

# Pure Tone Hearing Screening in Schools

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## **Identification of Hearing Impaired Students in the Classroom:**

- Approximately 130 students out of 1,000 have a hearing loss that affects communication, learning, and psychosocial development.
- These students show signs of anger, frustration, straining to hear, say “huh” frequently, have poor attention and poor participation in class. They are cued often by watching other students for assignments given in class. They prefer individual activities like reading books as oppose to playing with other students
- Children with hearing loss usually have poor academic skills.
- Children have a harder time hearing when background noise is present
- A child with a unilateral hearing loss is ten times more likely to repeat a grade than a normal hearing child.

## **How to Identify Students with a Hearing Loss:**

- Step 1: Screening (Identification of children at risk for hearing loss)
- Step 2: Referral for more comprehensive audiological assessment

## **How Does Sound Travel to the Brain?**

- The ear takes sound and transfers it into signals that the brain can understand.
- The ear has three main parts: the outer, middle, and inner ear
- Outer ear
  - Includes the pinna and ear canal
  - The pinna catches and directs sound into the ear canal
  - The ear canal directs the sound to the tympanic membrane
- Middle Ear
  - Includes the tympanic membrane (ear drum) and
  - Three bones (ossicles)
    - Malleus (hammer)
    - Incus (anvil)
    - Stapes (stirrup)
- Inner Ear
  - Includes the cochlea and the auditory nerve
  - The cochlea is a fluid filled system shaped in a spiral that is lined with tiny hair cells
  - The ossicular chain of the middle ear starts a fluid wave that moves the hairs. This signal is transmitted to the brain and interpreted as sound

### **Three types of Hearing Loss:**

- Conductive Hearing Loss
  - Can usually be medically or surgically treated
  - Child may be able to hear his or her own voice at the normal level, but not able to hear other people
  - Possible causes
    - Impacted earwax
    - Perforated eardrum
    - Middle ear infection (otitis media)
- Sensorineural Hearing Loss
  - Usually permanent and not medically treated
  - Child may have difficulty hearing his or her own voice and other people talking
  - Possible causes
    - Meningitis
    - Prenatal rubella
    - Family history of hearing loss
    - Hearing loss with aging (presbycusis)
- Mixed Hearing Loss
  - Both conductive and sensorineural hearing loss

### **Frequency:**

- Frequency is a physical characteristic of sound
- Change in frequency is perceived as a change in pitch
- The normal hearing range is from 20Hz to 20,000 Hertz (Hz, cycle per second)
- Daily Listening frequency include 500, 1000, 2000, 4000 Hz, which are critical for understanding speech sounds
- Children with a hearing loss may hear some frequency sounds, therefore they may hear people speaking, but may be unable to understand what is said

### **Intensity:**

- Intensity is another physical characteristic of sound
- Change in intensity is perceived in change in loudness
- The range of human hearing is from 0 to 100+ decibels (dB)
- Hearing loss will limit a child's ability to hear soft, moderate, or loud sounds depending on the degree of loss

### **Audiogram:**

- An audiogram is a graphical presentation of hearing ability
- Frequencies are at the top of the graph (250, 500, 1000, 2000, 4000, and 8000 Hz)
- Intensity runs down the left side starting with 0 to over 100 decibels
- This graph can be understood by considering common sounds
  - A lawn mower is a low frequency noise (250Hz), but it has very high intensity (90dB)
  - A bird is high frequency noise (4000 Hz), but it has a very low intensity (about 20 dB)

### **Speech Banana:**

- On the audiogram, there is a speech “banana”. This curve represents the area in which all speech sounds occur based on their frequency and intensity levels.
- A normal hearing individual can hear all the speech sounds.
- An individual with a mild or moderate hearing loss may hear some of the speech sounds, but not others. Sound may be muffled and difficult to understand.
- An individual with a more severe loss may not be able to hear any speech sounds without hearing aids or other forms of amplification.

### **Audiometer:**

- An audiometer is an electronic instrument designed to measure hearing.
- Care for the Audiometer
  - Avoid banging the audiometer.
  - Store audiometer above freezing but below 90 degrees.
  - Do not leave in car during extreme weather conditions.
  - Make sure the electrical cord is stored free of tangles.

### **How to Select a Screening Room:**

- The screening room should not be too noisy otherwise a large number of children will fail the hearing screening
- It is never acceptable to raise the intensity of the tone to compensate for noisy environment.
- The location should be quiet and away from the main flow of traffic.
- Examples of possible locations
  - Vacant classrooms
  - Nurse’s office
  - Library/media center
  - Large storage closet with an electrical outlet

### **Preparing the Equipment for Screening:**

1. Plug audiometer into wall outlet
  - A 3 prong adapter may be needed
  - Make sure that the cord is not a tripping hazard.
2. Earphones should be cleaned using an alcohol-free wipe
  - Clean cushions after each child
  - Alcohol may dry rot ear cushions
  - Moisture should stay away from holes in the center of the earphones (diaphragm)
3. Turn power switch to 'On'
  - Some audiometers have left and right ear buttons marked
  - For others, the right output is red and the blue output is blue.
  - The tone button produces a tone when pushed
  - There are two dials; one is for frequency (Hz) and the other is intensity (dB)
4. Perform a visual and listening check
  - Inspect the head set and cord for any visible damage
  - Make sure the headset is correctly connected to audiometer
  - Put the headset on and test your own hearing at 1000 Hz at 20 dB in the right ear, then do the same for 2000 Hz, and 4000 Hz
  - Check left ear starting with 20 dB at 4000 Hz, then 2000 Hz, then 1000 Hz

### **When the audiometer needs to be repaired:**

- If the tone does not sound normal
- No sound is being produced when tone button is pressed
- If static is heard
- Earphones do not remain in position over the ears correctly
- A dial or switch is not functioning properly
- The indicator lights do not glow
- The cords are frayed
- The ear cushions are ripped

### **Equipment Maintenance:**

- The audiometer should be calibrated once a year by a professional testing facility
- The date of last calibration should be on the audiometer or on file with the school or health department

**Procedures for Getting the Child Ready for the Screening:**

1. Instruct the child that he or she will hear a beep, first in the right ear and then the left ear.
2. Instruct the student that they should raise their hand every time a sound is heard, even if very soft, and then lower their hand when the sound goes away.
3. Demonstrate to students by presenting a tone at 100dB with headset on table. Have the children raise their hand when the sound occurs.
4. Be sure to turn down intensity before placing earphones on the child, as 100dB tone can be painful to a child.
5. Place the red earphone on the right ear and the blue earphone on the left ear.
6. Remove glasses, big earrings, and large hair clips before placing the headset. Push hair behind ear if needed before placing the headset on the ears.
7. Adjust the band on the top of the headsets for a snug fit.
8. The diaphragm of the earphone should be placed directly over the ear canal.
9. Give the student frequent praise for listening carefully.
10. If the student does not seem to understand the directions, remove the headset and repeat the instructions.
11. If the student does not understand the directions after repetition, remove the headset and have the child go back to class.

**Procedures for Screening:**

Summary		
Right ear	1000 Hz	20 dB
	2000 Hz	20 dB
	4000 Hz	20 dB
Left ear	4000 Hz	20 dB
	2000 Hz	20 dB
	1000 Hz	20 dB

1. The child should be seated so he/she cannot see the examiner pressing the button
2. Always screen the right ear first
3. Place the intensity at 20 dB and frequency at 1000 Hz, present the tone for 2-3 seconds and then release
4. Turn frequency to 2000Hz, present the tone for 2-3 seconds and then release
5. Turn frequency to 4000Hz, present the tone for 2-3 seconds and then release
6. Change to left ear
7. Leave frequency at 4000Hz for the left ear. Present tone at 20dB for 2-3 seconds and then release
8. Turn frequency to 2000Hz, present the tone for 2-3 seconds and then release
9. Turn frequency to 1000Hz, present the tone for 2-3 seconds and then release

**The Results:**

- If a child misses any of the 6 tones presented, they have failed the screening
- If a child responds to all 6 tones, then they pass the screening
- If the screener has any questions about the results, a rescreening should be recommended
- Write Pass or Fail on screening form with child's name and date of screening with an additional information that may be needed

**Why Do Screenings?**

Screening is the first step in detecting hearing loss. If a child fails the screening, he/she should receive diagnostic testing to confirm or deny a hearing loss. This will help children with hearing loss receive services needed for success in school.