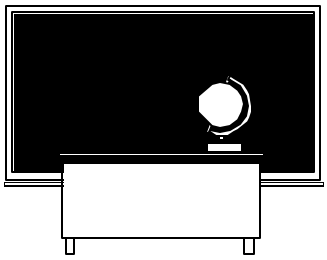
LISTENING FOR LEARNING 5:



RETROFITTING A NOISY CLASSROOM

The most important task in correcting a poorly-performing listening environment is identifying the nature of the problem. Noise can be controlled at its source, along its path, or at the receiver; for classrooms, only the first two choices are available, since the receiver choice implies earplugs. Most remedial work will occur along the sound path, as it is likely that replacing noisy equipment (such as through-wall HVAC units) will not be feasible outside the scope of a major alterations program. You will need to call in professional help if you can't easily identify the source and path of the noise or distinguish the relative contributions of reverberation and background noise.

Reverberation. Excessive reverberation and its contribution to background noise are usually easy to remedy, particularly if an acoustical tile ceiling already exists. Try these in sequence from inexpensive to costly:

- ☑ ***Replace existing ceiling tiles with high-NRC-rated acoustical tiles;***
- ☑ ***Add new suspended acoustical tile ceiling if room height permits; if not, mount (with maximum possible air space) high-NRC acoustical tiles;***
- ☑ ***Add sound-absorbing panels high on walls at sides and rear of room.***

If the classroom has a very high ceiling (>11 feet), acoustical panels on both ceiling and walls may be needed. Carpet adds little to reverberation control, but may be useful (see below) for controlling self-noise, especially in pre-school and lower grades.

Background Noise. *B*ackground noise is generated from both outside and in-room sources and may be conveyed through ducts, through small cracks and openings, through windows and doors, walls and roofs, and through the building structure itself.

Windows. Windows are often the weakest link in exterior wall construction. Consider this sequence of improvements if outside noise appears to be a major source and can't be controlled by closing the windows:

- ☑ ***Add storm windows;***
- ☑ ***Replace existing windows with new thermal insulating units (this will improve energy performance, too);***
- ☑ ***Install specially-fabricated sound-reducing windows.***

The US Department of Transportation has several programs that can help with sound control where highway, aircraft, or rail noise is a serious issue.

Doors. Check exterior and corridor doors for gaps. If keeping doors shut doesn't provide enough sound control, consider this sequence of improvements:

- ☑ ***Add good quality drop seals and gaskets;***
- ☑ ***Replace doors with tight-fitting solid core doors with seals and gaskets;***
- ☑ ***Install special sound-control doors if adjacent spaces are very noisy.***

Improving door and window performance may be enough to make a marginal classroom more conducive to listening and learning. Taking the next steps to heavy up exterior and interior wall and roof construction to reduce sound transmission adds dramatically to project cost and complexity. Structure-borne and impact sounds need the attention of an acoustical engineer; although some instances may be easily solved by equipment isolation, the majority of such sources are difficult to analyze and correct.

In general, mass is the best countermeasure for noise transmission through construction, while added acoustic absorption is the antidote to excessive reverberation. But because reverberation adds to background noise, it is useful, for instance, to add acoustical panels or ceiling tile to lower the noise in these areas and thus reducethe noise transmitted through classroom walls.

Heating, Ventilating and Air Conditioning (HVAC). HVAC noise is a common culprit in high-background-noise classrooms. In the past, it has been common practice to install relatively noisy fan-coil and similar in-room units in classrooms. However, recent changes in air quality and energy conservation standards now motivate the use of ducted central air systems in new buildings. This puts the fan and compressor right in the room with the students -- not a good idea. If you have noisy through-wall, through-roof, or under-window units in the classroom, they should first be serviced and balanced to be sure they are operating as intended. Next steps include:

- ☑ ***Add a custom built sound enclosure around the unit(s);***
- ☑ ***Add sound-lined ductwork to the unit(s) to attenuate air distribution noise;***
- ☑ ***Replace the unit(s) with quieter split systems or one of the quieter European through-wall models just entering the US market.***

Teachers often report turning off the HVAC during important lessons. Children with hearing loss should not be seated near an HVAC unit (or diffuser). If the system in question is already a central air system, but a mixing box is inappropriately located in the classroom, its relocation will be difficult and costly, if feasible. Other 'fixes' to existing noisy ducted systems may include:

- ☑ ***Increase open area at grilles and diffusers;***
- ☑ ***Rebalance system to reduce air volume delivered to the classroom;***
- ☑ ***Relocate ductwork and diffusers away from key teaching locations;***

☑ ***Add separate duct runs to eliminate noise from common use;***
☑ ***Add duct length to attenuate noise;***
☑ ***Add soundlining to ducts.***

Diagnosing and servicing a noisy system should always be a first choice. Sometimes a combination of countermeasures will work -- for example, by installing insulating glass windows, it may be possible to reduce the air volume supplied to the room without affecting student comfort.

Self-noise. Carpet, particularly the newer products developed to meet air-quality criteria in health care and hospitality settings, can quieten footfall and furniture noise, but many schools choose low-tech solutions, putting halved tennis balls on the legs of tables and chairs and asking kids to wear quiet shoes. Teachers report that quieter classrooms elicit quieter behavior from students.

Equipment. Gerbils in cages, aquarium pumps, movie projectors, even computers add noise to classrooms. A standard-setting effort similar to the one that produced the new ANSI/ASA S12.60-2002 classroom acoustics document is underway to encourage limits on the noise of audiovisual and other instructional equipment used in classrooms. In European nations where sound control is legally regulated, manufacturers are able to market only quiet appliances and equipment. Some of those products are now available in the US.

For more information… The ANSI/ASA S12.60-2002 standard for classroom acoustics was developed by the Acoustical Society of America (ASA) in collaboration with the U.S. Access Board and other stakeholders. Information on ordering the standard and other materials on classroom acoustics, including a videotape, design manuals, and a bibliography, are available on the Board's website at http://www.access-board.gov/publications/acoustic-factsheet.htm. The Board also maintains a toll-free technical assistance line at 1/800/872-2253 (v); 1/800/993-2822 (tty).

Many parents have found the new standard useful in obtaining acoustic accommodations -- like those described above -- under the Individuals with Disabilities Education Act (IDEA). Information on IDEA is available from the US Department of Education at http://www.ed.gov.