Record muscle activity with EMG

OPTIONAL RECORDING SHEET • Current-device adaptation

Adapted from the light/heavy-object EMG comparison described by Hanzlick-Burton and colleagues (2020). The bottle amounts, six-trial plan and worksheet are later teaching aids; this exact plan is unvalidated. Use your lab notebook instead if preferred. Record instructor-selected changes before data collection.

Original activity: Hanzlick-Burton et al., Journal of Undergraduate Neuroscience Education 19(1), A118-A123.

Group code: _____ Date: _____ Role: _____

Question: Does biceps electrical activity change from supported rest to a still hold? Does adding a light load change the signal during that hold?

The conditions

Condition	What you do	What it helps you test
Rest baseline	Forearm and bottle fully supported on the table. Relax the arm.	What the recording looks like before each hold.
A · lighter load	Hold an empty plastic bottle, forearm unsupported, elbow about 90°.	Electrical activity while maintaining the position.
B · added load	Hold an identical bottle containing 250 mL of water in the same position.	Whether the signal changes with a greater external load.

Predict before you measure

1. Predict rest versus hold. Explain why a muscle could be active while the joint is still.

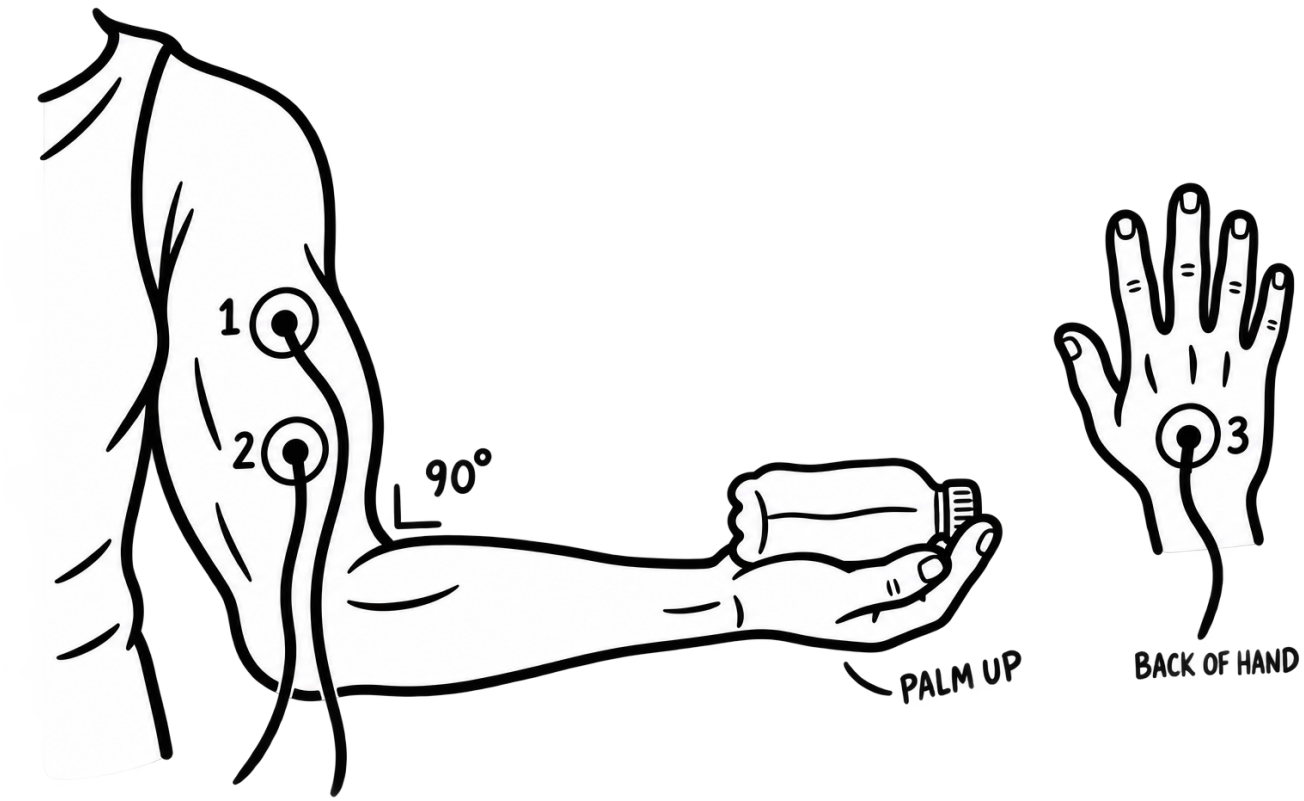
2. Predict B versus A. Give a physiological reason. The arm and empty bottle already have weight: A is not “zero load.”

3. Name three things you will keep the same to make the comparison fair.

Everyone contributes as recorder, timekeeper or analyst. Wearing electrodes is optional. Use shared volunteer data, or label the practice-data alternative as analysis only.

Set up the recording station

Human SpikerBox + battery; orange electrode cable; 3 fresh patches; USB data cable; computer with current Spike Recorder; two identical plastic bottles (A empty, B with 250 mL water); table, chair and timer.



Patches 1 and 2: one red lead each, along the biceps muscle belly, approximately 5 cm apart. Patch 3: black reference lead on the back of the hand, shown separately. Keep the same placement, palm-up grip and arm position throughout all six trials.

1. Put one red lead on each biceps patch; black lead on the hand reference. Plug the orange cable into one channel. Turn on the box and connect the USB data cable.

2. Open spikerecorder.backyardbrains.com/app/. Choose SpikerBox > Connect and allow the serial port. Enable the channel in SpikerBox > Channels. In that panel, use Configure channels to select the channel and EMG preparation if available, then confirm. Check the signal in Signal; keep channel and filters fixed. Test Record > Stop > save > File > reopen before collecting trials.

3. Sit upright, upper arm close to your torso, shoulder relaxed, elbow about 90°, palm up and wrist neutral. During holds, keep the forearm and bottle unsupported. Keep the same grip and patches throughout.

Use intact skin and comfortable holds; stop for discomfort. No maximal effort or exhaustion challenge is part of the activity. Students who do not wear electrodes use shared volunteer data.

Record six trials

Order: A1 > B1 > B2 > A2 > A3 > B3. Start Record and the timer together. Use a group code in filenames, not a student name.

Each trial lasts 25 seconds

Time in file	Participant	Recorder / timekeeper
0–5 s	Relax with forearm and bottle fully supported.	Start Record and the timer together. Call “rest.”
5–8 s	Move into the hold position.	Call “lift”; allow the arm to settle.
8–13 s	Hold still at about 90°, forearm unsupported.	Call “hold”; note any movement, cable tug or posture change.
13–25 s	Return the forearm and bottle to support; relax.	Call “rest,” then Stop at 25 s. Allow longer rest if needed.

After each trial: Stop > finish the save dialog > confirm the file. Reopen the first file; use SpikerBox > Connect to return to live recording. Rest longer if needed. Log clipping, connection loss or movement during a planned measurement window; retain and repeat the whole trial under a new filename. Keep clean unexpected results.

Measure the same windows

File > open trial > pause in Signal > Measure. Select 1–4 s for rest and 9–12 s for the steady hold. Check Length ≈ 3.00 s and copy RMS with its displayed unit. Repeat for all six files. Keep channel and filters fixed. Save one screenshot with axes, selection and RMS visible.

Arm / placement: _____ Bottle fill: _____ RMS unit: _____

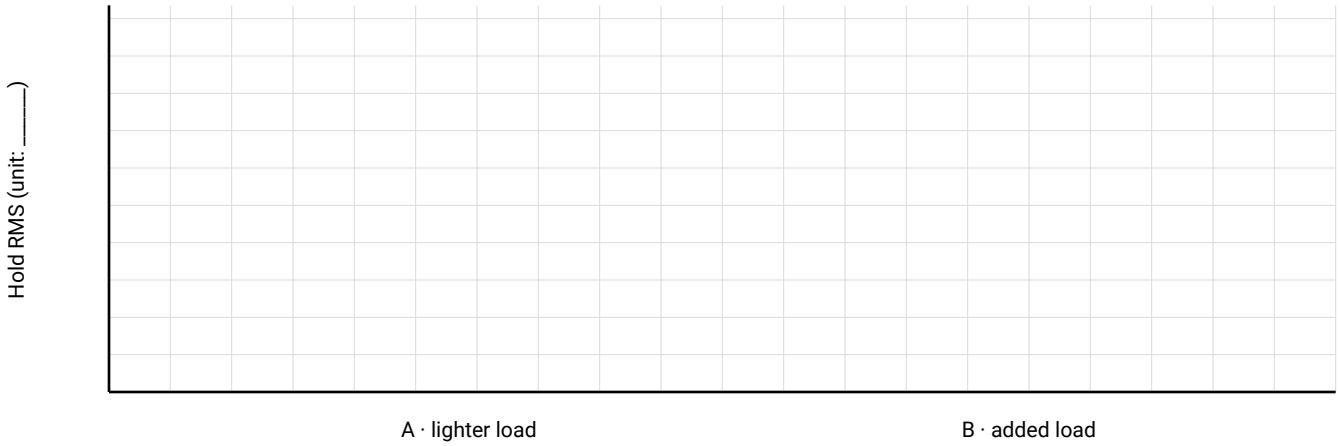
Channel / filters: _____ Actual changes from protocol: _____

Student recording table · enter your own measurements

Trial / file	Rest RMS · 1–4 s	Hold RMS · 9–12 s	Valid? / observations
A1	_____	_____	_____
B1	_____	_____	_____
B2	_____	_____	_____
A2	_____	_____	_____
A3	_____	_____	_____
B3	_____	_____	_____

Graph, explain and evaluate

Choose and label a numerical scale. Plot each trial; add each condition mean.



Mean hold RMS A: _____ Mean hold RMS B: _____ B − A: _____

1. Compare rest with hold, then B with A. Cite numbers and variability. Do your results support each prediction?

2. How can the muscle be active while the elbow is still? Draw motor neuron > neuromuscular junction > muscle fibers; label where the electrodes record.

3. Name one artifact or uncontrolled variable and one improvement. Why can't this graph tell you a person's strength, biceps force or the number of motor units firing?

Hand in: table, graph, annotated measurement screenshot, pathway drawing and explanation. For practice-data work, identify the source and describe the measurement windows instead of supplying a screenshot. Inconsistent results can earn full credit.

Practice-data activity · optional alternative

INVENTED TEACHING DATA. These are not measured human recordings, expected values or evidence of device performance. Use them for calculation and interpretation; they do not demonstrate acquisition or artifact recognition from a real trace.

Synthetic practice data · RMS in µV

Trial	Rest RMS	Hold RMS	Trial note
A1	7	35	No logged issue
B1	8	52	No logged issue
B2	8	44	No logged issue
A2	7	38	No logged issue
A3	9	41	No logged issue
B3	8	48	No logged issue
B2-invalid	8	110	Cable tug during 9–12 s; repeated as B2 above

Use the six valid rows. Complete the graph and explanation on page 4. Explain why the invalid row is excluded and why an unexpected clean value should remain.

College extension

Pair A1/B1, A2/B2 and A3/B3. Always calculate B − A, even when B was recorded first. List the three differences; report the mean and range. These are repeated trials from one participant, not three independent participants.

Explain why rest is a baseline check rather than a direct load control. What independent measurement would you add if muscle force were the target?

Full setup, teacher guide and current software help: backyardbrains.com/anatomy-physiology/emg-starter-lesson