Experiment HM-8: The Electrogastrogram (EGG) and the Growling Stomach

Equipment Required

PC or Mac Computer

IXTA, USB cable, IXTA power supply

iWire-B3G EGG cable and electrode lead wires

Disposable electrodes

Electronic Stethoscope - optional

Note – You must connect the iWire-B3G to the IXTA prior to turning it on.

EGG Cable Setup

1. Locate the iWire-B3G EGG cable and electrode lead wires in the iWorx kit.

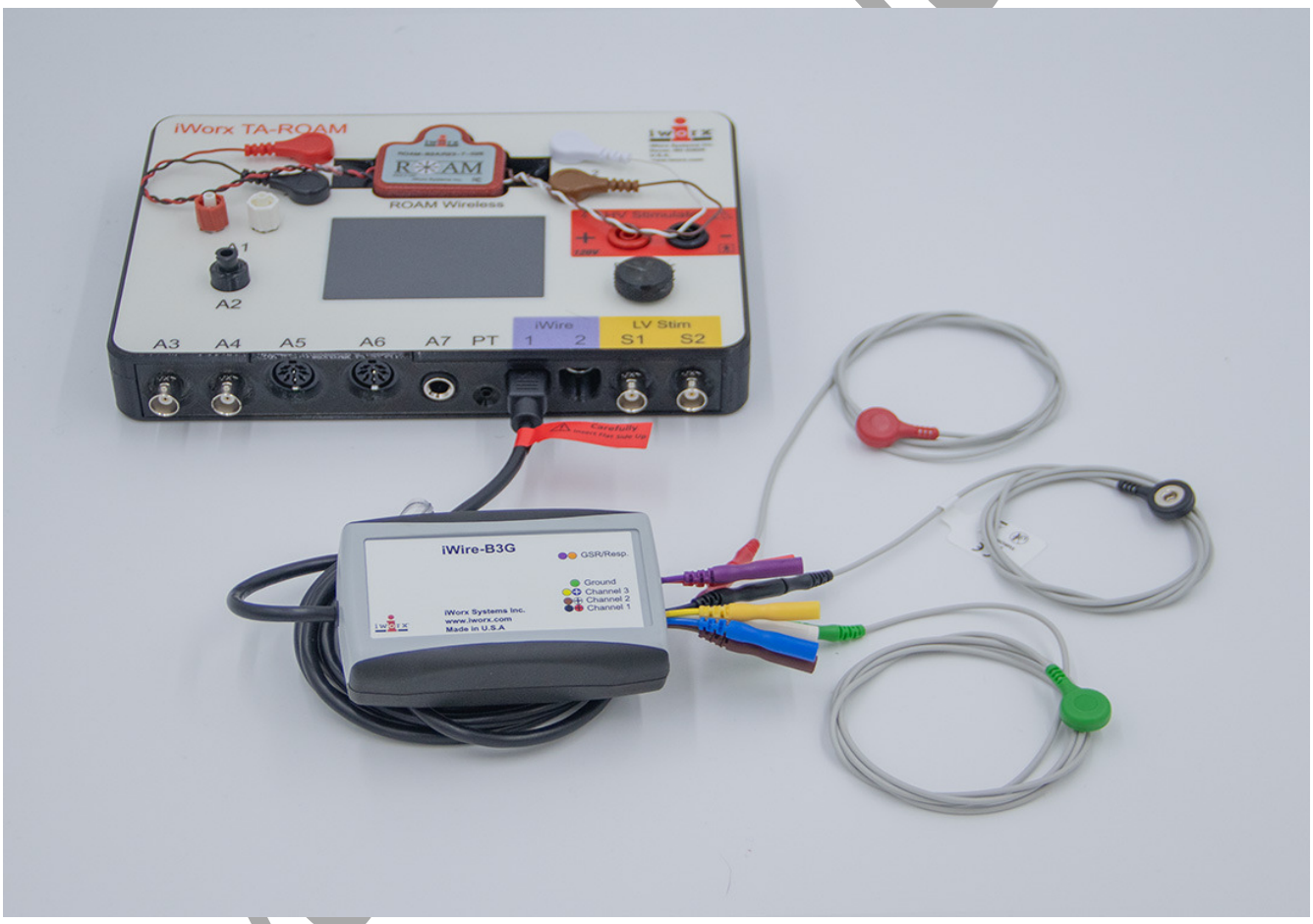

Figure HM-8-S1: The iWire-B3G EGG cable and red, black and green leads connected to an IXTA.

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2. Insert the connector on the end of the iWire-B3G EGG cable into the iWire 1 input on the front of the IXTA.
3. Insert the connectors on the red, black, and green electrode lead wires into the matching sockets on the iWire-B3G.
4. The subject should remove all jewelry.

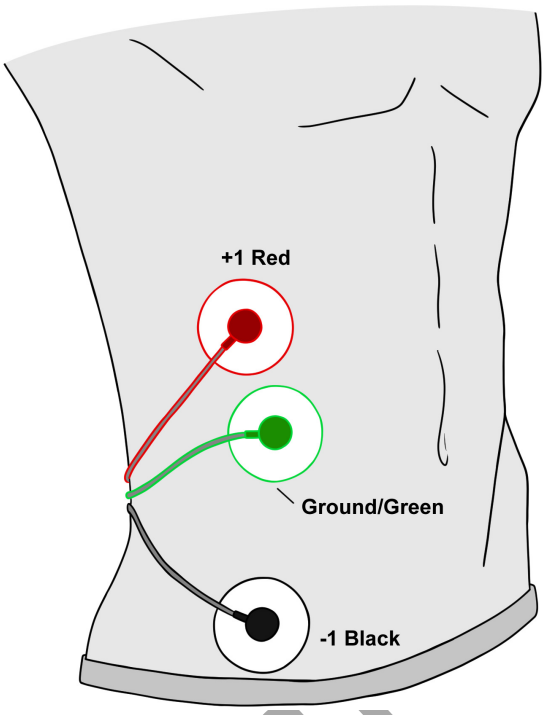

Figure HM-8-S2: Placement of EGG electrodes on the abdomen.

5. One area is approximately 3 cm to the left of the umbilicus (belly button), the second is above the first, and the third is just below and about 1 cm more to the lateral edge of the abdomen (left).
6. Remove the plastic disk from a disposable electrode and apply it to one of the scrubbed areas. Repeat for the other two areas.
7. Snap the lead wires onto the electrodes, so that:
    - the green lead (the ground) is attached to the electrode adjacent to the belly button.
    - the red "+1" lead is attached to the electrode above the green lead.
    - the black "-1" lead is attached to the electrode below and to the left of the green lead.

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Experiment HM-8: The Electrogastrogram (EGG) and the Growling Stomach

Exercise 1: EGG on an Empty Stomach

Aim: To determine the relationship between the frequency and power of EGG activity on an empty stomach.

Approximate Time: 30 minutes

Procedure

Note: The subject must have an empty stomach. The subject should not have ingested any food for at least 3 hours prior to this experiment.

1. The subject should get into a comfortable sitting or supine position. It is important that the subject is sitting or lying completely still during the recording.
2. Click the Record button to begin recording.
3. Record for a minimum of 15 minutes while the subject is lying prone with an empty stomach. Clinical EGG recordings are approximately 2 hours in length; however, a general understanding of the muscle activity can be seen in less time. The longer the recording, the more accurate the data. Do not record for longer than 30 minutes.
4. Click the Stop button after the desired length of recording. The recording should be similar to the recording below.
5. Select Save As in the File menu, type a name for the file. Click on the Save button to save the data file.

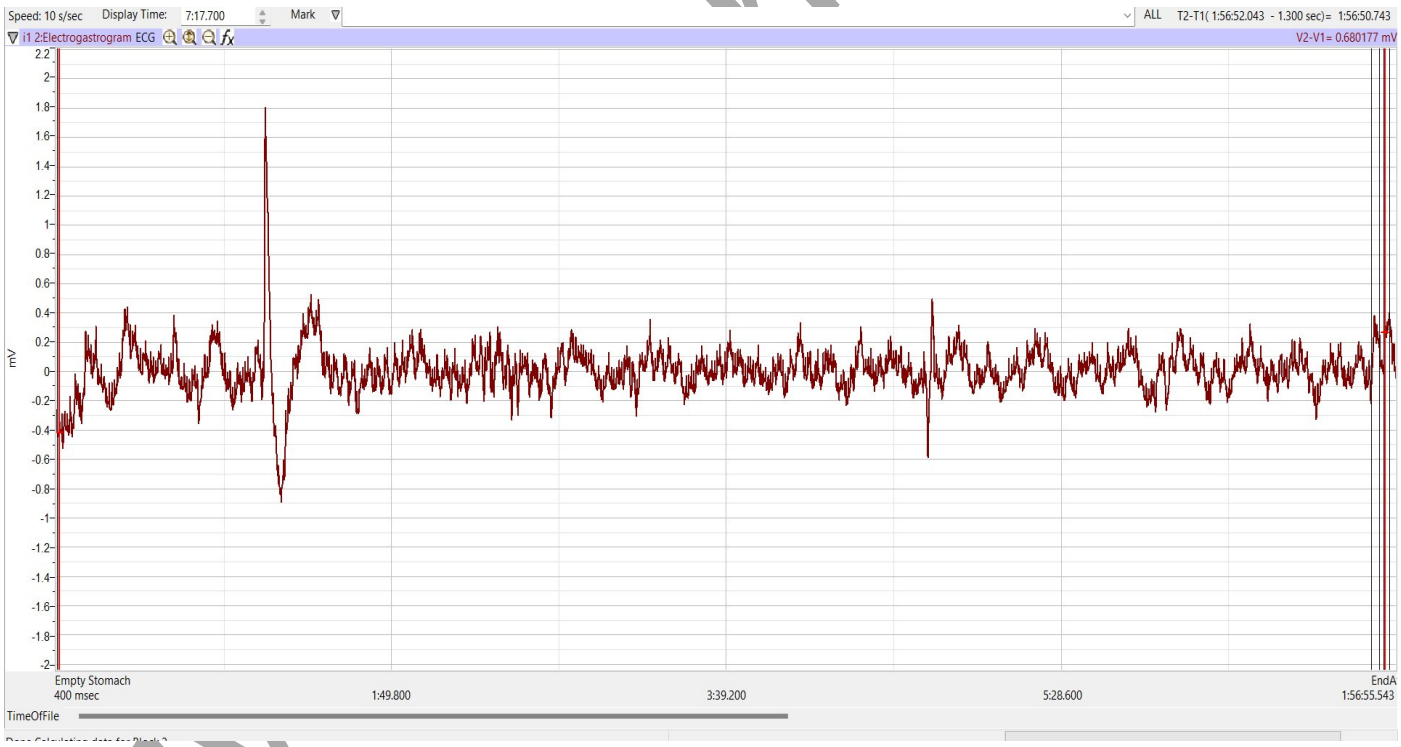

Figure HM-8-L1: The EGG recording in the Main window of a supine subject with an empty stomach. Note the fluctuations in muscle activity over the course of the recording.

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Exercise 2: EGG on a Full Stomach

Aim: To determine the relationship between the frequency and power of EGG activity on a full stomach.

Approximate Time: 30 minutes

Procedure

Note: The subject will eat a small meal. Have some food ready for the subject to eat. This can include a sandwich, fruit, desert and a small non-carbonated drink.

1. The subject should sit up and eat a small meal within 15 minutes.
2. Have the subject then get back into a comfortable sitting or supine position. It is important that the subject is sitting or lying completely still during the recording.
3. Follow the same directions as in Exercise 1, recording EGG activity for the same length of time.
4. Click the Stop button after the desired length of recording.
5. Click on the Save button to save the data file.

Data Analysis for both Exercise 1 and Exercise 2

This lab uses the Fast Fourier Transform analysis routine in LabScribe. The FFT function allows the user to look at both the frequency and the power output of a section of data recorded over time.

The way the FFT works is relatively straightforward. It takes a chunk of time called a *frame,* a certain number of samples of data, and considers that chunk to be a single period of a repeating waveform. The reason that this works is that most EGG activity are "locally stationary," meaning that over any period of time, the muscle contractions look like a regularly repeating function.

The stomach muscles contract at regular intervals, giving a repeating rhythmic electrical signal that is recorded by the electrodes placed on the abdomen. In a subject at rest with an empty stomach, the rhythm of the contraction is approximately three cycles per minute or about 0.05 Hz. The power and frequency of the signal will change after the subject eats a small meal.

1. Use the Display Time icons to adjust the Display Time of the Main window to show the complete set of all the EGG muscle contractions for an Empty Stomach on the Main window.
2. Click on the FFT window icon in the toolbar.

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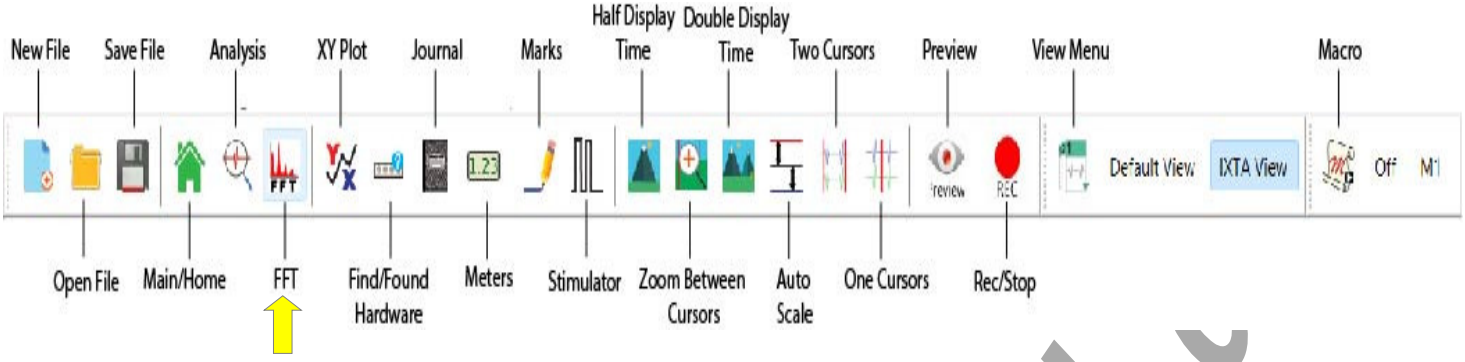

Figure HM-8-L2: The LabScribe toolbar.

4. Look at the new FFT window that opens. In the top section of the window is a direct copy of the raw data from the main window.
    - On the top graph, click and move the two vertical cursors so they are at either end of the data shown.
    - A histogram will be shown in the lower window as the cursors are moved into the correct position.
5. On the lower window:
    - Choose 0.01 Hz from the Freq. Resolution drop down menu to the right of the FFT Toolbar.
    - Click AutoScale to expand the histogram as shown in Figure HM-8-L4.

Figure HM-8-L3: The FFT Toolbar.

- Click and move the two vertical cursors so that they are placed in the correct positions zooming in on the "interesting" section of data at the beginning of the FFT window. This should be the area with the maximum histogram waves.
- Click the "Zoom Between Cursors" ("+") button, located between the Half and Double Display time buttons, once. This will expand the section of data showing the frequency and power of the EGG muscle contractions while the stomach is empty.

6. Move the left hand cursor to the first, largest peak. Move the right hand cursor to the end of the section of data.
7. Click Add Function in the lower (FFT) window (above the histogram graph) and add: Mean Frequency and Mean Power
8. Look at the numerical data for Mean Frequency and Mean Power for the frequency of the stomach contractions and the strength, or power, of those contractions.

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9. The functions in the Power Spectrum of the Electrogastrogram pull-down menu of the FFT window can also be used to enter the names and values of Mean Frequency and Mean Power to the Journal. To use these functions:
    - Place the left hand and right hand cursors as stated above.
    - Transfer the name of the mathematical function used to determine the means to the Journal using the Add Title to Journal function in the pull-down menu.
    - Transfer the values for the frequency and power to the Journal using the Add All Data to Journal function in the pull-down menu.
    - The graph can also be copied using the pull-down menu.
7. Record the values for the Frequency and Power on an Empty Stomach in the Journal using the one of the techniques described above and on Table 1.
8. Select Save from the File menu.

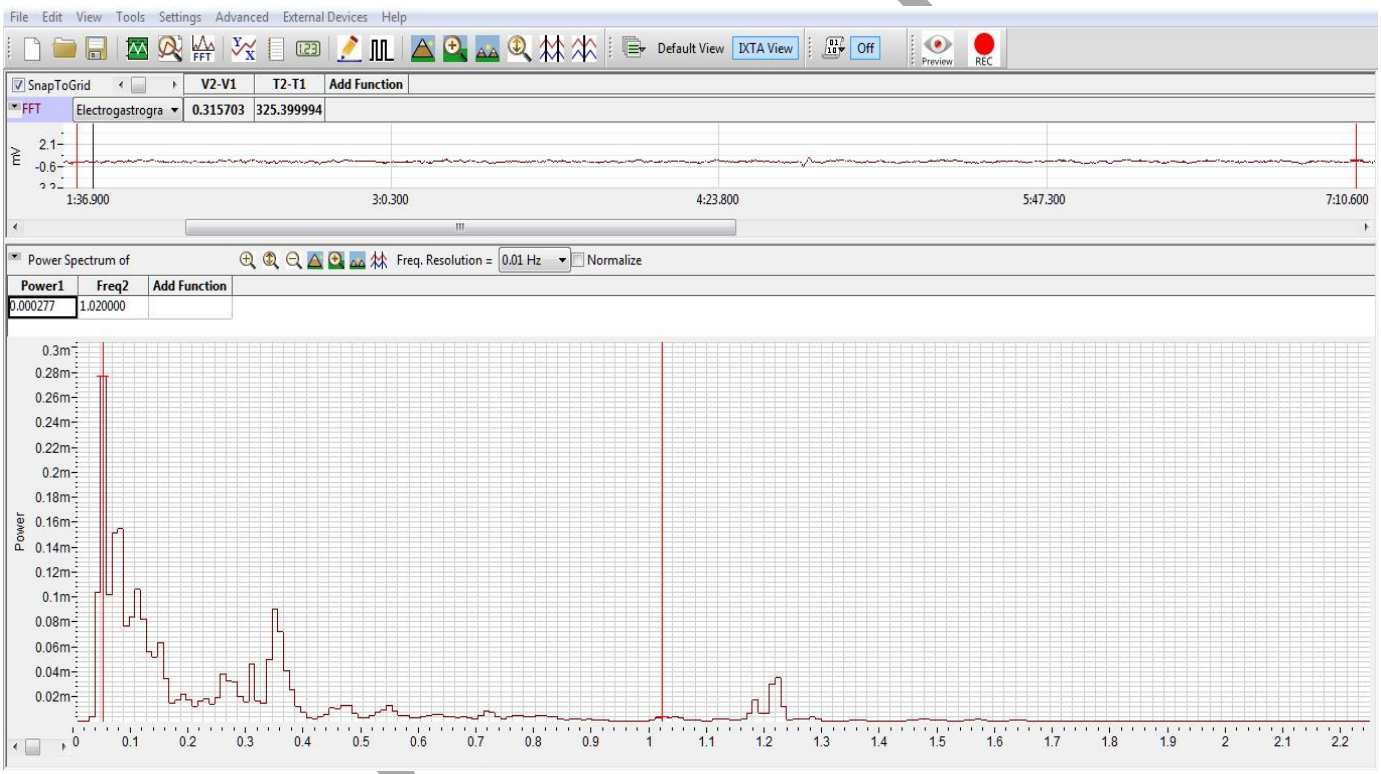

Figure HM-8-L4: The frequency and power of the EGG shown in the FFT window. The left hand cursor is placed on the peak of the highest wave in the histogram. The frequency and power are shown in the upper left of the graph.

9. Repeat Steps 1 through 8 for the data in Exercise 2 when the subject has a full stomach.
10. Select Save from the File menu.

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Questions

1. Was there a change in the frequency and power of the EGG waves before and after eating?
2. What is the physiologic relationship between frequency and power of the EGG contractions, whether before or after ingesting food?
3. Why is there a change in the frequency of the contractions after eating?
4. Why is there a change in the power of contractions after eating?
5. What are the physiologic causes for any changes seen in the subject's EGG after eating?

Table HM-8-L1:The Effect of Food on EGG Activity in a Supine Subject.

FFT Analysis of Electrogastrogram (EGG) Activity		
Supine Subject	Frequency of EGG waves (Hz)	Power
Before Eating		
After Eating		

Optional Exercise:

Plug the ES-300 Electronic Stethoscope into the iWorx data recorder to listen to the growling sounds of the digestive system while recording on both an empty and full stomach.

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