Process Explained

Your hands create vibrations in the handles from the adhesion of our wet skin to the brass. Oil reduces this adhesion.
As your hands move, the adhesion creates a tension in the skin of your palms. 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 dragons.

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 highpitched 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.

TEACHERS GUIDE

RESONANCE BOWL
ITEM # 6579-00

ENERGY - MOTION

The Chinese Spouting Bowl first appeared in the Han Dynasty (202 BC - AD 9). Four “Han” dragons can be seen in the bottom of the basin, spraying streams of water up the sides of the bowl. It is said that 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.
Use the resonance bowl to demonstrate the behavior of waves and their interactions. By rubbing the handles, vibrations begin to ripple the water’s surface around the rim. Soon water drops shoot up, quickly becoming continuous streams, like tiny fountain jets. The water droplets and jets grow and diminish with each rub of the handle. It is believed to generate the precise frequencies needed to produce standing waves - the spouts of water rise from these waves.

Instructions

1. Place the bowl on a surface that is firm, but will allow the bowl to vibrate. A damp, folded bath towel or most nonslip mats make a good base.

   Fill the bowl about halfway with clean water.

2. 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. Moisten your hands slightly by dipping your palms into the water.

3. 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.

4. A light touch seems to work better. With practice, you should have water spraying 50 cm (about 20 inches) out of the bowl.

Activities

1. Discuss with students the meaning of vibration. Ask them to suggest examples of vibration they've experienced in their own life. (Suggestions may include musical instruments, feeling from thunder, bass from a speaker, ringing a bell, etc.)

2. Explain that resonance is a periodic vibration and show a wave that resonates either by drawing one on the board or overhead projector. Show students where the nodes are found on the drawing.

3. Using a jump-rope or other long string, create a standing wave with nodes. (have a student hold one end or tie it to a cabinet and move the rope up and down until you produce a standing wave with visible nodes.) Have students relate this information to the strings on an instrument. If you have the time available, you may choose to have students make their own stringed instruments with a rubber band and empty tissue box or empty food storage containers. Ask students to change the pitch by making the band looser or tighter. If available, students could also investigate this phenomenon with an actual guitar, violin etc.

4. Have students relate this visible standing wave to the waves they cannot see.
   Have them think about sound and light waves that are not visible but they can sense the effects of in the world.

5. Have students view as you perform the sound/water spouting on the Resonance Basin. Allow students to touch the sides of the basin as it resonates or place their fingers in the water if they wish.

Note

It is always best to DO an experiment ahead of time to be able to best present it to the class.

6. Ask students to write a paragraph relating what they've learned about vibration, resonance, instruments and the resonance basin.

7. As an extension, ask students how these vibrations might relate to natural phenomenon such as thunder or earthquakes.