

SIGNALS, SYSTEMS, ACOUSTICS AND THE EAR LABORATORY WORKSHEET: EXPLORING SIGNALS

1. You are going to use a computer program (WASP) to record sounds and display them on the screen. Click on the red 'record' button and then use 'Test Levels' to make sure you are not overloading the system. The fluctuating horizontal bar measures the level of the recorded sound, and should be in the middle of its range. If it goes all the way to the right, you are overloading the system, which will distort the waveform. On the toolbar, you will see two adjacent buttons depressed (8th and 9th from the left). Press the right-most one of these (not the sinusoid), to turn it off, leaving you with a single display of the recorded waveform.



- a). In the *waveform* trace, what does the horizontal axis represent? _____. What does the vertical axis represent? _____.
2. The left and right mouse buttons can be used to position cursors on the display. The position of the cursors, and the time between them, will be displayed at the bottom of the WASP window. Click on the 'play' button (green arrow) to play the region between the cursors. You can also click on the ↑ 'zoom' button to expand the display, or on the ↓ button to go back.
- a) Record someone whistling a few notes of a tune (red circle). Hold the microphone off to the side of your mouth to avoid 'wind noise' from the force of your breath. Look at the shape of the waveform. Use the cursors to replay a low-pitched note and a high-pitched note. Measure the duration (or '*period*') of one complete cycle of a low-pitched note and compare it with the period of a high-pitched note. To get more accuracy, you could measure the duration of, say, 10 cycles, and then divide the total time by 10:
low pitch: _____ high pitch: _____
- b) using the formula: $\text{frequency} = 1/\text{period}$, calculate the frequency (number of periods per second) for each of these notes:
low pitch: _____ high pitch: _____
In what unit is frequency measured? _____

3. a) Record the word "see". Zoom in to 0.1 seconds worth of the waveform in the fricative sss and then the same amount of the vowel. What differences do you observe between the fricative part and the vowel part in the *waveform* ?

b) Measure the period of one cycle of the vowel. _____

c) Given the period, what is the frequency? _____

- d) Record 'ee' spoken on a relatively low pitch and 'ee' spoken on a relatively high pitch. Zoom in to 0.1s of each waveform. How has the difference in pitch affected the period and frequency?

4. Record the word "seashore" on as steady a pitch as you can (in other words, on a monotone). Compare the waveform shape in the "ee" vowel region with the waveform shape in the "aw" vowel region (not all accents of English will have the "aw" vowel in the word *shore*). Is the difference between "ee" and "aw" simply one of frequency?

5. (If you have time) Record yourself speaking your full name and zoom in so that it fills the screen. Click again on the button you first nullified, which will give you a *spectrogram* or *Voiceprint* to print out along with the waveform. Try to identify the regions of the signal corresponding to the different phonetic components of its pronunciation. Use the program to help you replay the signal in parts.

NOTE: The WASP software, which runs on any multimedia PC, is freely available from:

<http://www.phon.ucl.ac.uk/resource/sfs/wasp.htm>

For other demonstrations and links to information about acoustics and speech perception, go to:

<http://www.speechandhearing.net/>