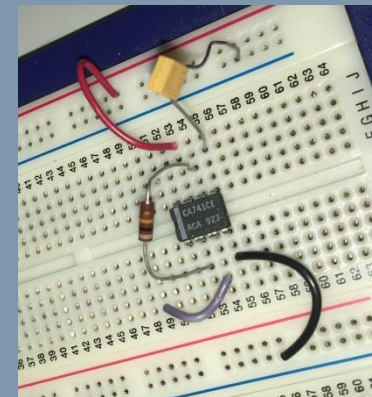
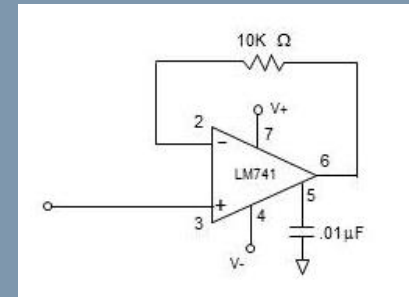
Yellow/green show available sockets for the IC pins

Example:
V+ (pin 14), GND (pin 7)



Note red/black “jumpers” to connect zones denoted by broken red/blue lines


Mini 741 circuit

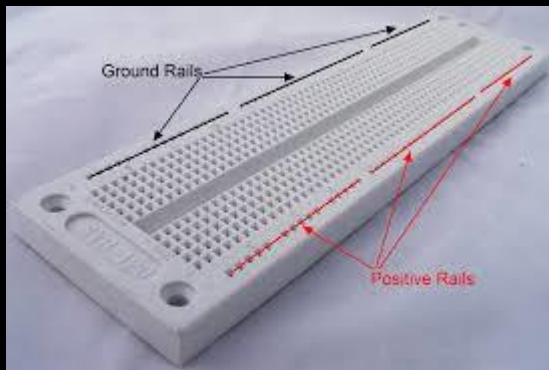


Note +/- V and GND are connected via perpendicular rails to supply voltages (not shown)

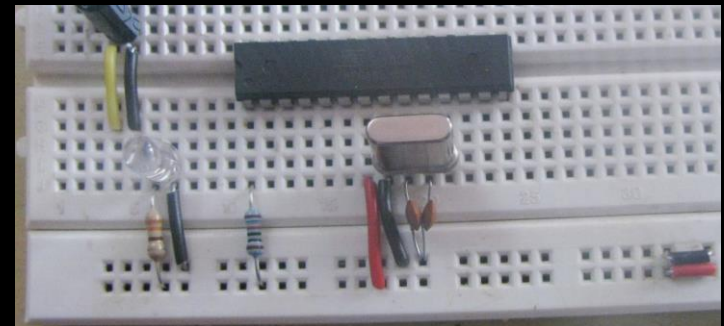
Note: red and black wires are used here to connect components as needed
Example: on the 741 circuit: the black wire connects pin 4 to ground.

COMMON GROUND

- “Ground” is a term used in circuit design to denote a common connection point
- Ground is typically the reference point for source voltages
- For our design: note both batteries are connected to ground (one “backward”) to create the + and – voltages needed by the circuit
- On bread boards, use one or more of the long “rows” for ground (as shown in Slide # 5)
- All components connected with a ground symbol  will be connected to this common connection.




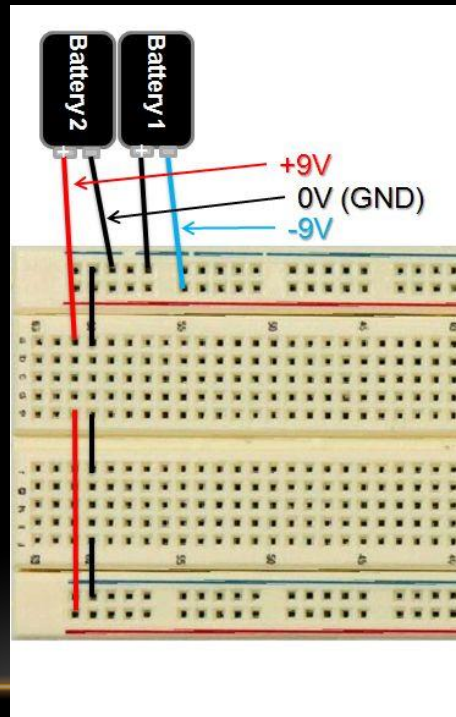
One possible way to use long rails:
ground and voltage supplies



Above: bottom black wires and capacitors
are connected to “ground”

BATTERY POWER

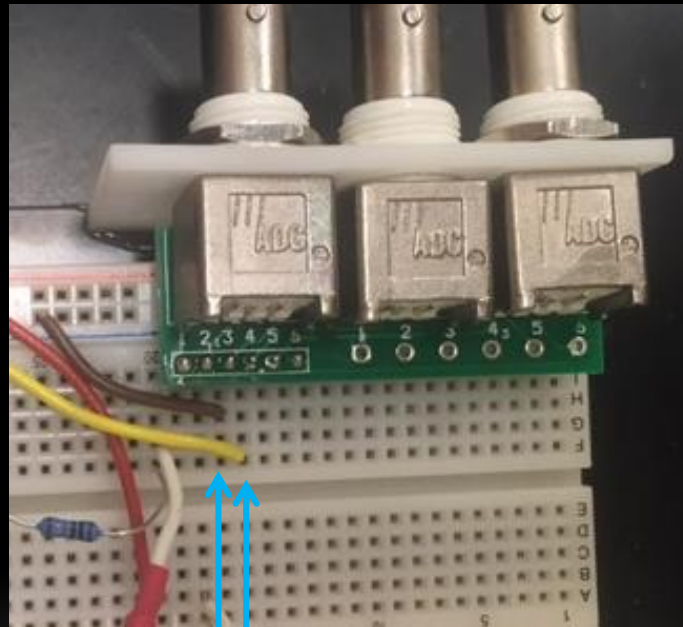
- 2 9V batteries supply positive and negative voltages (relative to ground)
- Labeled as V+, V- and  in the schematic.
- V+: Connect positive side of battery #2 to V+, negative side of battery to ground
- V-: Connect negative side of battery #1 to V-, positive side of battery to ground



Example of V+ and V- connections with 9V batteries. Both blue “rails” on the bread board are ground

BREAD BOARDING THE BNC FOR OUTPUT

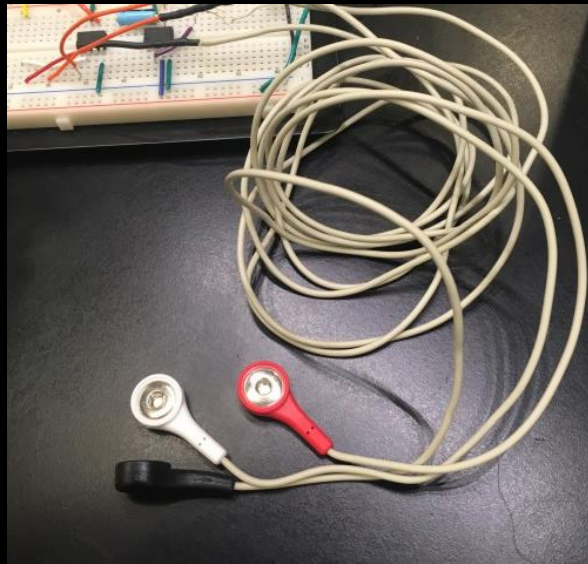
- 3 BNC connectors use 6 plug-in rows on the breadboard (2 for each BNC)
- They are labeled on the green board: 1-2 BNC#1, 3-4 BNC#2, 5-6 BNC#3 (left to right below)
- For example below, the yellow wire is connected to the positive (+) terminal of BNC#2 (Row 3 label), the brown wire is connected to the negative (-) part of BNC#2 (Row 4 label)



Row "3" Row "4"

BREAD BOARDING ECG WIRE INPUT

- Plug the 3 ECG wires into your breadboard at the appropriate locations:
 - One connects to the common ground connection, the other 2 connect to 100k resistors (see schematic)
 - The color coding on the wires does not matter.



WEEK 4 TOPICS FOR FINAL REPORT

- Brief description of the bread boarding process.
- Picture of your bread boarded circuit.