

Come along to a hearing visit

Follow one fictional listener from a question to a carefully explained graph.

Imagine trying to follow a conversation while the person beside you seems to hear every word. That is the concern that brings ECHO to a hearing clinic. ECHO is a made-up adult, and every measurement in this guide is invented teaching data.

The hearing specialist, called an audiologist, does not begin by guessing a cause. First, the specialist listens to ECHO's story. Then the specialist gathers measurements that can help explain it. You will follow those steps and learn how the measurements become a graph.

Before we enter the clinic, we need to understand the sound being measured. We will start with moving air, then learn why a decibel number needs a label. After that, we will build one point on ECHO's hearing graph before looking at the whole picture.

The route through this walkthrough

First	Then	Finally
Watch a sound wave. Compare modeled levels and explore how sound is measured.	Follow a clinic visit. Learn the two sound routes and why the other ear sometimes needs masking noise.	Find a repeatable result, build the graph, compare the routes and explain the limits.

An audiogram is a graph of the lowest test levels a person reliably detects at different sound frequencies. A frequency describes how quickly a sound vibrates. A threshold is the lowest level that meets the test's repeat-response rule. We will unpack both ideas before using them.

Work through the pictures with the words. The companion model uses fictional responses, so you can practice without testing your own hearing. This reference adds no submission.

Start with moving air

A taller wave and a more tightly spaced wave show different changes.

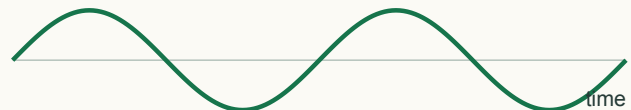
Picture a speaker playing a steady tone. The speaker moves nearby air back and forth. That motion creates small changes in pressure that travel outward. Nearby air particles move back and forth; they do not travel from the speaker all the way into your ear.

A Starting wave



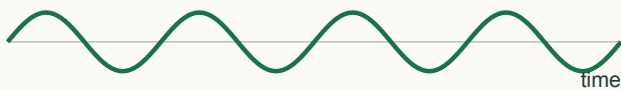
2 cycles in this time window

B Greater amplitude



Taller swings; same cycle spacing

C Higher frequency



More cycles; same swing height

Read the drawing

A to B: change the swing size.

A to C: change the cycle count.

Start with picture A. One full up-and-down pattern is a cycle. Now compare C with A. C fits more cycles into the same time. Its frequency is higher, which usually makes the sound seem higher in pitch. Hertz, written Hz, means cycles per second. A 1000 Hz tone has 1000 cycles each second. [S1]

Next, compare B with A. The spacing stays the same, but B has taller pressure swings. The size of those swings is called amplitude. Increasing amplitude changes sound level without requiring a change in frequency. Think of playing the same piano note more strongly, rather than switching to a higher note.

Carry this distinction forward: frequency helps describe pitch; pressure amplitude helps describe sound level. A high-pitched sound can be faint. A low-pitched sound can be strong.

Why use decibels?

A small change in the written number can represent a large physical change.

Now the scientist needs a way to describe sound levels. The range of sound pressures we encounter is enormous. Writing all of those pressures as ordinary numbers becomes awkward. The decibel, abbreviated dB, gives us a more manageable comparison scale.

A comparison needs a starting point. Suppose our model starts at 40 dB SPL and changes to 50 dB SPL. The letters SPL mean sound pressure level. They tell us which reference is being used. The difference is 50 minus 40, or 10 dB.

Here is the surprising part: a 10 dB increase means ten times the sound intensity under comparable conditions. Intensity describes how much sound power passes through a given area. Another 10 dB increase multiplies that intensity by ten again. Two increases of 10 dB therefore make a hundredfold change. [S1, S8]

The table also compares effective pressure: a single useful size for the changing pressure wave. The optional math page explains how scientists obtain that size.

Change from the starting level	Intensity compared with the start	Effective pressure compared with the start
0 dB	The same: 1 times	The same: 1 times
+3 dB	About 2 times	About 1.41 times
+6 dB	About 4 times	About 2 times
+10 dB	10 times	About 3.16 times
+20 dB	100 times	10 times
-10 dB	One tenth	About 0.316 times

This multiplication pattern is why the scale is called logarithmic. Equal steps in dB stand for equal multiplication factors. You can use the table before learning the formulas on the next page.

A 10 dB increase is often heard as roughly twice as loud, but the impression varies with the sound and the listener. Ten times the intensity does not mean ten times the perceived loudness. [S1, S8]

Optional math, explained slowly

Use this page to understand the calculations behind the model.

You already know the main pattern: an increase of 10 dB means ten times the intensity. The formulas let you work with changes between those familiar steps. You can continue the walkthrough without memorizing them.

First calculate the change

Subtract the starting level from the new level. For 50 dB SPL compared with 40 dB SPL, the change is $50 - 40 = +10$ dB. The plus sign tells us that the new level is higher.

Then calculate the intensity ratio

Intensity ratio = $10^{(\text{change in dB} / 10)}$. A ratio tells us how many times as large one quantity is as another. The ^ symbol means raised to a power. Put +10 into the formula: $10^{(10 / 10)} = 10^1 = 10$ times.

Pressure uses a different formula

A sound wave keeps changing, so scientists use an effective pressure called root mean square pressure, or RMS pressure. It combines the changing values into one useful size. It differs from the wave's largest single pressure, called its peak. [S8]

RMS pressure ratio = $10^{(\text{change in dB} / 20)}$. For +10 dB, this gives $10^{(10 / 20)}$, or about 3.16 times. For the same medium and comparable conditions, intensity grows with pressure squared. That is why the two formulas use different divisors. [S8]

Where does zero come from?

For dB SPL in air, the reference pressure is 20 micropascals, or 0.000020 pascal. A pascal is a pressure unit. At 0 dB SPL, effective pressure equals that reference. Zero therefore means equal to the reference, not silence. A value below the reference can be negative.

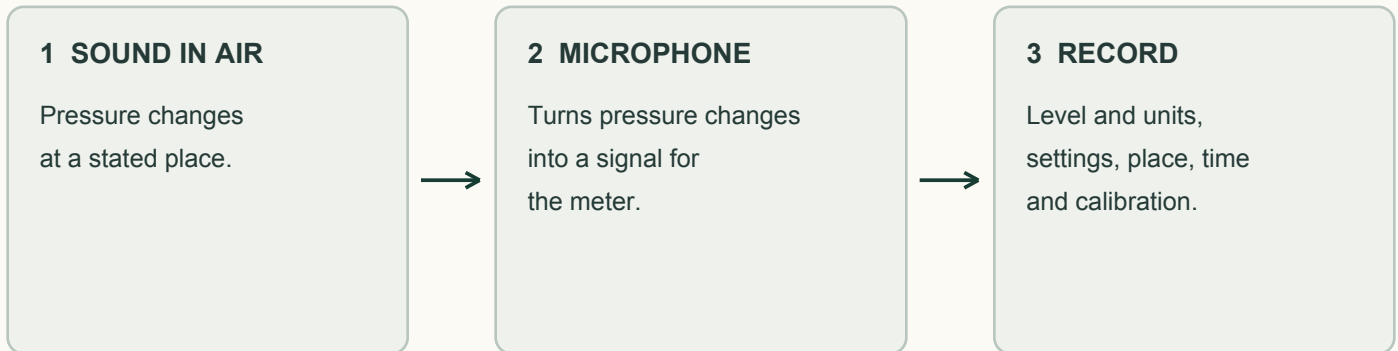
The full pressure formula is $L_p = 20 \log_{10}(p_{\text{RMS}} / p_{\text{REF}})$. L_p means sound pressure level; p_{RMS} means effective measured pressure; p_{REF} means reference pressure. The function $\log_{10}$ gives the power of ten needed to make the pressure ratio. At 40 dB SPL, p_{RMS} is 0.002 pascal, 100 times the reference. [S8]

Notice the two questions: How strong is the sound compared with a reference? How much did it change from our starting sound? Name the comparison before choosing a formula.

How does a meter measure sound?

Follow the sound from the air to the instrument to the written record.

The scientist now wants a real measurement at a chosen place. A sound-level meter uses a microphone to detect pressure changes. It processes the signal and displays a level. The number only becomes useful when we also know how and where it was measured. [S2]



Before the reading

First, state the question. Are you comparing two locations, following a changing sound, or studying exposure across a workday? A meter measures at a location. A worn device called a noise dosimeter adds up exposure over time. An audiometer, which we will meet in the clinic, presents controlled hearing-test sounds. [S2, S3]

Next, check the instrument against a known signal using the maker's procedure. This is part of calibration: checking or adjusting equipment against a known standard. An acoustic calibrator can supply a known sound for that check. A clear display by itself does not prove that the number is accurate. [S2]

Then record the location, microphone position, nearby surfaces and background sound. A reflected sound or a different distance can change the reading. Keep your hand away from the microphone while measuring.

The measurement is more than a number. Write the level, its units, the place, the instrument settings and the time being described. The next page explains why those settings matter.

Read the letters after dB

The same abbreviation begins four labels that answer different questions.

Suppose someone reports a sound as just 40 dB. Before comparing it with another result, ask: 40 dB on which scale? The extra letters tell us what the instrument is comparing or how it processes the sound.

Label	Read it as	What it tells us
dB SPL	Decibels of sound pressure level	Effective pressure compared with 20 micropascals in air.
dBA	A-weighted decibels	Sound level after a standard filter changes how different frequencies contribute.
dB HL	Decibels of hearing level	A hearing-test level compared with the reference for that frequency and test device.
dBFS	Decibels relative to full scale	A digital signal compared with the system's largest representable signal level, its full-scale ceiling.

For a changing room sound, the scientist also names the time being summarized. LAeq,T is an A-weighted level representing the average sound energy over a stated interval, T. A brief maximum or peak tells a different part of the story. A single moment cannot describe a whole day's exposure. [S2]

Now we can move from the room to ECHO's hearing. The clinic's graph uses dB HL. At 0 dB HL, the test level matches an audiometric reference for that frequency and device. It is not an absence of sound. At 40 dB HL, the test level is 40 dB above that reference. [S3, S4]

The device delivering the sound is called a transducer. Earphones and bone vibrators are examples. Their reference levels vary with frequency and device. You cannot add one fixed number to every dB HL value and turn an entire hearing graph into dB SPL.

A computer volume percentage or a digital dBFS value cannot tell you the actual dB SPL reaching an ear. Headphones, fit and playback equipment affect the result.

Try the model, then explore sound

You can investigate changes without turning the activity into a personal hearing test.

Open the companion [Decibel and Audiogram Simulation](#). It is silent. The changing wave and numbers show a mathematical sound comparison, so everyone can investigate the same example without needing to detect a tone.

Start at modeled 40 dB SPL. Change it to 50 dB SPL. Before reading the results, predict whether intensity will be ten times or twice the starting value. The model reports ten times the intensity and about 3.16 times the pressure. Next try 60 dB SPL. The +20 dB change gives 100 times the starting intensity.

Now change frequency while holding level steady. Look at how many cycles fit into the window. The spacing changes, but a higher frequency does not automatically mean a higher sound level. Explain this using amplitude and frequency.

A linked activity that can demonstrate sound

Open [PhET Sound Waves from the University of Colorado](#). Use the Intro screen. Begin with visual exploration. Keep frequency steady and change amplitude, then keep amplitude steady and change frequency. Watch what changes each time. If your teacher uses audio, begin with the device volume low and use a comfortable level. [S11]

The picture can demonstrate a sound wave, and the device can play sound. However, an on-screen setting cannot guarantee a particular dB SPL at your ear. To measure actual sound pressure, you need suitable calibrated equipment and a stated method.

What about an online hearing check?

[WHO explains its hearWHO screening app here](#). It asks a listener to identify spoken numbers against background noise. WHO describes it for ages 12 and older. It is a screening tool, not a formal hearing test or the pure-tone audiogram we are about to build. [S12]

For this lesson, use the fictional case. No personal score, app installation or health result is required. A personal concern belongs with a qualified health professional.

Meet ECHO at the clinic

Good instructions and suitable equipment come before a meaningful graph.

ECHO tells the audiologist that following speech has become difficult. The specialist asks when it started, where it happens, whether one ear seems different and what else ECHO has noticed. These questions guide the examination. They do not yet establish a cause.

The specialist looks into the outer ear and ear canal with a lighted instrument. This examination is called otoscopy. It can reveal conditions that affect testing. A sudden hearing change or other concerning symptom needs appropriate professional attention. [S9]

Next comes pure-tone testing. A pure tone is a simple tone with one frequency. The clinician uses a calibrated audiometer, correctly fitted test devices and a quiet test space. ECHO learns to respond whenever a tone is heard, even when it is very faint.

Before recording results, the clinician checks that ECHO understands the task. If room noise hides a faint tone, an earphone sits incorrectly, or the instructions are unclear, the apparent hearing result may change. Repeating measurements helps reveal inconsistent responses. [S9]

What the clinician is trying to find

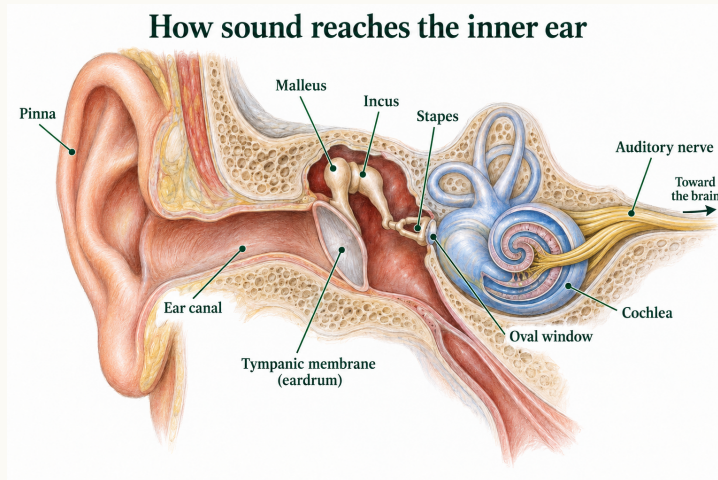
At each tested frequency, the specialist wants the lowest hearing level ECHO can detect reliably. That level is the hearing threshold. Think of it as a boundary supported by repeated responses, rather than a single lucky answer.

The clinic also needs to know how sound reaches the inner ear. The next page compares two routes. They give us a way to ask whether the outer and middle ear are affecting the result.

We are following a professional investigation using made-up data. Classroom headphones and a volume slider cannot replace the controlled equipment and conditions used in this visit.

Two routes to the inner ear

Learn the full names before using the short labels AC and BC.



Air conduction (AC)

Outer ear -> middle ear
-> inner ear -> nerve/brain

Bone conduction (BC)

Skull vibration -> inner ear
-> nerve/brain

First follow the usual route. Sound travels through the ear canal and moves the eardrum and the tiny middle-ear bones, called ossicles. Their motion helps transfer energy to the inner ear. The cochlea is the curled, fluid-filled inner-ear organ involved in hearing. From there, signals travel through the auditory nerve and brain pathways.

An earphone sends test sound along this route. The measurement is called air conduction, shortened to AC. It checks the route that includes the outer and middle ear as well as the inner ear and responding listener. [S6]

Now picture a small vibrating device resting against the skull. It sends vibration to the inner ear through the head. This is bone conduction, shortened to BC. It bypasses the usual sound transfer through the ear canal and middle ear. Comparing AC and BC helps the clinician investigate that transfer. [S6]

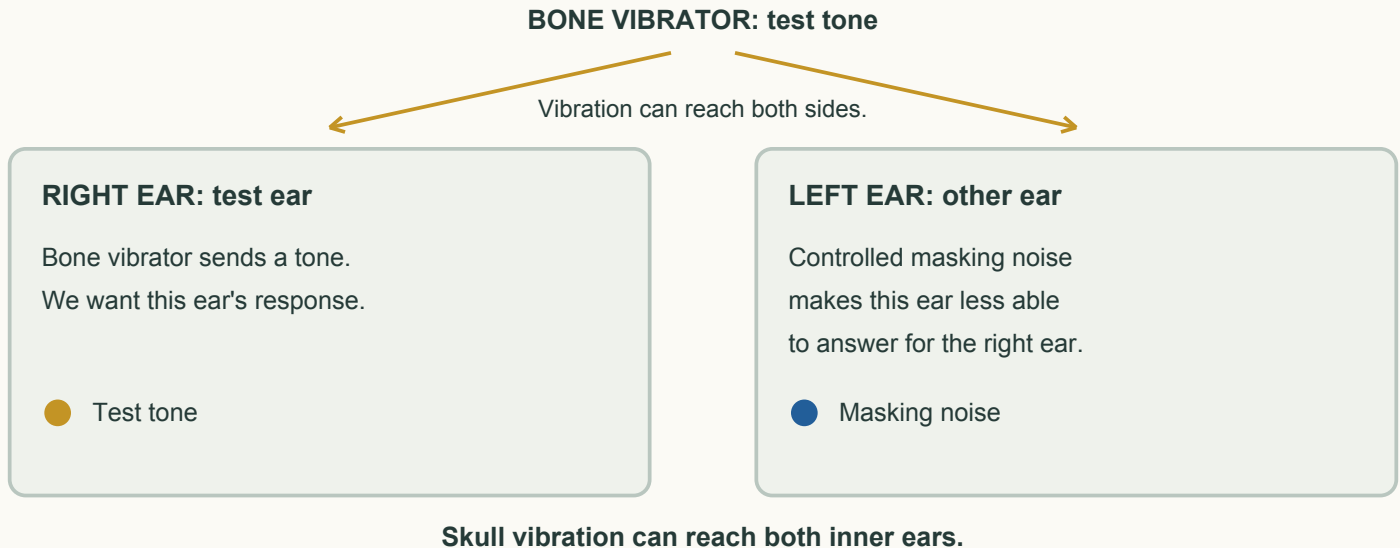
Legend: AC = air conduction, measured with an earphone. BC = bone conduction, measured with a bone vibrator. Neither measurement tests the auditory nerve alone. Both require the listener to detect the signal and respond.

There is one complication. The two ears are not perfectly separate testing systems. A vibration can sometimes reach the inner ear on the other side. Before we interpret BC as a right-ear result, we need to know which inner ear responded.

Why the other ear may need masking

Controlled noise helps keep the ear we are not testing from supplying the answer.

Imagine that the clinician wants to measure ECHO's right inner ear using a bone vibrator. Skull vibration can reach both inner ears. If the left inner ear detects the tone, ECHO may still respond. Without another step, that response cannot tell us which inner ear heard it.



To separate the responses, the clinician may send a carefully controlled noise to the ear not being tested. In this right-ear example, the noise goes to the left ear. This is called masking. The noise makes the left ear less able to detect the test tone and answer for the right ear. [S3, S4]

The clinician chooses and checks the noise level using a professional method. Too little noise may leave the other ear able to respond. Too much can interfere with the test ear. Masking does not physically block an ear, and it does not simply mean turning up a random noise.

A result labeled right masked BC means a right-ear bone-conduction measurement made with masking used to establish which ear responded. For this fictional record, assume the masking was effective and the measurements are reliable. Without that condition, unmasked BC alone cannot tell us which inner ear responded.

Legend: AC = air conduction; BC = bone conduction. Here, right is the test ear and left is the ear receiving masking noise. For left-ear testing, the roles would switch. Masking can also be needed during AC testing.

Listen to a sequence of responses

Find the faintest level ECHO detects repeatedly at one frequency.

We are ready to follow one part of the test: the right ear at 1000 Hz, using an earphone. This is an air-conduction (AC) measurement. Keep the frequency fixed for now. The clinician changes the hearing level, written in dB HL, to find a repeatable boundary between missed and detected tones.

After ECHO understands the task, the clinician starts this example below the expected threshold. When ECHO does not respond, the next tone is 5 dB higher. After a response, the clinician goes down 10 dB and works upward again. This upward search is called an ascending trial sequence. [S3]

Trial	Level (dB HL)	ECHO responds?	What happens next?
1	30	No	Increase to 35.
2	35	No	Increase to 40.
3	40	Yes	Decrease to 30; search upward again.
4	30	No	Increase to 35.
5	35	No	Increase to 40.
6	40	Yes	Use the repeated responses to judge threshold.

Read the two searches in order. ECHO misses 30, misses 35, then hears 40. The same pattern happens again. The response at 40 is repeatable, while the lower tested levels did not produce a response in this example.

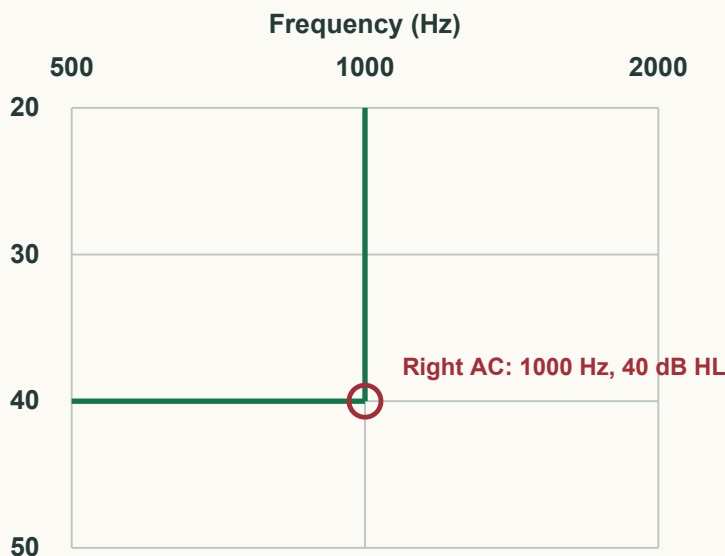
The clinical rule seeks the lowest level with responses on at least half of the upward presentations, with a minimum of two responses out of three. Here, two successful upward presentations already meet that minimum when the response pattern supports it. A third demonstration is not automatically required. [S3]

We can now record 40 dB HL as ECHO's fictional right-ear threshold at 1000 Hz. The next page shows exactly how that one result becomes one circle. Legend: AC = air conduction; BC = bone conduction. This example follows AC.

Turn one result into one circle

Follow the two guide lines until they meet.

The trial table tells the story of six tones. The audiogram, our hearing graph, summarizes the result of that story. We will place one mark for the lowest level ECHO detected reliably, rather than making a mark for every tone.



Level: dB HL

First, find 1000 Hz across the top. This is the frequency we held steady. Follow its vertical line down into the graph. You are choosing the correct frequency column.

Next, find 40 dB HL on the left. This is the threshold from the repeated responses. Follow its horizontal line across the graph. Where the two lines meet, draw an open circle, a circle with an empty center. [S4]

The circle means: during this right-ear air-conduction test, ECHO reliably detected the 1000 Hz tone at 40 dB HL. The symbol tells us the ear and test route; its position gives us the frequency and level.

What happened to the missed tones at 30 and 35? They stay in the trial notes because they helped find the boundary. We do not add circles there: ECHO did not reliably detect those levels. One circle summarizes this completed threshold search.

Legend: AC = air conduction; BC = bone conduction; Hz = cycles per second; dB HL = hearing level relative to the test reference. O = right-ear AC measured without masking.

What if no tone is detected?

A machine's highest available level is different from a measured hearing threshold.

ECHO's circle represents a tone that was heard repeatedly. Now consider a different situation: the clinician increases the test level, but the person still does not respond. Eventually, the audiometer cannot provide a higher suitable level for that frequency and device.

That equipment boundary is called its output limit. Here, output means the test signal the instrument can provide. It does not mean the listener has reached a known hearing threshold.

RESPONSE MEASURED

O marks a reliably detected level.



NO RESPONSE AT LIMIT

O + arrow records the test limit,
not a measured threshold.



The clinician records the appropriate no-response symbol, which has an attached arrow. In the right-ear example pictured here, the circle and arrow record no response at the highest level that was presented. The arrow warns the reader not to treat that level as a measured threshold. [S4]

Notice the difference in the two messages. A circle alone says a repeatable response was measured at that position. A circle with the no-response arrow says the test reached the stated level without a response. We still do not know a threshold beyond that limit.

This special symbol is useful to recognize, but it is not needed in ECHO's worked graph. Every ECHO point supplied in this guide represents a measured fictional threshold.

Legend: AC = air conduction; BC = bone conduction. Never raise classroom headphone volume to search for a limit or a threshold. This picture explains a clinical record, not an activity to perform on classmates.

Get to know the graph and its symbols

Read the directions on the graph before deciding what a line means.

Across the top, frequency increases from left to right: 250, 500, 1000, 2000, 4000 and 8000 Hz. Each step doubles frequency. A doubling is called an octave. The graph gives each octave the same width, rather than spacing every extra hertz equally. [S4]

On the left, hearing level increases as you move down. A point farther down means the listener needed a higher test level to detect that tone. A point near the top means a lower level was enough. The graph may feel upside down at first, so read its labels each time.

What was measured?	Right ear	Left ear
Air conduction (AC), no masking	O, open circle	X, cross
Air conduction (AC), with masking	Triangle	Square
Bone conduction (BC), no masking	<, angle pointing left	>, angle pointing right
Bone conduction (BC), with masking	[, opening toward the frequency line	], opening toward the frequency line



Right AC



Left AC



Right masked BC



Left masked BC

For masked BC, look at the middle of the bracket to read the level. The bracket sits just beside the frequency line so it stays visible. Its small sideways shift does not mean a different frequency. The right and left brackets open toward their frequency lines. [S4]

A line joining circles or crosses helps your eye follow one ear across the tested frequencies. Only the symbols are measurements. The line between two points does not create a new measurement at every frequency between them.

Legend: AC = air conduction; BC = bone conduction. Masked = controlled noise was used in the other ear to help establish the tested ear's response. Shape carries the meaning even when color is unavailable.

See the air-bone gap

Compare two routes for the same ear at the same frequency.

Return to the 1000 Hz column in ECHO's graph. The right-ear circle is at 40 dB HL, and the right-ear bracket is at 15 dB HL. These are two measurements for the same ear and the same frequency. The circle comes from the earphone test, or AC. The bracket comes from the bone-vibrator test, or BC.



Hearing level (dB HL): larger values are farther down

The labeled bracket spans the distance from 15 to 40. Subtract the BC level from the AC level: $40 - 15 = 25$ dB. That difference is the air-bone gap. It tells us how much higher the earphone test level had to be than the bone-vibrator test level at this frequency.

The individual levels are written in dB HL. Their difference is written in dB. A gap is not a percentage of hearing and is not an average for the whole ear. It is one comparison between two test routes.

Legend: AC = air conduction, using an earphone. BC = bone conduction, using a bone vibrator. Right masked BC means masking noise in the left ear helped make this a valid right-ear measurement. Compare only the same ear and the same frequency.

What does that gap help explain?

Connect the numbers to the two sound routes before naming a pattern.

Remember the routes: AC includes sound transfer through the outer and middle ear. BC bypasses that usual transfer. If the right ear detects the bone-vibrator tone at a lower hearing level, but needs a higher earphone level, that difference gives the clinician a question to investigate.

Frequency	Right AC	Right masked BC	Gap: AC minus BC
500 Hz	35 dB HL	10 dB HL	25 dB
1000 Hz	40 dB HL	15 dB HL	25 dB
2000 Hz	45 dB HL	15 dB HL	30 dB
4000 Hz	50 dB HL	15 dB HL	35 dB

Legend: AC = air conduction; BC = bone conduction. Right masked BC uses controlled noise in the other ear to support a right-ear result. Every row compares the same ear at the same frequency.

Read one row, then the overall pattern. At 500 Hz, the gap is 35 minus 10, or 25 dB. At the four frequencies with both tests, the gaps range from 25 to 35 dB. The BC thresholds of 10 to 15 dB HL are within the normal range under the convention used in this guide. [S5]

Together, those findings support a right conductive pattern: the comparison points toward a problem with sound transfer through the outer or middle ear. This interpretation assumes reliable testing and effective masking. The graph does not identify the exact cause of that transfer problem. [S6]

A clinician would combine this pattern with ECHO's history, ear examination and any further tests. Several conditions can affect sound transfer. The gap alone cannot choose a treatment or device.

No left BC measurements were supplied, so we cannot calculate left air-bone gaps. An empty entry means evidence is missing. Do not borrow a value from the right ear or invent a point.

Summarize three measurements

An average is helpful, but keep the full graph beside it.

The audiologist now wants a short summary of part of ECHO's graph. For this example, we will average AC thresholds at 500, 1000 and 2000 Hz. This summary is called a pure-tone average, shortened to PTA.

Start with the right ear. The three values are 35, 40 and 45 dB HL. Add them: $35 + 40 + 45 = 120$. Then divide by three because there are three measurements: $120 / 3 = 40$ dB HL.

Use the same frequencies for the left ear. Its values are 10, 10 and 10 dB HL. The sum is 30, and $30 / 3 = 10$ dB HL. Now we have a fair summary using the same three frequencies for both ears.

Ear	AC thresholds included	Calculation	Three-frequency PTA
Right	500, 1000, 2000 Hz: 35, 40, 45	$(35 + 40 + 45) / 3$	40 dB HL
Left	500, 1000, 2000 Hz: 10, 10, 10	$(10 + 10 + 10) / 3$	10 dB HL

Legend: AC = air conduction; BC = bone conduction; PTA = pure-tone average. This PTA uses only the three named AC frequencies. Other clinical summaries may use other frequencies.

Before putting the graph away, notice the right-ear threshold at 8000 Hz: it is 55 dB HL. That value was not included in this PTA. An average can hide a harder-to-detect frequency, which is why the clinician keeps the full graph.

A PTA is a hearing-threshold summary. It is not a percentage of hearing, a sound-exposure limit or a measure of how well ECHO follows speech in a noisy room. Next, we will add descriptive labels without losing that detail.

Use labels without losing the story

Degree, configuration and type each describe a different part of the evidence.

A number such as 40 dB HL can be given a descriptive category. This is called the degree of hearing loss under a named convention. This adult teaching case uses the ASHA/Clark ranges below. Other clinical contexts may use different conventions. [S5]

Degree under the ASHA/Clark convention	Threshold range (dB HL)
Normal	-10 to 15
Slight	16 to 25
Mild	26 to 40
Moderate	41 to 55
Moderately severe	56 to 70
Severe	71 to 90
Profound	91 and above

Find 40 in the table. ECHO's right PTA is in the mild range. But the right-ear thresholds of 45, 50 and 55 dB HL at higher frequencies fall in the moderate range. Calling every right-ear result mild would hide those values. The left PTA of 10 dB HL is in the normal range.

Now look at how the right-ear circles change across the graph. Higher frequencies require higher levels, so the circles move downward toward the right. The shape across frequency is called the configuration. A description of that shape adds information that one average cannot show.

Finally, type asks what the air and bone relationship suggests. ECHO's supplied right-ear results support a conductive pattern. A sensorineural pattern involves raised AC and BC thresholds without a meaningful conductive part. A mixed pattern combines raised BC thresholds with a conductive part. Clinical evidence determines the interpretation. [S6] A small difference between AC and BC does not by itself prove a conductive part. A clinician considers measurement reliability and clinical criteria before deciding whether a gap is meaningful.

Legend: AC = air conduction; BC = bone conduction; PTA = pure-tone average. Ask three separate questions: How high are the thresholds? How do they change across frequency? How do the two routes compare?

Explain ECHO's results in words

Bring the measurements back to the concern that started the visit.

ECHO came to the clinic because speech was becoming difficult to follow. We now have a carefully built graph, but it measures detection of simple test tones. Understanding conversation, especially with background noise, requires more information. The clinician may add speech and other tests. [S10]

A walkthrough of the explanation

Start with what was measured. In this fictional record, the right ear needed 35 to 55 dB HL to detect the tested earphone tones. The right three-frequency AC average was 40 dB HL. Higher-frequency right-ear tones needed more level, including 55 dB HL at 8000 Hz.

Then explain the comparison. At the four frequencies with right BC results, those thresholds were 10 to 15 dB HL. The right AC levels were 25 to 35 dB higher. Because the masking was effective, we can use those BC values as right-ear evidence. This supports a right conductive pattern, but not a specific cause.

Keep the other ear separate. Left AC thresholds were 10 to 15 dB HL, with a three-frequency average of 10 dB HL. We were not given left BC results. We cannot use this record to name a left-ear hearing-loss type.

Finish with the next question. What explains the right-ear sound-transfer difference, and what additional evidence would help? The clinician brings together ECHO's history, examination and further testing before advising on next steps.

A useful student explanation could say: The right ear needed higher earphone test levels than bone-vibrator levels at the same frequencies. That difference supports a problem with sound transfer through the outer or middle ear. The graph alone does not tell us the cause.

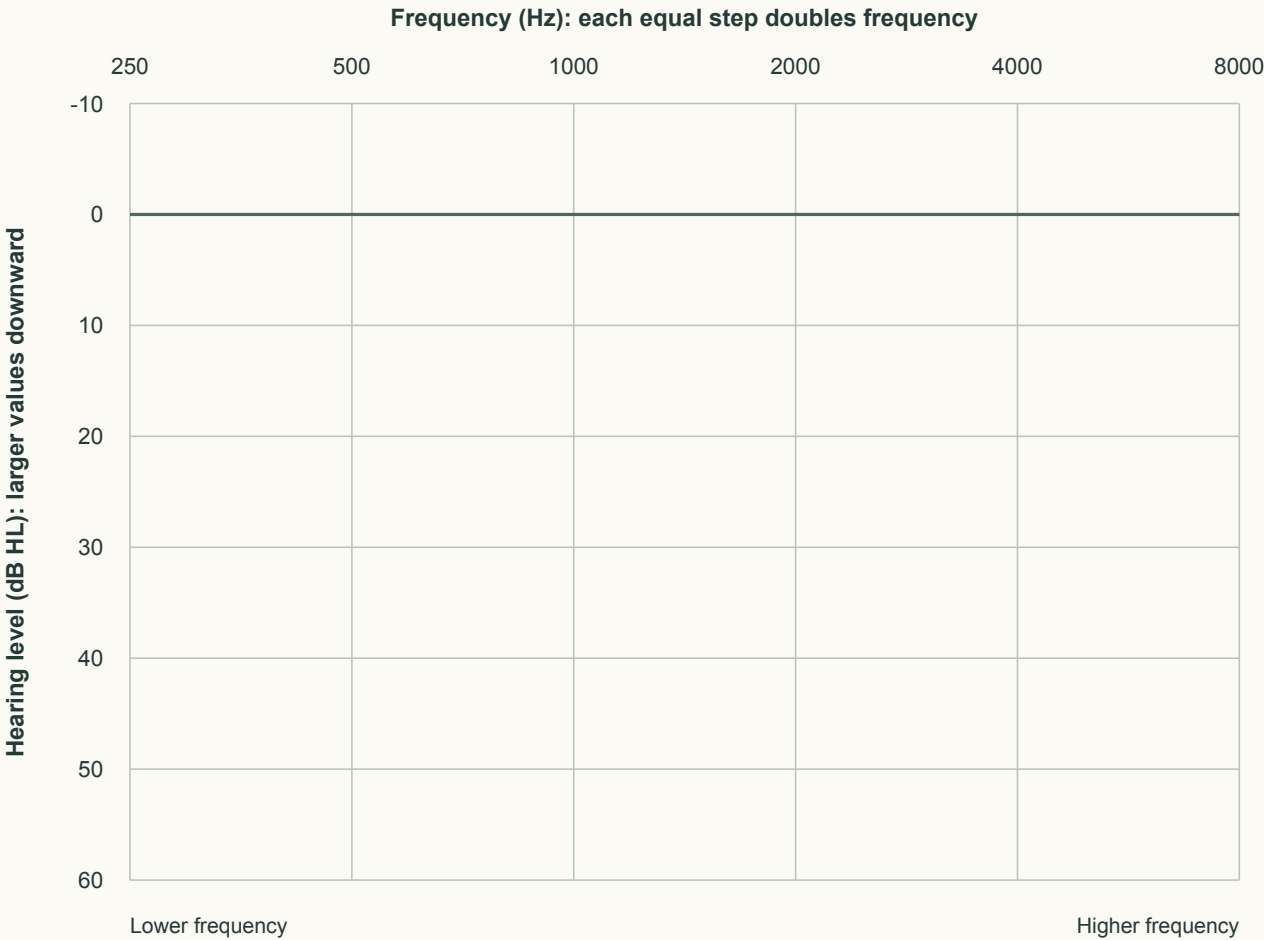
Legend: AC = air conduction; BC = bone conduction; PTA = pure-tone average. Separate the observed numbers, your supported interpretation and the questions that remain.

Try a new fictional record

Use the same steps with FOXTROT, a different made-up adult.

You have followed a complete example. Now try FOXTROT without borrowing ECHO's results. Assume the supplied right-ear thresholds are reliable and the right BC masking was effective. No left-ear measurements are provided.

Frequency (Hz)	500	1000	2000	4000
Right AC (dB HL)	40	45	50	60
Right masked BC (dB HL)	35	40	45	55



O Right AC **X** Left AC **[** Right masked BC

Legend: AC = air conduction; BC = bone conduction. Use O for the supplied right AC results and [for right masked BC. Masking noise was used in the left ear to support these right-ear BC results.

Talk yourself through the evidence

Use these prompts as a rehearsal, not as another assignment.

Begin by reading a single FOXTROT entry in a full sentence. Include the ear, test route, frequency and level. Then check that the symbol you plotted says the same thing as your sentence.

Plot one frequency at a time. Find its column, then each level. Keep the BC bracket beside the frequency line, with its middle at the measured level and its opening toward the line.

First compare the routes

At each of the four supplied frequencies, subtract right BC from right AC. Label the result as a gap in dB. Explain what the difference compares. Before naming a pattern, confirm that each pair comes from the same ear and the same frequency.

Next summarize without hiding detail

Calculate the right AC PTA using 500, 1000 and 2000 Hz. Write the three values, their sum and the division by three. Use the ASHA/Clark table to describe that average. Then look back at all four plotted AC points and describe anything the average leaves out.

Finally interpret within the evidence

Compare the BC levels with the named degree ranges and describe the size of the AC-BC differences. These gaps are much smaller than ECHO's. A small difference alone does not prove a conductive part. Explain why a clinician would need to judge its significance before naming the type. State why the graph cannot identify an exact cause and why no left-ear conclusion is possible.

Legend: AC = air conduction; BC = bone conduction; PTA = pure-tone average. Revisit the masking picture if right masked BC still feels like a label to memorize. Explain which ear received the noise and why.

Use the 6 Rs: Record the values. Reduce them into a labeled graph. Review each point against the table. Reflect on the limits. Recite the explanation in full sentences. Revise any claim that the evidence does not support.

Keep this word guide nearby

Return to a picture or worked example whenever a definition feels abstract.

Word or short label	Plain-language meaning
AC: air conduction	A hearing measurement using a test sound from an earphone along the usual outer, middle and inner-ear route.
BC: bone conduction	A hearing measurement using skull vibration to reach the inner ear while bypassing usual outer/middle-ear sound transfer.
Masking	Controlled noise in the ear not being tested, used when needed to keep that ear from supplying the response.
Right masked BC	A right-ear bone-conduction result with masking used to establish which ear responded.
Threshold	The lowest tested hearing level that meets a repeat-response rule. It is a supported boundary, not a guess.
Output limit	The highest suitable test level the equipment can provide for the selected frequency and test device.
No-response arrow	A warning that the presented level did not produce a response. That level is not a measured threshold.
Hz: hertz	Cycles per second, the unit of frequency.
dB: decibel	A way to express a ratio on a logarithmic scale. Name the reference or scale.
dB HL: hearing level	The hearing-test scale referenced to frequency and test device.
Air-bone gap	AC threshold minus valid same-ear BC threshold at the same frequency, expressed in dB.
PTA: pure-tone average	An average of specified tone thresholds. This guide uses AC at 500, 1000 and 2000 Hz.
Degree / configuration / type	Threshold category / shape across frequency / interpretation of the air-bone relationship with clinical evidence.

All clinical measurements in this walkthrough belong to fictional adults. Use them to learn the reasoning. Personal hearing concerns need qualified assessment, not a classroom volume experiment.

Sources and illustration notes

These links support the explanations and the optional sound activity.

The wording and diagrams are original classroom explanations. The professional guidelines describe clinical practice; reading this guide does not qualify someone to test hearing. The sources below provide fuller context.

[S1] NIDCD. How Is Sound Measured?

<https://www.nidcd.nih.gov/health/how-sound-measured>

[S2] CDC/NIOSH. Understand Noise Exposure.

<https://www.cdc.gov/niosh/noise/prevent/understand.html>

[S3] ASHA. Guidelines for Manual Pure-Tone Threshold Audiometry (2005).

<https://www.asha.org/policy/GL2005-00014/>

[S4] ASHA. Audiometric Symbols (1990).

<https://www.asha.org/policy/GL1990-00006/>

[S5] ASHA. Degree of Hearing Loss.

<https://www.asha.org/public/hearing/degree-of-hearing-loss/>

[S6] ASHA. Type of Hearing Loss.

<https://www.asha.org/public/hearing/type-of-hearing-loss/>

[S7] NIDCD. Noise-Induced Hearing Loss.

<https://www.nidcd.nih.gov/health/noise-induced-hearing-loss>

[S8] UNSW Physics. dB: What Is a Decibel?

<https://www.animations.physics.unsw.edu.au/jw/dB.htm>

[S9] British Society of Audiology. Pure-Tone Audiometry (2018), sections 4 to 6.

<https://www.thebsa.org.uk/wp-content/uploads/2024/01/Recommended-Procedure-Pure-Tone-Audiometry-2018.pdf>

[S10] Communication Health Support Association / ASHA. Types of Hearing Tests.

<https://helpingyoucommunicate.org/article/types-of-hearing-tests>

[S11] University of Colorado Boulder. PhET Sound Waves.

<https://phet.colorado.edu/en/simulations/sound-waves>

[S12] WHO. Hearing checks and the hearWHO app, March 20, 2025.

<https://www.who.int/news-room/questions-and-answers/item/deafness-and-hearing-loss-hearing-checks-and-the-hearwho-app>

The wave, meter, masking, plotting, no-response and gap diagrams are original vector illustrations. The ear image reuses the previously approved AI-generated colored-pencil teaching plate. It is a schematic, not a patient image. The graphs use the original frozen fictional case data.

For an actual hearing concern, seek qualified help. No listening level is certified by the model, a volume percentage or an uncalibrated browser tone. Source and link review: October 16, 2026.