• 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!
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 5x5 = 25 sockets) and used for power supplies
SIMPLE EXAMPLE

Schematic

Breadboard

Advice: color-code power wires:
Red = V+, Black = Ground
BREAD BOARDING INTEGRATED CIRCUITS

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

Span the “gutter”

Yellow/green show available sockets for the IC pins

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

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 breadboards, use one or more of the long “rows” for ground (as shown in Slide #5).
- All components connected with a ground symbol \( \rightarrow \) 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 \(\nabla\) 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)
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.