Interactive Lab Sound
Name______________________ Block____

During this interactive you are going to explore how sound is changed due to relative motion of the observer and source.

1. Explain why the frequency of a wave changes when there is relative motion between the source and the observer of the wave.

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2. Using your understanding of Doppler shift and the general equation complete the equations shown below.

Source and Observer moving closer to each other	Source and Observer not moving relative to each other	Source and Observer moving further from each other
1 $\left[\frac{v_{sound} \pm v_{observer}}{v_{sound} \pm v_{source}}\right]$	1 $\left[\frac{v_{sound} \pm v_{observer}}{v_{sound} \pm v_{source}}\right]$	1 $\left[\frac{v_{sound} \pm v_{observer}}{v_{sound} \pm v_{source}}\right]$

A horseshoe bat is perched upside down on a tree limb, as shown in the diagram to the right. A particularly clueless moth is flying directly at the bat. If the bat can determine when to open its mouth, it will not have to move an inch to enjoy a yummy snack. The bat will use its sonar to determine the moth's location and the moth's flying speed. Taken together, these two facts will enable you to time when to open and close the bat's mouth to allow it to swallow the moth.

Open the shortcut **IL Sound** on one of the lab stations.
Open the simulation contained in this section. **Do Not follow the directions in the simulation follow the following instructions.**

In the simulation, press GO to start the moth flying across the screen toward the bat. At any time, press the SEND SONAR button. High frequency sound waves will travel out from the bat, reflect off the moth, and return to the bat. The simulation will then pause, and you will see displayed in the control panel the total time, in milliseconds, it took the sound wave to travel to the moth and back. (The simulation runs in slow motion, so this is the not elapsed time you will experience.) The speed of sound in the simulation is 336 m/s (it is a little chilly out tonight). Also displayed in the control panel is the frequency of the sound waves emitted by the bat, as well as the frequency of the sound waves that return to the bat.

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3. Using the data you just gathered from the simulation calculate the speed of the moth. Note that because the moth is moving, the sound is Doppler shifted twice: once when the sound wave traveling from the bat reaches the moving moth, and again when the reflected sound wave returns to the bat. **Show all work and equations including substitution with units.**

4. Calculate how far away the moth is from the bat given the data gathered from the simulation and the speed of sound given to you. **Show all work and equations including substitution with units.**

5. Using your answers for questions 3 and 4 how long should the bat wait to open its mouth? (Note that the moth moves slightly closer to the bat in the time it takes the sound wave to return to the bat after reflecting off the moth. Since the moth moves much more slowly than the speed of sound, the distance is so slight that you can ignore it in your calculations.) **Show all work and equations including substitution with units.**

Enter the time, in seconds, in the box in the control panel. Press GO to resume the simulation, and the moth will continue to fly toward the bat. You have succeeded if the bat swallows the moth. Otherwise, press RESET and try again. You will have to redo all your calculations since the bat will send the sonar signal when the moth is at a different distance from the bat. Show all new work and calculations either on a separate sheet of paper or in a different color.

6. What do you understand better now as compared to before you preformed this interactive?

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