

## Experiment AM-2: Skeletal Muscle, Summation and Tetanus

### Equipment Required

PC Computer

IWX/214, USB cable, IWX/214 power supply

FT-104 Force transducer (or the FT-302)

A-BST-100 Stimulating electrodes

Female BNC to Dual Banana Adapter

Ring stand and clamps

Femur clamp

Weight pan

Thread

15 cm Ruler

Amphibian Ringer's solution (See appendix)

### Start the Software

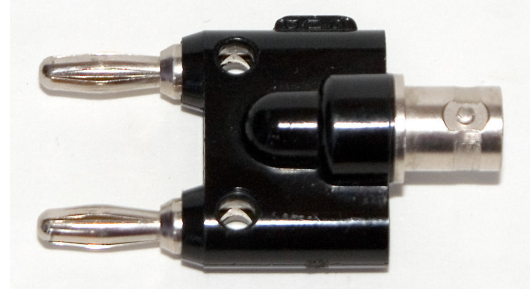
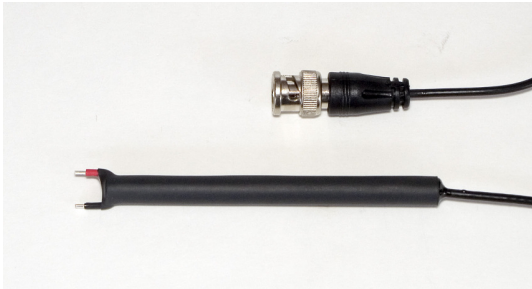
1. Click on LabScribe
2. Click Settings → Animal Muscle → SkeletalMuscle-Summation-Tetanus
3. Once the settings file has been loaded, click the **Experiment** button on the toolbar to open any of the following documents:
  - Appendix
  - Background
  - Labs
  - Setup (opens automatically)

### FT-104 and Stimulus Electrode Setup

1. Locate the following items in the iWorx kit: FT-104 force transducer ([Figure AM-2-S1](#)); A-BST-100 bipolar stimulator cable ([Figure AM-2-S2](#)); Male double banana-female BNC adapter ([Figure AM-2-S3](#)).

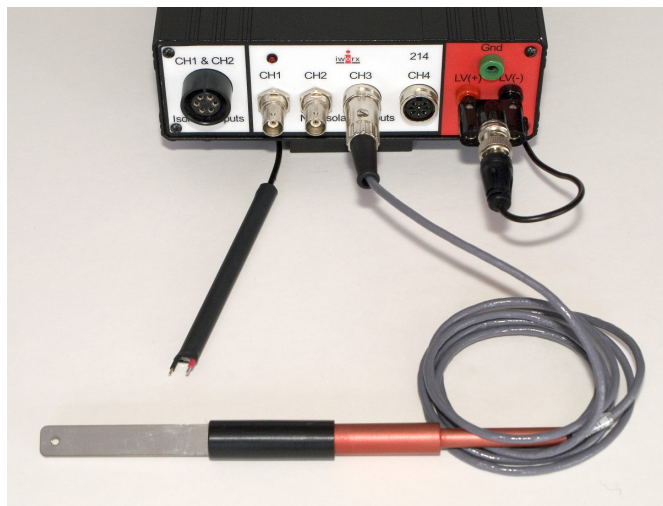


*Figure AM-2-S1: The FT-104 force transducer.*



*Figure AM-2-S2: The A-BST-100 bipolar stimulating electrode and Figure AM-2-S3: Female BNC to Dual Banana Adapter.*

2. Plug the DIN8 connector of the FT-104 into the Channel 3 input ([Figure AM-2-S4](#)).



*Figure AM-2-S4: The FT-104 force transducer and the A-BST-100 bipolar stimulating electrode connected to the IWX/214.*

4. Plug the male double banana-female BNC adapter into the positive (red) and negative (black) banana jacks of the IWX/214 stimulator. The banana plug that goes into the negative (black) stimulator output is identified by a tab, embossed with the letters GND (ground), on that side of the adapter.
5. Attach the BNC connector of the A-BST-100 bipolar stimulator cable to the adapter on the stimulator outputs.

### **The Dissection**

1. Place a frog in ice water for 15 minutes. Double pith the frog as soon as it is removed from the ice water.
2. Remove the skin from the legs by making an incision through the skin around the entire lower abdomen. Cut the connections between the skin and the body—especially around the base of the pelvic girdle. Use stout forceps to pull the skin off the frog in one piece (like a pair of pants).
3. Place the frog in a dissection tray with its dorsal side up.

***Note:** Moisten the exposed limbs of the frog with Ringer's solution every five minutes or so.*

4. Identify the Gastrocnemius muscle on the lower leg.
5. Use a glass hook to separate the Gastrocnemius muscle from the bone and other muscles of the lower leg.
6. Use scissors to free the Achilles tendon from the connective tissue around the heel of the foot. Double up a 24" piece of thread. Firmly tie the doubled thread around the Achilles tendon, leaving the ends of the thread long enough to attach the muscle to the displacement transducer.

***Note:** Isolate as much tendon as possible, since it will be used to attach the muscle to the transducer.*

7. Cut the Achilles tendon as close to the bottom of the foot as possible, so the thread is still attached to the Gastrocnemius muscle.
8. Move the Gastrocnemius muscle away from the rest of the lower leg. Cut the tibia just below the knee to separate the rest of the lower leg from the preparation. Rinse the preparation with Ringer's solution to moisten the tissue and rinse away any blood.
9. Dissect away the muscles of the upper leg and expose the femur. Use a stout pair of scissors to cut the femur close to the pelvis. Rinse the preparation with Ringer's solution to moisten the tissue and rinse away any blood.

## The Preparation

1. Use the femur clamp to mount the preparation on the ringstand ([Figure AM-2-S5](#)).
2. Attach the thread on the Achilles tendon to the hole on the end of the blade of the force transducer.
3. Adjust the femur clamp and the force transducer so the thread from the Achilles tendon to the hole on the end of blade is vertical. There should be no slack in the thread, but do not stretch the muscle past its in situ length.
4. Position the stimulating electrodes so they lay against the muscle about midway between the knee and the tendon. The two electrodes should not touch one another.
5. Place two nickels (10 g) in the weight pan.

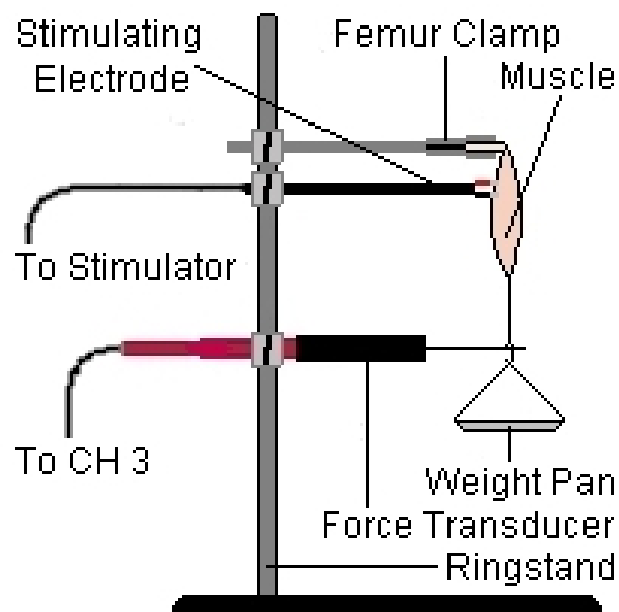


Figure AM-2-S5: The equipment used to evoke and record contractions from the frog *Gastrocnemius* muscle using the IWX/214.

**Warning:** The muscle preparation used in this experiment is functional for a limited period of time. If the muscle is bathed periodically in Ringer's solution, it will work for about four hours. To conserve time, complete all the exercises in the experiment before analyzing the data.

## Calibration of the FT-104 or FT-302 Force Transducer

1. Type "No Weight" in the Mark box. Click Record, and press the mark button to attach the comment to the recording. Record for ten seconds with no weight hanging from the arm or hook of the transducer.

2. Type “5 grams” in the Mark box. Hang a 5 gram weight on the arm or hook of the transducer. Press the mark button. Record for ten more seconds.
3. Click Stop to halt the recording.
4. Select Save As in the File menu, and name the file. Choose a destination on the computer in which to save the file. Click on the Save button to save the data file.

### **Unit Conversion**

1. Scroll to the beginning of data when no weight was attached to the force transducer.
2. Use the Display Time icons on the LabScribe toolbar to adjust the display time of the Main window to show the complete calibration data on the Main window.
3. Click the Double Cursor icon so that two vertical cursors appear on the Main window. Place one cursor on the flat section of data collected when no weight was attached to the force transducer, and the second cursor on the flat section of data collected when the 5 gram weight was attached to the transducer.
4. To convert the voltages at the positions of the cursors to pressure values, use the Simple Units Conversion dialogue window. Click V2-V1 on the force channel, then select Units, and select Simple.
  - Put a check mark in the box next to Apply units to all blocks. Notice that the voltages from the positions of the cursors are automatically entered into the value equations.
  - Enter “Zero” in the corresponding box to the right of the voltage recorded when no weight was attached to the transducer. Enter “5” in the box to the right of the corresponding voltage recorded when the 5 gram weight was hung on the hook of the transducer.
  - Enter the name of the units, grams, in the box below the weights. Click on the OK button in the lower right corner of the window to activate the units conversion.

The force transducer is now ready for use.