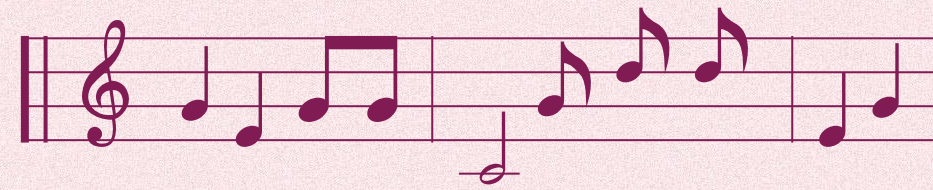


# Flute Physics 115

Jessica Arisetty  
Final Presentation







# Outline



01

## History

Where does the flute originate from? How old is it?

02

## Significance

What is significant about flutes? Why are they so common?

03

## Acoustics

How does the flute actually work? How are they built?

04

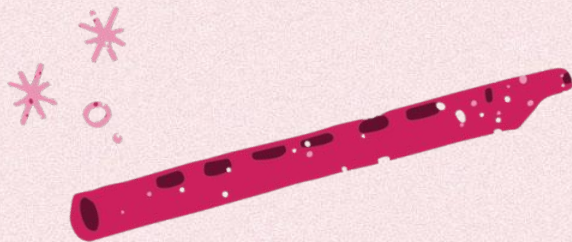
## Sound Wave Analysis

What does a flute sound wave look like? A flute spectrogram?

01



# History of the Flute







# Origins, Evolution, Geography



- ❖ The flute has appeared in many different forms throughout history
- ❖ Most ancient flutes have been discovered in Europe
- ❖ Typically carved out of animal bones
  - Flute from a mammoth tusk found in Germany, ~30,000-37,000 years old
  - Flute made out of swan's bone found in a German cave, ~36,000 years ago
- Partial fragment of a flute fashioned from a cave bear found in Slovenia, ~43,000 years old
- ❖ The version of the flute I'm focusing on is the transverse flute which is held sideways and horizontal to the player's body
- ❖ This version is recorded to have appeared in ancient Greece by the 2nd century BC





# Flute in Culture

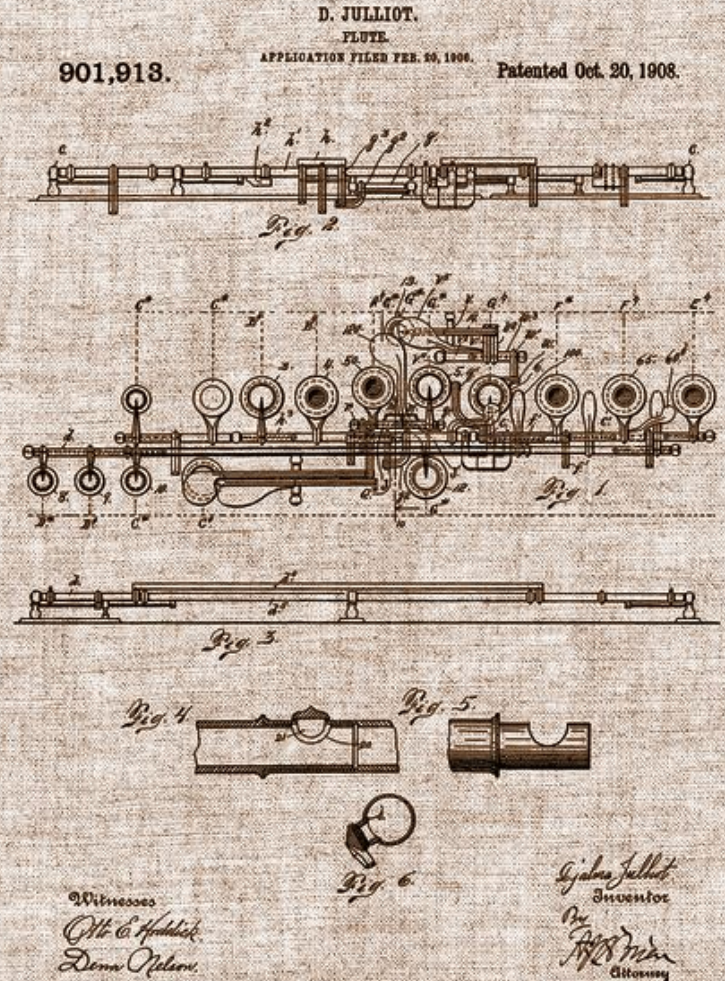


- ❖ Earliest version of the Western concert flute arrived in Europe from Byzantine traders
- ❖ Became so popular in Germany specifically that it became known as the german flute
- ❖ Widely used in courtly music and during the Renaissance
- ❖ Composers such as Vivaldi and Bach wrote numerous pieces for the solo flute in the 17th and 18th centuries
- ❖ Keyed version was developed around 1750 in London
- ❖ Flutes feature in most orchestras today



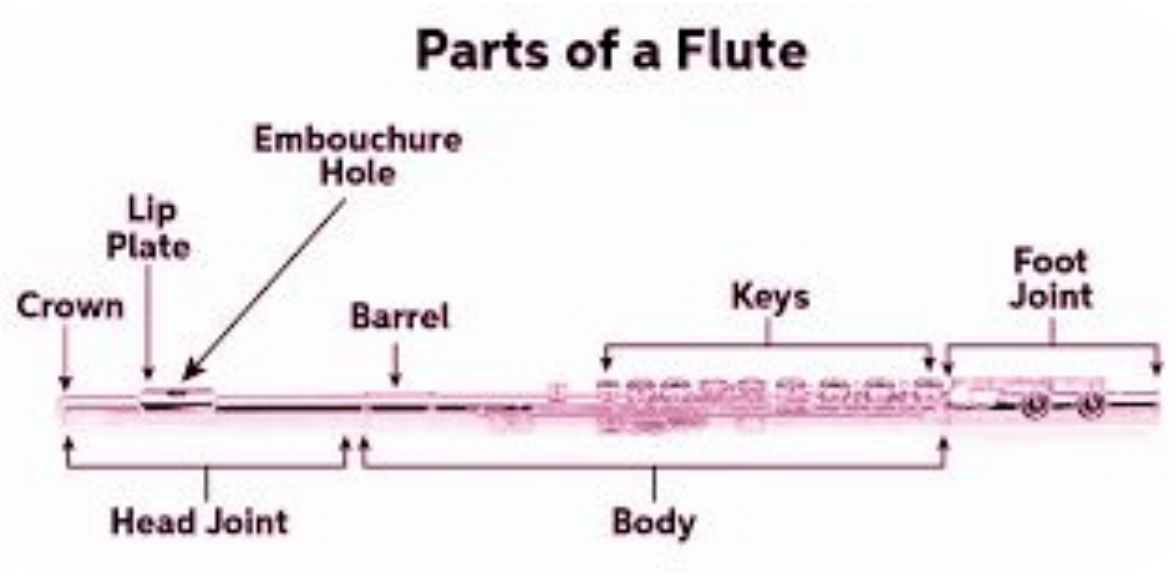
# Acoustics & Structure

Brief description of the  
structure of a flute

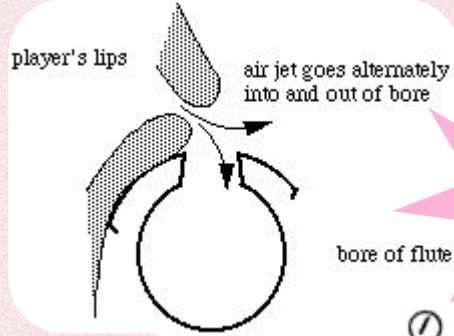




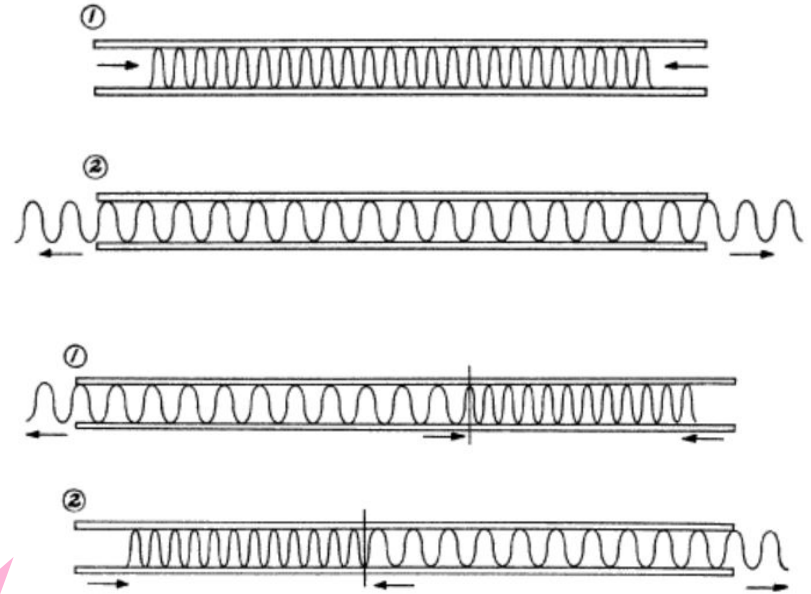
# Parts of the Flute



# Flute Acoustics

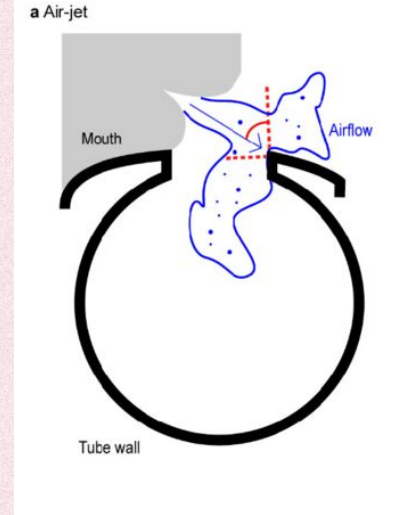
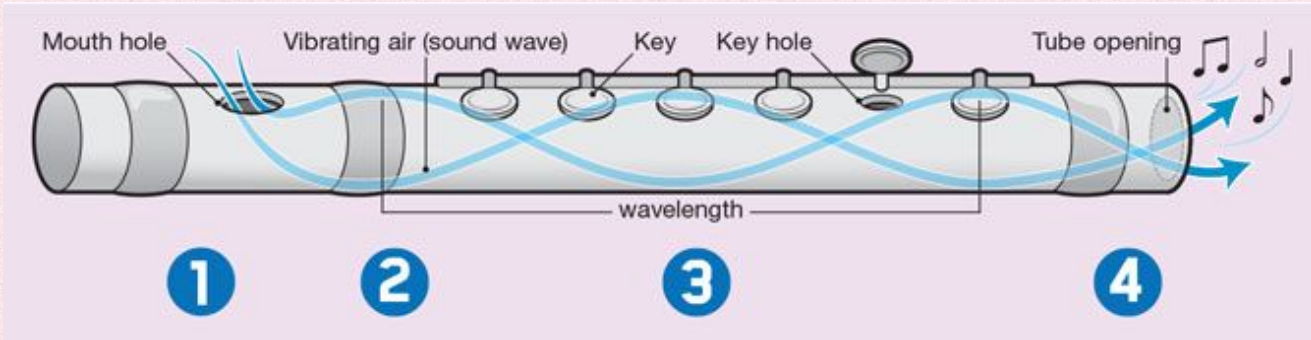


● = CLOSED HOLE





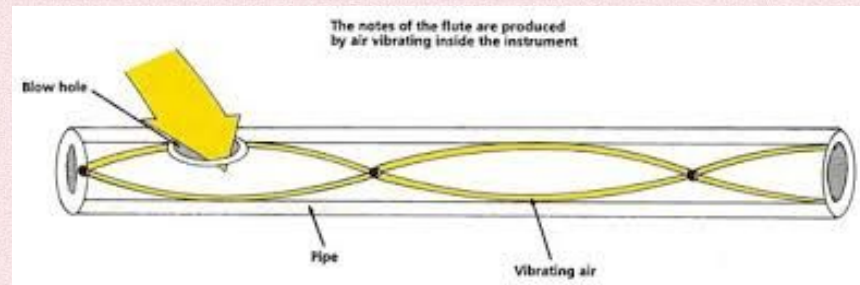
# Physics Diagram



All holes closed, flute is resonating at its lowest note. The pipe length starts at the mouth-hole, and ends at the end of the tube. As a result, flutes are longer in length than their resonating tube.



Fingers are only covering up to this point on the pipe. As a result, the pipe length is now shortened, still starting at the mouth-hole, but now ending where the air is able to escape through the open tone holes, creating the "end" of the tube.





# C Major Scale

Demonstrated by  
Rebecca Fuller on  
Youtube







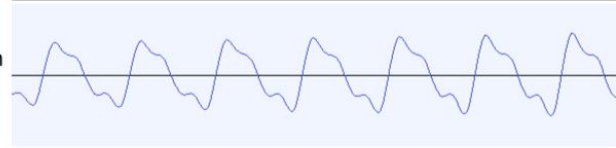
# Waveform & Spectrogram



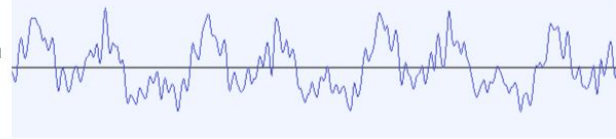
Sine wave form  
(C5 sound)



Flute waveform  
(C5 sound)



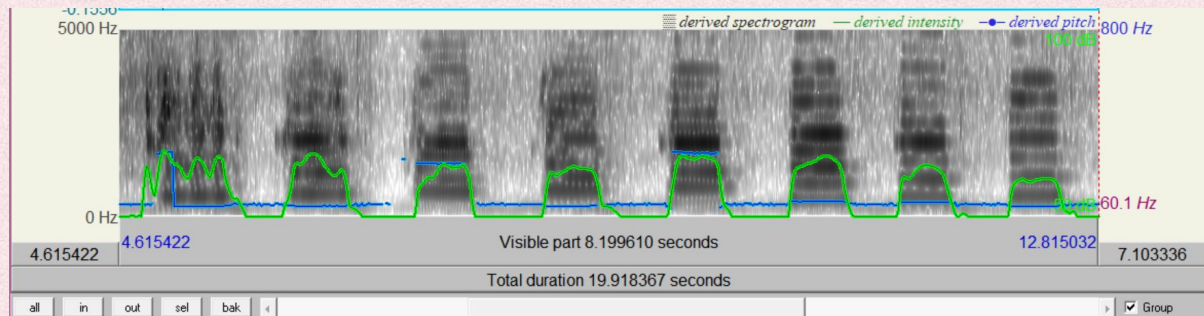
Guitar waveform  
(C5 sound)







# Graph of Sound Waves



## Waveform

- ❖ Typical waveform resembles a sawtooth wave
- ❖ More jagged than a sine wave
- ❖ Less regular
- ❖ Spectrogram shows that pitch is fairly regular



# Conclusion



**01**

Versions of the flute have been found all over the globe!

**03**

Flutes have a relatively delicate sound. The waveform is slightly more irregular than a sine wave



**02**

Flutes are essentially an open air column with holes the players uses to change its length

**04**

Flutes are an excellent example of how physics in music can be simplified or complicated! They're also very culturally present.



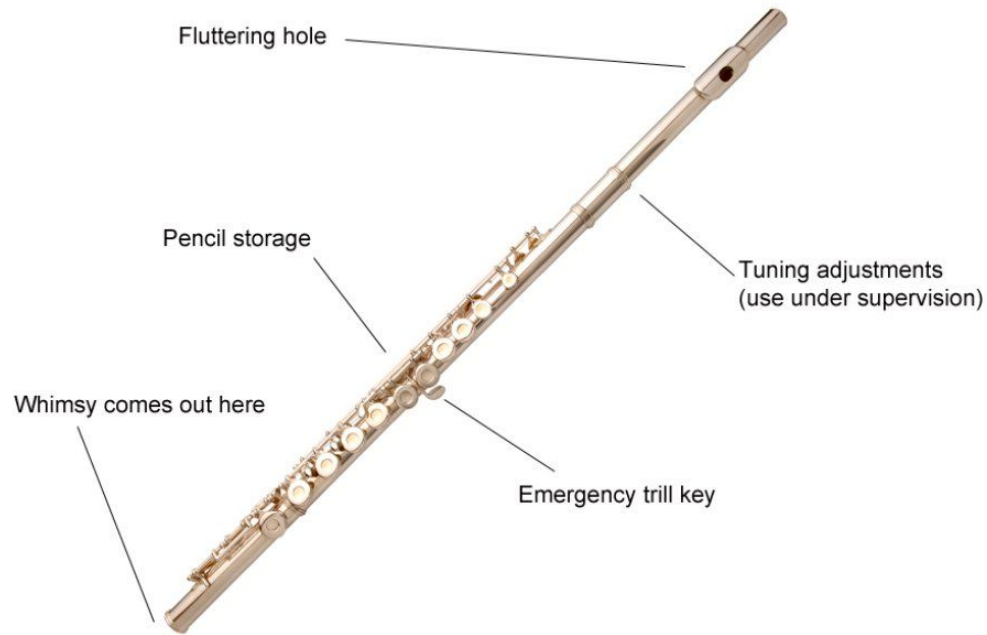


## Sources



- ✦ New World Encyclopedia: Flute
- ✦ Hello Music Theory: Flute Anatomy
- ✦ Brittanica: Flute
- ✦ The Instrument Place: Flute Parts
- ✦ Yamaha: Sound Production
- ✦ UNSW: Flute Acoustics

# Flute Anatomy (REAL NOT CLICKBAIT)





# Additional Images

