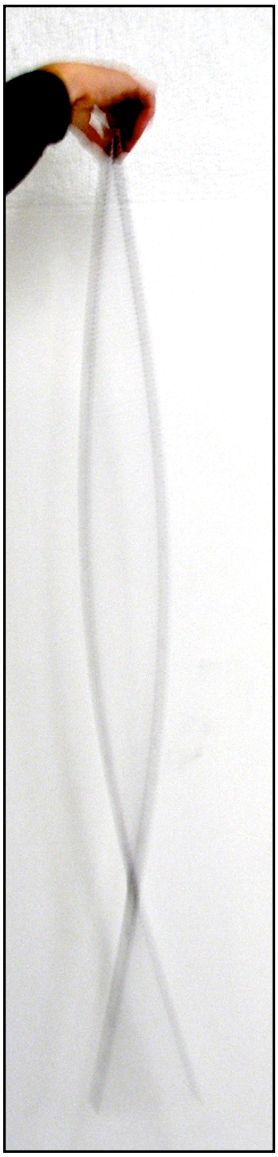
Vibrational Nodes



What is this about?

Have you ever hit a ball off the end of the bat and felt the "hand full of bumble bees?" When a bat hits the ball, the bat can start to vibrate. When this happens energy that could go into making the ball go further is used to make the bat vibrate. Part of designing a good bat is to be sure that the part of the bat that is likely to hit the ball should result in as little vibration in the bat as possible. You'll investigate the nature of these vibrations.

What do I need?

The only thing you need is a Sargent-Welch Photographic Meter Stick (CP72717-80).

What will I be doing?

Every object has a set of natural vibrational frequencies. This is how most musical instruments work, for example. You will excite the lowest natural vibrational frequencies of the Photographic Meter Stick, by shaking it at one end. In the picture you can notice a spot on the meter stick that isn't moving. This spot is called a "vibrational node," or "VN".

What to do and notice

1. Hold the meter stick vertically at the top and shake it at a low frequency. Adjust the frequency until the entire meter stick oscillates side to side. This is called the "fundamental frequency."
2. Shake it at a higher frequency until it looks like the picture at the right. This is called the "first overtone."

Write a description of your results. Draw a sketch of the oscillating meter stick in each natural frequency. Label the spot that doesn't move very much with VN.

What did I learn?

All objects, including bats, have a set of natural vibrational frequencies. For each frequency there are nodes where the vibrating object doesn't move. While the vibrational motion of a bat in your hands is a bit different that the vibration of the meter stick, the importance of the VN to hitting the ball can still be understood. If the bat is designed so that the ball is likely to hit a node, then none of the energy of the collision will go into vibration in the bat. The result is that there will be more energy available for the ball to go further. A well-designed bat should have the VN near the CP further reducing the energy absorbed by the bat. This region on the bat where both the VN and CP reside is called the "sweet spot" of the bat.

What else should I think about?

Have you ever noticed that a wood bat has a different sound than an aluminum bat. This is because the natural frequencies of the bats are very different. The aluminum bat has higher natural frequencies than the wooden bat. That is why the aluminum bat makes more of a "ping" sound when it hits the ball.