THE GOOD VIBRATIONS SMORGSBORD:
An Exploration of Vibration, Sound, and Music

Procedure: Perform these activities in any order. Record the answers to the questions on this sheet or on notebook paper.

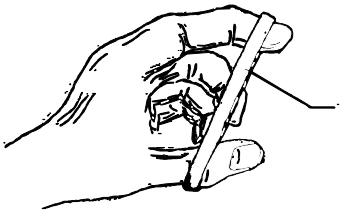
I. The Diving Tuning Fork

Strike the end of a tuning fork on the rubber pad provided or on the heel of your shoe. Barely touch the surface of a cup of water with the vibrating ends of the tuning fork. What do you observe? Do the vibrating ends of the tuning fork possess energy? How do you know?

II. Vibrating Meter Stick

Using one hand, hold an end of a meter stick down on a tabletop while allowing the other end to protrude over the edge of the table. With the other hand, set the meter stick into vibration by displacing, and then letting go of, the free end of the meter stick. Does the vibrating stick produce a sound? Repeat the procedure, this time with a shorter portion of the meter stick protruding over the edge of the table. Compare the sounds produced by the two lengths of meter stick. Continue the procedure of shortening and plucking the meter stick. At least for vibrating meter sticks, what relationship exists between length and pitch?

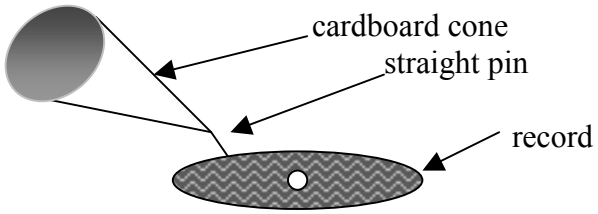
III. Stretching It A Bit



Stretch a rubber band between your thumb and forefinger. Note the pitch of the sound produced as you pluck the rubber band near your ear. Increase the tension in the rubber band by moving your fingers further apart. Once again observe the pitch as you pluck it. Did the increase in tension change the pitch? Is this what you would expect would happen? How can you explain your observation?

IV. Getting In The Grove

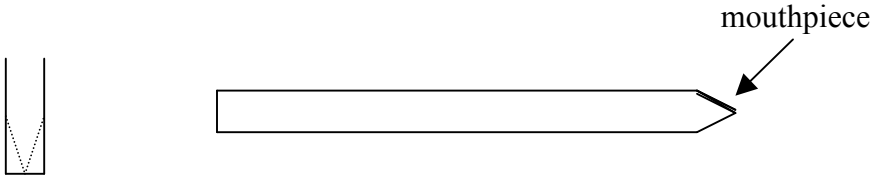
Form a cone out of a piece of poster board or file folder. Tape the edge so that the cone will retain its shape. After you place a straight pin through the tip of the cone, as is shown below, you will have an Edison-style record player.



Cradle the cone in both hands as you lower the straight pin into the groove of a spinning record. What do you hear? Describe the loudness and clarity of the sound. Explain how sound is produced with this simple record player.

V. The Last Straw!

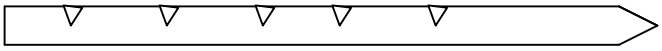
Using your teeth, pinch together about ¾ of an inch of the end a soda straw. This may be accomplished by pulling the end of the straw through clenched teeth. Using scissors, diagonally cut off the corners of the flattened end (see figure on left).



Place the flattened end in your mouth and blow gently. With a little practice, you will discover how to adjust your lips and air pressure to allow the straw's reeds to vibrate correctly. When the reeds vibrate, a sound will be produced. The device you have produced may be thought of as a "soda straw oboe," because like its namesake, it uses a double reed to produce sound.

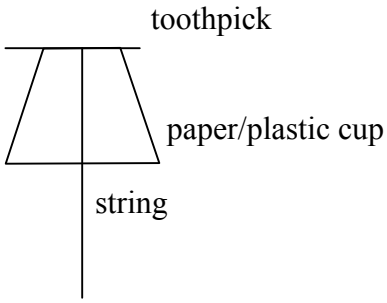
Once you have produced a clear, loud sound, cut off successive pieces of the open end of the straw. What happens to the pitch of the sound as the straw gets shorter? How does a real oboe achieve changes in pitch?

Make another straw oboe, but this time cut small notches along the length of the straw. The effective length of this device is changed by covering and uncovering the holes. See if you can play a tune on this oboe!



VI. Are You Chicken?

Using a toothpick, puncture a small hoe in the center of the base of a paper or plastic cup. Pull a 0.5, or so, length of string through the hole. With the cup turned upside down, tie the string around the toothpick (see figure).



Rub a little rosin on your thumb and index finger. Using a jerking motion, pull down on the string while gently pinching it between the thumb and index finger. Describe what you hear as the string moves between the fingers.

What is the source of the sound you hear? Why is the sound so loud? To answer this question, it may be helpful to pull on the string when it is not connected to the cup.

VII. Talking Can Be A Drag!

Hold the pointed end of the plastic strip between the thumb and the index finger. Using you other hand, drag your thumbnail along the ridges on the strip, moving from top to bottom. Do you hear anything?

If you didn't hear anything as you moved your fingernail along the strip, hold the pointed end of the strip against the end of a paper or Styrofoam cup. What do you hear this time? Why was the sound louder when the cup was used?

Try using other materials (for example, a piece of paper, a windowpane, a blackboard) to amplify the sound. List the amplifying materials you test and describe their effectiveness as amplifiers.

How do you suppose the strip "talks" as you drag your finger nail the ridges? Can you think of any other device that produces sound in a similar manner?

VIII. Making Waves

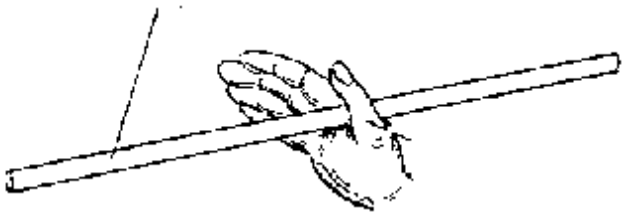
Fill a Styrofoam cup to the top with water. Drag the base of the cup along a smooth surface such as a Formica, slate, or polished wood tabletop. You will find that by adjusting your pressure on the cup, you will be able to cause it to vibrate. The vibrating cup will produce a sound and set the surface of the water into vibration. Carefully examine the surface of the water while it is vibrating. Describe what you see. What do you suppose produces the intricate pattern seen on the surface of the water?

IX. MacGyver Loudspeaker

After turning on the radio, place the open end of the cup, or soda container, over your ear and listen closely. What do you hear? What is actually producing the sound you hear?

Examine the "loudspeaker." List the materials that make up the device. How do you think they work together to produce sound? Look at the real loudspeaker at the this station. Compare the 2-liter loudspeaker to the actual loudspeaker. How are they similar? How are they different?

X. Singing Rod



Hold the aluminum rod with your fingertips at its center. (Note: The center may be located by balancing the rod in your hand in the region between the thumb and index finger as in the figure above.) Place some rosin on the tips of the thumb

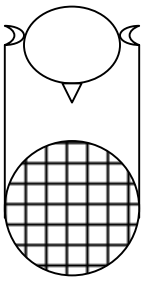
and index finger of the other hand. Grip one end of the rod between the rosin-covered fingertips and stroke the length of the rod between the end and center. With a little practice, you should be able to produce a piercing, high-pitched sound. If you are unable to get the rod to sing, tap the end of the rod with a mallet or hammer or tap it on a hard surface.

While the rod is "singing," bring a ping pong ball suspended on a string in contact with an end of the rod. Describe what happens. Can you explain why this occurs? What did stroking or tapping the rod do to it?

Grab the singing rod at a point off center. What happens? Why?

XI. The Bells of St. Weber

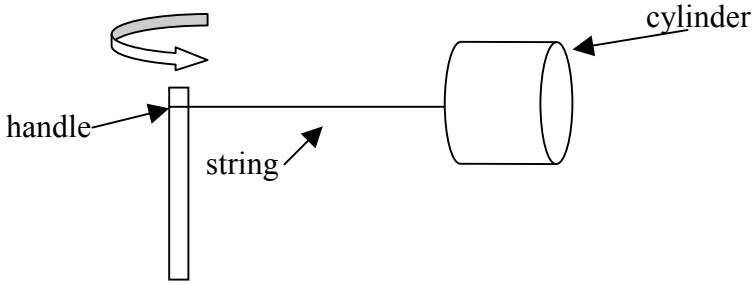
Pick up the grate from a barbecue grill by the strings. With the grate hanging by the strings, knock it against the side of a table. Describe the sound you hear. How does the sound produced by the vibrating grate reach your ears?



Now, with your index fingers, place the ends of the strings on the little flap of flesh that protrudes over the opening of each ear. Allowing the grate to hang freely from the strings, again swing the grate into the side of a table. Describe the sound you hear with the strings pressed against your ears. How is the sound reaching your ears? How do you explain the difference in sound quality?

XII. Taking The "Yo-Go" For A Spin

Pick the "Yo-Go" up by the plastic handle. Now move the handle so as to spin the cylindrical end cap at the end of the string around in a circle. Does it produce a sound? What is actually producing the sound? (Hint: examine the point where the string pivots about the top of the handle.) What makes the sound so loud?



XIII. Music Box Marvel

If necessary, gently wind the music box mechanism. Listen to the tune. Can you identify it? Can you even hear it?

Bring the mechanism in contact with a styrofoam or paper cup, tabletop, window, etc. Is the sound louder when it is in contact with a solid object? Why do you suppose this is so? Which object(s) makes the sound the loudest? Which objects tend to be the least effective amplifiers?

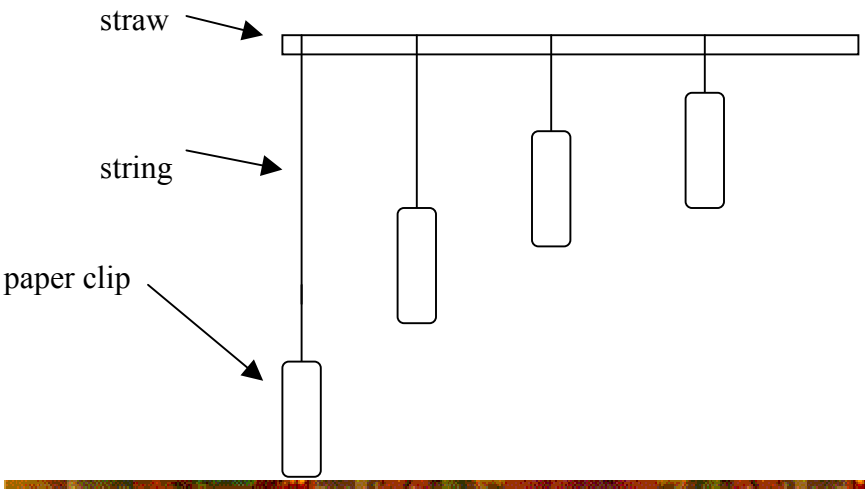
XIV. Singing Tubes

Hold one end of the plastic tube in one hand and swing the other end over your head. Start out swinging the tube slowly, then speed up. You should hear higher and higher pitches as you swing the tube faster and faster. **Be certain that no one is in the immediate area before you start swinging the tube.**

What do you think is producing the sounds you hear? Why does increasing the rate of swings increase the pitch of the sound produced? Can you produce any pitch you wish or are there only certain sounds that can be produced?

Now tear a sheet of paper into some small bits and place them on a tabletop. Hold the stationary end of the tube over the bits of paper while swinging the other end of the tube. Watch the paper fly! Based on the movement of the bits of paper, which way does the air flow through the tube?

XV. Mind Over Matter Pendulums



Construct the "Mind Over Matter Pendulum" device shown above by suspending paper clips from strings. Tie the strings around the soda straw and paper clips so that the lengths of string between the straw and the paper clips are 5, 10, 15, and 20 cm.

After completing construction, hold the end of the straw in your hand. Try to set a pendulum of your choice into motion by using *imperceptible* motions of your hand. Once you have mastered the technique, ask a friend to select a pendulum for you to set in motion using only your mind. We guarantee that you will mystify your friends with your power of "mind over matter!"

Can you explain the principle behind these mysterious pendulums?
(Hint: each pendulum has its own unique frequency of vibration.)

And Now….. The Grand Synthesis:

1. What is the source of all sound?

2. Give four examples of vibrating objects in this laboratory that produced sound.

3. How can sounds be amplified? Describe examples of amplification that you encountered in this lab. How does this work?

4. State the relationship between length of a vibrating object and the pitch of the sound produced.

5. How do players of woodwind instruments (e.g., oboes and clarinets) change the pitch of the sound produced by their instruments?

6. How is a talking strip similar to a record? How are they different? What is the vibrating object in each instance?

7. Air is said to be a *medium* for sound waves. What do you suppose this means? Did you encounter other media for sound in this exploration? Can you list other media for sound that you may not have encountered in the lab today?