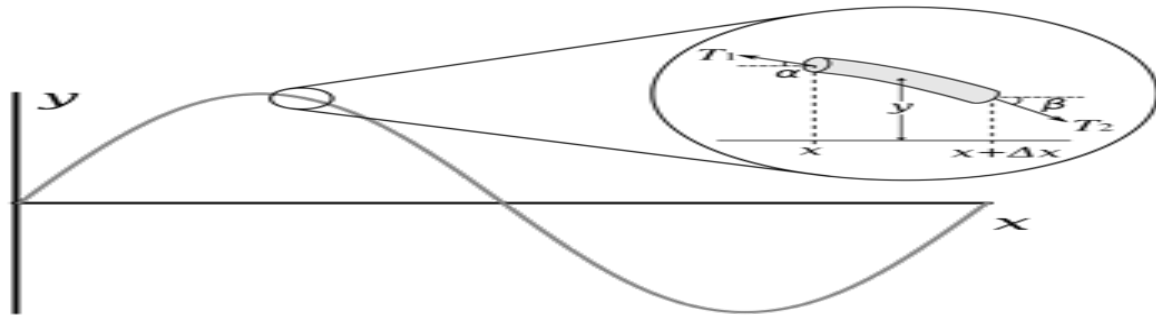


Then he put his finger in the middle of the board separating the string perfectly in half, plucked it again, and realized he had created two sections of the string that moved twice as fast as the longer, unseparated string.

Back when I was young, there was a brilliant piano technician name Pythagorus... so... maybe he was before my time and pianos hadn't been invented yet, but he certainly was brilliant. One day he decided to look at a vibrating string and figure out what was going on. He took a long string attached at two ends of a board of wood and plucked it. He watched the string wiggle back and fourth along the board and noticed there were high points and low points, he named them peaks and troughs. Then he put his finger in the middle of the board separating the string perfectly in half, plucked it again, and realized he had created two sections of the string that moved twice as fast as the longer, unseparated string. He decided to call the spot where he separated the string with his finger a node. Then he put another finger halving the half string he had created and noticed the two new sections were vibrating twice as fast as the halved section. He hypothesized that if he

continued to halve the string, it would continue vibrating faster and faster into infinity. He called this frequency.

Pythagorus then realized, instead of halving the strings continuously with many fingers, he could find a node of a positive multiple integer such as  $1/3^{\text{rd}}$  or  $1/7^{\text{th}}$ , (3 and 7 being the integer) and could place his finger at  $1/7^{\text{th}}$  of the string and the string would naturally create 7 sections of the string. He listened closely to the string and realized that it made a certain note that could be found in the musical scale.



Pythagorus got out his lute and pulled out a piece of paper and (well may I'm exaggerating again, but, anyway) wrote out the five lines of a musical staff. He played the lowest note on the largest string of his lute that just happened to be tuned to C2 on a piano keyboard (see graphic above). He created a node with his finger, halving the string. He listened and realized that he was now playing C3. Pythagorus smiled and continued onward, testing his idea.

He placed his finger on the string creating a node at  $1/3^{\text{rd}}$  the length of the string. He listened and heard that the string was now sounding at G3, a fifth above the previous note. Giggling, he scribbled down what he was experiencing. He then created a node at  $1/4^{\text{th}}$  the string's total length and held his ear close to his lute. He gasped and realized he was hearing C4 or middle C on a piano. He wondered what other notes he might create. Going forward in the same method, he discovered E4, G4, Bb4, C5, D5, E5, F#5, G5 and so on.

Putting down his lute, he got up and scurried over to his piano (I know, I know). He played C2 on his recently tuned piano, because this will only work on a recently tuned piano, and listened. Could he hear the harmonics created by the string on C2? He played a staccato note on C3 while holding down C2 and listened. He was amazed! Even though the string on C3 had already been silenced by its damper, the note rang through on the held C2. The harmonic was in the C2 string and quickly playing C3 emphasized it! He did this with G3, C4, E4 and so on and realized that he could hear each harmonic ringing clearly through the string tuned for C2. He was proud. He stood up and triumphantly said something in Latin that I am unable to translate 😊.

He created a node with his finger, halving the string. He listened and realized that he was now playing C3.