

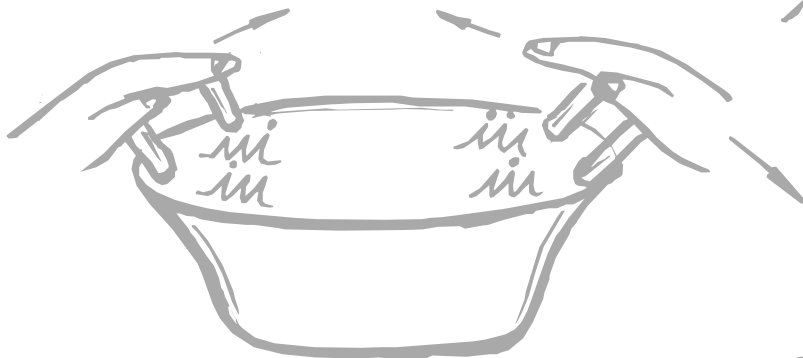
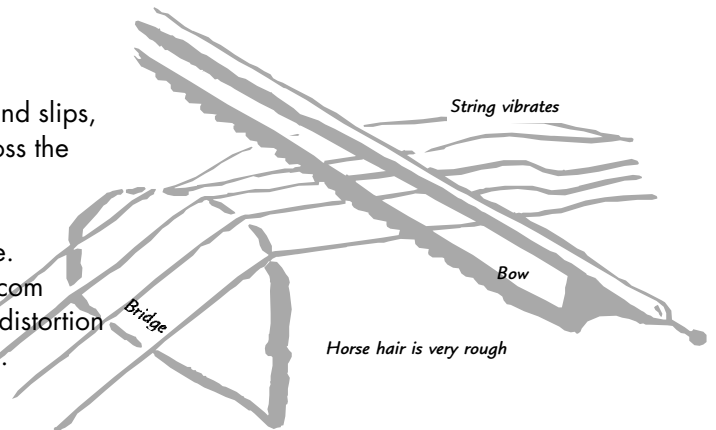
Resonant Bowl

What to do: Rub the handles of the bowl with wet hands.

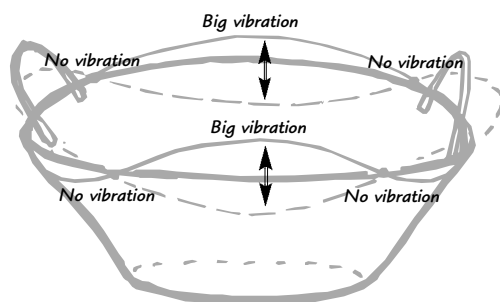
What happens: The bowl vibrates and the water surface shows a "standing wave" pattern. The water may vibrate so much that it is thrown up into the air.

HOW IT WORKS

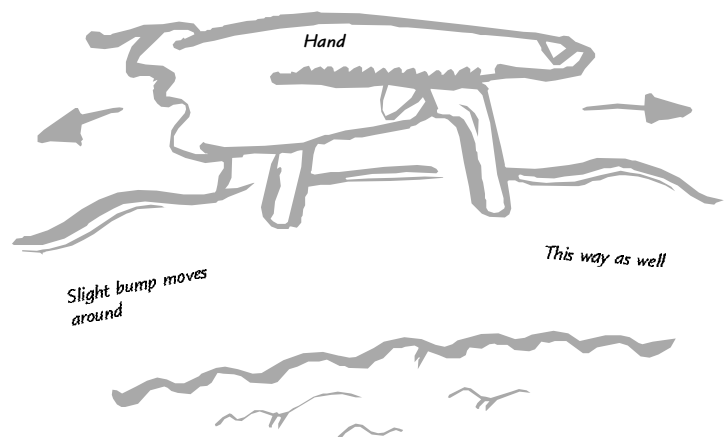
1. When your hand slides on the handle, it alternately grips and slips, just like the horsehair of a violin bow when it is drawn across the strings. If your hands are greasy, it won't work.
2. This alternate gripping and slipping makes the bowl vibrate. Technically, the bit of bowl near the handle is stretched or compressed or twisted (all of these distortions can happen) and this distortion travels away from the handle through the metal of the bowl.



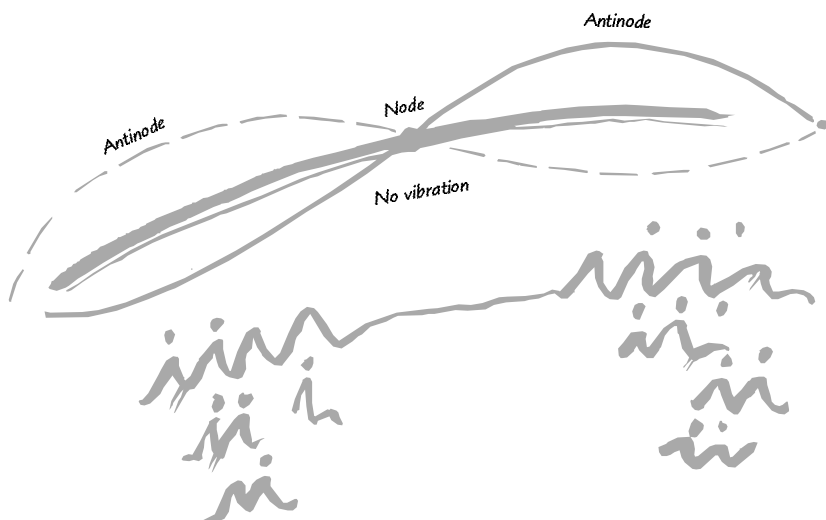
4. The bowl can vibrate in all kinds of ways, but the vibrations that are large and tend to persist are called **standing waves**. They are formed by the vibration of the handle being in step with the vibration that has been round the bowl once and is just passing the base of the handle again! In this way, the energy you put into rubbing the handle ends up in vibrations of one frequency only. This is called **"resonance"** - the bowl is **"resounding"** to the vibrations you are providing.



3. The most important vibrations produced are up and down (transverse) vibrations of the metal of the bowl. They travel from the handles round the bowl in both directions. Why both? There is no way of disturbing one bit of the bowl (where the handle is fixed) and making only the metal on one side vibrate!

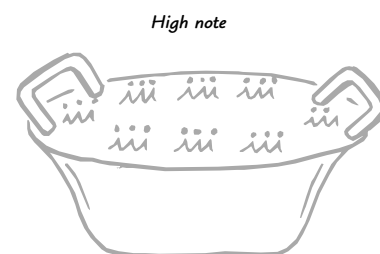
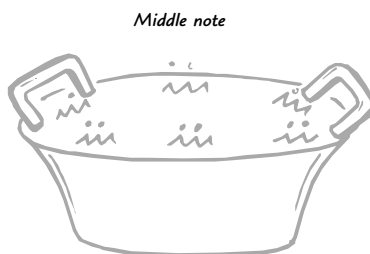
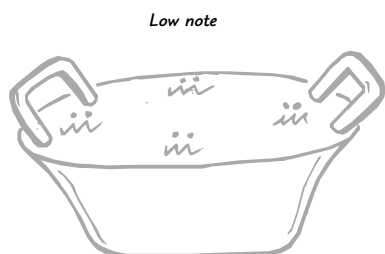


5. So standing waves are formed by waves going in opposite directions round the bowl and always being **in step** in some positions. At these positions (called the antinodes) the vibrations get very large. There are also positions where the two oppositely directed waves are always **out of step**, so they cancel out and produce no vibration at that point. If someone touches the bowl at these points (called the nodes), it doesn't stop the bowl from vibrating.



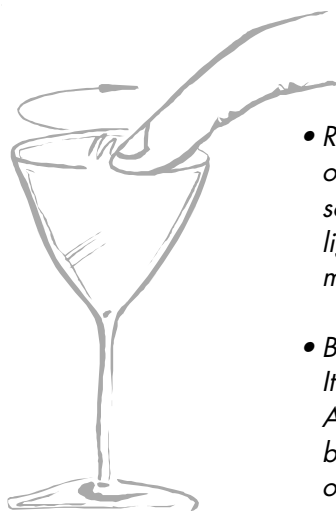
6. The water surface is affected by these strong standing waves, except at the nodes. Near the antinodes, where the vibration is largest, the water may get thrown up into showers of drops.

7. The strongest pattern of standing waves has four nodes (and four antinodes). With judicious rubbing of the handles, you should be able to produce patterns with six, eight and ten nodes, each pattern having a higher frequency of vibration.

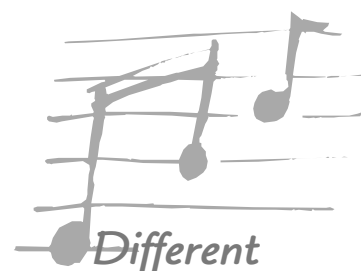
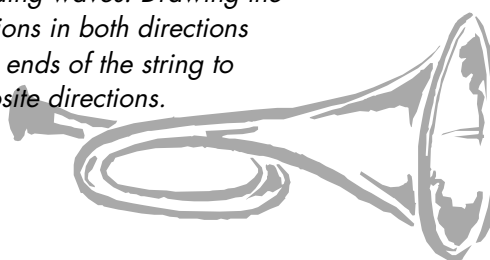


DID YOU KNOW?

- The vibrations of a violin string are also standing waves. Drawing the bow across the string sends transverse vibrations in both directions down the string. These bounce back from the ends of the string to maintain two sets of waves travelling in opposite directions.



- Resonance (or resounding) is a common occurrence in all kinds of things. It occurs with sound waves in all wind instruments, with light waves in lasers, with radio waves in microwave ovens, etc.
- Bronze is an alloy of copper and tin (10:1). It was discovered in antiquity (the Bronze Age) and used for implements and weapons because it is much harder than either copper or tin.



*Different
resonant notes*

THINGS YOU CAN TRY YOURSELF.

- You can make a wine glass sing by stroking the top edge/lip with a moistened finger. These vibrations are just the same sort as those in the **Resonant bowl**.