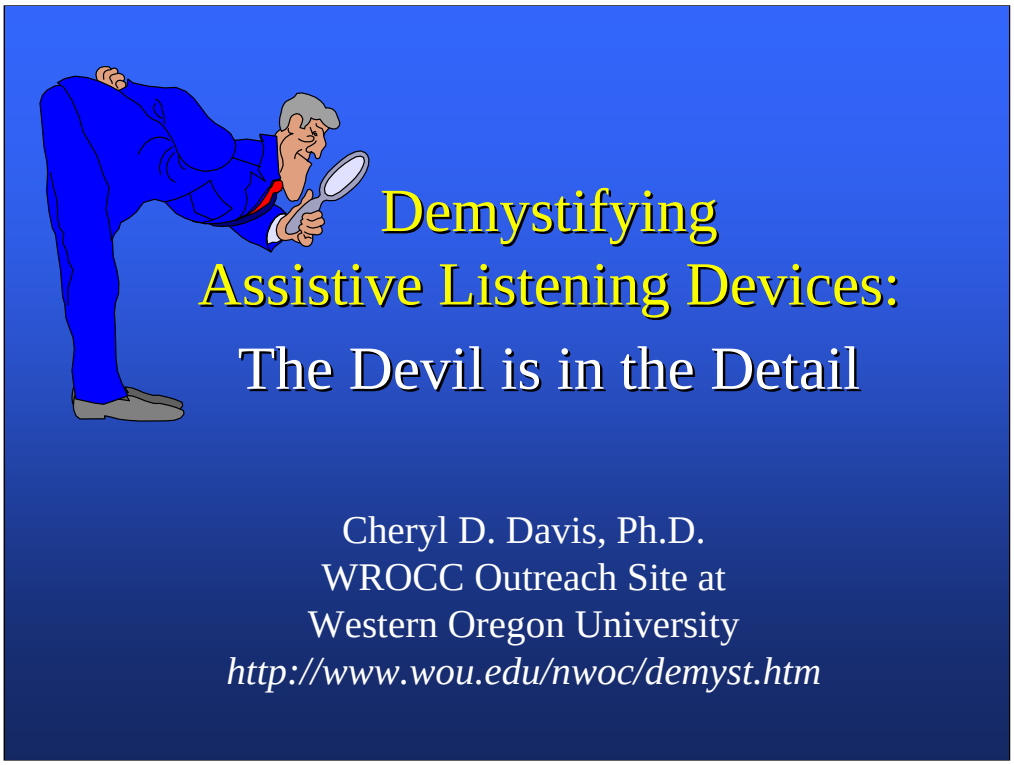
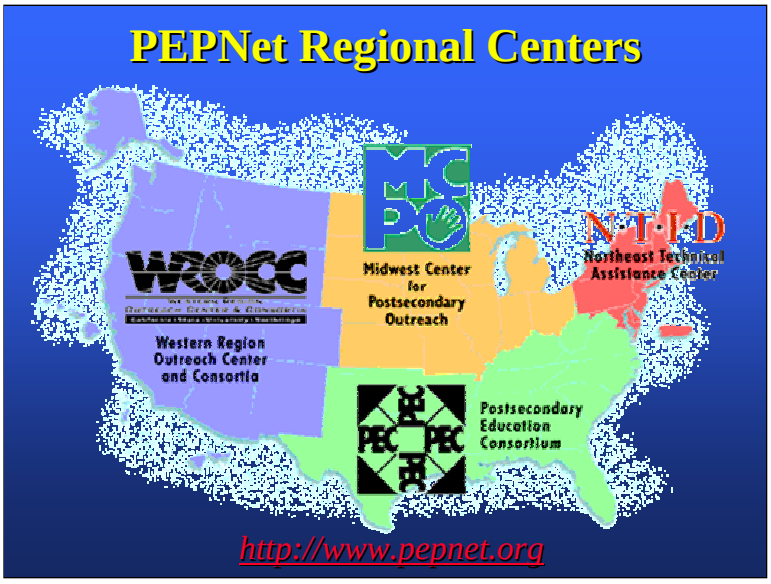


Many service providers are familiar with and accustomed to providing sign language interpreters and notetakers for Deaf consumers. However, much confusion exists about appropriate services to provide to hard of hearing consumers. In fact, both service provider and consumer may lack familiarity with ALDs, and thus miss out on the great benefit they provide in lecture and other group listening situations.

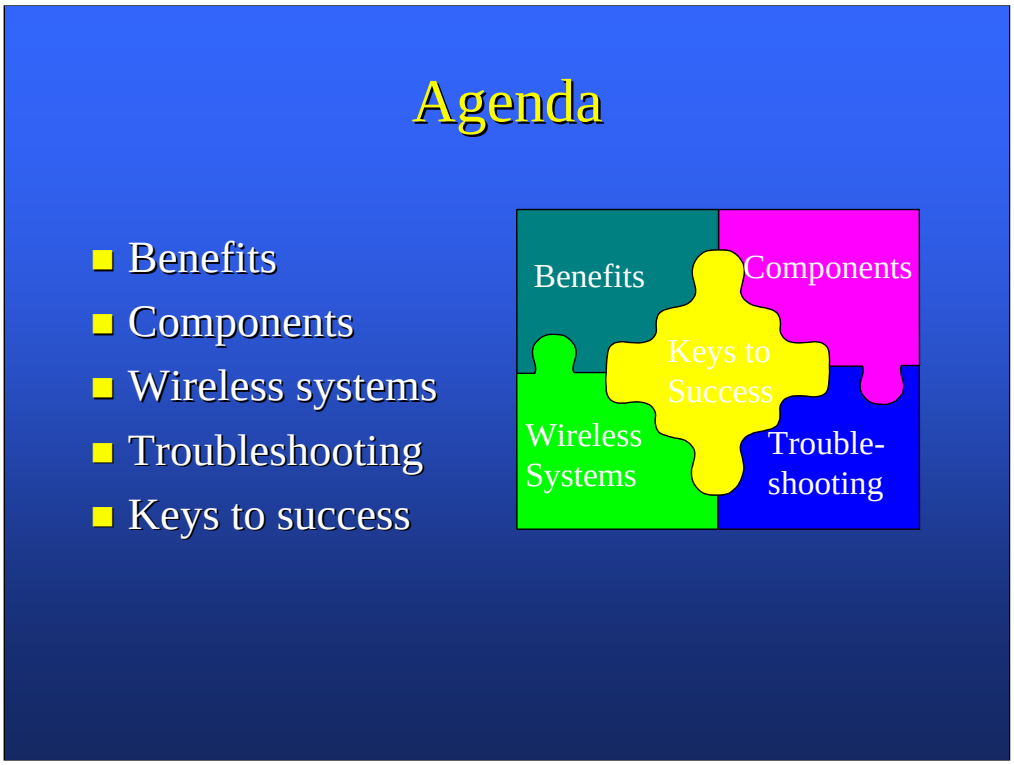
This presentation was developed to provide an overview of assistive listening devices and their use in postsecondary settings. Comments and questions about this module should be addressed to Cheryl Davis at davisc@wou.edu. Check the website http://www.wou.edu/wrocc, then Training Materials for updates to this module.



This training module was developed by Cheryl D. Davis, Ph.D, coordinator of the WROCC Outreach Site at Western Oregon University (http://www.wou.edu/wrocc). WROCC at WOU provides technical assistance and support to postsecondary institutions to assist them in accommodation and access issues that may arise around serving deaf and hard-of-hearing students/clients. It is one of several projects associated with the Regional Resource Center on Deafness, in the Division of Special Education, School of Education.

WROCC at WOU is funded through a subcontract from the Western Region Outreach Center & Consortia (WROCC). It is one of WROCC's (http://wrocc.csun.edu) outreach sites making up a network of programs serving the western United States and its territories. The National Center on Deafness (http://ncod.csun.edu), located at California State University, Northridge, hosts the PEPNet Resource Center (PRC), in addition to WROCC. PRC, which can be accessed through the website http://prc.csun.edu, is an invaluable resource for educators, disability services coordinators, vocational rehabilitation counselors, and other service providers seeking to provide and improve accommodations for students and clients who are deaf or hard of hearing. Most materials are available for free from the internet site, others, such as videos, are available for a minimal fee.

WROCC is one of four regional centers making up the Postsecondary Education Programs Network (PEPNet) (see the map above). Through this network, technical assistance is provided to postsecondary institutions across the country. Check out the PEPNet website http://www.pepnet.org for training materials and activities, and to locate the regional center serving your area. PEPNet is funded in part by the US Department of Education, Office of Special Education & Rehabilitative Services.



Many service providers are familiar with and accustomed to providing sign language interpreters and notetakers for Deaf consumers. However, much confusion exists about appropriate services to provide to hard of hearing consumers. In fact, both service provider and consumer may lack familiarity with ALDs, and thus miss out on the great benefit they provide in lecture and other group listening situations.

This presentation was developed to provide an overview of assistive listening devices and their use in postsecondary settings. The three major types of systems will be described as well as the components of each system. In addition to the devices, other components that will contribute to successful use of the systems are also included. Because no system will work perfectly 100% of the time, troubleshooting tips are discussed.

Familiarity with the technology is only one part of creating an effective listening environment for the hard of hearing consumer. Keys to the successful use of the systems for all parties involved are also provided.

A problem that service providers often face is that the student with a hearing loss will not want to identify him or herself as such to instructors and other students. They may not want to be singled out as a person with a disability and may fear the negative attitudes of others. While this fear may not be unfounded, the benefits of using ALDs far outweigh the negative attitudes of the few. The student's process at finding a balance that works for him or her must be respected. Information presented here can help students understand the benefits of taking advantage of technology that is available to them.

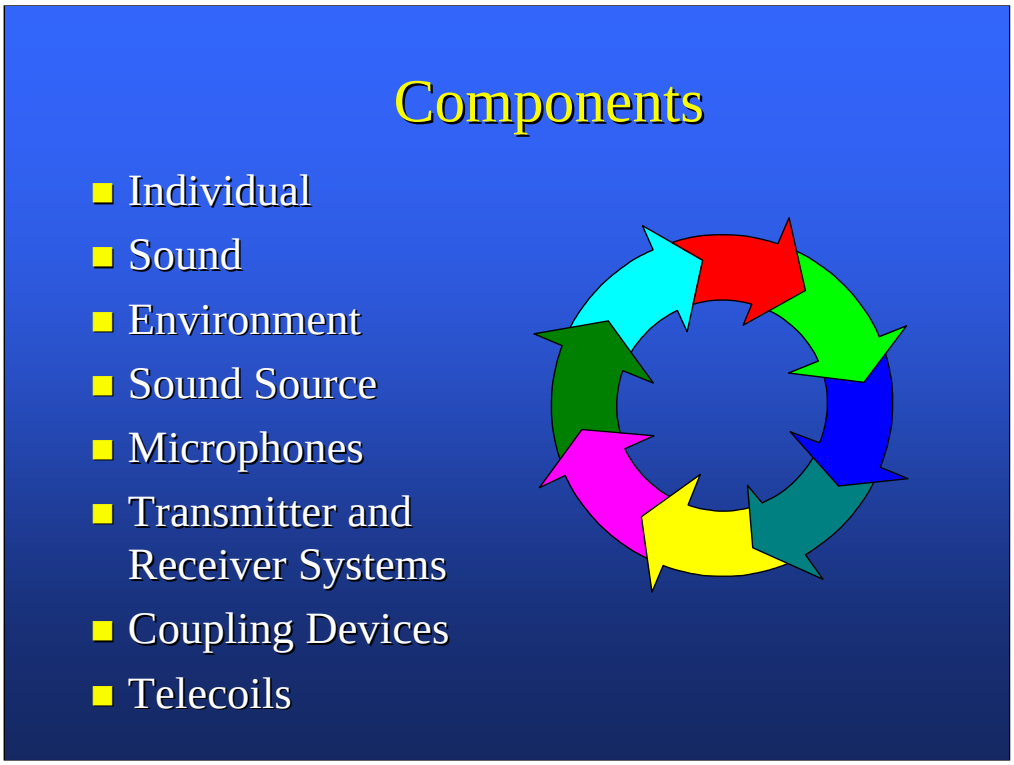
To see how an ALD can be helpful, let's first look at how hearing aids and ALDs interact. A hearing aid system consists of a tiny microphone that picks up sound waves from the air and converts them into electrical signals, an amplifier that increases the strength of the electrical signals, a battery that provides electrical energy to operate the hearing aid, and a tiny loudspeaker called a receiver that converts the amplified signals back into sound waves and directs them into the ear through a specially fitted mold.

Hearing aids are designed to fit the individual's hearing loss. If the person has a loss in the high frequencies, those frequencies are amplified, and others are left alone. Similarly, if a person has a loss in lower frequencies, those are the ones that are boosted. Unfortunately, most hearing aids do not discriminate between background noise and the sounds you want to hear. Any sounds of the targeted frequencies are amplified. This is why hearing aids do not provide '20/20 hearing'. Hearing aids are great for one-on-one interactions where there is little background noise. However, many situations, especially classrooms and group meetings, do not provide this ideal scenario.

An ALD consists of a microphone that takes in the sound, a transmitter that will send sound signals across a distance, a receiver to convert these signals, and some type of coupling device to transmit either the sound to the listener's ear *or* the signal to the listener's hearing aid. ALDs amplify only the sounds coming across the device's microphone. The voice of the person who is speaking into the mic is the only sound that is amplified for the ALD user, not the other noises in the room (unless they are loud enough for the mic to pick up). The ALD amplifies all the sounds at the same level, much like turning up the volume on the TV.

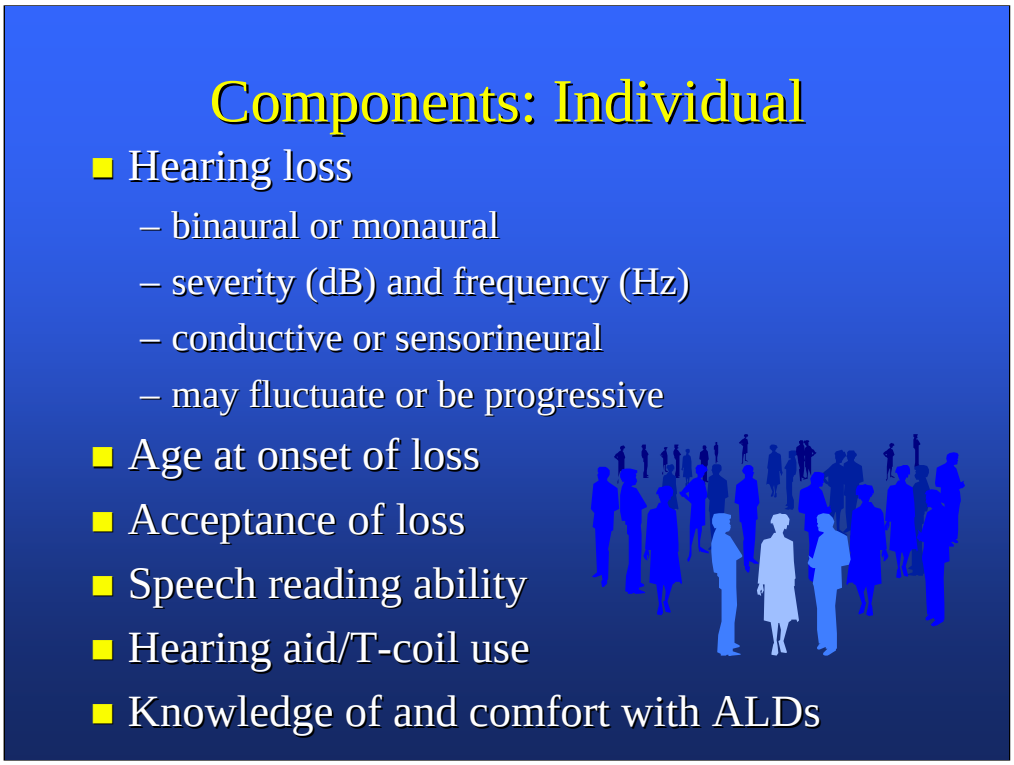
When you use the two devices together, you have only the targeted sounds AND the targeted frequencies amplified to fit the individual user. This is the incredible benefit of using ALDs.

The ADA specifies *effective* communication. Hearing aids alone are often not adequate for class lecture or group meeting situations. ALDs are used to improve the listening environment in these situations so that effective communication can take place.



For a moment, imagine a student in a classroom. The instructor is speaking into a microphone, clipped to her lapel, that is connected to a small transmitter in her pocket. The hearing-impaired student sitting in the audience has a receiver with either headphones or some other device that will connect to his or her hearing aids. The ALD, then, will bring the sound coming through the microphone directly to the ear without amplifying the background noise, maintaining the quality and intensity of the speech.

This is a common scenario for ALD use. However, people often try to use ALDs without really understanding how they work or the role the various components play in every listening situation. Problems with any one of these components can cause a breakdown in the system that can easily result in a negative experience with the device for the user. Especially if the user is not familiar with ALDs, he or she may think there is nothing that can improve their hearing experience. This is usually not true, but many people do not know that for group or lecture situations, hearing aid technology is not ‘as good as it gets’. Let’s examine each of the components and see how they contribute to the listening experience.



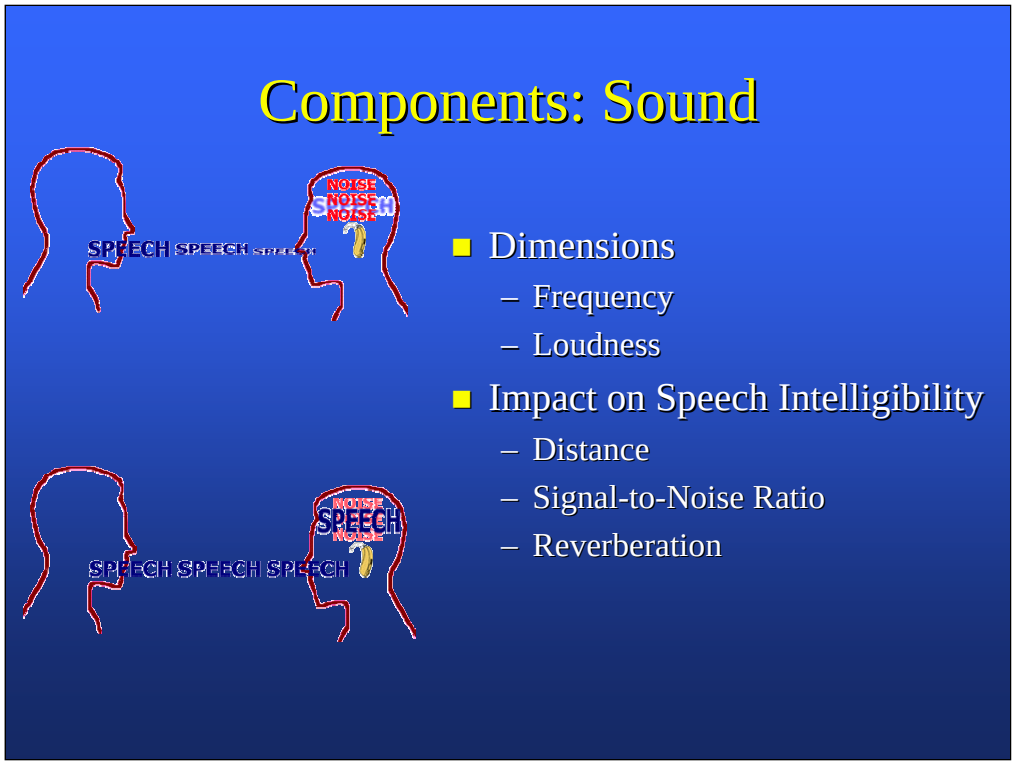
The first component is the individual with a hearing loss. There is nothing straightforward about hearing loss or how people react to it. This creates a great deal of confusion for people who have little or no experience with hearing loss, and often results in beliefs and attitudes about the individual with a hearing loss that are ill founded. They do not understand why the individual might hear one person better than another, how they can use a telephone, or why they seem to hear fine in some situations or not others.

The individual may have a loss in one or both ears. That loss may be different in each ear. Hearing may continue to deteriorate or fluctuate with allergies or illness. The individual may be able to hear high sounds but not low, or vice versa. They may have difficulty interpreting what they are hearing. The person may or may not use hearing aids, or may use aids for one or both ears.

They may have been dealing with the loss since childhood, or only recently. And like the rest of us, they will have varying levels of tolerance for frustration, stress and ambiguity-all of which are a part of trying to communicate with people who do not understand the nature of hearing loss. Some have developed effective coping strategies, some have not. Their families, coworkers, and bosses, likewise, provide varying degrees of support.

Speech reading does not come naturally-it is a trained skill. Even so, only 30-35% of the English language is visible on the lips. Accents and mustaches wreak havoc with the best speech reader. People must rely on contextual cues and what they CAN hear to be effective speech readers.

Finally, hearing loss does not come with an instruction manual. Assistive technology is wonderful--if you are aware of it and know how to use it. You should not expect that the person with a hearing loss will be an expert in the hearing mechanism, the psychology of grieving their loss, or assistive listening devices.



Individuals who have a hearing loss have much more difficulty with intelligibility than those with no loss. Once the person with a hearing loss perceives the sound, he must still interpret it to understand it. This is why hearing aids do not provide '20/20 hearing'. The studies described below are from Blair (1990).

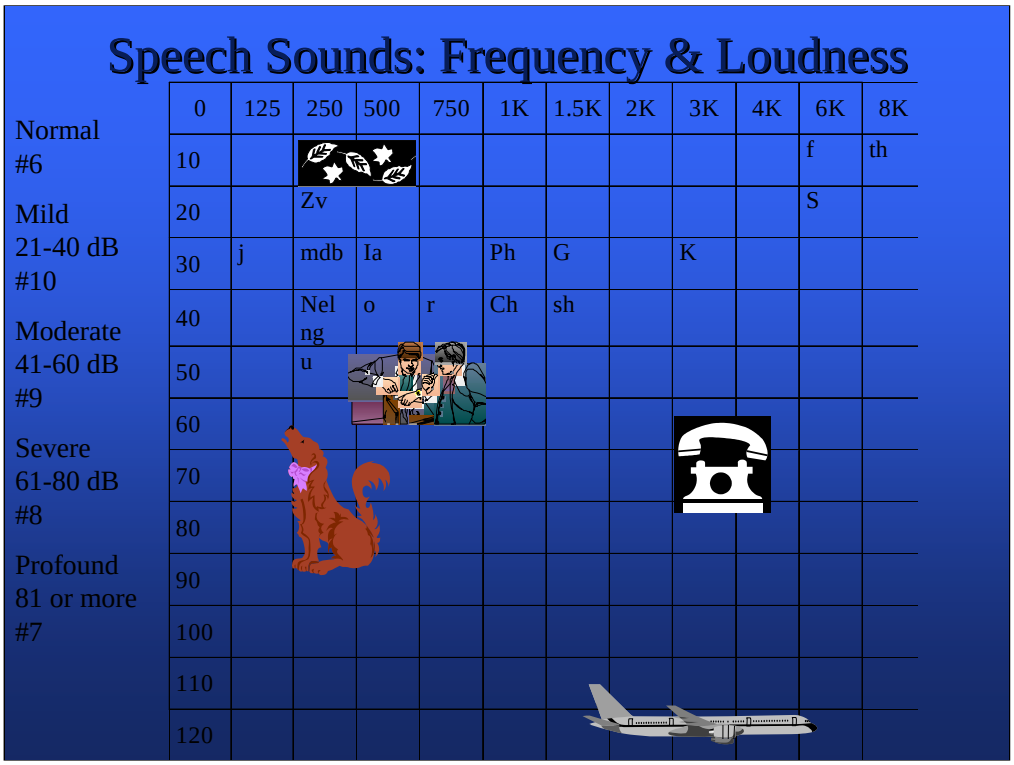
Distance: The further away from the sound one is, the softer the amount of pressure that is exerted on the eardrum, and thus the less intense (loud) the sound. Consider that the average speech is about 65 dB. At about 4 feet (for example, the first row in a classroom), the intensity drops to about 53 dB, and at 16 feet (about the 4th row) the intensity is only 41 dB. With or without a hearing aid, then, it would be beneficial to the person with a hearing loss to sit close to the sound source. In addition, it will also reduce eyestrain in speech reading.

Signal-to-Noise Ratio: This refers to how much louder speech is than the background noise. For the individual with normal hearing, speech discrimination is close to 100% as long as the speech is at least 6 dB louder than the background noise (this is an SNR of +6). Although we do not know why, SNRs must be +15 to +25 to achieve the same level of speech discrimination for individuals with a hearing loss.

Remember we said that the average speech intensity is 65 dB? Well, the average room noise level is 56 dB (SNR +9). The combined impact of distance and background noise can result in totally inaccessible listening environments for the individual with a hearing loss, even with a hearing aid. Why? Hearing aids do not improve the Signal-to-Noise Ratio because they amplify all sounds! Only ALDs will improve the SNR.

Reverberation is measured in time. It is the amount of time it takes for the intensity of a sound to drop 60 dB once it has stopped being produced. The longer the time, the more of an echo effect that is produced, and individual sounds will become slurred together. Although the definition is a little unwieldy, most of us have experienced this reverberation or echo in school gyms and sports stadiums.

For the person with normal hearing, a reverberation of up to 1 second will have little effect on their ability to discriminate speech (the reverberation in school gyms is about 1.5 seconds). Individuals who have a hearing loss, however, typically experience difficulty in speech discrimination with reverberations of only one-half a second (i.e., the individual with normal hearing will be able to repeat back words at nearly 100 percent accuracy until the reverberation time is above one second, but the individual with a hearing loss will start having trouble repeating words when the reverberation time is only about 0.5 seconds).

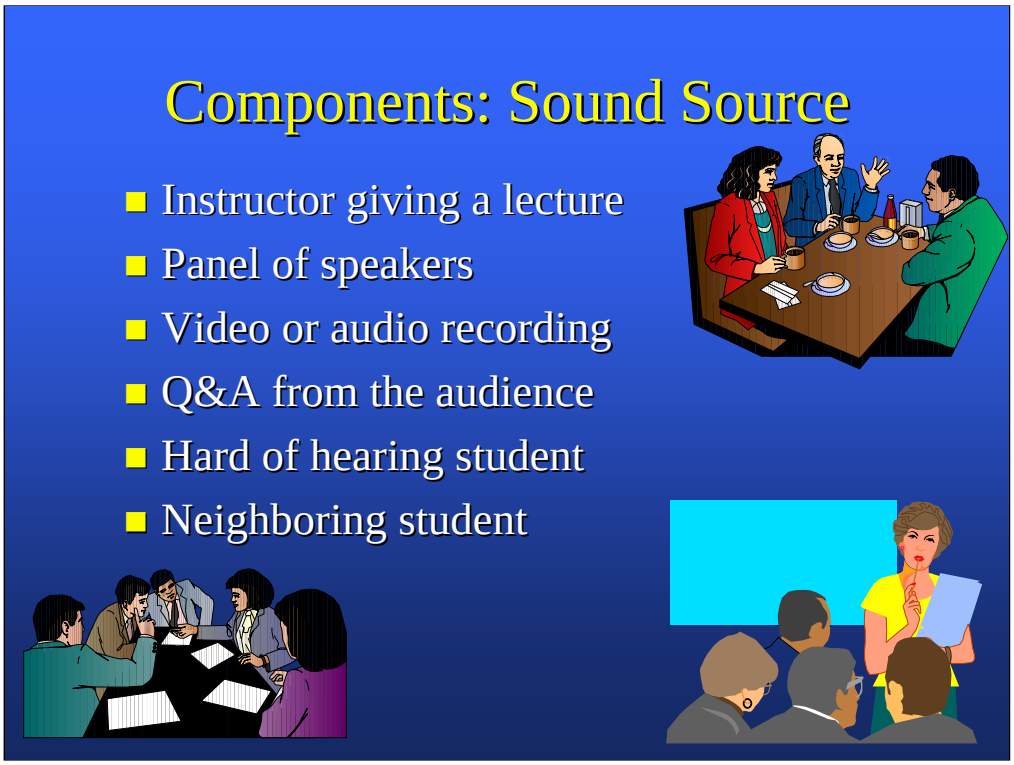


There is a much greater range of sound frequencies that what is shown in the above graphic. However, for educational purposes, we deal with the speech frequencies.

People often fail to consider the physical environment. The various aspects of the physical environment will impact the individual's ability and endurance in speech reading and will impact how much benefit they may obtain from their hearing aids

Is the room light or dark--and will the lights remain on throughout the class? Are there shadows on the speaker's face? Can the person with the hearing impairment sit relatively close (within 20 feet) to the speaker with an unobstructed view? Is the speaker moving around a lot or facing a board and writing? Remember, persons with a hearing loss depend on a variety of cues (e.g., visual, auditory, and contextual) to help them interpret what they are hearing. Speech reading will still be important, whether or not an assistive listening device is being used. All of these factors can impact the individual's ability to speech read by reducing the visibility and increasing stress and eyestrain. As you can imagine, a good deal of stamina is needed to speech read for long periods of time. In fact, before people realize they are experiencing a hearing loss, they often first recognize that they feel tired or stressed all the time.

In considering whether an environment is noisy or quiet, remember the function of the hearing aid. It amplifies all sounds coming in. Also remember that the average noise level in a room is 56dB. Right now, look around the room and think about it. Is there a fan running in the heating or cooling system? Can you hear the projector fan running? Is there background music or sound drifting in from another room or hallway? What about the people sitting around you? Are they shuffling papers, fidgeting or retrieving papers, pencils, etc.? Because speech is not the only sound amplified by the hearing aid, it is impossible for hearing aid users to tune out the background noise, and therefore very difficult to tune into speech.



Now let's evaluate the listening situation. What is it that the listener is trying to hear? One speaker giving a lecture, or several speakers, as in a panel discussion? Are there group discussions, questions from the audience, a comment from a neighboring student? Is electronic media, such as film, audio recordings, radio, CD, or computer being used? Will the audience member with the hearing loss need to speak-either to ask or answer a question, or make comments?

Before deciding the type of assistive listening device to use, the entire listening situation must be evaluated. Set ups that will work wonderfully with one speaker will fall flat if the situation involves a panel discussion. Why? Remember that no matter how many sound sources exist in the setting, the only sound that is being delivered to the individual using an ALD is what is directed into the microphone. Thus, one microphone for a panel of speakers is probably not enough, especially if they are expected to pass the mic back and forth between them. Most people will not consistently pass the mic around unless they are constantly reminded to do so. This is frustrating for both the student and the speaker. Do not put the hearing impaired student in this situation. Set it up in the first place so that everyone will experience success.

I can't stress how important it is for individuals to be able to see your face clearly...and with little interruption. Speech reading is not magic. It takes work. With or without assistive listening devices, pay attention to the communication tips that will aid the individual in everyday communication.

Facing the audience means don't: look down while talking, cover your face with your hands or papers, write on the board with your back to the audience and talk, or direct the individual's attention elsewhere and then continue to talk. The individual will have to fill in the blanks every time you do any one of these things. It's like trying to figure out what someone is saying when the cell phone keeps cutting out on you.

Make sure the lighting is adequate. If you make comments during a film while the lights are down, they will probably be missed. On the other hand, bright or glaring lights do not improve visibility, either.

Speaking up is great, yelling doesn't help. Be patient with the individual. Look for ways to improve the listening environment. If necessary, don't be afraid to write.

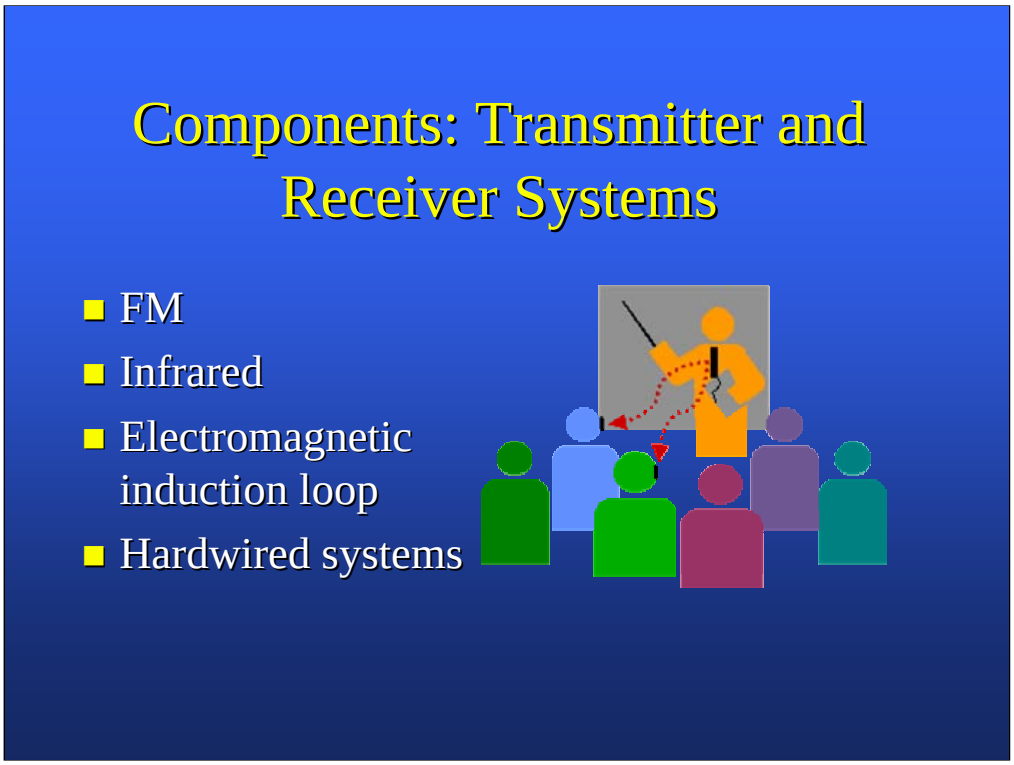
Now let's continue on with the mechanical components. The sound that is amplified for the listener is only as clear as what comes into the microphone. Distance has the same effect on sound going into a microphone as sound going into the ear-the farther the microphone is from the sound source, the softer it will be.

Distance may creep in and become a problem for hand-held mics or podium mics if the speaker is very active. Gesturing with the mic is a no-no, as is continuing to speak as you walk away from the podium. (Shuffling papers next to the mic and standing close to the overhead projector with a fan running are also no-nos!)

Lapel mics are a nice choice for individual speakers. The lapel mic should be clipped to the speaker's collar or upper lapel for the best effect. If the speaker is using visual aids and will often be pointing (and therefore looking and speaking) to one side, place the mic on that side of the lapel.

There are several characteristics of microphones you should be aware of. Microphones may be omnidirectional or unidirectional. The 'default' microphone typically sold is omnidirectional. That is, the microphone picks up sound from 360 degrees. A unidirectional mic only picks up sound coming in from one direction. For many situations, this is more desirable than having sound leak in from all directions. It will often cost more.

Setting up microphones for one speaker is a fairly simple matter. However, group discussions and multiple speakers require careful planning. Before you make a microphone purchase, think about the purpose it will serve, and purchase accordingly. If possible, check with the media or instructional technology department on your campus for help with setting the microphones up.

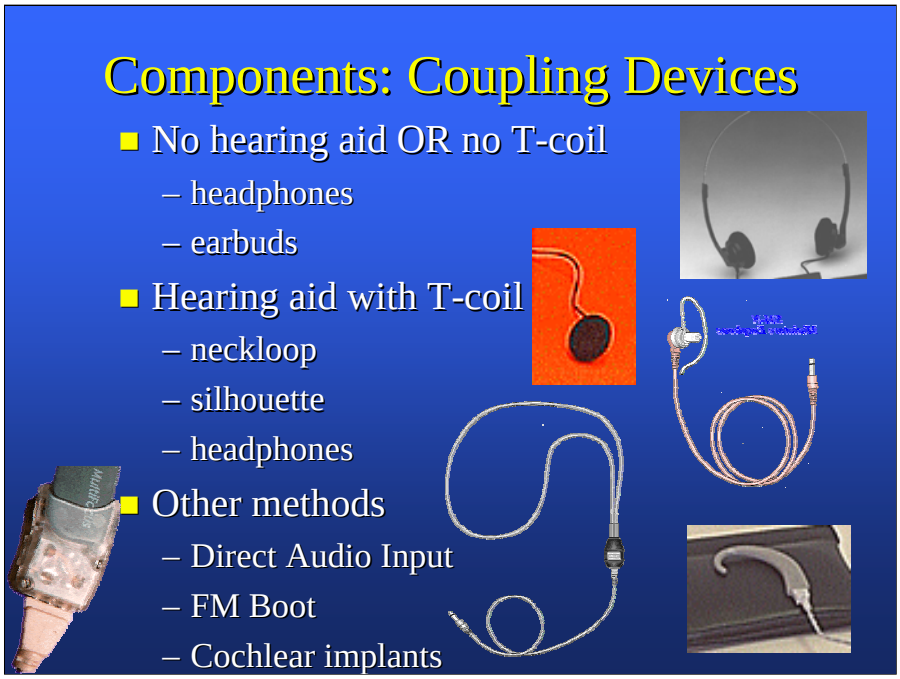


We have already stated that one of the wonderful characteristics of ALDs is that sound is brought from a distance directly to the ear. But how is this accomplished? Will the sound be sent from the transmitter to the receiver via radio waves, light, or electromagnetic waves? These are the three basic systems that are in use today: FM (radio waves), infrared (light waves) and induction loop (electromagnetic waves). Each of these systems will be discussed in more detail momentarily.

All of the systems have volume control settings that can be adjusted by the individual user, they all help to minimize the effects of poor acoustic conditions in classrooms, and they can be used with public address systems. As you will see, some systems are more appropriate in some settings than others.

These systems have other uses, as well. They are used in foreign language interpretation and with students who have difficulty concentrating due to distractions. The systems have also been used between sighted guides and persons with visual impairments, in activities such as skiing. They are also popping up in our everyday lives in ways that might surprise you.

There are other systems that are commonly called ‘hardwired’ systems. Instead of transmitting signals across great distances through the air, these systems transmit signals across much shorter distances through a connecting wire. These are not typically used in classroom situations so they are not covered here, however they are often used in offices, homes or in the car for one-on-one conversations.



Obviously, if the transmitter is sending light waves, the receiver must be able to pick up light waves. You cannot use an infrared transmitter with an FM receiver. While the transmitter and receiver must communicate in the same language, coupling devices, for the most part speak the same language. Couplers are separate from the receiver/transmitter system. If it weren't for a lack of uniformity in connecter plugs, couplers would, for the most part, be interchangeable among the different ALDs.

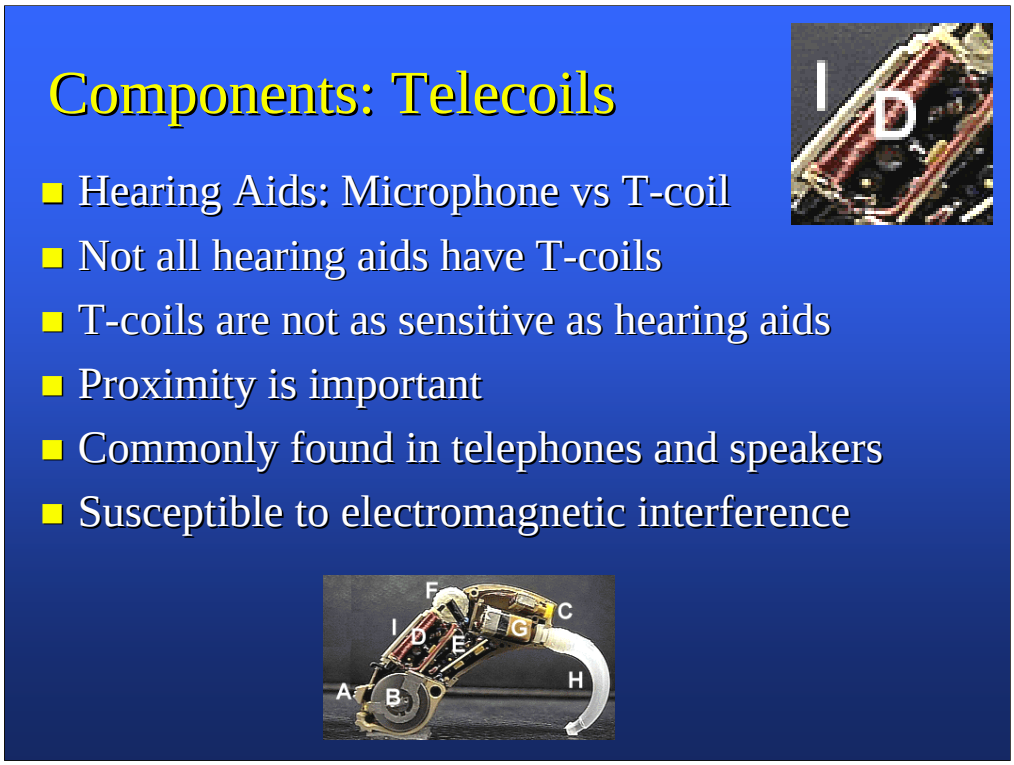
The coupling device is the mechanism that takes the transmitted signal from the receiver to the ear. How does that work? The receiver converts the signal to electromagnetic energy. The electromagnetic energy still must be converted into something we can hear-sound waves. The next step will depend on whether the individual is wearing hearing aids or not, and if their hearing aids have a T-coil (discussed in the next slide).

If the individual does not wear hearing aids or does not have T-coils in their hearing aids, they would use headphones (top) or earbuds or earphones (the middle 2 pictures). This is just like plugging headphones into a radio. The signal is converted to electromagnetic energy and transmitted to the speakers in the headphones, where it is converted into acoustic output-sound waves.

But what about this mysterious T-coil? Well, if the individual is wearing a hearing aid with a T-coil, they flip the switch from 'mic' to 'T'. Then, the signal is still converted to an electromagnetic signal in the receiver, but the coupler is one that sends the signal directly to the T-coil of the hearing aid (the bottom 2 pictures). The hearing aid then converts the electromagnetic signal into sound waves and sends the waves into the individual's ear canal. Why is this better? Because the sound is not being converted to acoustic waves until it reaches the individual's ear canal. This helps to prevent any degradation of the sound and delivers the best quality sound possible to the individual. These devices are available for one or both ears, and include neckloops (bottom left) and silhouettes that fit directly behind the hearing aid (bottom right).

You should be aware that there are other methods that are not covered here. The picture on the far left is an example of direct audio input, where the receiver plugs directly into the hearing aid, thus eliminating the coupling device.

Noisy situations are equally difficult for cochlear implant users, who may also receive great benefit from ALDs. Some implants do not have a volume control, only a sensitivity knob. The effect is like turning up the volume on a hearing aid…all the room noise is turned up with it. CI users will need an ALD with a jack, and a patch cord to connect it to the implant.



Let's look a little more closely at T-coils. Advocates will tell you that one of the most important things to get in a hearing aid is a *good* telecoil. What constitutes a good T-coil? Well, they are not as sensitive as hearing aids and require that the volume be turned up. Better T-coils have a higher sensitivity. Some may lose as much as 25dB, others only 3dB. The smaller the number the better. They should also be vertically oriented, as in the lower diagram, because they pick up the signals better in this position.

So just what is it? Delving into electronics a little, the alternating current of an audio signal creates an electromagnetic field that radiates away from the wire. When two wires are close, the electromagnetic field of one will *induce* a current in the other wire. The T-coil in a hearing aid is actually a small electromagnetic induction coil, i.e., a wire. NOTE: no matter what type of ALD is being used, the coupling device is receiving an audio signal that creates an electromagnetic field. The coupling device may convert the signal to sound, as in the case of headphones, or, as with neckloops and silhouettes, it may simply provide a way of getting the wire of the coupler close to the wire (the T-coil) in the hearing aid so that this induction can occur, and then the hearing aid will convert the electromagnetic field to sound.

The hearing aid microphone ONLY picks up acoustic sound waves. The T-coil ONLY picks up electromagnetic signals. The most common use of the T-coil is with the telephone, and it provides a vivid illustration of the difference between the mic and the T-coil functions on a hearing aid. Telephone speakers (as well as other speakers) contain induction coils. If an individual is using the telephone with the hearing aid on mic, he or she would put the telephone over the ear to hear. If, on the other hand, the individual is using the T-coil, he or she would place the earpiece of the phone over the hearing aid to bring the two wires to the closest proximity. If the individual is wearing a body-type aid, the earpiece of the phone may not be placed anywhere near the ear. The same applies to headphones, which also have electromagnetic fields (although some are stronger than others). Without T-coils, the headphones would be placed over the ears; with T-coils, the headphones would be placed over the hearing aids.

T-coils are susceptible to electromagnetic interference produced by microwaves, lights, computer monitors, appliances, power lines, elevator cables--anything that produces electromagnetic fields. If problems are occurring, watch for hidden sources of interference.

T-coils & Couplers & Mics! Oh My!

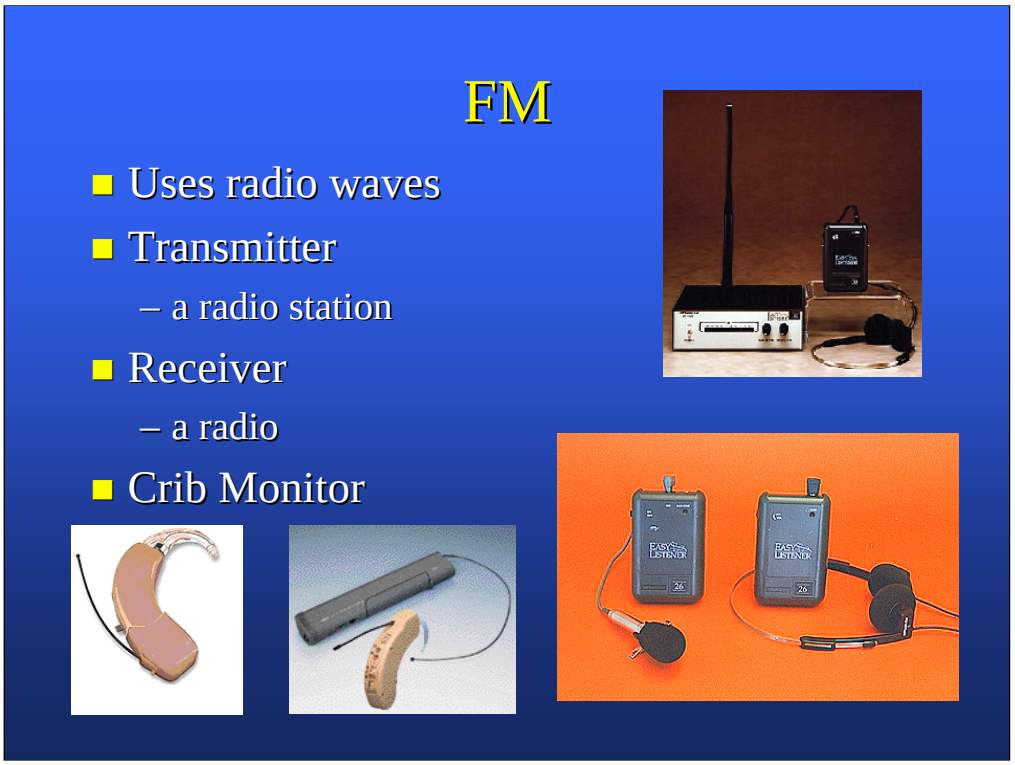
- Encourage T-coil purchase and usage.
- Inform students about the possibility of a Mic/T/Both switch.
- Make environmental mics available.
- Experiment with different coupling devices.

One final word about microphones. Many hearing aids come with a Mic/T switch. The mic setting is for general use and picks up acoustic sound, the T setting is for use with telephones and many assistive listening devices and only picks up electromagnetic signals. Although some newer hearing aids also have a setting for BOTH mic and T, many do not. Thus, switching to T to use a telephone or ALD means switching OFF the microphone on their hearing aids.

Why is this important? Functionally, this means that while the hearing aid is set to T, the individual may not be able to hear a person standing next to them speaking, and they may not be able to hear (and therefore monitor) the volume of their own voices. The hearing aid microphone is NOT picking up acoustic sound when the hearing aid is switched to T. This is very important in interactive classroom settings.

This can be remedied by purchasing ALDs that have an option for an *environmental mic*. This mic is on the receiver with the student, and picks up sounds around the student--including his or her own voice. These cost a little more, but they are worth it. Otherwise, how will the student be able to spontaneously interact in the classroom? I firmly believe that students should be familiar with these kinds of options and know how to use them. They will be interviewing for jobs soon and needing to instill confidence in their abilities to employers. They won't be able to do this if they are fiddling with inadequate equipment.

Students may also need to experiment with different couplers. For example, silhouettes may provide a stronger signal than a neckloop. For some students, this may be the difference between loving ALDs and leaving them in a drawer. Set up the users for SUCCESSFUL experiences with ALDs. Otherwise, the equipment you purchased from your dwindling resources will go unused.

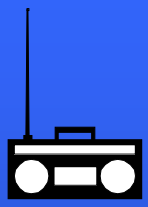


FM stands for frequency modulated. It is probably the best known system. It is made up of a transmitter, which can be thought of as a small radio station, and a portable receiver, comparable to an FM radio. The system transmits sound using FM radio signals.

They are very easy to set up, operate, and use. And they may be the better system for students with a more severe hearing loss, because they have a greater acoustic output (they can be turned up louder) than infrared.

You may have used an FM system without realizing it. Crib monitors are an common example of FM systems in use today. The transmitter is in the room with the baby, and the receiver is placed wherever the caregiver is. If the baby makes noise in one room, it can be heard over the monitor in another.

True or False?



- You can leave the room and still hear the presentation.
- This system can be used indoors or outdoors.
- You must have a receiver to use this system.
- You must have a hearing aid to use this system.
- You can use FM in multiple rooms in a building.
- I can use my FM receiver with your FM transmitter.

Based on the radio analogy, how many of these can you answer?

True. Just as you can carry a portable radio around with you and continue to pick up your station, the same is true of FM ALDs. Radio waves obviously transmit through walls and across great distances. Because of this, speakers should be reminded to turn off their microphone/transmitters before they leave the room and/or hold private conversations. A woman I know will take her receiver out in her yard with her so that if her husband wants her (e.g., if she gets a call or if the timer goes off) he can let her know without hunting her down!

True. FM systems can be used inside or outside. The only caveat here is proximity to sources of interference (i.e., other FM transmitters).

True. Each listener must have a receiver. In addition, the receiver must be set to the same channel as the transmitter to pick up the signal. Note: some hearing aids now have an FM boot, meaning that the receiver is actually a part of the hearing aid itself (usually a behind-the-ear style hearing aid).

False. With the appropriate coupling device (e.g., headphones, earbud) attached to the receiver, the hearing impaired user would not necessarily need to be wearing a hearing aid.

True. Like a radio station, the user can tune in various channels. I can be listening to one channel in one room, and someone else can listen to a different channel in the next room. If two systems are being used in close proximity (i.e., in the same building), there should be at least one channel free between the two systems to avoid spillover of the signals.

Possibly…but. Not all systems are compatible-some use a wide bandwidth and some use narrow bandwidth. Also, you would need to know the channel the signal is being transmitted from *and* be able to set your receiver to that channel.

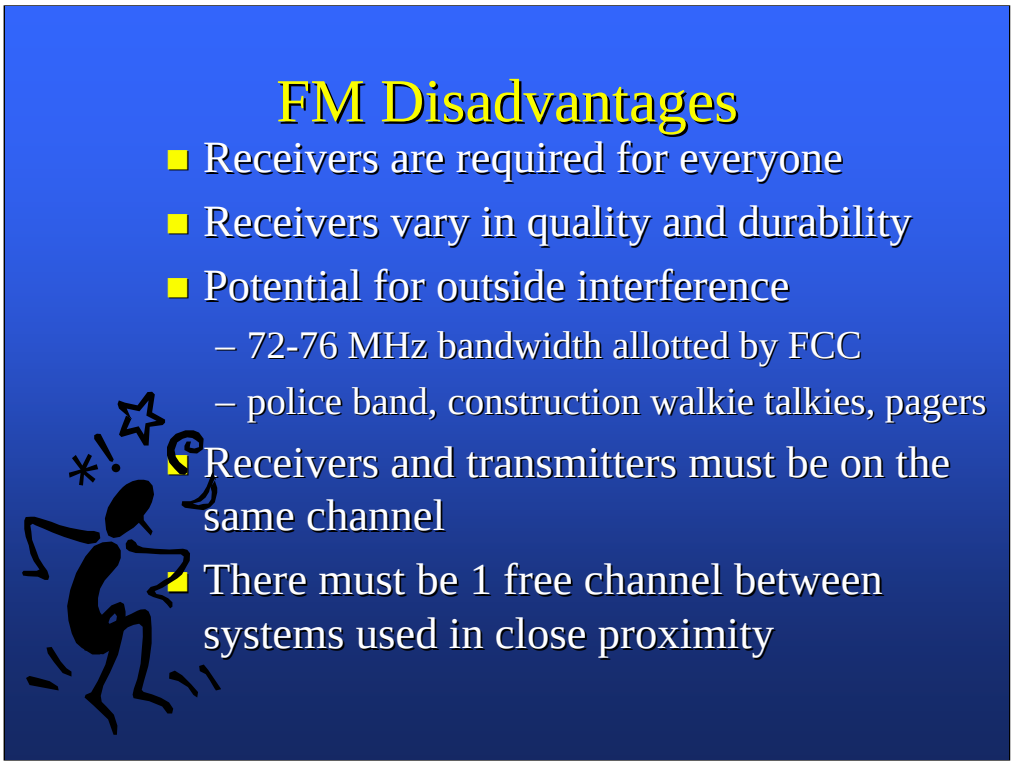
FM Advantages

- Very portable
- Very easy to set up and use
- Offers great flexibility of movement
- Used indoors or outdoors
- Appropriate for mild to profound losses
- Receiver can be covered or put in pocket
- No fluctuation in strength of signal

There are many advantages to using FM systems that make them very popular in classroom and other public settings. They are very portable and easy to set up and use. Both the hearing-impaired individual and the speaker have freedom of movement without interrupting the signal. They can be used indoors or outdoors. They are appropriate for mild to profound losses, and may be the preferred system for profound losses because of their superior acoustic output. However, some FM devices are capable of exceeding 140 dB of output. The Food and Drug Administration has determined that consumers must be warned of potential risk to residual hearing if an auditory amplification device exceeds 132 dB of output (Warick, et al., 1998).

Also, depending o the individual's comfort level with using ALDs, the FM receiver can be covered or clipped to a waistband like a pager so that it is very inconspicuous. In fact, if it were used with a neckloop as a coupler, others would probably not know it was in use.

Finally, within their range, there is no fluctuation in the strength of the signal.



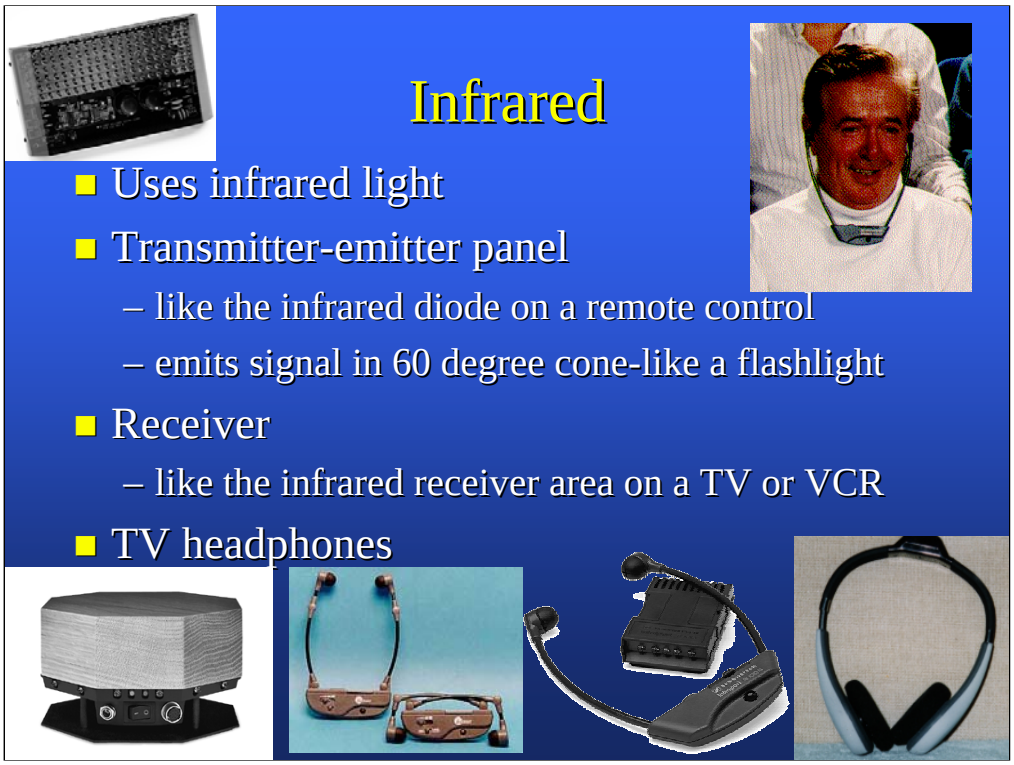
The biggest problem with FM is the potential for outside interference. Although 40 channels (narrow band) in the 72-76 MHz bandwidth have been set aside by the FCC for use in FM systems, outside interference may occur with nearby radio stations, pagers, police band, and construction walkie talkies. Sometimes devices 'drift' from their targeted frequencies and must be adjusted to correct for this. . However, newly developed 216MHz systems are now available that should alleviate this intereference problem.

This system is also not a secure system. If you can leave the room and still pick up the signal, this means others could pick it up, as well. If security is an issue (as in jury deliberations or in high-tech company business) an infrared system would be the system of choice (discussed in the next section).

Receivers are required for everyone. These receivers vary in quality with the manufacturer. Only purchase these systems from companies that will help you troubleshoot and that have a trial period and return policy.

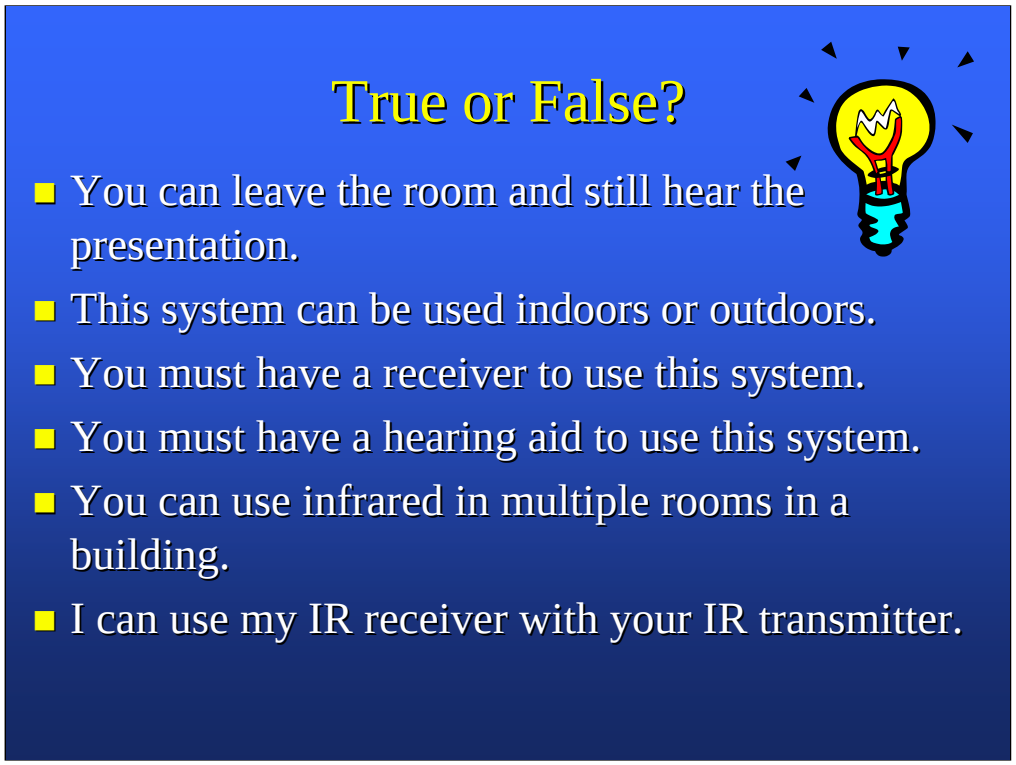
If you purchase multiple systems at separate times, color code or number transmitter and receiver pairs. Remember, the pairs must be tuned into the same channel.

Finally, if multiple systems are being used in close proximity, there must be at least one free channel between the separate systems to prevent interference in adjacent rooms.



Infrared systems use infrared light to transmit the signal across distance. This transmission is much like using a remote control with a TV or VCR. The signal is sent out in a 60 degree cone, like the light from a flashlight. You can recognize these systems by the infrared diode present on each receiver and transmitter. Systems for large areas will have an emitter panel with multiple diodes on it to send the signal out to a broader area. There may even be multiple emitter panels, depending on the size of the room.

You may have seen the TV headphones available in stores today that use infrared technology. The transmitter sits on top of the TV (or near it) and the user can sit across the room and still pick up the signal to listen to TV without bothering others.



Thinking about light transmission and remote controls, how many of these can you figure out?

False. Just like the remote on the VCR, the transmitter and receiver must be in direct line of sight of each other to receive the signal. You cannot change channels from a different room with a remote. In fact, if someone walks between you (and the remote) and the TV, the remote will not work. Light does not travel through solid surfaces.

False. Because infrared uses light, other intense light sources, such as the sun, can interfere with the signal. Infrared can be used indoors away from very bright areas, and outdoors ONLY in the evening or under cover.

True. Also, with infrared systems, the receiver is often built into a coupling device such as headphones, so that they are one piece.

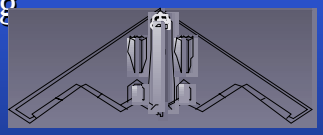
False. Again, if you have the appropriate coupling device for use with the receiver, you do not have to have a hearing aid. The ability to switch couplers will depend upon the manufacturer.

True. Because light will not travel through walls, infrared systems can be used in adjoining rooms with no spill over or interference.

Usually true. For the most part, infrared receivers and transmitters are interchangeable, with an industry standard of 95 KHz. Another type is being produced now due to interference from high intensity lighting transmitting at 250 KHz. The components from the two systems cannot be mixed.

Infrared Advantages

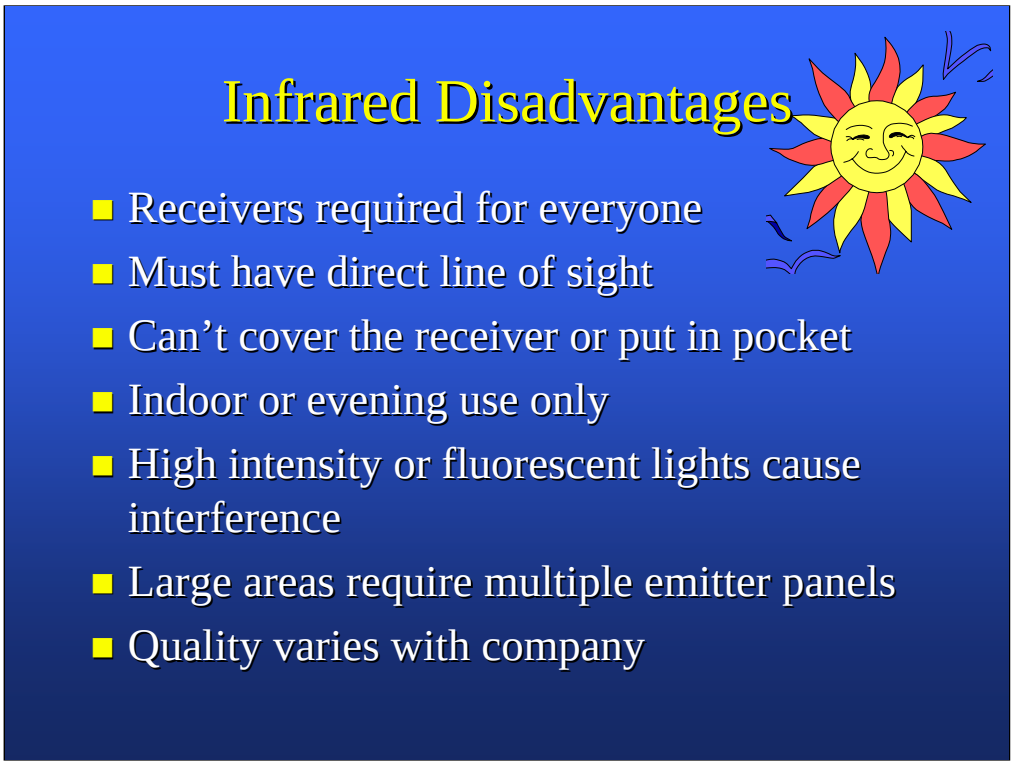
- Compatibility: 95 kKz is industry standard
  - Home receivers can be used with public transmitters
  - 250 kHz if high intensity lighting
- No spillover means security
- Can be used in adjacent rooms
- Widest bandwidth and best sound reproduction
- Appropriate for mild to moderate/severe loss
- Not affected by radio transmission



The greatest advantages of infrared are being able to use your own receiver with public transmitters (like in movie theatres) and getting the best sound reproduction. Because of their superior sound reproduction, they are often used movies, plays and musical productions. They may not be the best system for profound hearing losses as they lack the acoustic output (loudness) of FM systems. On the other hand, they also present less risk of injury.

Infrared systems are secure systems because the signal will not leave the room. Thus, it is the system of choice for jury deliberations and business meetings that need to protect discussions (e.g., around development of new materials or software).

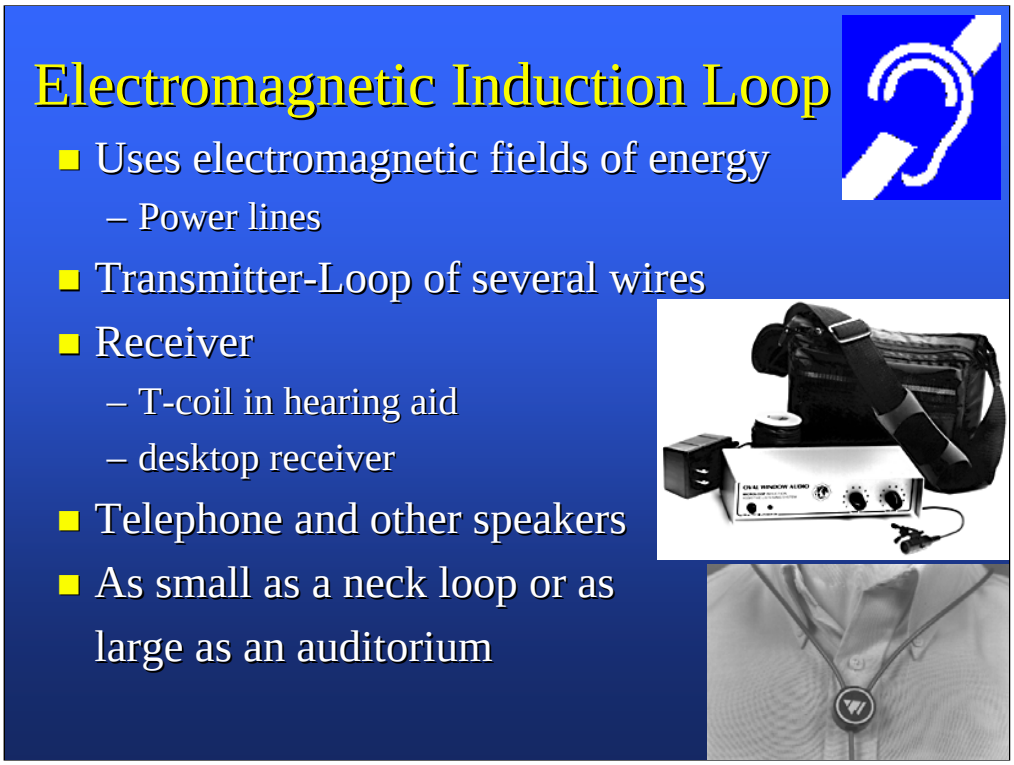
Because light does not transmit through walls, multiple systems can be used within a building. With the exception of high frequency lights and bright sunlight, there are few sources of interference with infrared systems.



Again, receivers are required for all users. The receivers and transmitters must be in direct line of sight of each other. This reduces the amount of flexibility you have in movement within the room without interrupting the signal. Unlike FM, you cannot cover the receiver or put it anywhere where the direct line of sight will be blocked (like clipping it to your belt and sitting in a class).

Quality varies with the company, here, too. Only purchase systems from dealers with trial periods and return policies, and who offer troubleshooting on the phone or in person.

Large areas require multiple emitter panels, which will increase the cost of the system.



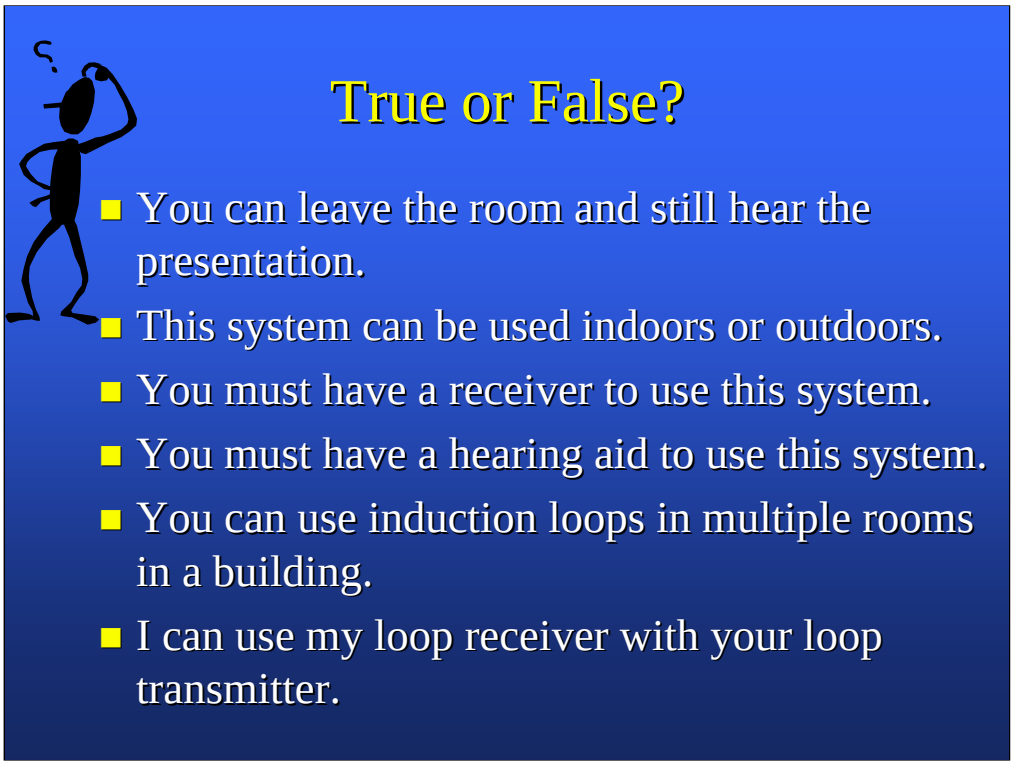
Although electromagnetic induction may be the most difficult to explain, it is one of the easiest systems to use. The induction loop is actually a loop of wires that surround a listening area. The user sits within the loop and switches his or her hearing aid to T. That is all there is to it. (However, if the user does not have a hearing aid with a T-coil, they will need a separate receiver and a coupling device, such as headphones.)

How does it work? The alternating current of an audio signal passing through wire creates an electromagnetic field that radiates away from the wire. When two wires are close, the electromagnetic field of one will *induce* a current in the other wire (this is where *induction* comes from). The room loop is one wire, but where is the other wire? The T-coil in a hearing aid is actually a small electromagnetic induction coil.

My analogies fail me here, although there are many every-day objects in our environments that create electromagnetic fields (e.g., telephones, speakers, computer monitors). Are you familiar with the news reports about EMF and power lines? The EMF stands for electromagnetic fields. High voltage power lines give off strong EMF. The farther away you are from the power lines, the weaker the EMF. The news reports were studies of the health impact on persons who were exposed to very high-level EMF over long periods of time, such as people whose houses are built underneath these power lines.

While the electromagnetic induction loop is no where near as strong as that of power lines (and so there is no danger), it may help you remember some of the characteristics of induction loops. First of all, distance makes a difference. The closer you are to the loop of wires (or power line), the stronger the signal (the EMF). In the case of hearing aid use, closer is better. Second, just as EMF travels through walls of houses, so will the signal from induction loop systems.

The symbol shown above is an international symbol indicating ALDs are available. It is also used to indicate an area that is looped.



Now, how many of these can you figure out?

True, although distance makes a difference, and the farther away from the loop you are, the more the sound will deteriorate.

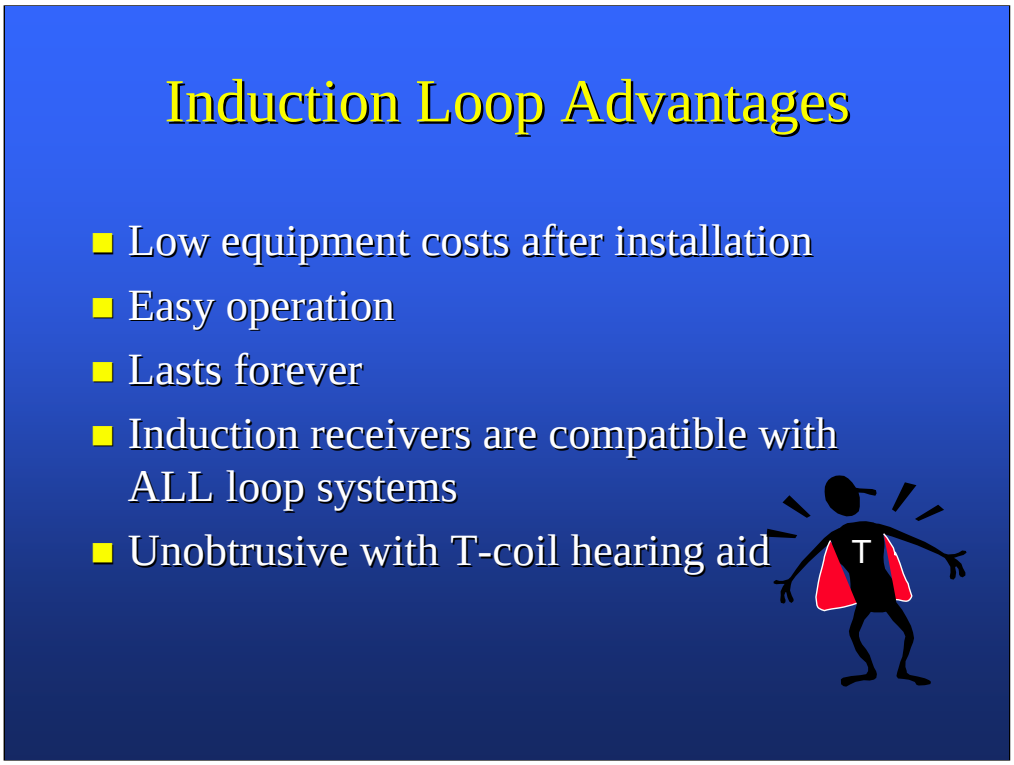
True. But you must watch out for sources of interference. Just as too much light causes interference with infrared because it is using light to transmit the signal, anything that creates EMF can cause interference with induction loops...and telecoils. This includes computer monitors, lights, appliances, and power lines, to name only a few.

False. Ok-trick question. If you have a telecoil in your hearing aid, you do not need a *separate* receiver. The telecoil itself is the receiver. If you do not have a telecoil *or* do not use a hearing aid, you will need a separate receiver.

True. You must have a hearing aid *with a telecoil* to use this system *or* have a separate receiver coupled to headphones if you do not have T-coils (this is a less common application).

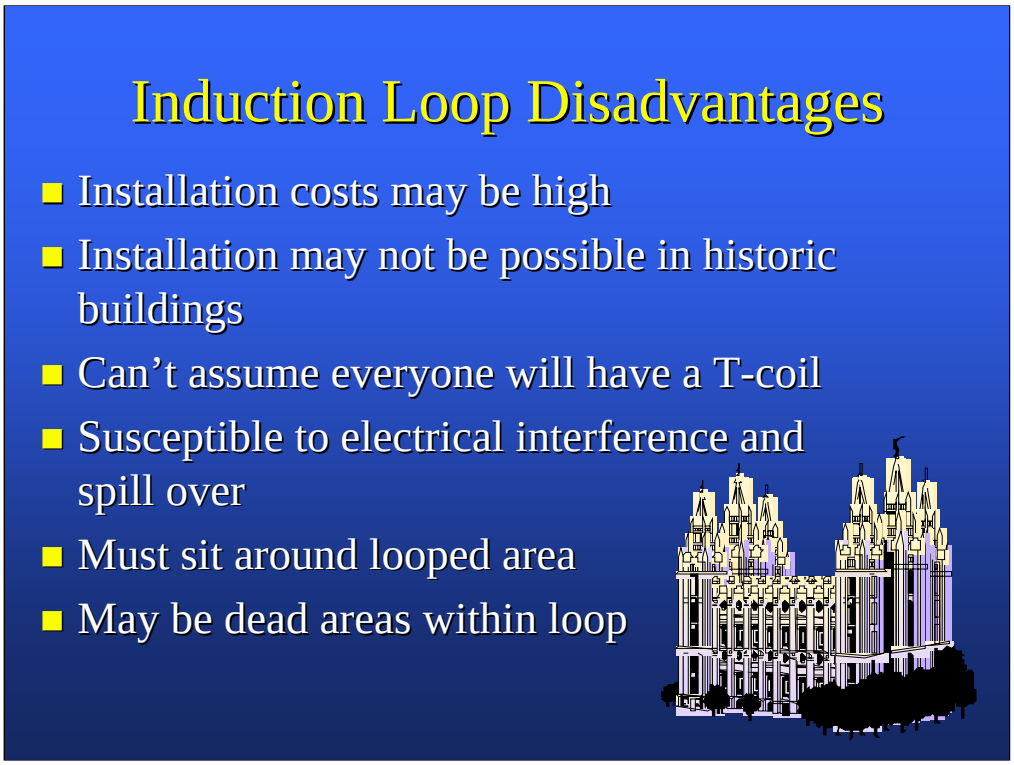
False. The EMF will pass through walls creating spillover and interference, just as the EMF from the power lines pass through the walls of a house. In addition, others may inadvertently pick up the signal. For example, if a telephone is on the wall outside a room that is using an induction loop, and a hearing-impaired user goes to the phone and switches his hearing aid to ‘T’, he may very well pick up what is going on in the room instead of what is coming across the phone, as the phone’s electromagnetic signal will be much weaker than that from the room’s loop.

True. The user with a T-coil simply walks into the looped area and switches the hearing aid to T. No other equipment is needed.



Once induction loop systems are installed, they should last a long, long time. They are one of the easiest systems for hearing-impaired users to access, as long as they have functioning T-coils in their hearing aids. Loops are used in many different situations. Information desks in airports can be looped, as well as bank windows, offices or desks, and classrooms. In homes, dining room tables, family rooms, sofas, any area where much of the family interaction takes place, can be looped. Even cars and tour buses can be looped. A carefully placed omnidirectional mic (placed in a flower arrangement, say) can pick up the sound from around a table so that the hearing-impaired user does not miss out on talk around the dinner table. The TV can be plugged into the system so that the hearing-impaired user switches to T instead of turning the volume up on the TV.

Here, again, you can see through these various applications why it would be advantageous to have hearing aids that have the option to have BOTH the T-coil and the hearing aid microphone active at the same time.



Installation in classrooms may be high if put in after the building has gone up. For example, carpet may be torn up to cover the wire so that it will not be a mobility hazard. It can actually be installed in the concrete floors or walls of a building. (In fact, because distance makes a difference, if possible it is best to install the wires about 3 ft. above the floor. This is about ear level when you are seated.) Obviously this is much less expensive if done while the building is first being constructed. This type of installation may not be possible in historic buildings, where the structure cannot be altered.

Induction loops (and therefore T-coils, by the way) are susceptible to spillover and interference of other objects that create EMF. (Induction loops would not be the system of choice in a computer lab!) Sometimes simply changing seats will help reduce the interference.

There may be some instances where only an area of a room is looped. This may be because of the size of the area. Large areas require carefully placed multiple loops in order to avoid dead spots in the center of the looped area. In any case, the individual must sit within the looped area.

Finally, not everyone will have a T-coil. Some receivers must still be kept on hand. (It is a good idea for service providers to have these receivers on hand, anyway, as a way to hook in headphones and test the loop system to see if it is working.)

The most obvious item to check is the battery in the receiver and the transmitter. The batteries in most systems are only good for about 3-6 hours, depending on amount of continuous use and how high the volume must be for the listener. Batteries on the hearing aids should be checked, also.

One helpful thing to do when you purchase a system is to purchase them in pairs. In this way, you can switch components of the device that is not working (e.g., microphone, transmitter, receiver, coupler), one at a time, with the one that is working to see where the system breaks down.

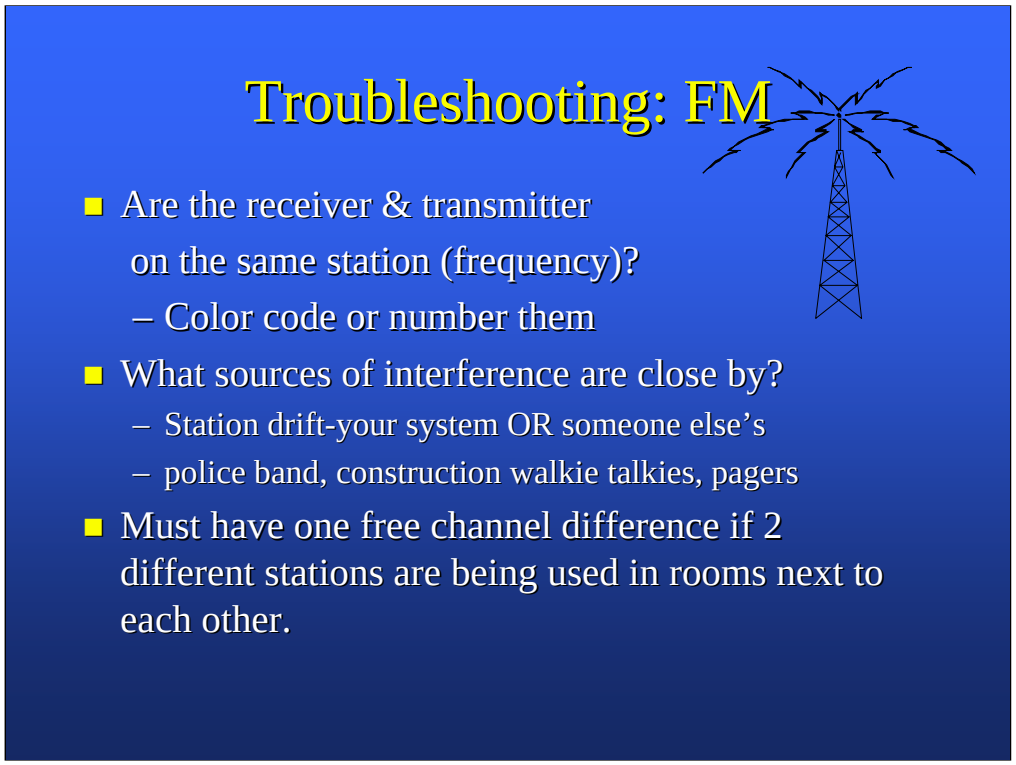
Even though the system might be working, the user may have difficulties for a variety of reasons. Make sure that the user has a good telecoil in their hearing aid and that it is working. If the user has never used their telecoil before, check it out with other devices, such as a hearing-aid compatible telephone or other headphones with a radio. If the T-coil does not seem to be working or if you can't tell, you will need a hearing aid manufacturer's or audiologist's help. T-coils can be added to hearing aids, and weak ones can be replaced with stronger ones. They should be considered a necessity when purchasing a hearing aid.

If the system is working and it is just not providing a benefit to the user, you may need to switch from infrared to FM, find out if the telecoil is strong enough for the user, and try out different coupling devices. Maybe the individual needs silhouettes instead of a neckloop to get enough boost out of the system, or needs the sound coming into both ears, not just one. Finally, sometimes changing head position or moving to a different location (even within the same room) is all that is needed.

Ultrasonic sensors designed to detect movement in rooms causes some hearing aid amplifiers to buzz and rapidly depletes the batteries. These sensors, required in some states, are used to control room lighting, heating and cooling. Research has shown that the sensors causing the problems emit signals between 25 to 27 KHz. At 32 KHz, the problem disappears. Manufacturers should be able to install the higher frequency devices (Cederbaum, 1996).

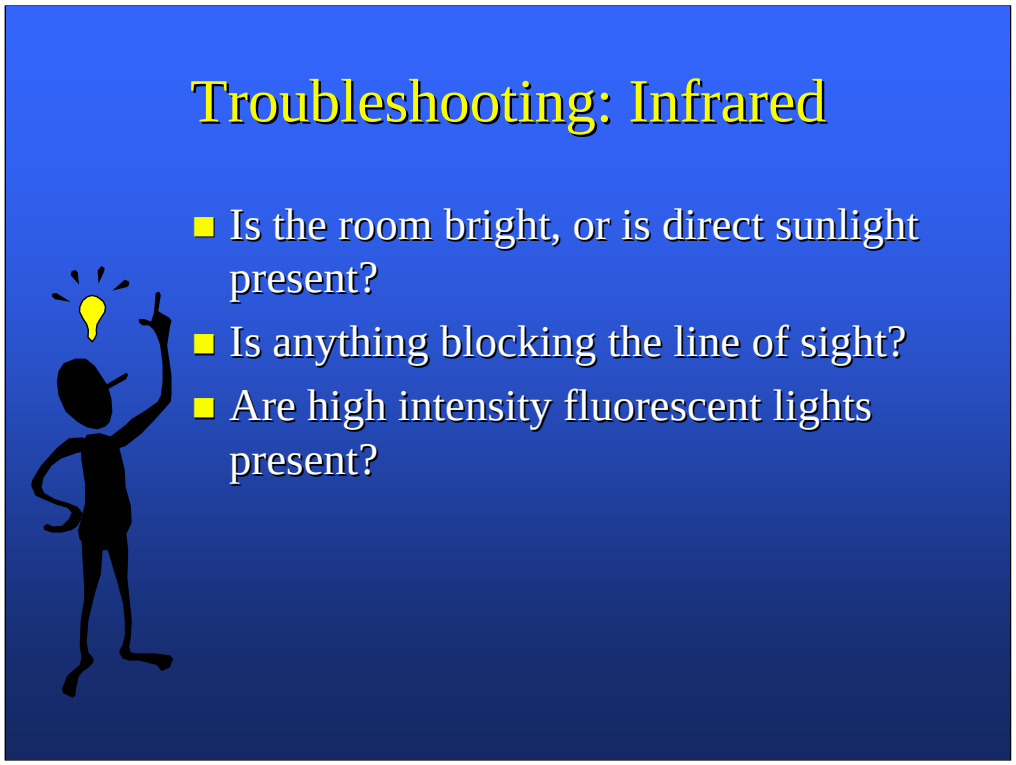
If you have access to a speech and hearing clinic on your campus, or maybe interact regularly with a particular audiologist, pick their brains about ALD technology. Check in with local or national SHHH and ALDA groups. These are consumer organizations that are more than willing to help you help a hearing impaired individual get the most out of assistive technology.

Finally, only purchase equipment from companies that provide service and trouble shooting over the phone! This can save you a lot of headaches!



When using FM systems, remember that the receiver and transmitter MUST be set to the same channel. Color code receiver-transmitter pairs with indelible ink or nail polish, or record matching numbers on them. Have a pile of them in a drawer that you inherited when you got the job? Put fresh batteries in them, speak into one of the mics and have some one tell you which receiver is picking it up. Then mark the pairs.

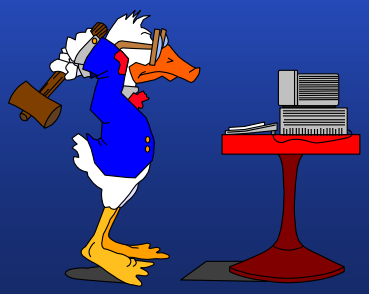
Interference will come from other devices that also use FM. Even though certain channels are set aside for ALDs, devices sometimes 'drift' off their channels and must be recalibrated. Some interference will be short term, some long term. If the student is picking up construction worker's directions in their Art History 201 course, you can try just switching channels on both the receiver and transmitter and see if that takes care of the problem. If not, you may need to get together with the construction folks, and maybe the company, to set up different channels for use.



The most common problems with infrared concern maintaining the line of sight between the transmitter and receiver, and interference from bright light. In some room setups, it may not be possible to maintain the line of sight with a personal infrared system (where both the transmitter and receiver are portable.) Make sure the speaker does not block the transmitter by walking in front of it, or moving papers in front of it. The same is true of the receiver. The student may inadvertently move objects in front of or accidentally cover the receiver. If this is not the problem, check to see if the lighting in the room is bright or from high intensity lights If these are in use, you may have to switch to a different transmitting method.

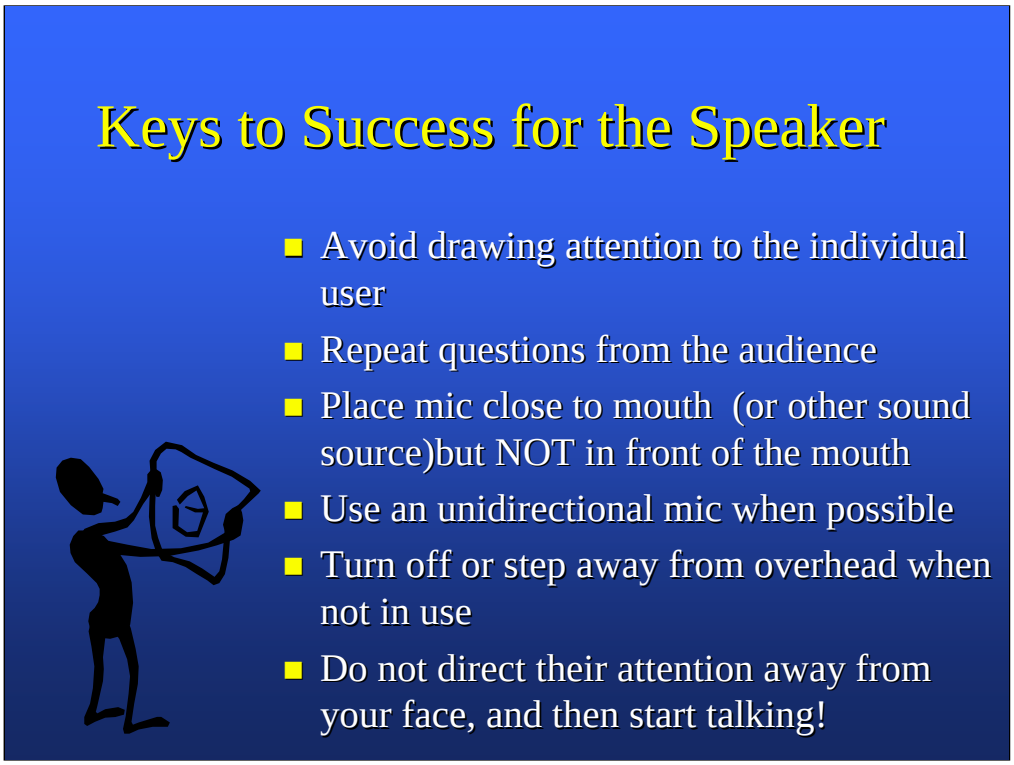
Troubleshooting: Induction Loop

- Are there sources of electrical interference and spillover nearby?
- Portable systems can be a mobility hazard. Are wires protected?



Often with induction loop systems, moving to a different seat will help. Why is this? The individual may be sitting close to a source of interference, which could be just about anything running off of electricity. Computer monitors often cause interference with telecoils. Laptop computers do not cause this problem.

Finally, if a portable induction loop system is in use, check that the wires are intact. If they have not been properly protected and have sustained travel wear, they may be damaged in some way.



First of all, avoid drawing attention to the individual user. That person may not be comfortable with using the device, and may not want to be singled out. Jokes (Hey-what's the score on that ball game?), announcements (Would the hearing impaired student please raise his hand?), and questions (Is this working-can you hear me?) may be completely innocent, but totally unwelcome to the student. Respect the student's comfort level with their hearing loss. Until you know this, check in with the student privately or the DSS coordinator if you have any questions.

Remember that the only sound that is coming across the ALD is what is going into the microphone. If someone in the audience has a question or comment, repeat it into the microphone so that the hearing-impaired user will also hear the question (usually the rest of the audience appreciates this too!)

Place the mic close to your mouth…and keep it there! Don't wave it around, use it as a pointer, rattle papers in front of it, or drop it or otherwise abuse it (and the listener's ear!) Using a unidirectional mic (for single speakers) is helpful to cut down on other noises coming in around the mic. And, of course, remember the importance of visual cues in speech reading. Don't hold the mic so that it blocks the view of your mouth.

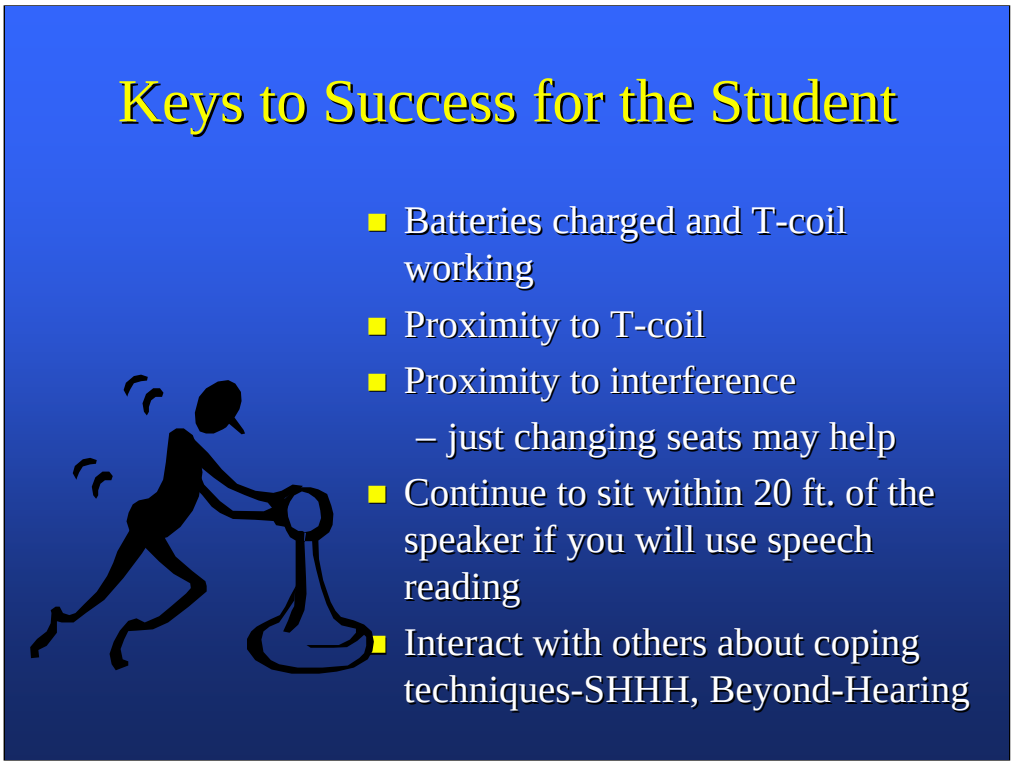
Overheads are the bane of hearing aid user's existence, for a couple of reasons. Folks with normal hearing don't notice, but they are VERY noisy! Turn it off if it is not in use, or step away from it to keep the sound of the fan from being transmitted directly into the listener's ear! Second, people tend to point at the slides and continue talking. The student will miss what you are saying while they try to view what you are pointing at! This is difficult for hearing people to remember, and they often do not realize how important it is. I had an 'aha!' moment with this that may help. I was getting computer instructions from someone on a tty that did not have a printer. The only way I could 'hear' the person was when I was watching the tty display-which only displays about 25 characters at a time. I could not execute the instructions until he told me to, because the minute I looked at the computer screen to see what he was talking about, I'd miss the next instruction. Don't ignore this important tip!

Many tips for the speaker apply even if you are not using an ALD. Again, repeat questions from the audience. This will help with speech reading. If the person is having trouble understanding something you said, try rephrasing it instead of repeating it. Remember, some speech sounds are higher frequency than others, and some words are easier to speech read than others. Just using a different word is often enough. For example, for the child with a high frequency loss, saying 'It's time to go to bed!' is more easily understood than 'It's time to go to sleep!' She will be able to hear 'bed' but not 'sleep'.

Eyestrain is a problem for students in class all day. Do not stand in front of windows or bright lights and add to this strain.

Face your audience when speaking. If you turn around to write or point, look down, or hold papers in front of you to read, students will not be able to speech read you. It would be like only hearing every 3 out of 5 words in a sentence. When you look down, they have to guess what you are saying. Remember, people who have hearing losses must use all available cues to get and interpret what they are hearing.

Finally, when you tell the class to retrieve materials, wait a few moments before continuing. Not only will the student with a hearing loss be looking down and retrieving the materials, a room full of people unzipping backpacks and flopping books around creates an uproar to a hearing aid user.

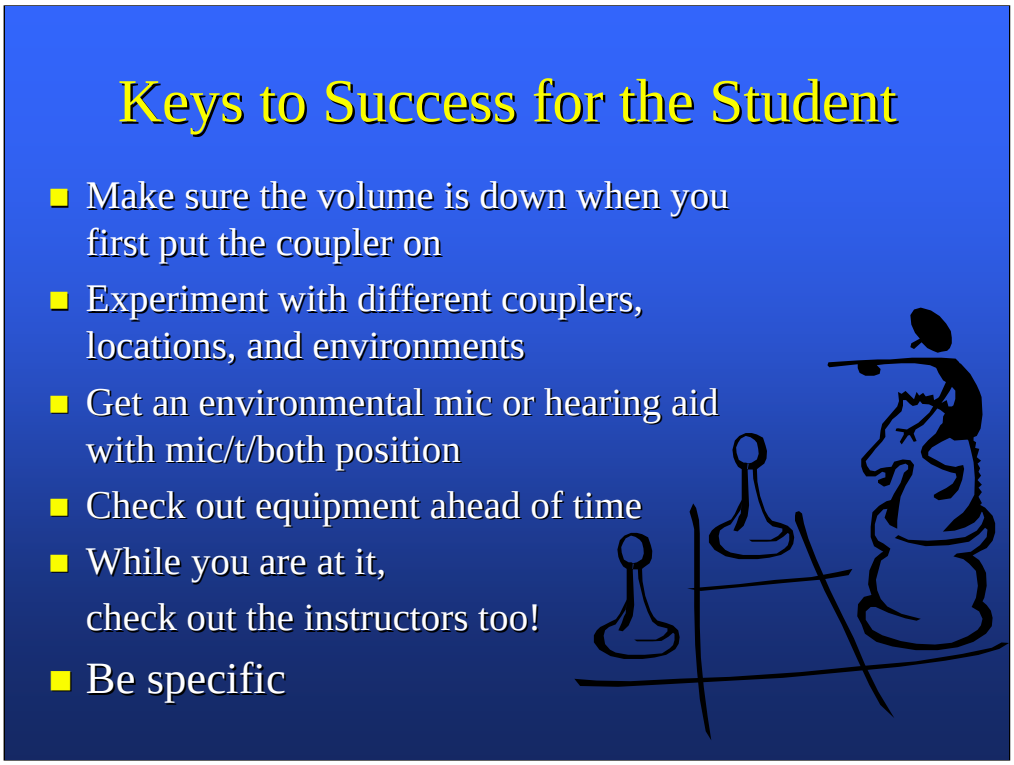


Always, always check that the batteries are charged BEFORE the lecture starts. Make sure that you have a properly working T-coil and that you know how to use it. Experiment with the placement of the headphones and other couplers to the hearing aid. Adjust the position to get the best reception.

Often, changing seats will help correct interference problems. BUT do sit close to the speaker. You won't believe the difference it makes in eye strain and speech reading ease AND in picking up sound with your hearing aid (remember the properties of sound traveling across distance). Get used to NOT sitting in the back of the room!

You will also be amazed at how helpful it is to talk to others to find out their experiences, see what troubleshooting tips they may have, and to find out how they cope with various situations. These groups can be found in local chapters of SHHH (Self-Help for Hard of Hearing Persons) and ALDA (Association of Late-Deafened Adults) and on the internet (Say What Club, Beyond-Hearing, Deaf-Hearing Couples). My web page has information on how to join several internet discussion groups, in addition to other hearing loss information:

http://www.wou.edu/wrocc

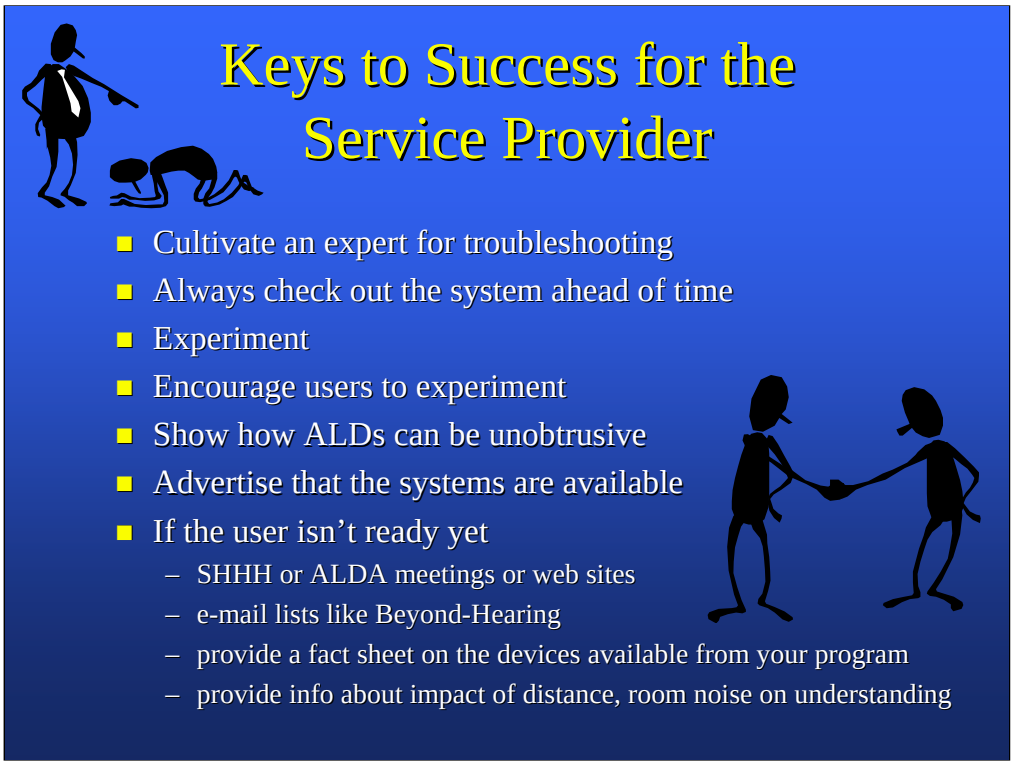


Experiment with the equipment ahead of time with friends (or TV or radio). Try out different coupling devices and see which ones work best for you. Play with placement around your hearing aid and your physical movement and location to see how the reception changes as you move around the room. Always make sure the volume is down before you put headphones on and then adjust it.

Finally, if you do not have a mic/T/both switch on your hearing aid, you may want to request an environmental mic so that you will be able to easily monitor your own voice. Alternatively, see if having 1 hearing aid on T and the other on Mic works for you.

ALWAYS check out the equipment and batteries ahead of time…and for that matter, check out the instructors ahead of time, too. Moustaches and accents make speech reading difficult if not impossible. Maybe one instructor's voice is easier for you to hear than another's, depending on your hearing loss. Some instructors use lecture only, some require group discussion. Some are organized and write outlines on the board. Finding out these kinds of characteristics ahead of time can greatly reduce strain in the classroom.

Eliminate "What?" from your vocabulary. Often you'll find you understood part of the sentence. Instead try (for example) " You found what in the drawer?" This is very helpful to the speaker, and may help to reduce frustration on both your parts. Sam Trychin, an educator on the topic who is hard of hearing himself, recommends you say "Because of my hearing loss, I need you to slow down" or "Because of my hearing loss, I need you to look at me when you speak". He emphases the importance of letting people know, and jokes that it really is better for people to know you can't hear them than to have them think you are stupid, strange, or stuck up when your response doesn't match what they said. Practice leaving off the "I'm sorry" that you may be tacking on to your requests without thinking about it!



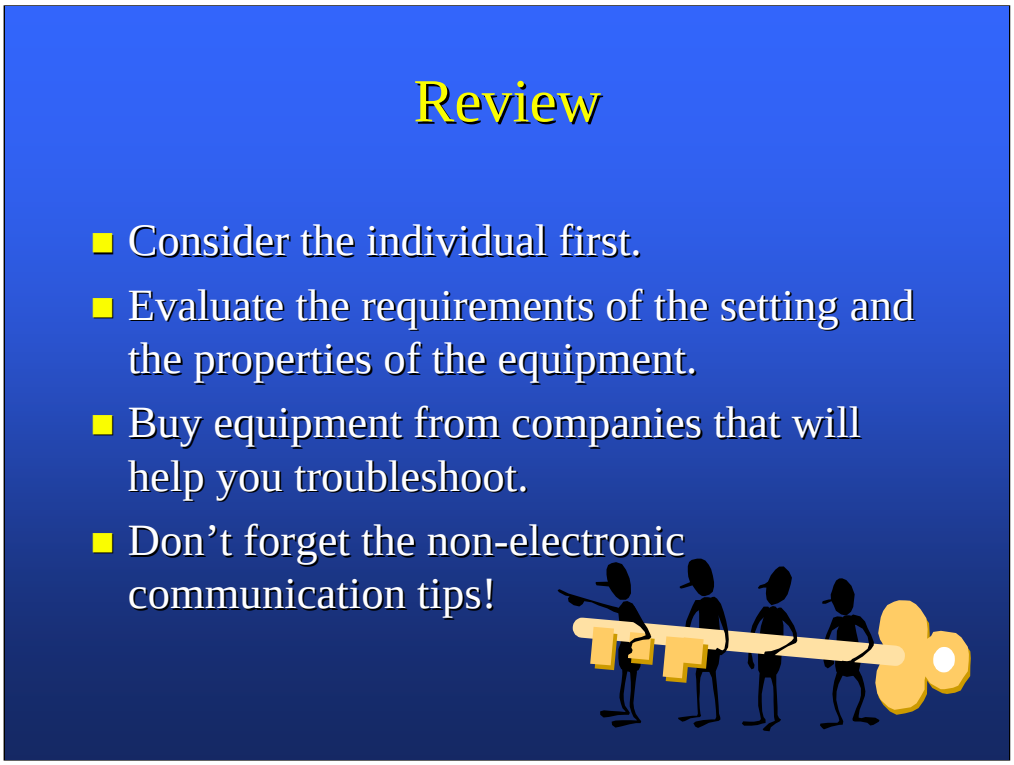
How many of you have put off purchasing eyeglasses you know you need? Well, often times the hearing-impaired student does not want others to know of his or her hearing loss, and may resist using ALDs or identifying him or herself to the instructor. You may *feel* like ordering students to use them, but you should respect the student's process of acceptance. Still, introduce the student to the benefits of using ALDs. Many hearing-impaired users are shocked at the difference in understanding that it makes for them. Some people have dropped out of school and given up jobs because they were not aware how much these devices can improve sound over and above hearing aids, and thus increase functioning and ease of communication.

Support groups like SHHH and ALDA are wonderful. But some people may feel they don't have time, are not interested in participating, or do not live in areas where they are available. Computer e-mail groups are a great alternative for the busy, reluctant, or isolated student. The messages can be read at any time of day or night--great for a busy student's schedule. You can interact or just read, and no one will know you are there--great for the person who is unsure. You don't have to go anywhere, and you can be involved as little or as much as you want. You don't have to interact to benefit from the information provided. Many campuses offer free e-mail accounts.

Encourage the student to experiment with the devices. Make their mantra 'Hearing aids are not as good as it gets!' Try ALDs out with the student in your office. SHOW them how they can benefit from their use. Have them try it out in a class outside of their own with a willing teacher, if they are resistant.

Be sure the student understands the impact of distance and room noise on sound, and why hearing aids and group situations do not mix. Some people respond to this kind of factual information.

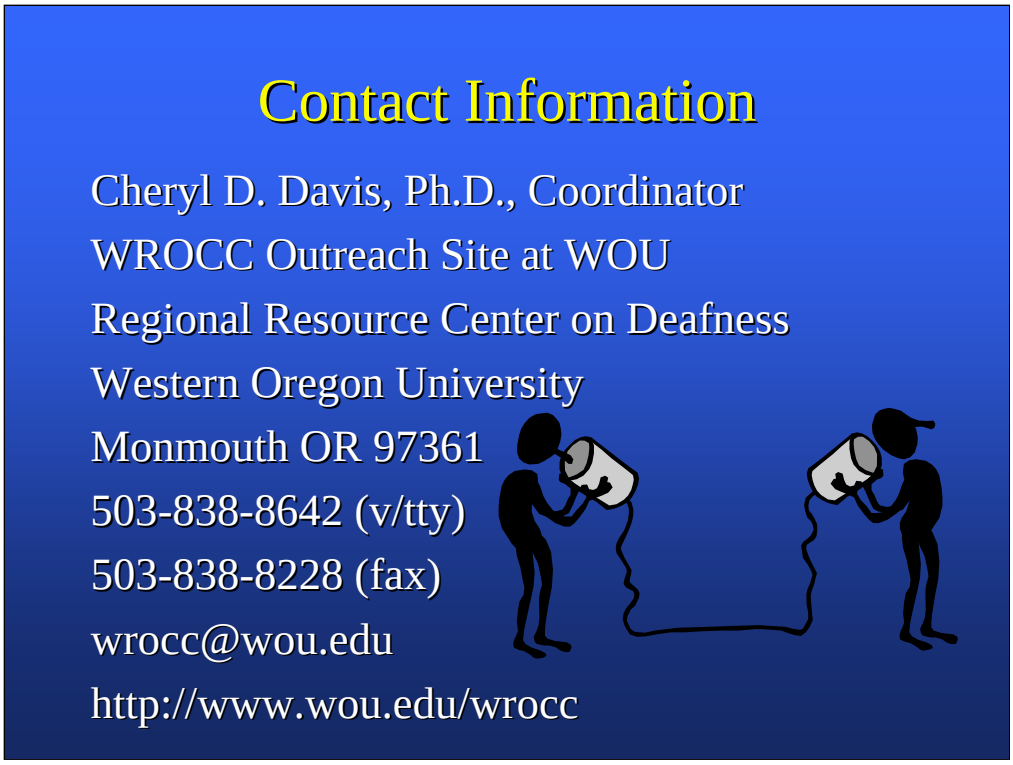
Finally, be sure the systems are working and EVERYONE knows how to use them. Something as basic as poor microphone placement will negate the benefits of ALDs, and create a negative experience for the user. Again, inexperienced users may think it is themselves, not the device, that isn't working.



"The minute you settle for less than you deserve, you get even less than you settled for." -Maureen Dowd

Hearing loss does not come with a manual. People with a hearing loss are constantly balancing being assertive with asking too much. Besides an audiologist, you may be the only person the student sees that has anything to do with disability-related issues. Do your best to educate the individual on what is available. The webpage I've pulled together (the address is on the next screen) provides links to many sources of information and connections to other people living with hearing loss. Pass this on to the student. This information can be vital in helping to create the knowledge in a person that there is a whole community of people out there who are dealing with the same problem.

Finally, for people who are not familiar with it and who have never used it before, all this ALD stuff may seem like space-age technology or something off the Jetsons. The more familiar people are with it, the more they see others using it, the more they integrate and understand the technology and the vast difference it can make, not only in their educational outcomes but in terms of how the feel at the end of the day and how connected they feel to their family and friends, the less resistent they will be to using it. How do you encourage people to integrate the technology into their lives? One way is by interacting with others who use it on a daily basis and who embrace it as being as much a part of their lives as an automobile or cooking with gas. You guessed it…I'm hawking internet surfing and e-mail discussion groups again!



Other resources: Besides my office and the entire PEPNet Network, the web page listed above has links to many, many resources on technology, legal issues, job and educational accommodations, and connections to other consumers.

References and Resources

Blair, J.C. (1990). Front-row seating is not enough for classroom listening. In Flexer, C., Wray, D., & Leavitt, R (Eds.) *How the student with hearing loss can succeed in college: A handbook for students, families, and professionals.* Washington, D.C., Alexander Graham Bell Association for the Deaf.

Cederbaum, E.J. (1996). What's the buzz? *NCOD Network News,* 1, 1-3. Northridge, CA: National Center on Deafness, CSUN.

Compton, C. (1992, October). Assistive Technology for Deaf and Hard of Hearing People: Selecting what's best for you. Paper presented at the Northwest Regional SHHH Convention, Portland Oregon.

Compton, C. (1993, February). Why use assistive listening devices? SHHH Journal, p. 14-16.

Paschell, W. (1991). Do-it-yourself Listening and Signaling Devices for People with Hearing Impairment. Wheaton, MD: Washington Area Group for the Hard of Hearing.

Ross, M. (Ed.) (1994). Communication Access for Persons with Hearing Loss: Compliance with the Americans with Disabilities Act. Baltimore: York Press.

Warick, R., Clark, C., Dancer, J., & Sinclair, S. (1998) Assistive Listening Devices: A report of the National Task Force on Quality of Services in the Postsecondary Education of Deaf and Hard of Hearing Students. Rochester, NY: Northeast Technical Assistance Center, Rochester Institute of Technology. Available at http://www.pepnet.org/index_netac.html (National Task Force Reports). This is an EXCELLENT resource!! Other Task Force Reports may be found here, also.

Graphic Images and credits: Images are included as examples only and are not meant to be endorsements of any particular product.

Slide 10: Example of ExtendEar (hearing aid with built-in FM transmitter) in use.

Slide 12: Neckloop and earphone from Comtek <http://www.comtek-wireless.com>; silhouette from Oticon; headphones from Easy Listener. Direct Audio Input photo courtesy of Brad Ingrao <www.bradingrao.com>.

Slide 12: My thanks to Bev Biderman for information on the use of ALDs with cochlear implants. Any error in relaying this information should be attributed to myself, and not Bev.

Slide 13: Telecoil and hearing aid graphic courtesy of the Electronic Deaf Education Network <www.bradingrao.com>

Slide 15: Top-Easy Listener Wide Area FM-Phonic Ear; bottom middle-ExtendEar <http://www.avrsono.com/products/index.html>; bottom left-hearing aid with FM boot

Slides 15&17: Easy Listener-Phonic Ear <http://members.aol.com/centrumweb/psporta.html#top>

Slide 19: Bottom left-Sennheiser <http://www.sennheiser.com>; Bottom middle: DirectEar <http://www.potpmactech.com>