FM TECHNOLOGY IN THE CLASSROOM
The purpose of this module is to acquaint the viewer with:

Factors influencing comprehension of speech in the classroom

How an FM system improves speech intelligibility

Types of FM systems

Determining candidacy for an FM trial

Conducting an FM trial

Maintenance of and troubleshooting the FM system

How to determine the success of an FM trial
FACTORS INFLUENCING COMPREHENSION OF SPEECH IN THE CLASSROOM
The average classroom can be described as an “auditory – verbal” environment in which students are expected to learn by listening.
The ability to discriminate individual phonemes, to hear words/sound differences, is defined as *intelligibility*, as distinguished from *audibility*, which is the ability to detect the presence of speech. If because of hearing loss, poor classroom acoustics, and/or poor attending skills, a child cannot discriminate *wave* from *raise*, for example, he or she will not learn appropriate semantic distinctions unless deliberate intervention occurs.

Three Obstacles to Hearing, Listening, and Learning In the Classroom

Noise

Distance

Reverberation
• Classrooms are noisy places with background noise levels between 55-75 dB.
• Background noise can emanate from both inside and outside the classroom.
• Traffic, playground noise, desks and chairs moving, fans, blowers and heaters all place demands on a student’s ability to hear.
• Hearing aids cannot selectively amplify the speaker’s voice alone; they amplify background sounds as well. Oftentimes the volume of the person speaking is quieter than the background noise.
• Teachers move around the room changing the distance between teacher and student.
• If the teacher’s voice starts at 85db; it drops to 65dB just 3 feet away.
• Ideally, the student should be 3-6 feet from the speaker for maximum speech understanding.
• Also known as echo, sounds that bounce off a surface can mask or muffle the main signal.

• Hard walls, high ceilings, glass windows and uncarpeted floors reflect sounds much more than carpeted floors and acoustically treated walls and ceilings.
I heard you…

but I did not understand you.

• Noise, distance and reverberation significantly reduce the student’s access to crucial speech information.

• Students with hearing loss demonstrate even greater difficulty understanding speech under these conditions.
HOW AN FM SYSTEM IMPROVES SPEECH INTELLIGIBILITY
The teacher wears a wireless transmitter with a microphone placed within 6 inches of his/her mouth.

The teacher’s voice is transmitted across the room through radio waves bypassing the effects of distance, noise, and reverberation.

The teacher’s voice is brought close to the student’s ears, through an ear level receiver, a desktop speaker, or a sound field tower.
Speech in Noise

This example depicts what a student might experience in a classroom. The teacher says to find the word **FIRETRUCK** on the worksheet.

**Without FM**

The student is unable to discriminate **FIRETRUCK** from all other words on the worksheet.

**With FM**

The teacher’s voice is 10 -15dB louder than background noise. The student can discriminate the targeted word.
In theory, the teacher is never more than a few feet from the student.

The student is better able to hear when the teacher moves around the room or when not facing the student.

With direct access to the speech signal, the student can use his/her energy not just on trying to hear, but on understanding what is being said.
TYPES OF FM SYSTEMS

ADVANTAGES AND DISADVANTAGES OF EACH
The three basic types of FM systems are:

- Ear level
- Desktop
- Sound Field Tower
Components

A microphone to collect sound

A transmitter to send the signal across a distance

A receiver to intercept the signal

A means to send the sound from the receiver to the user’s ear
Booted Ear Level FM Receiver
The student’s personal hearing aid is coupled with an FM receiver via an FM boot.
FM Microphones and Transmitters

Transmitters can be worn at the waist, around the neck, be handheld, or can rest on a table.
Booted Ear Level FM Receiver

How it works:
• An FM “boot” connects the student’s personal hearing aid to an FM receiver.
• Radio waves transmit the teacher’s voice directly to the student’s receivers.
• Student’s hearing aid amplifies teacher’s voice louder than environmental signal.

Power Source: Battery

<table>
<thead>
<tr>
<th>PROS</th>
<th>CONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Easy to transition from class to class</td>
<td>Higher level of wear and tear on personal equipment</td>
</tr>
<tr>
<td>Students can use their own hearing aids.</td>
<td>Small equipment can be easier to lose.</td>
</tr>
<tr>
<td>Personal hearing aids may be more</td>
<td>If the student’s personal hearing aid is not working, then</td>
</tr>
<tr>
<td>technologically advanced than school</td>
<td>FM receiver cannot be used.</td>
</tr>
<tr>
<td>equipment.</td>
<td></td>
</tr>
</tbody>
</table>

Self-contained Ear Level FM Receiver

Behind-the-ear hearing aids are coupled with an FM receiver.
Self-contained Ear Level FM Receiver

How it works:
• Radio waves transmit the teacher’s voice directly to the student’s receivers.
• Hearing aid amplifies teachers voice louder than environmental signal.

Power Source: Battery
Cost: $1500-$2000

<table>
<thead>
<tr>
<th>PROS</th>
<th>CONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perfect for the student who does not have personal aids.</td>
<td>A student may not like the receivers in his ears.</td>
</tr>
<tr>
<td>Easy to transition from class to class</td>
<td></td>
</tr>
<tr>
<td>Units are property of school and do not go home.</td>
<td></td>
</tr>
</tbody>
</table>
Desktop FM Systems
Desktop FM System

How it works:
• Radio waves transmit the teacher’s voice to the receiver.
• Two mini-speakers inside the bag are connected to the receiver.
• Speaker volume can be adjusted according to student need.

Power Source: Rechargeable Battery
Cost: $800.00

<table>
<thead>
<tr>
<th>PROS</th>
<th>CONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amplification is in close proximity to the student.</td>
<td>Slightly more cumbersome for transitions</td>
</tr>
<tr>
<td>Nothing is irritating the student’s ears.</td>
<td>Has many parts, can be confusing to set up and charge</td>
</tr>
</tbody>
</table>
Sound Field Tower FM System

How it works:
• Radio waves transmit the teacher’s voice to the tower.
• Receiver in tower picks up FM signal.
• Speaker volume can be adjusted.

Power Source: Rechargeable Battery

<table>
<thead>
<tr>
<th>PROS</th>
<th>CONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>The speaker’s voice is amplified for all students.</td>
<td>Cumbersome to carry from class to class.</td>
</tr>
<tr>
<td>Nothing irritating the student’s ears</td>
<td>Providing multiple speakers will increase cost</td>
</tr>
<tr>
<td>Some systems offer a “handheld” microphone for students’ use.</td>
<td></td>
</tr>
</tbody>
</table>
View this YouTube video that contrasts sound quality when wearing a hearing aid vs. when wearing a hearing aid booted to an FM receiver.

http://www.youtube.com/watch?v=1L37lzLIgQU
DETERMINING CANDIDACY FOR AN FM SYSTEM
Could the student benefit from an FM system?

Consider the following:

- Educational Audiological Evaluation
- Classroom Observation
- Classroom Environment
- Educational Feedback
- Parent Feedback
- Student Input
What type and degree of hearing loss does the student have?

Does the student have personal hearing aids?

What are the student’s aided results?

Most importantly, does the student have breakdown in noise?
Speech recognition scores reveal the student’s word discrimination ability in quiet and in noise.

The yellow circle indicates that the student achieved 100% accuracy when words were presented at 50dB in quiet.

The red circle indicates that the student achieved 64% accuracy when words were presented at 50dB against background noise.

This student has a significant breakdown of word recognition in the presence of background noise and would likely experience listening difficulty in the classroom.
Observe the student during academic instruction.

Avoid conducting an observation during:

• Independent reading
• Testing
• Movie time
• Lunch/recess
• Gym
• Free/play time
Consider the following:

- Is the student following directions?
- Does the student answer questions?
- Does the student volunteer to participate in class?
- Does the student visually attend to the speaker?
Parents provide additional information regarding a student’s hearing loss and listening abilities.

- Does the student have p.e. tubes?
- Does the student have allergies?
- Does the student turn the TV up too loud?
- Does the student have difficulty on the phone?
- Does the student have speech problems?
- Does the student get frustrated in group settings?
Take note of the classroom environment and the way in which it may impact the student’s auditory learning.

- Is the classroom near a gym or band room?
- Are there hard floors and/or surfaces?
- Are there loud fans and vents?
- How is the classroom arranged?
- How many students are in the classroom?
- Is there echo or reverberation in the room?

Noise, distance from the speaker and echo will affect the student’s ability to discriminate speech.
Obtain feedback from the teacher regarding the student’s performance in the classroom.

• Does the student pay attention in class?
• Does the student frequently need directions and information repeated?
• Is the student easily distracted?
• Does the student often look confused or lost?
• Does the student volunteer or participate in class?
• Does the student misinterpret information or directions?
• Is the student struggling academically in any subjects?
The Eisenhower Cooperative
Hearing Itinerant Educational Assessment
Teacher Feedback Form

Student: ________________________ Teacher Completing Form: ________________________
Date: ________________________

Please respond to each comment with a 1, 2 or 3. 1 = yes, 2 = sometimes, 3 = no

<table>
<thead>
<tr>
<th>Comment</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does not pay attention</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&quot;Hears when she wants to.&quot;</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Daydreams</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Is withdrawn</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Seems to hear better when she sees the teacher</td>
<td></td>
<td></td>
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<tr>
<td>Hears better on some days than others</td>
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<tr>
<td>Hears better when the classroom is quiet</td>
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<tr>
<td>Says &quot;What?&quot; frequently, asks for repetition</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Speaks loudly</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complains when the room is noisy</td>
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<tr>
<td>Often looks puzzled</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Visually attends to the person speaking</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Is easily distracted</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Appears unable to hear at times</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Needs directions repeated</td>
<td></td>
<td></td>
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<tr>
<td>Misinterprets information if not visually attending to the speaker</td>
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<tr>
<td>Volunteers to answer questions</td>
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<tr>
<td>Responds to teacher directed questions</td>
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<tr>
<td>Answers are appropriate for lesson/topic being discussed</td>
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<tr>
<td>Appears to hear, but does not understand</td>
<td></td>
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<tr>
<td>Reluctant to ask questions or participate in group discussions</td>
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<tr>
<td>Homework assignments are completed on a regular basis</td>
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<tr>
<td>Informs you when class content is not understood</td>
<td></td>
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</tr>
<tr>
<td>Won't pay attention or &quot;listen&quot;</td>
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</table>

Please rank student's performance in the following areas:

<table>
<thead>
<tr>
<th>Area</th>
<th>Above</th>
<th>Average</th>
<th>Below</th>
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<tbody>
<tr>
<td>Reading</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spelling</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Written Language</td>
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<td></td>
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<tr>
<td>Oral Language</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Math</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Attending Skills</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Speech Development</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social Skills</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Behavior</td>
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</table>

Achievement scores if available: _______________________________________________________

_________________________________________________________________________________

_________________________________________________________________________________

_________________________________________________________________________________

Additional information that helps further describe this student: __________________________

_________________________________________________________________________________

_________________________________________________________________________________
Student Survey Samples

Hearing Itinerant Program
Student Interview

Student: ______________________
School: __________________________
Date: __________________________
Person Conducting Interview __________________________

What is your favorite subject in school? How are you doing in this subject?

What subject is the hardest for you in school? How are you doing in this subject?

Do you have a hard time following directions in class?

What do you do when you do not understand something in class?

When/Where is it the easiest for you to listen?

When/Where is the hardest for you to listen?

Can you always hear and understand the teacher?

Can you always hear and understand your classmates?

Can you always hear at home?

Do you know what and FM system is and how it works?

Would you be willing to try it for awhile?

**LISTENING**

In the classroom I can... 1 2 3 4 5

1. Hear my teacher talking in the front of the room. ☆☆☆☆☆

2. Hear my teacher talking with her back turned or when writing on the board. ☆☆☆☆☆

3. Hear my teacher when the room is loud. ☆☆☆☆☆

4. Hear my teacher when she walks around the room. ☆☆☆☆☆

5. Follow directions. ☆☆☆☆☆

6. Pay attention when the teacher is talking. ☆☆☆☆☆

7. Understand what the teacher is saying. ☆☆☆☆☆

I am interested in trying an FM system at school. ______________________________
Student input throughout the trial is integral to its success.

- Is the student willing and motivated to proceed with an FM trial?
- What is the student’s level of interest in the system as the trial progresses?
- Classroom culture, social acceptance, parent support and the student’s self-image can influence the success of the trial.
- Written student feedback via survey forms may reveal more than what the student discloses during face to face interviews.
DECIDING WHICH FM SYSTEM TO TRIAL
How do you decide?

**Environment:**
- What are the acoustics of the classroom?
- What is the teacher’s teaching style?
- How many students are in the classroom?

**Student Input:**
- How old is the student?
- Does he/she have to transition between classes?
- What is his/her preference?

**Teacher Input:**
- Does the student have a tendency to play with things?
- Will the student advocate for himself if batteries die?
- Which system does the teacher think will work best in the classroom?
Collect data from the teachers, staff and student before, during and after the trial to document progress.

Data Collection

Teacher Feedback Form for FM System

Student: ___________________________ Date: ____________

Your name: ________________________ Subject(s) Taught: ________________________

Please rate the “improvement” of the student’s listening and learning behaviors since they began using the FM system in the classroom. Indicate your response in the appropriate box.

3- Significant  2-Moderate  1- Minimal  0-No Change

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<th>3</th>
<th>2</th>
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<tbody>
<tr>
<td>Focus during instruction</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Comprehension of instruction</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Participation in class discussions</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attending and understanding when background noise is present</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Answering questions appropriately</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attending in small groups</td>
<td></td>
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</tbody>
</table>

Please answer with “yes/sometimes/no” and any comments for the following:

Does the student respond more readily and/or more accurately when using the system? __________________________________________

Are there any overt changes in the student’s interactions with you or their peers when using the system? __________________________________________

Have there been any special problems demonstrated by the student since the introduction of the system? __________________________________________

Please answer with a yes or no and explain your answer-

Based on my knowledge and observations, I believe that the FM system is beneficial to the student’s overall attention, listening, and learning.

__________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________________
Additional Questionnaires Available

Classroom Participation Questionnaire

Children’s Auditory Processing Scale (CHAPS)
https://edaud.site-ym.com/store/default.aspx?

Early Listening Function (ELF)
http://home.earthlink.net/~karenlanderson/ELFpdf.pdf

FM Listening Evaluation for Children available online and opens as a Word Document

Listening Inventory for Education – Revised (LIFE – R Student)
http://home.earthlink.net/~karenlanderson/LIFE.pdf

Screening Instrument for Targeting Educational Risk for Preschool, Elementary and Secondary (SIFTER) available for purchase at
https://edaud.site-ym.com/store/default.aspx?
FM SYSTEM
MAINTENANCE
AND
INSERVICE
In-service for Student and Staff

[Image courtesy of [imagerymajestic] / FreeDigitalPhotos.net]
Who should attend the inservice?

- Student
- Student’s current teachers
- Classroom paraprofessionals
- Administrator (use at assemblies, etc.)
- Parent

Who will maintain and/or troubleshoot the FM system?

- Student (if capable)
- One teacher
- One ‘back-up’ teacher

Who will collect data?

- Student (if capable)
- Teacher and/or staff
InService for Student and Staff

Inservice content includes details regarding

• Student information
• Accommodations
• Purpose of system
• Names of system parts and accessories
• Charging capabilities
• Placement location (on person)
• Reception range
• Possible interference with other systems
• Troubleshooting
• When to use the system
• Recording data
• Contact information for assistance
• System practice
Inservice for Student and Staff

**When should the system be used?**

- At all times if safety is an issue
- All academic classes including Art, Library, Assemblies, and Field Trips
- Commonly not used during Physical Education, Recess, Lunch, and/or Music class

**How long is a typical FM system trial?**

- Six weeks
- Reluctant students may use the FM system for only one class, eventually adding additional time.
Inservice for Student and Staff

WHERE?

Placement of sound field tower
• Opposite end of the room according to most frequent location of the teacher
  • Ex. If the teacher most often lectures from the front of the room, the sound field tower should stand at the back of the room.
  • Allows teacher’s voice to reach the entire room

Placement of microphone on a person
• Usually center of sternum, 6 to 8 inches below the chin

Reception Range
• Sound field tower
  • Depends on volume level and presence of carpet, sound proofing, etc.
• Ear level FM system
  • 50 ft or more inside, up to 170 ft outside
  • System CAN work through walls
Inservice for Student and Staff

HOW?

Examples provided represent common systems used in classrooms and are not an endorsement of one product or brand over another.
Charging the Transmitter

When to charge

- Overnight (every night) and weekends
- Some transmitters can NOT charge more than three nights at a time (ruins rechargeable battery – do not charge over 3 day weekends or winter/spring break).

Length of charge

- A full charge requires two or more hours.
- A full charge usually provides two school days of power.
- Transmitter display will indicate low power.
Time to Mute

- Work/Personal calls
- Private conversations
- Restroom visits
FM radio waves can be transmitted through walls.

Distance of 50 Feet or More Indoors
RECEIVERS

Power

- Battery case door = On/Off
- Turn on receivers, wait 10 seconds before turning on microphone
- Open battery case door when not in use

iSense User Guide - Phonak
Amigo R12 User Guide - Oticon
Nios Micro User Guide - Phonak
Receiver Maintenance

Batteries
- Different sizes
- Must be put in ‘+’ side ‘up’
- May last from 3 to 5 school days
- Open battery cases after school to save power

Cleaning
- Wipe earmolds with audio-wipes only
- Remove visible wax
Filters – Type A

- Some receivers will need filter changes.
- Clogged filters can affect sound production.
- First remove the hood if it has one
- Second, pull a new filter wand out of its case
Removing the hood has revealed the dirty filter.

- Use the empty end of filter wand to remove dirty filter.

3. Gently press into dirty filter

4. Gently pull dirty filter out
5. Flip wand to end with new filter

6. Gently press new filter into opening

7. Gently remove wand
Receiver Maintenance

Filters – Type A

8. Cover filter with hood

9. Gently press until secure
1. Remove hood
2. Pull new filter wand out of its case
**New Filter**

**Empty End of Filter ‘Wand’**

1. Gently press into dirty filter

2. Gently pull out dirty filter

**Filters – Type B**
Receiver Maintenance

3. Flip wand to end with new filter

4. Gently press new filter into opening

5. Gently remove ‘wand’
Receiver Maintenance

Filters – Type B

6. Cover filter with hood

7. Gently press until secure
Listening Tube

- Insert ear piece in your ear as far as feels comfortable
- Place sound output portion of student’s receiver or earmold that enters his or her ear canal into horn
- Turn on student receiver and you will hear what the student hears

If a student is unable to describe an FM sound difficulty, a listening tube will allow you to hear for yourself.
It’s Beeping!

Battery replacement beeps

- Student will hear a pattern of beeps when power is low
- Refer to quick guide or user manual for beep patterns

Acoustical warning beeps

- Not all systems will beep regarding poor sound quality
- This signal may indicate need to change filter
Things to Remember

Equipment

• FM Systems are not perfect
• Troubleshoot options
  • Power everything off and back on (turn on receivers first)
  • Check transmitter charge
  • Check receiver batteries
  • Check filter if applicable

Hearing Itinerant

• Keep contact information handy
• Call/email for help or with questions
• Be sure more than one staff member is trained in FM System use
HOW TO DETERMINE THE SUCCESS OF THE FM TRIAL
Successful Trial Considerations

The student

• Is motivated to use the FM system on a daily basis.
• Is developing independence with the system.
• Demonstrates improved attending skills in class.
• Is comfortable with and socially accepted by peers when using the system.

The teacher

• Indicates that the student’s listening and attending skills have improved.
• Incorporates the FM system within lessons and throughout the school day.
• The teacher supports the student in wearing and maintaining the system.
This module was prepared by the Hearing Itinerant Teachers of the Eisenhower Cooperative

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