

# Activity 10: Beat Frequency







## Background

When two sound waves with slightly different frequencies combine, the pattern of interference produced is known as beats. The rate at which the beats occur is the beat frequency.

In this activity, the GLX will generate two tones whose frequencies differ by  $\Delta f$ , and you will hear the resulting beats. By varying the frequency of one of the tones, you will discover the relationship between  $\Delta f$  and beat frequency.




## Before You Begin

Start a new experiment on the GLX.

1. Press  to go to the Home Screen.
2. Use the arrow keys to highlight the Data Files icon and press  to open the Data Files screen.
3. Press  to open the Files menu and press  to select New File.
4. When the GLX asks if you would like to save the previous file, press  to save or  not to save.

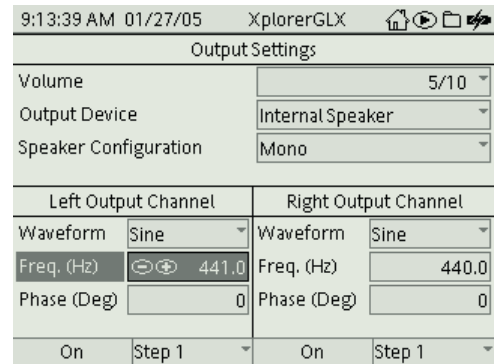
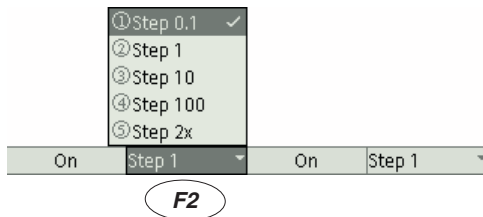
## Procedure

### GLX Set-Up

1. Press  to return to the Home Screen.
2. Use the arrow keys to highlight the Output icon and press .
3. If the Speaker Configuration is not already set to Mono, use the arrow keys to highlight Speaker Configuration and press  to set it to Mono.



- Use the arrow keys to highlight the Frequency of the Left Output Channel (as pictured to the right) and press  $\oplus$  to increase the Frequency to 441 Hz.
- Press  $F2$  to open the Left Step Size menu. Press the up arrow key to highlight Step 0.1, then press  $\checkmark$ .



**Data Collection**

- Press  $F1$  and  $F3$  to turn on the Left and Right Output Channels. Describe what you hear.

---



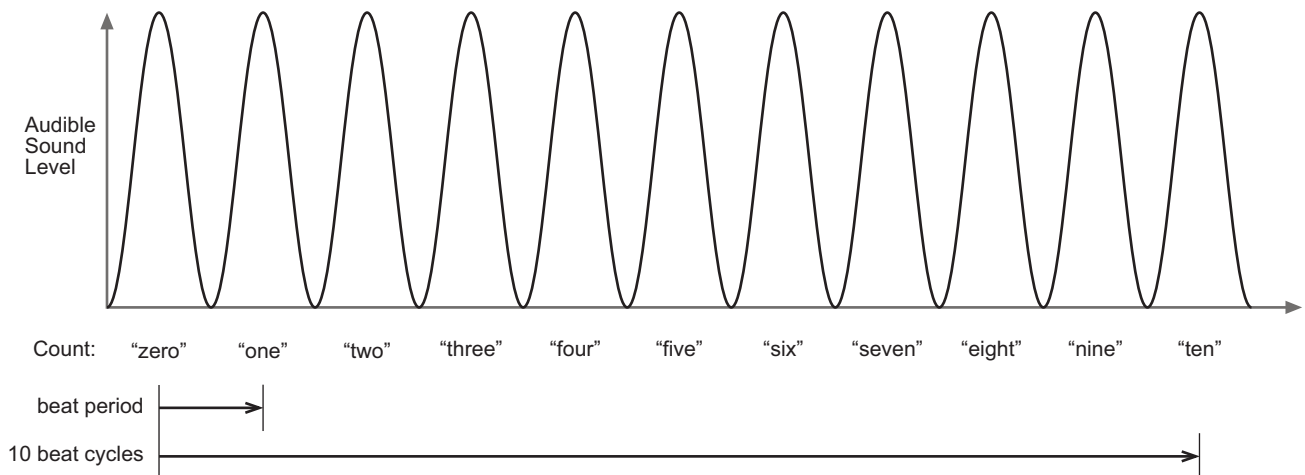
---





---



- In the chart on the next page, write the frequencies of the Left and Right Output Channels ( $f_{left}$  and  $f_{right}$ ).

You will use the GLX's Stopwatch screen to time the beat period. Since it is not practical to measure the very short time between two beats, you will time 10 full beat cycles and later divide by 10 to calculate the period. Start timing on beat "zero" and stop timing on beat "ten," as illustrated below.






3. Press  to return to the Home Screen; use the arrow keys to highlight Stopwatch and press .



4. Count the beats, “zero, one, two, three, . . . , ten.” Press  on beat “zero” to start timing. Press  again on beat “ten” to stop timing.


5. Write the elapsed time of 10 cycles in the chart below.

6. Press  to reset the Stopwatch.

7. Press  to return to the Home Screen; use the arrow keys to highlight Output and press .





8. Use the arrow keys to highlight the Frequency of the Left Output Channel.

9. Press  twice to increase the Frequency by 0.2 Hz.

10. Record the Frequencies of the Left and Right Output Channels in the next line of the chart.

11. Repeat steps 3 through 10 until you have written data in 6 lines of the chart.

12. While viewing the Output Screen, press  and  to turn off both output channels.

Left Channel Frequency $f_{\text{left}}$	Right Channel Frequency $f_{\text{right}}$	Frequency Difference $\Delta f$	Elapsed Time for 10 Full Cycles	Beat Period $T_{\text{beat}}$	Beat Frequency $f_{\text{beat}}$

## Analysis

1. For each line of the chart, calculate and record the frequency difference ( $\Delta f = f_{\text{left}} - f_{\text{right}}$ ) and beat period,  $T_{\text{beat}}$ . (You can do these calculations in your head.)
2. Press  $\text{\textcircled{H}}$  to return to the Home Screen; press  $\text{\textcircled{F3}}$  to open the Calculator. Use the calculator to calculate the beat frequency,  $f_{\text{beat}}$ , for each line of the chart.

$$f_{\text{beat}} = 1/T_{\text{beat}}$$

3. According to your data, what is the relationship between  $\Delta f$  and  $f_{\text{beat}}$ ?

---

---

---