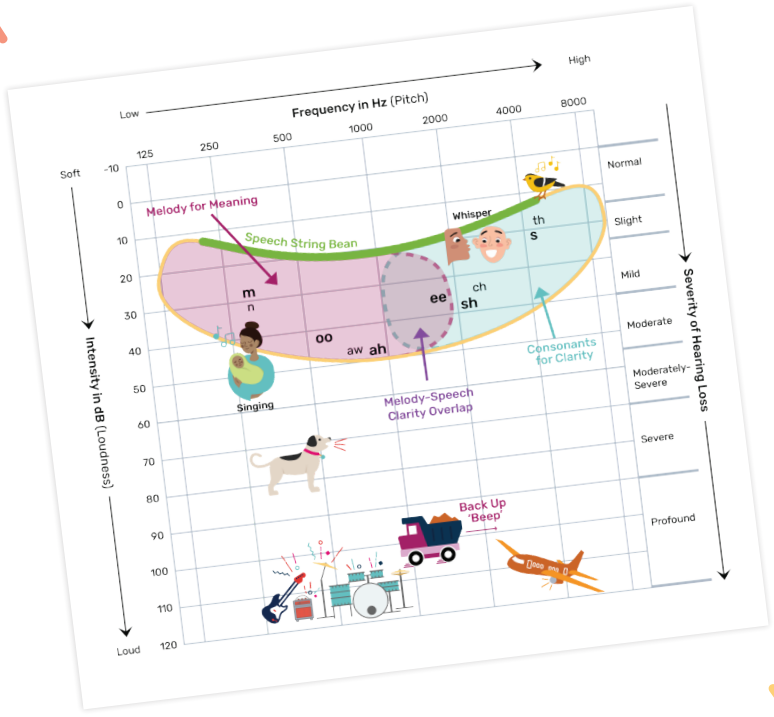
Familiar Sounds Audiogram

Understanding Your Child's Hearing



HEARING FIRST

FOREWORD

Every day children who are deaf or hard of hearing are learning to listen and talk! The first step in the Listening and Spoken Language (LSL) journey is a diagnosis from a pediatric audiologist. At this point, most families enter an unfamiliar world of terms, vocabulary, tools, and tests. One of the first things a family will encounter is an audiogram which provides information about their child's hearing loss. With the audiogram filled with numbers, lines, and shapes, families seek to understand "What can my child hear?" and "What does their hearing loss mean?"

To help answer these questions, Hearing First collaborated with Dr. Carol Flexer, Distinguished Professor Emeritus of Audiology, University of Akron, to create an updated Familiar Sounds Audiogram and this accompanying eBook. These evidence-based tools will help families better understand what their child can hear with and without hearing technology. We have designed it to be used in partnership between parents and professionals to discuss and explain a child's hearing status.

This new audiogram relies on the most recent research to accurately show the speech spectrum and all aspects of speech necessary for developing listening and spoken language. Parents and professionals will chart a child's hearing loss on the audiogram. The concepts 'speech banana,' 'melody for meaning,' and 'consonants for clarity' provide an opportunity to discuss goals for setting hearing technology to ensure the child has full access to all aspects of spoken language.

Families are their child's first and most important teachers. When parents understand their child's hearing loss and the role of hearing technology, they can make the most out of every moment they have with their child, like talking, reading, singing, and playing. When parents and professionals work together, parents have the tools they need on the LSL journey so their child can reach their full potential.

Kindest Regards,

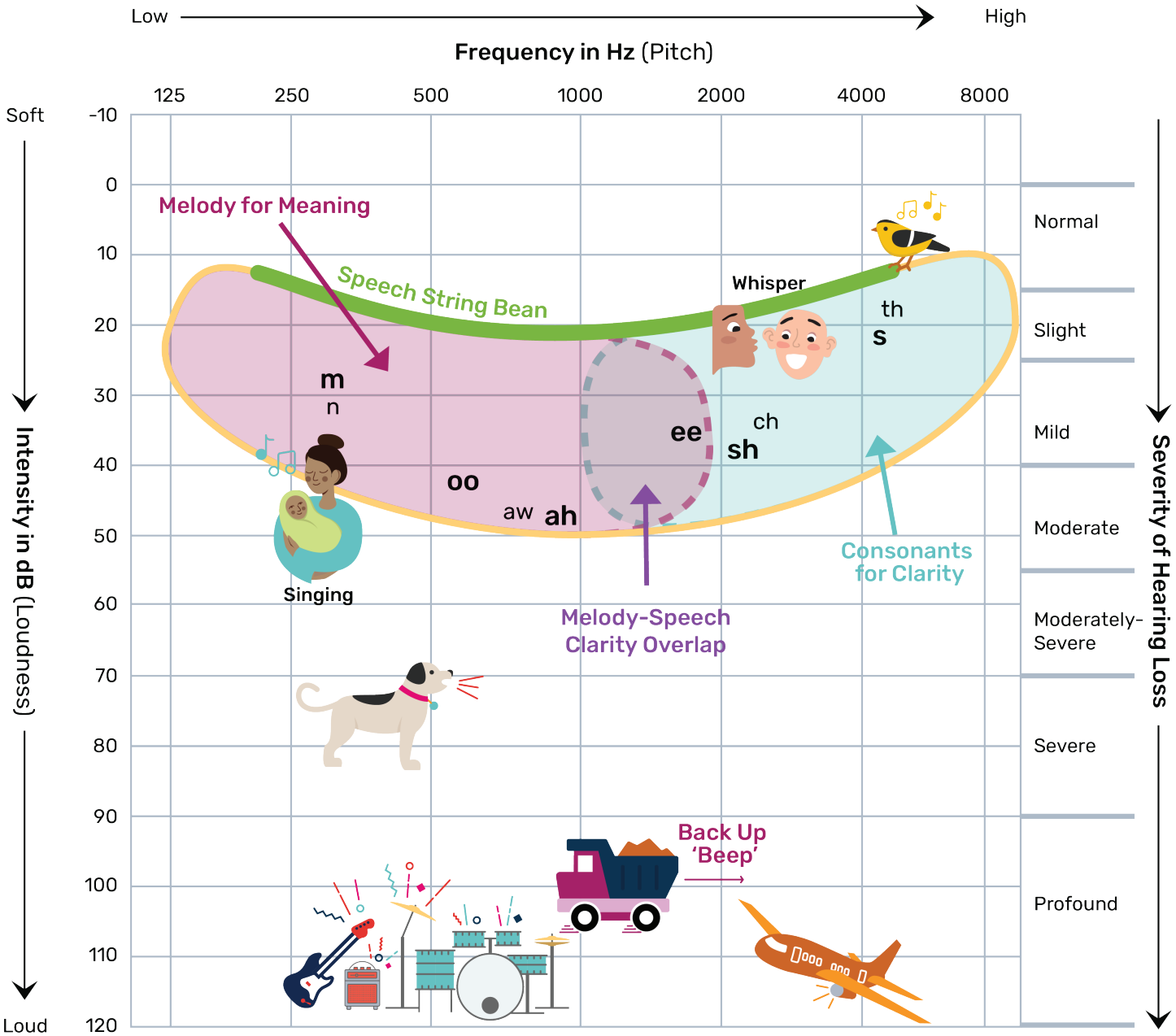
Teresa H. Caraway, PhD, CCC-SLP, LSLS Cert. AVT
CEO
Hearing First

Child's Name: _____

Date of Birth: _____

Date of Hearing Evaluation: _____

Familiar Sounds Audiogram



HEARING IS ABOUT THE BRAIN

We tend to think we hear with our ears, but actually we hear with our brain.

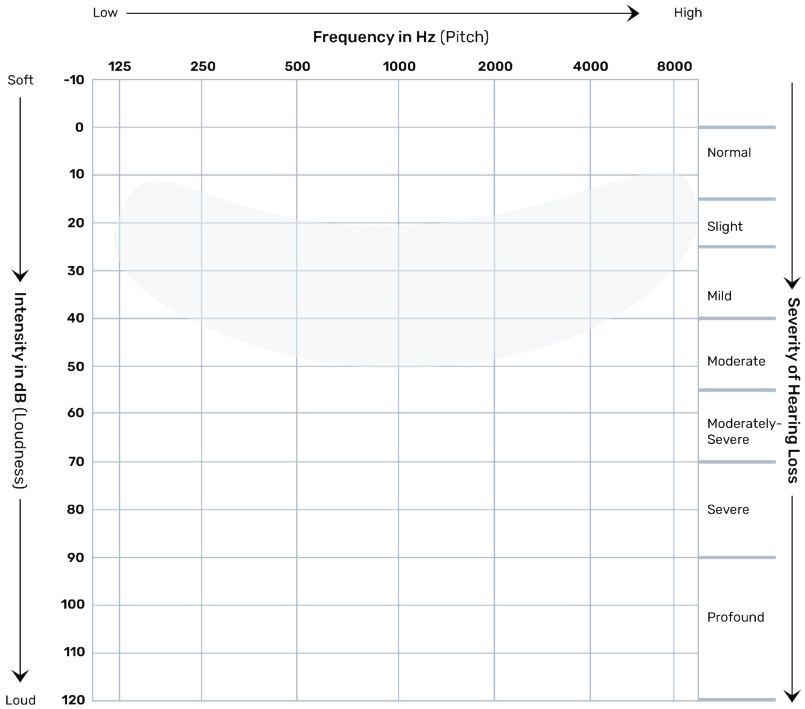
Our ears act like a doorway to help get sound or auditory information to our brain. Think of your child's hearing loss as a "doorway" problem. The doorway can be blocked a little bit or a lot, depending on your child's specific hearing loss. This means that auditory information, such as your conversations, lullabies, reading aloud, and more, isn't reaching your child's brain clearly.

Modern hearing technologies such as digital hearing aids, cochlear implants, and other assistive listening devices are designed to break through the blocked doorway. They deliver clearer auditory information to your child's brain so they can learn to understand the full meaning of sounds, words, and all the language they experience with you. Remember, sound carries information and information becomes knowledge!

WHAT IS AN AUDIOGRAM?

The audiogram is a simple graph that charts the softest sounds, called **thresholds**, that your child is able to hear.

Frequencies (pitches) from 250 Hz through 8,000 Hz are usually included in the hearing test and are shown along the top of the audiogram. Intensity (loudness) in decibels (dB HL) is displayed along the left side and ranges from -10 (very soft) to 120 dB (very loud). Your pediatric audiologist will test your child's hearing in a sound-isolated booth by presenting pure tones to each ear separately through an insert earphone.



The softest sound your child is able to hear is referred to as threshold, and will be determined for each frequency, and this is what is indicated on the audiogram. For example, if the softest sound your child heard when a 500 Hz pure tone was presented was at a loudness of 60 dB, this would be indicated as their threshold on the audiogram. A threshold of 60 dB indicates the child can hear sounds that are 60 dB or louder but cannot hear sounds at this frequency if they are softer than 60 dB. The audiogram helps the audiologist determine if a hearing loss is present. If a hearing loss is present, the audiogram indicates the type and severity.

These particular frequencies are used because together they include all speech sounds. Think about how individual threads weave together to make a fabric. Just as we're not aware of each individual thread in a shirt, we don't notice the individual sounds contained in someone's speech. However, each tone makes its own unique and important contribution to speech detection and clarity.

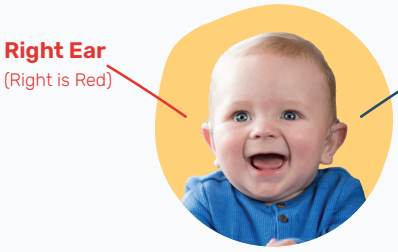
The audiogram shows three things about your child's hearing loss that was learned from the complete audiological evaluation:

1. The **type of hearing loss**, whether it is conductive, sensorineural, or mixed.
2. The **severity of hearing loss**, whether it ranges from minimal to profound.
3. The **pattern of hearing loss**, or how much hearing loss exists at different frequencies. This pattern would be specific to each child.

An audiogram is only one part of a thorough hearing test. Other parts include speech perception testing, evaluation of middle ear function (looking for an ear infection), and obtaining a detailed case history. You'll receive a new audiogram each time your child is tested.

How to Read Your Child's Audiogram

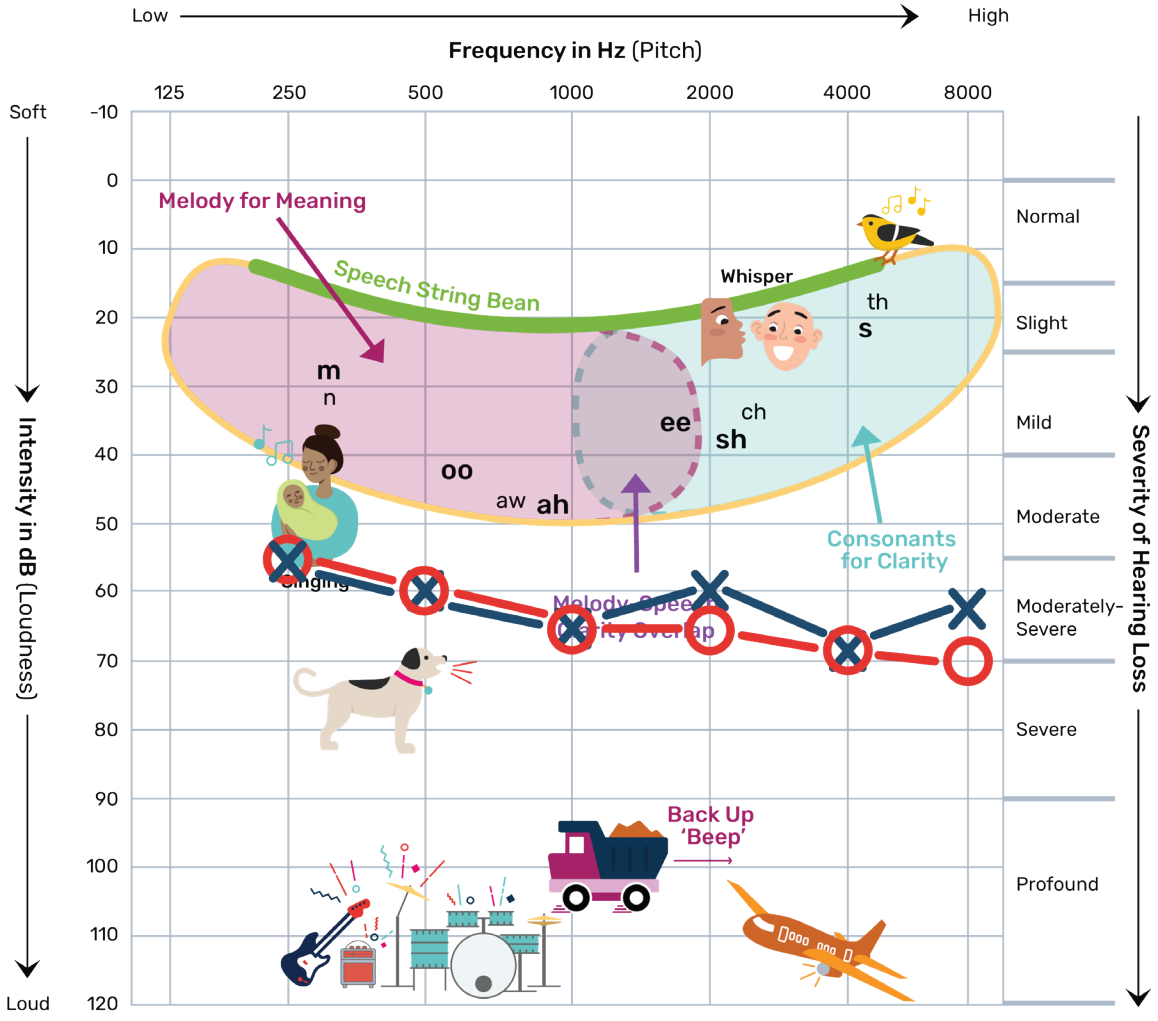
The symbols indicate if the sounds were delivered by air conduction (via insert earphones) or by bone conduction (via a small stimulator placed behind your child's ear) and whether the child was tested with or without hearing technology.



O	The softest sound your child can hear WITHOUT hearing technology using insert earphones	X
<	The softest sound your child can hear with bone conduction testing	>
↙	An arrow pointing down indicates no response at that frequency (pitch) and intensity (loudness)	↘
A or C	The softest sound your child can hear WITH their hearing aids (A) or cochlear implants (C)	A or C

The audiogram will show your child's hearing thresholds in each frequency for each ear.

Below is an example of an audiogram showing a moderately-severe hearing loss in both ears. Notice where the lines connect the symbols for the right ear and the left ear on the audiogram.

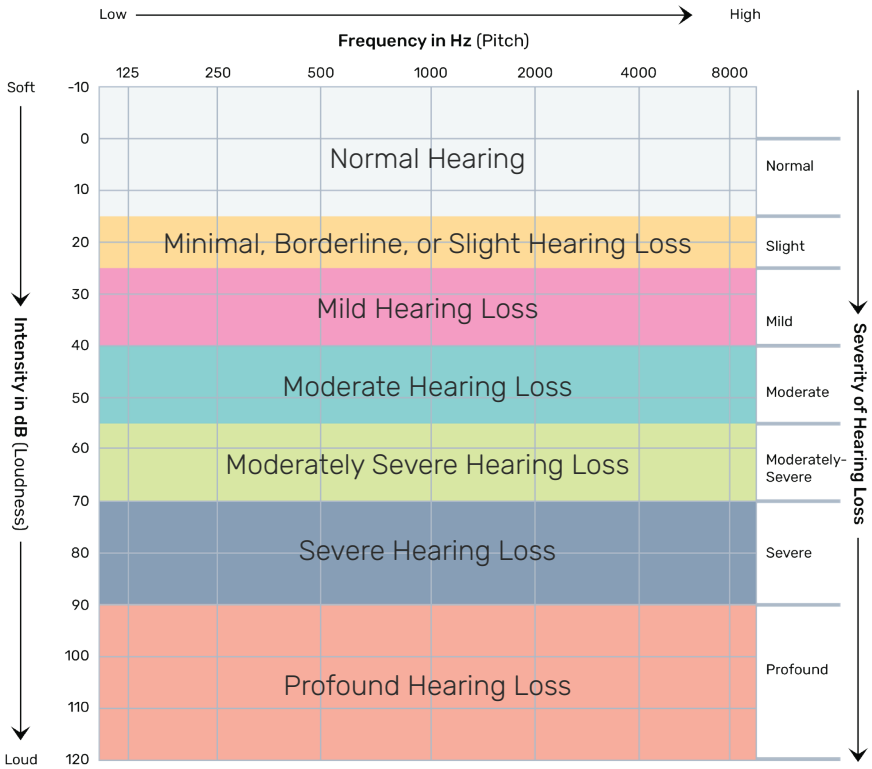


SEVERITY (OR DEGREE) OF HEARING LOSS

The severity of hearing loss tells how much sound is blocked from reaching your child's brain. The image below shows severity ranges by decibels (dB). The higher in dB the threshold, the louder sounds need to be in order to be heard and the more severe the hearing loss. The severity of the hearing loss determines the type of hearing technology that is needed to make it possible for speech sounds to break through the doorway to reach and develop the child's auditory brain.

Impact of Severity

The amount of speech and conversational information a child will miss depends on the severity of the hearing loss. Thresholds that fall outside the range of normal place the child at risk for spoken language delays, reading problems, and academic difficulties. This information is summarized below for a variety of hearing thresholds:



Normal Hearing Thresholds (0 dB – 15 dB HL)

The audiogram for a child with normal hearing means their softest sounds (thresholds) fall between 0 dB and 15 dB at all frequencies in both ears. Children with normal hearing typically hear all of the speech sounds needed to develop spoken language.

Minimal, Borderline, or Slight Hearing Loss (15 dB – 25 dB HL)

A child with a slight hearing loss of 25 dB may experience problems with understanding speech and language. For example, they may have difficulty understanding soft speech or speech from a distance. They also may not follow discussions or keep up with the fast pace of social conversations. Consonant sounds (such as s, th, and d) that are associated with plurals (cat versus cats), possessives (Daddy's car), or regular past tense verbs (cry versus cried), can be hard to detect with this degree of hearing loss without appropriately fit hearing technology.

Mild Hearing Loss (25 dB – 40 dB HL)

A child who experiences a 30 dB hearing loss can miss 25% to 40% of the speech around them without appropriately fit hearing technology. This is because soft speech, word endings, and unstressed words (the, and, a) will not reach their brain. Different factors, like environmental noise level, distance from the talker, and the pattern of the hearing loss, will also determine how much they can hear.

Moderate Hearing Loss (40 dB – 55 dB HL)

A child with a 40 to 50 dB hearing loss without appropriately fit hearing technology may miss 50% to 80% of speech information in a typical conversation. A child with this hearing loss may understand face-to-face conversations from 3 to 5 feet away, if they are in a quiet room and the vocabulary is familiar. This means that sometimes parents greatly overestimate how much their child can hear.

Moderately-Severe Hearing Loss (55 dB – 70 dB HL)

A child with a 55 to 70 dB hearing loss without appropriately fit hearing technology may miss 100% of the conversations around them. Spoken communication must be very close and loud to be understood. Social interactions can be very difficult and frustrating.

Severe Hearing Loss (70 dB – 90 dB HL)

A child with a 70 to 80 dB hearing loss will experience significant difficulty developing spoken language without early use of appropriate hearing technology and participation in therapy focused on using their hearing to develop language. Appropriate hearing technology (typically cochlear implants) makes it possible for the child's brain to receive all speech sounds since their auditory brain can't receive any conversational speech without such technology.

Profound Hearing Loss (90 dB – 120 dB HL)

The brain of a child with a 90 to 120 dB profound hearing loss cannot receive any speech or environmental sounds without hearing technology (typically cochlear implants). Today, the degree of hearing loss doesn't determine the child's spoken language outcomes when there is early use of hearing technology, like cochlear implants, coupled with family-focused LSL intervention.

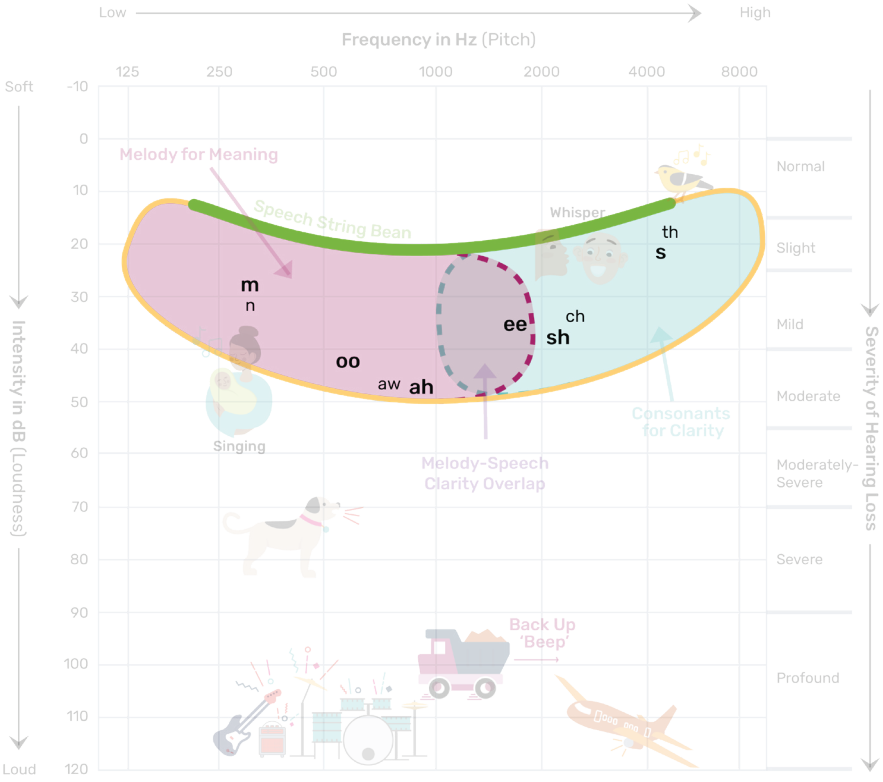
The severity of your child's hearing loss may also be described as:

- **Stable** – Hearing loss is about the same over time; it does not seem to be getting worse.
- **Progressive** – Hearing loss becomes worse over time.
- **Fluctuating** – Hearing loss varies over time.

WHAT YOUR CHILD'S AUDIOGRAM MEANS FOR LSL

Your child's brain needs to hear all speech sounds clearly in order to develop speech and language.

The speech banana is the shaded area on the audiogram showing where speech sounds occur in a typical conversation. Speech information spreads throughout the speech banana and specific speech sounds occur at different frequencies and intensities.



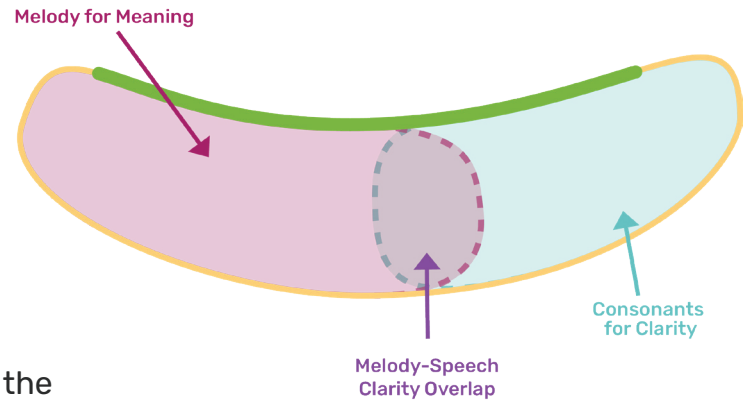
Speech Sounds

Only a sample of the many possible speech sounds are shown on the Familiar Sounds Audiogram to give a general understanding of the frequency and intensity of vowels and consonants. Specific speech sounds are placed in the area of the audiogram identified with their primary energy, but each speech sound is made up of multiple frequencies.

Vowels, such as oo and ah, show up mostly in the lower frequencies of the speech banana. Note that the nasal sounds of m and n are also in the low frequency zone. These low frequency sounds provide about 90% of the energy of speech, but only 10% of the clarity.

On the other hand, consonants, such as sh, ch, s, and th, show up mostly in the higher frequencies of the speech banana. Consonants tend to be very weak, faint sounds, but they deliver 90% of the clarity of speech.

Melody for Meaning



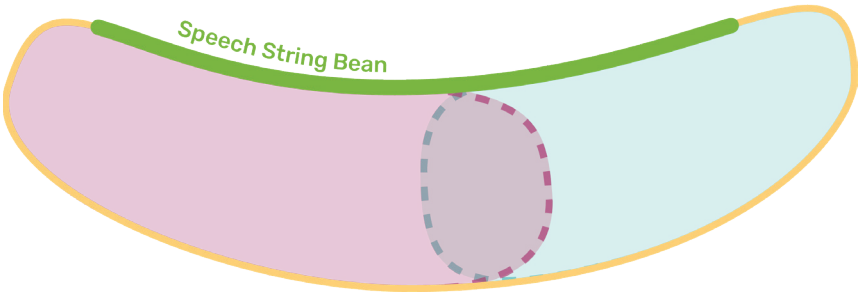
In addition to analyzing individual speech sounds, your child's brain also analyzes the meaning of conversational speech by its melody, which refers to the rise and fall in pitch that occurs over time. Every language has its own melody. The pink area on the left side of the speech banana, labeled "Melody for Meaning," displays the low frequency area that contains critical vowel sounds and the important features of duration (which helps your child understand long versus short words, such as 'mmmmmm' vs. 'hop'), intensity (which helps your child recognize the emotion of a speaker, such as loud and angry vs. soft and soothing), and pitch (which helps identify different types of voices).

Consonants for Clarity

The light blue area on the right side of the speech banana, labeled "Consonants for Clarity," displays the high frequency zone that contains critical consonant sounds. Consonants help to make important distinctions between words (cut vs. cup) or can be added to a word to change its meaning (cat vs. cats, walk vs. walked). Your child's brain needs to have auditory access to all of the consonants of speech in order for it to be clear and to understand the message. It's not enough for them to only hear 'cu-' because they would not be able to know if the speaker said "cut" or "cup."

Melody-Speech Clarity Overlap

All low and high frequency elements of the speech signal, including melody and clarity, need to be made available to your child's brain and need to blend together seamlessly. The "Melody-Speech Clarity Overlap" bubble in the center of the speech banana displays how melody and speech sounds support each other. Both need to be present to understand the meaning of the message.



Learn more about the Speech String Bean in this video.

The Speech String Bean

The goal of hearing technology is to make sure your child's hearing aids or cochlear implants are programmed so their aided thresholds fall near the top of the speech banana on the audiogram. Cochlear implants should be programmed so thresholds fall about 20-25 dB HL across frequencies, meaning that all speech sounds, including soft speech, are available to your child's brain. The target area on the audiogram for the child's aided responses for each ear is known as the "**Speech String Bean**" (also called the Speech Green Bean), a term from Dr. Jane Madell, PhD, CCC-A/SLP, LSLS Cert AVT, a prominent pediatric audiologist.

Singing and Music

Music is a critical part of helping your child with hearing loss learn to listen and talk. By music, we mean **singing with your child** – having a musical conversation. The frequencies of music are well within the hearing range of most children who have hearing loss. Music is low frequency dominant. Middle C on the piano is at approximately 262 Hz and the highest note on the piano is at 4,186 Hz. Pitch, intensity, and rhythmic cues are boosted in the singing voice. Sing, sing, sing with your child!

Singing with your child represents the perfect blend of melody and speech. The rhythm of the song emphasizes the low frequencies of loudness, pitch, and especially duration, and the lyrics emphasize specific speech sounds. Your child's brain loves to put all of these things together!

HOW TO CHECK YOUR CHILD'S HEARING AT HOME

Ling 6-Sound Test

You can check your child's hearing at home with the Ling 6-sound test. This test was developed by Dr. Daniel Ling, a key leader of the LSL approach we know today. This test is a quick and easy way to be sure your child is able to hear the vowel and consonant sounds of spoken language. The speech sounds used for this test (shown in bold on the familiar sounds audiogram) were selected because they each cover a unique area of the speech range on the audiogram as noted below:

/m/ corresponds to a band of sound around 250 Hz

/oo/ is like a narrow band of noise corresponding to 500 Hz

/ah/ is like a narrow band of noise corresponding to 1,000 Hz

/ee/ has bands of energy around 500 Hz, and also at 2,000 Hz

/sh/ is a band of noise corresponding to 2,000 Hz and higher

/s/ is a band of noise corresponding to 4,000 Hz and higher

Learn more about how to do this test here.

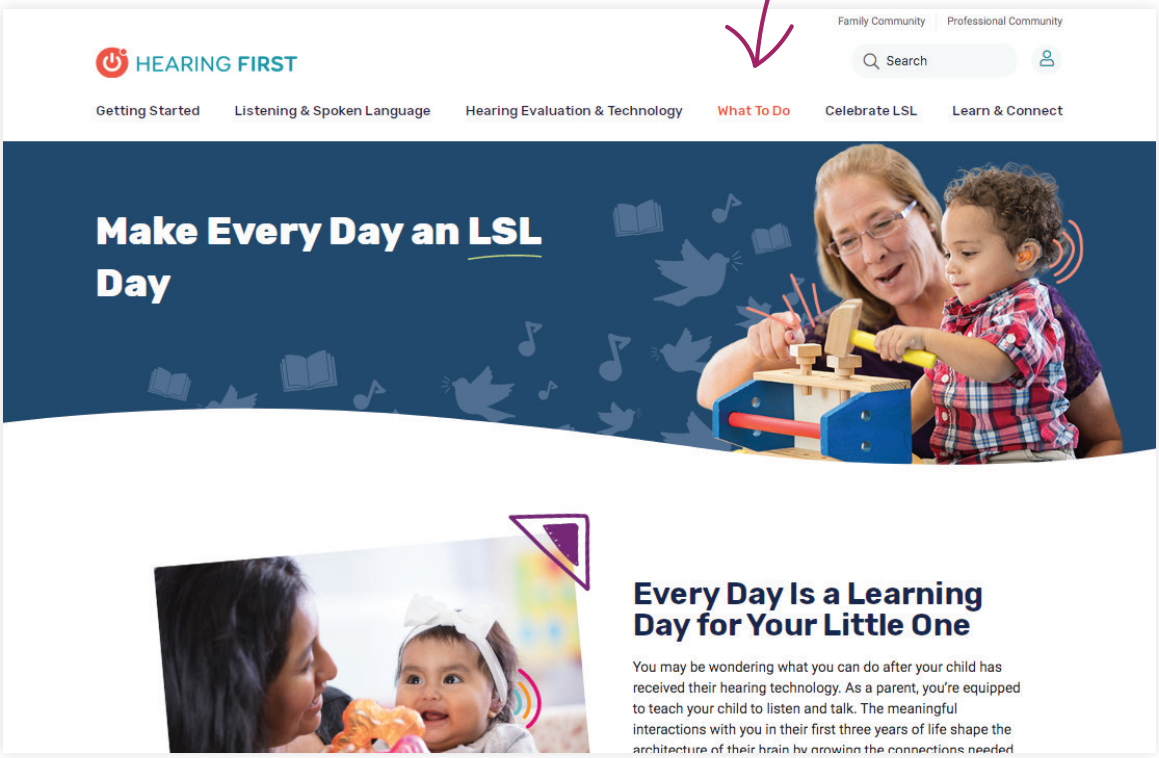
Make sure to keep notes on your child's responses to these sounds. If your child does not respond to one or more of these sounds consistently, contact your audiologist immediately! It could indicate a problem with their hearing or hearing devices.

Key Takeaway

Why is it so important for your child's brain to have full access to speech and language?

Your child's brain develops by interacting with you, your family, and other caregivers. When you talk, read, and sing with your child during play and daily routines, their brain seeks important patterns of melody, flow, and energy that help them develop spoken language. Their brain also needs to have full access to all of the consonants of speech so they can hear conversations clearly. When your child wears their hearing technology at least 10 hours a day, they can receive all of this important information from you.

Learn more at HearingFirst.org/what-to-do.



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Acknowledgement

Hearing First gratefully acknowledges Dr. Carol Flexer and her work on this eBook. We recognize how important it is for families to have an updated, accurate Familiar Sounds Audiogram to help them understand their child's hearing loss.

We appreciate the opportunity to collaborate with our colleague and friend, Dr. Flexer, in developing this resource that explains an audiogram in detail and empowers families to confidently know what their child can hear with and without hearing technology. With the Familiar Sounds Audiogram explained and discussed in this eBook, we can foster a greater understanding of hearing loss and the Listening and Spoken Language (LSL) journey for professionals, families of children who are deaf or hard of hearing, and the general public.

Carol Flexer, Ph.D., CCC/A, LSLS Cert. AVT

Dr. Carol Flexer is a Distinguished Professor Emeritus of Audiology at the University of Akron. Her career has been dedicated to advocating for better listening, learning, and literacy for children with hearing loss. An international lecturer and consultant in pediatric and educational audiology and author of more than 155 publications including 17 books, Dr. Flexer is a past president of the Educational Audiology Association, the American Academy of Audiology, and the AG Bell Academy for Listening and Spoken Language. For her research and advocacy for children with hearing loss, Dr. Flexer has received four prestigious awards: two from The AG Bell Association for the Deaf and Hard of Hearing, the Volta Award and Professional of the Year Award; one from the American Academy of Audiology, the 2012 Distinguished Achievement Award; and one from Kent State University, The EHHS Hall of Fame Distinguished Alumni Award, 2015. Dr. Flexer is a Certified Auditory-Verbal Therapist (LSLS Cert. AVT) and a licensed audiologist.

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