

Thumb Piano

Category: Physics: Sound & Waves

Type: Make & Take

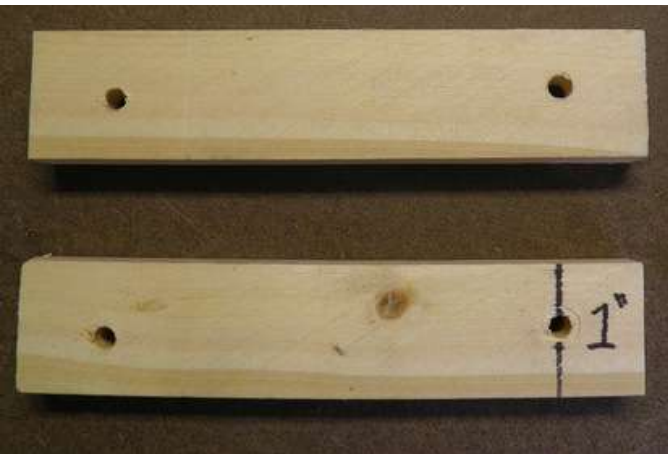
Rough Parts List:

2	Blocks of wood, 5-8" long
4-5	Small craft sticks
2	Machine screws or carriage bolts, $\frac{1}{4}$ "
2	Wing nuts, or regular nuts

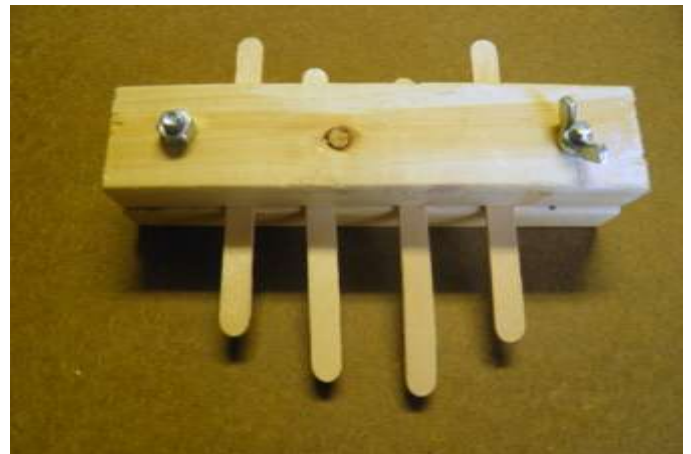
Small saw
Drill and $\frac{3}{16}$ " bit
Screw driver



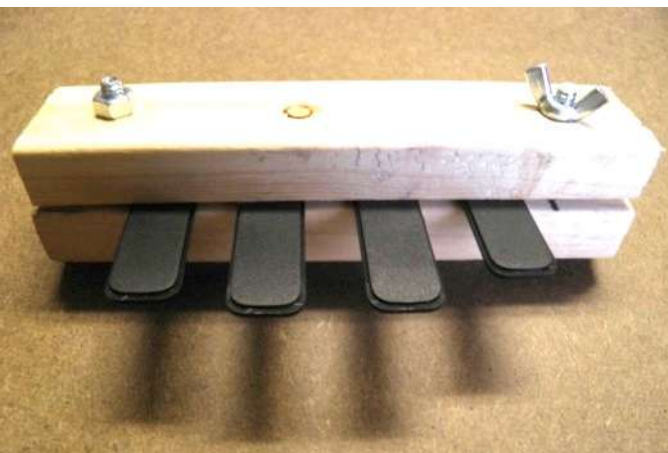
How To:



Put one board on top of the other. Drill a hole through each end of the boards. Center the holes about 1" from the ends.



Place craft sticks between the boards, varying the length of the sticks. Put the screws in and tighten the nuts.



Another version built with plastic stir sticks.

Fine Points:

- Tighten the nuts until the craft sticks do not sound buzzy when plucked.
- Wing nuts are nice since you won't need a special tool to loosen them and adjust the sticks. Adjusting the sticks requires loosening only one nut, so really only one wing nut is necessary.
- Playing the thumb piano alone will produce very soft sounds. Press it up against any hard surface and it plays very clearly.
- It may also be fastened to a base board.

Concepts Involved:

- Sound is vibration. The vibrations push on air and make sound waves that travel through the air to your ear.
- The longer the resonator, in this case the craft sticks, the slower it will move back and forth and the lower the tone (frequency) it will produce.
- Instruments that use vibrating strings or tines have soundboards.

Focus Questions:

1. How does the length of the craft stick correspond to the tone it produces?
2. What materials will work best to amplify the Thumb Piano? What materials will work worst?
3. What could you do to make the thumb piano louder?
4. What would happen if you made the player three times as large or $\frac{1}{2}$ its size?

Elaboration:

Sound is created when something is vibrating. The vibrations can be changed in two ways: how fast or slow the vibration is – the pitch or tone or frequency - and how hard it is vibrating – the volume. In this project, the sticks get plucked and they don't just go back to their original position. Instead they begin vibrating back and forth for a short time. This is what creates the sound. Longer craft sticks will produce a lower tone or frequency. For a more dramatic example of this try pressing a yard stick or dowel firmly to the edge of a table and plucking the end. The longer the part of the stick is that hangs off the edge of the table the lower note it will produce; hanging less off of the table will produce a higher note.

Instruments that use vibrating strings or tines have soundboards. For example, the vibrating strings on a guitar alone are not loud; the strings are in contact with a bridge which transfers the vibration of the strings to the soundboard on the face of the guitar's box. The soundboard has much more surface area in which to push the air more efficiently, creating a louder sound. The guitar's box also helps make the sound louder by creating a cavity for the sound waves to resonate in.

Links to k-12 CA Content Standards:

Grades k-8 Standard Set Investigation and Experimentation:

Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other strands, students should develop their own questions and perform investigations.

Grades k-12 Mathematical Reasoning:

1.0 Students make decisions about how to approach problems:

1.1 Analyze problems by identifying relationships, distinguishing relevant from irrelevant information, sequencing and prioritizing information, and observing patterns.

1.2 Determine when and how to break a problem into simpler parts.

2.0 Students use strategies, skills, and concepts in finding solutions:

1.1 Use estimation to verify the reasonableness of calculated results.

1.2 2.2 Apply strategies and results from simpler problems to more complex problems.

1.3 Use a variety of methods, such as words, numbers, symbols, charts, graphs, tables, diagrams, and models, to explain mathematical reasoning.

2.5 Indicate the relative advantages of exact and approximate solutions to problems and give answers to a specified degree of accuracy.

3.0 Students move beyond a particular problem by generalizing to other situations:

3.1 Evaluate the reasonableness of the solution in the context of the original situation.

3.2 Note the method of deriving the solution and demonstrate a conceptual understanding of the derivation by solving similar problems.

3.3 Develop generalizations of the results obtained and apply them in other circumstances.

Grade 2 Standard Set 1: Physical Sciences

The motion of objects can be observed and measured.

1.g. Students know sound is made by vibrating objects and can be described by its pitch and volume.

Grade 3 Standard Set 1. Physical Sciences (Energy & Matter):

1.d Students know energy can be carried from one place to another by waves, such as water waves and sound waves, by electric current, and by moving objects.