

# Guitar

**Category:** Physics: Sound & Waves

**Type:** Make & Take

**Rough Parts List:**

2	Pieces of wood for handle, 1x2, one should be longer than the other
1	Large cardboard tube
1	Marker cap
2	Eye screws
1	Popsicle or craft stick
	Thin sheet of plastic wrap, big enough to fit over open end of cardboard tube
	Fishing line, 40-lb test if possible
	Double-sided tape
	Electrical tape
6	Nails



**Tools:**

Hair dryer
Drill
Hacksaw or utility knife
Hammer

**Video:** <http://youtu.be/sJSAD36pbbc>

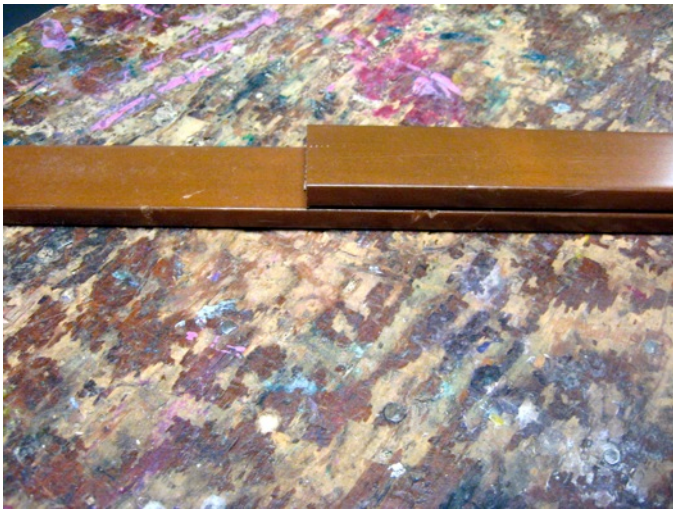
**How To:**



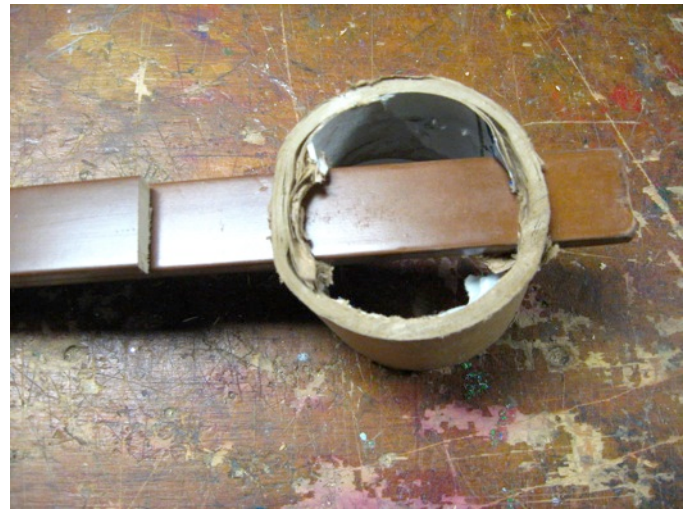
Cut a piece of cardboard tube. Trace an outline of the wooden handle onto the cardboard.



Cut two holes for the handle on each side of the cardboard. The holes should be in a straight line so the wood can easily slide through both. Begin the hole with a drill and use a knife or hacksaw blade to shape it.



Nail together the two pieces of wood, aligned at one end.



Slide the handle through the cardboard.



Cut a piece of plastic to cover one end of the cardboard tube. Use double-sided tape to attach the plastic to the sides of the cardboard.



Blow hot air over the plastic. The plastic will shrink and fit tightly over the tube.



Hammer two nails into the bottom of the handle.



Tie a piece of fishing line to each nail.



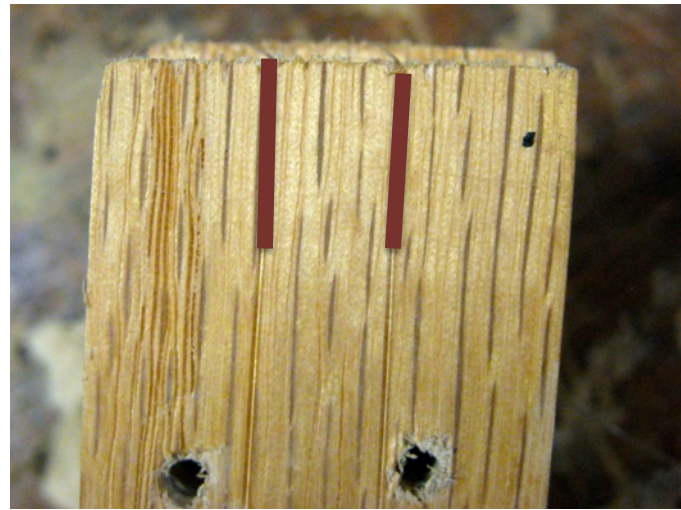
Cut two slits into the side of the cap with a hacksaw. This is the bridge.



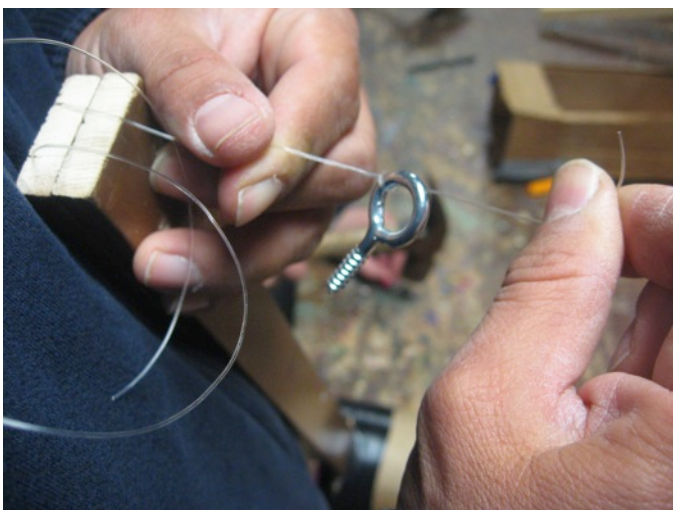
Run a fishing line from each nail over a slit in the bridge.



Make sure the small gap in the eye screw is completely closed



Cut two slits along the top of the front side of the handle. Drill two holes slightly smaller than the eye screws into the top of the back of the handle. The screws should go in tightly.

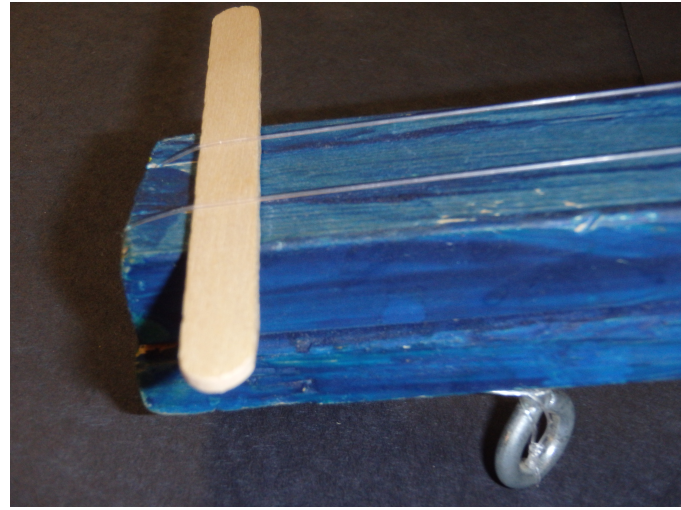


Run the two fishing lines from the marker through the slits on top, across the top of the handle, and tie each wire to an eye screw.



Pluck the strings on the guitar and listen to the sound it makes.

Screw each eye screw onto the back of the guitar handle. It is a trick to get the fishing line to come tight just as the eye screw goes in all the way



If the strings are too loose, wind the eye screws tighter. If the strings cut into the wood, try sticking a popsicle stick or a piece of plastic near the top of the handle.

### Fine Points:

- Blowing hot air over the plastic will tighten the plastic and produce a better sound. Listen if it goes up or down in pitch as you blow on it.
- Different sized strings may produce different sounds as well. Two of different sizes may give an interesting sound.

### Concepts Involved:

- When something is vibrating, it sends out waves traveling in all directions. These are called sound waves and can travel through lots of things, but they can't travel through a vacuum. Because of this, there is no sound on the moon or in outer space.
- The frequency of a sound vibration is called pitch. The pitch of something vibrating is related to its tightness: Tighter things tend to have higher pitches, looser things lower pitches.
- The amplitude of a sound vibration is called volume. The more energy you put into an instrument, the bigger amplitude of vibration can happen and the louder it becomes.

### Focus Questions:

1. What part of this instrument is vibrating to make noise?
2. How could you make the guitar louder?
3. How could you change the pitch of this guitar?

### Elaboration:

Sound is created by something vibrating that sends out waves. If you can hear a sound, it means those waves made it to your ear. In this project the strings are plucked and continue to vibrate back and forth. The strings' vibrations go through the bridge to the head of the guitar, which vibrates according to the strings' vibrations. All these vibrations push on air and make sound waves that travel through the air until they run out of energy. When our ears receive sound waves from the air, the vibrations are transmitted through the ear canal to the eardrum where they are transformed into the nerve impulses

that tell us we are hearing sound. If the waves run out of energy before they get to our ears, we can't here the sound!

### **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.

#### **Grade 2 Standard Set 1. Physical Sciences**

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**

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.

#### **Grade 9-12 Physics Standard Set 4. Waves:**

Waves have characteristic properties that do not depend on the type of wave.

4.a Students know waves carry energy from one place to another.

4.d Students know sound is a longitudinal wave whose speed depends on the properties of the medium in which it propagates.

#### **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:

2.1 Use estimation to verify the reasonableness of calculated results.

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

2.3 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.