1987

An educational curriculum outline for teaching sound and hearing in elementary schools

Marty Bush

Marty Bush 1987

AN EDUCATIONAL CURRICULUM OUTLINE FOR TEACHING SOUND AND HEARING IN ELEMENTARY SCHOOLS

Since the Industrial Revolution, man has found an increasing number of ways to manufacture goods which make his work more efficient, household chores a breeze and give more free time. The mechanical/electrical machinery and gadgets capable of accomplishing tasks which once took much longer to finish have a hidden price tag in the form of a by-product: noise. With the increasing number of factories came increased noise at the work site and with the increase in the number of household appliances came an increase of noise at home. Cars have also been guilty of producing unwanted sound. Music has taken on a new form in the shape of rock and roll and with it came dangerously high levels of sound for one's listening pleasure.

Noise is now the fourth most common pollution behind air, water,and solid waste and it is damaging man's hearing sensitivity.(1) Escaping noise has become more difficult as it has moved into every facet of life, work, home and recreation. Community noise increases at a rate of 1 dB per year.(2) Hearing Conservation programs may be effective and enforceable at the worksite, but ear plugs are not a practical option to daily exposure in the community and at home.

The most logical solution is to make people aware of the dangers of high levels and extended exposures of noise and to instill this concept in them as a part of their personal health program. People protect their bodies with proper diet and exercise, and their sight with sunglasses and protective goggles when necessary. Now people must learn the necessity of protecting their hearing.

This learning process can begin at school. At a young age children should be taught the virtues and attributes of sound along with its dangers with excessive exposure. The aim of this study was to develop a brief, viable curriculum for elementary school children which could be used to educate them regarding sound, ears, hearing and deafness.

SURVEY OF TEXTS

A review of six health and/or science texts for elementary school classes found that little or no attention was given to the physics of sound, hearing or deafness. A small amount of space and time was given to noise, noise pollution and the effects of noise on hearing.

Following are brief summaries of the texts. All of these texts were designed for the sixth or seventh grade level.

Abruscato, Joseph, J.W. Fossaceca, J. Hassard, D. Peck; Holt Science. Holt Rinehart and Winston, NY, 1986.

This text, although it describes various systems of the body, such as the digestion and respiratory systems, tells nothing of the ear or sound.

Barufaldi, James P., George T. Ladd and Alice Johnson Moses; Heath Science. D.C. Heath and Company, Lexington, Mass, 1985. pp.266-272.

There is a brief description of sound and how it is transmitted through wires (as in a telephone). Although three pages are spent on this, an adequate description of sound and sound waves is lacking.

Bierer, Loretta and V. Lien, Ph.D.; Heath Life Science. D.C. Heath and Company, Lexington, Mass., 1984.

This text had one page on the ear and a brief description of anatomy, including one picture. In contrast, there were two and one half pages about the eye.

Meeks, Linda Brower, M.S; Health 7. Charles E. Merrill Publishing Company, Toronto, 1984.

There is one page in this book devoted to noise pollution. It mentions that noise causes stress on your body and that loud noises may injure the hairs in the inner ear. Decibels are described by comparing them to known sounds. The fact that the effect of noise depends on the level of loudness and length of exposure is stated in a sentence, and not stressed.

There are about two pages about the ear which identify structures of the ear and their function and how to care for the ear.

Ramsey, William, L. Gabriel, J. McGuire, C. Phillips, and F. Watenpaugh; Holt Science. Holt, Rinehart and Winston, NY, 1986. pp.218-223.

These five pages tell what sound is, how sound waves are like other kinds of waves, describes the speed of sound, sonic booms, and frequency. It includes one page of activities and study questions.

Rockcastle, V. N., B. J. McKnight, F. R. Salamon, and V. E. Schmidt; Science. Addison-Wesley Publishing Co., Menlo Park, CA, 1980.

This text is devoted strictly to physical science; it makes no attempt to address health or anatomy. Therefore, although it is not surprising that no mention of hearing is made it seems odd that sound was not included.

SURVEY OF LITERATURE

To further research the availability of information on sound and hearing, literature of the past ten years was searched in order to find how much work and progress had been made in the education of children regarding this topic. The result of the search was four articles. The first was taken from a PBS documentary and the remaining three constituted a series which appeared in "Science Activities" in 1979 and 1980.

William G. Neill wrote "Orchestrating the Soundscape" which was a portion of the PBS show "To Hear" which aired in October, 1982. Neill, in a simple and straight forward manner, began by discussing the importance of sound in our lives. His initial focus was to make the audience aware of the importance of sound and that it is always present. He continued to discuss what sound was by describing vibrations, pitch and volume. This was followed by a description of the ear from the pinna to the hair cells of the inner ear. Decibels were described as units used to measure the intensity of sound and then a list of sounds with their corresponding sound levels was given. Finally, Neill finished with a discussion of insulation and sound absorption.

Each of the above topics had a suggested corresponding activity designed to facilitate learning and to demonstrate the principles discussed. Neill's format which includes physics and anatomy presented itself as a good basis for a more involved program.

The three articles comprising Thomas J. Rillo's series entitled "Exploring Noise:Sound Pollution" comprised the only information found regarding education about noise pollution. In his series of articles Rillo covered sources of noise pollution, the problems it causes, i.e., physical, psychological and social stress, and the approaches suggested to alleviate the problem.

The series also discussed decibels, sound level meters and loudness as a function of perception. Rillo briefly covered anatomy. Part III of the series was completely devoted to listing experiments and activities that could be done in the classroom and were designed to compliment his discussion.

Rillo's series addressed noise pollution as a problem pertinent to the youth of today, not as though it were an issue affecting adults only.

The small number of publications found during this search indicated the necessity to further the availability of information to teachers of elementary school age children and to encourage them to include such information in their classroom. The scientists and educators need to direct each other toward the goal of teaching the young to understand the value of sound and hearing and that the two should not be taken for granted. Protecting their hearing is as important as protecting their sight. While loss of sight may separate people from the world of things, loss of hearing separates people from other people. Seemingly, the best motivating factor for the advancement of conservation of hearing is awareness of the benefits of hearing and of the dangers to that hearing.

WORK DONE IN THE CLASSROOM

Work was done with children in a classroom situation in order to assess the knowledge they had of sound and hearing and to aid in the planning of a viable curriculum to educate them about sound and hearing.

There were sessions with three groups of children during which they were taught about sound and hearing. The purpose was to educate and to glean, for use in this study, how much the students already knew on the subject.

Short questionnaires were completed by the students at the Gifted and Talented Education Program (GATE) prior to the classes. Questions covered noise, anatomy, deafness, and physics of sound. The children were also asked if they learned about sound at home or school. Some children gave more than one answer for some questions.

Most children knew that some sounds could be dangerous; only eight out of fifty-four did not. Only four thought deaf people could not talk but all knew that the deaf could learn. Speaking and making friends were listed fifty-eight times as being the most difficult things for a hearing impaired child to do. Most of the students listed school as their source of information but many listed both home and school. See Appendix A for specific responses to the questionnaire.

Following are descriptions of the classes conducted.

A one hour class was held for children of the Gifted Resource Council of Greater St. Louis. During the class anatomy was discussed and the children were able to look at a skull allowing them to see the cochlea and internal auditory meatus as well as

larger sections of the ear and head. Some time was spent on frequency and pitch as the class moved into a discussion of hearing sensitivity and the dynamic ranges of various animals. The use of the chinchilla versus the monkey or dolphin for hearing research was explained by describing the similarity between the hearing of a chinchilla and man and by explaining the economic and environmental reasons for using the chinchilla versus other animals.

Noise pollution and the effects of exposure to noise were discussed. Slides were shown to describe the effect on hair cells that noise can have.

The hearing sensitivity of the children was measured and a sound level meter was used to help explain the decibel as a unit of measure of sound.

There were three children in this class which was held in an informal discussion format. Their ages ranged from eight to eleven and none apparently had much experience with sound, hearing or deafness.

Classes for groups of children from GATE, a program in University City for "gifted" children, were held. Each group heard a lecture which included descriptions and information regarding deafness, anatomy and noise and hearing research.

The first group was comprised of thirty-six third and fourth graders. These children attend school across the street from St. Joseph's Institute for the Deaf and were seemingly more aware of deafness than the average eight year old. Some knew hearing impaired children. These children appeared more knowledgeable of the limitations of deafness and of the education of the deaf than the average person of any age.

The effects of noise were discussed including the effects of a loud sound on heart rate and respiration - the fight or flight response. Most of the children had personal headset stereos which they admitted to playing loudly and, although they knew noise could be dangerous to their hearing, they had not considered loud music to be dangerous.

Hearing research was also discussed. The use of the chinchilla, and some methods for training animals for research were briefly touched upon.

The second group was made of fifth and sixth graders. These children also attended school across from St. Joseph's and so knew hearing impaired children. No broad generalizations could be made about the knowledge or awareness level of these children regarding deafness. A few knew more than was to be expected and the remainder knew little. The same topics were discussed with this group as with the younger class. Anatomy, noise, personal

stereos and animal research were each discussed. Slides of a healthy cochlea and a damaged cochlea were shown and explained.

These same groups of children were brought to CID on two separate days. Each group visited three sites in the Clinics and Research Building. Site One was a room where microscopes were set up so the children could look at the ossicles and other slides of ear anatomy, particularly hair cell structure.

A second site as Dr. Clark's noise lab where a short review of what was discussed in the classroom lecture concerning noise was reviewed. Decibels were discussed and compared with noises known by the children. An example was made by having one child shout and see how loud his voice registered on the sound level meter. Then two children shouted and then the whole class shouted. In this way, by comparing measurements, the nonlinearity of the decibel system related to sound pressure level was demonstrated. At this site the children also saw a chinchilla whose hearing sensitivity was being tested. The procedure was explained as the children watched on a monitor.

The third site was Dr. Weisenberger's tactile aid lab. There the children learned that some people do not benefit from an acoustical hearing aid because their hearing impairment is so extensive. Two types of tactile aids were described, single channel and multi-channel aids and the students participated in a demonstration which showed how tactile aids benefit the wearer when used with speech reading. While some children wore the aid, others presented the stimuli words, thus involving them in the demonstration.

Conclusions drawn from the experiences with the children from GATE and from the Gifted Resource Council must be qualified by saying that these children are generally considered to be above average in intelligence or academics. In addition , the children from GATE had slightly more experience with the hearing impaired than the average child since their school was near a school for the deaf. Overall, however, an interest in the various aspects of sound, e.g. frequency and hearing research, was noticed. Interest was easily peaked through various activities requiring the participation of the children as occurred in the various labs.

The children were essentially poorly informed about noise, noise pollution and the effects of noise on the ear. Surveys conducted after the sessions indicated an improvement in understanding deafness and research but there was still a lack of comprehension that noise, even in short exposures, can cause permanent damage to hearing. This may indicate that teaching techniques were not to the point; that a more direct approach would have been better instead of an informal approach. Perhaps the slides shown were beyond the understanding of the children. All this points to a need for cooperation between the scientists and educators in preparing for the classroom presentations.

For specific responses to the Post-Questionnaire, see Appendix B.

CONCLUSIONS

Before stating conclusions drawn on the basis of this project, it must be repeated that there were some drawbacks to the population used in the classroom work. These children are considered "gifted" intellectually or at least are above average academically.Secondly, the children in the GATE program attend school across the street from St. Joseph's School for the deaf and so have knowledge, experience and relationships with the hearing impaired children who attend St. Joseph's. This gives them information regarding the hearing impaired which most Americans do not have, regardless of their age.

With these factors in mind, it may be that the level of instruction used here would be inappropriate for the average child. An even more basic approach may prove more successful or perhaps simply an adjustment in vocabulary would do the trick. An attempt was made to bear this in mind while preparing the curriculum outline. Additionally, it would seem logical for an educator and a scientist to work together in developing a curriculum for young children. At one point in 1986 the Acoustical Society of America was trying to develope such a program but lost their funding. Perhaps if educators had also been involved, their project could have proceeded.

Changes in the program used for the GATE children would be necessary under any circumstance. The portion of their visit to CID in which they studied anatomy by looking through microscopes was impractical for the number of students involved. Viewing through a microscope takes time, particularly when what is being looked at is unfamiliar. The children waiting became restless. Projecting pictures on a screen may be the preferable approach.

The visit to the tactile lab was a success but, perhaps, would have been better appreciated had the group been smaller. The size of the lab itself was a problem in that it is so small.

Time spent in the animal research /noise lab went well, but again, the numbers of children made it difficult for all to view the monitor of the working chinchilla at once. Those waiting became restless. Also, keeping the chinchilla in the room with the children became a distraction. Moving it out would have made the remainder of the session quieter, calmer.

An effort was made to make note of how much prior knowledge the children had regarding sound, hearing and deafness. The questionnaires were kept short and simple due to the age spread among the children (seven through ten years old). Information obtained from the pre-questionnaire and from responses in the classroom indicated that very little was known about anatomy and the dangers of loud noise. Their perception of deafness was, as

stated earlier, probably above average. They were aware of its effect on speech development and were appropriately impressed by the speaking ability of the children used in the demonstrations at CID. Some other children may have expected the hearing impaired to be unable to speak and others may have expectations too high.

The above are observations only. The opinion of educators familiar with the age group and with American children in general would be an asset in further efforts to develop educational programs about sound, hearing, and deafness for elementary school children.

The result of the above literary search and classroom work is the following outline for a curriculum to be used in elementary schools. Although the target, at first, was to direct this program towards the sixth and seventh grade levels, work done with younger children indicated that classes about sound and hearing could be conducted for the primary grades, thus not having to wait for children to be ten or eleven to begin this facet of education.

CURRICULUM OUTLINE

I.Introduction to Sound: make the children aware of sounds and to appreciate the effect of sound on their lives such as communication and warnings.

A.Why does a baby cry? (Communication)

B.What is the value of a honking horn or a siren? (Warning)

C.Have the children name unpleasant sounds and pleasant sounds.

D.Discuss: Are we ever without sound?

II.Physics of sound

A.What is sound?

1.Vibrations in a "medium" that produce a "sound wave"

a.Compression/rarefaction

b.cycles per second/length of wave

(1)middle "C" has 256 cps and a wave length of about 1 foot

(2)a pitch twice as high as middle"C" would have a wave length one half the length of middle "C"

c.speed of sound is 1120 feet/second; light travels much faster than sound at a rate of 186,000 miles/second so lightening is seen before thunder is heard

2.Examples of mediums

a.air

b.water

c.Indians put their ear to the ground to listen for buffalo,i.e. the earth is a medium

3.Activity: Pluck guitar strings. You can see and feel the vibrations of the string. Strings with higher pitch vibrate faster (more cps) than strings that produce a low pitch.

B.What is pitch?

1.Frequency - cps

2.The higher the cps the higher the pitch

C.What is volume?

1.Intensity is a force indicating the strength of the sound pressure level. Pluck a guitar string gently and then with more force; it produces increased intensity.

2.Loudness has to do with how we perceive sound, i.e., what is too loud to one person may not seem too loud to another.

3.Activity: Have the children suggest such sounds, e.g., music. Sometimes parents feel their children play rock and roll too loudly but the children think it sounds wonderful

III.Anatomy - have a model of the ear

A.Three sections

1.The outer which includes the pinna catches sound and funnels it to the eardrum. Cats and bats localize sounds by moving their pinnas.

2.The middle ear

a.has tiny bones and muscle
b.transfers sound to the inner ear

3.The inner which transfers sound by electrical/chemical impulses to the brain
a.fluids in the inner ear
b.the auditory nerve
c.30,000 hair cells which are associated with the various pitches (frequencies) we hear. If some hair cells are damaged we are then unable to hear sounds at that pitch.

B.Discuss the benefit of having two ears instead of one. What if we had just one ear in the middle of our foreheads? Would it be easier to localize sound that way?

C.Activity: Have the children close their eyes and then drop objects around the room. Ask them to localize them with their eyes closed.

IV.Measuring Sound

A.dB - decibel: a unit of measure used to measure sound pressure level

B.List dB levels of sounds children know (3)

sound treated booth----------	0-20	dB
library----------	20-40	
conversational speech----------	40-60	
work----------	80-85	
idling bus----------	90	
food blender----------	93	
subway----------	95	
motorcycle----------	111	
pain----------	130	level of sound that causes pain
jet aircraft on takeoff----------	150	
rocket launch pad----------	180	

C.Activity: Have the children measure some sound levels in the environment, e.g., rustling leaves, a creek, whispering, conversation with a sound level meter.

D.How can sounds levels be lessened?

1.sound absorption - the use of furniture, rugs, curtains, soft objects are good for sound absorption; ceramic tile, metal objects are bad sound absorbers.

2.Have the children name places where it is easier to be heard and understood. Is it easier to carry on a conversation in the living room or in the garage? Why?

E.Activity: Drop coins on various surfaces and discuss sound absorption.

F.Can sound be too loud? Have the children name some loud sounds.

V.Noise Pollution

A.Noise is unwanted sound

B.Sources of noise - Have the children name some such as highways, airplanes, lawnmowers, dishwashers, etc.

C.Pollution: to make physically impure

1.What is noise pollution? Discuss with the children:

a.noise pollution is the fourth pollution behind air, water, and solid waste. (4)

2.noise invades our privacy by interfering with phone conversations, picnics on the patio and sleep

3.noise interrupts communication

4.noise causes permanent hearing loss*

5.noise causes stress and physical damage*

*time related

D.Places where noise is prevalent

1.Job Site, e.g., factories, orchestra pit, construction work sites

2.Community, e.g., traffic, airplanes, lawnmowers, leaf rakers, chain saws, air conditioners

3.Home, e.g., kitchen appliances (disposers, dishwashers, mixers, blenders, refrigerators, vacuum cleaners, washer/dryers, etc.

4.Recreational areas e.g., motorcycle race tracks, shooting galleries, boating

E.Can music be noise? If grandparents do not like rock and roll music they may consider it to be noise. Consider the definition of noise i.e., unwanted sound.

F.Controlling the effect noise has by

1.zoning urban areas

2.landscaping

3.ear protection, i.e., plugs, ear muffs, distancing

VI.Deafness

A.Attitudes of the children towards the hearing impaired; How would a lack of hearing effect:

1.playing games

2.speaking

3.education

B.Ask the class what they think a deaf child is like i.e., pretty/plain, quiet/loud, fun/dull, smart/dumb...Discuss

C.Communication Disorders

1.Explaining that hearing impaired children can learn to speak and to communicate in alternative ways.

2.Education of hearing impaired - discuss their intelligence. Why should a deaf child learn to speak if it is easier to learn to sign?

a.Oral training

b.Manual training

c.Total communication

d.Lip reading or speech reading

3.Ask the class what type of school they would prefer to attend if they were hearing impaired.

D.Recreation and the social life of the hearing impaired; how is it the same and how does it differ from normal hearing people?

E.Careers for the hearing impaired; are there jobs a deaf person might not be able to perform? What about safety on the job site? Can the hearing impaired hear warning sirens?

APPENDIX A

QUESTIONNAIRE

CAN SOUNDS BE DANGEROUS? YES 71 NO 3

CAN SOUNDS BE HELPFUL? YES 70 NO ____

NAME A DANGEROUS SOUND. CRYING BABY ____ LOUD MUSIC 32

ROAD TRAFFIC 9 AN EXPLOSION 57

CAN A DEAF PERSON TALK? YES 63 NO 4

CAN DEAF PEOPLE TALK TO EACH OTHER? YES 59 NO 6

HOW MANY SECTIONS OF THE EAR ARE THERE?

ONE ____ TWO 6 THREE 27 FOUR 28

CAN DEAF CHILDREN LEARN? YES 71 NO ____

IF YOU WERE DEAF, WHAT WOULD BE THE MOST DIFFICULT:

LEARNING 9 SPEAKING 38 SPORTS 1 MAKING FRIENDS 20

WHAT IS SOUND?

A VIBRATION 43 A MYSTERY ____ A GAS ____ A WAVE 24

HAVE YOU EVER BEEN TAUGHT ABOUT YOUR EARS, HEARING OR SOUND?

IF SO, WHERE? SCHOOL? HOME?

45 24

The above answers were from approximately 75 children. Not all questions were answered by all the children and some children answered more than once for a question.

APPENDIX B

POST QUESTIONNAIRE

IF YOU NOTICE A CHANGE IN YOUR HEARING FOR A DAY OR TWO, HAS PERMANENT DAMAGE BEEN DONE TO YOUR EARS?

YES 12 NO 58

HOW MANY SECTIONS OF THE EAR ARE THERE? ONE____ TWO____

THREE 53 FOUR 17

WHY ARE CHINCHILLAS USED FOR HEARING RESEARCH?
BECAUSE THERE ARE TOO MANY OF THEM. 1
BECAUSE THEY WON'T BITE YOU.____
BECAUSE THEIR HEARING IS LIKE MAN'S. 63
BECAUSE THEY DON'T LIVE VERY LONG.____

A TACTILE AID IS:
EASY TO LEARN TO USE. 2
GOOD FOR ALL DEAF PEOPLE TO HAVE. 2
RECOMMENDED MAINLY FOR THOSE PEOPLE WHO ARE "STONE DEAF." 54
WORN BEHIND THE EAR.____

A "DECI-BEL" IS:
A UNIT FOR MEASURING SOUND LEVELS. 51
A NOISE. 3
A METHOD OF TEACHING THE DEAF. 3
APPLIES ONLY TO CHINCHILLAS. 2

FOOTNOTES

(1) Thomas J. Rillo, "Exploring Noise: Sound Pollution" Science Activities. v16,n4 p21; 1979.

(2) Ibid. p.23.

BIBLIOGRAPHY

Abruscato, Joseph, J. W. Fossaceca, J. Hassard, D. Peck; Holt Science. Holt Rinehart and Winston, NY, 1986.

Barufaldi, James P., George T. Ladd and Alice Johnson Moses; Heath Science. D.C. Heath and Company, Lexingto, Mass. 1985, pp 266-272.

Bierer, Loretta and V. Lien, PhD.; Heath Life Science. D. C. Heath and Company, Lexington, Mass. 1986.

Meeks, Linda Brower, M.S.; Health 7. Charles E. Merrill Publishing Company, Toronto, 1984.

Neill, William G; "Orchestrating the Soundscape," Science and Children, v.20, n2, p15, Oct, 1980.

Ramsey, William, L. Gabriel, J. McGuire, C. Philips, and F. Watenpaugh; Holt Science. Holt, Rinehart and Winston, NY, 1986, pp 218-223.

Rillo, Thomas J. "Exploring Noise: Sound Pollution, Part I," Science Activities, v.16, n4, p21-23,28; 1979.

Rillo, Thomas J. "Exploring Noise: Sound Pollution, Part II," Science Activities, v 17, n1, pp31-37; 1980.

Rillo, Thomas J. "Exploring Noise: Sound Pollution, Part III," Science Activities, v 18, n2, pp34-38; 1980.

Rockcastle, V. N., B. J. McKnight, F. R. Salamon, and V.E. Schmidt; Science. Addison-Wesley Publishing Co., Menlo Park, CA, 1980.