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WIRED GENERATION SOUND CORONATION: CUTE SOUND MUTE BRAIN

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ABSTRACT

Headphones are a pair of small loudspeaker drivers worn on or around the head over a user's ears. They are electroacoustic transducers, which convert an electrical signal to a corresponding sound. Headphones let a single user listen to an audio source privately, in contrast to a loudspeaker, which emits sound into the open air for anyone nearby to hear. Headphones are also known as earphones or, colloquially, cans. Circumaural ('around the ear') and supra-aural ('over the ear') headphones use a band over the top of the head to hold the speakers in place. Another type, known as Earphones or earpieces consist of individual units that plug into the user's ear canal. A third type are bone conduction headphones, which typically wrap around the back of the head and rest in front of the ear canal, leaving the ear canal open. In the context of telecommunication, a headset is a combination of headphone and microphone.

KEYWORDS: acoustics, decibel, earphone, headphone, radiofrequency, circumaural and supra-aural earphone, out Ear fitting earphone and in ear earphone, open back, semi-open and closed back earphone, headset earphone, transducer and electrostatic loudspeaker, electret and planar magnetic microphone, planar magnetic driver and magnetostriction headphones.

Overview: The man behind the invention of the first modern headphones was the American engineer **Nathaniel Baldwin**. Nathaniel Baldwin (December 1, 1878 – January 19, 1961) was an American inventor and industrialist, known for his improved telephonic earphone, among other inventions.[1]

Figure-1: Earphone and inventor.

It was said he made the first pair - a headset that could amplify sound - by hand in his kitchen in 1910. Samsung Galaxy Buds2 Pro, Bluetooth Truly Wireless in Ear Earphones.

Apple AirPods (3rd Generation) with Lightning Charging Case. Earphone, small loudspeaker held or worn close to the listener's ear or within the outer ear. Common forms include the hand-held telephone receiver; the headphone, in which one or two earphones are held in place by a band worn over the head; and the plug earphone, which is inserted in the outer opening of the ear. Headphones, Earphones, and earphones typically differ in design. The ear-cups of headphones embrace the outer ears, whereas Earphones are supposed to enter your ear canal. However, they typically do it without accessories. These are earphones that come with foam, silicone or rubber ear-tips also to enter an ear canal. JBL

[James B. Lansing Sound] is among the most popular headphone brands in India. It offers a diverse selection of goods in the nation, including multiple headphones in various price ranges. Its popularity in the country is attributed mainly to the high quality of its audio and smart style.

Figure-2: Earphone.

Applications of headphones and earphones

1. For monitoring. This type is mainly used at music production sites.
2. For listening. It is designed to enjoy music mainly for home audio, portable headphones and wireless headphones.
3. For portability.
4. Noise canceling.
5. DJ headphones.
6. For drums.

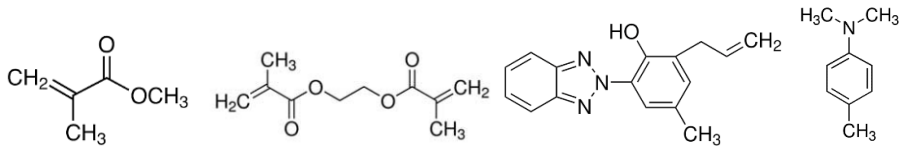

Figure-3: Chemicals.

Table 1: Chemical constituents.

Constituents	CAS	Concentration
Methylmethacrylate	80-62-6	50-100%
Ethandiol-1,2,-dimethacrylate	97-90-5	2.5-10%
2-Benzotriazolyl-4-methylphenol	2440-22-4	≤ 2.5%
N,N-dimethyl-p-toluidine	99-97-8	≤ 2.5%

Some earphones may use metal in their construction, while others may not use metal at all. One common type of earphone is the in-ear earphone, which is often made of plastic and rubber materials. These earphones typically have small metal speakers, which are encased in plastic and inserted into the ear canal. Plastic earpieces will be made by an injection molding process – where liquid plastic is injected into a mold. This is a very quick and cheap method which is ideal for mass production. While plastics are quite tough and rigid, they are not particularly dense or solid. Gold, silver and copper are all malleable metals, and the most common materials used in headphone cables. Gold is the most malleable, followed by silver, and in fourth place behind aluminum is copper. Metal earphones are more durable and can withstand more wear and tear than plastic earphones. They also provide better sound quality, with a more precise and accurate sound. Wireless headphones, such as Bluetooth headphones, use a technology known as radio frequency (RF) to transmit audio signals to the headphones.

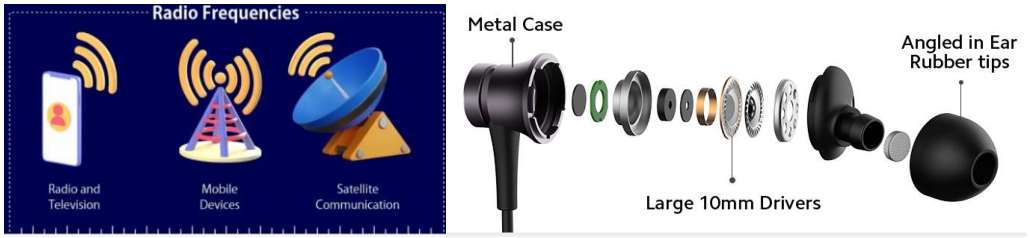

Figure-4: Radiofrequency.

RF technology allows the headphones to receive audio signals from a device, such as a smartphone or MP3 player, without the need for a physical connection. The oxygen-free copper wire, surrounded by silicone rubber,

lead up to the main component of the Earphones—the earpieces. These are made up of more oxygen-free wire, neodymium magnets, and a paper cone, encased in more plastic. You'll learn about the components that make headphone listening so enjoyable. An alloyof boron, neodymium and iron is used to make the strong permanent magnets used in the speakers, headphones and in the vibration unit of a smartphone. Boron is extracted from borate minerals such as borax and colemanite. Turkeyand USA are the largest producers of boron.

Parts

Driver: Drivers are undoubtedly the most important part of headphones.

Cable. Cables connect the headphone's speakers to its jack.

Jack.

Headband.

Earphones are a great way to listen to music on the go, but it's important to avoid wearing them too tight. Doing so can cause pain and damage to the ear canal. It can also lead to hearing loss. To avoid these problems, it's best to keep the Earphones loose and take breaks from using them every few hours. Two stripes earphone is a stereo earphone without microphone input. So it is not Handsfree for talking on mobile. Three stripes earphone includes microphone input connection. This makes it Handsfree enabling one to speak as well on mobile. They are usually smaller and lighter than over-ear headphones, making them very comfortable. They differ from over the ear headphones—as they don't have a seal around the ear—making it more difficult to block out outside noise. Headphones offer better noise cancellation, fuller coverage, and a more comfortable listening experience. Earphones are cheaper and more convenient, slipping into your pocket or bag with ease, and they aren't as conspicuous to wear. You can choose between wired or wireless Earphones or headphones in different price ranges. **Headphones are safer than earphones**.

History: Both, headphones and earphones are equally safe to use if you keep the volume levels under control. The myth is born from the idea that earphones sit deep inside the ear canal, closer to your ear drums while headphones don't. Both Boult and Boat are reputable audio brands, but the "better" brand depends on your specific preferences and needs. Consider factors such as the type of product you're looking for, your budget, and any specific features you prioritize, such as sound quality, battery life, or design. Boat ranked as the top TWS Earphones company in India in Q2 23 with a market share of 35.3%. Both are great. But, Wings Phatom Pro offers you a better look and similar performance at lower price than Boat. Boat has kept price higher due to its branding and popularity. That earpiece is called an in-ear monitor. It allows her to hear exactly what she wants. For example if you are a singer singing with a live band, there is a lot of noise onstage with you, especially from the drummer. It can be very hard to hear yourself which can make you sing louder and even shout. The other uses to which respondents put their headphones include: Watching TV shows and movies (49%) Listening to the radio (36%). At low volumes, they're useful little devices. But playing loud music so close to your eardrums can cause permanent hearing loss. 3D audio effects are a group of sound effects that manipulate the sound produced by stereo speakers, surround-sound speakers, speaker-arrays, or headphones. This frequently involves the virtual placement of sound sources anywhere in three-dimensional space, including behind, above or below the listener. If you use in-earphones or large headphones on a regular basis, you've probably noticed the 'L' and 'R' signs on each earbud and ear cup. This signifies left and right and is an instruction for which one goes in each ear. AirPods are wireless Bluetooth Earphones designed by Apple Inc. They were first announced on September 7, 2016, alongside the iPhone 7. Within two years, they became Apple's most popular accessory. AirPods are Apple's entry-level wireless headphones, sold alongside the AirPods Pro and AirPods Max. In addition to playing audio, the AirPods contain a microphone that filters out background noise as well as built-in accelerometers and optical sensors capable of detecting taps and pinches (e.g. double-tap or pinch to pause audio) and placement within the ear, which enables automatic pausing of audio when they are taken out. On March 20, 2019, Apple released the second-generation AirPods, which feature the H1 chip, longer talk time, and hands-free "Hey Siri" support. An optional wireless charging case which costs extra was added in the offerings. On October 26, 2021, Apple released the third-generation AirPods, which feature an external redesign with shorter stems similar to AirPods Pro, spatial audio, IPX4 water resistance, longer battery life, and MagSafe charging capability.[2]

Figure-5: Various earphones.

First generation AirPods: Apple announced the first generation of AirPods on September 7, 2016, at an Apple Special Event alongside the iPhone 7 and Apple Watch Series 2. Apple originally planned to release the AirPods in late October, but delayed the release date. On December 13, 2016, Apple began taking online orders for AirPods. They were available at Apple Stores, Apple Authorized Resellers, and select carriers on December 20, 2016. AirPods contain a proprietary Apple W1 SoC processor which helps optimize battery use as well as the Bluetooth 4.2 and audio connections. The advanced connectivity functions of the W1 requires devices running iOS 10, macOS Sierra, watchOS 3, or later. They can also function as standard Bluetooth headphones when connected to any device that supports Bluetooth 4.0 or higher, including Windows laptops and Android devices. There are two microphones inside each AirPod, one facing outward at ear level and another at the bottom of the stem. Each AirPod weighs 0.14 oz (4.0 g), and its charging case weighs 1.34 oz (38 g). The AirPods are capable of holding a charge of around five hours. Charging them for fifteen minutes in the case gives three hours of listening time. The charging case provides 24 hours of total usage time. During a complete dismantling, each AirPod was found to contain a 93 milliwatt hour battery in its stem, while the charging case contains a 1.52 watt hour or 398 mAh at 3.81 V battery. The model numbers for the first-generation AirPods are A1523 and A1722. Production of the first-generation AirPods was discontinued on March 20, 2019, after the second generation was released.

2nd generation earphones: Apple announced the second generation AirPods on March 20, 2019. They are the same design as the first generation, but have updated features. They include an H1 processor which supports hands-free "Hey Siri", Bluetooth 5 connectivity. Apple also claims 50% more talk time and faster device connection times. The "Announce Messages with Siri" feature was added in iOS 13.2, which allows the user to dictate text messages to Siri.

Figure-6: 1st, 2nd and 3rd gereration earphones.

Second-generation AirPods can be purchased with the same charging case as the first generation, or for an additional price bundled with the Wireless Charging Case, which can be used with Qi chargers. The Wireless Charging Case can be purchased separately and is compatible with first-generation AirPods. It moves the charging indicator LED to the exterior of the case. The Wireless Charging Case was initially announced in September 2017 alongside the AirPower charging mat, but was delayed by AirPower's protracted development and eventual cancellation. The second generation AirPods remained on sale with a price cut following the release of the third generation in October 2021, but only available with the Lightning charging case.

3rd generation earphones: Apple announced the third generation AirPods on October 18, 2021. They feature an external redesign with shorter stems, similar to AirPods Pro, and use similar force-touch controls. They include support for spatial audio and Dolby Atmos, IPX4 water resistance, skin detection and a case supporting MagSafe charging. Apple claims increased battery life, with AirPods lasting six hours and the charging case providing up to 30 hours. Preorders of the third generation AirPods began on October 18, 2021. The third generation AirPods were released on October 26, 2021, and are priced at $179. In September 2022, Apple released a $169 variant with a charging case lacking Qi and MagSafe charging compatibility. Headphones are a pair of small loudspeaker drivers worn on or around the head over a user's ears. They are electroacoustic transducers, which convert an electrical signal to a corresponding sound. Headphones let a single user listen to an audio source privately, in contrast to a loudspeaker, which emits sound into the open air for anyone nearby to hear. Headphones are also known as earphones or, colloquially, cans. Circumaural ('around the ear') and supra-aural ('over the ear') headphones use a band over the top of the head to hold the speakers in place. Another type, known as Earphones or earpieces consist of individual units that plug into the user's ear canal. A third type are bone conduction headphones, which typically wrap around the back of the head and rest in front of the ear canal, leaving the ear canal open. In the context of telecommunication, a headset is a combination of headphone and microphone. Headphones connect to a

signal source such as an audio amplifier, radio, CD player, portable media player, mobile phone, video game console, or electronic musical instrument, either directly using a cord, or using wireless technology such as Bluetooth, DECT or FM radio. The first headphones were developed in the late 19th century for use by telephone operators, to keep their hands free. Initially the audio quality was mediocre and a step forward was the invention of high fidelity headphones.[3]

Figure-7: Earphones in male youngsters.

Headphones exhibit a range of different audio reproduction quality capabilities. Headsets designed for telephone use typically cannot reproduce sound with the high fidelity of expensive units designed for music listening by audiophiles. Headphones that use cables typically have either a 1⁄4 inch (6.4 mm) or 1⁄8 inch (3.2 mm) phone jack for plugging the headphones into the audio source. Some stereo Earphones are wireless, using Bluetooth connectivity to transmit the audio signal by radio waves from source devices like cellphones and digital players. As a result of the Walkman effect, beginning in the 1980s, headphones started to be used in public places such as sidewalks, grocery stores, and public transit. Headphones are also used by people in various professional contexts, such as audio engineers mixing sound for live concerts or sound recordings and DJs, who use headphones to cue up the next song without the audience hearing, aircraft pilots and call center employees. The latter two types of employees use headphones with an integrated microphone. Headphones grew out of the need to free up a person's hands when operating a telephone. By the 1880s, soon after the invention of the telephone, telephone switchboard operators began to use head apparatuses to mount the telephone receiver. The receiver was mounted on the head by a clamp which held it next to the ear. The head mount freed the switchboard operator's hands, so that he could easily connect the wires of the telephone callers and receivers. The head-mounted telephone receiver in the singular form was called a "headphone". These head-mounted phone receivers, unlike modern headphones, only had one earpiece. French engineer Ernest Mercadier in 1891 patented a set of in-ear headphones. He was awarded U.S. Patent No. 454,138 for “improvements in telephone-receivers…which shall be light enough to be carried while in use on the head of the operator."

Figure-8: Earphones in female youngsters.

Applications for audiometric testing: Various types of specially designed headphones or earphones are also used to evaluate the status of the auditory system in the field of audiology for establishing hearing thresholds, medically diagnosing hearing loss, identifying other hearing related disease, and monitoring hearing status in occupational hearing conservation programs. Specific models of headphones have been adopted as the standard due to the ease of calibration and ability to compare results between testing facilities.[4]

Electrical characteristics: Electrical characteristics of dynamic loudspeakers may be readily applied to headphones, because most headphones are small dynamic loudspeakers.

Impedance: Headphones are available with high or low impedance (typically measured at 1 kHz). Low-impedance headphones are in the range 16 to 32 ohms and high-impedance headphones are about 100-600 ohms. As the impedance of a pair of headphones increases, more voltage (at a given current) is required to drive it, and the loudness of the headphones for a given voltage decreases. In recent years, impedance of newer headphones has generally decreased to accommodate lower voltages available on battery powered CMOS-based portable electronics. This has resulted in

headphones that can be more efficiently driven by battery-powered electronics. Consequently, newer amplifiers are based on designs with relatively low output impedance. The impedance of headphones is of concern because of the output limitations of amplifiers. A modern pair of headphones is driven by an amplifier, with lower impedance headphones presenting a larger load. Amplifiers are not ideal; they also have some output impedance that limits the amount of power they can provide. To ensure an even frequency response, adequate damping factor, and undistorted sound, an amplifier should have an output impedance less than 1/8 that of the headphones it is driving (and ideally, as low as possible). If output impedance is large compared to the impedance of the headphones, significantly higher distortion is present. Therefore, lower impedance headphones tend to be louder and more efficient, but also demand a more capable amplifier. Higher impedance headphones are more tolerant of amplifier limitations, but produce less volume for a given output level.

Sensitivity: Sensitivity is a measure of how effectively an earpiece converts an incoming electrical signal into an audible sound. It thus indicates how loud the headphones are for a given electrical drive level. It can be measured in decibels of sound pressure level per milliwatt (dB (SPL)/mW) or decibels of sound pressure level per volt (dB (SPL) / V). Unfortunately, both definitions are widely used, often interchangeably. As the output voltage (but not power) of a headphone amplifier is essentially constant for most common headphones, dB/mW is often more useful if converted into dB/V using Ohm's law: dB (SPL)/V = dB (SPL)/mW − 10 · log 10 Impedance/1000

Specifications: Headphone size can affect the balance between fidelity and portability. Generally, headphone form factors can be divided into four separate categories: circumaural (over-ear), supra-aural (on-ear), earbud and in-ear.

Wired: Headphones with soldered headphone jack cables.

Wireless
Wireless on-ear headphones. Often have an inbuilt headphone jack.
Wireless over-ear headphones. Often have an inbuilt headphone jack.
Wireless earphones connected via a neckband.

True wireless: True wireless Earphones have no cord to keep each bud connected to each other. They rely on wireless technology such as Bluetooth to transmit audio from a hardware device. Depending on hardware and software configuration, both channels may be first transmitted to one earbud, which splits off and forwards one channel to the other bud, coordinating the two. Alternatively, each bud only receives its individual audio signal, while the coordination is done in the signal source.[5]

Ear adaption
Circumaural: Circumaural headphones have large pads that surround the outer ear. Circumaural headphones (sometimes called full size headphones or over-ear headphones) have circular or ellipsoid earpads that encompass the ears. Because these headphones completely surround the ear, circumaural headphones can be designed to fully seal against the head to attenuate external noise. Because of their size, circumaural headphones can be heavy and there are some sets that weigh over 500 grams (1 lb). Ergonomic headband and earpad design is required to reduce discomfort resulting from weight. These are commonly used by drummers in recording.

Figure-9: Circumaural and Supra-aural earphone.

Supra-aural: A pair of supra-aural (on-ear) headphones. Supra-aural headphones or on-ear headphones have pads that press against the ears, rather than around them. They were commonly bundled with personal stereos during the 1980s. This type of headphone generally tends to be smaller and lighter than circumaural headphones, resulting in less attenuation of outside noise. Supra-aural headphones can also lead to discomfort due to the pressure on the ear as compared to circumaural headphones that sit around the ear. Comfort may vary due to the earcup material.

Figure-10: Out Ear fitting earphone and In ear earphone.

Out Ear-fitting earphones: Earphones sit in the outer ear. Earphones are very small headphones that are fitted directly in the outer ear, facing but not inserted in the ear canal. Earphones are portable and convenient, but many people consider them uncomfortable. They provide hardly any acoustic isolation and leave room for ambient noise to seep in; users may turn up the volume dangerously high to compensate, at the risk of causing hearing loss. On the other hand, they let the user be better aware of their surroundings. Since the early days of the transistor radio, earphones have commonly been bundled with personal music devices. They are sold at times with foam or rubber pads for comfort. (The use of the term Earphones, which has been around since at least 1984, did not hit its peak until after 2001, with the success of Apple's MP3 player.)[6]

In-ear headphones: In-ear monitors extend into the ear canal, providing isolation from outside noise. In-ear headphones, also known as in-ear monitors (IEMs) or canalphones, are small headphones with similar portability to Earphones that are inserted in the ear canal itself. IEMs are higher-quality in-ear headphones and are used by audio engineers and musicians as well as audiophiles. The outer shells of in-ear headphones are made up of a variety of materials, such as plastic, aluminum, ceramic and other metal alloys. Because in-ear headphones engage the ear canal, they can be prone to sliding out, and they block out much environmental noise. Lack of sound from the environment can be a problem when sound is a necessary cue for safety or other reasons, as when walking, driving, or riding near or in vehicular traffic. Some in-ear headphones utilize built-in microphones to allow some outside sound to be heard when desired. Generic or custom-fitting ear canal plugs are made from silicone rubber, elastomer, or foam. Such plugs in lower-end devices may be interchangeable, which increases the risk of them falling off and getting lodged in the ear canal. Custom in-ear headphones use castings of the ear canal to create custom-molded plugs that provide added comfort and noise isolation. Some wireless earphones include a charging case.[7]

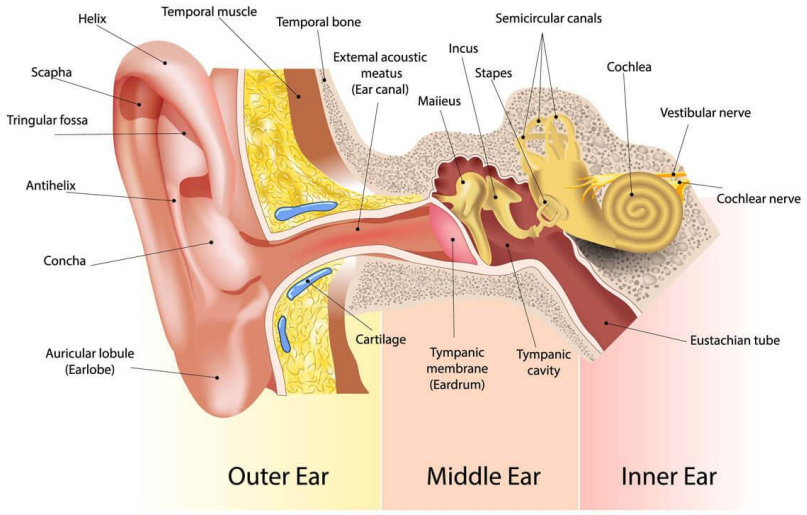

Figure-11: EAR [Excellent Acoustic Reader] anatomy.

Both circumaural and supra-aural headphones can be further differentiated by the type of earcups:

Open-back: Open-back headphones have the back of the earcups open. This leaks more sound out of the headphone and also lets more ambient sounds into the headphone, but gives a more natural or speaker-like sound, due to including sounds from the environment.

Semi-open: Semi-open headphones, have a design that can be considered as a compromise between open-back headphones and closed-back headphones. Some believe the term "semi-open" is purely there for marketing purposes. There is no exact definition for the term semi-open headphone. Where the open-back approach has hardly any measure to block sound at the outer side of the diaphragm and the closed-back approach really has a closed chamber at the outer side of the diaphragm, a semi-open headphone can have a chamber to partially block sound while letting some sound through via openings or vents.[8]

Open- or closed-back

Figure-12: Open back, semi-open and closed back earphone.

Closed-back: Closed-back (or sealed) styles have the back of the earcups closed. They usually block some of the ambient noise. Closed-back headphones usually can produce stronger low frequencies than open-back headphones.

Headset: A headset is a headphone combined with a microphone. Headsets provide the equivalent functionality of a telephone handset with hands-free operation. Among applications for headsets, besides telephone use, are aviation, theatre or television studio intercom systems, and console or PC gaming. Headsets are made with either a single-earpiece (mono) or a double-earpiece (mono to both ears or stereo). The microphone arm of headsets is either an external microphone type where the microphone is held in front of the user's mouth, or a voicetube type where the microphone is housed in the earpiece and speech reaches it by means of a hollow tube.[9]

Ambient noise reduction: Unwanted sound from the environment can be reduced by excluding sound from the ear by passive noise isolation, or, often in conjunction with isolation, by active noise cancellation. In-ears are among those good for noise isolation. Passive noise isolation is essentially using the body of the earphone, either over or in the ear, as a passive earplug that simply blocks out sound. The headphone types that provide most attenuation are in-ear canal headphones and closed-back headphones, both circumaural and supra aural. Open-back and earbud headphones provide some passive noise isolation, but much less than the others. Typical closed-back headphones block 8 to 12 dB, and in-ears anywhere from 10 to 15 dB.

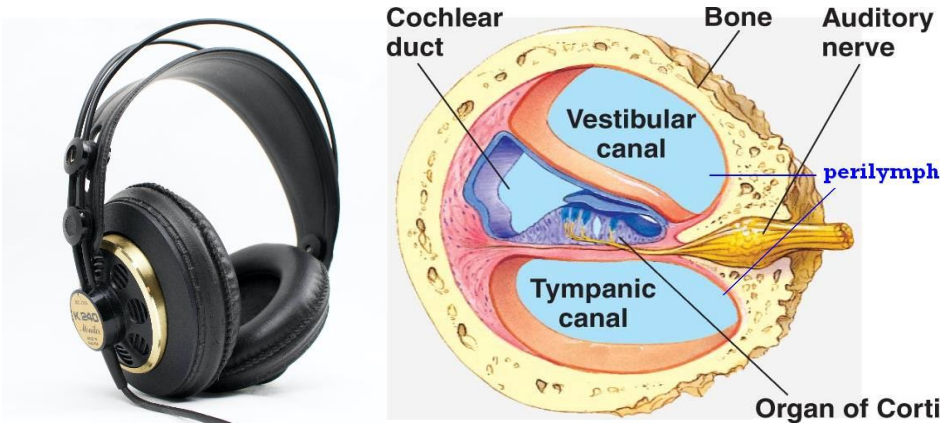

Figure-13: Headset earphone & Organ of Corti.

Some models have been specifically designed for drummers to facilitate the drummer monitoring the recorded sound while reducing sound directly from the drums as much as possible. Such headphones claim to reduce ambient noise by around 25 dB. Active noise-cancelling headphones use a microphone, amplifier, and speaker to pick up, amplify, and play ambient noise in phase-reversed form; this to some extent cancels out

unwanted noise from the environment without affecting the desired sound source, which is not picked up and reversed by the microphone. They require a power source, usually a battery, to drive their circuitry. Active noise cancelling headphones can attenuate ambient noise by 20 dB or more, but the active circuitry is mainly effective on constant sounds and at lower frequencies, rather than sharp sounds and voices. Some noise cancelling headphones are designed mainly to reduce low-frequency engine and travel noise in aircraft, trains, and automobiles, and are less effective in environments with other types of noise. Sounds at or below 70 dB are considered safe for our hearing. That's the sound of a normal conversation between two people. Sounds above 70 dB will damage hearing over time. Like the Richter scale for measuring earthquakes, the decibel scale is logarithmic. Loud noise above 120 dB can cause immediate harm to your ears. The table below shows dB levels and how noise from everyday sources can affect your hearing.[10]

Figure-14: Decibel sound classification.

Transducer technology: Headphones use various types of transducer to convert electrical signals to sound.

Moving-coil: The moving coil driver, more commonly referred to as a "dynamic" driver is the most common type used in headphones. It consists of a stationary magnet element affixed to the frame of the headphone, which sets up a static magnetic field. The magnet in headphones is typically composed of ferrite or neodymium. A voice coil, a light coil of wire, is suspended in the magnetic field of the magnet, attached to a diaphragm, typically fabricated from lightweight, high-stiffness-to-mass-ratio cellulose, polymer, carbon material, paper or the like. When the varying current of an audio signal is passed through the coil, it creates a varying magnetic field that reacts against the static magnetic field, exerting a varying force on the coil causing it and the attached diaphragm to vibrate. The vibrating diaphragm pushes on the air to produce sound waves.[11]

Electrostatic: Electrostatic drivers consist of a thin, electrically charged diaphragm, typically a coated PET [Polyethylene terephthalate] film membrane, suspended between two perforated metal plates (electrodes). The electrical sound signal is applied to the electrodes creating an electrical field; depending on the polarity of this field, the diaphragm is drawn towards one of the plates. Air is forced through the perforations; combined with a continuously changing electrical signal driving the membrane, a sound wave is generated. Electrostatic headphones are usually more expensive than moving-coil ones, and are comparatively uncommon. In addition, a special amplifier is required to amplify the signal to deflect the membrane, which often requires electrical potentials in the range of 100 to 1,000 volts. Due to the extremely thin and light diaphragm membrane, often only a few micrometers thick, and the complete absence of moving metalwork, the frequency response of electrostatic headphones usually extends well above the audible limit of approximately 20 kHz.

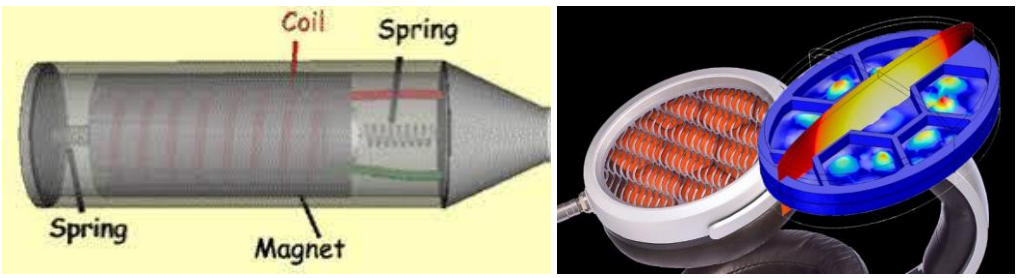

Figure-15: Transducer and Electrostatic loudspeaker.

The high-frequency response means that the low-midband distortion level is maintained to the top of the audible frequency band, which is generally not the case with moving coil drivers. Also, the frequency response peakiness regularly seen in the high-frequency region with moving coil drivers is absent. Well-designed electrostatic headphones can produce significantly better sound quality than other types. Electrostatic headphones require a voltage source generating 100 V to over 1 kV, and are on the user's head. Since the invention of insulators, there is no actual danger. They do not need to deliver significant electric current, which further limits the electrical hazard to the wearer in case of fault.[12]

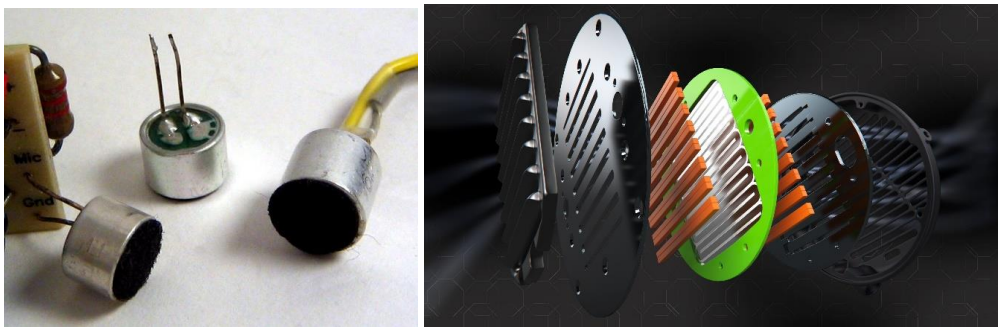

Figure-16: Electret and planar magnetic microphone.

Electret: An electret is a dielectric material that has a quasi-permanent state of electric polarization. The polarization is linked to either the real electric charges on the surface and/or the volume, or to the oriented dipoles, fixed in the volumeAn electret driver functions along the same electromechanical means as an electrostatic driver. However, the electret driver has a permanent charge built into it, whereas electrostatics have the charge applied to the driver by an external generator. Electret and electrostatic headphones are relatively uncommon. Original electrets were also typically cheaper and lower in technical capability and fidelity than electrostatics. Patent applications from 2009 to 2013 have been approved that show by using different materials, i.e. a "Fluorinated cyclic olefin electret film", Frequency response chart readings can reach 50 kHz at 100 db. When these new improved electrets are combined with a traditional dome headphone driver, headphones can be produced that are recognised by the Japan Audio Society as worthy of joining the Hi Res Audio program. US patents 8,559,660 B2. 7,732,547 B2.7,879,446 B2.7,498,699 B2.

Planar magnetic: Planar magnetic (also known as orthodynamic) headphones use similar technology to electrostatic headphones, with some fundamental differences. They operate similarly to planar magnetic loudspeakers.[13]

A planar magnetic driver consists of a relatively large membrane that contains an embedded wire pattern. This membrane is suspended between two sets of permanent, oppositely aligned, magnets. A current passed through the wires embedded in the membrane produces a magnetic field that reacts with the field of the permanent magnets to induce movement in the membrane, which produces sound.
Balanced armature
Balanced armature transducer
Armature balanced and exerting no force on diaphragm
Armature torqued and exerting a force on diaphragm

A balanced armature is a sound transducer design primarily intended to increase the electrical efficiency of the element by eliminating the stress on the diaphragm characteristic of many other magnetic transducer systems. As shown schematically in the left diagram, it consists of a moving magnetic armature that is pivoted so it can move in the field of the permanent magnet. When precisely centered in the magnetic field there is no net force on the armature, hence the term 'balanced'. As illustrated in the right diagram, when there is electric current through the coil, it magnetizes the armature one way or the other, causing it to rotate slightly one way or the other about the pivot thus moving the diaphragm to make sound.[14]

Figure-17: Planar magnetic driver and Magnetostriction headphones.

A custom in-ear monitor which uses 8 balanced armatures in a triple crossover configuration (4 low/2 mid/2 high). Headphone designs often use multiple balanced armatures to provide a higher fidelity sound. The design is not mechanically stable; a slight imbalance makes the armature stick to one pole of the magnet. A fairly stiff restoring force is required to hold the armature in the 'balance' position. Although this reduces its efficiency, this design can still produce more sound from less power than any other. Popularized in the 1920s as Baldwin Mica Diaphragm radio headphones, balanced armature transducers were refined during World War II for use in military sound powered telephones. Some of these achieved astonishing electro-acoustic conversion efficiencies, in the range of 20% to 40%, for narrow bandwidth voice signals. Today they are typically used only in in-ear headphones and hearing aids, where their high efficiency and diminutive size is a major advantage. They generally are limited at the extremes of the hearing spectrum (e.g. below 20 Hz and above 16 kHz) and require a better seal than other types of drivers to deliver their full potential. Higher-end models may employ multiple armature drivers, dividing the frequency ranges between them using a passive crossover network. A few combine an armature driver with a small moving-coil driver for increased bass output. The earliest loudspeakers for radio receivers used balanced armature drivers for their cones.[15]

Thermoacoustic technology: The thermoacoustic effect generates sound from the audio frequency Joule heating of the conductor, an effect that is not magnetic and does not vibrate the speaker. In 2013 a carbon nanotube thin-yarn earphone based on the thermoacoustic mechanism was demonstrated by a research group in Tsinghua University. The as-produced CNT thin yarn earphone has a working element called CNT thin yarn thermoacoustic chip. Such a chip is composed of a layer of CNT thin yarn array supported by the silicon wafer, and periodic grooves with certain depth are made on the wafer by micro-fabrication methods to suppress the heat leakage from the CNT yarn to the substrate.[16]

Other transducer technologies: Transducer technologies employed much less commonly for headphones include the Heil Air Motion Transformer (AMT); Piezoelectric film; Ribbon planar magnetic; Magnetostriction and Plasma or Ionic. The first Heil AMT headphone was marketed by ESS Laboratories and was essentially an ESS AMT tweeter from one of the company's speakers being driven at full range. Since the turn of the century, only Precide of Switzerland have manufactured an AMT headphone. Piezoelectric film headphones were first developed by Pioneer, their two models used a flat sheet of film that limited the maximum volume of air movement. Currently, TakeT produces a piezoelectric film headphone shaped similarly to an AMT transducer but, which like the Precide driver, has a variation in the size of transducer folds over the diaphragm. It additionally incorporates a two way design by its inclusion of a dedicated tweeter/supertweeter panel. The folded shape of a diaphragm allows a transducer with a larger surface area to fit within smaller space constraints. This increases the total volume of air that can be moved on each excursion of the transducer given that radiating area. Due to the small volume of air in a headphone, the plasma or ionic transducer can become a full range driver although the high temperatures and voltages of these types makes them very rare with only the Plasmasonic being commercial.[17]

Magnetostriction headphones, sometimes sold under the label Bonephones, work by vibrating against the side of head, transmitting sound via bone conduction. This is particularly helpful in situations where the ears must be unobstructed, or for people who are deaf for reasons that do not affect the nervous apparatus of hearing. Magnetostriction headphones though, are limited in their fidelity compared to conventional headphones that rely on the normal workings of the ear. Additionally, in the mid-1980s, a French company called Audio Reference tried to market the Plasmasonic plasma headphone invented by Henri Bondar. There are no known functioning examples left. Due to the small volume of air in a headphone, the plasma or ionic transducer can become a full range driver although the high temperatures and voltages needed makes them very rare.

Benefits and limitations: Sony MDR-7506 headphones in stowed configuration. A micro audio amplifier for boosting the output power of smartphones etc. to headphones. Used for example to compensate a built-in volume limit in smartphones, the higher volume levels could, however, lead to ear damage.[18]

Headphones can prevent other people from hearing the sound, either for privacy or to prevent disturbing others, as in listening in a public library. They can also provide a level of sound fidelity greater than loudspeakers of similar cost. Part of their ability to do so comes from the lack of any need to perform room correction treatments with headphones. High-quality headphones can have an extremely flat low-frequency response down to 20 Hz within 3 dB. While a loudspeaker must use a relatively large (often 15" or 18") speaker driver to reproduce low frequencies, headphones can accurately reproduce bass and sub-bass frequencies with speaker drivers only 40-50 millimeters wide (or much smaller, as is the case with in-ear monitor headphones). Headphones' impressive low-frequency performance is possible because they are so much closer to the ear that they only need to move relatively small volumes of air. Marketed claims such as 'frequency response 4 Hz to 20 kHz' are usually overstatements; the product's response at frequencies lower than 20 Hz is typically very small. Headphones are also useful for video games that use 3D positional audio processing algorithms, as they allow players to better judge the position of an off-screen sound source (such as the footsteps of an opponent or their gunfire). Although

modern headphones have been particularly widely sold and used for listening to stereo recordings since the release of the Walkman, there is subjective debate regarding the nature of their reproduction of stereo sound. Stereo recordings represent the position of horizontal depth cues (stereo separation) via volume and phase differences of the sound in question between the two channels. When the sounds from two speakers mix, they create the phase difference the brain uses to locate direction. Through most headphones, because the right and left channels do not combine in this manner, the illusion of the phantom center can be perceived as lost. Hard panned sounds are also heard only in one ear rather than from one side. It is possible to change the spatial effects of stereo sound on headphones, to better approximate the presentation of speaker reproduction, by using frequency-dependent cross-feed between the channels. Headsets can have ergonomic benefits over traditional telephone handsets. They allow call center agents to maintain better posture without needing to hand-hold a handset or tilt their head sideways to cradle it.[19]

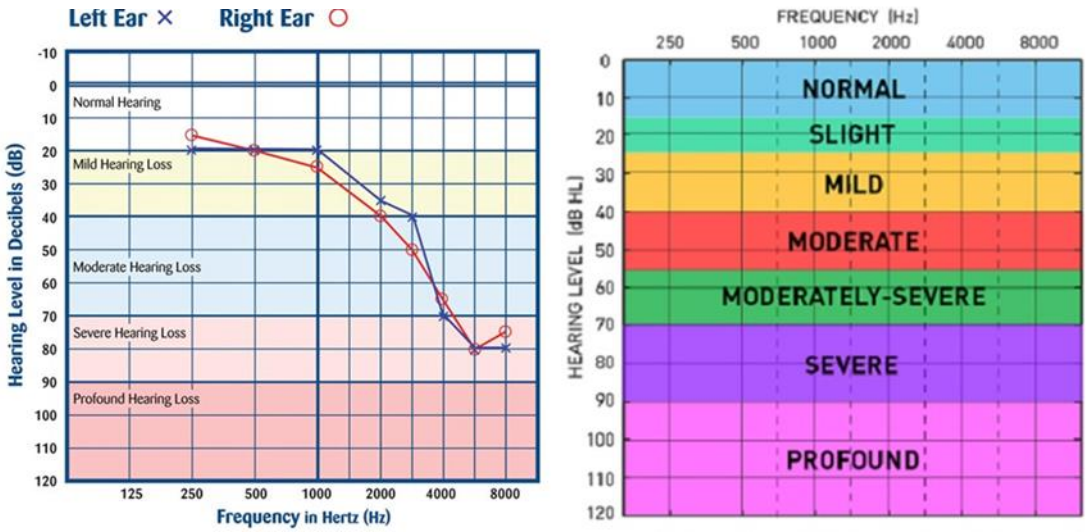

Figure-18: Audiogram.

Health and safety: Using headphones at a sufficiently high volume level may cause temporary or permanent hearing impairment or deafness. The headphone volume often has to compete with the background noise, especially in loud places such as subway stations, aircraft, and large crowds. Extended periods of exposure to high sound pressure levels created by headphones at high volume settings may be damaging to hearing; Nearly 50% of teenagers and young adults (12 to 35 years old) in middle and high income countries listen to unsafe levels of sound on their personal audio devices and smartphones. However, one hearing expert found in 2012 (before the worldwide adoption of smartphones as the main personal listening devices) that "fewer than 5% of users select volume levels and listen frequently enough to risk hearing loss." The International Telecommunication Union recently published "Guidelines for safe listening devices/systems" recommended that sound exposure not exceed 80 decibels, A-weighted dB(A) for a maximum of 40 hours per week. The European Union have also set a similar limit for users of personal listening devices (80 dB(A) for no more than 40 hours per week) and for each additional increase of 3-dB in sound exposure, the duration should be cut in half (83 dB(A) for no more than 20 hours, 86 dB(A) for 10 hours per week, 89 dB(A) for 5 hours per week and so on. Most major manufactures of smartphones now include some safety or volume limiting features and warning messaging in their devices. though such practices have received mixed response from some segments of the buying who favor the personal choice of setting their own volume levels. The usual way of limiting sound volume on devices driving headphones is by limiting output power. This has the additional undesirable effect of being dependent of the efficiency of the headphones; a device producing the maximum allowed power may not produce adequate volume when paired with low-efficiency, high-impedance equipment, while the same amount of power can reach dangerous levels with very efficient earphones. Some studies have found that people are more likely to raise volumes to unsafe levels while performing strenuous exercise. A Finnish study recommended that exercisers should set their headphone volumes to half of their normal loudness and only use them for half an hour. Other than hearing risk, there is a general danger that listening to loud music in headphones can distract the listener and lead to injury and accidents. Noise-cancelling headphones add extra risk. Several countries and states have made it illegal to wear headphones while driving or cycling.

There have also been numerous reports of contact dermatitis due to exposure to in-ear headphones such as Apple AirPods. The contact dermatitis would be caused by in-ear headphones that contain gold, rubber, dyes,

acrylates, or methacrylates. However, there have been no studies done to prove that exposure to in-ear headphones will cause contact dermatitis, rather that there is a correlation between in-ear headphone use and contact dermatitis cases.[20]

Occupational health and safety. Hearing risk from headphones' use also applies to workers who must wear electronic or communication headsets as part of their daily job (i.e., pilots, call center and dispatch operators, sound engineers, firefighters, etc.) and hearing damage depends on the exposure time. The National Institute for Occupational Safety and Health (NIOSH) recommends sound exposure not exceed 85 dB(A) over 8 hour work day as a time-weighted average. NIOSH uses the 3-dB exchange rate often referred to as "time-intensity tradeoff" which means if sound exposure level is increased by 3 decibels, the duration of exposure should be cut in half. NIOSH published several documents targeted at protecting the hearing of workers who must wear communication headsets such as call center operators, firefighters, and musicians and sound engineers. The model numbers for the third-generation AirPods are A2565 and A2564.

Figure-19: Ear adaption testing.

Ear adaptation for sound: With a sound impulse of 80 db above the auditory threshold, the adaptation reaches a value of 40 to 50 db. Binaural determination of adaptation, by leading the stimulating impulse to one ear and the testing impulse to the other, shows that adaptation is a monaural and therefore a peripheral process. Auditory adaptation, as perceptual adaptation with other senses, is the process by which individuals adapt to sounds and noises. As research has shown, as time progresses, individuals tend to adapt to sounds and tend to distinguish them less frequently after a while. Adaptation is defined as the elevation of the auditory threshold by a previous sound stimulus. It may be determined by means of a short tone impulse (testing impulse) which follows the sound stimulus (stimulating impulse) causing the adaptation. The testing impulse is adjusted to the threshold value. Loudness adaptation is defined as a decrease in loudness for a sustained, fixed-level tone. Loudness adaptation is typically measured by a comparison tone presented either in the opposite ear at the same time or in the same ear right after the test tone. Audiometry consists of tests of function of the hearing mechanism. This includes tests of mechanical sound transmission (middle ear function), neural sound transmission (cochlear function), and speech discrimination ability (central integration). Sound waves enter the outer ear and travel through the external auditory canal until they reach the tympanic membrane, causing the membrane and the attached chain of auditory ossicles to vibrate. The motion of the stapes against the oval window sets up waves in the fluids of the cochlea, causing the basilar membrane to vibrate. This stimulates the sensory cells of the organ of Corti, atop the basilar membrane, to send nerve impulses to the central auditory processing areas of the brain, the auditory cortex, where sound is perceived and interpreted. Audiography (audiogram) An audiometry exam tests your ability to hear sounds. Sounds vary, based on their loudness (intensity) and the speed of sound wave vibrations (tone). Hearing occurs when sound waves stimulate the nerves of the inner ear. The audiogram is a graph showing the results of a pure-tone hearing test. It will show how loud sounds need to be at different frequencies for you to hear them. The audiogram shows the type, degree, and configuration of hearing loss.

CONCLUSION

Among technologies, the smartphone may be the most useful technology by people. Even if people forget their key, they may not forget their smartphone. That much influence is there for smartphone on people. Earphones are best friends of the smartphone, that always accompany with them. Like the usage of smartphone people also get addicted to earphones.

Advantages Of Using Earphones

1. Easy to use: We like to use advanced technology to make our life more easy and comfortable so if you are using earphones for playing music or calls, it itself has buttons on it for pause or play music and also for pick or end the call. Earphones are easy to use which does not have any complications. In the advanced form of technology, there are earphones such as Bluetooth headset or earbuds, which are wireless and can be used comfortably.

2. Can easily carried: In markets, nowadays there is availability of earphones largely. Both wired and wireless can be easily carried and are can be brought without any difficulty. Carrying earphones with you while travelling or any other thing is not difficult. Earphones are less weight and portable. So people can carry them with you while travelling into longer as well as shorter place for listening music or easiness of calling. As we would not like to carry phone in all way and attending a call or listening to music so earphones makes it easy.

3. Feel comfort: Earphones are very much comfortable to use. We can use it for long hours without any discomfort. Nowadays, earphones are made according to the comfort of users to reduce the pain while plug in to your ears. While using earphones we may feel uneasiness because of the pain feeling in-ear. But earbuds used in earphones help us to reduce the pain and we are able to use earphones for longer hours.

4. Sound quality: The most important benefit of an earphone is its sound quality. Earphones produce best sound quality. The earphones are designed in the way that sounds are capture inside our ears. Thus feel can experience best sound effect. As we play music, we feel that sounds are made from inside our self. While using earphones we could experience best quality of sound , which make us to enjoy the music well. The quality of sounds produced by earphones may vary according to the company which they are produced.

5. Reduction of noise: Best way to free from external noises and disturbance it to plug in your earphone and listen to music. Earphone helps to reduce noise around us. As we plug in earphone we may not hear external noises. Not all earphones remove external noises completely. The removal of noise depends usually upon the production of earphones. Even though some earphones cannot remove noise, but it can reduce the noise for our better experience. Using of earphones benefits us with reduce of disturbance and noise around us. Even if we are recording anything it helps to avoid the background disturbances that are caused.

Disadvantages Of Using Earphones: Since earphones are easy to use, many people are addicted to it very much. Addiction of earphones cause many problems on people. It mostly cause health issues. As usage of earphones has benefits it also has many disadvantages too. High usage of earphones may lead to severe problems. Let us see some of the disadvantages of using earphones :

1. Ear pain: Usage of earphones cause many health issues. The main problem caused due to usage of earphones are pain in ears. We feel severe pain in ears after long use of earphones. We may also feel some kind of vibration or ache in certain part of the ear. Not only longer usage of earphones cause problems, listening music loudly also results in the pain. It is better to not use earphones for longer hours or play music loudly. As these kinds of activities continues it may lead to serious issues. It even infection can be caused and sometimes it can lead to hearing problem.

2. Forget about real world: Already the 21st generation are ruled by technologies. Now people got a way to escape from real world in to their own world. As usage of earphones increasing they forget to communicate with other people. People are not even aware of what is going around us while they plugged in an earphone. Many people even met with accidents by crossing roads or paths by plugging earphones deeply into their ears. Some noise removal earphones cause problem as people use it they may not hear anything other than sound from their earphone. Old days, people will communicate each other especially while travelling. Nowadays we could only see a new kind of species, like people who plug their ear buds and fly away into their own world.

3. Hearing loss: Earphones provides best sound quality. But the continues use of earphones lead to hearing loss, which may face problems later. Longer hours of use may result in temporary or permanent hearing loss, which may turn us into complete deaf. Playing loud music in earphone also result in hearing loss. It is safe that if we play music in average sound which does not become a problem for our ears. Continues use of earphones also result in hearing loss. It is better that to remove earphones for a while and not use it frequently. Avoid using earphones that can go directly into your ear because such earphones may cause damage for ear drum which gradually lead to hearing loss. The usage of earphones also increase ear wax. If these ear wax become increased it may cause hear loss.

4. Effect on brain: Earphones are an electric device that worn on ear to listen music or to make calls. Since earphones are an electric device, the high amount of usage f it causes many problems, including the brain. Brain is the important part of our body. Any cause of damage results in severe problems for our body. Earphones usually generate electromagnetic waves which risks brain very much. Loud music also cause damage to nerves which may result in giving nerve signals. The inner ear of the human body has a direct connection with the brain, so a cause age or infection cause to the inner ear also affects the functioning of the brain.

5. Ear infection: People are really addicted to earphones. There are some people who even can't live without earphones. Result of continuous use of earphones, lead to many ear infections. There may cause infection for ear or in any part of the ear, which may even make the user to become deaf. We may share earphones with others for listening to some kind music or other. This action is quite friendly but we may get infected from the germs of the other people. Sharing of earphones results in the transferring of germs from other people to us. Not only using others earphones or sharing earphones with others make us infected, from our own earphones we may get infections. It is important to clean earphones regularly. There will be many germs which get in to our ears while we using it. Sanitize earphones, this may keep us from getting infecte. As we see both

advantages and disadvantages of earphones, we get an idea that how efficiently we should use it. Earphones benefits us lot, as it provides us our own privacy. We can use earphones at anytime, anywhere as it can easily carried and can use it comfortably. But as every coin has two sides, usage of earphones too has its own merits and demerits. Demerits if earphones cause many severe problems such as mentioned above. So while using earphones we should care about not to get addicted to it and use it efficiently. Not only earphones cause addiction, addiction to evey technology cause problems.

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