Name _____ Date _____ Period _____

LAB: Making a Whistle

THE PHYSICS OF MUSIC

Background: Whistles: A simple **whistle** is a Persian woodwind instrument which produces sound from a stream of forced air. Many types exist, from small police and sports whistles (also called pea whistles), to much larger train whistles, which are steam whistles specifically designed for use on locomotives and ships. Although whistles have a musical characteristic (for example train whistles sound a minor-seventh musical chord) whistles are not usually considered 'musical' in the sense of being able to play a chosen melody, but mainly the small whistles can also be used as a - very shrill and loud - noise and rhythm instrument. However, musical whistles exist, including any of several 2-octave musical instruments known as tin whistles (sometimes known as pennywhistles or low whistles), as well as the calliope (an array of separately actuable steam whistles), organ pipes and the recorder. Pea whistles are used in jazz and Latin music as a percussion instrument.

The whistle works by causing the smooth flow of air to be split by a narrow blade, sometimes called a ***fipple***, creating a ***turbulent vortex*** which causes the air to ***vibrate***. By attaching a ***resonant chamber*** to the basic whistle, it may be tuned to a particular note and made louder. The length of the chamber typically defines the resonant frequency. A whistle may also contain a small light ball, usually called the ***pea***, which rattles around inside, creating a chaotic vibrato effect that intensifies the sound. Japanese bird whistles use several small balls and are half filled with water in order to reproduce the sound of a bird song. A steam whistle works the same way, but using steam as a source of pressure: such whistles can produce extremely high sound intensities.

Infrasonic Whistles: Sometimes, unintentional whistles can be set up. A common one is the opened sunroof of a car: air passing over the top of the vehicle can, at certain speeds, strike the back edge of the sunroof, creating a very low frequency whistle which is resonated by the closed interior of the car. Since the sound frequency is around 4 Hz, the effect is very uncomfortable for occupants, who feel the vibration rather than hear it. Such low frequencies can induce nausea, headache, disorientation and dizziness. The effect can be prevented by opening a side window a few inches. Subsonic whistles have also been developed for use as weapons, or to deliberately create a sense of uneasiness in an enemy.

Ultrasonic Whistles: A **dog whistle** (also known as **silent whistle** or **Galton's whistle**) is a type of whistle used in the training of dogs and cats. It was invented by Francis Galton. The frequency range of a dog whistle is largely out of the range of human hearing. Typically, a dog whistle is within the range of 16000 Hz to 22000 Hz with only the frequencies below 20000 Hz audible to the human ear. Some dog whistles have adjustable sliders for active control of the frequency produced. Depending on the way the whistle is used, a trainer may simply gather a dog's attention or inflict pain for the purpose of behavior modification. The name dog whistle is often used for both lung-powered whistles as well as electronic devices that emit ***ultrasonic*** sound via piezoelectric emitters. The electronic variety are sometimes coupled with bark detection circuits in an effort to curb barking behavior. These kind of whistles are also used to determine the hearing range of people or for physics demonstrations. Some political observers have used the phrase "dog-whistle politics" to refer to the use of words and phrases that one's political allies will recognize and appreciate but that may not mean anything to other listeners.

Examples of whistles: Industrial whistles are used for signaling and timekeeping both on railroad and ships, and in factories. Most of these whistles were steam powered and not standardized. Individual locomotives could be identified by their whistles. At noontime in industrial areas up into the 1950s whistles of every pitch could be heard, as each factory had a boiler and a whistle, if not full steam power.

Railroads in particular used elaborate whistle codes for communication both within the train and with other trains. These methods are maintained today with motor-powered air horns. Trucks also use air horns, especially since they often have air brakes and so there is already a source of compressed air on board.

Train whistles generally produce three or four different frequencies at the same time, to produce a non-major chord, that is distinct, loud, and low in pitch.

warning Whistles are often used as warning devices or as safety devices serving to attract attention to the user. Some cyclists use a whistle as a substitute for a bell or horn. It should be noted, however, that many jurisdictions require that the warning device be permanently attached to the bicycle.

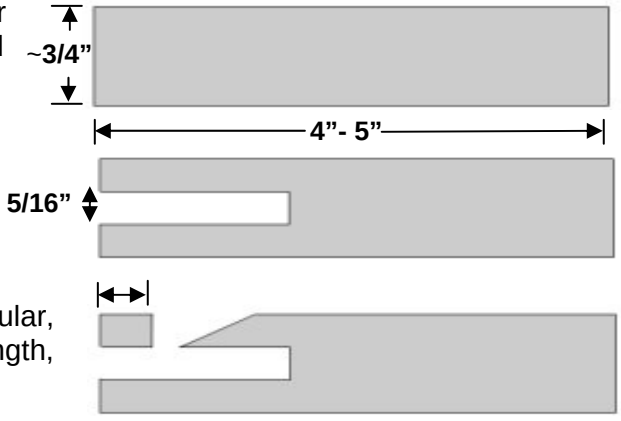
Rescue or Survival whistles are often packed in survival kits and attached to Personal flotation devices to allow a victim to signal for help. The whistle is audible at much greater distances than the human voice, and is less likely to cause exhaustion if used repeatedly. Survival whistles differ from pea whistles in that they are usually flat, so that water cannot collect inside if the user is immersed, for example after falling overboard from a boat.

Retrieved from "http://en.wikipedia.org/wiki/Whistle"

Procedure:

1. Read the background information on whistles and answer the **"Pre-Lab "questions** *(page 3)* **<u>before</u>** returning to class. *(You will not be able to participate in the lab unless you have answered these questions prior to the actual lab day)*

2. Obtain a small section of wood (tree branch) from your teacher to make your whistle (about **4-5 inches** long and about **3/4"** to **1"** in diameter.)

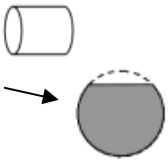


3. Lightly sand your wood to remove any rough edges.

4. Bring your branch to the teacher to drill hole **5/16"** in diameter x **1 1/2"** deep.

5. Then make two cuts to create a notch (one cut perpendicular, the other at **45 degrees**) about **3/4"** down the stem's length, and so that the notch cuts through into the bored cavity.

6. Now cut a small length of dowel **5/16"** in diameter X **3/4"** long.



7. Take a piece of sandpaper and flatten the top surface of along the length of the dowel.

8. This small length of dowel will be inserted into the hole you previously drilled. It should fit snuggly with the flat surface facing towards the direction of the notch you cut.

9. At this point you may want to shape the end of the whistle that you put to your mouth. Lightly sand and round the edges as shown.

10. Now that you whistle is completed, you may choose to add some decorations. Drill a hole in the opposite end of the whistle (1/8") about **3/8"** from the end. Thread a **8"** length of leather or string through the hole, tie and overhand knot, and add some beads (just like summer camp…..) You are now ready to try out your whistle.

Pre-lab Questions **(answer after reading the background information)** ***3 points each***

1. Where were the first simple whistles thought to have been developed?

2. What is a whistle's "***fipple***" and what is the importance of this in the production of sound?

3. What is the importance and function of a whistle's "***resonant chamber***"?

4. What is an ***infrasonic*** whistle and what frequency of sound do they produce?

5. What is an ***ultrasonic*** whistle? What frequency range do they exhibit?

6. What makes a ***train whistle's*** sound so unique?

Conclusion Questions: ***(answer after you have completed your whistle) 3 points each***

1. Were you able to successfully create a working whistle? If not, what do you think you did wrong?

2. How did the sound of your whistle compare to some of the other whistles created in your class? (amplitude and frequency) Explain what may have caused the differences in sound.

3. What would you have to do to create a whistle like this one that had a higher pitch (frequency)? A lower pitch?

4. Label the diagram below with the following terms: ***fipple, resonant chamber***

5. The picture to the right shows what is known as a "penny whistle" or "tin whistle". What is the function of the holes located along it's length and how do they change the pitch of the instrument?

Pennywhistle

6. List at least three situations where you have noticed the "whistle" effect in normal surroundings (e.g. your house, your car, out in nature, etc.) Identify what is acting as the fipple and the resonating chamber in each scenario.

7. How would you create a wood whistle that could "play" (sound) different notes? (explain. You can make a drawing to describe it)