**EMG activity instructions** – estimated time to complete, 2 hours

**Materials**:

Logger Pro unit

EMG unit

Accelerometer unit

Dynamometer unit

Computer

Medical tape

EMG Logger Pro instructions

**Question:**

What is the relationship between EMG activity and muscle output?

**Background:**

We will be measuring force generation directly for grip strength, using a hand dynamometer. We will be measuring acceleration as a stand-in for force generation for the other muscles. Acceleration of movement roughly corresponds to the amount of force generated – a body part moving faster has more force applied to it.

**Section A: EMG and grip strength**

1. Connect the EMG and dynamometer units to your Logger Pro unit.
2. Follow the instructions in Logger Pro experiment guide 18 – parts 1 and 3 ONLY and fill out the data tables.

**Section B: EMG and acceleration**

1. Connect the EMG and accelerometer units to your Logger Pro unit
2. Start up Logger Pro experiment 14A – Reflexes with Acceleration. Do not follow the instructions for experiment 14A. Our experiment uses the same sensors.
3. We will be measuring hand extension (group of muscles), hand contraction (group of muscles), forearm contraction (biceps), and forearm extension (triceps).
4. For each muscle or muscle group below you will record: largest absolute value of acceleration of the moved body part and CHANGE in EMG signal.
   1. We take the absolute value of acceleration because the acceleration might record as negative, depending which way you held the sensor.
   2. We record change in EMG instead of maximum because the baseline might not be 0, depending on how you set up the electrodes.
5. Record YOUR data on your sheet. We will collect the class’s data at the end.

Hand extension

1. Attach the red and green electrodes to the lateral forearm – trace along back of hand from ring finger to halfway between wrist and elbow, and place electrodes along that line about 1.5 inches apart. Attach ground to your upper arm or back of your hand.
2. Attach accelerometer to knuckles or hold it between fingers. Make sure the axis is pointing the direction of movement! (Hint: arrow should be oriented as though it were pointing through the palm of your hand.)
3. Alternate holding hand at 90**°** angle and flipping back to flat quickly. Repeat 5 times. Record change in EMG amplitude in each movement and maximum acceleration in each movement. Remember to note units!

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Move 1 | Move 2 | Move 3 | Move 4 | Move 5 | **Average** |
| ∆ EMG |  |  |  |  |  |  |
| Acceleration |  |  |  |  |  |  |

Hand contraction

1. Attach the red and green electrodes to the front of forearm – trace along palm from middle finger to halfway between wrist and elbow, and place electrodes along that line about 1.5 inches apart. Attach ground to upper arm.
2. Attach accelerometer to knuckles or hold it between fingers. Make sure the axis is pointing the direction of movement!
3. Alternate holding hand flat on table and pulling hand towards you quickly. Repeat 5 times. Record change in EMG amplitude in each movement and maximum acceleration in each movement. Remember to note units!

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Move 1 | Move 2 | Move 3 | Move 4 | Move 5 | **Average** |
| ∆ EMG |  |  |  |  |  |  |
| Acceleration |  |  |  |  |  |  |

Forearm extension

1. Attach the red and green electrodes to the middle of the triceps (back of upper arm) about 2 inches apart and attach ground to collarbone or forearm.
2. Attach accelerometer to back of hand. Make sure the axis is pointing the direction of movement!
3. Alternate holding arm bent and contracting triceps as though lowering a dumbbell quickly. Repeat 5 times. Record change in EMG amplitude in each movement and maximum acceleration in each movement. Remember to note units!

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Move 1 | Move 2 | Move 3 | Move 4 | Move 5 | **Average** |
| ∆ EMG |  |  |  |  |  |  |
| Acceleration |  |  |  |  |  |  |

Forearm contraction

1. Attach the red and green electrodes to the middle of the biceps (front of upper arm) about 2 inches apart and attach ground to collarbone or forearm.
2. Attach accelerometer to back of hand. Make sure the axis is pointing the direction of movement!
3. Alternate holding arm straight and curling biceps as though lifting a dumbbell quickly. Repeat 5 times. Record change in EMG amplitude in each movement and maximum acceleration in each movement. Remember to note units!

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Move 1 | Move 2 | Move 3 | Move 4 | Move 5 | **Average** |
| ∆ EMG |  |  |  |  |  |  |
| Acceleration |  |  |  |  |  |  |

**Collect class data**

Enter your average EMG and acceleration for each of the four muscle groups.

Enter your EMG and force for each time point for the grip strength experiments.

**Analysis (include these findings in your results and discussion sections)**

1. Use the whole class’s data for all your analyses.
2. For part 1: for the continuous and intermittent experiments, make two scatter plots of ∆EMG vs. dynamometer output.
   1. Find a separate correlation coefficient for each time point of the experiment (0-20, 60-80, 80-100s).
   2. How does the relationship between EMG and grip strength vary with fatigue?
   3. How are the two experiments different?
   4. What else do you observe?
3. For part 2: make four scatter plots of ∆EMG vs. acceleration, one for each muscle or muscle group separately, using the data from the whole class. Calculate the correlation coefficient.
   1. How does the relationship between EMG and acceleration vary for different movements of the same body part (hand contraction vs. extension, forearm contraction vs. extension)?
   2. How does the relationship between EMG and acceleration vary for different body parts?
   3. What else do you observe?