

Educational Innovations^{INC}[®]

SPT-100



Chinese Spouting Bowl



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The Chinese Spouting Bowl first appeared in the Han Dynasty (202 BC - AD 9). Four "Han" dragons or fish can be seen in the bottom of the basin, spraying streams of water up the sides of the bowl. It is said that long ago the bowl was a kind of plaything for nobles, gifted scholars, and socialites in the Ming Dynasty. It was believed to foster happiness, prolong life, and increase strength.

Procedure:

1. Place the bowl on a surface that is firm, but will allow the bowl to vibrate. A damp, folded bath towel makes a good base.
2. Fill the bowl about halfway with clean water.



3. Wash your hands thoroughly, ensuring that your hands are completely free of any oils. Also, clean the handles of the bowls thoroughly with isopropyl alcohol. (This is especially important before using it the first time.) You will not be able to work the bowl with even the smallest amount of oil or lotion on your hands or the handles of the bowl.

4. Moisten your hands slightly by dipping your palms into the water.
5. Rub your hands back and forth in opposite directions on the brass handles. You should have that "squeaky-clean" feeling where your hands meet the handles. Soon you will notice standing waves developing on the surface of the water in the bowl. As the vibrations build, the water will begin to spout up and out of the bowl.



Your ability to control the bowl will improve with practice. Try to make long, steady strokes using your whole hand, from the tips of your fingers to the heel of your palm. Also, try varying the amount of downward pressure you use. A light touch seems to work better. With practice, you should have water spraying 50 cm (about 20 inches) out of the bowl.



Explanation:

Your hands create vibrations in the handles from the adhesion of your wet skin to the brass. Oil reduces this adhesion. As your hands move, the adhesion creates a tension in the skin of your palms, and when this exceeds the frictional force, your skin will slide, reducing tension. If your hands are in constant motion, your skin will vibrate the handles as it repeatedly sticks and slides. The vibrating handles will then create transverse mechanical waves to travel outward from the handle along the metal rim of the bowl in both directions. The metal rim acts as an elastic medium to transmit these waves. If the circumference distance around the rim from handle to handle is equal to a multiple of a half wavelength, then stable standing waves will be produced. It is easy to create a mechanical wave in the rim with a wavelength exactly equal to the arc length along the rim from handle to handle. In this case, $n = 2$ in the standing wave equation: $L = n\lambda/2$ where L is the arc length of the rim from handle to handle, and λ is the wavelength of the mechanical vibrations in the rim.

Standing waves are produced by the addition of two identical waves traveling simultaneously in opposite directions through any elastic medium. These waves will constructively and destructively interfere with each other as they pass one another. The resultant wave from the addition of these two waves will form a standing wave in the metal rim. The handles and the midpoint along the rim between the handles will experience minimal vibrations. These positions are called nodes. There will be four positions around the rim that are nodes, and another four positions that are anti-nodes. The anti-nodes appear at $1/4$ and $3/4$ arc lengths from handle to handle. Between the anti-nodes, a node will appear at $1/2$ the arc length between handles. These positions will be regularly spaced and evident from the ripples and disturbances in the water

along the edges of the bowl. The nodes show very little water rippling while the anti-nodes show maximum water rippling. With practice, you should see four anti-nodes along the entire rim of the bowl that are so strong that the water will spray out of the bowl. This occurs where the artist knowingly engraved the spray from the fish.

Try This!

If the bowl is touched firmly at any of the anti-nodal positions, the finger will dissipate the vibrational energy, and the waves will be reduced or totally stopped. This effect is called dampening. If the bowl rim is touched at any node, there will be no energy lost since the node has minimal vibrational energy.

Try varying the amount of water in the bowl. Is it easier or more difficult to play?

By rubbing harder and faster, try to make the bowl produce a high-pitched squeak. When it does, you can sometimes create additional nodal and anti-nodal points in the water.

Try floating a cork or small bowl in the water while playing the bowl. Observe its movements.

Put a small amount of sand in the bottom of the bowl and observe how the vibrations move the sand. (Magic Sand from Educational Innovations works quite well for this.)

Special thanks to Marshall Mosesson, Moorestown High School, New Jersey for his contributions.

