

Inquiry into the Physics of Guitars

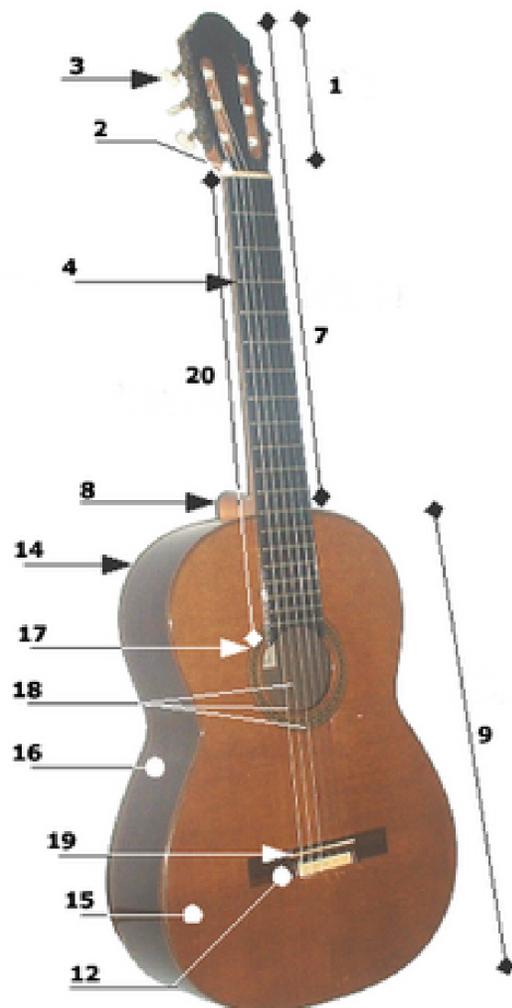
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Exploration of Musical Instruments

Parts of a typical acoustic guitar

1. Headstock
2. Nut
3. Tuning Pegs
4. Frets
6. Inlays
7. Neck and fretboard
8. Heel
9. Body
12. Bridge
14. Back
15. Soundboard (top)
16. Body sides (ribs)
17. Sound hole
18. Strings
19. Saddle
20. Fretboard



Citation:
Information gathered from Wikipedia 2013

Wild Guess: How does a guitar work?

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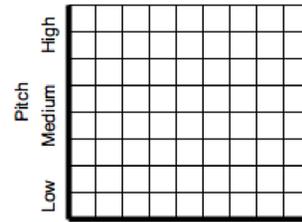
Hypothesis:

Brainstorm - Think of 3 variables that could affect the pitch and 1 that could affect the loudness of sound you would hear from a guitar. Graph a low data prediction about the variables' relationship and a one sentence explanation for how you think your idea would have an effect on the pitch.

1.

Variable: [Click Here To Type](#)

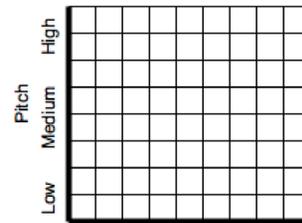
Proposed Explanation for Effect: [Click Here To Type](#)



2.

Variable: [Click Here To Type](#)

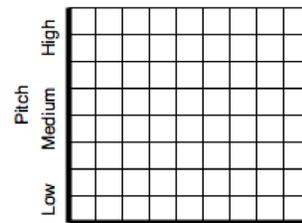
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3.

Variable: [Click Here To Type](#)

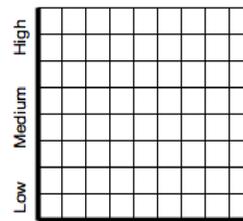
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4.

Variable: [Click Here To Type](#)

Proposed Explanation for Effect: [Click Here To Type](#)

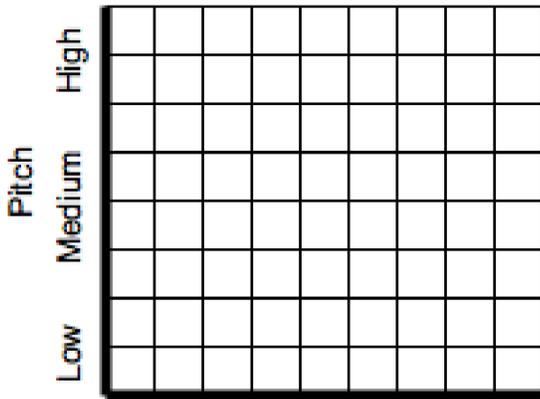


Inquiry into the Physics of a Guitar

Data Collection:

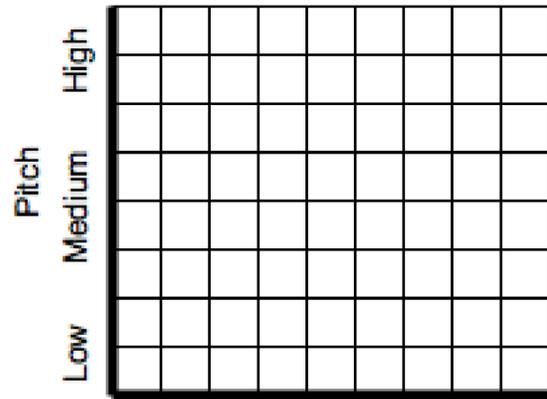
Once your guitar is built to specifications (see last page), experimentally investigate **all three** of your variables relating to pitch and **one** for loudness.

Graph 1. [Click Here To Type](#)



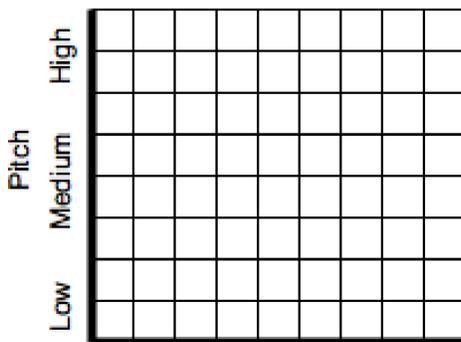
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Graph 2. [Click Here To Type](#)



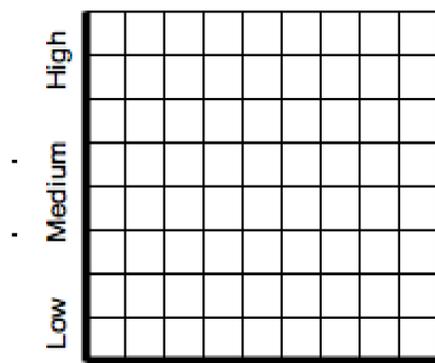
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Graph 3. [Click Here To Type](#)



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Graph 4. [Click Here To Type](#)



Variable:

Variable: [Click Here To Type](#)

Learning from Other People's Inquiry:

[Guitar Physics with Mr. Borowicz](http://goo.gl/Jefc4d) or <http://goo.gl/Jefc4d>

[How Does a Guitar Work?](http://goo.gl/clpOyE) or <http://goo.gl/clpOyE>

[Physics of the Acoustic Guitar](http://goo.gl/uNct84) or <http://goo.gl/uNct84>

[The Physics of Everyday Stuff—The Guitar](http://goo.gl/8EJPGC) or <http://goo.gl/8EJPGC>

[Rock in 11 Dimensions: Where physics and guitars collide](http://goo.gl/ebNBIV) (first 20 minutes or so) or <http://goo.gl/ebNBIV>

Final Evidence-Based Explanation

Helpful questions to think about when constructing an explanation of how guitars work:

Why does a guitar have its various parts?

Why does it have tuning pegs?

Why does it have frets?

Why are the strings different?

What makes a guitar sound different than a similar a violin or cello?

Why do guitars have that big front and box with a hole?

The Advanced Physics of a Guitar:

For the written description cite your evidence (graphs) and include the technical terms: pitch, string, natural frequency, tension, length, thickness (linear mass density), transfer of energy, bridge, soundboard, loudness, resonance, vibration, motion.

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Blending Art and Science: Build a Guitar



Directions for Building a Simple Guitar

Materials

- 1 3' x 1" x 4" neck board
- 1 large plastic jug
- 6 3.5" string wire (fishing line with each a different test strength)
- 6 panel board nails
- 6 eye screws
- 2 1" x 1/4" x 3" wood bridge board

Assembly

1. Cut off top portion of plastic container (this later will also allow us to access the inside to electrify the guitar). On the neck side of container, cut a three sides of a rectangle, leaving the flap attached to push against the fingerboard and make a snug fit between the neck and body (container), as seen in the photo to the right.



2. At the tail of the instrument, hammer in panel board nails side by side so that only a small portion of the nail protrudes (see photo above).

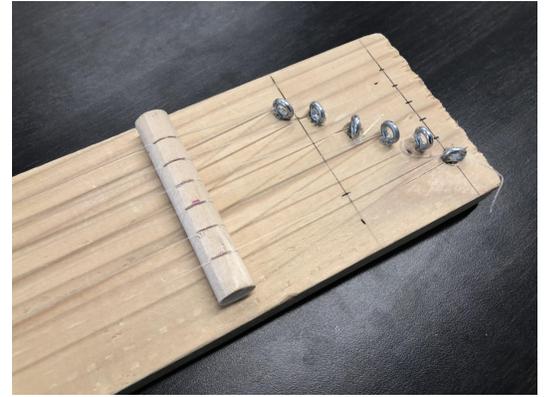


3. At the head of the instrument, place screw eyes so when turned they do not bump into each other. Do not screw them in **too far** until after strings are attached (see photo below).

4. Secure 6 different thicknesses of fishing line between nails and screws. Thickest line is on the top. Tie knots so they will not slip when tensioning strings.

5. Insert small chunk of wood under strings for bridge. Notch shallow slots into bridge to keep strings from sliding off.

6. Add a small piece of wood next to the eye screws (tuning pegs) for nut (see photo to the right). Optional, to add smaller versions to make frets.



7. Tension strings by turning screw eyes into wood. Make adjustments where necessary. Strings should be fairly tight for maximum resonance.

To Play

Attempt to tune your guitar to as close as possible the following scale, known as "standard tuning" (EADGB_e), and is as follows:

- ❖ sixth string: E - lowest tone - (a minor thirteenth below middle C—82.4Hz)
- ❖ fifth string: A (a minor tenth below middle C—110Hz)
- ❖ fourth string: D (a minor seventh below middle C—146.8Hz)
- ❖ third string: G (a perfect fourth below middle C—196.0Hz)
- ❖ second string: B (a minor second below middle C—246.92Hz)
- ❖ first string: e - highest tone - (a major third above middle C—329.6Hz)

Standard tuning has evolved to provide a good compromise between simple fingering for many chords and the ability to play common scales with minimal left hand movement.