



# New Career Paths for Students with Disabilities

## Opportunities in Science, Technology, Engineering, and Mathematics

American Association for the Advancement of Science

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## Acknowledgements

Roadmaps & Rampways *by Virginia Stern and Michael Woods with contributions from Virginia Van Horne, Laureen Summers, LaTasha Mason, and Anne Williams, was published by the American Association for the Advancement of Science in January 2002. It chronicles the journeys of three dozen students with disabilities from childhood to early career decisions in the science, technology, engineering, and mathematics fields. The students were selected from a much larger internship program that AAAS sponsors called ENTRY POINT! The demographic information was prepared from data by Cathy Henderson.*

*Shirley Malcom, head of the AAAS Directorate for Education and Human Resources Programs, provided critical input to the report, especially on issues related to policies needed to support the goals of ENTRY POINT!*

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*To order a copy of* Roadmaps & Rampways, *please call 1-800-222-7809. The cover price of the book is $29.95 and AAAS members can purchase it at the discounted price of $23.95. For further information on the Project on Science, Technology, and Disability please contact: Virginia Stern, director, vstern@aaas.org 202-326-6630 (voice/tdd).*

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# *Executive Summary*

In 1996, the American Association for the Advancement of Science (AAAS) launched a unique internship program demonstrating that students with disabilities have enormous career potential. ENTRY POINT! is a collaborative project among AAAS, industry, and government agencies designed to meet the human resources needs of the private and public sectors. The program identifies, screens, and places undergraduate and graduate students with disabilities who are pursuing careers in the science, technology, engineering, or mathematics (STEM) fields in paid summer internships.

To date, ENTRY POINT! has made more than 350 intern placements. Ninety-two percent of the ENTRY POINT! alumni are either working in the science or engineering fields or are pursuing degrees in graduate programs. The number, quality, and diversity of the students' majors demonstrate the opportunities in those career fields that value *ability.*

In January 2002, AAAS published *Roadmaps and Rampways*, profiles of 34 students with disabilities who completed at least one ENTRY POINT! internship and went on to graduate school or to pursue a career in STEM. This is the first major publication to chronicle the life experiences—from young childhood to early careers—of students with disabilities who were educated after passage of major legislative protections.

The success of *Roadmaps* students can be attributed to four critical factors:

**1 | Assistive Technology.** Computers, software programs, and other assistive technology give students with disabilities full access to the Internet and research resources. This helps level the playing field in both education and professional employment.

**2 | Families and Communities.** For students with disabilities at every age, family and community support is essential. This support must continue for students who pursue science and engineering degrees and transition from campus to the competitive workplace.

**3 | Mentors and Role Models.** Students with disabilities can face tremendous obstacles. Mentors and role models—teachers, professors, co-workers, or bosses—are pivotal in breaking down barriers and encouraging students to persevere in their chosen disciplines.

**4 | Internships.** Students with disabilities greatly benefit from professional internships. They gain confidence in their own intellectual abilities and demonstrate to themselves, and to their supervisors and peers, that they are

valuable contributors. Exposure to competent interns with disabilities helps eliminate employers' fears and dispels prejudice within an organization.

## *Next Steps*

Although the nation has made important progress in helping students with disabilities reach their fullest potential, much more remains to be done at the pre-college and post-secondary education levels—and beyond those into competitive employment. For those students who choose to pursue STEM fields, quality education can lead to promising technical careers.

AAAS suggests that future disability legislation, policies, and initiatives focus on five key areas:

**1 | Protect and strengthen the laws we already have.** Case studies in education and employment demonstrate success more clearly than the body of case law. According to Shirley Malcom, head of the AAAS Directorate for Education and Human Resources (EHR), "Laws let things happen. People make them happen."

**2 | Encourage businesses, educators, and health care providers to support the enabling technology that can foster independence.** The cost of assistive technology is repaid many times over when a citizen with a disability becomes a productive employee.

**3 | Provide legislative incentives to encourage corporate internships and the hiring of persons with disabilities.** The ENTRY POINT! internships have had a major impact on converting interns with disabilities into full-time employees in our competitive economy. For the employer and the student, internships are the most effective road to employment.

**4 | Improve research on students with disabilities and their progress in a variety of fields, particularly STEM**—where the economy has the greatest needs and presents some of the greatest opportunities.

**5 | Encourage communities, businesses, and schools to include persons with disabilities in local organizations.** Involvement in the community is critical to supporting a strong and diverse society and workforce.

*Roadmaps and Rampways: Profiles of Students with Disabilities in Science, Mathematics, Engineering, and Technology*, represents a small fraction of students, scientists, and engineers with disabilities who are studying and working productively in STEM careers throughout the United States. The book is available from AAAS. See the inside front cover of this publication for ordering information.

# New Career Paths for Students with Disabilities

*The power of the mind* and human spirit can transcend physical limitations. Here are three persons with disabilities who have achieved what many thought was impossible in science, technology, engineering, and mathematics, or the "STEM" fields.

- Randy Horwitz's fifth grade teacher wrote a five-page letter to school officials describing why a blind student could not succeed in a regular science class. The next year, Randy was her star student. He is now a software engineer at International Business Machines (IBM) Poughkeepsie, NY facility.

- Ashwini Deshpande has fibromyalgia, a chronic disability that causes muscle pain, exhaustion and tender points in different parts of the body. In college, she sometimes could barely walk across the Massachusetts Institute of Technology (MIT) campus or type on a computer keyboard for more than a few minutes. Today she is an image scientist for Kodak in Rochester, NY, and a Ph.D. candidate in oceanography at Oregon State University.

- Robert Hill has cerebral palsy and limited use of his arms and legs, but that didn't stop him from finishing at the top of his high school class in Illinois. He is now a mechanical engineer at Boeing in Seattle, WA and designs devices for persons with disabilities in his spare time.

These individuals succeeded against all odds. Few of their doctors, early educators or neighbors thought they would even finish school, yet they have become skilled contributors to the American STEM workforce.

A major reason for their achievements is a unique internship program called ENTRY POINT! that was launched in 1996 by the American Association for the Advancement of Science (AAAS). IBM and National Aeronautics and Space Administration (NASA) through its Achieving Competence in Computing, Engineering and Space Science (ACCESS) program and the National Science Foundation (NSF), joined AAAS in this effort to demonstrate that students with disabilities have enormous career potential. To date, ENTRY POINT! has made 350 intern placements. Almost all of the interns are pursuing graduate studies or careers in technical fields.

"We are very proud of the ENTRY POINT! program," says AAAS CEO Dr. Alan Leshner. "It has provided a career path for hundreds of highly determined young people who have demonstrated that students with disabilities can make a substantial contribution to American leadership in technical fields."

In January 2002, AAAS published *Roadmaps & Rampways*, 34 profiles of students with disabilities who completed at least one ENTRY POINT! internship and went on to graduate school or to pursue a career in STEM. This is the first major publication to chronicle the life experiences of students with disabilities from young childhood to the early stages of their careers. The case studies highlight their struggles and triumphs, providing a compelling snapshot of how young persons with disabilities are progressing in American society. All students with disabilities have made enormous progress in the past 25 years, but there is still much to be done.

Seven years ago, AAAS staff recognized that the academic success of students with disabilities was not being linked to the world of competitive

employment. Students with disabilities needed to showcase their talents to prospective STEM employers before they pursued STEM careers in these disciplines. The expanding STEM fields provided ideal career paths for students with disabilities because of their ability to reason, sort through complexity and build technical products and services. In other words, the STEM fields value the mind more than the body, and that is why students with disabilities are capable of handling the challenges of STEM careers. The development of personal computers and increasingly sophisticated software makes it possible for people who are blind, deaf, unable to use their hands or are otherwise disabled to tackle complicated projects. ENTRY POINT! provided a first step in a STEM career path for these students.

A generation ago, career opportunities for persons with disabilities were extremely limited. If they attended schools at all, they usually went to special and separate institutions. They were also programmed into fields seen as "appropriate" for them. For example, deaf students were often trained to be linotype operators because they would not be bothered by the noise. Blind students were taught to cane chairs or tune pianos. Finishing high school was considered an enormous accomplishment.

*"ENTRY POINT! students are a vital source of talent for the IBM Corporation...IBM is a stronger corporation as a result of this partnership with AAAS," says Jack Sinnott, Vice President of Human Resources, IBM Microelectronics Division.*

# Impetus for *Roadmaps* Student Success

**A number of factors, such as social, legislative and technological changes, created an environment in which the *Roadmaps* students succeeded. Here are just a few of them:**

- They came of age when overall growth in the economy was centered on information technology, biotechnology, and related disciplines. This was a "Tech Generation."
- Changes in the laws regarding accessibility in K-12 and institutions of higher education made it possible for students to enter and/or graduate from high school and college. Some are pursuing doctorates.
- They were determined, smart and highly motivated.
- They had mentors and families willing to go the extra mile to help them.
- They chose STEM fields that value the power of the mind much more than physical ability.
- Improved assistive technology allowed them to study, work and deal with their environments.
- They received the support they needed, not only for traditionally defined disabilities, but also for learning and other invisible disabilities, because educators began to understand and accept that some students learn differently and could be served by new, creative approaches.
- They participated in ENTRY POINT! which helped them prove their value, develop a work history and convince prospective STEM employers that they would make excellent, productive employees.

# A Decade of Historic Change

*Today,* Roadmaps *students* are demonstrating just how inappropriate this stereotyping is. They are making significant contributions in highly competitive STEM fields such as aerospace engineering, biology, human factors engineering, information technology, ocean instrumentation and physics. Through the ENTRY POINT! program, executives at participating organizations find that a small upfront investment in an individual with a disability can lead to a successful and highly motivated employee.

"ENTRY POINT! students are a vital source of talent for the IBM Corporation," says Jack Sinnott, Vice President of Human Resources, IBM Microelectronics Division. "In just the past few years, this program has proven to be our primary channel for the identification and recruitment of persons with disabilities into our company. IBM is a stronger corporation as a result of this partnership with AAAS."

Assistive technology and the flexibility of the personal computer allow students with disabilities to break through seemingly impenetrable barriers. Take Jamie Sharples, a wheelchair rider and one of the more significantly disabled individuals featured in *Roadmaps & Rampways*. Until recently, Jamie, who holds engineering degrees from the University of Illinois and Purdue University, was a bridge designer at J. Muller International in Chicago. With assistive technology, Jamie can design bridges without climbing one or traveling extensively. He is currently an MBA student at the University of Pennsylvania's Wharton School.

Twenty-five years of historic change in American disability laws also have had an enormous positive impact on students with disabilities. The *Roadmaps* students, who are now in graduate school or have completed their education and began working in the 1990s, are the first generation to profit from the new laws. Shirley Malcom, head of the AAAS Directorate

for Education and Human Resources Programs, likes to say, "Laws *let* things happen, people *make* them happen."

Her words proved prophetic, particularly for the *Roadmaps* students. Once the students declared a love for one or more STEM disciplines, they diligently pursued those fields. For example, Christine Mouser, who had an extremely late diagnosis of dyslexia, a learning disability that impairs a person's ability to read, discovered her love of math.

"I thought I wanted to be an astronaut," says Christine. "I still want to be an astronaut. I've wanted this since I was four-years-old. But I never really thought it would be possible." Christine hasn't achieved that dream yet, but she did help design four software applications for NASA's NEAR Mission, the first spacecraft ever to orbit, scan, and land on an asteroid.

As former *Roadmaps & Rampways* students become more entrenched in today's technical workforce, they are becoming advocates for and future leaders of STEM workers with disabilities. Students who have experienced this program are high achievers and are uniquely dedicated to the science and technology fields. Now they are starting to give back to the system that helped them. They are mentoring young students with disabilities, working to foster a greater understanding of persons with disabilities within the companies they have joined, and, in at least one instance, designing assistive technology to make it easier for workers with disabilities to function within their chosen fields.

Each of the *Roadmaps* students has a unique and exciting story to tell. They are testaments to the power of the mind and the human spirit.

# A Brave New World

*Citizens with disabilities are* a powerful force in lobbying for equal access to education and jobs, and they have been very successful. Three major pieces of legislation dramatically altered their prospects. The first was the 1975 Education for All Handicapped Children Act (PL 94-142), now called the Individuals with Disabilities Education Act (IDEA). It guaranteed all children with disabilities the right to a pre-college education and opened the doors of schools in their communities to them.

The second legal breakthrough came in 1977, when the 504 Regulations opened up access to higher education by requiring colleges and universities to make their programs accessible to qualified students with disabilities. Campuses now have a disability resource office that offers a wide range of technologies and services, including interpreters and scribes, or note takers; these offices can even arrange for additional time or special accommodations to complete exams. They also offer textbooks on tape, tutors, special orientation, and, in some instances, software such as Dragon Dictate,™ a voice recognition computer software program that permits hands-free writing.

The third legislative breakthrough came in 1990 with the signing of the Americans with Disabilities Act (ADA), which reinforced the requirements of 504 and also mandated curb cuts, ramps, elevator access to public accommodations and accessible telecommunications. It also prohibited employment discrimination.

The number of students with disabilities attending higher education institutions is climbing. More than one million students with disabilities are now enrolled in American colleges and universities, triple the number of these students in those institutions during the late 1970s. The students have a wide range of disabilities including orthopedic, speech and learning difficulties, visual and hearing impairment, and health-related disabilities.

# Why *Roadmaps* Students Succeed

*Roadmaps students have* had difficult journeys. While changes in disability laws opened doors for them, they had to push to get through those doors and keep going. All students tell stories of others' ignorance, of discrimination and of people who told them they would never make it to where they are today. Students who were diagnosed with learning disabilities later in their lives were first counseled toward fields where their "lack of ability" was not an issue. A common thread of four reasons for success runs through most of their stories: access to assistive technology, family and community support, mentors, and the availability of internships.

### 1 | Assistive Technology

Fifty years ago, some of the *Roadmaps* students would have lived out their lives in institutions. Today they are graduating from top universities and launching promising careers, largely due to assistive technology.

The advent of the PC, e-mail and the Internet are providing more efficient ways of communicating and accessing information. Computers level the playing field and allow persons with disabilities to function like employees without disabilities. For instance, Marco Midon, an engineer in the microwave systems branch at NASA's Goddard Space Flight Center in Greenbelt, MD, is blind and uses a computer program called Job Access with Speech (JAWS). It allows him to monitor and control test measurement equipment, track satellites, and evaluate electronic components for satellite transmissions.

"If I want to be the best and compete on the same level as those in the sighted world, I need to have the best equipment," Marco says. "It enables me to maximize communications with others and get things done. I take it wherever I go."

Some technologies allow users to do things they never before thought possible. A cochlear implant lets Erika Nelson, who is deaf, talk on the phone with friends and hear her co-workers at the consulting firm Accenture. This small, complex electronic device is surgically implanted behind the ear and acts almost as an artificial ear. Therapy provides the person with the implant the skills to hear and understand speech signals.

## 2 | Families and Communities

All of the *Roadmaps* students have had incredible family and community support. Their parents and siblings believed in them and did whatever it took to get them to where they currently are. The love and commitment shown by those around them was extraordinary. Yet, the students also encountered tremendous obstacles; some families were more equipped than others to deal with the challenges of a student with disabilities.

Each of these individuals has a story to tell that demonstrates just how hard it really was. Jamie Sharples, for example, was born with a condition called osteogenesis imperfecta—or brittle bone disease—that delays and stunts growth. Even in kindergarten, he learned just how unsupportive a school community could be. Someone had forgotten to install the wheelchair ramp, and he couldn't get up a flight of stairs to enter the school building. With his classmates watching, an attendant carried his wheelchair up the stairs while Jamie crawled up behind him.

Jamie's mother, a single parent, was indefatigable. After he was born, doctors told her Jamie wouldn't live and should be institutionalized. She recalls, "I took him home and tried to raise him like any other child.

The only limitations were those he set for himself, and it's pretty obvious that to Jamie, the sky is the limit."

## 3 | Mentors and Role Models

Everyone needs someone to look up to—someone who inspires him or her, believes in his or her abilities without hesitation and encourages him or her to be the best. In sports, that person is the coach. For students with disabilities, that person is a mentor who can be a friend, co-worker, boss, or teacher. What sets these mentors apart is they were able to overlook obstacles and challenge the *Roadmaps* students to forge ahead.

Pre-college teacher mentors often encourage students to pursue a subject they are particularly interested in or to expand upon a natural talent. Several of the *Roadmaps* students had science or math teachers who helped them choose a STEM major and, ultimately, a career in a technical field. For example, Nichole O'Connell has attention deficit hyperactivity disorder (ADHD), which makes her inattentive and easily distracted. As early as fifth grade, it would take her several hours to finish a simple homework assignment. An algebra teacher in middle school went out of her way to play math games with her and take time to explain concepts in a language that Nichole could understand.

"I probably wouldn't be a math major today if I hadn't been her student," Nichole says. She plans to pursue a doctorate in biophysics.

Role models can motivate persons with disabilities to pursue their dreams rather than limit their expectations. One of the most powerful role models is British cosmologist Steven Hawking. A wheelchair rider with a brilliant mind and barely intelligible speech, Hawking has amyotrophic lateral sclerosis (ALS), or Lou Gehrig's disease. Hawking is the Lucasian

Professor of Mathematics at Cambridge University. He communicates and writes books by selecting words from a computer monitor with small hand, head or eye movements that send the text to a speech synthesizer.

"He could barely move," says Jacob Gapko, a *Roadmaps* student. "And yet he is one of the best thinkers on earth."

## Demographic Makeup of Students with Disabilities in STEM Fields, 1995-1996

### Undergraduate Students

| | |
|---|---|
| Average age of students with disabilities in college | 30 |
| Average age of students without disabilities in college | 26 |
| Men with disabilities | 50% |
| Women with disabilities | 50% |
| *Racial background of students with disabilities:* | |
| Caucasian | 81% |
| African Americans, Hispanic Americans, Asian Americans and Native Americans | 19% |
| Percentage who attend two-year institutions | 49% |
| Percentage who attend public, four-year colleges and universities | 25% |
| Percentage who attend independent, four-year institutions | 15% |

*(Percentages do not add up to 100 because some information was proprietary.)*

### Graduate Students

| | |
|---|---|
| Percentage who continue schooling after college | 10% |
| Percentage of total number of graduate or professional students with disabilities | 3.3% (or 91,872 total students) |
| Number of women | 68.7% |
| Number of men | 31.3% |

*(Sources: American Association for the Advancement of Science, based on data from U.S. Department of Education, National Center for Education Statistics.* Profile of Undergraduates in U.S. Postsecondary Education Institutions: 1995-96, with an Essay on Undergraduates Who Work. *U. S. Government Printing Office: Washington, DC, 1998.)*

## 4 | Internships

Students with disabilities, like all students, benefit tremendously from professional internships. Internships act as a bridge into the professional world because they allow students with disabilities to learn what accommodations they will need to succeed. They can also educate others about themselves and gain confidence in their own abilities.

Three internships with NASA's Project ACCESS, its AAAS program counterpart, launched hearing-impaired Kelly Halacka on the right path. Kelly explains, "The internship at NASA was my first paid job except for babysitting. I was a little nervous at first, but the NASA people made me comfortable and I gained confidence fast." Kelly is now a biomedical engineering student at Case Western Reserve University.

Internships were extremely valuable to Rodney Stewart, who uses a prosthetic leg. While Rodney was an engineering student at New Mexico State University, he joined a consortium of 16 educational institutions in that region affiliated with the ENTRY POINT! program. He worked at an IBM help center and did database configuration and programming. Rodney now has a full-time job as an equipment engineer in IBM's Poughkeepsie, NY facility.

"The internship was a major plus in my career," Rodney says. "It helped introduce me to the corporate work place in the real world. I gained a lot of self-confidence. Individuals with disabilities sometimes need a little help to get them headed in the right direction."

Internships also help eliminate employer fears about the limitations of persons with disabilities. Human resources staff and hiring managers may not have had experience with applicants who have disabilities. Often they react with discomfort. Exposure to highly competent interns with disabilities can break down traditional stereotypes and demonstrate that disability is

not a barrier to intellectual productivity. A series of positive intern experiences creates a respectful environment within an organization where persons with disabilities are valued, without prejudice, for the skills they bring to the team.

AAAS recruits students with disabilities for NASA's Project ACCESS. Maryanne Stoutsenberger, University Program Manager at Project ACCESS, explains, "We recruit high achieving math, science, and engineering interns with disabilities to work at our centers performing research on aeronautical and space projects. Since we started this project five years ago, our managers and staff have learned that students with disabilities are hardworking, talented individuals who can make a substantial contribution. In fact, one of NASA's ACCESS students was selected as a Rhodes Scholar in 1998."

## Types of Disabilities Among Students Pursuing STEM Fields, 1998

| Type of disability | First-time, full-time college freshman | Postsecondary undergraduates | Graduate and first professional students |
|---|---|---|---|
| Learning | 41.0% | 29.2% | 18.2% |
| Visual | 13.3% | 16.3% | 24.2% |
| Hearing | 11.6% | 16.3% | 21.2% |
| Orthopedic | 9.1% | 22.9% | 18.2% |
| Health-related | 19.3% | - | - |
| Other | 21.8% | 21.2% | 21.2% |
| Any disability | 9.4% | 5.5% | 3.3% |

*(Sources: American Association for the Advancement of Science, based on unpublished data from Cathy Henderson.* College Freshmen with Disabilities: A Biennial Statistical Profile; *American Council on Education, HEATH Resource Center: Washington, DC, 1999; U.S. Department of Education, National Center for Education Statistics.* Profile of Undergraduates in U.S. Postsecondary Education Institutions: 1995-96, with an Essay on Undergraduates Who Work; *U.S. Government Printing Office: Washington, DC, 1998; and unpublished tabulations from NCES, NPSAS 96, 1998.)*

# Suggested Next Steps

*Although the nation has made* important progress in helping students with disabilities reach their fullest potential, much more remains to be done. Sometimes steps forward are followed by half steps back. Stereotyping, prejudice, and misunderstanding still plague students with disabilities throughout their education and as they try to enter the workforce.

Through the ENTRY POINT! program, AAAS staff recognized the impact of the current laws and developed an understanding of issues to address them. AAAS suggests that future disability legislation focus on five key areas:

### 1 | Protect and strengthen the laws we already have.

In the past decade, laws protecting the rights of persons with disabilities have come under fire. In 1999, the Supreme Court began hearing cases tied to the ADA. The decision with the most negative impact to date is *University of Alabama v. Garrett*, in which the Court eliminated the possibility of suing states under Title I of the ADA.

In this case, a nurse and security officer in Alabama sued the state for not providing "reasonable accommodations" for them. While many of the lower court decisions that negatively impacted persons with disabilities can be addressed legislatively, this case provided a new interpretation of constitutional law that is much harder to challenge.

Media coverage of ADA-related complaints often gives the impression that these court cases are a nuisance to corporate America. It is not clear that sufficient time is available in the judicial process, or that it is the best forum to consider the nuances that govern employment of people with different jobs and different disabilities. The role of the courts is to look at

the case, and not at wider case studies that might suggest how a worker's limitations could be changed if the employer provided the right accommodations. As a result, employers and persons with disabilities alike begin to consider their employment issues as potentially adversarial. Steps are needed to eliminate these types of misunderstandings and to protect and strengthen the disability laws currently in place. This could come in the form of legislation adding more muscle or better analytical tools to the ADA. The case studies in *Roadmaps & Roadways* clarify what is possible.

Lawsuits are often a last resort for some persons with disabilities, because they delay solving the problem. If the immediate desired outcome is to get the job or go to school, the *Roadmaps* case studies illustrate that education and negotiation are often better tactics than litigation.

For example, Keely Kemnitz was injured in a 1988 fall from a log while on vacation with her family. She is now a wheelchair rider with a spinal cord injury. Her town of 3300 in Mobridge, SD rallied to help her, as did some members of the local school who carried her wheelchair up the

*Lawsuits are often a last resort for some persons with disabilities, because they delay solving the problem. If the immediate desired outcome is to get the job or go to school, the* Roadmaps *case studies illustrate that education and negotiation are often better tactics than litigation.*

school steps. The school was required by law to help Keely gain access to the building, and her parents urged local school board officials to install an elevator in the high school. Her parents say they knew legal recourse was possible, but in a small community it would have done more harm than good. With patience and persistence, the Kemnitz family was able to achieve the same end.

### 2 | Encourage businesses, educators and health care providers to support enabling technology that can foster independence.

Employers need to evaluate the cost/benefit ratio of providing assistive technology to workers with disabilities. While the cost of assistive technology might seem high as an upfront investment, it is minimal when compared to the potential output from an employee over several years. Both the private sector and the government should conduct analyses of the longer-term implications of providing tools that move individuals from dependence to independence.

The ENTRY POINT! program is building leaders who will, because of their education, be able to change technologies, shift policies, change the work environment and redefine the resources that are made available to us all.

Some *Roadmaps* students tell stories of how much help assistive technology provides, only to lose access to that technology later on because they could no longer afford it and could not convince an employer or educational institution to pay for it.

The education community—though required to do so by law—has in some instances been slow to respond to the needs of persons with

disabilities. Despite legislation requiring it, a Department of Education survey reported that only 58 percent of colleges provide assistive technology to persons with disabilities, 55 percent offer textbooks on tape, 45 percent provide sign language interpreters and 32 percent have special orientation programs. In other areas, colleges and universities have made more progress. Eighty-eight percent provide alternative exam formats and additional time for exams, 77 percent offer tutors and 69 percent provide readers or classroom note takers.

Most of the systems that support training for persons with disabilities are not designed to include the special needs of individuals who will enter the STEM workforce. For instance, the Vocational Rehabilitation System often provides for short-term course work to build skills needed to enter lower-level occupations. By contrast, pursuing a STEM degree is usually a multi-year process. A person who wishes to enter a STEM field at a professional level must have at least a B.S. degree. An M.S. degree is a common requirement for advancement, and some positions require graduate education through the Ph.D. level. Study in STEM fields, although it demands more time, clearly offers an opportunity to achieve a higher potential.

Providers of financial aid, such as the Vocational Rehabilitation System, and others need to take into account the longer and more demanding study programs that are characteristic of STEM fields. Vocational rehabilitation programs generally fund shorter terms of study than are needed to complete the degrees necessary to compete in STEM fields.

While employers are required by law to provide assistive technology at work, when asked to duplicate that technology at home, they often say no.

Yet those same organizations may provide lap top computers, cell phones, pagers, or other technology to employees who telecommute or work nights at home. AAAS suggests that employers rethink their policies on work-at-home arrangements for persons with disabilities. When employees with disabilities hold professional or technical positions, they may need to work at home to complete their assignments in the same manner as other professional employees. Smart employers provide their employees with the tools they need to get their work done, no matter where they work.

Some corporations, such as IBM, have found that resistance to paying for assistive technology comes from individual department managers who do not want to take the funds out of their budgets. In this situation, creating an interdepartmental pool of money that can be used to purchase these products can remove financial disincentives to units or divisions.

Other firms have created management training programs to teach hiring managers the most effective ways to interview persons with disabilities. In job interviews managers should ask about the capability to do a job, rather than question the limitations of a disability. This way, employers can obtain the information they need to make smart decisions without asking discriminatory or demeaning questions.

Technology developed for individuals with disabilities can have broader applications. For example, technology that converts print to speech was first developed to serve users who are blind. Technology that recognizes speech is critical to individuals who cannot easily access a keyboard, but now it is used everywhere by the telephone system, transportation information system, and many others in the general community. In fact, very few

*Technology developed for individuals with disabilities can have broader applications. In fact, very few technologies developed for persons with disabilities are so specialized that they do not have markets beyond the groups for whom they were created.*

technologies developed for persons with disabilities are so specialized that they do not have markets beyond the groups for whom they were created.

The ENTRY POINT! and ACCESS programs are building leaders who, because of their education, will be able to change technologies, shift policies, restructure the work environment and redefine the resources that are made available to us all. AAAS's experience with ENTRY POINT! has demonstrated that internships are the most effective way for students with disabilities to make the transition from higher education to competitive employment in technical fields, in both the public and private sectors.

AAAS recommends a campaign to educate school administrators and businesses about the benefits of internships for persons with disabilities and how little accommodation is needed for them. One study showed that on average, assistive technology could be purchased for as little as $75 per student. Universities should be identifying and publicizing internships in technical fields and be encouraged to partner with programs such as ENTRY POINT! Federally-funded programs such as the National Science Foundation's Research Experiences for Undergraduates (REUs) and similar programs funded by the Department of Energy are also important opportunities for students with disabilities to try out their skills in real research environments.

The National Science Foundation (NSF), through its review criteria set by the National Science Board, could ask universities to examine their policies and practices in supporting students with disabilities in STEM. Universities receiving NSF funding could be asked to provide an accounting of services, assistive technology, and other accommodations for student with disabilities, as well as identifying administration and faculty programs that encourage the students to enter and persist in STEM courses of study.

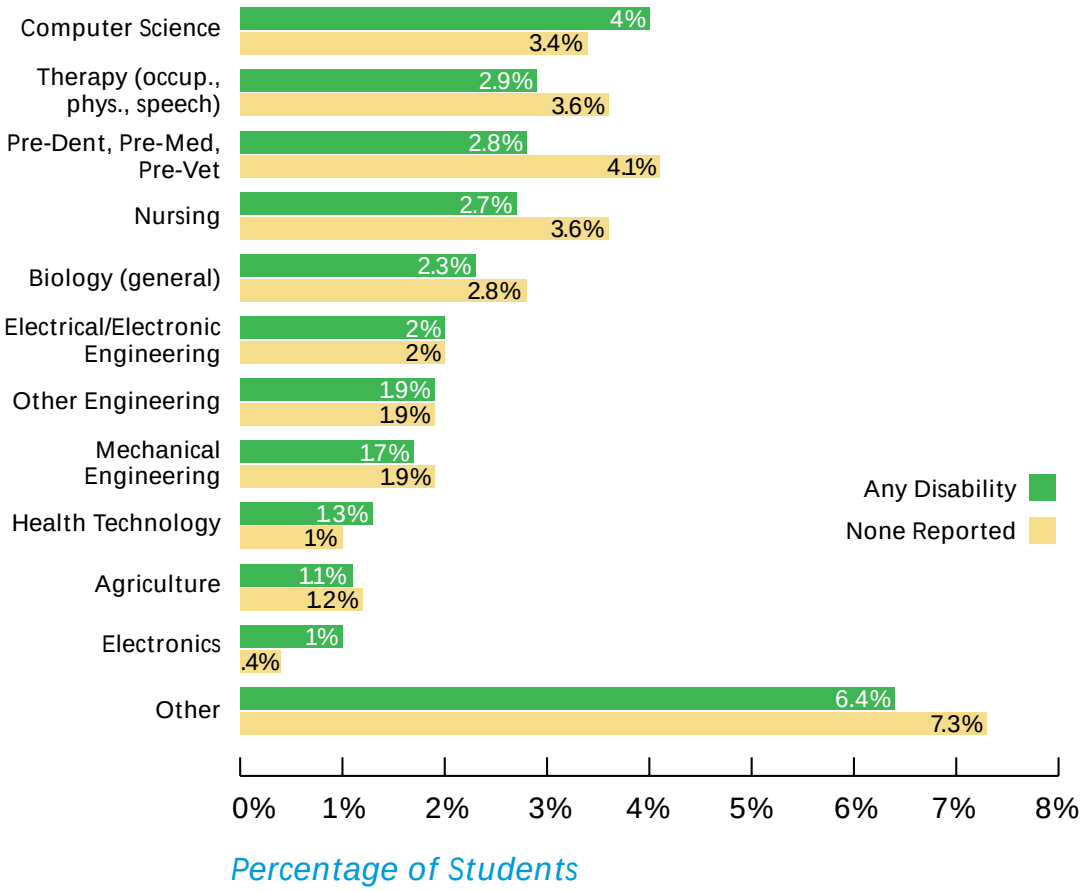
### 3 | Provide legislative incentives to encourage corporate internships and the hiring of persons with disabilities.

Internship programs, like ENTRY POINT! are excellent ways to introduce potential employers to talented students with disabilities. While some organizations have made enormous progress, others are still reluctant to make an investment in someone who may require additional time, effort, commitment, and financial investment.

Randy Horwitz's experience as a student at the Rochester Institute of Technology (RIT) is not unusual. Although he was sent on interviews by the RIT co-op office with a resume showing that he had won an award for "Young Blind Person of the Year," Randy encountered what he said was blatant discrimination from several potential employers. He was searching at a time when there were more jobs than the schools could fill.

"I sent out about 25 resumes and got just five responses," Randy says. "Friends of mine with similar grades would send out five resumes and get five responses. In at least three interviews, there were discriminatory comments, or if it was not said directly it was heavily implied via tone of voice. Interviewers couldn't imagine me doing computer work."

## STEM Fields Popular Among Students with Disabilities, 2001




*(Sources: American Association for the Advancement of Science, based on unpublished data from the HEATH Resource Center, American Council on Education and the Cooperative Institutional Research Program, UCLA, 2001.)*

Internship programs can change perceptions. AAAS recommends that companies receive tax breaks or other special incentives for providing internships to students with disabilities.

Legislation already provides three tax incentives to help employers cover the cost of accommodations for employees with disabilities and to help

make their places of business accessible to customers with disabilities. These incentives allow for small business tax credits for businesses trying to become accessible, for annual expense deductions to remove physical and transportation barriers, and for Work Opportunity Tax Credits for employers who hire certain vocational rehabilitation referrals.

It is also critical to develop a core group of leaders among scientists and engineers with disabilities, similar to what has been done for women and minorities. These leaders can act as mentors to students with disabilities in internship programs and can be advisers to corporations and government agencies, imbedding students with disabilities into existing STEM internship programs.

### 4 | Improve research on students with disabilities and their progress in a variety of fields, particularly STEM.

Much of the research that focuses on students with disabilities in higher education and the workforce is incomplete and dated. Studies are not conducted annually by any major organization, and the most recent data available on post-secondary educational achievements, fields of study, types of institutions attended and races or ethnicities is from 1995-1996. Information on students with disabilities in graduate school and the workforce is very limited.

Funding should support projects that examine the impact of the ADA on the post-secondary studies and achievements of students with disabilities in STEM. Among the many areas that need to be studied are:

- Best practices and critical pathways to student progress.
- Financial support for students with disabilities.
- Why students with disabilities either pursue or shy away from STEM careers.
- The progress of underrepresented minorities with disabilities in education and their progression into STEM careers.

This type of research is critical to smart decision-making about policies that impact persons with disabilities. The policy environment is changing, and many of the shifts are made based on anecdotal evidence from a single organization rather than on collected and analyzed data. AAAS suggests that a base of research and data be constructed so that informed decisions on how to best support students with disabilities through their education and employment can be made.

The *Roadmaps* students and their successes demonstrate how far students with disabilities can go to get the assistance and support that they need. Persons with disabilities are a largely untapped source of talent to fill gaps in a rapidly growing STEM workforce. It is our hope that the ENTRY POINT! program will serve as a model for the development of other STEM internship programs across the country. AAAS's experience with ENTRY POINT! demonstrates that when the right programs are in place, there are no limits to a person's growth potential.

### 5 | Encourage communities, businesses and schools to include persons with disabilities in local organizations.

Students with disabilities benefit enormously from involvement in community-based activities. They gain teamwork and performance skills by participating in activities such as Boy Scouts, 4-H Clubs, faith-based activities, and community center recreational activities. Students with disabilities need to be integrated into the fabric of their communities. Unless a concerted effort is made, they often do not participate in local and regional activities as frequently as other students do.

Out-of-school opportunities afford students with disabilities community-based experiences they could never have within the formal school system. These experiences are important in shaping outlooks, both for those with disabilities and their non-disabled peers. These programs are not covered by legal protections; for example, a science and technology museum must have certain physical accessibility to comply with the ADA, but the law does not require programmatic accessibility.

The experience of AAAS with all STEM students, those with and without disabilities, is that the physical environment is not the only factor that engages and keeps them in the STEM pipeline. The programmatic and psychological environments are equally important, as is financial access.

Community groups should be encouraged to develop outreach programs so that students and other persons with disabilities can participate in their activities, volunteer for general fund-raising campaigns, and serve on their committees and boards. Local governments should solicit input so

that they can gain understanding of the issues that citizens with disabilities consider critical to full participation.

Joining the Boy Scouts helped Jamie Sharples develop the confidence that he needed to pursue a college education and a professional career. He was the only boy in the troop with a physical disability and without a father at the annual soap box derby race. His mother helped him build a race car, which she described as far less sophisticated than those made by the fathers and sons. But Jamie and his mother astounded everyone by winning the race.

Founded in 1848, the American Association for the Advancement of Science (AAAS) is the world's largest federation of scientific and engineering societies, with over 270 affiliated organizations. AAAS members include more than 138,000 scientists, engineers, science educators, policymakers, and interested citizens.

AAAS seeks to "advance science and innovation throughout the world for the benefit of all people." To fulfill this mission, the AAAS Board has set the following broad goals:

- Foster communication among scientists, engineers and the public;
- Enhance international cooperation in science and its applications;
- Promote the responsible conduct and use of science and technology;
- Foster education in science and technology for everyone;
- Enhance the science and technology workforce and infrastructure;
- Increase public understanding and appreciation of science and technology; and
- Strengthen support for the science and technology enterprise.

AAAS also is the publisher of *Science* magazine.

The Directorate for Education and Human Resources (EHR) seeks to:

- Improve education in science, technology, engineering, and mathematics.
- Foster equal access to these fields for racial/ethnic minorities, women and persons with disabilities.
- Enhance the public understanding of science and technology.

Its many initiatives and projects include:

- School reform in science, mathematics, and technology.
- Education research on schools, colleges, universities, and human resources.
- Informal science and mathematics education with community-based organizations.
- Libraries, science museums, and technology centers.

EHR projects and activities include a children's science and mathematics on-line after school program, science media fellowships, science and technology summer internships in government and business for students with disabilities, and a science radio show.

Any interpretations and conclusions contained in this report are those of the authors and do not represent the views of the AAAS Board of Directors, the Council of AAAS, its membership, or the National Science Foundation.

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**Project on Science, Technology, and Disability**
**Directorate for Education and Human Resources Programs**

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