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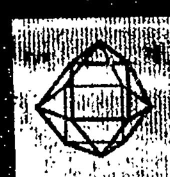
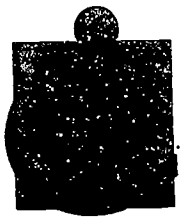
ABSTRACT

This booklet is one of four volumes developed to make the classroom environment more accessible to students with disabilities. The following areas are discussed: (1) What Are Barrier-Free Laboratories and Classrooms? (2) Why Are Barrier-Free Laboratories and Classrooms Necessary? (3) How to Organize Barrier-Free Laboratories and Classrooms; (4) Accommodations in the Classroom; (5) Accommodations in the Laboratory; (6) Accommodations by Disability; (7) Building Access Checklist: and (8) Resources, which includes a list of accessible labs and classrooms. (ZWH)



Laboratories and Classrooms in Science and Engineering

BARRIER
FREE
IN BRIEF



LABORATORIES AND CLASSROOMS IN SCIENCE AND ENGINEERING

AMERICAN ASSOCIATION FOR THE
ADVANCEMENT OF SCIENCE
1333 H Street, N.W.
Washington, DC 20005
202-326-6630 V/TDD

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INTRODUCTION

Barrier-Free in Brief: Laboratories and Classrooms in Science and Engineering has been developed to assist professors, administrators and university laboratory directors to incorporate the needs of students with disabilities in their science and engineering programs. It provides information and resources on adapted facilities, teaching styles, and general accessibility. It can be used as a guide for accommodations in any educational institution as well as in research laboratories.

This guide is one in a series of four AAAS booklets on accessibility which also includes *Workshops and Conferences for Scientists and Engineers*, *Access in Word and Deed*, and *Access to Science Literacy*. We hope you will find them all useful.

I. WHAT ARE BARRIER-FREE LABORATORIES AND CLASSROOMS?

A ***barrier-free*** laboratory or classroom is one that is fully accessible to people with disabilities. Each student with a disability is an individual, and may require different kinds of access and adaptation—or no accommodation at all. A barrier-free laboratory or classroom might include:

- an accessible building for students with mobility impairments
- adapted teaching methods for visually or hearing-impaired students
- adapted lab and safety equipment.

Remember that

...barrier-free is about attitude as well as physical accessibility. The most important aspect of a barrier-free environment is a professor, administrator or lab director who is aware of and responsive to the individual needs of students with disabilities, and who takes the lead in creating a receptive and accommodating atmosphere in the lab and classroom.

...barrier-free laboratories and classrooms do not entail lowered expectations or different academic criteria. Students with disabilities want the same opportunity as all students to benefit from the academic and laboratory experience. They want to be judged by the same academic standards. Like other students, students with disabilities expect support and encouragement.

II. WHY ARE BARRIER-FREE LABORATORIES AND CLASSROOMS NEEDED?

Some professors and administrators may wonder whether science and engineering are appropriate fields of studies for students with disabilities. Should these students, already faced with considerable obstacles, seek to enter such rigorous and demanding careers? As one student with a disability who went on to become an engineering professor was told: "Life is hard. Why make it harder?". In fact, there are many reasons why students with disabilities should be encouraged to study science and engineering. Here are a few:

A national need: Science and engineering professionals are vital to our society. A federal task force reported in 1988 that the United States may face a declining supply of scientists and engineers well past the year 2000[1]. We cannot afford to ignore an important pool of potential scientists and engineers: students with disabilities.

A valuable resource: Science and engineering are careers in which intellectual ability and hard work, not physical prowess, combine for achievement. The National Science Foundation reports that there are at least 100,000 working scientists and engineers with disabilities[2]. They include such eminent researchers as physicists Stephen Hawking and Philip Morrison, and Nobel Prize winners such as chemists Sir John Cornforth and James Sumner. But, the full potential of many of the students with disabilities are not yet being realized.

Students with disabilities, whose lives are likely to have been significantly improved by technology, are also more likely to take an interest in technology development.

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[1] *Changing America: The New Face of Science and Engineering*, Interim Report of the Task Force on Women, Minorities, and The Handicapped in Science and Technology, September 1988.

[2] *Report of the National Science Foundation Task Force on Persons with Disabilities*, October 1990, pp 18-20.

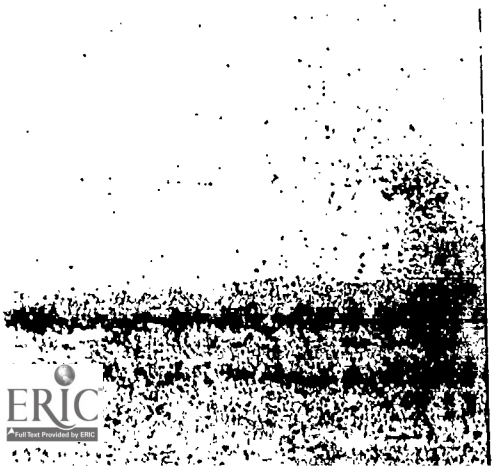
It's the law: Every post-secondary institution that receives federal funding is covered under Section 504 of the Rehabilitation Act of 1973, which ensures that qualified people with disabilities are given full access to all programs within those institutions. Access under Section 504 requires that people with disabilities be able to move about and use facilities, as well as participate in all programs alongside non-disabled participants.

The 1990 Americans with Disabilities Act (ADA) extends civil rights protections for persons with disabilities to employment in the private sector and extends accessibility to transportation, public accommodations (such as meeting places, lodgings, restaurants, and museums), services provided by state and local governments, and telecommunications.

It's easier than you think: It is often simple and inexpensive to make laboratories and classrooms accessible. Most barriers can be overcome with planning, sensitivity, and input from students with disabilities. Sometimes the only adaptation needed is to keep aisles clear or create better lighting in the laboratory.

We all gain: Many adaptations made to accommodate students with disabilities—such as cleared lab spaces, improved teaching methods, and extra safety measures—benefit all students. One chemistry professor who is of short stature uses inexpensive portable platforms built to access laboratory equipment. The unexpected benefit, she reports, is that her non-disabled colleagues also find them practical and frequently borrow them.

In sum, classrooms and laboratories can be made accessible at relatively little cost but with tremendous benefit to the students, school, and to society as a whole.



III. HOW TO ORGANIZE BARRIER-FREE LABORATORIES AND CLASSROOMS

Student Interview

The first step in making an environment accessible is to talk with the student concerned. Each student with a disability has individual needs and ways of adapting; what works for one student may not work for the next. Keep in mind the following:

- The student, professor, and/or lab instructor need to work as a team. The student knows his or her needs, as well as solutions that have been effective in the past. The instructor knows what activities will be conducted in the class or lab. Together, the student and the instructor can identify potential problems and strategies to solve them.
- The earlier the discussion is held, the easier it will be for both the instructor and the student. If possible, talk with the student before the semester starts. This allows time for the teacher and the student to learn each other's requirements and make the necessary arrangements. Early arrangements leave the student free to concentrate on class or laboratory work.

Identification

It is the student's responsibility to initiate a discussion about his or her special needs. For various reasons, some students with disabilities may not wish to identify themselves as such. Even severe disabilities, such as deafness or legal blindness, can go unrevealed in the classroom or laboratory. The teacher or lab director could help by making an announcement at the beginning of the term inviting students with special needs to schedule appointments. For example, the teacher might say, "I would appreciate knowing if anyone in this class has a disability which may require some special accommodation. I am reasonably sure we can work out something. See me after class, or during my office hours."

In some cases, when a disability is apparent, it may be helpful to bring up the question with a student. If you do mention it, remember that some

students with disabilities may not wish or need to make any special arrangements.

Advising Students

Most Principal Investigators (PIs), in their roles as professors or research team directors, are called upon to advise students. PIs might give advice on course selection, research, coping strategies or choice of a field of study. Positive, constructive counseling has a tremendous impact on students with disabilities, who may have previously been discouraged from studying science by well-meaning but poorly informed advisors. Scientists and engineers with disabilities often comment on the effect a good advisor had on their education. One spinal-cord injured engineer has said, "It was the Dean of Engineering who believed in what I was doing and encouraged me to continue....It worked for me because the Dean was behind me."

Advising a student with a disability requires the same skills as advising always does: caring, willingness to help, and knowledge of one's field. Remember what helped you and the challenges that motivated you.

Testing and Evaluation

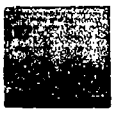
Some students with disabilities may need special arrangements to take an exam or to complete lab work. Be sure to remember the following:

1) It is the student's responsibility to make known any special requirements. Any arrangement should be made with the student.

2) **Be flexible with arrangements, but hold a student with a disability to the same academic standard as all other students.**

Remember that the needs of students vary greatly. Many students with disabilities need no special testing arrangements. Some students use special equipment such as an electronic device or an optical-to-tactical (Optacon) scanner, or they may need to take a test orally or with the use of a reader or writer. Others simply need more time. For example, a student with a mild visual impairment who reads at a slower pace, a student with a learning disability, or a student who writes slowly because of a coordination impairment such as cerebral palsy or spinal-cord injury may need more time to complete a lab or an exam.

Experienced students who cannot take examinations in the usual manner will usually have developed an alternative they can present to the professor. An inexperienced student may need to work out a practical and fair solution with the help of the professor. See the disability-specific sections of this



book (pages 28 to 35) for more suggestions. Working scientists and engineers with a similar disability can also be a good source for solutions. (See the **RESOURCES** section.)

Physical Accessibility

An accessible laboratory or classroom begins with a physically accessible room in an accessible building. Important features of an accessible facility include:

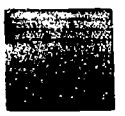
- wide parking spaces near the building
- at least one accessible entrance (i.e., with a ramp if there are steps)
- elevators if there are several floors
- elevator buttons and room numbers marked in raised notation or braille
- wheelchair-accessible bathrooms
- door openings wide enough for a wheelchair
- enough cleared space for a wheelchair in the classroom or laboratory.

Use the checklist on page 27 to evaluate your facility's accessibility. Here are remedies for common problems:

- Parking spots that are not wide enough for wheelchair users can be enlarged by marking off 1-1/2 or 2 regular spaces for each wheelchair-accessible space.
- Paste-on letters, available in a hardware store, or other tactile signs for doors, elevator panels and other signage can make a facility accessible to people with visual impairment.
- Removal or re-arrangement of furniture may make an otherwise inaccessible classroom comfortable for wheelchair users and safer for people with visual impairments.
- Portable ramps can be made and moved easily. It does not always cost a lot to make a permanent ramp. (Ramps should have no more than a 1/12 slope.)

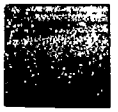
Where to Go for Help

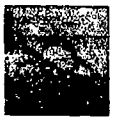
Most colleges and universities have a disability support service office (DSSO), sometimes called Office of Students with Disabilities or Disabled Student Services, that helps make an institution's programs accessible. Offices vary in the range of service they provide and the size of the population they serve, but most DSSOs coordinate services such as priority registration, interpreters, readers, and proctors. Computer adaptations for students



with disabilities are sometimes provided from DSSOs and sometimes from the institution's regular computer center. Students with disabilities and their professors can consult with their campus DSSO about accommodations. Remember to talk with the student to understand his or her needs before consulting other resources.

The sections that follow offer more specific information about teaching students with disabilities, in the classroom and in the laboratory.



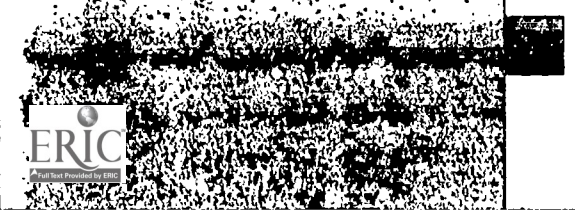


IV. ACCOMMODATIONS IN THE CLASSROOM

Teaching Methods

The way a class is taught matters to all students, including students with disabilities. Techniques generally associated with good teaching, such as speaking clearly and being specific, are helpful to disabled and non-disabled students alike. Here are some basic lecture and discussion techniques that are likely to help:

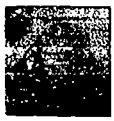
- Speak clearly. Write legibly. This will help all students, including students who are hearing or visually- impaired.
- Read out loud what you write on the blackboard. This technique will help a student with a hand-dexterity impairment who may be taping lectures, a student at the back of a class who cannot read the blackboard clearly, and any student taking notes.
- Be specific. Refer to all charts, numbers, demonstration materials, overhead projections, chalkboard writings, and other classroom materials specifically. For example, say "oil" instead of "the liquid," and "from 20 to 40 newtons" and not "from this to that force."
- Use visual aids whenever needed. Visual aids usually make things clearer for all students; they can make all the difference for a student who is hearing impaired. Describe the visual aid for the student who is visually-impaired. This will also make the material more memorable for those who can see.
- Avoid standing with your back to a window or other source of a light. All students, and especially those who are deaf or hard-of-hearing, look to a well-lit face for important communication cues.
- Give out materials in advance. Issuing the following materials can be particularly useful for students with disabilities who may need to rely on advance preparation: the course syllabus, course requirements and objectives, due dates, schedule of tests and exams, important vocabulary for each lecture, print or disk copies of lectures.



Special Arrangements

The following services can help a wide range of disabled students:

- **Notetakers:** Upon a student's request, the professor can help by finding volunteers to take or share notes, making their own notes available, or allowing students to tape lectures.
- **Seating arrangements:** The lecturer can help by making sure that a student who wishes to do so can sit near the front or in another preferred spot. A student who is hearing-impaired may want to sit near the front to read lips or to use an interpreter. A student who is blind or learning disabled may want to place a cassette recorder on a chair in front.



V. IN THE LABORATORY

Laboratory experience is essential to a good science and engineering education. As always, common sense and open-mindedness are the best guides for the professor and student. Clearly some disabilities will limit the student's laboratory activities more than others. On the other hand, a student should not be excluded from laboratory work just because he or she cannot manipulate certain equipment. **The student should be encouraged to participate actively in the laboratory experience as much as possible.** The teacher and the student need to determine on an individual basis the most practical level of involvement.

There are several ways a professor or instructor can help a student with a disability in the laboratory. Consider the following issues, and raise them with the student if appropriate:

- **Lab partners:** It is customary to pair students up for laboratory work. This is very helpful to a student with a disability. The lab instructor can help by making sure everyone has a congenial partner or group, and has the opportunity to participate fully.
- **Lab assistants:** A few students with severe disabilities may require full-time laboratory assistants. The assistant should not be taking the course at the same time, but should be familiar with the equipment and terminology. Depending on the student's disability, the assistant may manipulate equipment or give visual feedback. **Selecting a suitable assistant is the joint responsibility of the student and the lab instructor.**

  Assistive technology such as voice output, light-level indicators, or lever controls (for faucets, cabinet handles, etc.) may eliminate or reduce the need for an assistant.
- If working with partners or assistants, it is important that a student with a disability be able to be involved in all aspects of the learning process: planning, monitoring, organizing, analyzing, concluding. An assistant should do only what the student tells him or her to do, and report accurately what he or she sees, does, or hears. Lab partners

should work with the student who is disabled just as they would with any other student, with everyone sharing in the thinking and discovery process.

- Check occasionally to make sure the arrangements you and the students have made are working well, and make adjustments if necessary.
- If the student needs more time to complete the lab, he or she may be permitted to enter two lab sections.
- See section VI, **ACCOMMODATIONS BY DISABILITY**, for more specific suggestions.

ADAPTATIONS AND TECHNOLOGY

In some cases, a student with a disability may require special accommodations in the laboratory. The student and lab instructor should determine together what accommodations are necessary. For more ideas, the student and the lab instructor may consult with students with disabilities who have gone through the class or with working scientists and engineers.

Many modifications are inexpensive. Here are a few examples:

- The easiest modification to make—and one that makes for good laboratory practice for all students—is to clear the aisles and work surfaces. Students who use crutches or a wheelchair, as well as students who are blind, will move about more easily in an uncluttered lab.
- A chemist who uses a wheelchair may have a rotary evaporator with a built-in mechanical jack for raising the apparatus. One described his as "nothing special, simply one of several models listed in the catalog, but it is the one that best suits my needs."
- A geologist with no arms uses an electron microscope equipped with foot controls. The modifications were designed and built by a laboratory colleague.
- Some students who can comfortably transfer from a wheelchair may prefer to do lab work in a straight chair fastened to a platform on casters. The platform raises the user to a practical height for manipulating laboratory equipment in tight lab spaces.
- Introductory physics work with a pendulum or an inclined plane experiment can be made accessible to students who are visually-impaired with the help of a "photoelectric horseshoe." Using a small light and sensor mounted on either end of a portable horseshoe-like device, these students can measure the period of a pendulum or the speed of a block on an inclined plane.

- More complicated devices, such as an oscilloscope, can also be adapted. Most recent oscilloscopes have an output/input jack for computers. This jack can be connected to a speech synthesizer and, with a little programming, allows a student who is blind to determine frequency, voltage, wave patterns, or the presence of a "ringing effect."
- Sometimes technology is not worth the cost. For example, while it is technically possible to design a device that will "speak out" color changes for people who are blind, a student may decide it is more effective to have an assistant or partner in the lab call out the color changes. The student should evaluate each accommodation to decide whether its benefits are worth the cost.

Safety in the Laboratory

Safety is a crucial issue for all students in the laboratory. Safety measures designed for people with disabilities make the laboratory safer for all students, and they are usually minor additions to the large set of standard safety practices.

Keep in mind that **students with disabilities are not a safety risk. Safety should never be an excuse to keep a student with a disability out of the lab.** The following suggestions can help make your laboratory safer for everyone:

- Make sure all students are following good safety practices. If all students are aware of and practice safe procedures, the lab will be safer for students with disabilities as well.
- Keep lab aisles cleared at all times.
- Have visual alarms for students who are deaf or hard-of-hearing. Flashing-light or sensory alarms are widely available commercially.
- Give a student with a visual impairment the chance to become familiar with the lab environment before the first sessions. Make sure the student is given an individual orientation and shown the location of exits, showers, and extinguishers.
- Students in wheelchairs or with limited dexterity should be encouraged to wear a heavy rubber apron while working with chemicals.
- For students of short stature or those who use wheelchairs, add extension hoses to eye and face washes and lower the pull chains on drench showers. This costs a few dollars and can help many students, since some needing to use a drench shower may not be able to reach for the end of a pull chain suspended seven feet above the floor.

- Students, including students with disabilities, should never be pressured to perform operations with which they are uncomfortable. The student and the lab instructor should determine together the extent of involvement possible.

VI. ACCOMMODATIONS BY DISABILITY

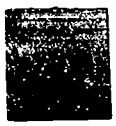
Accommodations for Students Who Are Deaf or Hard-of-Hearing

Severity of hearing loss varies from slight to complete deafness One student may have enough residual hearing to use a hearing aid and take notes. Another may be profoundly deaf and need to use interpreters and notetakers. Some students who are pre-lingually deaf may have difficulties reading and writing English. It is important to understand that this is deafness-related language impairment and not an intellectual weakness.

In the Classroom

Attention to method can make a class accessible to students who are deaf or hard-of-hearing. Here are a few suggestions:

- Make sure the student has the seating arrangements that best suits him or her. If the student uses an interpreter, the student should be able to see both you and the interpreter.
- Face the student when you speak, and keep your face visible and well-lit. Speak clearly but naturally.
- Use an overhead projector and visual aids as much as practical. The overhead projector allows a lecturer to show materials while facing the audience, which is extremely helpful to students who are deaf or hard-of-hearing.
- Whenever possible use captioned films or videos. **Captioning** (or subtitling) can make the experience accessible to students who are deaf or hard-of-hearing, and more memorable for all students. Real-time captioning of classroom lectures is a new technology used in some college classrooms. See the **RESOURCES** section for information on captioning.
- At the beginning of a session or after an interval of silence, draw the student's attention before speaking. This can be done by making eye contact, tapping gently on the shoulder, or some other method worked out with the student. When calling on a student who is deaf, make sure you establish eye contact first.



- Repeat the questions and the comments of others in the room.
- Speak to the student, not to the interpreter.
- When possible, provide the students with class outlines, lecture notes, reading assignments, lists of new technical terms and printed transcripts of audio and audio-visual materials.
- Provide the student with all assignments, deadlines, test schedules, grading policies, etc., in written form. (Many science students who are deaf or hard-of-hearing use computers to communicate and store information, and may prefer to receive these materials through electronic mail, if possible.)
- Make sure the student has arranged for a notetaker. Insert appropriate pauses during demonstrations. A student cannot lipread or use an interpreter at the same time that he or she is taking notes, watching a demonstration, or reading written material.
- Ask the student about **Assistive Listening Devices (ALDs)** if you think they may be useful. ALDs can help students who are deaf or hard-of-hearing in both small class discussions and large lectures. Common ALDs include induction loops, FM systems, and infrared devices. To find out about the availability of these devices, as well as which one best fits the student's needs, contact your campus DSSO, or use the **RESOURCES** section of this booklet.

In the Lab

In general, students who are deaf or hard-of-hearing require few specific accommodations in the laboratory. If students are divided in groups, make sure that the student who is deaf or hard-of-hearing participates fully in his or her group.

Important laboratory safety items for students who are deaf or hard-of-hearing include:

- visual or sensory alarms
- equipment with lights and other visual means of indicating on/off status, where possible
- emergency lighting in case of power failure
- telecommunication devices for the deaf (TDDs) wherever there are telephones.

Testing and Evaluation

Some students who became deaf before they learned to speak may not use proper sentence structure. This is because it is more difficult to learn to read

and write a language one has never heard. In evaluating tests and lab reports for these students, it is important to distinguish the student's understanding of the course material from disability-related writing deficiencies.

Accommodations for Students Who Are Blind or Visually Impaired

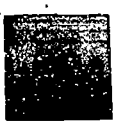
Students who are visually impaired may have a wide range of impairment, and adapt in different ways. A student who is blind may rely on braille or computerized reading equipment such as the Versabraille (tactile), Kurzweil or Arkenstone systems (with synthesized speech). Students who are partially sighted may use their residual vision with the help of adaptive equipment such as low-tech magnifiers or closed-circuit TV enlargers. It is important to talk with the student to determine what, if any, adaptations are needed in the classroom and laboratory.

Before the Semester

- Provide reading lists or syllabi in advance so that arrangements can be made to transcribe texts to tape or braille. **Recording for the Blind** (see the **RESOURCES** section) has an extensive collection of science textbooks on tape, and will record on request any book not yet available. However, it can take up to six months to tape or braille a book, so recently published text books are often accessible only via readers.
- Many science students who are blind or visually impaired use computers to communicate and store information, and may wish to receive materials through electronic mail.
- Help the student and the DSSO find readers, tutors, or notetakers if necessary.

In the Classroom

- Make sure the student who is blind or visually-impaired can make the seating arrangement he or she wishes.
- Call on students who are blind by name.
- Read out loud whatever you write on the blackboard. To the extent practical, explain in words visual aids or cues you use. Spell difficult or unusual words.
- Be specific. Say "90 degrees Celsius" instead of "this temperature."
- Make large print copies of materials you distribute, if this is useful to the student. Large print (14- to 24-point) can be generated through



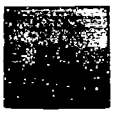
word-processing programs or by enlarging with a photocopying machine.

- Permit your classes to be taped, if needed. Copies of your lecture notes may be useful to a visually-impaired student with an enlarger.
- Make raised-line drawings of important charts and graphs if this is useful to the student. You can make a simple raised-line drawing by following the outline of a graph or chart with liquid glue.

In the Lab

For students who are blind and visually impaired, as much as for other students, laboratory work is an important part of a science and engineering education. Students who are blind or visually-impaired should not be excluded from laboratory work because of their disability. A student who is visually-impaired may need a magnifying glass or larger letters on labels. In some cases, a number of accommodations may be necessary to make the experience safe and worthwhile. Remember to talk with the student before or early in the semester to determine the best strategies. The following suggestions can help:

- Keep aisles cleared.
- Take time to orient the student around the lab, showing the location of exits, glassware, chemicals, cabinets, extinguishers, showers, eye sprays, and other safety devices. Put braille or large print labels on shelves and chemical containers.
- Students who are blind may wish to have a full-time laboratory assistant. Remember that for some experienced students appropriate technology and a little more time and individual orientation can eliminate the need for a full-time assistant. If this is the case, the lab instructor should be involved in the selection of the assistant. The instructor should also make sure that the assistant functions properly: the student should be doing all the thinking. If the student who is blind has a lab partner, it is important that they work well together.
- Discuss with the student what, if any, adaptive equipment will help the student in the laboratory. A wide range of assistive technology is available, including:
  - talking calculators, thermometers, voltmeters, and timers
  - braille and large print labeling
  - sandpaper labeling for hazardous chemicals
  - light probes
  - laboratory glassware with raised numbers (to be used with a light level-indicator)



- computers with voice or braille output
- spoons with sliding covers

Equipment already in the laboratory can often be adapted. Devices ranging from pendulums to computers have been made accessible to blind people at very little cost, using widely available technology such as light probes which turn visual cues into sound and adapters that transform digital information into voice output.

Accommodations for Students Who Have Mobility Impairments

Mobility impairments vary greatly, and there are many ways of providing accommodations. Talk with the student about individual needs and accommodations. Make sure that the class laboratory building is accessible to people who use wheelchairs. Use the checklist on page 26 to evaluate your facility's accessibility.

In addition, the following tips can help:

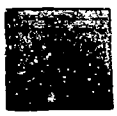
In the Classroom

- Recognize that hand writing may be difficult for many students with mobility impairments. Allow the student to use a tape recorder or make sure the student has arranged for a notetaker, if necessary.
- Make sure mobility-impaired students are not relegated to a doorway, a side aisle or the back of the room. This requires some adaptation, but often common sense will work. For example, a "fixed" seat may simply be unbolted and removed to make room for a wheelchair.

In the Laboratory

Students who have mobility impairments can and have worked successfully in the laboratory. Necessary accommodations can vary from moving a desk around to re-designing a work station. Helpful adaptations include:

- aisle width of 42 to 48 inches, to allow a wheelchair to maneuver easily
- controls for safety and utility equipment that are easy to reach and to use. Faucets and valves with lever handles, push-plate switches, and large push buttons can be used conveniently by people with limited strength and dexterity.
- work surfaces no higher than 30 inches from the floor. Work tables for equipment such as microscopes can also be lowered for people in wheelchairs or with short stature.



- cleared spaces under work surfaces; clearances should be 29 inches high, 36 inches wide and at least 20 inches deep to allow leg space for someone seated in a wheelchair. If necessary, a work surface can be raised with telephone books or other props.

There have been many adaptations designed for people with mobility impairments. Portable lab stations designed for individuals in wheelchairs are commercially available (see the **RESOURCES** section). Some individuals have simply fastened a wooden chair to a rolling platform. This type of chair can be useful when an experiment relies on magnetic fields that may be disrupted by a conventional steel wheelchair.

These innovations can help many people, but none is universal. Every student should be accommodated in the way that works best for him or her.

Accommodations for Students with Other Disabilities

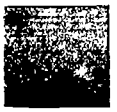
There are many different kinds of disabilities. You may have a student in your class with a disability that fits in none of the categories in this booklet, such as:

- a specific learning disability such as dyslexia, which can make reading print text difficult for a student.
- a speech impairment that prevents a student from giving oral reports
- a disability, such as muscular dystrophy or arthritis, which subjects a student to intermittent or unpredictable functional limitations
- a temporary and/or recent disability, which the student may need advice to accommodate.

Whatever the disability, the same principles apply:

1) It is the student's responsibility to make any special needs known, but the professor or lab instructor may help in certain cases. See the **Identification** section on page 10 for tips.

2) Be flexible with arrangements, but hold a student with a disability to the same academic standard as all other students.



VII. BUILDING ACCESS CHECKLIST

Note: It is usually not the responsibility of a professor or lab instructor to make a building accessible. But a word from you to administrators can make a difference. Use this checklist to determine if changes are needed, and give a copy to the people responsible for making the building accessible.

Parking

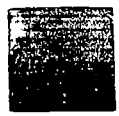
- Are there well-marked, accessible (12'6" wide) parking spaces near an accessible entrance? Are there enough accessible spaces for everyone who needs one?
- Is there a wheelchair-accessible pathway from the parking area to an accessible entrance?

Outdoor Access

- Are there curb cuts from the sidewalk to the street and parking lot? Who will clear the curb of ice, snow, or other barriers?
- Is there an accessible entrance to the building via level entrance, ramp, or elevator?
- Are accessible entrances to the building at least 32 inches wide? Unlocked? Well-marked? Do the doors swing easily?

Inside the Building

- Are doorway thresholds no higher than 1/2 inch?
- Are doors at least 32 inches wide?
- Are there ample signs to accessible facilities?
- Are sloping ramps provided when there are steps? (Ramps should have no more than an 8% (1/12) slope.)
- For the safety of participants who are visually impaired, are there no protruding objects?
- Are there elevators?
- Are all elevator buttons marked in braille numbers or raised notation? Do the elevators have auditory and visual signals for floors?



- Are the elevator controls within easy reach of a person seated in a wheelchair?
- Are lower public telephones provided for persons who use wheelchairs?
- Are volume-control telephone handsets available for people who are hard-of-hearing?
- Are telecommunication devices for the deaf (TDDs) available?
- Can the water fountains be used by someone sitting in a wheelchair?

Restrooms

- Are there wheelchair-accessible restrooms near the classroom or laboratory?
- For a large building: How many wheelchair-accessible restrooms are available on each floor: Women's? _____ Men's? _____
- Are all the wheelchair-accessible restrooms marked on the door with the international sign of accessibility?
- Do all the wheelchair-accessible restrooms have door openings at least 32 inches wide?
- Do accessible stalls
  - ...measure at least 3 feet wide and five feet deep?
  - ...have door openings at least 32 inches wide?
  - ...have outward swinging doors with sliding latches?
  - ...have doors or at least curtains?
  - ...have two grab bars mounted at right angles on the side and back of the stall?
- Are soap and towel dispensers and other accessories within easy reach of someone who is short-statured or sitting in a wheelchair?
- Do faucets have lever-type knobs?

VIII. RESOURCES

For more information on accessible labs and classrooms
HEATH Resource Center
American Council on Education
One Dupont Circle, Suite 800
Washington, D.C. 20036-1193
(202) 939-9320 (V/TDD)
(800) 544-3284 (V/TDD)

HEATH is the national clearinghouse on post-secondary education for persons with disabilities. HEATH can provide information and referral on a wide range of topics involving students and others with disabilities in the higher education community.

Job Accommodation Network (JAN)
West Virginia University
809 Allen Hall
Morgantown, WV 26506
(304) 293-7186
(800) 526-7234

JAN, the informational service of the President's Committee on Employment of People with Disabilities, can provide information about adapting a class or lab. Be prepared to explain the specific details of your situation.

Teaching Chemistry to Physically Handicapped Students, edited by Kenneth M. Reese, American Chemical Society, 1981, revised 1985; available from
Committee on Chemists with Disabilities
American Chemical Society
1155 16th Street, NW
Washington, DC 20036
(202) 955-5823 (V/TDD)

This publication was designed for instructors and teachers, but offers many suggestions that are applicable to all science laboratories and classrooms.

Association on Handicapped Student Service Programs in Postsecondary Education (AHSSPPE)
P.O. Box 21192
Columbus, OH 43221
(614) 488-4972 (V/TDD)

AHSSPPE is an association of disability support service offices (DSSOs) from over 600 institutions of higher learning. AHSSPPE promotes information sharing through a bimonthly newsletter, a national database, and special interest task forces. It provides information on laws and testing accommodations for students with disabilities.

American National Standards Institute, Inc. (ANSI)
1430 Broadway
New York, NY 10018

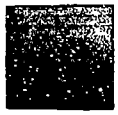
This organization publishes the guide to the most generally-accepted architectural accessibility standards.

To contact scientists and engineers with disabilities
Resource Directory of Scientists and Engineers with Disabilities (2nd Edition, 1987); available from
The American Association for the Advancement of Science
1333 H Street, N.W.
Washington, DC 20005
(202) 326-6630 (V/TDD)

The directory lists over 950 scientist and engineers with disabilities who are willing to act as consultants and advisors.

Barrier-Free in Brief: Access in Word and Deed (1991); available from
The American Association for the Advancement of Science
1333 H Street, N.W.
Washington, DC 20005
(202) 326-6630 (V/TDD)

This booklet includes a directory of 80 experts on science and disability issues.



For more information on assistive technology
RESNA, an association for the advancement of rehabilitation and assistive technologies
1101 Connecticut Avenue, N.W., Suite 700
Washington, DC 20036
(202) 857-1199

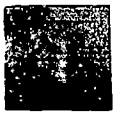
RESNA staff can answer specific questions about adapting labs and classrooms for people with disabilities. RESNA also publishes the *Technology for Independent Living Sourcebook*, a complete reference on available technology and sources of funding, as well as other resources.

The Workplace Workbook: An Illustrated Guide to Job Accommodation and Assistive Technology, by James Mueller, from RESNA (above) or
The Dole Foundation
1819 H Street, N.W., Suite 850
Washington, DC 20006
(202) 457-0318 (V/TDD)

Technical Assistance Resource Center
1101 Connecticut Avenue, N.W.
Washington, D.C. 20036
(202) 857-1140 (V/TDD)

This is the national network of the Technology-Related Assistance for Individuals with Disabilities Act of 1988 (known as the Tech Act). The legislation gives grants to states to develop and implement a statewide program to assist people with disabilities to understand and use assistive technology. This technology can be anything from a page-turner to a wheelchair or a computer. The Center will refer you to the program closest to you.

Rehab Engineering Center (REC) on Access to Computers and Electronic Equipment
University of Wisconsin/Madison
Trace Center
1500 Highland Avenue
Madison, WI 53705
(608) 262-6966 (Voice); (608) 263-5408 (TDD)



Sensory Access Foundation (SAF)
399 Sherman Avenue, Suite 12
Palo Alto, CA 94306
(415) 329-0430
(415) 329-0433 (TDD)

SAF educates consumers and employers on assistive technology most appropriate to a job.

For more information on helping students who are deaf or hard-of-hearing

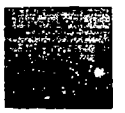
Alexander Graham Bell Association for the Deaf (AGB)
3417 Volta Place, NW
Washington, DC 20007
(202) 337-5220 (Voice/TDD)

National Information Center on Deafness
Gallaudet University
Carnegie Hall, Room 205
800 Florida Avenue, NE
Washington, DC 20002
(800) 672-6720 (V/TDD)

Self-Help for Hard-of-Hearing People (SHHH)
7800 Wisconsin Avenue
Bethesda, MD 20814
301/657-2248; 301/657-2249 (TDD)

The Washington Area Group for the Hard-of-Hearing
P.O. Box 6283
Silver Spring, MD 20916
301/942-7612

These organizations will provide information on a wide range of topics affecting students who are deaf or hard-of-hearing, including assistive listening devices and adapted technology.



For interpreters:
National Registry of Interpreters for the Deaf
814 Thayer Avenue
Silver Spring, MD 20910
(301) 588- 2406 (V/TDD)

National Technical Institute for the Deaf
Rochester Institute of Technology
One Lomb Memorial Drive
Rochester, NY 14623
(716) 475-6400 (Voice/TDD)

For information on captioning:
Modern Talking Picture Service
5000 Park Street, North
St. Petersburg, FL 33709
(800) 237-6213

This service provides a variety of captioned films, including scientific films.

The Caption Center
WGBH
125 Western Avenue
Boston, MA 02134
(617) 492-9225 (V/TDD)

This service will develop captions for video tapes and also Descriptive Video Service (DVS) for persons with visual impairments. It captions NOVA and other educational videos.

For more information on helping students who are blind or visually impaired
American Council of the Blind (ACB)
1010 Vermont Avenue, NW, Suite 1100
Washington, DC 20005
(202) 393-3666 or (800) 424-8666

ACB is a national consumer and advocacy organization composed primarily of people who are blind or visually-impaired. ACB affiliates include a teacher and a student group.

American Foundation for the Blind (AFB)
15 West 16th Street
New York, NY 10011
(212) 620-2000 or (800) 232-5463.

AFB will provide information about issues involving students who are blind or visually impaired.

National Federation of the Blind (NFB)
1800 Johnson Street
Baltimore, MD 21230
(301) 659-9314

NFB is a consumer group which can answer questions about blindness or refer people to appropriate resources.

Recording for the Blind, Inc. (RFB)
20 Roszel Road
Princeton, NJ 08540
(609) 452-0606

RFB provides cassette recordings of educational and professional books. Over 79,000 titles are currently available; other titles are recorded on request. RFB is currently conducting a special project to expand its collection of science textbooks. The materials are provided on loan; there is a one-time starter fee of $25, and no further charge.

Computerized Books for the Blind (CBFB) has merged with RFB to produce books on computer diskettes.

For more information on helping students who have mobility impairments
Spinal Cord Injury Hotline
American Paralysis Association (APA)
c/o Montebello Rehabilitation Hospital
2201 Argonne Drive
Baltimore, Maryland 21218
(800) 526-3456

The Spinal Cord Injury Hotline is an information and referral service for people with spinal cord injury.

Spinal Network (Publishers of the resource book, *Spinal Network* and quarterly magazine, *Spinal Network, Extra.*)
Spinal Associates, Ltd.
P.O.B. 4162
Boulder, CO 80306
(303) 499-5412

Fisher Scientific Co.
30 Water Street
West Haven, CT 06516
(203) 934-5271

Fisher manufactures a portable lab station for students with orthopedic impairments.

For more information on communication aids and technology for people who cannot speak

Commication Outlook
Artificial Language Laboratory
Michigan State University
405 Computer Center
East Lansing, MI 48824
(517) 353-0870

This is an international quarterly for individuals interested in the application of technology to the needs of persons with communication impairments due to neurological, sensory, or neuromuscular conditions.

For more information on helping students who have learning disabilities

National Center for Learning Disabilities (NCLD)
99 Park Avenue
New York, NY 10016
(212) 687-7211 or
(703) 451-2078

NCLD offers information, referral, advocacy and outreach for individuals with learning disabilities.

For more information about barrier-free meetings
Barrier Free in Brief: Workshops and Conferences for Scientists and Engineers
(1991); available from
The American Association for the Advancement of Science
1333 H Street, N.W.
Washington, DC 20005
(202) 326-6630 (V/TDD)

About AAAS

The American Association for the Advancement of Science (AAAS) was founded in 1848 and has become the world's largest federation of scientific and engineering societies, with over 130,000 members and nearly 300 affiliate societies and academies of science. AAAS publishes *Science*, a weekly professional journal, *Science Books & Films*, a source of critical reviews of educational materials for schools and libraries, and numerous other publications.

AAAS programs and activities aim to broaden the human resource pool of scientists and engineers, shape science and technology policy, increase public understanding of science, expand scientific cooperation in global issues, defend scientific freedom, and raise professional standards.

The AAAS Directorate for Education and Human Resources Programs seeks to improve formal and informal education in mathematics, science and technology; to foster equal access to careers in these fields for women, minorities, and people with disabilities; and to enhance the public's understanding of all areas of science.

The Directorate's Project on Science, Technology and Disability strives to improve access to science and engineering education and careers for people with disabilities. Among its programs are the Project on Access to Engineering, the *Resource Directory of Scientists and Engineers with Disabilities*, and support for out-of-school activities for young people with disabilities.