SOUND & VIBRATION

REVIEW AND APPLICATION

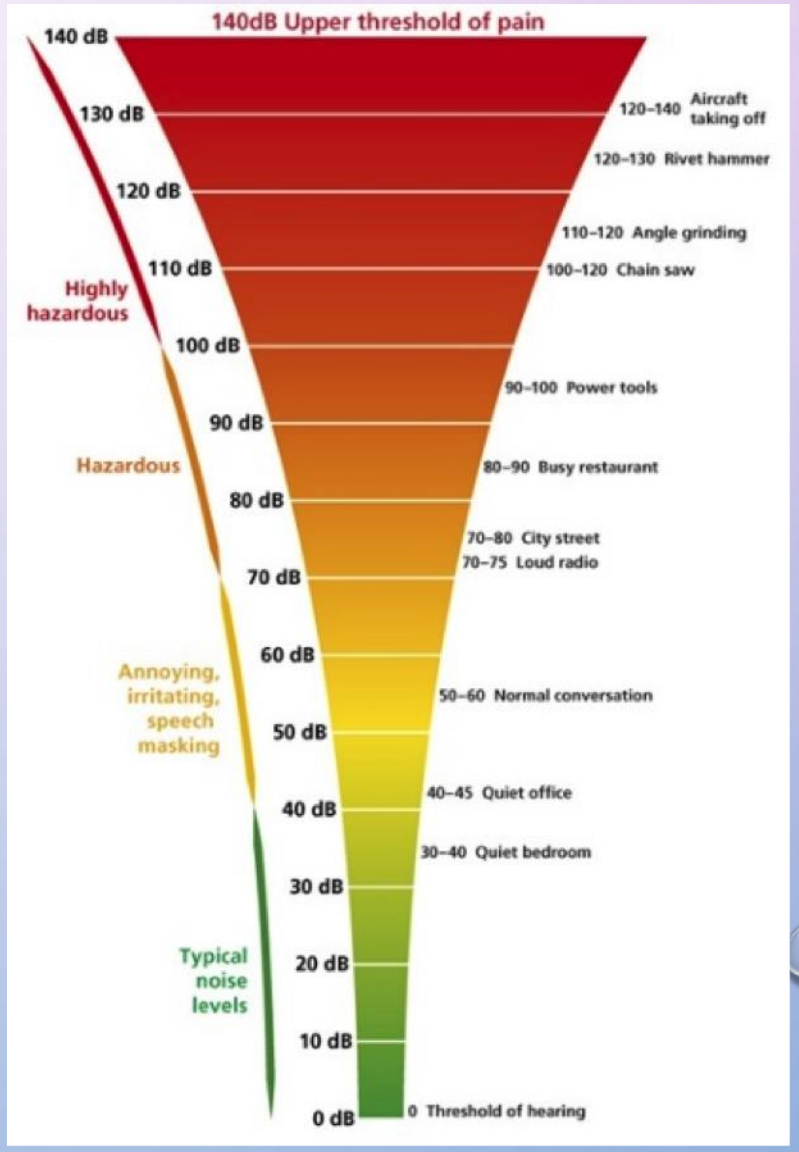
IN THE MATRIX AURA SYSTEM

WHAT IS SOUND?

- Sound is a form of *energy* that travels through waves in the air or other mediums. When an object vibrates, it creates sound waves that travel through a medium (like air) and are detected by our ears. These sound waves are then converted by our ears into electrical signals that are sent to our brain, allowing us to hear and interpret the sound.
- Sound has 3 characteristics: pitch, volume, and frequency
    - Volume is a measure of loudness or pressure
    - Pitch is how high or low the sound is
    - Frequency is how fast the sound moves

HOW LOUD IS LOUD?

- Sound pressure level (SPL) is a measurement of how **loud** something is
- Extended levels of sound that is too loud will cause permanent damage to the ears
- Some frequencies can cause issues with the brain as reverberations can build up inside the skull
- The human ear is more sensitive to high sounds, so they may seem louder than a low noise of the same intensity. Decibels and intensity, however, do not depend on the ear. They can be measured with instruments. A whisper is about 10 decibels while thunder is 100 decibels. Listening to loud sounds, sounds with intensities above 85 decibels, may damage your ears. If a noise is loud enough, over 120 decibels, it can be painful to listen to. One hundred and twenty decibels is the threshold of pain.
- Always use common sense when listening to sound

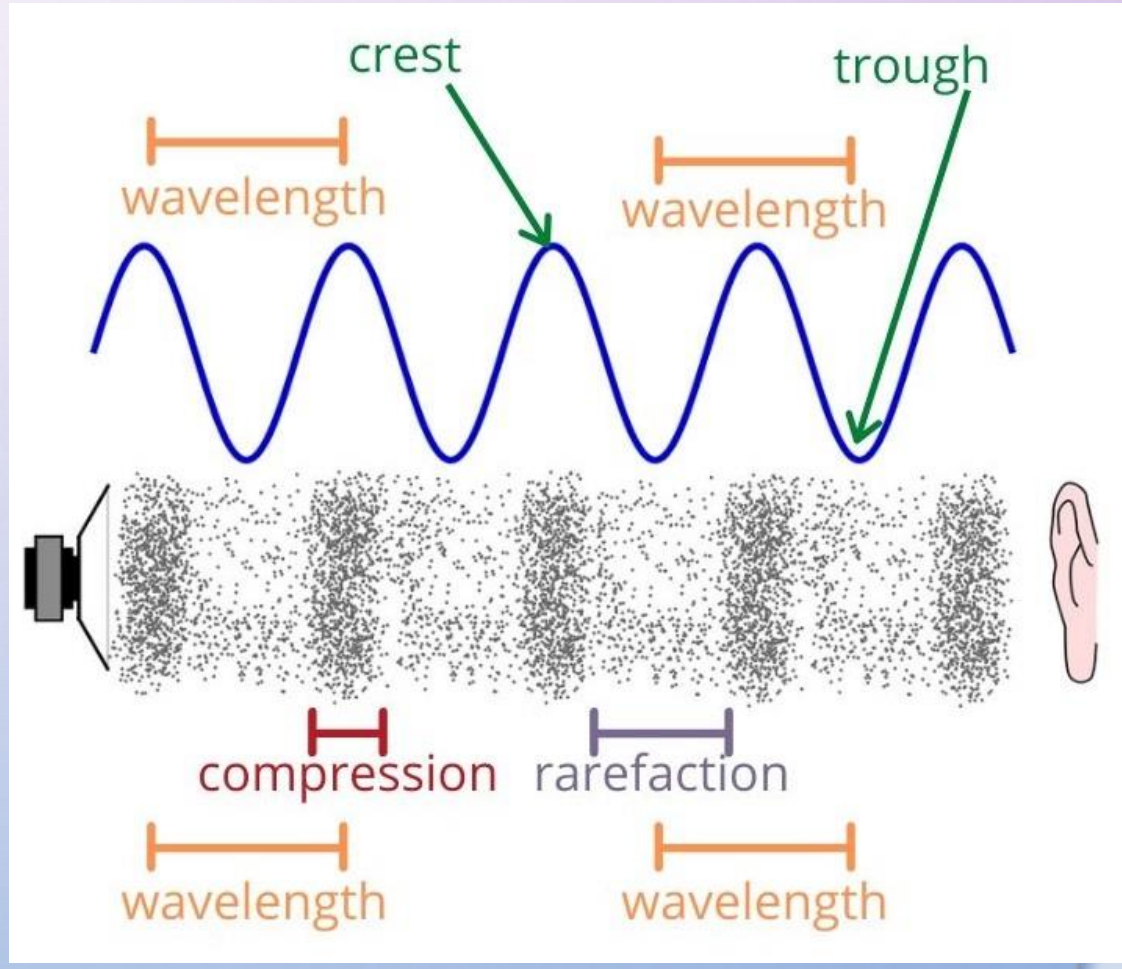


OTHER CHARACTERISTICS OF SOUND

- In a perfect world, our ears hear between 20Hz and 20KHz
- most people by their 30's hear somewhere between 40Hz and 16KHz
- Sounds beyond our hearing range can be interpreted by feeling
- Feeling a sound is called "tactile"
- Sounds can be harmonious or harsh, loud or quiet or anything in between
- Sound travels at different speeds through different objects- water, air, wood, metal
- Sounds needs particles to travel

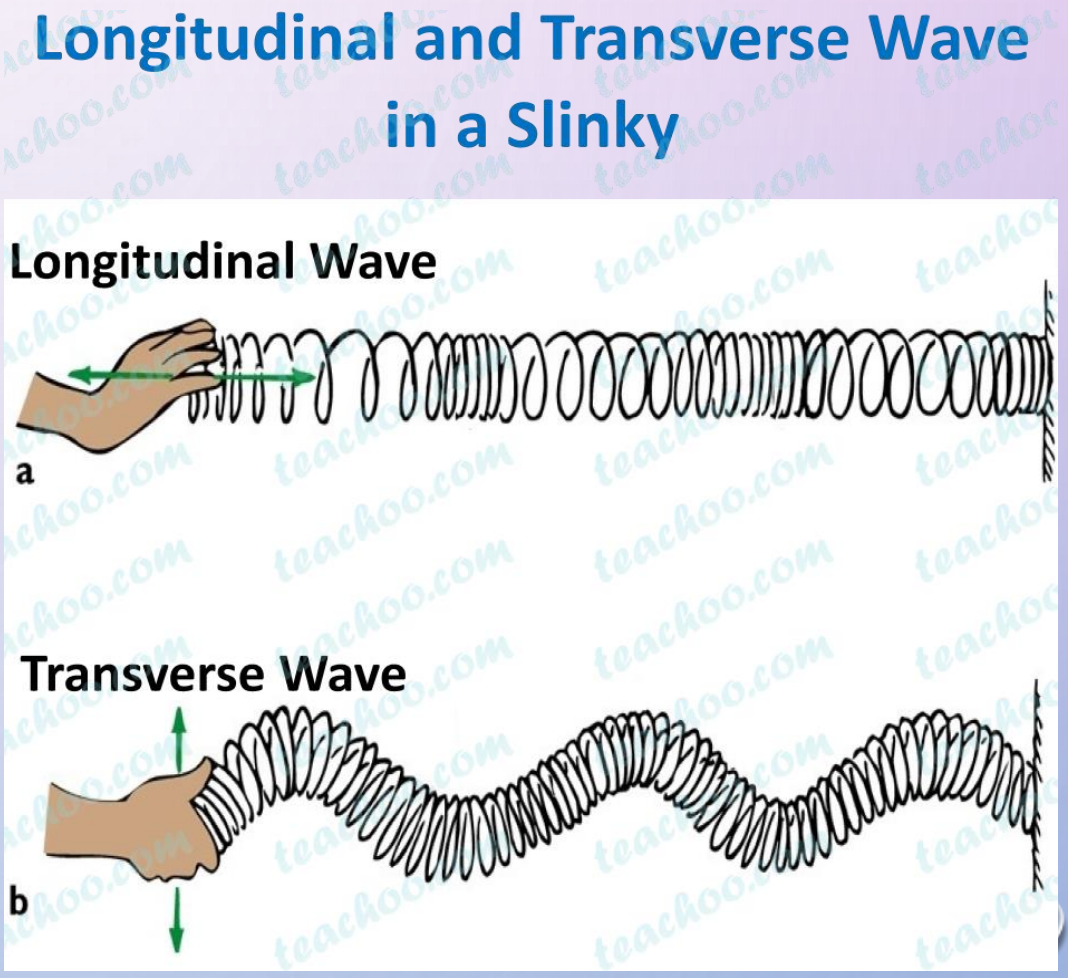
SOUND AS PRESSURE

- Sound creates pressure which we hear and feel
- Pressure is created by the compression and rarefaction of particles
- Compression happens when particles are forced together
- Rarefication happens when particles relax or move apart
- As the particles are moved from their rest position, they exert a force of the adjacent particles and pass the kinetic energy thus sound energy travels outward from the source



DIFFERENT TYPES OF WAVES

- If we use a slinky for example, we will see longitudinal waves take shape
- By simply pushing a slinky in one direction, the slinky will respond by producing linear waves of movement or pulses
- These longitudinal waves are easiest to produce of all waves and travel the fastest.
- Transverse waves or Shear waves travel at slower speeds than longitudinal waves, and can only be made in solids such as wood
- Shear waves are typically weak compared to longitudinal waves but require the longitudinal wave to form



HOW FAST IS FAST

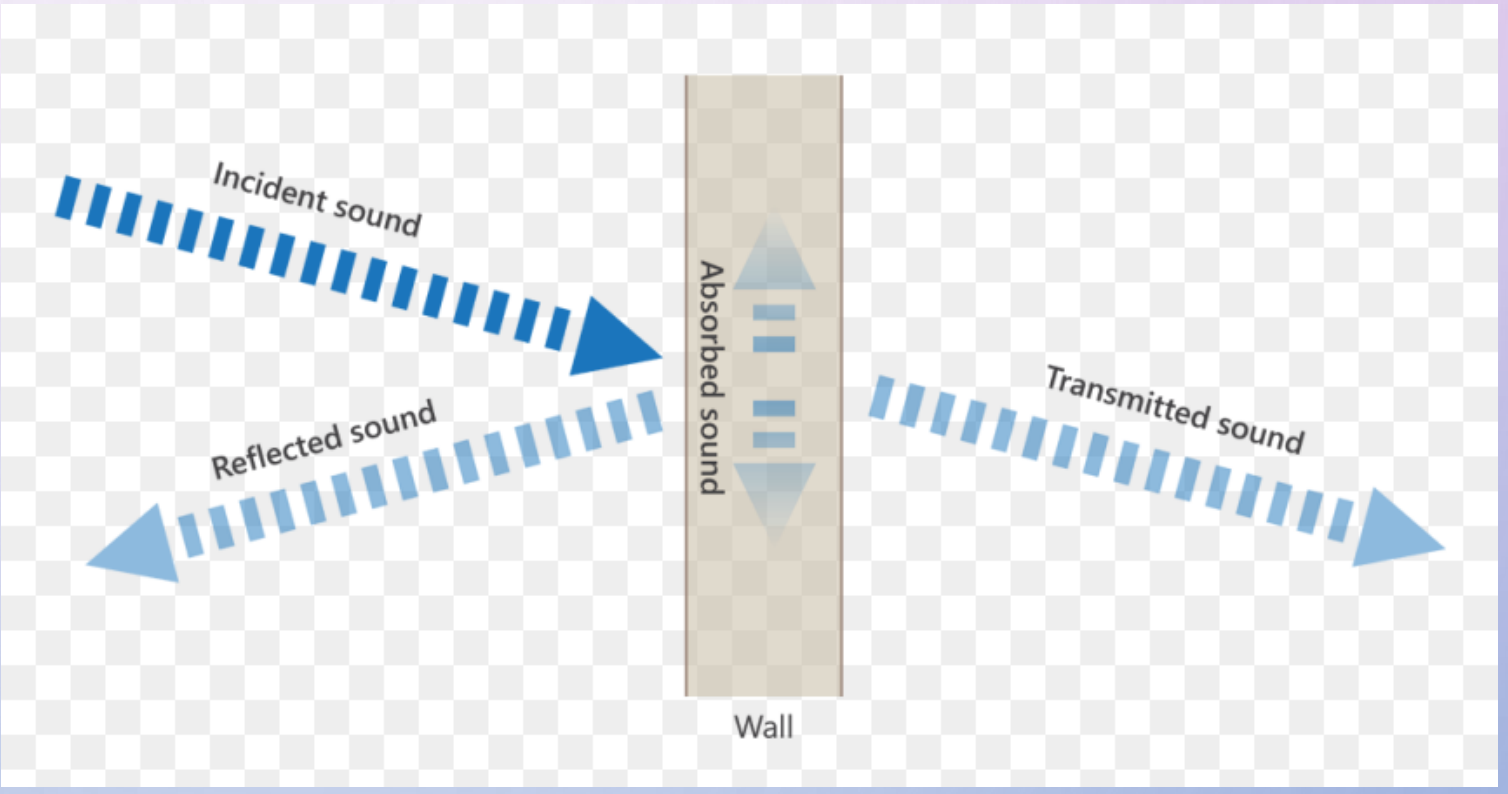
- When we talk about how fast sound travels through objects, we use terms like meters per second (M/S)
- As you can see, air is not very efficient at sending sound
- *Fat, Muscle, Water* are all similar in propagation of sound which is helpful in knowing because as humans, we contain a lot of water, muscle and fat!
- Bone, Wood, Stone, and Metal (aluminum in chart) are all similar in speed of travel
- Because sound travels at different speeds through different media, we start to understand the latency or how long a sound takes to register with our auditory system.
- NOTE: These are only speeds of Longitudinal waves. Transverse waves are typically half of these speeds

SPEEDS OF SOUND

MATERIAL	SPEED M/S
Rubber	60
Air @ 40 deg	350
lead	1210
Fat	1450
Water	1500
Muscle	1600
gold	3240
Bone	4000
glass	4500
Wood (oak)	5000
Stone	6000
Aluminium	6300
Diamond	12000

ATTENUATION

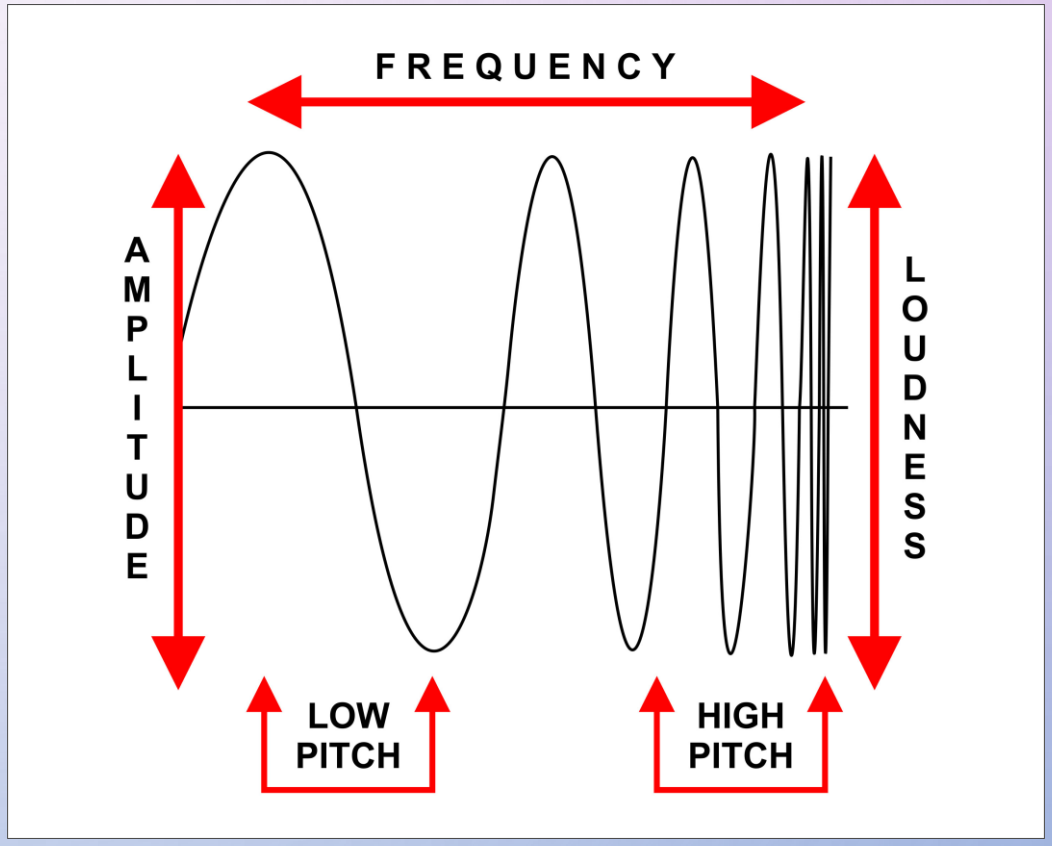
- As sound waves travel, their intensity is reduced due to spreading, scattering, and absorption this is called **attenuation**
- Attenuation is basically a drop in sound level
- Attenuation is a complex formula based on the object, frequency, amplitude and temperature.
- When we add in multiple types of media, the sound can drop by more than 60% before you hear or feel the sound



The goal in the Matrix Aura system is to get as much of the sound *accurately* to the body and ears, so we can get the most benefit from it.

FREQUENCY

- Sound waves traveling through the air or other mediums sometimes affect the objects that they encounter
- **Frequency** refers to the number of vibrations that an individual particle makes in a specific period of time, usually a second.
- The frequency of a wave is different than the speed of a wave.
- Frequency refers to how often a wave passes through a certain point, while speed refers to how fast a wave passes through the point.



RESONANCE

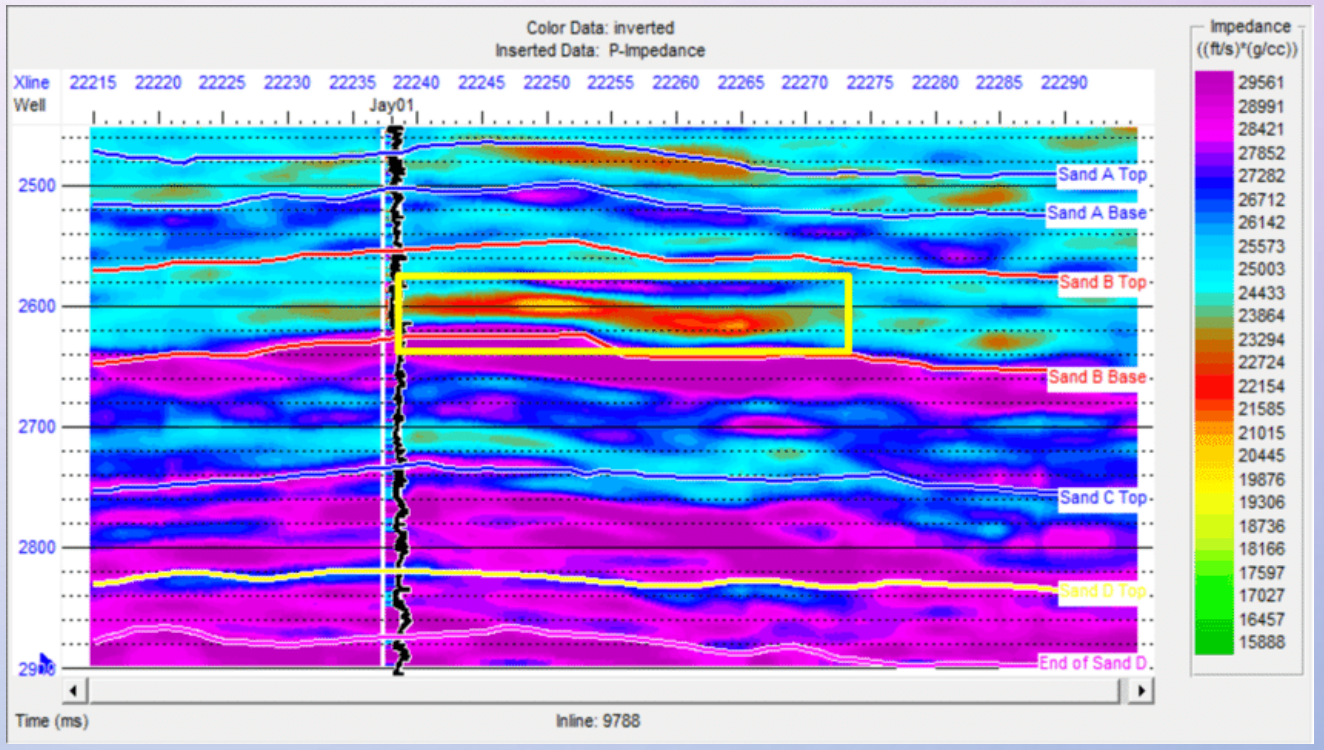
- Particles vibrate at a specific frequency for each source, called its **natural frequency**.
- Steel, brass, and wood all have different natural frequencies.
- Occasionally, objects vibrating at their natural frequencies will cause resonance.
- **Resonance** is when objects with the same natural frequency as the vibrating source also begin to vibrate.
- Resonance does not happen very often and only affects object close to the vibrating source.
- Sometimes, the effects of resonance can be powerful. A singer can make glass vibrate enough to shatter, just by singing a note with the glass's natural frequency!

ACOUSTIC IMPEDANCE

- Sound travels because it is a wave being compressed. The “sound” is travelling through atoms of a solid
- These atoms are bound elastically to one another, the excess pressure results in a wave propagating through the solid- this is how our *Matrix Aura* transducers work
- When the solid(s) change density, the result is a change of speed and thus more (or less) energy is required with each change
- The amount of pressure vs. flow (or movement) is a measure of impedance

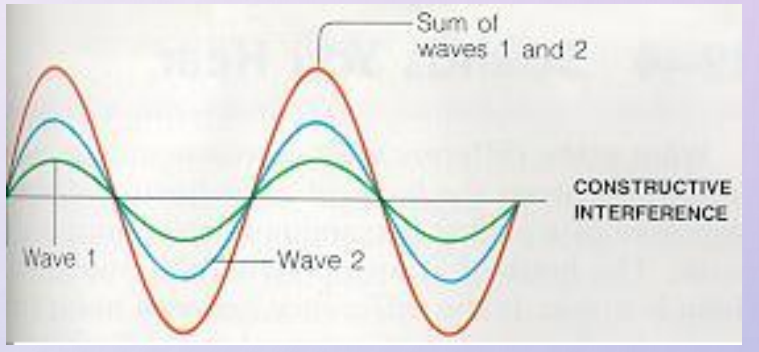
Visual representation of Impedance in layers of earth

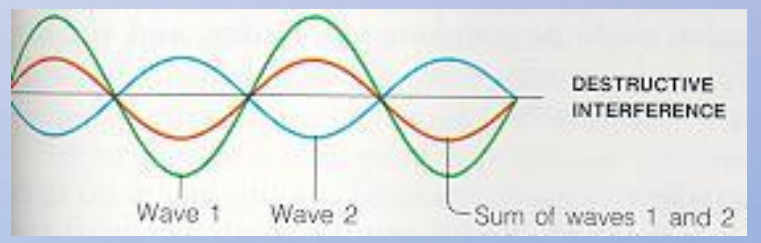
Colors represent different layers and the needed energy to pass through



WAVE INTERFERENCE

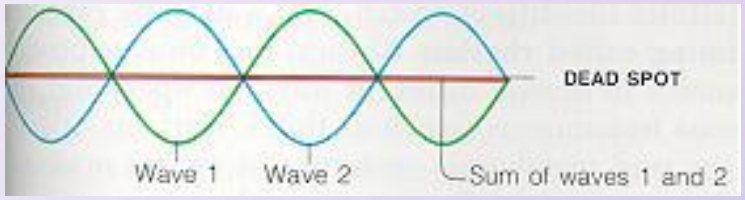
- When two or more sound Waves from different sources are present at the same time, they interact with each other to produce a new wave. The new wave is the sum of all the different waves.
- Wave interaction is called **interference**
- If the compressions and the rarefactions of the two waves line up, they strengthen each other and create a wave with a higher intensity. This type of interference Is known as **constructive**
- When the compressions and rarefactions are out of phase, their interaction creates a wave with a dampened or lower intensity. This is destructive interference. When waves are interfering with each other destructively, the sound Is louder in some places and softer in others. As a result, we hear pulses or beats in the sound
- This can be problematic when using multiple speakers





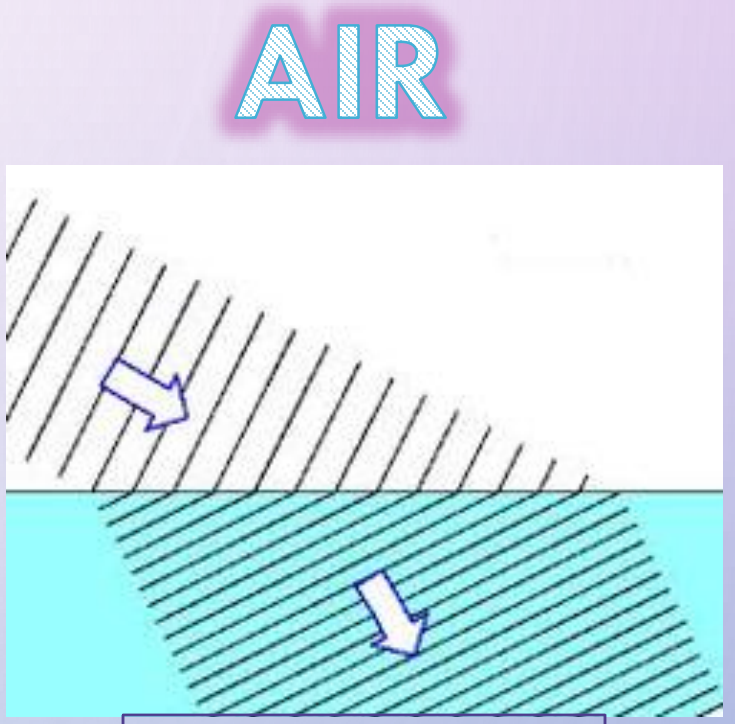
DEAD SPOTS

- Waves can interfere so destructively with one another that they produce **dead spots**, or places where no sound at all can be heard.
- Dead spots occur when the compressions of one wave line up with the rarefactions from another wave and cancel each other.
- In our system, we have carefully chosen the correct placement of the transducers to eliminate dead spots while at the same time allowing constructive wave formations



SOUND MOVING BETWEEN MATERIALS

- Remember that sound travels faster in some materials than others.
- Sound waves travel outward in straight lines from their source until something interferes with their path.
- When sound changes mediums, or enters a different material, it is bent from its original direction. This change in angle of direction is called refraction.
- Refraction is caused by sound entering the new medium at an angle.
- Because of the angle, part of the wave enters the new medium first and changes speed. The difference in speeds causes the wave to bend.
- The same principle applies to the *Matrix Aura* system but only in wood, foam, bone, water, muscle, metal



CONCLUSION

Sound is energy that allows us to spatially orient ourselves in the environment.

Sound also needs an object to travel. Remember, sound does not travel through the vacuum of outer space.

Sound can inform or confuse us, mask other sounds and can even be destructive (you can cook with sound)

Because the objects in our environment have different properties, sound changes from the original form.

We acknowledge these limitations and work with them by using technology, special materials and shapes.

In the end, we strive to bring this element of the Matrix Aura system to a place that benefits our bodies through the processes we have developed.

Sound is Profound!