# **LAB 6 PROTOCOL: MUSCLE PHYSIOLOGY (iWorx)**

1. Turn on both iWorx 214 box and SI-200 stimulator box.
2. On the SI-200 stimulator box, turn the Pulse Amplitude Knob to “0”. Do this by rotating the Pulse Amplitude knob in a counterclockwise direction until the values on the dial and in the counter window read zero. The Pulse Amplitude knob controls the current output. Starting from zero, each 360 turn of the knob adds two milliamperes of current to the output.
3. Click on the LabScribe2 icon on the Desktop. Close the tip of the Day that pops up. A pop up box should also appear indicating that the iWorx 214 unit has been found.
4. When the program opens**, click** on settings on the toolbar on top. Then **select** Load Group. Next, **double click** on Complete Settings. Now **double click** on IPLMv6Complete.iwxgrp.
5. **Click** on the settings menu again and **select** Human Muscle and then Human Muscle Twitch.
6. **Click** on View menu on top of page and then **select** Stimulator Panel (This panel will appear just below the Labscribe2 tool bar)
7. Student should remove all jewelry from his/her right hand and wrist.
8. Obtain two disposable electrodes.
9. Peel the protective shield off one of the electrodes and attach it in the center of the back of the right hand, half way between the knuckle of the middle finger and the wrist. This is the positive stimulating electrode and functions as a current sink or reference electrode. Connect the red lead from the Positive High Voltage Output of the stimulator to this electrode.
10. Peel the protective shield off the other electrode. Attach it slightly above the lateral edge of the right palm, about 3/8” or 1 cm onto the back of the hand and half way between the knuckle of the little finger and the wrist. This electrode is the negative stimulating electrode. It is being placed where the stimulus usually elicits a large response from the little finger (the motor point). Connect the black lead from the Negative High Voltage Output of the stimulator to this electrode.
11. Attach the SMT-100 striated muscle transducer (twitch sensor) along the side of the little finger. Use the short Velcro strap to attach the tip of the sensor to the end of the little finger. Use a longer Velcro strap to attach the base of the sensor along the lateral edge of the palm of the hand. Be sure the side of the transducer marked “OUTSIDE” faces away from the skin. If using Velcro strap across the palm, make sure that it does not slip upwards and interfere with the movement of the little finger.



1. On the Stimulator control panel set the parameters as seen in this table and **click** on the Apply button to complete the change.

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| # pulses | Pulse amplitude (Amp) | Pulse width (W) | Frequency (F) |
| 0 | 5.0 V | 5 ms | 1 HZ |

1. **Click** on the Record button on the LabScribe Main window to activate the iWorx 214 unit and SI-200 stimulator. There should be no response from the subject’s finger since the current output is zero. Continue to record.
2. **Slowly rotate** the Pulse Amplitude Knob clockwise 1 turn, which is equal to a current output of 2 milliamperes (mA). Ask the student to indicate the first occurrence of tingling. If no finger movement is seen, the stimulus current is below the threshold current of the most sensitive muscle fibers controlling the finger’s movement. Threshold is the current level that is needed to create a muscle fiber contraction.
3. If a finger twitch does not occur at 2 mA, rotate the Pulse Amplitude knob an additional ¼ turn to increase the stimulus current to 0.5 mA. Check for tingling and finger movement. Increase the current output in increments of 0.5 mA until the subject’s finger twitches with the largest range of motion.
4. If the stimulus current has been raised to 5 mA and the student feels tingling but no finger movement is observed, adjust the position of the negative stimulating electrode before making additional increases in the stimulus current.

-lower the stimulus current to 2.5 mA before moving the negative stimulating electrode.

- move the negative stimulating electrode a centimeter closer to the positive stimulating electrode.

- stimulate the student’s hand. Raise the stimulus current as high as 5 mA.

- if the response from the student’s hand is miniscule, or non-existent, with 5 mA of current, place the negative electrode at different points along an imaginary line on the back of the hand, from the base of the little finger to the lateral edge of the wrist.

1. Find the lowest stimulus current that creates the largest twitch from the student’s finger (this is the maximal stimulus), and then click Stop on the LabScribe Main window to turn off the stimulator.
2. Note the reading on the Pulse Amplitude Knob and set the current at this level for Activity 1.

## **Activity 1: Single Muscle Twitch**

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| **In this activity, you will find your abductor digiti minimi motor point and use this motor point to cause a single muscle twitch. This twitch will be recorded by the computer, and you will then analyze the latent period, twitch amplitude, period of contraction, and period of relaxation.** |

1. Ask student to place the right hand on the bench with palm up and relax.
2. On the Stimulator control panel set the number of pulses to 15. The pulse amplitude should be set to 5.0 V, the pulse width to 5 ms, and the frequency to 1 Hz. **Click** the Apply button to finalize the changes.
3. Set the Pulse Amplitude knob of the SI-200 to the maximal stimulus level as determined in step 17 above.
4. **Click** the Record button on the LabScribe Main window. **Click** on the AutoScale button on the top half of the Main window to enlarge the muscle twitch tracing if needed. **Click** Stop when the stimulus pulse stops firing. There should be fifteen twitches on the recording. The bottom half of the Main window (Stimulus Trigger channel) shows the stimulus signal at a frequency of 1 Hz.
5. Measure Latent Period, Twitch Amplitude, Length of Contraction Period, Length of Relaxation Period, and Length of Entire Twitch.



## **Activity 2: Threshold Stimulus and Motor Unit Recruitment: The Effect of Stimulus Strength on Tension Development (Twitch Amplitude)**

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| **In this activity, you will determine the threshold stimulus required to cause your abductor digiti minimi or your flexor digitorum superficialis muscle to contract. You will also demonstrate the consequences of increasing the stimulus strength (increased force of contraction due solely to recruitment).** |

1. Remind the student to relax and place the hand that is used for the experiment on the bench, with the palm up.
2. On the stimulator control panel set the number of pulses to 0, the duration of the stimulus to 5 milliseconds (ms), and the frequency to 1 Hz. Setting the number of pulses to zero make the SI-200 stimulator isolator fire continuously. **Click** the Apply button on the stimulator control panel to save the changes.
3. Make sure the Pulse Amplitude knob on the front of the SI-200 is set to zero. **Type** zero in the Mark box that is to the right of the Mark button. Click the record button on the LabScribe Main window**. Press the enter key** on the keyboard to mark the recording.
4. While recording, type 0.5 mA in the Mark box that is to the right of the Mark button. Increase the current output of the SI-200 by 0.5 mA by rotating the Pulse Amplitude knob half a turn. Press the Enter key on the keyboard to mark the recording. Record at this stimulus current for ten to fifteen seconds.
5. Repear Step 4, in increments of 0.5 mA, until the stimulus reaches the maximal level as determined previously (when the finger deflection reaches a maximum and stops increasing. Click the Stop button.
6. Locate the segment of the finger twitches that occurred at threshold stimulus current (where first see a muscle twitch recorded). **Click** AutoScale to maximize the size of the twitch on the window.

## **Activity 3: Summation and Tetanus**

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| **In this activity, you will demonstrate an increase in the strength of contraction due solely to summation. You will also demonstrate tetanus.** |

1. Remind student to relax and place the hand that is used for the experiment on the bench, with the palm up.
2. On the stimulator control panel set the number of pulses to 15, the duration of the stimulus pulses to 5 milliseconds (ms), and the frequency to 1 Hz. **Click** the Apply button on the stimulator control panel to save the changes.
3. Use the Pulse Amplitude knob of the SI-200 to set the stimulus current to the maximal level as used in Activity 1.
4. Type 1 Hz in the Mark box to the right of the Mark button. **Click** the Record button on the LabScribe Main window. **Press the Enter key** on the keyboard. **Click** Stop when the stimulus pulse stops firing. There should be fifteen twitches on the recording.
5. Change the stimulus frequency to 2 Hz. Go to the stimulator control panel on the LabScribe Main window, and change the value in the stimulus frequency box, labeled F (Hz), from 1 to 2. Click the up arrow in the box to increase the frequency. Click the Apply button to put any frequency change into effect.
6. Repeat step 5 with the stimulus frequency set to 2 Hz. Type 2 in the Mark box that is to the right of the Mark button.
7. Repeat Set 5 for stimulus frequencies of 3, 4, 5, 10, 15, and 20 Hz. At higher frequencies, you will also need to increase the number of pulses sent to the student’s finger to see the effects of summation and tetanus. For example, it may take a few seconds to see the complete effect of tetanus at 20Hz. So, the total number of pulses may need to be set to 40 or higher to see the complete effect. Remember to click Apply button to effect changes.
8. When performing the experiment at the highest frequency of 20 Hz, keep recording after complete tetanus is reached. Remove the cable from the stimulator of the iWorx 214 to stop the SI-200 stimulus isolator from firing. Continue to record as the tension in the muscles of the finger begins to relax.
9. **When the muscles in the finger are relaxed, click** **Stop** to halt the recording.
10. Analyze your data that shows the frequency in where summation and tetanus occur.





**POPS PROJECT:**

**How many biceps curls could you do holding a 3-pound weight in one minute?**