Manual

For the

School Audiometrist

AUDIOMETRY GUIDELINES
HEARING CONSERVATION PROGRAM

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DEPARTMENT OF HEALTH SERVICES
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Hearing Conservation Program
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To obtain applications, forms and publications, please visit the Hearing Conservation Program's Website at : http://www.dhs.ca.gov/pcfh/cms/publications/hcp.htm

Special thanks to:

Illinois Department of Public Health
Division of Health Promotion & Screening
Springfield, Illinois

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All those who contributed to the completion of this manual

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INTRODUCTION

The purpose of this manual is to provide information concerning the School Hearing Conservation Program. It is a summary of information that is presented at the training courses for the school audiometrist conducted by universities and colleges. The manual is intended for persons who have had formal training in audiometry and is not intended as a substitute for that training. The material can be interpreted properly only with reference to the total content of the course.

This manual is divided into ten chapters, a glossary and an appendix. The chapters represent the major areas of a hearing conservation program. The Appendix consists of forms used in hearing conservation programs and copies of such forms. Local considerations will dictate the design and distribution of specific forms. The samples in this manual are provided only as guidelines for the development of forms.

PM 100, Annual Report of Hearing Testing, is provided in quantity by the State Department of Health Services. The intent is to establish a uniform means of recording, collecting, reporting and evaluating audiometric screening data. These forms are distributed annually from the Hearing Conservation Program, Children's Medical Services/Child Health and Disability Prevention Program.

I. CALIFORNIA NEWBORN HEARING SCREENING PROGRAM

The California Newborn Hearing Screening Program, a component of the 1998-99 Early Childhood Development Initiative, establishes a comprehensive coordinated system of early identification and provision of appropriate services for infants with hearing loss by:

- Offering the parents of approximat ely 400,00 infants the opportunity to have their newborn babies screened for hearing loss at the time of the hospitalization for birth.

- Tracking and monitoring of up to 25,000 infants to assure that appropriate follow-up testing and diagnostic evaluations are completed.

- Providing access to medical treatment and other appropriate educational and support services.

- Providing coordinated care through collaboration wi th those agencies delivering early intervention services to infants and their families.

The incidence of permanent significant hearing loss is approximately 2-4 per every 1000 infants. It is the most common congenital condition for which there is a screening program. It is estimated that the Newborn Hearing Screening Program will identify 1200 infants with hearing loss each year.

The major focus of the program is to assure that every infant, who does not pass a hearing test, is linked quickly and efficiently with the appropriate diagnostic and treatment services and with the other intervention services needed for the best possible outcome. Recent research shows infants with hearing loss, who have appropriate diagnosis, treatment and early intervention services initiated before six months of age, are likely to develop normal language and communication skills.

The California Newborn Hearing Screening Program has three major components:

1. Outreach and Awareness Campaign

An independent contractor will conduct an outreach and awareness campaign. The contractor will be responsible for:

- The development of appropriate educational materials for pregnant women, families of newborn infants and the primary care physicians serving them
- Materials describing the value of early hearing testing, the meaning of the results of the tests and how the program works
- The development of a public media campaign

2. Screening

All California Children's Services (CCS) approved hospitals will offer hearing screenings to all newborns in their hospitals and will perform hearing screenings on all infants receiving care in a CCS approved neonatal intensive care unit (NICU) prior to the infant's discharge. The Department of Health Services will assure the quality of the screening tests by certifying that the hospital's hearing screening program meets CCS standards. The certification will allow the hospitals to be reimbursed by the State for Medi-Cal eligible infants. The process will be phased in so that the nearly 200 CCS approved hospitals will have certified programs by December 2002.

When fully implemented, this program will serve approximately 400,000 infants, over 70 percent of the births in California. Funding is available to separately reimburse hospitals for the testing of infants whose care is paid for by the Medi-Cal program. This will provide payment for about 50 percent of the infants tested.

Hospitals to be certified must demonstrate that an internal system is present that:

- Uses appropriately trained and supervised individuals to perform the test
- Uses appropriate equipment
- Has a commitment to staff physician education
- Has a commitment to family/parent education
- Has policies and procedures in place to assure the forwarding of test results and referral of infant with abnormal results.

3. Geographically Based Hearing Coordination Centers

The Centers, a concept unique to California's newborn hearing screening program, are a very critical component. The Centers will assure that the system operates efficiently; the screening and services are of high quality, and, most importantly babies failing the hearing screening test are not lost to follow-up. In states without coordinated tracking systems, up to 50% of the infants who fail the inpatient screen do not receive the necessary services to determine if a hearing loss is present. It is essential that infants who do not pass the screening test receive prompt evaluation and intervention if appropriate. Otherwise, the benefit and purpose of early screening and identification is lost.

Each Center will be responsible for a specified geographic area. The function of the Centers include:

- Assisting hospitals to develop and implement their screening programs.
- Certify hospitals to participate as screening sites
- Monitoring programs of the participating hospitals
- Assuring that infants with abnormal hearing screenings receive necessary follow-up including rescreening, diagnostic evaluation, treatment, and referral to early intervention service agencies, as appropriate
- Providing information to families and providers so they can more effectively advocate with commercial health plans to access appropriate treatment.

For more information on the

Newborn Hearing Screening Program

Call

916-322-5794

Or

Toll Free 1-877-388-5301

II. HEARING CONSERVATION FOR CHILDREN

A hearing loss affects not only the ears of a child, but the whole child. Consequently, hearing conservation programs for children are important for several reasons:

1. A hearing loss seriously affects a child's ability to communicate because it interferes with the development of normal language and learning. Language is the tool for learning that allows children to store information, exchange ideas, and to express feelings.

2. A hearing loss may affect a child's ability to develop normal speech. The average listener cannot understand the speech of some children, with severe hearing loss, when left untreated.

3. Hearing loss may isolate a child from everyday surroundings including parents, family members, and playmates. Consequently, the child is deprived of the usual opportunity to learn language, speech, social skills, and develop a feeling of self-worth.

4. Children with a hearing loss often demonstrate behavior problems. Some children compensate for their hearing loss by becoming overly aggressive, defiant, or disobedient; others withdraw, avoid, or shun group activities.

5. Children with a hearing loss are often at a disadvantage because their parents may not have sufficient information regarding their child's disability. Anxiety about their role as parents and feelings of guilt about the impairment may cause serious problems within the family.

6. Hearing loss is costly. It necessitates diagnosis, treatment and, possibly, special education. Both parents and community share this financial burden.

The goal of a hearing conservation program should be directed toward prevention of educationally significant hearing loss and should include activities which: (1) promote hearing health; (2) prevent hearing loss; (3) detect hearing problems through periodic evaluation of hearing health status; (4) assure medical and educational follow-through of all hearing health problems; (5) provide for education of children with hearing impairment; and (6) provide an ongoing program of public education regarding the cause, nature, and effect of hearing impairment. All of these activities are vital parts of any hearing conservation program.

Hearing loss may be permanent, progressive, temporary or reversible. All losses have medical and educational significance. Experience has shown that many hearing problems found in school age children respond to medical treatment. As with any pathological condition, the earlier the condition is discovered and remediation initiated, the better the chance of successful treatment.

The school has the responsibility to identify all children with hearing loss, to refer such children for diagnosis and treatment and to determine if program modification or special placement is needed. A comprehensive hearing conservation program in the schools should, therefore, identify all children with hearing impairment, whether temporary or permanent; help families secure remediation; identify and prevent conditions which may contribute to loss of hearing; interpret test results and recommendations of hearing specialists to teachers, parents and child and provide classroom and program adaptation to meet the special educational needs of children with impaired hearing.

Each of you plays an important role in the lives of children, regardless of your level of participation. Some users of this manual will be engaged only in the first part of a hearing conservation program. Others will be involved in several levels, including identification audiometry, referral for medical and educational services, follow-up and other activities. All of the activities of hearing conservation programs should be viewed as links in a chain; if any link is broken or missing, the chain is useless.

III. ANATOMY OF THE EAR

The primary purpose of the human ear is to receive sound from the environment, process it, and transmit it to the higher brain centers. This function will be discussed as it relates to the four major areas of the auditory system: the external ear, the middle ear, the inner ear, and the auditory nervous system.

A. THE EXTERNAL EAR

The external ear (Figure 1) consists of the auricle and the external auditory canal. The auricle (pinna), the visible portion of the external ear, serves in a limited way to collect and funnel sound from the environment into the external auditory canal.

The external auditory canal is slightly curved and is approximately one and one-fourth of an inch in length and one-fourth of an inch in diameter. This canal carries sound to the eardrum. Within the external auditory canal are hair follicles, sweat glands, and oil glands. The shape of the canal, the hair follicles, and the wax (cerumen) produced by the aforementioned glands serve to protect the delicate eardrum from foreign objects. It also helps maintain a constant temperature and humidity in the region surrounding the eardrum.

B. THE MIDDLE EAR

The middle ear (Figure 1) is an air-filled cavity about 3 mm wide and 15 mm tall. Certain landmarks characterize the walls of this cavity. The outer wall contains the tympanic membrane (eardrum) which is the entrance into the middle ear cavity. The eardrum is a very thin, translucent membrane which vibrates in response to the sound waves funneled through the external auditory canal. The posterior or back wall of the middle ear cavity provides an entrance into the mastoid, which is a bony area consisting of air-filled cells. The anterior or front wall of the cavity contains the opening of the Eustachian tube. This tube extends from the middle ear to the back wall of the throat. It serves to equalize air pressure between the person's environment and the cavity of his middle ear. It further provides an avenue for the drainage of fluid from the middle ear cavity. The internal wall of the middle ear contains the round and oval windows. Their function will be described in the segment on the inner ear.

The primary function of the middle ear is to transfer movements of the eardrum through the ossicular chain to the fluid in the inner ear. The ossicular chain is composed of the three smallest bones in the body. These bones are commonly called the hammer, anvil, and stirrup. The anatomical terms for these tiny bones are the malleus, the incus, and the stapes. The malleus is attached to the eardrum and moves in synchrony with it. The malleus is attached to the incus, which is in turn, attached to the stapes. Thus, these three bones form a bridge across the middle ear space and transmit sound vibrations to the fluid medium of the inner ear.

C. THE INNER EAR

The inner ear (Figure 1) is composed of two sensory organs: the organ for balance and the organ for hearing. These organs are encased in a bony capsule and are both fluid-filled. The organ for balance (vestibular mechanism) helps to maintain a person's equilibrium. The organ of hearing (cochlea) resembles a snail shell coil of two and three-quarter turns. The cochlea consists of three fluid-filled chambers, or tunnels, which run the entire length of the coil (Figure 2). These chambers are termed the scala vestibuli, the scala media, and the scala tympani. The scala vestibuli and the scala tympani are filled with a fluid known as perilymph. The opening from the middle ear into the scala vestibuli is referred to as the oval window. This window contains the footplate of the stapes. When a sound is present, the stapes begins a pumping action, which sets the fluid within the inner ear in motion. Because the bony capsule cannot expand, it is necessary to have some type of a release valve so the fluid can move. The release valve is located in the scala tympani. It is covered by a thin membrane and is called the round window. As the footplate of the stapes in the oval window is pushed inward, the fluid movement results in an outward bulge of the membrane covering the round window.

Located between the scala vestibuli and the scala tympani is the scala media. The middle compartment in the cochlea is filled with a fluid known as endolymph. It is most important as it houses the sensory receptor for hearing called the organ of Corti which rests on the very flexible basilar membrane. This receptor has thousands of microscopic hairs, which detect the fluid movements within the inner ear. The bending of these hairs results in nerve impulses in the auditory nerve.

D. THE AUDITORY NERVOUS SYSTEM

The auditory nervous system (Figure 3) is composed of the auditory nerve (eighth cranial) and its associated pathways to the brain. The nerve impulses, initiated by the bending of the hair cells on the organ of Corti, travel along many of the 30,000 fibers of the auditory nerve. These fibers twist as a wire cable and progress through a bony canal (internal auditory canal) entering the lower portion of the brain stem. From the brain stem, the fibers progress along a well-defined pathway to their final destination in the auditory portion of the temporal lobe of the brain. The interpretation of sound which takes place along this pathway and within the brain is not completely understood.

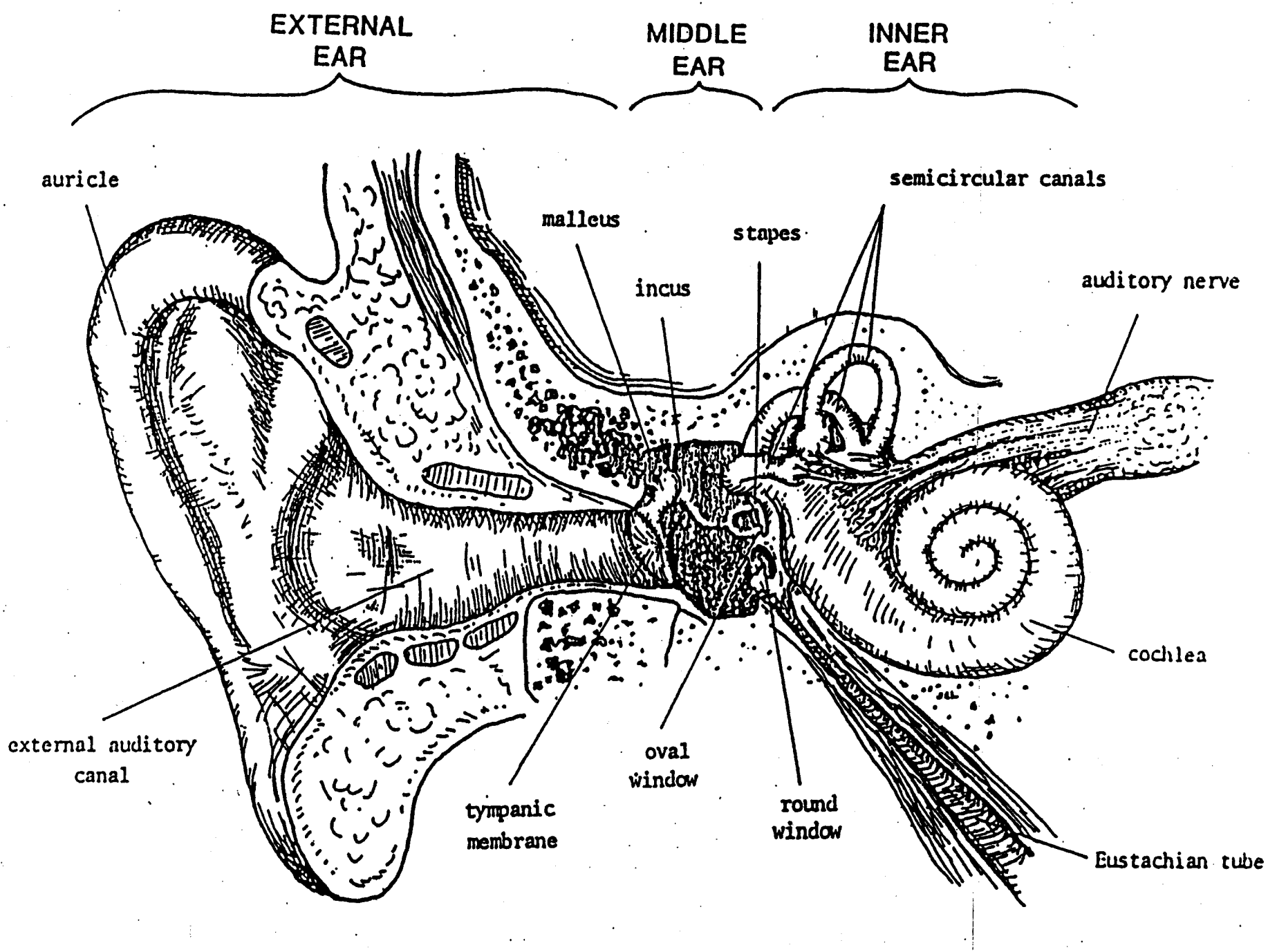

Fig.1 ANATOMY OF THE HUMAN EAR

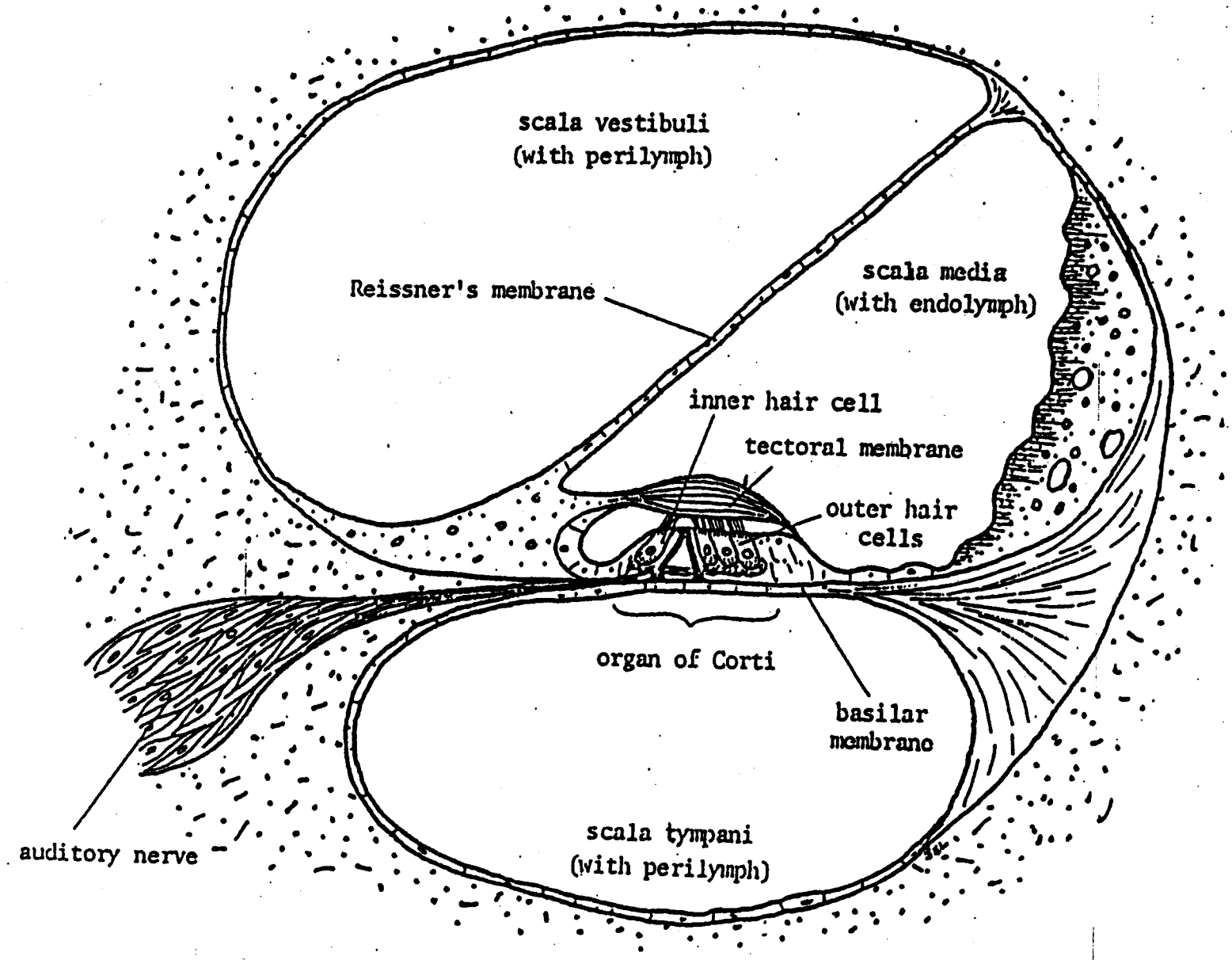

Fig. 2 CROSS-SECTION OF COCHLEA

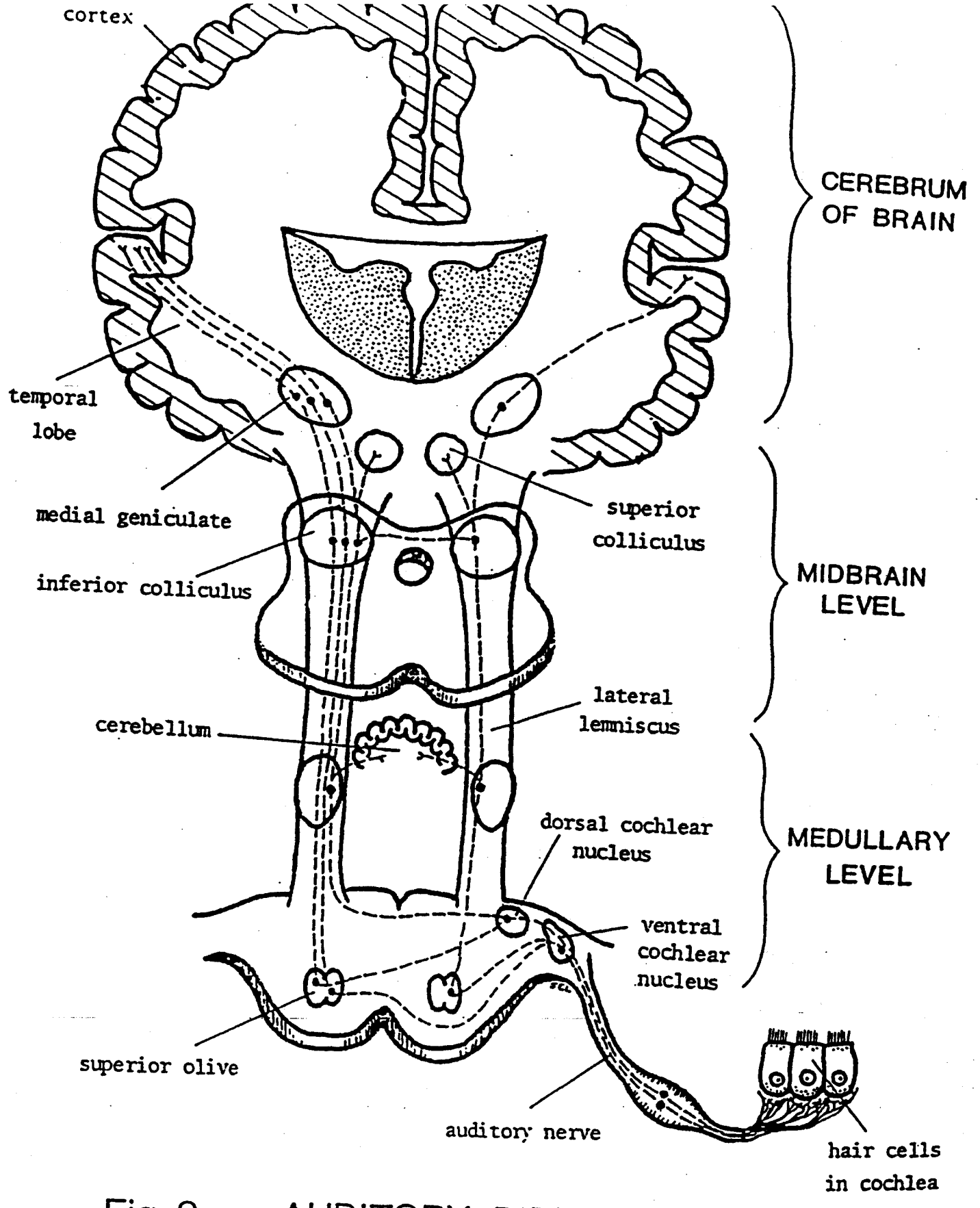

Fig. 3 AUDITORY PATHWAY OF THE CENTRAL NERVOUS SYSTEM

IV. THE DISORDERS OF HEARING IN CHILDREN

A disorder of hearing may be defined as a problem with the hearing mechanism, which prevents it from functioning normally. Hearing disorders are commonly classified into one of four major categories: conductive, sensorineural, mixed, and non-organic hearing losses. In the following sections each of these categories will be discussed according to its associated symptoms, causes, and treatments.

A. CONDUCTIVE HEARING LOSS

A conductive hearing loss is defined as a malfunction of the external and/or middle ear while the inner ear and nerve are normal. The effect of a conductive hearing impairment is reduction in the level of sound being conveyed or "conducted" to the inner ear. The symptoms which are associated with this type of impairment may vary with the degree of the hearing loss but, in general, may be described as follows. A person with a conductive hearing loss:

1. Demonstrates either a hearing loss predominantly in the low frequencies or a similar hearing loss extending across all frequencies;

2. Understands speech well when the loudness of the speaker is increased sufficiently to overcome the amount of the conductive loss;

3. Is usually not annoyed by the presence of loud sounds in his environment;

4. Appears to understand speech in a noisy environment better than a person who has normal hearing;

5. May speak in a relatively soft voice.

The causes of a conductive hearing loss are described according to the part of the hearing mechanism, which is affected: the external ear or the middle ear. The following sections include the most common causes of conductive hearing impairments as well as their treatments.

1. The External Ear

a. The absence or malformation of the pinna and the external auditory canal. This condition is most often a birth defect commonly referred to as atresia. The treatment may involve the surgical construction of the pinna and the external canal. In a few instances, the outer ear is normal but the ossicles of the middle ear are malformed.

b. Obstruction of the external auditory canal. The presence of a foreign object or a build-up of cerumen in the external canal may cause a reduction in the intensity of sound reaching the eardrum. The treatment is the removal of the obstruction.

2. The Middle Ear

a. Inflammation or infection of the lining of the middle ear cavity. This inflammatory process is referred to as otitis media and may result from many conditions including allergies or an upper respiratory infection. The inflammation often results in a build-up of fluid in the middle ear space, which, because of its presence, reduces the normal transmission of sound across the ossicular chain. A similar problem occurs when the opening of the Eustachian tube is blocked because of enlarged adenoids. If drainage from the middle ear space does not occur and the volume of fluid is increased within the cavity, the eardrum begins to bulge from the force of the fluid pressure. A further increase in fluid build-up may result in severe pain and a potential ruptured eardrum. A short-term occurrence of otitis media is referred to as acute otitis media, whereas, a long-term involvement is referred to as chronic otitis media.

The treatment for middle ear infections may depend on the severity of the problem or on the specific cause. The treatment may vary from the administration of antibiotics, to the insertion of ventilation tubes through the eardrum, the removal of the tonsils and adenoids, or allergy management. If the presence of a long-term infection has destroyed or damaged the ossicles, or has entered the air-filled spaces of the mastoid, it may be necessary for the physician to remove the infected area and surgically rebuild the damaged structures at a later time.

b. Perforation of the eardrum. Damage to the eardrum may be the result of punctures produced by foreign objects, extremely loud sounds, increased external pressure, or by fluid pressure build-up within the middle ear space. If the eardrum does not spontaneously repair itself, the physician may find it necessary to patch the perforation.

c. Otosclerosis. This conductive hearing impairment is not thought to be a disease process found in children. It is usually seen in young adults and older age groups. However, there are rare isolated reports of this condition occurring among children. Otosclerosis is caused by deposits of a bony substance around the footplate of the stapes. Upon the hardening of the bony substance, the stapes cannot move and the level of the sound reaching the inner ear is reduced. The treatment for otosclerosis consists of the surgical removal of the stapes or other affected members of the ossicular chain. Following the removal of these bones, the surgeon may insert a synthetic device to bridge the gap between the working portion of the ossicular chain and the oval window, which housed the footplate of the stapes.

B. SENSORINEURAL HEARING LOSS

A sensorineural hearing loss is defined as a malfunction of the inner ear (cochlea) and/or the auditory nerve, in the presence of a normal external and middle ear. A sensorineural hearing loss may result in both a reduction in the loudness level of sound, and a loss of clarity of speech. Unlike the conductive hearing loss, the sensorineural hearing loss usually cannot be corrected by medication or surgery. The symptoms associated with a sensorineural hearing loss may vary with the severity of the problem or the location of the problem. A person with a sensorineural hearing loss:

1. Demonstrates a hearing loss, which may range from mild to profound in one or both ears. The loss may be greater for higher frequency sounds;

2. Will demonstrate a reduced ability to understand speech with the common complaint of "I can hear, but I can't understand". The limitations imposed upon the understanding of speech may vary with the amount of the hearing loss;

3. May display an inability to tolerate loud sounds;

4. May have poor speech because of the inability to hear others as well as to monitor oneself;

5. May speak in a relatively loud voice;

6. Will often complain of a ringing or buzzing sound in his ears. This problem, although not totally understood, is referred to as tinnitus.

The cause of sensorineural hearing loss can best be described according to the time in life when the hearing loss begins. If the hearing problem develops before birth, it is termed congenital; if it occurs after birth, it is termed acquired.

1. Congenital Hearing Loss

Congenital simply means present “present at birth”. Approximately 50% of cases of childhood deafness are hereditary. The Joint Committee on Infant Hearing (JCIH) has provided risk indicators for use in neonates (birth through age 28 days) where universal hearing screening is not yet available. These risk indicators are:

a.) An illness or condition requiring admission of 48 hours or greater to a NICU (Cone-Wesson et al., 2000; Fortnum and Davis, (1997).
b.) Stigmata or other findings associated with a syndrome known to include a sensorineural and or conductive hearing loss (Cone-Wesson et al., 2000).
c.) Family history of permanent childhood sensorineural hearing loss (Cone-Wesson et al., 2000; Fortnum & Davis, 1997).

d.) Craniofacial anomalies, including those with morphological abnormalities of the pinna and ear canal (Cone-Wesson et al., 2000; Fortnum & Davis, 1997).
e.) In-utero infection such as cytomegalovirus, herpes, toxoplasmosis, or rubella (Demmler, 1991; Littman et al., 1995; Williamson, Demmler, percy, & Catlin, 1992).

Interpretation of the Cone-Wesson et al. (2000) data reveals that 1 to 56 infants identified with permanent hearing loss revealed clear evidence of late-onset hearing loss by one year of age. The definition of late-onset hearing loss for this analysis was a present ABR at 30 dB in the newborn 8-12 months greater than 40 dB for all stimuli. . Risk indicators for an infant with late-onset loss at one year of age this included low birth weight, respiratory distress syndrome, bronchio-pulmonary dysplasia, and 36 days of mechanical ventilation. While these data are valuable, additional study of large samples of infants is needed before risk indicators for progressive or delayed-onset hearing loss can be clearly defined.

2. Acquired Hearing Loss

An acquired hearing loss is not present at birth. The JCIH recommends the following indicators for use with neonates or infants (29 days through 2 years). These indicators place an infant at risk for progressive or delayed-onset sensorineural hearing loss and/or conductive hearing loss. Any infant with these risk indicators for progressive or delayed-onset hearing loss who has passed the birth screen should, nonetheless, receive audiologic monitoring every 6 months until age 3 years. These risk indicators are:

a.) Parental or caregiver concern regarding hearing, speech, language, and or developmental delay.
b.) Family history of permanent childhood hearing loss (Grundfast, 1996).
c.) Stigmata or other findings associated with a syndrome known to include a sensorineural or conductive hearing loss or Eustachian tube dysfunction.
d.) Postnatal infections associated with sensorineural hearing loss including bacterial meningitis (Ozdamar, Kraus & Stein, 1983).
e.) In-utero infections such as cytomegalovirus, herpes, rubella, syphillis, and toxoplasmosis.
f.) Neonatal indicators-specifically hyperbilirubinemia at a serum level requiring exchange transfusion, persistent pulmonary hypertension of the newborn associated with mechanical ventilation, and conditions requiring the use of extracorporeal membrane oxygenation (ECMO) (Roizen, 1999).
g.) Symdromes associated with progressive hearing loss such as neurofibromatosis, osteopetrosis, and Usher's syndrome.
h.) Neurodegenerative disorders, such as Hunter syndrome, or sensory motor neuropathesis, such as neurofibromatosis, osteopetrosis,and Usher's syndrome.
I.) Head trauma.
J.) Recurrent or persistent otitis media with effusion for at least 3 months (Stool et al. 1994).

Because some important indicators, such as family history of hearing loss, may not be determined during the course of Universal Newborn Hearing Screening (UNHS) programs, the presence of all late-onset risk indicators should be determined in the medical home during early well-baby visits. Those infants with significant late-onset risk factors should be carefully monitored for normal communication developmental milestones during routine medical care.

The JCIH recommends ongoing audiologic and medical monitoring of infants with unilateral, mild, or chronic conductive hearing loss. Infants and children with mild or unilateral hearing loss may also experience adverse speech, language and communication skill development, as well as difficulties with social, emotional, and educational development (Bess, Dodd-Murphy, & Parker, 1998; Tharpe & Bess, 1995, Blair, Petterson, & Viehweg, 1985; davis et al., 1986; Matkin & Bess, 1998; Roush & Matkin, 1994). Infants with unilateral hearing loss are at risk for progressive and/or bilateral hearing loss. (Brookhouser, Worthington, & Kelly, 1994). Infants with frequent episodes of otitis media with effusion (OME) also require additional vigilance to address the potential adverse effects of fluctuating conductive hearing loss associated with persistent or recurrent OME (Friel-Patti & Finitzo-Hieber, Conti, & Brown, 1992; Gravel & Wallace, 1992; Jerger, Jerger, Alford, & Abrams, 1993; Roberts, Burchinal, & Medley, 1995; Stool et al., 1994; Wallace et al., 1988)

C. MIXED HEARING LOSS

A mixed hearing loss is a combination of a conductive and a sensorineural loss in the same ear. An example of this is the individual who has a sensorineural congenital or acquired hearing loss, while at the same time, experiencing a conductive hearing loss because of the presence of middle ear effusion.

The symptoms associated with a mixed hearing loss may be either characteristic of a sensorineural or conductive problem, or may be a combination of the symptoms of both disorders. Causes and treatments for mixed hearing losses are the same as those discussed previously in the sections entitled "Conductive Hearing Loss" and "Sensorineural Hearing Loss".

D. NON-ORGANIC HEARING LOSS

A non-organic hearing loss may be defined as a hearing loss for which there is no known physical basis but is thought to be a result of the psychological state of the individual. The following are symptoms, which may be associated with this hearing disorder:

1. The hearing test usually reflects mild to moderate, flat, bilateral "hearing loss".

2. A child who displays a non-organic hearing loss usually has good speech and no difficulty in communicating in normal conversation. When the hearing of the person is audiometrically tested, however, the results are significantly poorer than would be predicted.

3. The results of repeated hearing tests will vary for an individual manifesting a non-organic hearing loss.

4. Some of these children may have a positive history of ear infections, a factor, which can be misleading to the audiometrist.

There are several possible causes for non-organic hearing loss, but in a school age population it is primarily used as an attention-getting mechanism, as a cover-up for poor performance in school, or because of family problems. Management of a child with non-organic hearing loss may require a complete audiological evaluation and the expertise of a professional who is trained to manage emotional problems. A child suspected of having this problem should not be labeled or handled by the school audiometrist.

V. NOISE

Noise can be any auditory disturbance that interferes with what a listener wants to hear. In January of 1990, the National Institute on Deafness and Other Communicative Disorders convened a Consensus Development Conference on Noise and Hearing Loss.[2] The purpose of this conference was to discuss the effect of environmental sounds on human listeners. The areas most pertinent to the school audiometrist are interference with speech communication and other auditory signals, annoyance and aversion, and noise-induced hearing loss.

A. INTERFERENCE WITH SPEECH COMMUNICATION AND OTHER AUDITORY SIGNALS

We expect children to hear, understand, and learn in a setting full of noises coming from inside and outside the classroom. The inaccurate perception of speech in noisy environments is known to affect a student's attention, behavior, and learning. It is the position of the American Speech-Language-Hearing Association (ASHA) "that all students (children and adults) be provided with appropriate acoustical environments in educational settings, to include classrooms, assembly areas, and communication-related treatment rooms."[3] ASHA states that classroom generated noise such as students talking, desks/chairs sliding on non-carpeted flooring, and shuffling books and papers may be the most detrimental to classroom communication because this noise is similar in frequency to the desired signal, the teacher's voice. Also present in the classroom are externally generated noises from sources such as hallway traffic and heating/ventilation/air conditioning (HVAC) operation, or noise coming from large assembly areas such as gymnasiums or cafeterias. Whether internally or externally generated, the presence of noise can produce relatively poor signal-to-noise ratios (SNRs) in the classroom setting.

To ensure that all students (particularly those students with specific communication/educational needs) be provided with appropriate acoustical environments in educational settings, ASHA has set forth guidelines for acoustics when adding to, remodeling, or building new schools. In addition, they have provided some more practical acoustical improvement strategies to assist communication-related professionals. Some suggested methods by which classroom noise can be minimized and the desired communication signals maximized include locating classrooms away from external noise sources, such as adjacent traffic or construction areas, HVAC equipment, or playground areas; locating rooms away from busy hallways and other large group areas, such as gymnasiums and cafeterias; and using internal acoustical treatments such as carpeting, curtains and acoustical wall and ceiling panels. They also suggest minimizing the speaker-to-listener distance, when possible, to improve SNRs or employ assistive listening systems as an appropriate additional consideration.

The Americans with Disabilities Act (enacted July 26, 1990) has brought into focus the need for removing barriers and improving accessibility of all buildings and facilities. Acoustical barriers that

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[2]Noise and Hearing Loss. NIH Consens Dev Conf Consens Statement 1990 Jan 22-24; 8(1).

[3]American Speech-Language-Hearing Association, (1995, March). Position Statement and Guidelines for Acoustics in Educational Settings. *Asha*, 37 (Suppl.14, p.15).

limit access to communication and information caused by background noise present a barrier to learning and communication. These barriers must be identified and minimized or removed in order to provide the best acoustic environment for academic success.

B. ANNOYANCE AND AVERSION

Unwanted noise can be annoying to both the teacher and the student. It can derail the train of thought and cause sufficient distraction to make listening difficult if not impossible. Noise can limit the students ability to concentrate on a given task and can be a source of additional stress for both student and teacher. Taking steps to remediate a noisy classroom setting (as detailed above) will result in a less stressful learning environment for everyone.

B. NOISE-INDUCED HEARING LOSS

Hearing loss afflicts approximately 28 million people in the United States. Approximately ten million of these impairments are at least partially attributable to damage from exposure to loud sounds.[4] The effects of exposure to high levels of noise is both damaging and cumulative over a lifetime and is not currently treatable. Once hearing is gone, it's gone. Hearing loss associated with noise exposure can occur at any age and is often characterized by difficulty in understanding speech. Exposure to high levels of noise of short duration can result in temporary or permanent hearing loss. Longer exposure to less intense but still hazardous sounds will take a gradual toll on hearing sensitivity. Hearing loss in the high frequencies appears to increase with age and is becoming more common in high school students. In a recent study[5], the prevalence of noise-induced hearing loss among U.S. children age 6 to 19 years old, was estimated to be 12.5% of the population. These findings suggest that children are being exposed to excessive amounts of hazardous levels of noise. The popularity of high intensity recreational sound sources such as motorcycling, sport shooting, live music concerts, and the use of personal listening devices have increased in recent years. This recreational noise, especially in combination with noise exposure inherent in industrial art and music classes, can be a significant risk factor for hearing loss.

The Occupational Safety and Health Administration (OSHA) has set guidelines for the length of time a person can be exposed to various levels of continuous noise without potential damage. The following figure demonstrates these levels and maximum duration allowed.

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[4]Noise and Hearing Loss. NIH consens Dev Conf Consens Statement 1990 Jan 22-24; 8(1).

[5]Miskar, A.S., ETAL (2001) Estimated Prevalence of Noise Induced Hearing Threshold Shifts Among Children 6 to 19 years of Age. *Pediatrics*, 108, 40-43.

Figure 4: OSHA GUIDELINES FOR CONTINUOUS NOISE LEVELS (dBA scale)

SAFE SOUND LEVEL	DURATION PER DAY
90 dB	8 hours
92 dB	6 hours
95 dB	4 hours
97 dB	3 hours
100 dB	2 hours
102 dB	1 ½ hours
105 dB	1 hour
110 dB	½ hour
115 dB	1/4 hour

These OSHA levels are merely guidelines for industry and do not in any way imply that a person who is exposed to 90 dBA noise for eight hours will not sustain damage to his/her hearing. In fact, such exposure over a working lifetime without wearing hearing protection will certainly result in some hearing loss and in some cases, a substantial hearing loss.

The following figure illustrates noise levels that may be encountered in industrial art and music classes. It is obvious that the sound levels experienced in these environments are potentially hazardous.

Figure 5: INDUSTRIAL ARTS NOISE LEVELS

NOISE SOURCE	SOUND LEVEL dBA
Band	90 - 112 dB
Carpentry	92 - 114 dB
Auto Shop	94 - 106 dB
Welding	72 - 108 dB
General Shop	92 - 109 dB

Taken from Arthur, D., (1988) Hearing Conservation in an Educational setting. In D. Lipscomb (Ed.), Hearing Conservation in Industry, Schools, and the Military. Mass. College Hill Press.

The hazards of intense noise exposure must be a consideration when establishing a hearing conservation program. Although not curable, hearing loss produced by exposure to noise can be prevented through education and the proper use of hearing protection. Is should be noted that OSHA has set a level of 85 dB for eight hours of exposure as the action level to institute mandatory use of hearing protection. Personal hearing protection, like any other piece of safety equipment, must be used as a means of preventive care. Educational materials and/or resources to inform both teachers and children regarding the effects of noise on hearing should be made available as part of the hearing conservation program.

Multimedia educational materials on noise pollution and hearing protection designed to supplement regular curriculum and stimulate student awareness of the dangers of exposure to loud sounds are available for use by educators. The appendix of this manual contains a listing of resources from which educational materials and information on noise abatement and noise exposure can be secured.

VI. THE MEASUREMENT OF HEARING

A. IDENTIFICATION AUDIOMETRY

The measurement of hearing will be discussed in relationship to the procedures recommended by the California State Department of Health Services. Audiometric screening of children should be carried out in two stages. The first stage is known as sweep screening and involves the testing, in an abbreviated way, of large numbers of children. The purpose of the sweep screening is to identify: (1) those children who have no hearing problems; and (2) those children who are suspected of having a hearing loss. The second stage involves a more detailed test, known as the threshold test. The threshold test either confirms or nullifies the screening test result and leads to a medical-audiological and educational referral, if indicated. It should be noted that threshold testing is only undertaken with those children who are suspected of having a hearing loss. In both stages, the ears are tested individually.

For screening, the "sweep" test has been devised for rapid appraisal of the individual's hearing. During the sweep test, the audiometer is set to a predetermined intensity level and the frequency dial is then "swept" from the low through the high tones. A detailed description of this procedure will follow.

The technique for threshold testing is more complicated. Unless a number of variables are controlled, an accurate estimate of the child's hearing cannot be obtained. The fundamental feature of this technique is that the hearing threshold is measured for each frequency by decreasing the intensity of the tone from a level where it is audible to the level where it can't be heard. A detailed description for determining threshold will be presented later.

B. SCREENING PROCEDURE

It is recommended that the right ear be tested first. The reason for this is merely to establish a routine for the benefit of the audiometrist, since there are fewer chances of error in conducting the test and recording the results if the same procedure is followed in test after test. Screening is done at the frequencies 1000, 2000, and 4000 Hz at a hearing level not to exceed 25 decibels.[6, 7]

Test Frequencies	Decibels
1000 Hz	20, or 25 dB
2000 Hz	20, or 25 dB
4000 Hz	20, or 25 dB

[6]The American Speech-Language-Hearing Association (ASHA) (1985, May) Guidelines for Identification Audiometry, recommends "screening levels of 20dB (re ANSI-1969) at all frequencies tested." See F,2. "Choice of a Testing Room" for environmental criteria.

[7] California Code of Regulation (CCR) Title 17 Section 2971

Set the frequency selector dial at 1000 Hz and the hearing level dial at 50 dB. Depress the interrupter switch, introducing the tone for one-to-two seconds, and then release it taking care not to allow it to spring back suddenly.[8] Present the tone one or two times at 50 dB to orient the child and to assure a response to the correct signal. Once you have received the desired response (hand raised) set the hearing level dial at the chosen screening intensity setting for the remainder of the screening test. Complete the sweep screening test in the following manner:

1. Test the right ear at 1000, 2000, and 4000 Hz;
2. Switch the tone to the left ear leaving the frequency selector dial at 4000 Hz;
3. Test the left ear at 4000, 2000, and 1000 Hz;
4. Record the results and dismiss the child.

If the child fails to respond to any tone at the screening intensity, you should immediately perform the first threshold test.

Make sure, in operating the interrupter switch that you do not fall into rhythmical patterns. Some children will perceive this rhythm and will respond even though they do not hear the test tone. The pattern of tonal presentations should be irregular; that is, one time the interrupter switch may be off for several seconds, and the next time it may be depressed almost immediately after it has been released. In any event, the child should not be able to predict the next presentation of the tone. Information regarding the validity of a child's responses is obtained by noticing how promptly the child becomes aware of the presence of the tone, and also how promptly he indicates that the tone is inaudible. Sometimes, a child will continue to respond after you have released the interrupter switch. If the child's responses are inconsistent in either of these ways, it may be necessary to rephrase the instructions. Make certain the child understands that he is to signal as soon as he thinks he hears the tone and to keep signaling as long as the tone is present. Even with the repetition, there will be some children whose responses pose a problem in interpretation. In such cases, the tester must note on the audiogram that the child's responses were not consistent and/or any other conditions that may have adversely affected the test results.

Avoid the following errors:

1. DO NOT LET THE CHILD SEE YOU OPERATE THE INTERRUPTER SWITCH.
2. DO NOT "LOOK UP" EACH TIME YOU PRESENT THE TONE. A child will soon associate your head or eye movements with the presentation of the tone and will begin to respond to these movements.

Special procedures used to screen exceptional children are discussed later in this manual. Procedures to screen pre-school children can be obtained through the Child Health Disability Prevention (CHDP) Program by attending an audiometric workshop. Please contact your local CHDP office.

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[8]Care must be taken to pause between each presentation of a frequency and each adjustment of the intensity. Changes in these controls should be made only while the interrupter switch is in "off" position. This will prevent the child from hearing and responding to switching noise that may be introduced into the earphones while the interrupter switch is in the "on" position.

C. PASS - FAIL CRITERIA

A child is considered to have "failed" the screening test, if he/she fails to respond to any one of the test frequencies at the screening intensity in either ear.

Children "failing" the sweep screening test should be given a threshold test immediately. The second threshold test should occur two-to-six weeks after the first test. For consideration of time constraints, threshold testing may be performed **at the failed frequencies only**.

D. THRESHOLD TEST PROCEDURE

Remember, ***the first threshold test is used only to confirm the screening results. If the child responds to all of the previously failed frequencies at 25 dB, a second threshold test will not be required***. The same mode of response (hand raised) will be transferred from the screening test to the threshold test.

The procedure for determining threshold is the same for all frequencies. Start with the frequency selector set at a failed frequency and the hearing level dial at 40 dB. Depress the interrupter switch, introducing the tone for one-to-two seconds, and then release it taking care not to allow it to spring back suddenly.

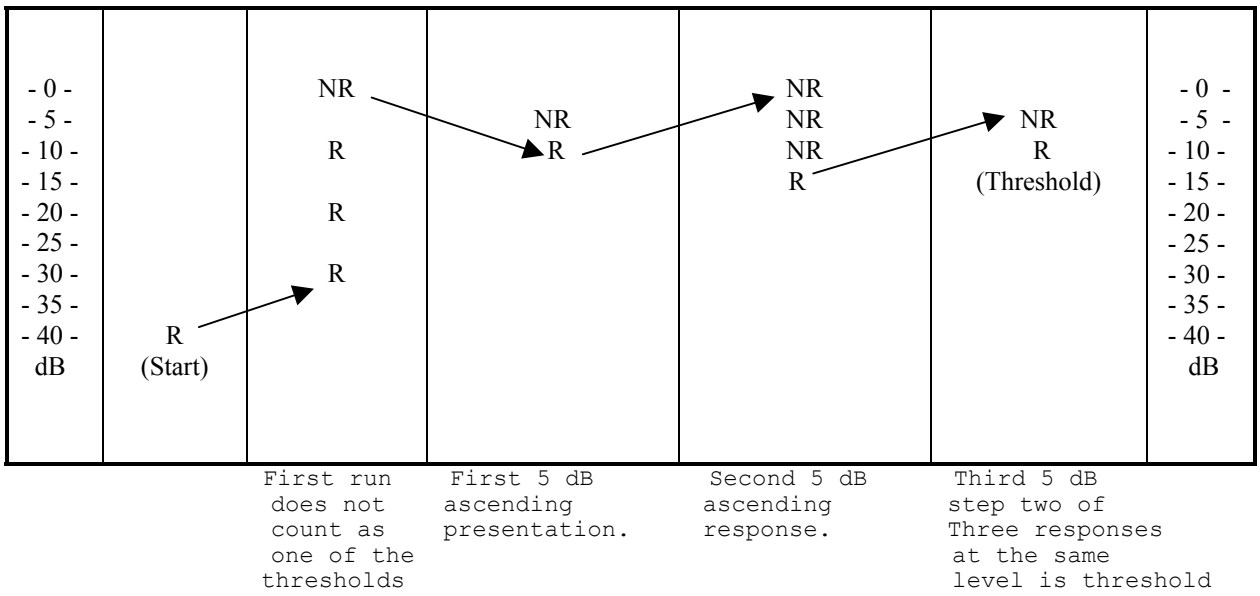
If the child does not respond, increase the intensity 10 dB and present the tone again. If necessary, continue to increase the intensity in 10 dB steps until the child responds. At that point, increase the intensity an additional 10 dB to be absolutely certain that the child is able to hear the tone well. You have now established the upper limit of the child's threshold. That is, his hearing is not poorer than this level and, in fact, is likely to be better.

Now decrease the intensity to the level that is 10 dB below the hearing level at which the child first responded. If the child responds to the tone at this level, lower the intensity another 10 dB and present the tone again. Continue decreasing the intensity by 10 dB until the child does not respond. You have now established the lower limit of his threshold. That is, the hearing is not better than this level and, in fact, is likely to be poorer. With these two levels, the upper limit and the lower limit, you have "bracketed" the child's threshold between two extremes. Threshold is some level between these two lines.

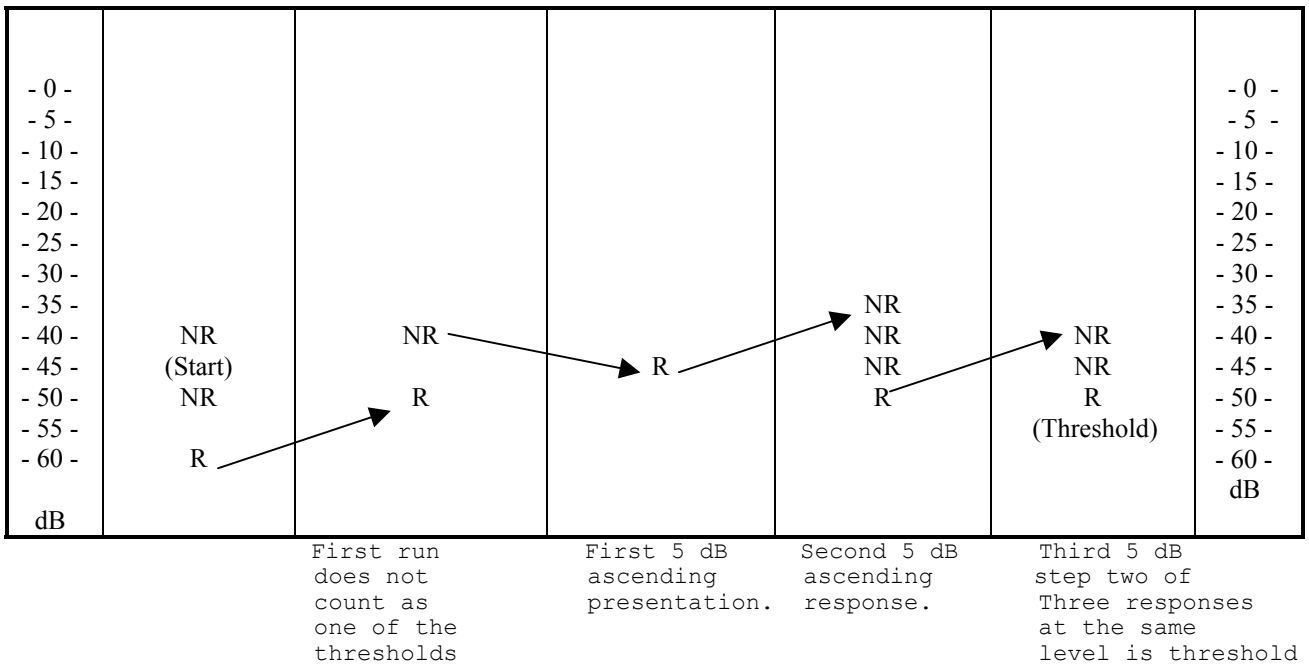
The task now is to reduce this range until you find the level at which the child hears the tone at least 50 percent of the time. This is done by increasing the intensity of the tone in 5 dB steps, starting at the lower limit, until the child responds to the same level at least 50 percent of the time on ascending presentations. A mental note is made of the level at which he responds on each ascending presentation. **THRESHOLD IS DEFINED AS THE LOWEST HEARING LEVEL AT WHICH THE SUBJECT RESPONDS AT LEAST 50 PERCENT OF THE TIME.** Since the number of "rounds" (increases and decreases) is small, it is often difficult to pinpoint the 50 PERCENT response level. Generally, two responses out of three tone presentations at the same level or two responses out of two presentations at the same level will constitute threshold. These responses can only be counted if they are in 5 dB ascending presentations. Figure 6 illustrates this procedure.

Figure 6: DIAGRAM OF BRACKETING FOR THRESHOLD TESTING

NORMAL HEARING



HEARING LOSS



R = Response
NR = No Response

After obtaining thresholds for the failed frequencies, retest the same ear at one frequency and compare the results. If the two thresholds do not differ by more than 5 dB in either direction, the reliability of the test is adequate. If, on the other hand, there is a difference of 10 dB or more between the first and second threshold, the child should be re-conditioned and tested again.

After a reliable retest is obtained, screen both ears at 500 Hz. If the child fails at 500 Hz, in either ear, perform a threshold test.

Administer a second threshold test at an interval of at least two weeks, and no more than six weeks, to those children who fail the first threshold test.

If the threshold at any frequency in one ear differs by 40 dB or more from the threshold at the same frequency in the other ear, it is possible that the tone being presented to the poorer ear is crossing through the bones (or skull) of the head and is being heard in the better ear. In order to know whether this is occurring, it would be necessary to block out or mask the better ear while the poorer ear is tested. Masking is a complex procedure and should not be attempted by the audiometrist. The comment section of the audiogram should note that "there is a major difference between the ears and masking was not used. As a result, the poorer ear may be worse than the audiogram indicates."

Whenever a difference of 40 dB or more exists between the ears in several frequencies, it is wise to refer the child for an audiological evaluation. An audiometrist's role is to discover individuals with suspected hearing problems. An audiometrist, however, has the prerogative of suggesting to the physician the need for more detailed audiological testing. Generally, such testing should be accomplished through the school audiology program or at an audiological clinic.

Avoid spending a great deal of time on the test. The beginner usually makes the mistake of spending too much time in an effort to obtain the best possible thresholds for the subject. By prolonging the test, the audiometrist is only defeating the purpose of obtaining accurate results. It is preferable, therefore, to proceed through a test as quickly as accuracy will permit.

Threshold testing is very tiring to a child. Fatigue and all of its manifestations must be taken into account during a test as they will affect reliability and validity. If the child becomes fatigued and you suspect he will "quit" before you complete the test, reschedule the testing for another time.

E. REFERRAL CRITERIA

A child is considered to have "failed" the threshold test and is referred for a medical/audiological examination if either or both of the following criteria are met:

1. A hearing level of 30 decibels or greater for two or more frequencies in an ear at 500, 1000, 2000, or 4000 Hz, or a hearing level of 40 decibels or greater for any ONE of the frequencies tested, 500 through 4000 Hz, on two threshold tests completed at an interval of at least two weeks and no more than six weeks California Children's Services (CCS) requires a six week waiting period; or

2. There is evidence of pathology, e.g., an infection of the outer ear, chronic drainage or a chronic earache.

A child with a partial or complete impairment in the speech range functions under adverse listening conditions. That is, the majority of speech sounds (vowels and consonants) which make up words are composed of frequencies in the range 500-4000 Hz. A hearing loss of 30 dB and greater in this frequency range will interfere with the normal development of speech and language. The outcome is a breakdown in communicative ability. As a result, the child's language development, school achievement, as well as his emotional and social adjustment, are jeopardized.

Keep in mind that "normal hearing" is a statistical concept and represents a range of hearing rather than a single level. The Zero Hearing Level on the dial of the audiometer represents the average threshold level of a particular segment of the general population. Since this is a statistical concept and represents a restricted sample of the population, normal hearing is considered to include minor deviations above and below the zero reference. Consequently, a person's hearing is considered normal if his screening threshold level does not exceed 25 dB at the test frequencies.

In summary, the testing sequence is as follows:

1. Administer a sweep-check screening test;

2. Administer an individual threshold test, immediately following the sweep test, to those children who fail the screening test;

3. Administer a second threshold test at an interval of at least two weeks, and no more than six weeks, to those children who fail the first threshold test;

4. Refer those children who meet referral criteria on the threshold test for medical-audiological examination.

F. THE CHOICE OF A TESTING ROOM

It is advisable to inspect the testing site prior to the time of testing for the purpose of selecting an appropriate room. This will probably necessitate an extra trip to the schools in your area, however, this can save time on the screening day and will, in the long run, help hold down program costs.

The first consideration in selecting a room is the level of noise in and surrounding the room. Secondary considerations are size and location. The testing room must be as quiet as possible and as remote from street traffic, shop classes, locker rooms, restrooms, band or vocal music rooms, cafeterias, and hall traffic as the design and location of the building will allow. Noise from these and other sources may affect your testing results to the point of invalidating them. The quietest rooms in a school are usually located on the side away from the street traffic. An acoustically treated music room is an ideal location for testing.

The adequacy of a room, with respect to noise levels, can be judged by the audiometrist in the following manner:

1. If the environmental noise level does not exceed 41.5dB sound pressure level (SPL) in the 500 Hertz band, 49.5dB SPL in the 1000 Hz band, 54.5dB SPL in the 2000 Hertz band, and 62dB SPL in the 4000 Hertz band; or

2. If the noise levels do not cause a threshold shift greater than 10 dB at those frequencies which must be included in a pure tone air conduction threshold test. (This procedure may be performed on the audiometrist.)

The testing room should be evaluated during average daily conditions. Noise created by occasional or temporary conditions such as recess, an airplane, school bell, etc., may be overlooked because testing should always be discontinued while these noises are occurring.

The testing room, whenever possible, should be located so that it is readily accessible to all children being tested. A central location will reduce the distance that the children must travel from the classroom to the test room. If you keep this distance at a minimum, you will reduce noise and save testing time.

The room used for testing should be large enough to accommodate a sturdily built table and at least eight chairs. Be sure that the table is stable; it should not jiggle or move about as you manipulate the audiometer controls. The table should be large enough so that the audiometer can be positioned on it, and enough table space remains so that you can comfortably see and work with your class lists or any other records that are in use. An electrical outlet should be easily accessible and there should be adequate ventilation. Figure 7 shows a typical physical arrangement of a testing room during screening.

Such an environment is important not only for the purpose of securing valid test results, but because noise delays the testing and has an emotionally disturbing effect on the audiometrist and on the children being tested. The effects of disturbing noise on the hearing testing program are seldom mentioned, and it is doubtful whether they are ever given the full consideration they should have.

It should be obvious that the fewer interruptions, which occur during the testing, the faster, the scheduled program will move, and hence more effective use will be made of the audiometrist's time and skills. Everyone in the school shares some responsibility for maintaining a quiet environment during the period that hearing testing procedures are being carried out. Cooperation in carrying out these responsibilities is usually achieved without difficulty when the school administrator provides strong leadership in setting the stage for the program.

G. THE INSTRUCTIONS TO THE CHILD

The first step in testing is to be reasonably certain that the children understand what is expected of them. This can be accomplished in their classroom in the following manner:

1. Introduce yourself to the group telling them that you are there to check their hearing. Tell them that they will hear some sounds; that the sounds will be very soft and they will have to listen very carefully; that sometimes they may not hear the sound but as soon as they think they do, they should raise their hand, keep it up as long as it is heard and put it down as soon as the sound stops.

   Remember that this is to be an interesting and pleasant experience for them and this can be accomplished only as much as your performance and enthusiasm allow.

   As in any other instructional situation, children will attend to, grasp and remember your instructions to the extent that you command their attention and interest. Therefore, present instructions in keeping with their level of understanding and use whatever techniques are necessary to command their attention.

   For example, one would approach kindergarten children with a game-situation to show them the task but would address eighth grade children with concise instructions without the use of "gimmicks".

2. Direct the first group of children to accompany you to the test room, instructing the person assisting you to keep a group of children waiting so there will be no delay between groups.

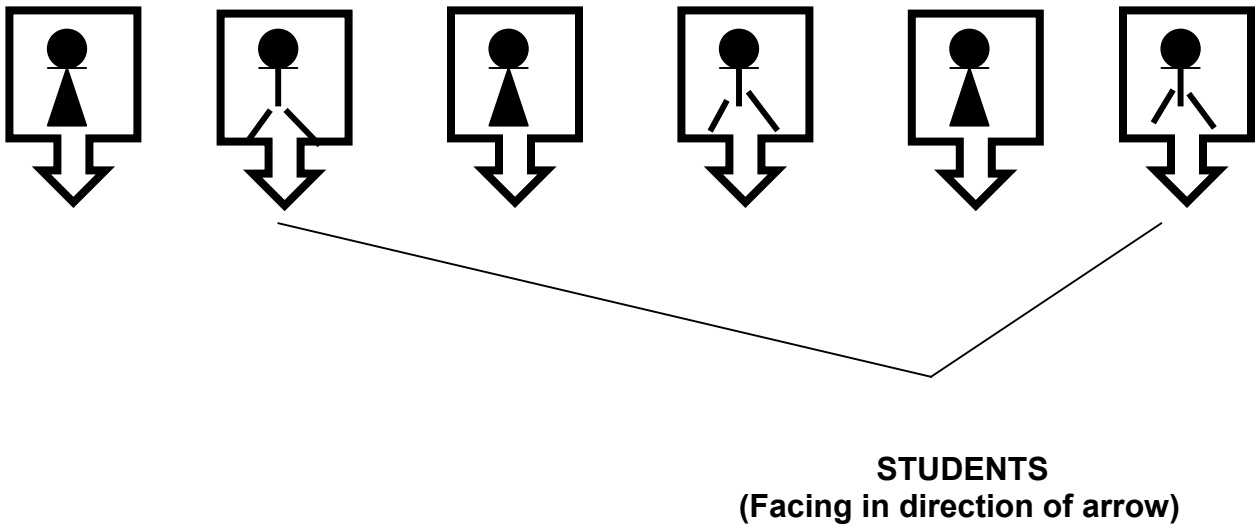
3. Seat the first child in a chair to one side and slightly behind the audiometer, in a position so that you can see most of the child's face. Be sure that the child cannot see the face of the audiometer or the other children who are waiting to be tested.

If appropriate instructions have been given, the majority of children will be able to perform the task without additional directions.

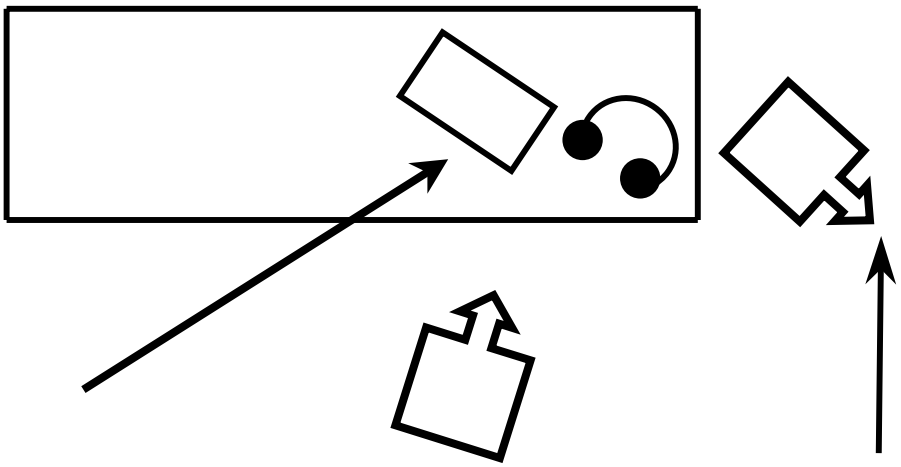
When placing the earphones on a child, be sure that the red phone is on the right ear and the blue phone is on the left ear. Adjust the headband so that the earphone openings line up directly with the ear canal openings. The phones must fit snugly; however, they should not cause the skin flap (tragus) which protrudes back over the ear canal to seal the canal or cause the canal to collapse. For the child over six, objects on the face or head such as glasses, hair bands and earrings should be removed if they interfere with earphone placement. Instruct the children to push their hair back; long hair may be tucked behind their ears. When placing the earphones on the child, smile. If you look confused, indecisive or in agony, the child will sense this and refuse to wear the earphones. The audiometrist should be alert for "running ears". If a child's ear is discharging, the child should not be tested as there is no question that there is need of medical attention.

Test instructions for the exceptional child will differ somewhat from those described above. These special instructions are discussed in Chapter VI.

FIGURE 7: TYPICAL ROOM SETTING FOR SCREENING



STUDENTS
(Facing in direction of arrow)



AUDIOMETER AND EARPHONES

STUDENT BEING TESTED
(Facing in direction of arrow)

AUDIOMETRIST

VII. TESTING EXCEPTIONAL CHILDREN

Occasionally, an audiometrist will encounter children with special needs who are unable or unwilling to perform the required task rapidly or in the usual manner. The audiometrist should be aware of ways to modify the test procedure in order to obtain reliable and valid results and to successfully complete the test. These children will typically require more time to be tested and, therefore, one should not attempt to proceed at the usual rate of speed. It may be necessary to test exceptional children on more than one occasion.

There is a tendency to equate value or worth with performance. This is especially unfortunate for children with special needs who are repeatedly subjected to testing. These children often see themselves in terms of their performance or production. The audiometrist should remember that the outcome of a hearing test has absolutely nothing to do with the "goodness" of a child, nor does it reflect on the personal worth of the audiometrist. If these points are kept in mind, the integrity of the child won't be threatened and the audiometrist will find it much easier to work with and relate to the child.

1. The Shy, Frightened or Crying Child

   Some young children are easily disturbed by any new or unfamiliar situation. It is usually best to allow the child to observe a number of other children during the test activity. When the child understands that the test is harmless and perhaps even an enjoyable experience, he usually begins to cooperate with the tester. If you are unable to gain cooperation during the initial screening, excuse the child along with the group; note the situation on the class list, and attempt to test the child when you are retesting previous screening failures. Under no circumstance should this child be intimidated. This type of child needs reassurance and acceptance.

2. Children with Behavioral Disabilities

   When a child is unable to refrain from talking or disrupting the rest of the group, the best recourse is to test this child as soon as possible and to ask the "runner" to accompany the child back to the classroom. Keep in mind that this type of behavior is often motivated by a desire for attention. If this is the case, an angry reaction will be more satisfying than no reaction and the disruptive behavior will continue in order to command your attention.

3. Children who are Developmentally Delayed

   Some children are unable to grasp and follow directions. They may forget to raise their hands when they hear the tone; may not respond until the loudness of the tone is much above threshold; or, continue to respond when the tone is discontinued. It is preferable to work with these children on an individual basis. One technique that is often successful is to associate the tone with a play activity such as placing a block into a bowl. This then becomes a game and more easily understood. This technique (Play Audiometry) will be described in detail at the end of this chapter.

4. Children with Cerebral Palsy

The most obvious manifestation of cerebral palsy is the lack of muscular control, particularly control of the arms and legs. If this lack of muscular control makes it impossible for the child to raise a hand, it will be necessary to ask for a verbal response. Ask the child to say "yes" as soon as the tone is heard.

5. Children with a Syndrome

Certain syndromes are associated with a hearing loss, for example, Usher's Syndrome, with congenital deafness and progressive loss of vision. It is preferable to work with these children on an individual basis using play audiometry as an activity that may be more easily understood. Any child under this section or in three and four of this chapter, should be evaluated under Special Education Programs.

6. The Non-English Speaking Child

The problems that are peculiar to non-English speaking children are those that are related to the inability to understand verbal instructions. The child may not raise the hand when the tone is heard; may not lower the hand when the tone has been turned off; or may respond only to tones of certain loudness or pitch. Instruction can often be conveyed effectively through pantomime. Letting these children observe some of the others being tested is often all that is necessary. Play audiometry is the preferred method.

A. PLAY AUDIOMETRY

When testing the very young or exceptional child it may be necessary to condition the child to make the correct response to a tone by using a technique referred to as play audiometry. The technique requires props, which may be blocks and a bowl or any similar combination of articles. Animated facial expression, enthusiasm, and positive reaction to the child's responses are very important. Following is a suggestion for the steps to be used when conditioning the child to respond to a tone:

1. Seat the child as you would for a normal hearing screening. Set the audiometer to test the right ear first. Do not put the earphones on the child. Tell the child that you are going to play a game. Present a 90 dB tone at 4000 Hz and respond to it in an animated manner .

2. Put the bowl on the table in front of the child and hand the child a block. The audiometrist also takes a block. Explain the game. "When you hear the beep, put the block in the bowl." Present the tone as before, this time put the block in the bowl. If the child does not put the block into the bowl, you may gently move the child's hand over the bowl or bring the bowl toward the child.

3. Play the game again. This time let the child "win". Wait until the child puts the block into the bowl, then the audiometrist puts the block in making a big deal about the fact that the child "won".

4. Play the game again. This time the audiometrist does not "play". Be sure to reward the behavior with lots of enthusiasm.

5. Give the child a block, reduce the intensity to 50 dB then place the earphones on the child. Play the game again. Reward appropriate behavior with enthusiasm. (If there is no response, repeat this step at left ear. If still no response, remove earphones and recondition as above. If still no response, the screening is failed.)

6. Reduce the intensity to 25 dB and continue screening using play audiometry following the screening procedures outlined in Chapter V.

This technique is taught to those persons attending the Child Health and Disability Prevention (CHDP) hearing screening training program conducted by the Hearing Conservation Specialist, State Department of Health Services. Further information on play audiometry is available by contacting that office or your local county CHDP Program.

VIII. SETTING UP A HEARING CONSERVATION PROGRAM

The following suggestions are presented to assist in the initiation and management of a hearing conservation program. Experience has shown that these activities establish meaning and purpose and provide a means for evaluating the effectiveness of the program. The suggestions are general in nature and may need to be modified to fit individual situations. Following is an outline of suggested procedures:

A. PLANNING

1. Meet with appropriate administrators early in the school year.

2. Explain the purpose of the hearing conservation program and provide the administrator with a written hearing conservation plan.

3. Discuss the number and age groups of children to be tested and the time allotted for tests.

4. Outline and explain the need for a quiet, convenient testing room for screening and threshold testing. Inspect and evaluate the proposed testing sites - what is quiet and convenient to a school administrator may not be quiet and convenient enough to meet testing needs.

5. Discuss and agree upon a schedule for screening and threshold testing.

6. Ask administrators to announce the screening dates and grades to be tested in the school paper or teacher bulletin. It is a good idea to meet with all teachers and explain the program.

7. Know what medical/audiological, educational and rehabilitation resources are available locally or, if not available locally, where they can be obtained.

8. Know the procedure to follow to make all referrals.

9. Outline referral criteria and procedures for the teachers and administrators.

10. Decide the total number of children who will be screened.

11. Secure names and locations of schools in the area of responsibility.

12. Estimate the enrollment for each school by grade level, including kindergarten and any special classes for the handicapped.

13. Design a master schedule showing tentative dates for screening and threshold testing for each school.

14. Send a reminder note to the local school administrator about a week prior to screening.

15. Set dates for follow-up threshold testing.

16. Conduct the re-testing program two weeks after the initial screening.

17. Notify parents and the school principal of those children who fail the threshold evaluation.

18. Explain the follow-up procedures:

    a. Referral for medical evaluation and/or audiological screening for those who meet the recommended criteria;

    b. Diagnosis, treatment, and prognosis by medical and/or audiological personnel;

    c. Return of the medical and/or audiological information to the appropriate person or persons for the purpose of closing a case or providing additional services such as special education and hearing aid evaluations.

B. RECORDS AND REPORTS

1. Establish a system of records and reports that will reveal areas of strength and areas of weakness in the total program.

2. Ask these questions as the records and reports are reviewed:

    a. Are an adequate number of children being screened each year? (See California Code of Regulations (CCR), Title 17, Section 2951.)

    b. Are at least 80 percent of the children with referable hearing losses being seen by physicians and/or audiologists?

    c. Are the children who are in need of special handling receiving needed services?

    d. Is there a rapid and efficient flow of information between all individuals concerned with the Hearing Conservation Program - parents, physicians, audiologists, school personnel, health workers, and personnel in diagnostic clinics and rehabilitation centers?

3. CCR, Title 17, Section 2951 states that a school district may request a waiver of the hearing screening test for tenth and/or eleventh grade pupils once each school year. Submit the request form prior to implementing the current year hearing testing program. A waiver request form can be found in the Appendix.

4. Report yearly program results to the California State Department of Health Services. A summary form PM 100 can be found in the Appendix.

C. COMPETENCIES WHICH AUDIOMETRISTS SHOULD POSSESS

The competencies which the audiometrist should possess in order to carry out the responsibilities and duties associated with the school hearing testing programs include: (1) required certification, (2) acceptable personality characteristics, (3) administrative abilities, and (4) technical skills as outlined.

1. Possession of a Certificate of Registration as a School Audiometrist issued by the State Department of Health Services.

2. Acceptable Personality Characteristics.

   The audiometrist should possess acceptable personality characteristics, which include:

   a. Ability to cope with deadlines and tensions frequently encountered in the work, which requires good health, stability, and dependability.

   b. Ability to properly use confidential materials which implies professional integrity, trustworthiness, and possession of good judgment.

   c. Ability to recognize and appreciate both the scope and the limits of the responsibilities, duties, and authority assigned to the audiometrist and to be able to accept the limits as set forth in the position.

   d. Ability to accept supervision within the framework of the agency or agencies involved in the program.

   e. Ability to establish and maintain good public relations with all of the individuals and agencies involved in the program.

   f. Ability to work with children at the various age levels, and to work with these children individually and in groups.

3. Administrative Abilities

   a. Ability to select and compile data and information needed for planning school hearing testing programs.

   b. Ability to plan the hearing testing program, in cooperation with staff representing other disciplines of the agency or agencies having responsibilities in the program.

      (1) This implies an understanding of the organization of the agency or agencies (school and/or health department) concerned, and also what persons on the staffs of these agencies should be involved in the planning.

      (2) Implies ability to work harmoniously with both professional and nonprofessional staffs of the agencies involved in the program.

c. Ability to prepare reports pertaining to the program as indicated or required.

d. Ability to participate in the evaluation of the testing program in cooperation with other staff.

e. Ability to participate in special studies in which the hearing testing program may be involved.

f. Ability to maintain lines of communication with individuals who may be concerned with the child who has a hearing loss, e.g., the public health nurse, the school physician, the school administrator, the school counselors or the guidance staff.

4. Technical Skills

a. Ability to use precision hearing testing equipment, which includes frequent testing for calibration and function, as well as arranging for periodic service and repairs as needed.

b. Ability to perform screening and threshold tests.

c. Ability to choose appropriate test techniques suitable for the individual or the groups of children to be tested.

d. Ability to explain and demonstrate the test to children at all grade levels.

e. Ability to recognize factors which may interfere in securing a valid test.

f. Ability to keep accurate records and prepare reports as required or indicated.

g. Ability to select children for:

(1) Observation and further re-tests

(2) Referral for medical care

(3) Consideration for special education

(4) Other referral reasons as indicated or requested (e.g., psychological problems, or obvious physical abnormalities).

IX. THE AUDIOMETER

The success of an audiometric identification program largely depends on the skill of the audiometrist, the adequacy of the testing room, and the function of the audiometric equipment. Throughout the manual, we have been concerned with the recommended procedures for testing, the testing room, and the technician. The term audiometer has appeared frequently in the description of the identification program. This chapter will deal with the proper use of the pure tone audiometer, the upkeep and care of the instrument, and the need for accurate calibration. A great part of the success and validity of a hearing screening program depends on the proper function and use of the audiometer. It is extremely important for the audiometric technician to keep in mind, at all times, the importance of a properly calibrated and functioning instrument.

The California Code of Regulations (CCR), Title 17, Section 2951, (a) requires that audiometers used for audiometric testing of pupils in public schools shall be instruments which meet or exceed the current American National Standards Institute (ANSI) specifications for audiometers and be calibrated at least once a year.

The audiometer will produce several different FREQUENCIES of pure tones at electronically calibrated INTENSITIES or levels of loudness. Generally, these audiometers are portable and simple in design. The manufacturer may arrange the dials, switches, and controls in different ways. However, for your purpose, there are certain controls and switches with which you must be familiar BEFORE you attempt to use an audiometer.

1. POWER SOURCE: The instrument shall be powered by AC current.

2. POWER SWITCH: The "on" and "off" control. This may be a knob, a metal switch, or combined with the "ear selector" control.

3. EAR SELECTOR CONTROL: A knob, switch, or push-button that enables you to direct the "tone" to one or the other earphone, e.g., RIGHT-LEFT or RED-BLUE.

4. FREQUENCY SELECTOR: This is an easy to read dial that indicates the frequencies (pure tone), i.e., 250, 500, 1000, 2000, 3000, 4000, 6000 Hz (Hertz or cycles per second). Some instruments display the frequencies in a "window", controlled by a dial on the side of the audiometer; others may have a "push-button" frequency selector.

5. ATTENUATOR (INTENSITY): (This may be designated: Hearing Threshold Level, HTL, Hearing Loss, etc.): The attenuator controls the "loudness" or intensity of the tone. It is calibrated to produce levels in 5 decibel (dB) increments, e.g., 0, 5, 10, 15, etc. decibels. "O" decibels is the average intensity level at which the normal ear is barely able to detect any one of the frequencies or pure tones. (The "zero" reference level is established by ANSI.)

6. TONE CONTROL SWITCH ("INTERRUPTOR SWITCH"): This is a level, touchplate, or button that is used to present or interrupt the tone. Be certain that this control (or a secondary tone reversal control) is in the "normal off" position. The tone should be audible ONLY when the control is activated.

7. EARPHONES AND HEADBAND: Matched earphones are "color coded". The RED phone is for the RIGHT EAR and the BLUE phone is for the LEFT EAR. Earphones are calibrated to the audiometer

and must not be replaced or switched with another audiometer without electroacoustic re-calibration of the audiometer.

8. MASKING: A noise introduced to the non-test ear to eliminate the non-test ear from participating in the test.

It is advisable for the technician who is considering the purchase of a new audiometer to consult California Department of Health Services, Hearing Conservation Program before making a purchase.

A. TROUBLESHOOTING THE AUDIOMETER

1. Needed Accessories

The equipment needed for a hearing screening program consists of a properly calibrated pure tone audiometer and a few basic accessories. Accessory equipment includes the following and should be carried at all times:

a. Spare fuse for the audiometer, when appropriate - if the audiometer does not come equipped with a spare fuse, tape one inside the storage compartment. Consult the operating instruction manual for the fuse installation procedure.

b. Electrical extension cord - electrical outlets are very often inaccessible or inconveniently placed. An extension cord of at least nine feet (common household variety) will allow the audiometer to be placed appropriately in the testing room.

c. Adapter for a three-pronged power plug - most audiometers come equipped with a three-pronged power cord plug, which is to be used in a special type of electrical outlet. Because many electrical outlets are not designed for this type of plug, an adapter (available at any hardware store) will make it possible to plug the instrument into any standard (AC 110 volt) electrical outlet.

2. Handling and Daily Checks

An audiometer is a precision electronic device, which provides a means of controlling both the pitch and the loudness of pure tones. Like any other electronic device, an audiometer must be handled with care at all times. Generally, the audiometer receives the greatest abuse when it is being transported. This instrument should be protected from shocks, bumps, or extreme temperature changes. Even with proper care, an audiometer may, over a period of time, malfunction and/or go out of calibration for no apparent reason. Each day prior to testing, the audiometer should be checked by the audiometrist. These checks will not replace periodic servicing or calibration checks using an artificial ear, but are designed to aid the operator in detecting gross malfunction that will affect the results obtained from it.

3. Checking for Electrical Power

Plug in the instrument; be sure the power switch is on; the dials or an indicator light should glow. Allow the instrument to warm up for at least five minutes. If the audiometer does not function:

a. Check the electrical outlet for power by using a lamp or some other convenient electrical appliance.

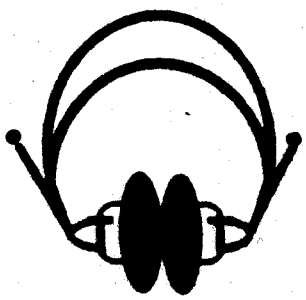
b. If there is power in the outlet, unplug the audiometer and check the fuse; replace, if necessary, with the spare.

c. If neither of these conditions is responsible for the audiometer's failure to operate, discontinue testing and call the person who sold the audiometer or the one responsible for servicing it.

4. Checking Earphones

While the audiometer is warming up, check the earphone cushions - they should be reasonably soft, resilient, and free from cracks. Check the shape of the headband - the earphone cushions should lay together with a small amount of tension. If the cushions do not meet or if they seem to lay together with too much tension, shape the headband by bending it with a twisting motion. The correct position is shown in Figure 8.

Figure 8: EARPHONE HEADBAND TENSION



RIGHT

WRONG

5. Checking for Hum in the Earphones[8,9]

Any extraneous noise present in the earphones may affect test results. Check for this condition as follows:

a. Set frequency at 1000 Hz;

b. Set attenuator to 60 dB (tone on) and listen for noise or hum;

c. Interrupt tone and listen for noise;

d. Decrease attenuator to 40 dB (tone on) and listen for noise;

e. Interrupt tone and listen for noise;

f. Decrease attenuator to its lowest setting and listen for noise (tone on);

g. Interrupt tone and listen for noise.

If humming or extraneous noises are heard at the above settings with the tone on or off, the instrument requires service.

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[8]All of the following checks are made with the earphone properly placed on the audiometrist and assumes that the audiometrist has normal hearing for 500 through 4000 Hz.

[9]If repair of the audiometer is required as a result of any of the following "checks", it may be necessary to have the audiometer re-calibrated. The manufacturer's representative should advise you accordingly.

6. Checking for Crosstalk in Earphones

An audiometer sometimes develops "crosstalk". This means that when the tone is sent to one earphone it is also heard in the other phone. The crosstalk is usually weak, but it may cause false testing results. To check for "crosstalk", apply a tone to the right earphone. Next, disconnect or unplug the right phone from the audiometer but leave the selector switch in the "right earphone" position. Move the frequency selector dial across the test range while you listen for a tone in the left earphone. Finally, reverse the procedure, listen to the right phone while it is plugged into the audiometer and the tones are being sent simultaneously to the disconnected left phone. If the earphone cords can only be disconnected by unscrewing the cord connections, this test need not be done prior to each use, but should be done at regular intervals.

7. Checking Earphone Cords

The earphone cords should be checked for breaks and loose connections in the following manner:

a. Set hearing level dial at 40 dB or higher;

b. Set frequency selector at 2000 Hz;

c. While listening to the tone, flex the cord along its length and especially at its connections (at earphones and audiometer);

d. If scratchy noise is heard or the tone is intermittent, discontinue testing until cords have been replaced or the connections are made secure;

e. Under no circumstances should headphones from one audiometer be interchanged for headphones of another audiometer. Earphones are calibrated as an integral part of the instrument. Earphones cannot be interchanged even temporarily without re-calibration on an artificial ear.

8. Checking for Noise from Attenuator

Lack of lubrication or the presence of dirt deposits in the attenuator (hearing level dial) may cause noise to be heard in the earphones when the hearing levels are changed. In order to check for this:

a. Set frequency to 1000 Hz;

b. Slowly increase attenuator from 0 to 60 dB and listen for scratchy noise in the earphones;

c. If noise is heard, move the attenuator back and forth with rapid motion about ten to 12 times. This will many times alleviate dirt deposits, which may be causing the noise.

If noise does not disappear after following the above procedure, it will have to be corrected by a service technician. However, the instrument may be used, if necessary, as long as adjustments of the attenuator are made only when the tone is off.

9. Checking for Noise from Frequency Selector

Scratchy noises or clicks may develop in the frequency switch. To prevent this noise from getting to the headphones, the operator should change the frequency dial only when the tone is off.

B. ELECTROACOUSTIC CALIBRATION

An electroacoustic calibration of audiometers shall be made at least every 12 months or more frequently if indicated by the biological calibration (California Code of Regulations (CCR), Title 17, Section 2951, (a)(3)(B).

1. The following measurements shall be included:

   a. puretone levels
   b. puretone frequencies
   c. rise/decay time for puretones
   d. harmonic distortion of puretones
   e. signal-to-noise ratio for all outputs
   f. attenuator linearity
   g. shock hazard

2. If the audiometer fails to meet any of the ANSI specifications for the parameters listed above, electroacoustic adjustments must be made and standards met before the audiometer may be used for screening.

3. A calibration sticker or chart, showing proof of performance, shall be kept with the audiometer.

Make sure the company you send the audiometer to is performing an electroacoustic calibration and not an electroacoustic check. A check does not guarantee that the audiometer meets ANSI standards, although it may imply it does.

X. TYMPANOMETRY

Tympanometry is the measurement of the mobility of the eardrum with varied pressure. This procedure can help identify problems with the eardrum and the middle ear system. Several studies have indicated that a conductive pathology, left undetected, can lead to speech, language, educational, social, and psychological complications. Tympanometry is a valuable tool that can help identify children with medical and educational needs that may be missed by a pure tone hearing screening alone.

The Hearing Conservation Program has always supported the use of tympanometry in the schools for preschool, kindergarten, and first grade children when used in conjunction with a hearing screening program and performed by a trained individual. Since tympanometry only measures the function of the middle ear and does NOT tell us anything about hearing sensitivity, it is not a mandated or regulated screening procedure. Only the following persons may perform tympanometry in the public schools:

A. Any supportive personnel working under the direct supervision of an audiologist who holds a Certificate of Clinical Competence in Audiology (CCC-A).

B. A school nurse who has been trained in the use of a tympanometer.

The following are suggested guidelines for the use of tympanometry in schools which have the equipment and the above mentioned personnel.

CALIBRATION

As with the pure tone audiometer, service and calibration should be performed annually. In addition, a "daily check" should be performed whenever the tympanometer is used. This check may be performed on the screener.

GRADE LEVELS TO SCREEN

Tympanometry screening should be performed on each child in preschool, kindergarten, and first grade on the same day as the pure tone screening.

PASS/FAIL CRITERIA

Consult the manufacturer's manual for pass/ fail criteria. Do not attempt to interpret the results.

RETEST CRITERIA

Retest those children failing the initial tympanometry screening in two to six weeks.

REFERRAL

If there is evidence of pathology at the first or second screening, such as infection of the outer ear, chronic drainage, or a chronic earache, the child should be referred for medical and/or audiologic evaluation.
Those children failing the second screening should be referred for medical and/or audiological evaluation.

XI. GUIDELINES FOR AGENCIES DULY AUTHORIZED TO PERFORM HEARING TESTS

A. STANDARDS AND STAFFING FOR HEARING SERVICES

1. Allocation of qualified supervisors of health as specified in Sections 44871 to 44879, inclusive, and Section 49422 of the Education Code shall be determined by the amount and type of training, screening, supervision, referral, and follow-up necessary to carry out the intent of the law and these regulations.

2. All training programs shall meet the standards set forth in Section 2950 of the California Code of Regulations, Title 17, and the Board of Education guidelines and shall so state on certificates of program completion.

B. SCREENING

1. Supervision of hearing testing shall be conducted only by qualified supervisors of health as specified in Sections 44871 to 44879, inclusive and Section 49422 of the Education Code, employed by, or under contract with, the district or the county superintendent of schools, or pursuant to contract with an agency authorized to perform such services by the county superintendent of schools of the county in which the district is located pursuant to Sections 1750 to 1754, inclusive, and Section 49452 of the Education Code, Section 485 of the Health and Safety Code, and guidelines established by the State Board of Education and the State Department of Health Services.

2. The hearing testing shall be conducted only by qualified individuals who are employees of the district or of the county superintendent of schools or pursuant to contract with an agency or an individual authorized to perform such services by the county superintendent of schools of the county in which the district is located pursuant to Sections 1750 to 1754, inclusive, and Section 49452 of the Education Code, Section 485 of the Health and Safety Code, and guidelines established by the State Board of Education and the State Department of Health Services.

3. Hearing testing conducted under contract with agencies and individuals authorized by the county superintendent of schools shall be conducted only under the supervision of qualified supervisors of health as specified in Sections 44871 to 44878, inclusive, and Section 49452 of the Education Code.

C. CONTRACT AGENCIES

Standards and requirements for public, private, profit or nonprofit agencies, organizations, individuals or corporations, hereafter referred to as contractors, that seek to enter into a contract with the schools of California for the purpose of providing hearing testing services pursuant to Section 49452 of the California Education Code, and Section 2951 of the California Code of Regulations, Title 17 (Health Services) shall be as follows:

1. Qualifications of Personnel

   a. **The Director.** The director of an agency providing hearing testing services through contracts with the schools of California shall be a physician, or a licensed audiologist, or a licensed speech pathologist, or a credentialed school nurse who is registered as a school audiometrist by the State Department of Health Services.

   b. **Hearing Testing Personnel.** Hearing testing services provided by a contractor shall be conducted by "qualified" personnel who function under the supervision of one of the licensed or credentialed personnel cited above.

2. Hearing Testing Services

   a. All hearing testing services shall comply with current hearing testing regulations, pursuant to Section 2951, California Code of Regulations, Title 17. In the public schools, hearing testing is subject to the provisions of Sections 49451, 49452, 49454, and 44879 of the Education Code and the regulations in Title 17.

   b. A school district that enters into a contract for hearing testing services shall ensure that all screening and related hearing testing services are conducted under the supervision of the credentialed school nurse who is registered as a school audiometrist, or the credentialed speech and hearing specialist, or the credentialed audiologist employed either by the district or by the county superintendent of schools.

   c. The contractor shall submit a report of all individual hearing screening and thresholds test results to the contracting district or contracting county superintendent within ten days following completion of the testing.

   d. The district shall submit an annual report of hearing testing to the Department of Health Services.

3. Registration of Contractors (Agencies) Providing Hearing Testing Services

a. Contracting agencies that intend to provide hearing testing services in the schools of California register annually, on or before January 31, with the Children's Medical Services of the Department of Health Services. The registration includes the name, address and qualifications of the director and the names and qualifications of all hearing testing personnel on state form PM 210.

b. The Department of Health Services maintains a current list of all registered contractors (agencies). The list is made available to all consultants in the school health services in the Department of Education, and to the county superintendent of school offices.

4. County Authorization of Contractors Providing Hearing Testing Services

a. All contractors for hearing testing services shall be authorized by the county superintendent of schools.

b. Contracting agencies shall register according to the procedures outlined in Section 3 (above). In addition, the names and qualifications of all testing personnel shall be on file with the office of the county superintendent of schools.

c. Contracting individuals shall have on file with the office of the county superintendent of schools, their credential and certificate of registration as a school audiometrist.

d. The county superintendent of schools shall determine that all hearing testing services are provided in compliance with current hearing testing standards in Section 2951 of the California Code of Regulations, Title 17.

e. Validation of contracts and the approval of payment for services are subject to prior authorization of the contractor by the county superintendent of schools.

D. CONTRACTS

Contractual arrangements shall specify responsibilities of both parties agreeing to the contract. The contract shall include, but not be limited to, the following:

1. Names and Qualifications of supervisory personnel - county or district.
2. Names and Qualifications of supervisory personnel - contractor.
3. Names and qualifications of hearing testing personnel.
4. Description of testing equipment to be used.
5. Date of last equipment calibration.
6. Name and address of calibrating agency.
7. Manner of submission of required reports.
8. Dates services are to be provided.
9. Costs and fee arrangements.
10. Assurance that agency has current authorization from county superintendent of schools.

E. PROCEDURES

1. Prior to initiation of the program, parents or guardians must be informed, in their primary language, about the plan to conduct the program and of their right of refusal to consent for the child's participation. Such refusal must be submitted to the school in writing and shall be honored pursuant to Section 49451 of the Education Code.

2. Hearing testing services shall be conducted in accordance with Section 49452 of the Education Code, Section 2951 of the California Code of Regulations, Title 17, and these guidelines adopted by the State Board of Education and the State Department of Health Services.

3. When a suspected hearing condition has been identified as a result of a screening, a report shall be made by the supervisor of health to the parent or guardian in their primary language. Such report shall include performance on the audiometry screening test and explanation of the importance of further evaluation. Referral of the child and the child's parent or guardian to the appropriate community resources shall be made pursuant to Sections 49426 and 49456 of the Education Code and in accordance with criteria set forth in this manual.

F. DEFINITIONS

1. "Qualified" personnel shall mean licensed or credentialed audiologists, credentialed speech and hearing specialists, and registered school audiometrists who function under the supervision of one of the licensed or credentialed personnel cited.

2. "Hearing testing services" shall be those services in accord with Section 2951, California Code of Regulations, Title 17.

GLOSSARY

Acquired - obtained or developed subsequent to birth (postnatal) non-hereditary.

Acuity - the sharpness, clearness, or distinctness with which one is able to hear a sound.

Adenoids - mass of lymph (tonsil-like) tissue surrounding the eustachian tubes in the back of the throat and/or nasopharynx.

Air conduction - the process by which sound waves are conducted to the inner ear through the air filled ear canal. A hearing test, conducted using earphones, is called an "air conduction" hearing test because the sound wave moves from the earphone through the air filled external ear canal, strikes the eardrum which produces vibration which is transmitted through the middle ear via the ossicles.

Ambient noise - in audiometry this term refers to any noise exclusive of an intentional signal in a test room environment. The noise may come from outside or from within the room.

ANSI - American National Standards Institute. A private federation of trade associations, technical societies, professional groups, and consumer organizations whose purpose is to eliminate duplication and produce nationally accepted standards

Artificial ear - a device used to "couple" or join an earphone to a microphone for the purpose of checking calibration of the audiometer.

Atresia - the absence or closure of the external or middle ear.

Attenuate - in audiometry this term refers to the reduction in intensity of tone or speech signals.

Audiogram - a record of hearing levels measured a different frequencies. A graphic representation of hearing.

Audiologist - an individual who is professionally trained to administer and interpret complex hearing evaluations.

Audiology - the science of hearing; particularly the hearing function. It is a diagnostic profession concerned with the determination of the type of hearing loss being manifested by a particular individual.

Audiometrist - an individual who, after appropriate training, has the skills necessary to administer, but not interpret, basic hearing tests.

Audiometry - the technique of measuring hearing. Measurements may be made of the response to any of several auditory stimuli, but fixed-frequency pure tones and speech sounds are most commonly used.

Auditory - having to do with hearing or the organs of hearing.

Auditory Brainstem Response (ABR) - electrophysiological procedures assess the functional status of an individual's central or peripheral sensory nervous system by presenting auditory stimuli and recording the evoked response through electrodes.

Auditory nerve - sensory nerve (VIII cranial nerve) composed of fibers which arise from the cochlea and vestibular apparatus terminating in the brain stem.

Bone conduction - the process by which sound is conducted to the inner ear through the cranial bones.

Brain stem - the bundle of nerve fibers which is located below the cerebrum and above the spinal cord.

Cochlea - the snail shaped, fluid filled cavity which serves as the receptor for hearing.

Conductive hearing loss - a hearing loss caused by the impediment of the movement of sound waves as they pass through the external and middle ear on their way to the inner ear. A conductive hearing loss usually can be corrected and/or improved via medical treatment.

Congenital - existing at birth. Could be a hereditary condition.

Decibel (dB) - a numerical expression of intensity (loudness) of a sound.

Disability - any restriction or lack (resulting from an impairment) of ability to perform an activity in the manner or within the range considered normal for a human being.

Discrimination score - a percentage score which reflects a person's ability to understand speech.

Disorder - any anatomic abnormality; pathology. May or may not result in a change in function of a given organ or organ system.

Eardrum - the thin, translucent membrane which moves in response to sound waves traveling through the external auditory canal.

Endolymph - the fluid found within the scala media.

E.N.T. - refers to a physician who specializes in the treatment of disorders of the ear, nose, and throat. E.N.T. is synonymous with Otolaryngologist.

Environmental sound - sounds that surround us in our everyday life. See ambient noise.

Eustachian tube - a tube-like passage way which extends from the middle ear cavity to the back of the throat (nasopharynx). There is one eustachian tube for each ear. Adenoidal tissue usually surrounds the eustachian tube openings at the back of the throat.

External auditory canal - a cylindrical passageway, which funnels sounds, waves from the pinna to the eardrum.

Frequency - the number of vibrations per second and may be written as c/s, cps. or Hz (Hertz).

Handicap - the difficulty experienced by an individual as a result of an impairment/disability and as a function of barriers, lack of accommodations, and/or lack of appropriate auxiliary aids and services necessary for effective communication.

Heredity - the passing on of genetic qualities from an ancestor.

Hertz (Hz) - the international designation for frequency or cycles per second.

Identification audiometry - the application of hearing testing procedures to persons for the purpose of identifying those individuals with hearing less acute than generally defined as within normal limits. The actual finding of hearing problems with an audiometer.

Impairment - any loss or abnormality of psychological or physiological function.

Incus - the second or middle bone of the ossicular chain which is located between the malleus and the stapes commonly referred to as the anvil.

Internal auditory canal - a tube-like passageway in the temporal bone which houses the auditory nerve.

Interrupter switch - the tone presentation control of an audiometer.

Malleus - the first bone of the ossicular chain which is attached to the eardrum and to the incus commonly referred to as the hammer. It is the largest bone in the ossicular chain.

Mastoid - a bone composed of a series of air-filled cells located behind the middle ear cavity.

Middle ear cavity - a small air-filled space which houses the ossicular chain and from whence the Eustachian tube originates.

Mixed hearing loss - a hearing loss which has both a conductive and sensorineural component.

Noise - any unwanted sound.

Non-organic hearing loss - an apparent loss of hearing for which there is no known organic basis.

Organ of Corti - the highly sensitive receptor of hearing which contains the hair cells and the auditory nerve endings. It is housed within the cochlea.

Ossicles or ossicular chain - the bridge of three small bones (malleus, incus, and stapes) across the middle ear cavity. Also referred to as the hammer, anvil, and stirrup respectively.

Otitis Media - inflammation or infection of the middle ear.
Acute: an ear infection lasting for a short period of time.
Chronic: a long-term or continuing ear infection.

Otoacoustic Emission (OAE) - an auditory stimulus is presented into the external ear canal, a normal ear responds by emitting a subaudible sound or echo back through the middle ear. OAE procedures measure the echo with a microphone placed in the external ear canal and connected to a computer.

Otologist - a physician whose practice is confined to the medical treatment of ear disorders.

Otology - the branch of medicine dealing with the ear and its disorders.

Otosclerosis - a disease process by which the bone surrounding the oval window becomes abnormal and may hamper the movement of the stapes' footplate.

Oval window - a small opening in the middle ear which accommodates the footplate of the stapes.

Perilymph - the fluid found in the scala vestibuli and scala tympani.

Pinna - the most visible portion of the external ear.

Pure tone - a single frequency sound without accompanying overtones or other sounds.

Reliability - refers to the ability of a test to furnish consistent results under similar testing conditions. SYN - repeatability.

RH incompatible - a problem with certain blood components which can result in damage to the newborn child.

Round window - a small opening in the middle ear covered by a thin membrane located below the oval window.

Rubella - German measles.

Scala media - the middle fluid-filled tunnel of the cochlea which houses the organ of Corti.

Scala Tympani - the outer fluid-filled tunnel of the cochlea which communicates with the middle ear via the round window.

Scala vestibuli - the fluid-filled tunnel of the cochlea which communicates with the middle ear via the oval window.

Sensorineural hearing loss - a dysfunction of the sensory or neural structures of the ear. This is a non-correctable disorder.

Signal-to-noise ratio (SNR) - the relationship of wanted sound (signal) to unwanted sound (noise) expressed in decibels relative to the signal. For example: a +5 dB SNR would indicate that the signal is 5 decibels more intense than the noise; a -5 dB SNR indicates that the signal is 5 decibels less intense than the noise.

Sound level meter - an instrument used to measure sound levels in decibels. It is used in conjunction with an artificial ear when checking calibration.

Stapes - the third and smallest bone of the ossicular chain which is located between the incus and the oval window. It is commonly referred to as the stirrup.

Threshold of hearing - the intensity at which a stimulus is just strong enough to be perceived or produce a response. In pure tone audiometry, threshold is defined as the minimal hearing level at which an individual is able to respond to a tone at least 50 percent of the time. It is the minimal hearing level that one plots on an audiogram that indicates an individual's best level of hearing for that particular frequency .

Tinnitus - a noise in the ears or head which may sound like ringing, buzzing, roaring, etc.

Tone - a sound wave perceived as an auditory sensation of definite pitch.

Validity - refers to a test which tests what it is supposed to test.

Vestibular apparatus - the organ of balance located in the inner ear. Sometimes referred to as the semi-circular canals

APPENDIX

Department of Education (CDE)
www.cde.ca.gov
P.O. Box 944272
Sacramento, CA 994244-2720
(916) 319-7079

Department of Rehabilitation
www.rehab.ca.gov
P.O. Box 944222
2000 Evergreen St.
Sacramento, CA 95818-1690
(916) 263-7474

Department of Social Services
www.dss.cahwnet.gov
Office of Deaf Access (TDD)
744 "P" Street
Sacramento, CA 95814
(916) 653-7651
TDD (800) 952-8349

Special Education Division
Department of Education
www.cde.ca.gov/sp
P.O. Box 944272
Sacramento, CA 94244-2720
(916) 445-4613
TDD (916) 323-9779

California Congress of Parents, Teachers and Students Association (PTA)
www.capta.org
930 Georgia Street
Los Angeles, CA 90015-1322
(213) 620-1433

California School Nurses Organization
www.csno.org
801 12th St., Suite 230
Sacramento, CA 95814
(916) 448-5752
(888) 628-CSNO

Children's Medical Services (CMS) Branch
Department of Health Services
www.dhs.ca.gov/pcfh/cms
1515 K Street, Room 400
MS 8100
P.O. Box 997413
Sacramento, CA 95899-7413
(916) 327-1400

Maternal and Child Health Branch
Department of Health Services
www.mch.dhs.ca.gov
1615 Capitol Ave. MS 73-275
Sacramento, CA 95814
(916) 650-0367

American Speech-Language-Hearing Association www.asha.org
10801 Rockville Pike
Rockville, MD 20852
(301) 897-5700
(800) 638-8355

California Speech-Language-Hearing Association www.csha.org
825 University Avenue
Sacramento, CA 95825
(916) 921-1568

Cal/OSHA
www.dir.ca.gov/dosh
Division of Occupational and Health
455 Golden Gate Ave. 10 floor
S.F., CA 94102
(415) 703-5100

Speech Pathology and Audiology Examining Committee
www.slpab.ca.gov
1422 Howe Avenue, Suite 3
Sacramento, CA 95825
(916) 263-2666

MATERIALS

"I Love What I Hear" Teachers guide for grades three through six.
National Institute on Deafness and Communication Disorders Clearing House
www.nidcd.nih.gov
31 Center Drive MSC 2320
Bethesda, MD 20892-2320
(800) 241-1044
grades 3 through 6

"Know Noise"
Sight & Hearing Association
www.sightandhearing.org
674 Transfer Road
St. Paul, MN 55114-1402
(800) 992-0424
grades 3 through 6

"Hip Talk!"
The Hearing is Priceless Program
www.hei.org
House Ear Institute
2100 West Third Street, 5th Floor
Los Angeles, CA 90057
(213) 483-4431
Junior High and High School

"H.E.A.R."
www.hearnet.com
Hearing Education and Awareness for Rockers
1405 Lyon St.
San Francisco, CA 94115
(415) 409-3277
Junior High and High School

EXCERPTS FROM THE CALIFORNIA HEALTH AND SAFETY CODE
THE SCHOOL AUDIOMETRIST

SECTION 1685

The governing body of a city, county, city and county or school district may employ one or more school audiometrists, each of whom shall be registered with the State Board of Public Health and possess such qualifications as may at the date of registration be prescribed by the State board.

Audiometric testing as conducted by the qualified school audiometrists, pursuant to Section 13300 of the Education Code*, or by other qualified certificated school personnel, as defined in Section 11751 and 11824 of the Education Code, shall meet the standards which the State Board of Public Health determines necessary to insure the adequacy of hearing testing in the schools. Subject to Section 11822 of the Education Code, audiometric tests may be administered to school and preschool children in school buildings and other agencies that provide qualified personnel to conduct such tests. (Amended by Stats. 1968)

SECTION 1686

The State Board of Public Health shall, subject to the provisions of Section 1685, issue certificates of registration to school audiometrists and to qualified supervisors of health, pursuant to Sections 11751 and 11824 of the Education Code*. The State Board shall prescribe such qualifications as may be necessary for the testing of the hearing of school children.

Candidates for registration who present evidence of having satisfactorily completed the required training in audiology and audiometry at an accredited university or college, as prescribed by the State Board of Public Health, may be issued certificates or registration without further examination.

The State Board shall require a registration fee not in excess of ten dollars ($10) for each certificate issued. Such fee shall be based upon a determination by the board as to the amount that is reasonably necessary to pay for the costs of the issuance of certificates of registration. (Amended by Stats. 1986)

*Statutes of 1976 renumbered the Education Code as follows:

Section 11822--Renumbered 49451
Section 11823--Renumbered 49452
Section 11824--Renumbered 49454
Section 11751--Renumbered 49420
Section 13300--Renumbered 44879

NOTE: For information on training, approved course work and the certificate of registration as SCHOOL AUDIOMETRIST, contact:

Hearing Conservation Specialist
Children's Medical Services Branch
MS 8100
P.O. Box 997413
Sacramento, CA 95899-7413
916-323-8087 FAX 916-323-8104
srawisze@dhs.ca.gov

HEARING TESTING OF SCHOOL CHILDREN:
THE SCHOOL AUDIOMETRIST AND TESTING STANDARDS

The following are excerpts from the California Code of Regulations (CCR), Title 17, pertaining to SCHOOL AUDIOMETRIST and HEARING TESTING in the schools. (eff. 4.95)

SECTION 2950
Qualifications

The qualifications required for registration as school audiometrist shall be as follows:

(a) Satisfactory completion of required training in audiology, audiometry, and hearing assessment at an accredited university or college. Such training must include a minimum of eight quarter hours, or equivalent, academic, and practical preparation in audiology, identification audiometry, and hearing assessment in courses approved by the Hearing Conservation Specialist of the State Department of Health Services. If the applicant completed the required training more than five years prior to the date of application for registration, the applicant must have had at least one year of verified supervised experience in the interim in the administration of hearing tests to school children in the public or parochial schools, or in other tax maintained educational institutions in this State. Verification will be documented in writing by the applicant's supervisor.

(b) Public health nurses and credentialed school nurses may either fulfill the requirements of subsection (a) or demonstrate satisfactory completion, at an accredited university or college, of a four quarter hours, or equivalent, hearing assessment course approved by the Hearing Conservation Specialist of the Department of Health Services.

(c) For purposes of subsections (a) and (b) accreditation of colleges or universities shall be by one of the following accrediting associations:

(1) New England Association of Schools and Colleges .....
.....
.....

(6) Western Association of Schools and Colleges

(d) Applicants for registration as school audiometrist shall receive written notification informing the applicant that the application is complete and approved, or that the application is deficient and what specific information is required. Notification must occur within two week of receipt of the application by the State Department of Health Services. This two-week time period is a median based on a minimum of one week and a maximum of three weeks actual performance in 1985 and 1986.

(g) Within four weeks of receipt of an approved application the State Department of Health Services shall issue a certification of registration to the applicant.

SECTION 2951
Testing Standard

Schools conducting hearing testing shall comply with the following criteria:

(a) Equipment

(1) Hearing threshold tests.

(A) Pure tone audiometers used for testing thresholds shall be those manufactured to meet or exceed specifications for wide range or limited range audiometers as defined by American National Standards Institute (ANSI) Specification
Section 3.6--1969 Specifications.

(2) Hearing Screening Test.

(A) Pure tone audiometers used for hearing screening tests shall be manufactured to meet or exceed specifications for wide range audiometers or limited range audiometers as defined by the ANSI Section 3.6--1969, Subsections 2.1.1. and 2.1.2. and shall be maintained to meet such specifications.

(B) Pure tone audiometers used for hearing screening tests shall not be battery powered. Audiometers in use on the effective date of the amendment to the regulations may be utilized until they no longer meet ANSI Section 3.6--1969 Specifications, Subsection 1 through 4.9.2.

(3) Care of Equipment.

(A) Audiometric testing personnel shall be trained in the proper care of the testing equipment.

(B) Biological checks.

Audiometric testing personnel shall maintain continuous surveillance of the audiometer used, by performing biological check as follows:

1. Daily. A brief biological check of the audiometer shall be made each day the audiometer is in use. The check shall consist of testing each earphone on a person with stable audiometric thresholds that do not exceed 25 decibel hearing level at any frequency tested between 500 Hertz and 4000 Hertz and comparing the test results with the subject's baseline audiogram. The subject may be the audiometrist.

2. Monthly. A detailed biological check of the audiometer, which includes a careful listening test of earphones to insure that the audiometer, displays no evidence of:

a. Cross talk
b. Signal distortion;
c. Transient clicks;
d. Abnormal noise; or
e. Intermittent signal.

(C) Calibration.

1. An electroacousitic calibration check of audiometers shall be made at least every 12 months, or more frequently if indicated by the biological checks, and meet or exceed the specifications outlined in Subsections 1 through 4.9.2., American National Standards for Audiometers, (published in 1969).

2. A calibration chart, showing proof of performance, shall be kept with the audiometer.

(b) Test environment.

(1) For audiometric threshold testing and screening testing, the environmental noise level shall not exceed 41.5 decibel sound pressure level in the 500 Hertz band, 49.5 decibel sound pressure level in the 1000 Hertz band, and 54.5 decibel sound pressure level in the 4000 Hertz band; or,

(2) The test environment shall be considered adequate if the noise levels do not cause a threshold shift greater than 10 decibels at those frequencies which must be included in a pure tone conduction threshold test. This procedure may be performed on the audiometrist.

(c) Testing procedures.

(1) Each pupil shall be given a hearing screening test in kindergarten or first grade and in second, fifth, eight, tenth, or eleventh grade and first entry into the California public school system.

(A) **A school district may request a waiver of the hearing screening test for tenth and/or eleventh grade pupils once each school year. The request for a waiver must be in writing and addressed to the State Department of Health Services, Hearing Conservation Specialist. The waiver request must include the dates of the school year for which the waiver is requested and an alternative testing plan that will insure that each pupil at risk of hearing loss will receive testing services. Pupils at risk of hearing loss are: those exposed to loud noises, including loud music; pupils that have been referred for testing by a parent or teacher; repeat tests for those pupils for whom there was a previously documented problem, pupils who have not had a hearing test for three years; and any pupil who has enrolled for the first time in the school district. An approved waiver of the hearing screening test does not exempt a school district from reporting requirements contained in Section 2951, (e).**

(B) Each pupil enrolled in a special education program (as described in Section 56001 of the Education Code), other than those pupils enrolled for a hearing problem, shall be given a hearing test when enrolled in the program and every third year thereafter. Hearing tests may be given more frequently as needed based on the individual education program team's evaluation of each individual pupil.

(2) Pure tone audiometric screening tests shall be conducted at a level not to exceed 25 decibels and shall include the frequencies 1000, 2000, and 4000 Hertz. A pupil's failure to respond to any of the required frequencies constitutes a failure of the screening test. Individual tests may be used for pupils of all ages. Group tests may only be used for pupils who demonstrate reliable results.

(3) Pure tone air conduction threshold tests shall include the frequencies 500, 1000, 2000, and 4000 Hertz and shall be given to:

(A) All pupils who fail the screening tests;

(B) All pupils who are to be considered for further audiological or otological evaluation.

(d) Referral.

The schools shall provide the parents or guardians of children who fail the hearing tests with a written notification of the test results and recommend that a medical and audiological evaluation be obtained whenever the test demonstrates:

(1) A hearing level of 30 decibels or greater for two or more frequencies in an ear at 500, 1000, 2000, and 4000 Hertz, or a hearing level of 40 decibels or greater for one of the frequencies tested, 500 through 4000 Hertz, on two threshold tests completed at an interval of at least two weeks; or,

(2) The evidence of pathology, such as infection of the outer ear, chronic drainage, or a chronic earache.

(e) Reporting Results.

(1) Dates and results of all screening hearing testing shall be recorded on each pupil's health record. Copies of all threshold tests shall be filed with the pupil's health records.

(2) Each school shall prepare an annual report of the school hearing program using Annual Report of Hearing Testing forms (PM 100). PM 100, provided by the State Department of Health Services with copies to the District Superintendent and the County Superintendent of Schools.

Note: Authority cited: Section 208, Health and Safety Code.

Reference: Sections 1685 and 1686, Health and Safety Code and Section 44879 and 56001, Education Code.

EXCERPTS FROM THE CALIFORNIA EDUCATION CODE

(Sections pertaining to supervisors of health, e.g., School Nurse, Audiologist, etc.)

SECTION 49421
Joint Employment

The governing boards of two or more school districts in the same county may join in the employment of a supervisor of health, or supervisors of health, and may use funds not set aside for the payment of teacher's salaries or for library purposes shall be used for this purpose.

SECTION 49422
Supervision of Health and Physical Development of Pupils

No physician, psychiatrist, oculist, dentist, dental hygienist, optometrist, otologist, podiatrist, audiologist, or nurse not employed in that capacity by the State Department of Health Services, shall be, nor shall any other person be, employed or permitted to supervise the health and physical development of pupils unless he or she holds a health and development credential or a standard designated services credential with a specialization in health or a valid credential issued prior to the operative date of the amendment to this section enacted at the 1970 Regular Session of the Legislature.

Any psychologist employed pursuant to Section 49403, and this article, shall hold a school psychologists credential, a general pupil personnel services credential authorizing services as a school psychologist, or a standard designated services credential with a specialization in pupil personnel services authorizing service as a psychologist, or services credential issued by the State Board of Education or Commission for Teachers' Preparation and Licensing.

The services credential with a specialization in health authorizing service as a school nurse shall not authorize teaching services unless the individual holds a baccalaureate degree, or its equivalent, and has completed a fifth year if preparation.

No Physician employed by a district to perform medical services pursuant to Section 44873, shall be required to hold a credential issued by the State Board of Education or Commission, provided he or she meets the requirements by Section 44873.

*See Section 44879 (School Audiometrist)

EXCERPTS FROM THE CALIFORNIA EDUCATION CODE HEARING TESTING

SECTION 49451
Parent's Refusal To Consent

A parent or guardian having control or charge of any child enrolled in the public schools may file annually with the principal of the school in which he is enrolled a statement in writing, signed by the parent or guardian, stating that he will not consent to a physical examination of his child. Thereupon, the child shall be exempt from any physical examination, but whenever there is a good reason to believe that the child is suffering from a recognized contagious or infectious disease, he shall be sent home and shall not be permitted to return until the school authorities are satisfied that any contagious or infectious disease does not exist.

SECTION 49452
Sight and Hearing Test

The governing board of any school district shall, subject to Section 49451, provide for the testing of the sight and hearing of each pupil enrolled in the schools of the district. The test shall be adequate in nature and shall be given only by duly qualified supervisors of health employed by the district; or by certificated employees of the district or of the county superintendent of schools who possess the qualifications prescribed by the Commission for Teacher Preparation and Licensing; or by contract with the agency duly authorized to perform such services by the county superintendent of schools of the county in which the district is located, under guidelines established by the State Board of Education; or accredited schools or colleges of optometry, osteopathy, or medicine. The records of the tests shall serve as evidence of the need of the pupils for the educational facilities provided physically handicapped individuals. The equipment necessary to conduct the tests may be purchased or rented by governing boards of school districts. The state, any agency, or political subdivision thereof may sell or rent any such equipment owned by it to the governing board of any school district upon such terms as may be mutually agreeable.

SECTION 49454
Use Of Audiometer

A person employed by a school district in a position requiring certification qualifications who holds a valid credential authorizing the teaching of lipreading or the teaching of the deaf and hard-of-hearing or a standard teaching credential with specialized preparation in the area of the deaf and hard-of-hearing or in the area of speech and hearing handicapped or who holds a certificate or registration to serve as a school audiometrist issued by the State Department of Health Services may, subject to Section 49451, test the hearing of pupils of the district through the use of an audiometer for the purpose of detecting pupils with impaired hearing.

SECTION 44879
Qualifications For School Audiometrist

The qualifications for an audiometrist working under the direction of health services personnel pursuant to Section 49420 shall be a valid certificate or license issued by, or valid registration with, the California state agency authorized by law to issue the certificate or license, or to effect the registration, required for performance of the service.

QUICK REFERENCE
for the School Audiometrist

WHO CAN TEST**

The following prioritized list provides guidance on which district employees are qualified to administer hearing testing to pupils in public schools.

1. A credentialed school nurse who is registered with the State Department of Health Services (DHS) and holds a school audiometrist certificate pursuant to 17 CCR Section 2950 (a) or (b).
2. A person who has a valid special credential authorizing the teaching of the deaf and hard of hearing; a standard teaching credential with specialized preparation in the area of the deaf and hard of hearing or in the area of speech and hearing handicapped; or a certificate of registration to serve as a school audiometrist issued by the State Department of Heath Services pursuant to CEC Section 49454.
3. A non-credentialed individual certified by the DHS as having fulfilled the requirements of 17 CCR Section 2950 (a) and employed by a school district may assist with basic hearing screening for pupils if they work under the immediate supervision of a credentialed school nurse or other duly qualified supervisor of health. Non-credentialed employees trained under 17 CCR Section 2950(a) are not qualified to perform hearing screening or to make referrals for follow-up hearing testing in California public schools.
4. A school district may also contract for the provision of testing with an agency authorized to perform such services pursuant to CEC Section 49452. These contract agencies may provide basic hearing screening for pupils if they work under the supervision of a credentialed school nurse or other duly qualified supervisor of health.

WHO TO TEST*

Each pupil in **kindergarten or first** grade and pupils in **second, fifth, eighth, tenth, or eleventh** grade and at **first entry** into the California public school system shall be given a hearing screening.

A school district may request a waiver of the hearing screening test for tenth and/or eleventh grade pupils once each school year. A form has been developed to facilitate this process and will be provided to each district early in the school year. An approved waiver request must be on file prior to implementing the annual hearing testing program. Results of testing "at risk" pupils must still be reported on PM 100.

Test each pupil enrolled in **special education** program, other than those enrolled for a hearing problem, on first entry and every third year thereafter.

SCREENING & FIRST THRESHOLD TEST

If there is evidence of **pathology, refer** for medical evaluation **immediately.**

Instruct the child to raise his/her hand when the tone is heard.
Condition to tone at 50 dB.
Set hearing level to **25 dB.***
Start with right ear.
Screen at **1000, 2000, and 4000** Hz.*
Switch to left ear.
Screen at **4000, 2000, 1000** Hz.

If there is a response in both ears at all frequencies, note "pass" on class list and dismiss the child.

If there is no response to one or more of the screening frequencies at either ear, perform the first threshold test to **confirm** screening failure. You may test **only** at failed frequency(ies) and screen at 500 Hz in both ears.

If threshold is 25 dB or better note "pass" on class list and dismiss the child.

If hearing level is confirmed to be greater than 25 dB, note "did not pass" on class list and dismiss the child. A second threshold test shall be performed in two to six weeks.

SECOND THRESHOLD TEST

The second threshold test is performed two to six weeks after the first threshold failure and is performed in the same manner as the first threshold test.*

REFERRAL CRITERIA*

1. Evidence of pathology.
2. a. Hearing Level of 30 dB or greater for two or more frequencies in an ear or,

   Hearing level of 40 dB or greater for any one frequency.

REPORTING RESULTS*

1. Record dates and results of screening and a copy of threshold tests (if any) in pupil's health record.
2. Prepare annual report (PM 100). **Remember:** Only the pupils who **failed** the **second threshold** test and would be eligible for referral are noted in column 4. Completed forms should be mailed by June 30th of the current school year to:*

Hearing Conservation Specialist
Children's Medical Services Branch
MS 8100
P.O. Box 997413
Sacramento, CA 95899-7413
(916) 323-8087 FAX (916) 323-8104
srawisze@dhs.ca.gov

In accordance with California Code of Regulations
* (CCR) Title 17, Section 2951
**(CCR) Title 17, Section 2950

FORMS

State of California Health and Human Services Agency

Department of Health Services
Children's Medical Services Branch

ANNUAL REPORT OF HEARING TESTING

Reporting School Year

REPORT DUE JUNE 30
CURRENT SCHOOL YEAR

CDS Code Number (County / District)	School District	Superintendant	
Address (number and street)	City	Zip Code	County
Period Covered From: To:	Supervisor of Health Name: Title:		Office Telephone Number

GRADES IN DISTRICT Check Box for Highest Grade in District (1)	Enter Number of Pupils Enrolled in EACH GRADE as of the October (CBEDS) Report (2)	INITIAL SCREENING Number of Pupils Screened Per Sec. 2951(c), CCR, Title 17 (3)	RESULTS Number of Pupils Failed Both Threshold Tests Per Sec. 2951(d), CCR, Title 17 (4)	DISPOSITION AND FOLLOW-UP Number of Pupils Referred for Medical and/or Audiological Evaluation [From Col. (4)] (5)	Number of Pupils Examined by Doctor and/or Audiologist or Under Treatment (6)
K * or 1					
* 2					
3					
4					
5					
☐ 6					
7					
☐ 8					
☐ 9					
10 * or 11					
☐ 12					

* All pupils in these grades shall be tested annually (Section 2951(c), CCR, Title 17).

SPECIAL EDUCATION: (See instructions on reverse side of this form.)

DISTRIBUTION OF COPIES

☐ Hearing Conservation Specialist
Department of Health Services
Children's Medical Services Branch
MS8103
P.O. Box 997413
Sacramento, CA 95899-7413

☐ County Superintendent of Schools

TESTING CONDUCTED

Testing was conducted by the following personnel employed by the District:

☐ District School Nurse-Audiometrist, per Section 49420, CEC and Section 2950, CCR, Title 17.

☐ District School Audiometrist, per Section 44879, CED.

☐ District Speech/Hearing Specialist, per Section 49454, CED.

Testing was conducted by qualified personnel employed by:

☐ _____ County Office of Education

☐ _____ County Health Department

☐ _____
A private agency authorized by the County Superintendent, per Section 49452, CEC.

SEE OTHER SIDE FOR INSTRUCTIONS

PM 100 (9/03)

INSTRUCTIONS FOR COMPLETING FORM PM 100
ANNUAL REPORT OF HEARING TESTING

A. Complete identifying information. Insert reporting school year. Your District's "CDS CODE NUMBER" can be obtained from the California Public School Directory; it designates your COUNTY and DISTRICT, i.e., 19-64212 is the Code Number for the ABC Unified Schools in Los Angeles County. The PERIOD COVERED will include the date the hearing testing was started and the date when *testing and follow-up* were completed.

B. COLUMN (1). **GRADES IN DISTRICT:** Please *circle* the highest grade in your District.

COLUMN (2). **Number of Pupils ENROLLED in Each Grade**: Enter the number of pupils enrolled in *ALL GRADES* as of the October (R-30) report made to the California Department of Education.

COLUMN (3). **INITIAL SCREENING: Number of Pupils SCREENED**: Enter the number of pupils in each grade that were screened per Section 2951(c), California Code of Regulations (CCR), Title 17. (Figures for tests conducted in all grades SHALL be included.)

COLUMN (4). **Number of Pupils who FAILED BOTH THRESHOLD TESTS**: Enter number of pupils who failed BOTH THRESHOLD TESTS per Section 2951(d), CCR, Title 17.

COLUMN (5). **Number of Pupils REFERRED for Medical and/or Audiological Evaluation**: From column number (4), enter the number of pupils who were referred per Section 2951(d), CCR, Title 17.

COLUMN (6). **Number of Pupils EXAMINED by Doctor and/or Audiologist or Under Treatment**: From column number (5), enter the number of pupils who reached the doctor and/or audiologist, were examined, or who are known to be receiving treatment.

C. **SPECIAL EDUCATION**: Briefly describe the audiometric, audiological, and medical services used when evaluating and placing pupils in need of special education. (You may attach additional information if necessary.)

D. Check the appropriate boxes describing testing personnel. *If any of the testing services were provided by contract with an authorized agency*, per CEC, Section 49452, *enter the name of the agency, organization, or company*. A county office of education and the county health department are considered to be "authorized agencies."

E. Check the distribution and send copies of the report as indicated.

THIS REPORT IS DUE ON OR BEFORE JUNE 30 OF THE CURRENT SCHOOL YEAR

HEARING SCREENING REQUEST WAIVER

_____
School Year

CDS code number	School district		
Address (number and street)		City	ZIP code
Name	Title		Date
Signature		Office telephone number ( )	

A school district may request a waiver of the hearing screening test for tenth and/or eleventh grade pupils once each school year. This request is for waiver of hearing screening for tenth and/or eleventh grade pupils.

The California Code of Regulations, Title 17, Section 2951, requires an alternative testing plan that will ensure that each pupil at risk of hearing loss will receive testing services. Pupils at risk of hearing loss are:

- those exposed to loud noises, including loud music;
- pupils that have been referred for testing by a parent or teacher;
- pupils for whom there was a previously documented problem;
- pupils who have not had a hearing test for three years; *and*
- any pupil who has enrolled for the first time in the district.

☐ We will follow the alternative hearing testing plan as described above.

☐ We will modify the alternative hearing testing plan described above in the following fashion:

_____

_____

_____

_____

_____

_____

_____

Please submit this form prior to implementing the current year hearing testing program. **An approved waiver of hearing screening does not exempt a school district from reporting requirements contained in Section 2951(e).**

Submit this request to: California Department of Health Services
Children's Medical Services Branch
Hearing Conservation Specialist
MS 8103
P.O. Box 997413
Sacramento, CA 95899-7413

DO NOT WRITE IN THIS SPACE	
☐ Approved ☐ Not approved	
Reviewed by	Date

Form PM 101 Application for Registration as School Audiometrist can be found by at:
http://www.dhs.ca.gov/publications/forms/pdf/pm101.pdf

Please visit the Hearing Conservation Program's webpage at: http://www.dhs.ca.gov/pcfh/cms/publications/hcp.htm

Return to: California Department of Health Services
Children's Medical Services Branch
Hearing Conservation Specialist
MS 8103
P.O. Box 997413
Sacramento, CA 95899-7413

FOR DEPARTMENT USE	
Registration accepted ☐ Yes ☐ No	
Date	Initials

REGISTRATION OF AGENCY INTENDING TO PROVIDE HEARING TESTING SERVICES PER SECTION 49452, CALIFORNIA EDUCATION CODE

Pursuant to Section 49452, California Education Code, the current Guidelines for Authorization by the County Superintendent(s) of Schools and the current hearing testing standards, as prescribed by Section 2951, California Code of Regulations, Title 17 (Health), we submit herewith, for acceptance and registration the following description of our services, facilities, and personnel.

Name of agency or private provider

Address	City	County	ZIP code	Phone number ( )
Director's name	Degree	☐ Licensed physician ☐ Licensed audiologist	☐ California Credential—Speech/Hearing ☐ California Credential—School Nurse	

Description of testing services, facilities, special equipment:

All hearing testing services shall meet or exceed the standards prescribed by the California Code of Regulations, Title 17, Section 2951.

THE FOLLOWING PERSONNEL WILL CONDUCT TESTING SERVICES		QUALIFICATIONS		
NAME	ADDRESS	Number Licensed Audiologist	Number School Audiometrist	Number Speech/ Hearing Specialist

CHANGES IN PERSONNEL WILL BE REPORTED TO THE DEPARTMENT WITHIN TEN DAYS.

Director's signature	Degree	Title	Date

CLASS LIST

Hearing Screening

School _____

Date _____ Grade _____ Room _____

Audiometrist _____

Audiometer _____ ☐ ANSI

Key to Recorded Information:

☐ Responded at the 25 dB Screening Level

☐ No Resp onse at 25 dB

		Threshold only	Screening or Threshold			Passed Hearing Screening at 25 dB	Unable to Screen (See Comments)	Threshold Testing Required	Comments:
Child's Name	**Ear**	**500**	**1000**	**2000**	**4000**				
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REV.12/00

AUDIOLOGICAL/MEDICAL REFERRAL

School District and School: _____

Name of Child: _____

As a result of hearing screening tests at school, we believe your child should have:

____ A complete hearing examination by an audiologist ____ A medical examination

PLEASE GIVE THIS FORM TO THE PERSON WHO EXAMINES YOUR CHILD TO COMPLETE AND HAVE THEM RETURN IT TO SCHOOL

AUDIOLOGY EXAMINATION

(Fill in form or attach copy of audiogram)

ANSI HEARING LEVELS

EAR	250	500	1000	2000	4000	8000
Right						
Left						

IMPEDANCE/IMMITTANCE

EAR	Pass/Fail	PVT
Right		
Ear		

Findings: Right: _____ Left: _____

Recommendations: (Please Circle)
A. Noise Protection
B. Hearing Aid Eval.
C. Speech Evaluation
D. Education Assessment
E. Rehab. Counseling
F. Special Seating
G. Developmental Evaluation
H. Special Tests
I. Repeat Audio Date:_____
J. Other: _____

AUDIOLOGIST: _____ **RETURN TO**:
ADDRESS: _____
_____
DATE: _____

PHYSICIAN'S EXAMINATION

EARS: Canals: Right: _____ Left: _____
T.M. & Middle Ear: Right: _____ Left: _____

NOSE: _____

THROAT: _____

EXAMINER: _____ **RETURN TO:**
ADDRESS: _____
_____
DATE: _____

Rev. 01/01