

# Including Children with Cochlear Implants in General Education Elementary Classrooms

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## Abstract

Cochlear implants can provide partial hearing to individuals with substantial hearing loss. Because of improvements in early identification and intervention, more children with cochlear implants will be included in elementary school general education classrooms. Thus, general education teachers should be prepared for teaching children with cochlear implants. Our aim in this paper is to help prepare general education teachers for this role by (a) describing the cochlear implant and how it functions, (b) offering important general guidelines for teaching a child with a cochlear implant, and (c) listing ways to increase inclusion of children with implants.

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## Keywords

cochlear implant, hearing impairment, social inclusion, education, deafness

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A cochlear implant is an electronic device that can provide partial hearing to individuals with severe to profound sensorineural hearing losses. Currently, there are approximately 10,000 children with cochlear implants in the United States (National Institute of Hearing, 2000) and the number of young children with profound hearing loss receiving implants is increasing about 25% each year (Cochlear Corporation, 2001). Moreover, newborn hearing screenings currently are mandated in 32 states and the Food and Drug Administration has recently approved cochlear implants for children 12 months of age and older (Universal Newborn Hearing Screening Legislation in the U.S., 2005). Advances in early identification, implant technology, and early intensive therapy are making it more likely that many of these children are and will continue to be entering general education elementary classrooms. Thus, general education teachers should be prepared for teaching children with cochlear implants. The purpose of this paper is to help prepare teachers by (a) describing the cochlear implant, (b) presenting some important general guidelines for teaching a child with a cochlear implant, and (c) discussing ways to increase inclusion of children with implants.

#### *What is a Cochlear Implant?*

A cochlear implant is an electronic device that changes sound to electrical energy and may give partial hearing to individuals with severe to profound sensorineural hearing losses. All cochlear implants share similar features. Each implant consists of an external portion that remains outside the skin and an internal portion that is surgically implanted beneath the skin. The external portion consists of a microphone, sound processor, transmitter, and cables. The internal portion

consists of a receiver and electrodes. Sounds are collected from the microphone and sent to the sound processor, where they are encoded into a digital signal. From the processor, the digital signal goes to the external transmitter that forwards the signal, by radio wave connection, through the skin to the internal receiver. The internal receiver sends the signal to the electrodes within the cochlea, where it directly stimulates the auditory nerve. From the auditory nerve, the signal is relayed to the brain, where it is processed similarly to typical hearing. Table 1 and Figure 1 provide examples of the various cochlear implant components.

#### *How Do Children Learn to Use Their Cochlear Implant?*

Children have been wearing hearing aids for many years. Although hearing aids can improve hearing, especially if the hearing loss is mild to moderate, a cochlear implant fosters listening and hearing in a different way. A hearing aid amplifies specific frequencies of speech, or, in other words, it makes sounds louder. A cochlear implant does not make sounds louder; instead it changes sound into electrical energy that stimulates the auditory nerve with a digital signal. This signal is interpreted by the brain as sound with varying pitches. Children with cochlear implants may learn to interpret the signal from a cochlear implant quite differently from the way that children with hearing aids learn to interpret amplified sound.

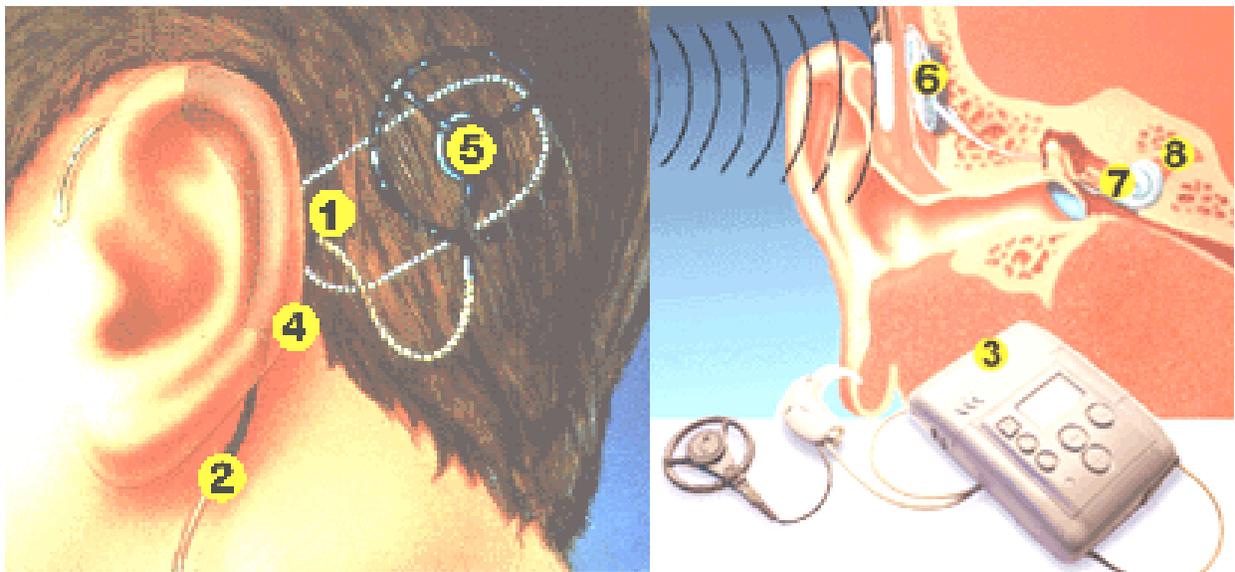
The first step a teacher should take when a child with a cochlear implant starts in the general education classroom is to determine the length of time that the child has had the cochlear implant. Often the first six

Table 1

*What is a cochlear implant?*

- ◆ An electronic device that provides sound by directly stimulating the surviving auditory nerve fibers in the inner ear (the cochlea).
- ◆ Internal components are implanted surgically under the skin and consist of;
  - o Receiver
  - o Electrode array
- ◆ External components consist of;
  - o Microphone
  - o Speech processor
  - o Magnetic head piece
  - o Cable
- ◆ Sound is collected from the microphone, sent to the processor, coded and sent across the skin to the internal receiver. It is then passed to the electrode array in the cochlea which is interpreted by the nerve fiber as sound.

*Figure 1. The components of a cochlear implant.*



*Photos courtesy of Cochlear Ltd.*

1. Microphone
2. Cord
3. Sound Processor
4. Cord
5. External Receiver
6. Internal Receiver
7. Electrode Array
8. Hearing Nerve

months after the implant was activated are the most difficult time of adjustment. This adjustment time begins by having the child simply learn to listen with the implant and to get acquainted with the new sense of hearing. The type of intervention that the child received or is receiving during this time will also greatly affect the outcomes of a cochlear implant. For example, children who have been trained with an oral or auditory-verbal approach generally have been found to have more intelligible expressive speech and better language skills, although they still may have some language gaps compared to same-age hearing peers (Tobey, Rekart, Buckley, & Geers, 2004). It is likely that a child with this background will be included in a general education classroom.

A cochlear implant can enable children to hear many sounds, but it does not provide an individual with typical hearing. This situation means that many individuals with cochlear implants may not be able to talk on the phone, fully appreciate music, or understand speech from an audiotape or computer. Children with implants must learn to interpret the meaning of sounds and this initially requires much repetition. Visual distractions, background noise, or any other environmental sounds can be very overwhelming and may interfere with understanding speech for a child with an implant. Thus, teachers will benefit from learning strategies to help these children become successful listeners in general education classrooms, which are often filled with a myriad of sounds of activity and conversations.

### **Being Part of a Team**

As more children with cochlear implants are included and often require supplemental services, Individualized Education

Plans (IEPs) will be developed and implemented. Generally an IEP is put into place by a team of professionals and parents who meet twice a year to establish goals for the child. For a child with a cochlear implant, the IEP team members often include the parents, general education teacher, hearing itinerant teacher, speech-language pathologist, audiologist, outside therapists (often auditory-verbal therapists or speech therapists), and if other areas of concern arise, psychologists and occupational and physical therapists. The team establishes and approves goals with the child's best interests in mind. Being a part of a team helps to ensure collaboration among parents and professionals. Working together and sharing ideas will help all the team members become more effective and consistent.

### **What Teachers Can Do in Their Classrooms**

There are several things that teachers can do to help children with cochlear implants succeed in the classroom. We present several strategies below, and Table 2 provides examples of classroom enhancements to make listening easier for children with cochlear implants.

#### *Ensure That the Cochlear Implant is Working*

It is imperative to ensure the child's cochlear implant is working at all times during the day. A teacher can test the cochlear implant by completing the *Ling 6 Sound Test* in the morning, after lunch, and later in the afternoon. The Ling 6 test consists of six sounds: ooh, ah, mmm, sh, eee, and sss, and represent low, middle, and high pitch sounds that make up conversational speech (Ling, 1989). It is best to have the child about four feet from the teacher and facing away to ensure that he or she is not reading the teacher's

Table 2

*Tips for Teachers*

What can I do to help children with Cochlear implants be successful?

- Ensure the cochlear implant is on and working
- Reduce background noise in the classroom
- Use carpeting, drapes, and non-sound reflective surfaces to absorb and reduce noise
- Reduce fan noise, air conditioner noise, and television/radio/computer noise
- Close the classroom door to eliminate distracting hallway noise
- Use an FM System in the classroom to improve the speech signal in noise and provide the best acoustic environment
- Position the child with a cochlear implant to be close to speakers
- When speaking with a child, sit on the same side as the child's cochlear implant
- Speak at a slightly slower rate when presenting new information
- Explain to children what is coming up in discussions or studies
- Don't raise your voice or shout; this distorts the speech signal, making it more difficult to understand. Rather, move closer to the child's cochlear implant.
- Gain the child's attention prior to giving directions
- Allow the child extra time to process auditorally
- Repeat new vocabulary often and give alternative words when teaching new vocabulary
- Use a buddy system with projects
- Use written outlines to help the child follow directions

lips when he or she is completing the listening check. The teacher then randomly says the six sounds at varying intervals and at a normal speaking volume, so the child does not learn to respond by memorizing the sequence. The teacher will know that the implant is working if the child is able to repeat these sounds readily and if no audible alarm is heard or flashing lights are seen on the processor to indicate a connection breakdown.

*Learn About Troubleshooting and Care of the Implant*

Parents of children with cochlear implants can often give educators information about their child's specific cochlear implant. It is a good idea for a teacher to have a meeting with parents to discuss how to troubleshoot the implant if problems arise. It is also beneficial to have some spare materials on

hand at school, such as an extra headpiece, an extra microphone, cables, and some batteries. The teacher should have the audiologist's name and phone number from the implant center. A discussion to target troubleshooting, goals, and progress with the school speech pathologist, itinerant deaf education teacher, or both will ensure that all professionals are working toward the same goals. Table 3 provides a list of materials to have at school and Table 4 gives care and maintenance suggestions for the cochlear implant.

*Reduce Background Noise*

One of the most important things to do in a classroom is to reduce background noise. When a child with an implant is expected to listen and perform in the presence of background noise, they may become easily fatigued, distracted, and inattentive. Hearing children have been listening for more than

Table 3

*A List of Supplies That Should be Kept at School*

Cochlear implant supplies to have on hand at school:

1. Spare headpiece and cable
2. Replacement microphone
3. Spare batteries
4. Alcohol swabs
5. Audiologist's name and phone number from the implant center
6. Educator's guide from the Cochlear Implant Manufacturer

Table 4

*Cochlear implants go to school: Do's and Don'ts*

<b>Do's</b>	<b>Don'ts</b>
<ul style="list-style-type: none"><li>○ Ensure the implant is working <b>twice</b> a day</li><li>○ Meet with parents to explain parts of the implant and troubleshooting techniques</li><li>○ Avoid dropping or banging the processor</li><li>○ Avoid extreme temperatures below 32 degrees and above 115 degrees</li><li>○ Prevent static electrical charge</li><li>○ Remove processor and headpiece when child plays on plastic equipment if static guard is not in place</li><li>○ Use an anti-static shield on computer monitors</li><li>○ Ensure cables are worn beneath clothing</li><li>○ Touch a conductive surface such as metal prior to handling the processor</li><li>○ Avoid exposure to moisture</li><li>○ Have the child wear a large t-shirt over the processor during messy art activities</li><li>○ Encourage the child to wear a headband during physical activity that results in sweating</li><li>○ Place the processor in a zip-lock bag if it is at risk for getting sprinkled</li><li>○ Encourage the child to wear a hooded jacket when it is raining</li><li>○ Have the child wear protective head-gear during contact sports</li></ul>	<ul style="list-style-type: none"><li>○ Assume the implant is always working</li><li>○ Assume the child knows how to trouble shoot his/her implant</li><li>○ Allow overly rough play without wearing protective headgear</li><li>○ Expose the processor and microphone to prolonged episodes of heat or cold</li><li>○ Allow the child to wear the processor and microphone while playing on fiberglass or hard plastic surfaces, unless the static guard is in place</li><li>○ Allow the child to play near water without protecting or removing the processor</li><li>○ Allow the child to play contact sports without appropriate head gear</li></ul>

four years by the time they enter school and they have learned to tune out sounds that are not important. Children with cochlear implants may not have the skills to tune out such background noise as the air conditioner, the fan on the computer, buzzing from fluorescent lighting, or the movement of other children. Listening with a cochlear implant can be exhausting, and reducing these noises and limiting the surfaces in the classroom that reflect and bounce sound around the classroom will help greatly. Reducing noise can be done by using drapes on the windows, carpeting on the floor, or at least fabric pads under the feet of the chairs to reduce the loud scraping on the floor. Adding small cushioned pads to desks tops, drawers, and cabinets will help decrease the auditory distraction of closing doors (Nevins & Chute, 1995).

#### *Use an FM or Infrared System in the Classroom*

An FM (frequency-modulated radio transmission) or infrared system is a supplemental listening device that works like a radio. Sound is degraded as it travels from the source; that is, the further away from a speaker a child is, the softer and more difficult the speech signal is to understand. The purpose of an FM system or infrared system is that the listener is placed technologically closer to the speaker. Infrared systems are being used more frequently than in the past to cut down on the number of interfering signals that might affect the transmission (Flexer, 1999).

The teacher wears a microphone that transmits her voice through classroom speakers, through a child's personal desk speaker, or directly into the cochlear implant itself. An FM or infrared system makes a voice loud enough for a child with a cochlear implant to

hear over the background noises that occur in all classrooms. Shouting can distort speech, making it more difficult for the child to understand. The use of an FM or infrared system eliminates the need to raise your voice. No wires are required to connect the teacher and listeners because the unit uses radio waves or infrared light. Because the teacher is wearing the microphone within 6 inches from his or her mouth, the FM or infrared system creates a sound field similar to being within 6 inches from the child's cochlear implant, no matter where the teacher is in the room (Flexer, 2000).

There are a variety of different styles of FM and infrared systems. The newest development in FM systems is that all implants now have the capability to have direct input receivers on the processor of the cochlear implant so a separate speaker is not required (Phonak Hearing Systems, 2005). Other FM and infrared systems are portable and small enough for the child with a cochlear implant to carry from class to class and put on his or her desk; others have speakers that can be positioned on various walls or hung from the ceiling. An FM or infrared system also benefits the educator by reducing the amount of strain on the voice. Many teachers who use an FM or infrared system report that they feel less fatigued at the end of the day and that they do not have to repeat directions as often (Rosenberg, Blake-Rahter, Heavner, Allen, Redmond, & Phillips, 1999).

#### *Arrange the Classroom*

Seating arrangements can enhance what a child with a cochlear implant hears. The teacher may position the child in the front of the room or group so that the child can see the teacher talking and know when to attend to the teacher's voice. If the teacher is using an

FM or infrared system in the classroom, positioning may not be quite as imperative, although in a classroom discussion, the microphone needs to be passed around the room to the various speakers. It should also be pointed out that if there is a source of ambient sound, such as an air conditioner that is intermittently on and off, the child with a cochlear implant should be positioned away from such noises. Table 4 lists ways to ensure the child with a cochlear implant is following class discussions and lists recommendations for remedying misunderstandings.

#### *Alert the Child to Topic Transitions*

When introducing new information, the teacher should gain the child's attention and alert him or her when transitioning topics. Transition alerts and reviews give children an idea of the topics you are going to be discussing. For example saying, "Okay class, now we are going to discuss the Civil War" and then reviewing a small amount of what has previously been discussed (e.g., "Remember yesterday we talked about the reasons this war was started. Today we are going to talk about where the fighting actually took place, how long it lasted, and when the war ended.") is an effective way to help a child with a cochlear implant follow changes in topics. Informing children of transitions will aid in attention to discussions and their ability to ask questions relevant to the subject.

#### *Talk a Little Slower*

It may also help the child with a cochlear implant to have the teacher speak slower when introducing new material. This strategy allows time for children to process what has been said and to ask questions for clarification if needed (Seaver Creative Services Incorporation, 2000). Slowing speaking rate is often a technique used after a cochlear im-

plant is activated. As the child becomes more accustomed to listening and processing auditory sounds, speaking rates can approach more normal rates; however, it is still beneficial for children with cochlear implants to have extra time to process information that is new and important.

#### *Make Eye Contact and Ask, "What did you hear?"*

Establishing eye contact with the child with a cochlear implant prior to giving directions or new information will help ensure that the child is paying attention. Remember that listening is a hard task for the child and requires full attention to hear and comprehend new information. If the child who has a cochlear implant is looking down or around the room, it is likely that he or she is not attending to the teacher's directions. Requiring all children to make eye contact with the teacher will aid in ensuring the child is following along.

Asking the child what he or she heard will give you information about if and where a breakdown in communication occurred. Many parents and teachers often ask a child, "What did I just say?" This statement often puts children on the defensive and does not give the teacher insight into what the child understood. The child may have understood the first part of the message or the last part, but not the section in the middle. Asking the child "What did you hear?" may alert the teacher about some missed or misunderstood information that the teacher can then clarify or correct. Another benefit of using this phrase is that it encourages the child to think about what he or she heard but did not understand.

### *Pre-teach Vocabulary*

Ensuring that the child with a cochlear implant understands key vocabulary in various academic subjects will also improve learning. Children with cochlear implants may not be able to hear or process the conversations of others or ads on television, movies, and radio; thus, they are often excluded from *incidental learning*. Incidental learning takes place for hearing children daily, from attending and listening to all the talking and conversations that take place within hearing range but in which they may not be directly involved. The quantity and quality of incidental learning increases a child's vocabulary (Hart & Risley, 1995). Because children with cochlear implants may not have this incidental learning background, they often require pre-teaching of vocabulary. The pre-teaching of vocabulary enhances the child's ability to understand the discussion that surrounds the new vocabulary and the details that accompany it. A teacher will know if a child needs to have vocabulary pre-taught if the child has exhibited difficulty in the past with vocabulary or if he or she is unable to follow and participate in a general conversation with new vocabulary. Discussing upcoming units with hearing itinerant teachers, auditory-verbal therapists, and parents will allow teachers to identify words that may be unfamiliar to the child and can then be pre-taught.

### *Use Outlines*

Another important way to keep children with cochlear implants on the same track as the rest of the class is for the teacher to provide them with a written outline of the information he or she will be talking about (Seaver Creative Services Inc., 2000). The teacher can write the outline on the chalk board, an overhead, or paper. Some school systems have found great benefits from having content

typed by a parent or volunteer as the teacher is talking and then projecting it onto a screen at the front of the class (Seaver Creative Services, Inc. 2000). An outline allows the child with a cochlear implant to really focus on listening, while providing the visual representation needed to clarify spoken words. These typed notes can also serve as a study guide to be used at home for review.

### **The Buddy System and Positive Peer Interactions**

A buddy system is pairing two children together. It can be beneficial to pair a child with a cochlear implant with a hearing child. The hearing child can help to clarify directions and procedures for the child with a cochlear implant. For example, the hearing child in the pair can repeat what subject the class is moving on to or when an assignment is due.

Children need to communicate with others by using speech and language to acquire age-appropriate social skills and to understand the rules for interactions in various school contexts. Children who receive a cochlear implant at a very young age may come from a typical developing preschool program and may not exhibit any difficulty with social skills. Children who receive cochlear implants after the age of four may not have had access to social interactions and the language surrounding them as much as their typical hearing counterparts. This late implantation may result in the child having some delays in knowing and following subtle social rules and expectations. A buddy can help a child with an implant learn these skills both by modeling them and by explaining them.

Incorporating positive attitudes about peers with disabilities will increase social interaction among classmates. This can be

done by setting up activities and encouraging normal hearing peers to interact with children with cochlear implants. As children learn more about a disability they are more apt to interact with a child who has a disability (Favazza & Odom, 1997). Educating children by explaining what a cochlear implant is, how it works, and by inviting a guest speaker, such as an implanted teen or adult, to discuss their life experiences will help to educate the class. Making it clear that it is important for children in the classroom to be sure the child with a cochlear implant is looking at them when they are talking may also stimulate problem solving skills within the classroom (Brown, Odom, & Conroy, 2001).

## Summary

As the number of children receiving cochlear implants increases and the age of children receiving implants decreases, it is inevitable that general education instructors will be teaching more and more children with “high tech ears”. Learning the various strategies to help children with cochlear implants succeed will aid in successful inclusion in the general education classrooms. Children with cochlear implants benefit most from a team approach, and having informed educators on the team makes everyone more successful. Please see Table 5 for a list of websites and recommended books for further information.

Table 5  
*Resources*

### Cochlear Implants

[www.advancedbionics.com](http://www.advancedbionics.com)  
[www.cochlearcorp.com](http://www.cochlearcorp.com)  
[www.medel.com](http://www.medel.com)  
[www.cici.org](http://www.cici.org)

### FM Systems/Infrared Systems

[www.audioenhancement.com](http://www.audioenhancement.com)  
[www.lightspeed.com](http://www.lightspeed.com)  
[www.phonicear.com](http://www.phonicear.com)  
[www.phonak-us.com](http://www.phonak-us.com)  
[www.telex.com](http://www.telex.com)

### Recommended Books and Motion Picture

Estabrooks, W., (1994). *Auditory verbal therapy for parents and professionals*. Washington, DC: Alexander Graham Bell Association for the Deaf, Inc.

Estabrooks, W., (1998). *Cochlear implants for kids*. Washington, DC: Alexander Graham Bell Association for the Deaf, Inc.

Estabrooks, W., (2001). *50 Frequently asked questions about auditory verbal therapy*. Ontario, Canada: Learning to Listen Foundation.

Schwartz S., & Miller, J. (1996). *The new language of toys*. Bethesda, MD: Woodbine House Inc.

Seaver Creative Services Incorporation (Producer). (2000). *Teaching kids with high tech ears*. [Motion Picture]. Available from Seaver Creative Services Incorporation, 4135 South Oneida Street, Denver, CO 80237.

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Center for Hearing Assessment and  
Management Utah State University  
Web site:

<http://www.infanthearing.org>

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