Name: _____ **Date:** _____

Frequency Hearing Testing Worksheet Answers

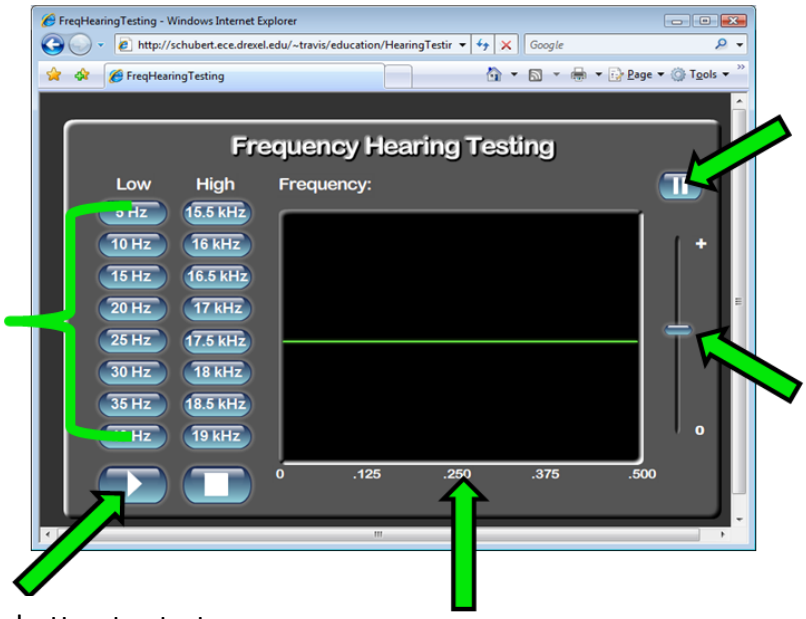
Define the Problem

In the first stage of designing, engineers determine what a product must be able to do, and what limitations (constraints) might exist in designing it. With your group, brainstorm ideas for what the **hearing aid must be able to do**. Remember, no ideas are too "silly" to be written down. All ideas should be respectfully heard. In the next two minutes, write down all your ideas.

Research & Investigate

In the next stage of designing, engineers gather information by doing research and performing experiments. This helps them make informed decisions about the design. In this design project, you are investigating how well we hear at various frequencies.

1. Open the Frequency Hearing Testing website interface at http://schubert.ece.drexel.edu/~travis/education/HearingTesting/FreqHearingTesting.html
2. Play with the features for a few minutes, and record your observations on the next page. Look at the diagram for a few tips on how to use this tool.



Use these buttons to choose a frequency.

Click the pause button to freeze the wave display so it does not move.

This is the "amplitude adjustment slider," which increases the amplitude (volume) of the sound

Click the play button to start the wave frequency. You should hear a sound.

After you select a frequency and press the play button, you should see a moving wave in this black box area.

Observations

1. Describe what you notice when you change the frequency in the simulation. What happens to the sound? What happens to the wave?

   Example answer: As the frequency increases, the sound becomes higher in pitch and the wave has more oscillations (wiggles).

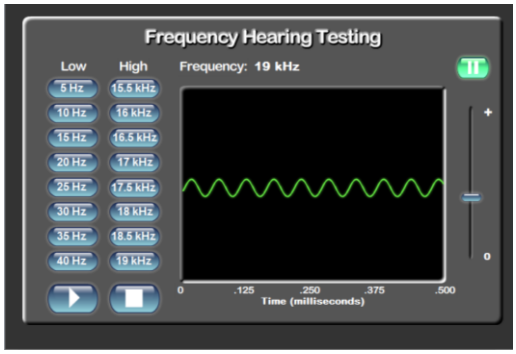
2. Describe what you notice when you change the amplitude in the simulation. What happens to the sound? What happens to the wave?

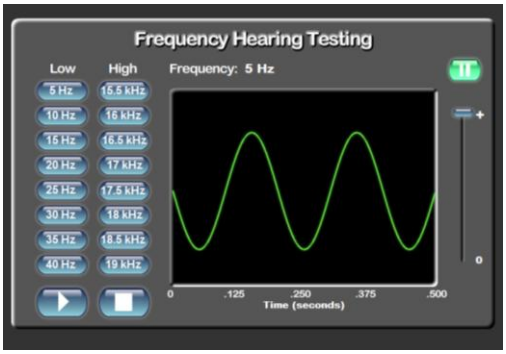
   Example answer: As the amplitude increases, the sound becomes louder and the wave looks bigger.

3. In the boxes below, draw the sound wave indicated. Then, say what you would hear if you listened to this sound wave.

   Wave with high frequency and low amplitude **Wave with low frequency and high amplitude**

   Example answers: The waves drawn should resemble these pictures:





What would this wave sound like? **What would this wave sound like?**

Example answers: High pitch, low volume **Low pitch, high volume**

4. Now pretend you are an engineer using the tool you have just been exploring. Before designing a hearing aid, you want to know what is considered the normal range. Collect data on yourself and share it with the class to determine the class' "normal" range of hearing.

Your Team's Hearing Test for Highest Frequency

Place a check next to the frequencies you can hear for each member in the group:

_____ 15500 Hz (15.5 kHz) _____ 17000 Hz (17 kHz) _____ 18500 Hz (18.5 kHz)

_____ 16000 Hz (16 kHz) _____ 17500 Hz (17.5 kHz) _____ 19000 Hz (19 kHz)

_____ 16500 Hz (16.5 kHz) _____ 18000 Hz (18 kHz)

Your Team's Hearing Test for Lowest Frequency

Place a check next to the frequencies you can hear for each member in the group:

_____ 5 Hz _____ 20 Hz _____ 35 Hz

_____ 10 Hz _____ 25 Hz _____ 40 Hz

_____ 15 Hz _____ 30 Hz

Your Team's Results

1. What are the highest and lowest frequencies that each member of your group can hear? Record answers here.

   Highest frequency each member can hear: _____ _____ _____ _____

   Lowest frequency each member can hear: _____ _____ _____ _____

2. When you are done, have one team member record your group's findings on the board. Then record the class results, below.

Collected data from ____ students in total.

Class Data for Lowest Frequency Heard

_____ 5 Hz	_____ 20 Hz	_____ 35 Hz
_____ 10 Hz	_____ 25 Hz	_____ 40 Hz
_____ 15 Hz	_____ 30 Hz	

Class Data for Highest Frequency Heard

_____ 15500 Hz	_____ 17000 Hz	_____ 18500 Hz
_____ 16000 Hz	_____ 17500 Hz	_____ 19000 Hz
_____ 16500 Hz	_____ 18000 Hz	

Calculations

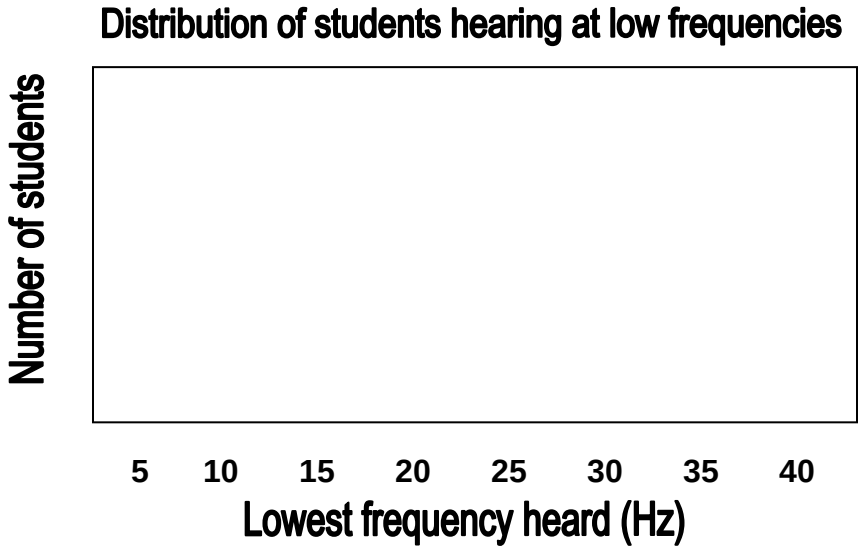
1. Find the mean, median, mode(s) and range of the lowest frequency class data. Show your work and make sure to **include the units in the answer**!

mean _____ median _____ mode(s) _____ range _____

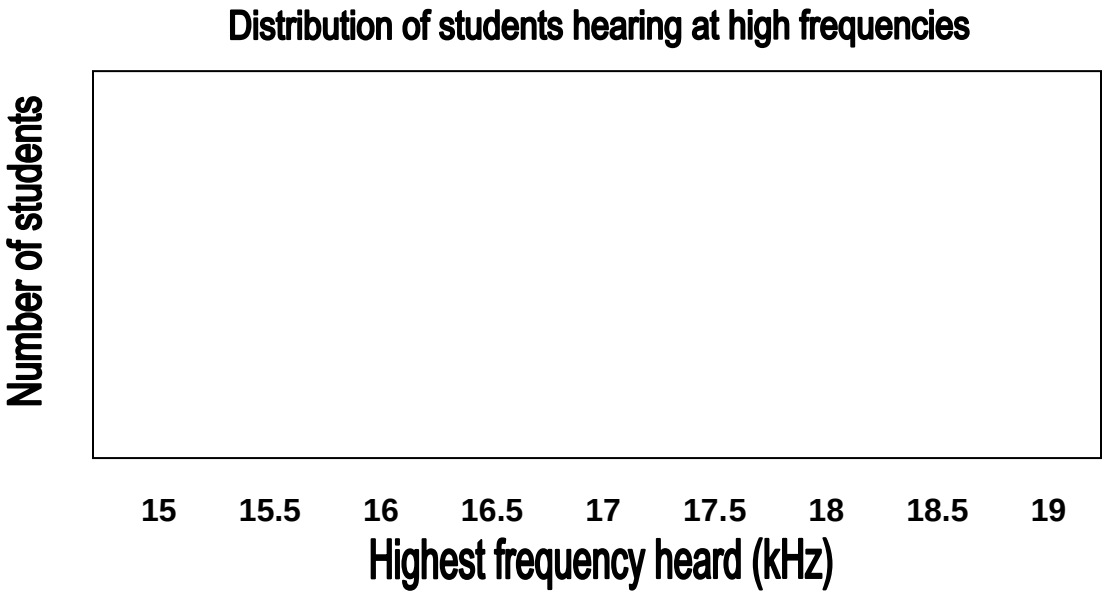
2. Find the mean, median, mode(s) and range of the highest frequency class data. Show your work and make sure to **include the units in the answer!**

mean _____ median _____ mode(s) _____ range _____

3. Create a bar graph showing how many students had their lowest frequency heard at each of the following frequencies.



4. Create a bar graph showing how many students had their highest frequency heard at each of the following frequencies.



Propose Design Options

Once engineers have gathered information (as you have with this experiment), they use that information to propose ways to design a product. What have you learned from this experiment that could be applied to designing a hearing aid? What could this device do to try to make each frequency sound equally loud? Write your ideas down on a sheet of paper, and be ready to share them with the rest of the class. **Example answers: Suggest an appropriate range of frequency that the hearing aid should strive to provide; suggest making the very high and very low frequency sounds have greater amplitude, so they are easier to hear.**