

Generalizing how musical instruments work

Name: Solution

1. What were the three characteristics that the straw instrument needed to 1. make sound, 2. produce a variety of notes and 3. be loud?

The tip vibrating when air is blown through it makes the sound
The length of the straw determines the straw's natural frequency
It's loud because the whole straw vibrates at the natural frequency

2. What were the three characteristics that the cup instrument needed to 1. make sound, 2. produce a variety of notes and 3. be loud?

Plucking the string or sliding the towel along the string are the source of vibration
The length of the string changes the natural frequency
The cup moves a lot of air and makes it loud.

3. Can these three important features be generalized for all instruments including your straw, cup, and guitar?

Need a source of vibration to make the sound
Need a way to change pitch which in most cases is by changing the length of something to change its natural frequency
Need a way to move a lot of air to make it loud.

★ Stop – class discussion

4. What is natural frequency?

The frequency that an object likes to vibrate at.

5. What is resonance?

Is something that is happening. When you wiggle something at its natural frequency, you are in resonance with that object.

6. How is it possible for one pasta to wiggle a lot while the other two that were being held don't wiggle much?

If I shake my hand at the same frequency as a particular pasta/raisin natural frequency, then my hand will be in resonance with the pasta and keep adding energy to it. If I'm shaking my hand at a frequency different than the natural frequency, I don't

add to the pasta's wiggle. Like the push of a swing. If you push at the wrong time, you slow the swing down.

7. Show when the “push” from the hand has to happen for a pasta stick to resonate. For example, if the pasta is about to bounce back to the right, which way does your hand have to push?

The push should push in the same direction the pasta is moving. If you push opposite, you slow it down.

☆ Stop – class discussion

8. What part of the instrument determines the natural frequency with each of the instruments we worked with this week?

- a. Straw instrument

In the straw body

- b. Tuning fork

On the tines

- c. cup instrument

On the string

- d. your voice

In your vocal chords – you make them shorter to sing higher. In your mouth and throat, you make the chamber shorter for higher notes.

- e. acoustic guitar

with the strings

- f. electric guitar

with the strings

9. Two students are discussing the body of an acoustic guitar. Which, if either, student do you agree with and why?

Kaiya: I think the body of an acoustic guitar is a resonance chamber and is what makes the guitar loud.

Jasmine: I don't think it is a resonance chamber because a resonance chamber only supports a certain tone like a flute or the water bottles. When you change its length it likes a new tone. Acoustic guitars can play a really large range of notes so I don't think the body can be a resonance chamber.

Jasmine is correct. Resonance is when something is driven at its natural frequency. That means when something resonates, you'll hear the natural frequency not just any frequency.



Stop – class discussion

10. What makes each of these instruments loud? Resonance or Sympathetic Vibration?
Where is the amplification happening and why do you think this?

	Resonance or Sympathetic Vibration?	Where is amplification?	Why do you think this?
g. Straw instrument	Resonance	Body of straw	Moves the most air
h. Tuning fork	None		It's not loud
i. cup instrument	Sympathetic vibration	Cup	Moves the most air and amplifies all notes. The string alone is not loud
j. your voice	Both!	Mouth and throat, chest, cheek bones	Mouth resonance, chest sympathetic vibration
k. acoustic guitar	Sympathetic vibration	Body of guitar	Amplifies all notes
l. electric guitar	None		Not loud without an external amp.

11. Based on what you've seen today and this week, how do you think a pipe organ in a church works? Why does it have all the different pipes?



The source of vibration is the air from the pedals blowing into the pipes. Each pipe is able to play one note. That's why there are so many pipes. The pipes act like a straw and resonance makes it loud. Each pipe is very large and can move a lot of air. However, the pipes are also mounted to the wall and all the wood around it. That's not just for decoration, the pipe organ also vibrates the wall via sympathetic vibration making it VERY loud.