

Chapter 10: Applications of Waves

Mini Investigation: Distinguishing between Music and Noise, page 449

A. Answers may vary. Sample answer:
The noise waves have varying amplitudes and do not repeat themselves, unlike the waves created by the instruments.

B. Answers may vary. Sample answer:
In everyday life, the difference between noise and music is subjective. In physics, more rigorous definitions are required.

C. Answers may vary. Sample answer:
The tuning fork produces a consistent up and down wave. The instruments produce repeating waves, but they include mini troughs and crests. In my opinion, the instruments produce a higher quality sound. The repeating waves overlap the mini troughs and crests producing a fuller sound by allowing for the sounds produced by the repeating waves and mini troughs and crests to be distinguishable.

Section 10.1: Human Hearing

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1. Answers may vary. Sample answer:

Part of the ear	Location	Description	Function
pinna	outer ear	round part of the outer ear with a lobe at the bottom	gathers sound and channels it into the auditory canal
auditory canal	outer ear	tube-like structure in the outer ear connecting eardrum and pinna	magnifies sound in the frequency of 1000 Hz to 5500 Hz
eardrum	middle ear	tightly stretched, cone-shaped membrane	vibrates with the incoming sound waves and transfers the vibrations to the inner ear
hammer	middle ear	first of the three smallest bones present on the other side of the eardrum	transmits the vibrations of the eardrum to the anvil
anvil	middle ear	second of the three smallest bones present on the other side of the eardrum	transmits the vibrations of the hammer to the stirrup
stirrup	middle ear	third of the three smallest bones present on the other side of the eardrum	transmits the vibrations of the anvil to the cochlea
Eustachian tube	inner ear	tube-like structure connected to the mouth	maintains equivalent air pressure inside and outside the ear
cochlea	inner ear	snail shaped organ	produces pressure waves when vibrations from middle ear pass through
hair cells	inner ear	microscopic structures attached to basilar membrane	convert the mechanical energy of the waves into electrical energy
auditory nerve	inner ear	nerve connecting the inner ear and the brain	transmits the electrical signals produced in the inner ear to the brain
semicircular canals	inner ear	three hard fluid-filled loops	act like accelerometers that maintain the balance of the body

2. Answers may vary. Sample answer:

(a) The sound waves produced from a source are diverted into the auditory canal by the pinna and then proceed toward the eardrum. The waves vibrate the eardrum, which in turn produces vibrations through the cochlea. These vibrations are converted into electrical waves that travel through the auditory nerve to the brain. The brain understands the electrical signals and interprets the sound.

(b) The diagram is too simple. It does not explain how the mechanical waves are converted into electrical waves, how the vibrations from the eardrum are transferred into the cochlea, and how the pressure waves come into the whole process.

3. Answers may vary. Sample answer:

The Eustachian tube will be blocked and the pressure equalization will not occur. As a result, pressure builds up inside the cavity, causing pain. To avoid this, people should come back to a place where there is normal pressure outside.

4. The air pressure decreases as the altitude increases. When people have sinus infections, their Eustachian tube gets blocked, so pressure equalization does not occur. Without pressure equalization, the change in pressure during takeoff and landing can be painful.

5. Answers may vary. Sample answer:

Hearing loss due to the destruction of hair cells could be cured if scientists were able to cause new hair cells to grow in the human ear.

6. Answers may vary. Sample answers:

(a) Hair cells are destroyed by exposure to loud noise so over time too much exposure to noise will cause hearing loss.

(b) To avoid hearing loss as they age, people who are regularly exposed to loud noises should wear ear protection like ear muffs or earplugs.

7. Answers may vary. Sample answer:

For humans, the optimal hearing occurs when the source of the sound is in front. However, the position of the source does not matter for animals that can rotate their pinnae. This helps them react to prey faster.

8. Answers may vary. Sample answers:

(a) Hearing loss or improper hearing may occur because the vibrations may not be properly transmitted to the cochlea due to perforations or scarring.

(b) Perforated eardrums weaken the ear's ability to hear properly and leave the usually protected middle and inner ear exposed to infection.

Perforated eardrums may heal on their own, but doctors can chemically stimulate tissue growth or use skin grafts to rebuild the eardrum.

9. Answers may vary. Students should research and explain the design, limitations, risks, and costs of cochlear implants or one of the different types of outer-ear hearing aids.