

# Chladni's Plates

## Oscillations & Waves



**SW0855-001**

### Description:

There are many methods to demonstrate vibrations and waves in air columns, strings, springs etc. but an interesting investigation is the demonstration of vibrations in flat plates.

In 1787 a scientist named Chladni studied the behaviour of fine sand sprinkled on flat plates when the plates were set into a natural vibration. To this day the study of vibration patterns on plates is performed in the same manner.

The plate of metal or glass is supported rigidly at its centre and is agitated into 'singing' by the passing of

a violin bow across its edge. This 'singing' is the sound heard when the plate vibrates at its natural resonant frequency.

If the natural relaxed state of the plate is disturbed by touching the plate and thus applying a slight restriction to vibration, the natural resonance will alter and the vibration pattern on the face of the plate will alter. The 'touching' point on the plate and the 'bowing' point on the plate are both important. (see diagrams).

Diameter: 160mm

Height: 160mm

Weight: 1.7kg

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## Kit Parts:

- 1 pce. Square plate on clamp 150x150mm .
- 1 pce. Round plate on clamp. 150mm diameter
- 1 pce. Violin bow.
- 1 pce. Resin for bow.
- 1 kg. Specially graded fine silica sand (100 grit). Demonstrate

## Instructions For Use:

Take either the square or the round plate and clamp it to the edge of a table top with the plate horizontal. Be sure the centre screw is tight and the clamp is firm. The experiment will not work if the plate is not rigidly clamped to a solid table.

Take the violin bow, gently tension the bow's horse hair by screwing the handle and observing the horse hair become taut under tension. Do not over-tension the bow.

Take the block of 'resin' and wipe the violin bow back and forth across the resin block to transfer a slight coating of resin to the horse hair. When playing the violin, it is necessary to apply resin to the bow so that as it passes across the strings of the violin, they are agitated and thus vibrate at their natural frequencies. In the case of Chladni's plates, it is necessary to, apply resin to the bow to cause agitation to the edge of the plate and thus vibration to the surface of the plate.

Try passing the bow vertically past the edge of the plate until you have the technique of making the plate 'sing'. Do not press the bow too firmly against the edge of the plate. Sweep the bow past the plate with a steady gentle action and smoothly lift the bow from the plate at the end of the stroke.

When you can make the plate 'sing' reliably, try touching the plate on the edge whilst passing the bow across the edge and see if the pitch of the

'singing' alters. If so, you are ready to perform the experiment.

Lightly sprinkle a small quantity of the fine dry sand (supplied in the kit) evenly across the surface of the plate.

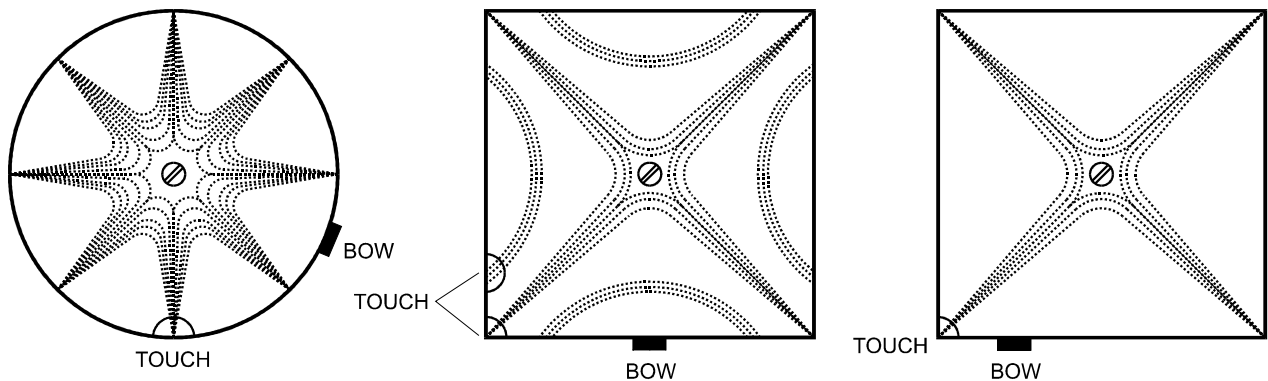
**DO NOT APPLY TOO MUCH SAND OR THE PLATE WILL NOT VIBRATE.**

Use your bowing technique to the edge of the plate and watch the patterns form. Have an assistant touch the edge of the plate whilst you are bowing and hear the change in pitch and watch the pattern change. Change to the other plate and observe the various patterns. Discuss the meaning of the patterns and try to predict the pattern (before bowing) when the plate is touched at a particular place on the edge. (see figures.)

Remember that the sand resides in the areas of minimum vibration and is bounced off the areas of maximum vibration. The sand thus occupies the nodal areas and the plate is vibrating in opposite phase on either side of the nodal lines.

As a general rule, the pattern becomes more complicated as the frequency increases. Prove this by altering the touch point or touch in two or three places at once to raise the pitch of the 'singing' and observe the patterns.

## Some Resonant Patterns:



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