



Curiosity Guide #302

Sound Resonance

Accompanies Curious Crew, Season 3, Episode 2 (#302)

Resonant Rods

Investigation #3

Description

Make a model that will help you understand more about vibrations, sound waves, and resonance.

Materials

- Three one-fourth-inch wood dowels, at least 30 inches in length
- One three-eighths-inch wood dowel, 24 inches long
- Saw
- Measuring tape
- Pencil
- Straight edge
- Drill
- One-fourth and three-eighths drill bits
- 4 solid rubber balls, larger than 1 inch in diameter
- Wood glue
- 2 by 4 wood block, cut to 24 inches
- Toothpicks if necessary

Procedure

- 1) Cut a length of 2 by 4 to 24 inches in length.
- 2) Cut the three one-fourth-inch dowels so that one is 18 inches long, one is 24 inches long, and one is 30 inches long.
- 3) Cut the three-eighths-inch dowel to 24 inches long.

- 4) Measure and draw a centered pencil line on the long face of the 2 by 4.
- 5) Measure and mark the line at 3 inches, 9 inches, 15 inches, and 21 inches. In the next step, you will be drilling holes at these marks to receive the dowels.
- 6) Drill the first three holes, using a one-fourth-inch drill bit. Drill the last hole, using a three-eighths-inch drill bit.
- 7) Insert the dowels into the holes to test for a snug fit. Toothpick shims can be used if the sticks wobble.
- 8) You may choose to glue in the dowels, but this is not necessary.
- 9) Drill a centered hole halfway into each of the rubber balls. Use the one-fourth-inch drill bit for the first three balls and the three-eighths-inch drill bit for the final ball.
- 10) Slide a ball onto each of the dowels. This will make the dowel movement easier to see, as well as adding mass.
- 11) While keeping the model on the table, grip the end of the 2 by 4 and begin to slide it back and forth. Change the speed of the movement and watch what happens.
- 12) How does changing the speed of the moving 2 by 4 affect the different rods?
- 13) What happens if you go faster? Or slower?

My Results

Explanation

Consider swinging on a swing. As the rider pumps his or her legs, the pumping motion adds energy to the direction of the swing. This makes the path the swing takes increasingly larger, or having greater amplitude. Pushing someone on a swing works the same way. If you time the push with the existing swinging motion, you add force, and the swinging motion gets bigger.

In this case of the resonant rods, the rods begin to swing in their natural rhythm, which is determined by how stiff the rods are and their length. But when the sliding of the board matches their natural swing, the swing gets bigger. When you combine the push with the swing, the swing is amplified, which is called resonance. By experimenting with different push speeds on the board, it is possible to make one rod swing a great deal while another hardly seems to move. That is because if the swings are in opposition, the motion is limited. Longer dowels swing more slowly and have a lower frequency, while shorter dowels swing more quickly with a higher frequency. The three-eighths-inch dowel is stiffer and its resonant frequency is higher.

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