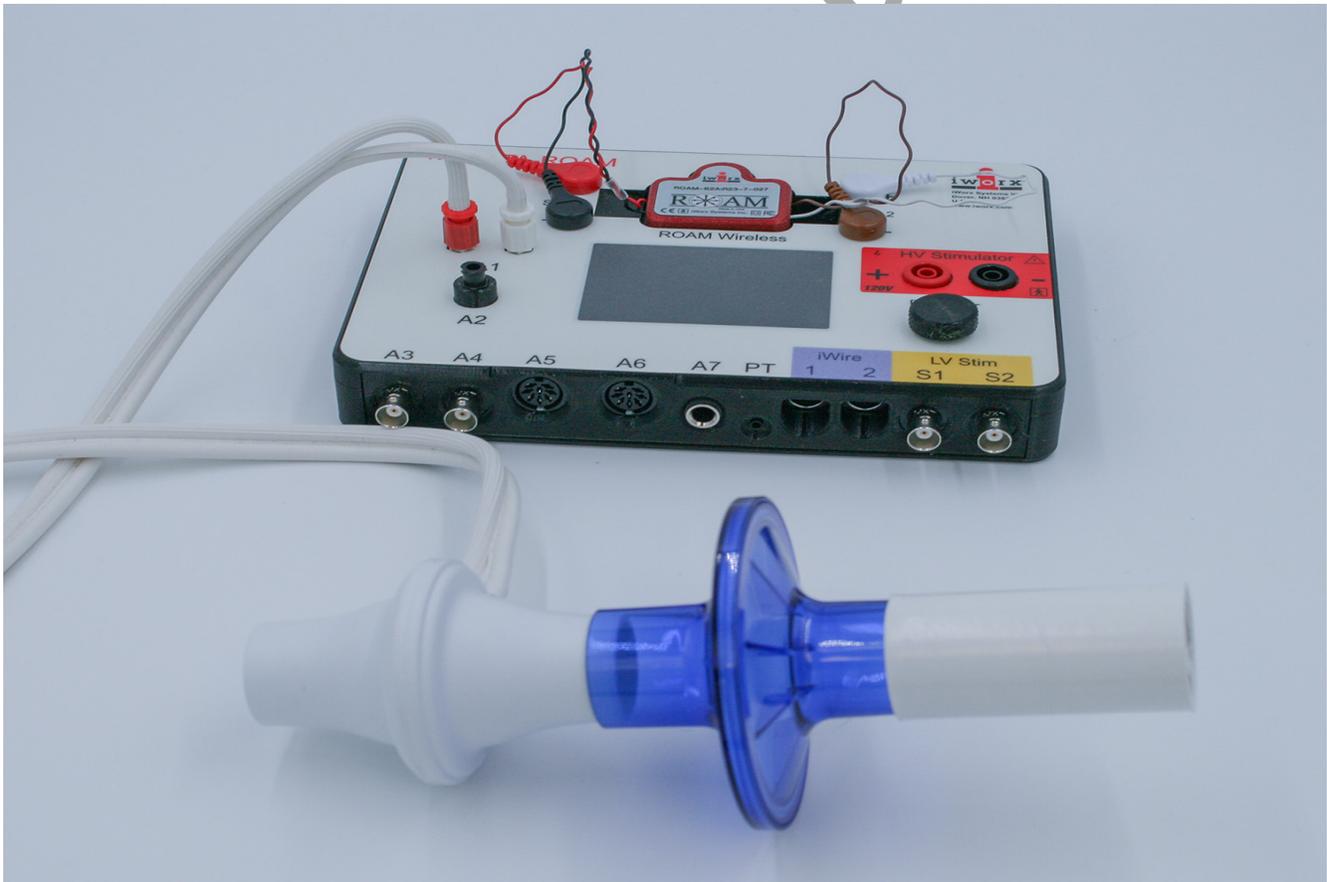


Foundations Lab 4: Breathing Parameters

Spirometer Setup

1. Connect the flow head and the airflow tubing, make sure the ridged tubing goes on the red port of the flow head.
2. Connect the other ends of the tubing to Channel A1 on the IXTA. Connect the red port to the red connector on the tubing.
3. If using, connect the student respiratory kit to the flow head as shown.



Before Starting

1. The spirometer will monitor breathing from a subject. It is important that the subject is healthy and has no history of respiratory or cardiovascular problems.
2. The ports on the flow head should always be facing up so that moisture does not collect in them.
3. The subject will wrap his/her mouth around the entire opening, making a good seal. He/she should also hold their nose or use a nose-clip to prevent any air from not going through the mouth.

Exercise 1: Practice Breathing While Sitting

Aim: To practice breathing through the flow head.

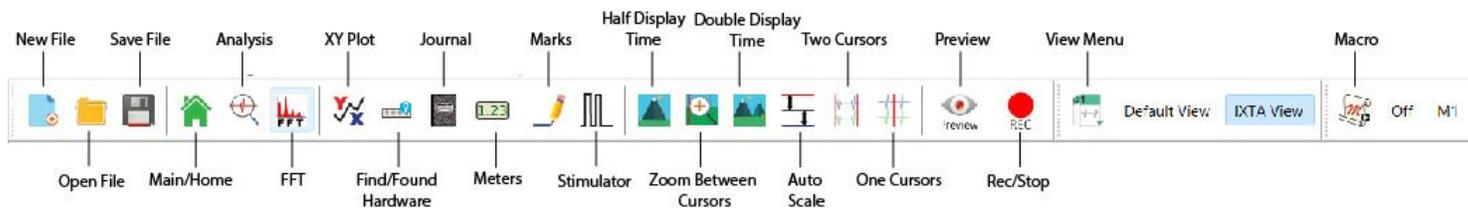
Approximate Time: 20 minutes

Note: The LabScribe software will zero the Lung Volumes channel during the first ten seconds of recording. No air should be moving through the flow head during this time.

Procedure

1. Instruct the subject to:
 - Sit quietly and become accustomed to breathing through the spirometer flow head.
 - Make sure to breathe through the “red port” side of the flow head.
 - Breathe normally before any recordings are made.
 - Hold the flow head so that its outlets are pointed up.
 - Remove the flow head from his or her mouth and place it on the table.
 - Place the nose clip on the nose or hold their nose.
2. Click Record. Do **NOT** begin breathing into the flow head until the first 10 seconds has elapsed.
3. After waiting ten seconds have the subject place the flow head in his or her mouth and begin breathing.
4. Have the subject turn away from the computer screen and breathe through the flow head for approximately 1 minute.
5. Click the AutoScale All button on the toolbar.
6. Click Stop.
7. Click Save As in the File menu, type a name for the file. Click on the Save button to save the data file.

Data Analysis



5. Use the “two mountains” icon to double the display time to show about 10 breaths on the screen.
6. On the Lung Volume channel, move one red cursor before the trough of a breath and move the other to the peak of that breath. Note that when the subject inhaled, the trace should go up.
7. Read the value for V2-V1 in the upper right corner of the Lung Volume channel. This measures the Tidal Volume (TV) of the subject. Measure a few breaths.
 - It should read about 500 ml (0.5 L).
 - If it is too low or too high, the subject is not breathing normally.
 - Repeat the Practice session if needed.

Exercise 2: Measuring Lung Volumes While Sitting

Aim: To measure normal breathing parameters in a sitting subject.

Approximate Time: 30 minutes

Note: The LabScribe software will zero the Lung Volumes channel during the first ten seconds of recording. No air should be moving through the flow head during this time.

Procedure

1. Have the subject place the nose clip on the nose or hold their nose.
2. Click Record. Do **NOT** begin breathing into the flow head until the first 10 seconds has elapsed.
3. After waiting ten seconds have the subject place the flow head in his or her mouth and begin breathing.
4. Click the AutoScale All button on the toolbar.
5. Have the subject breathe 10 normal breaths and then take an immediate, huge, deep breath in and then breathe all the way out. The subject should breathe normally again.

6. Repeat step 5 two more times without stopping.
 - Breathe normally 10 times
 - Big in/out breath
 - Repeat – breathe 10 times; big in/out breath
 - Breathe normally 10 times
7. Click Stop.
8. Click AutoScale All.
9. Click Save to save your file.

Lab

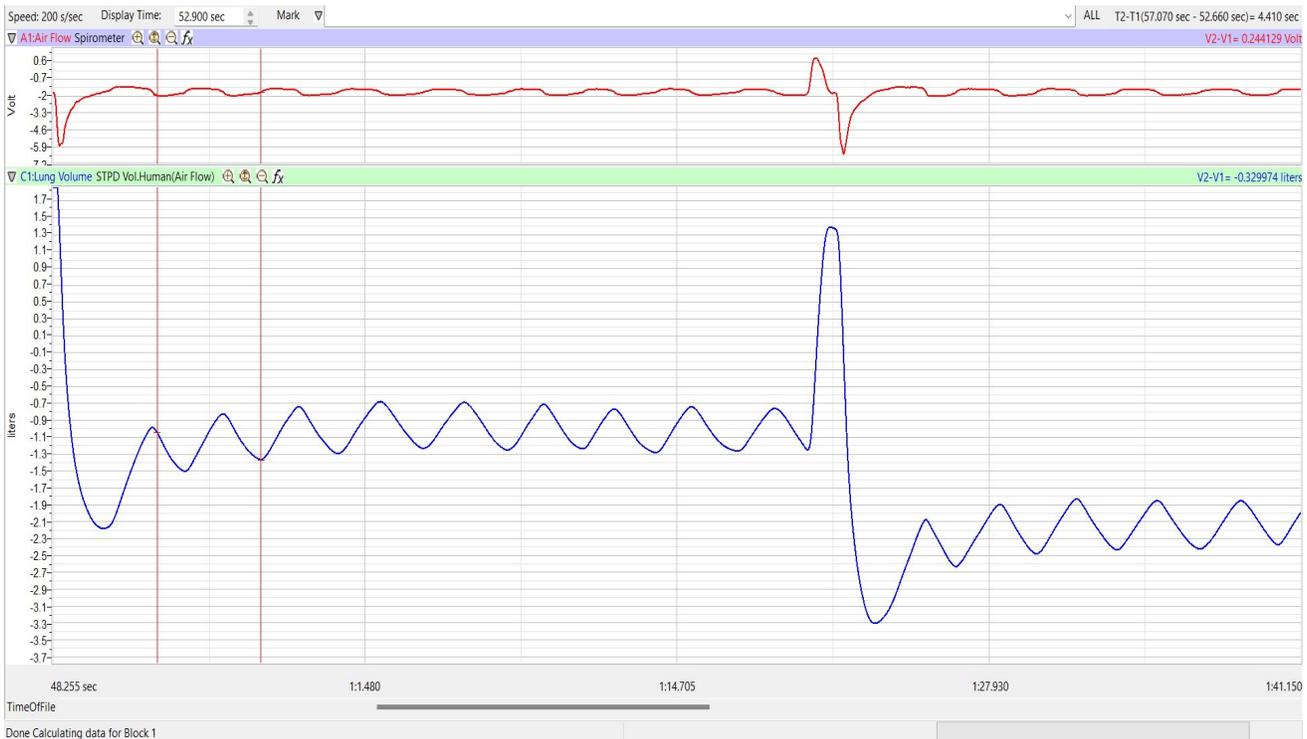


Image showing regular breaths and a large in/out breath.

Data Analysis – Measuring Lung Volumes

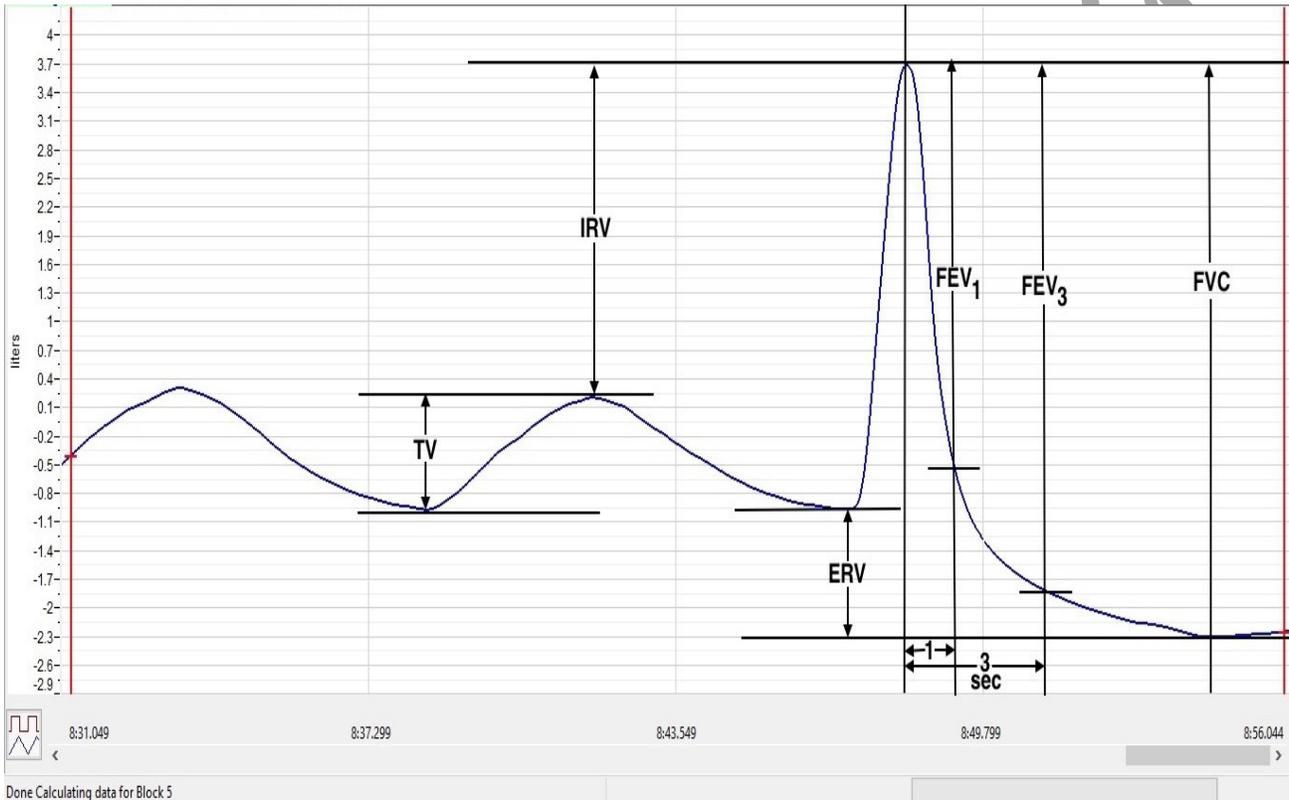
Note – you have the option of analyzing from the Main window or from the Analysis window.

Main Window Analysis:



1. Use the “two mountains” icon to double the display time to show 1 full breathing set (10 breaths and the big in/out breath) on the screen at once.
2. On the Lung Volume channel, move one cursor before the trough of a normal breath and move the other to the peak of that breath.

3. Read the value for V2-V1 in the upper right corner of the Lung Volume channel. This measures the Tidal Volume (TV) of the subject. Measure three breaths and calculate the mean Tidal Volume. Place the value in the Table.
4. Read the V2-V1 value for Inspiratory Reserve Volume (IRV). Place one cursor on the peak of the breath before the big breath in. Place the second cursor on the peak of the big “in” breath. Place the value in the Table.



5. Read the V2-V1 value for Expiratory Reserve Volume (ERV). Place one cursor on the trough of the breath before the big breath in. Place the second cursor on the trough of the big “out” breath. Place the value in the Table. Ignore the negative sign.
6. Read the V2-V1 value for Vital Capacity (FVC) by placing one cursor on the peak of the big in/out breath and the other on the trough of that breath. Place the value in the Table. Ignore the negative sign.
7. Measure the Forced Expiratory Volumes (FEV) at both 1 second and 3 seconds. Use V2-V1 for these values.
 - Keep the one cursor on the peak of the big in/out breath and move the other cursor towards the first, so that T2-T1 equals 1 second. Read V2-V1 and place that value in the table. Mathematically calculate the ratio by dividing FEV1 by FVC, add this to the table.

- Still keeping the one cursor on the peak of the big in/out breath, move the other cursor so that T2-T1 equals 3 seconds. Read V2-V1 and place that value in the table. Mathematically calculate the ratio by dividing FEV3 by FVC, add this to the table.

8. Repeat steps 2 through 7 for the next two breathing sets.

Analysis Window Analysis



1. Use the “two mountains” icon to double the display time to show 1 full breathing set (10 breaths and the big in/out breath) on the screen at once.



2. Click the Analysis window icon.

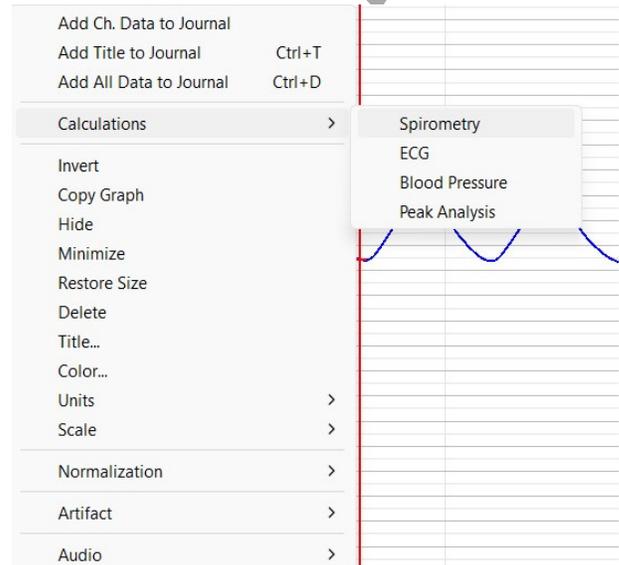
3. Right click in the Spirometry graph.

4. Click Calculations – Spirometry

5. Using the image below:

1. Control Click to choose the Spirometry parameters to be measured

- TV – Tidal Volume
- IRV – Inspiratory Reserve
- ERV – Expiratory Reserve
- FEV1 – Forced Expired Volume (1 sec)
- FEV3 - Forced Expired Volume (3 sec)
- VC – Vital Capacity



2. Move the blue vertical cursors so one is on the trough of the full regular breath before the big in/out breath and the 2nd is on the slight up-slope right after the trough of the big out breath. Refer to the image for placement of the cursors.
 3. Click Save on the left side of the chart.
 4. Click Add To Journal on the lower right of the Spirometry Calculations window.
 5. Click the “x” in the upper right to close the window.
6. Repeat all the above steps for the other 2 full breathing cycles including the big in/out breaths.



7. Click the Journal icon and then click Table. All your values for the breathing parameters will be shown here.

Send data to Journal						
Table Editor						
*	A	B	C	D	E	F
1						
2	TV	IRV	ERV	FEV1	FEV3	VC
3	0.518858	1.698314	2.201260	3.005230	4.248423	4.418432
4	0.491328	2.148636	2.056581	3.677725	4.180285	4.696546
5	0.369981	2.748699	0.416174	1.780541	2.936863	3.534854
6						

Lung Volumes and Capacities

	Description	Average Value
Tidal volume (TV)	Volume of air entering or leaving lungs during a single breath	500 ml
Inspiratory reserve volume (IRV)	Extra volume of air that can be maximally inspired over and above the typical resting tidal volume	3000 ml
Inspiratory capacity (IC)	Maximum volume of air that can be inspired at the end of a normal quiet expiration (IC = IRV + TV)	3500 ml
Expiratory reserve volume (ERV)	Extra volume of air that can be actively expired by maximal contraction beyond the normal volume of air after a resting tidal volume	1000 ml
Residual volume (RV)	Minimum volume of air remaining in the lungs even after a maximal expiration	1200 ml

Questions

1. Are the lung volumes the same in all students?
2. Combine class data to see whether there is any correlation between tidal volume or vital capacity and gender, smoking, or apparent fitness.

NOTE: This experiment can be expanded by having the subject exercise (example - by running for about 5 minutes) and then coming back and repeating Exercise 2 and the data analysis.

Table: Lung Volume Parameters.

	Breath Set 1	Breath Set 2	Breath Set 3
Mean (from 3 breaths) Tidal Volume(TV)			
Inspiratory Reserve Volume (IRV)			
Expiratory Reserve Volume (ERV)			
Vital Capacity (FVC)			
Forced Expiratory Vol-1sec (FEV ₁)			
Forced Expiratory Vol-3sec (FEV ₃)			
<ul style="list-style-type: none">• FEV₁/VC Ratio			
<ul style="list-style-type: none">• FEV₃/VC Ratio			

Worx Sample Lab

Experiment GB-7: Venus Flytrap ~ Reactions

Exercise 1: The Effect of Delayed Stimuli on Trap Closure

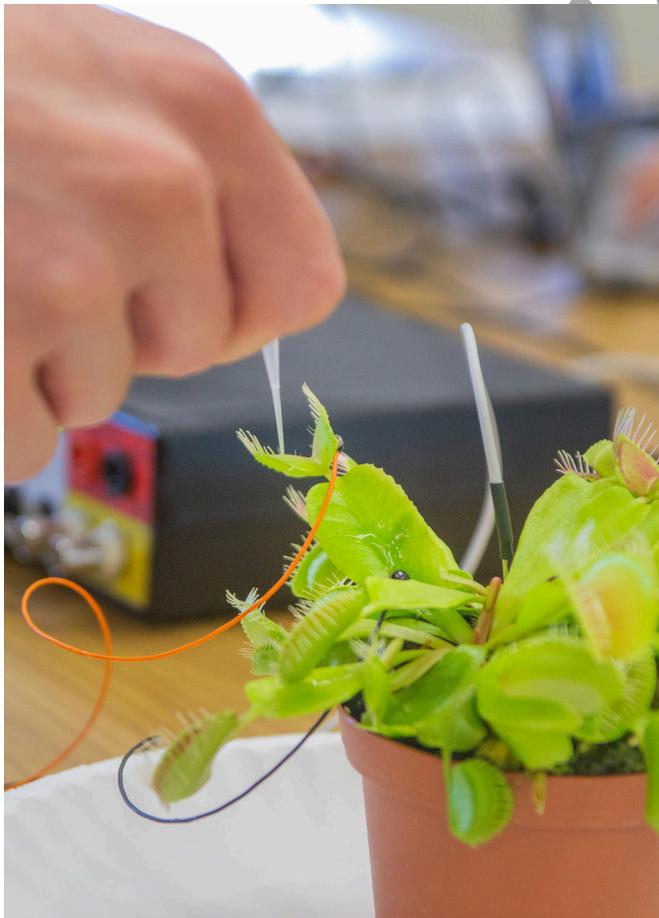
Aim: To observe how the timing of stimuli affects trap closure.

Approximate Time: 15

NOTE: Timing is important. The person operating the computer needs to be ready to immediately mark the recording when the internal spines are touched.

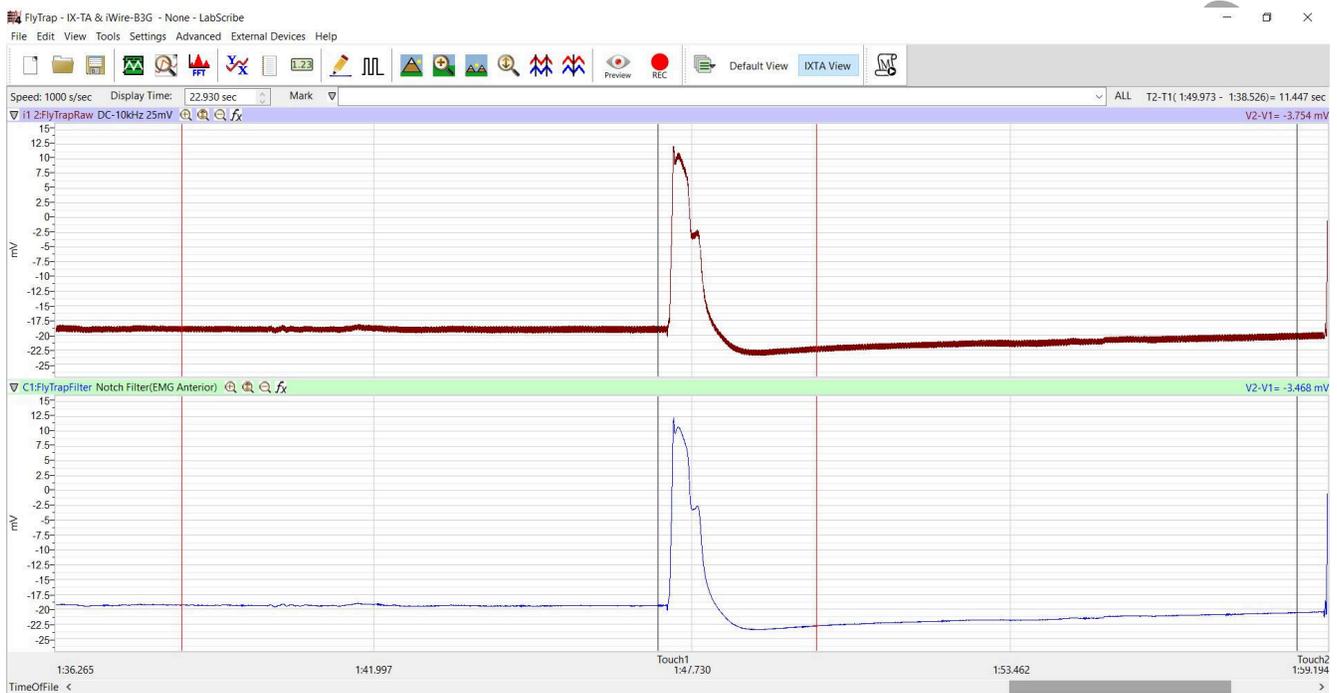
Procedure

1. After the electrodes have been placed on the Venus Flytrap, make sure they are adhered well.
2. Click Record.
3. Type **Touch 1** in the Mark box.



4. Drag the pipette or coffee stirrer along the internal spines – make sure to click the Mark button on the toolbar to annotate the recording as soon as this occurs.

5. You should see a reaction as seen below.



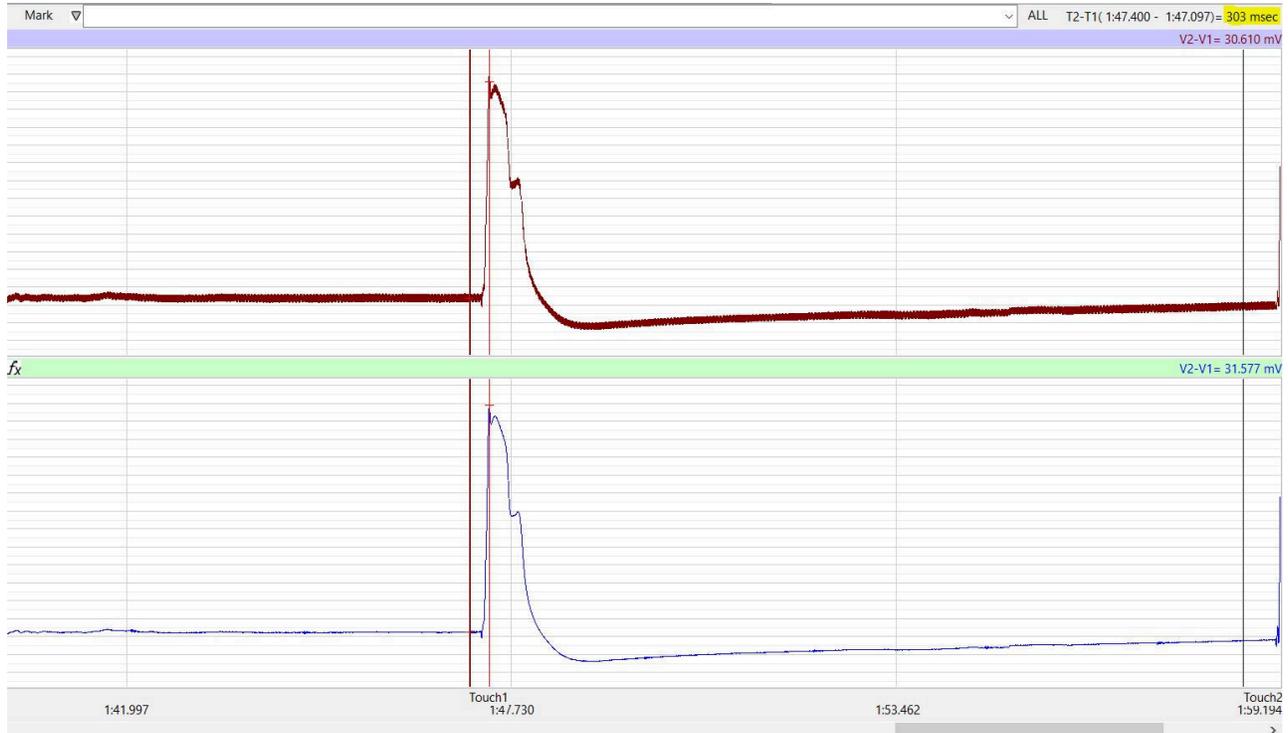
6. Continue recording but wait **AT LEAST** 30 seconds before doing the next touch.
7. After 30 seconds has elapsed – type **Touch 2** in the Mark box, drag the pipette across the internal spines and immediately click the Mark button.
8. Wait a few seconds and then click Stop.
9. Click Save As in the File menu. Save your data to the desktop or USB drive.

Data Analysis

1. Scroll to the section of the data file when you did the first touch.
2. Place one cursor on the ‘Touch 1’ mark and the other cursor on the peak of the reaction.
3. Measure T2-T1 in the upper right hand corner of the screen.
4. Scroll to the ‘Touch 2’ mark and repeat steps 2 and 3.

Questions

1. Did the trap close after the first touch? Why or why not?
2. Did the trap close after the second touch? Why or why not?
3. Hypothesize what would happen if you touched a 3rd time, but still waited the full 30 seconds before doing so.



Exercise 1: The Effect of Multiple Stimuli on Trap Closure

Aim: To observe how the timing of multiple stimuli affects trap closure.

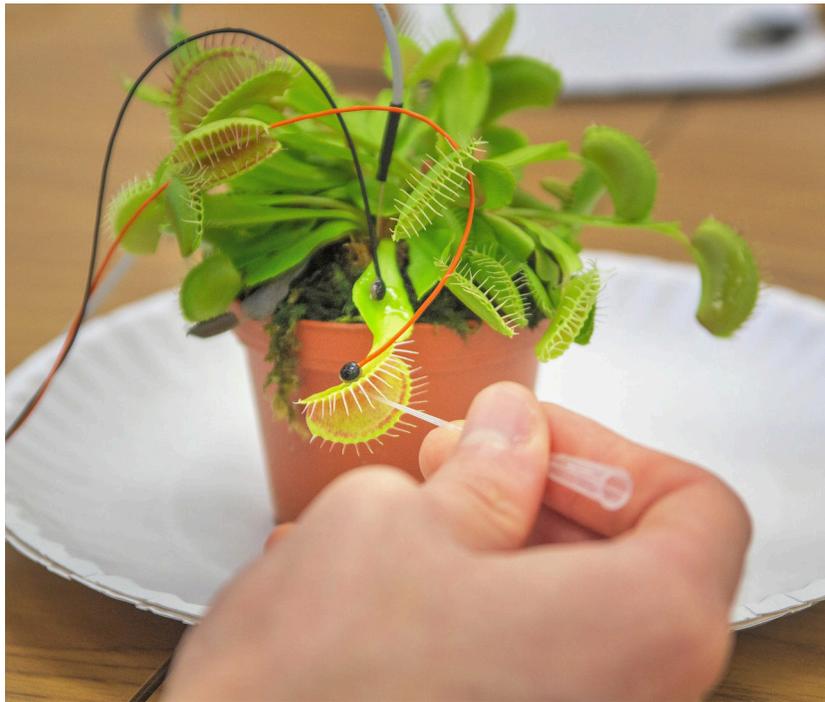
Approximate Time: 15 minutes

NOTE: Timing is important. The person operating the computer needs to be ready to immediately mark the recording when the internal spines are touched.

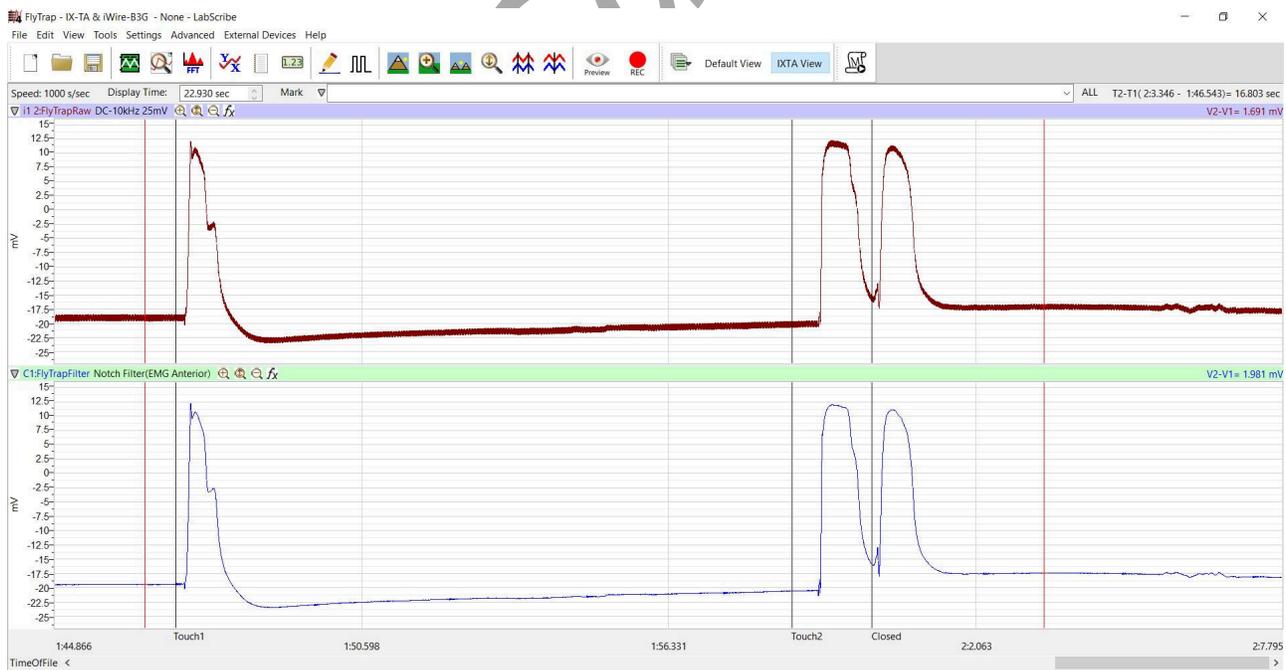
Procedure

1. After the exercise 1, double check the electrodes to make sure they are still adhered well.
2. Click Record.
3. Type **Touch 1** in the Mark box.
4. Drag the pipette or coffee stirrer along the internal spines – make sure to click the Mark button on the toolbar to annotate the recording as soon as this occurs.
5. You should see the same reaction as in Exercise 1.
6. Wait **5** seconds, type **Touch 2** in the Mark box and repeat step 4
7. If the trap does not close, repeat the process.

Note: If the trap still does not close, double check the electrodes. Reattach them with tac gel if needed and repeat Exercise 2.



5. Wait a few seconds and then click Stop.
6. Click Save As in the File menu. Save your data to the desktop or USB drive.



Data Analysis

1. Scroll to the section of the data file when you did the first touch.
2. Place one cursor on the 'Touch 1' mark and the other cursor on the peak of the reaction.
3. Measure T2-T1 in the upper right hand corner of the screen.
4. Scroll to the 'Touch 2' mark and repeat steps 2 and 3.
5. Place one cursor on the peak of the first action potential when the trap closed, and place the other cursor on the 2nd peak. Measure T2-T1 to find the time between the 2 successive reactions.

Questions

1. Did the trap close after the first touch? Why or why not?
2. Did the trap close after the second touch? Why or why not?
3. Explain how the Venus Flytrap knows when to close or not to close.

Comparative Labs

This lab is an excellent comparative lab with frog, earthworm and human action potentials.

These are the Animal Nerve and Human Nerve labs:

- Action Potentials-Worm
- Compound Action Potentials (Frog)
- Human Nerve Conduction