Deafblind Focus

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The Technology Frontier

Bionic Eyes

(This is a reprint of an article by Steve Price and Dr. Tony Phillips from the *Science at NASA* websites at http://science.nasa.gov/headlines/y2002/03jan_bioniceyes.htm)

Using space technology, scientists have developed extraordinary ceramic photocells that could repair malfunctioning human eyes.

Rods and Cones. Millions of them are in the back of every healthy human eye. They are biological solar cells in the retina that convert light to electrical impulses -- impulses that travel along the optic nerve to the brain where images are formed. Without them, we're blind.

Indeed, many people are blind -- or going blind -- because of malfunctioning rods and cones. Retinitis pigmentosa and macular degeneration are examples of two such disorders. Retinitis pigmentosa tends to be hereditary and may strike at an early age, while macular degeneration mostly affects the elderly. Together, these diseases afflict millions of Americans; both occur gradually and can result in total blindness.

"If we could only replace those damaged rods and cones with artificial ones," says Dr. Alex Ignatiev, a professor at the University of Houston, "then a person who is retinally-blind might be able to regain some of their sight."

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Under the Magnifying Glass: Technology and Accessibility

Increase Independence of Students with Disabilities Using Windows and Microsoft Word

By Subhashini Balagopal and Patti Young
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Indiana special educators Subhashini Balagopal and Patti Young saw the potential of using word processing and presentation capabilities of Microsoft Windows 98 and Office 2000 for adapting activities to help students with disabilities feel successful at school and increase their independence. They shared some of their ideas at the Closing the Gap conference in October, 2001.

Picture a child with orthopedic impairments in a classroom struggling to turn pages in a book, working hard to complete pencil and paper tasks, dictating to an adult aide, wishing he could do his work all by himself, independently.

Picture another child with low vision, struggling to complete a worksheet, laboring just to read her own handwriting.

Now picture these students proudly, happily, independently going about their work, without having to rely on others, using just one ubiquitous tool - a computer.

Is special software required to increase the independence of these children? Not necessarily. Not if you have access to Windows 98 and Microsoft Word 2000 (or the latest versions of these products: Windows XP and Word 2002)!

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Under the Magnifying Glass: Technology and Accessibility

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Educators are searching to find assistive technology options that are viable for students with a wide range of disabilities. Often, the options available are fairly expensive. At the annual "Closing the Gap" conference in October 2001, our workshop focused on utilizing standard Microsoft Word 2000 features and Windows 98 features to provide adaptations and increase our students' independence in school activities.

We used these programs for students with orthopedic impairments, visual impairments, and learning disabilities to customize computer access and increase student participation and efficiency in completing school-based tasks. The biggest advantage is the cost-efficiency of using software that is already on every computer in our school. We are able to utilize something that is readily available which means that our students have access to what they need everywhere in the district. This software is also age-appropriate, utilized by most of their peers as well as adults, and teaches them skills that will be of even greater value as they get older. These tools are not just useful for students with special needs, but all students. The workshop at the conference focused on teaching professionals how to enhance student participation in the general education classroom by using technology that is already on most Windows-based computers.

Below are ideas that evolved from evaluating the needs of our students and attempting to use existing software to meet these needs. The use of these powerful tools is limited only by your creativity. In the following examples, we used Microsoft Windows 98 and Microsoft Office 2000 products. Here are some ideas shared at the workshop:

- **Windows Accessibility Features**

  Accessibility features are available by default for computers running Microsoft Windows 98 and later versions of Windows (including Windows 2000, Windows Me, and Windows XP). These features make computer access far easier for individuals with disabilities. One accessibility utility, Microsoft Magnifier, is used to enlarge what is viewed on the monitor. Font size, titles, menus, buttons, icons, scrollbars, mouse cursors, etc. can be adjusted for optimal viewing and efficient access. High-contrast options, captions with sounds/warnings, and special keyboard options are also available.

- **Form Filling Using Imaging for Windows 98**

  This feature allows the user to scan-in a document and mark annotations on it. We use this with students who have orthopedic impairments, so that they can scan in a workshop, and use the annotation tools to complete their work independently. It allows the user to ad, highlight, and underline text. There is also a rubber stamp feature, which enables the user to insert frequently used items such as name, date, subjects, etc. that might be used for every paper he/she types.

- **Keyboard Shortcuts**

  These increase efficiency and decrease the need for mouse access to commonly used buttons and icons. Internet Explorer shortcuts and Word shortcuts are covered in our workshop.

- **Creating Forms**

  Using the forms toolbar in Microsoft Word 2000, you can create a form that can be used by a student to easily tab through the fields to complete a document. Text fields, check box fields, and drop-down lists (to specify choices for the user to select) can be inserted. It is possible to lock, or protect, the form so that it cannot be modified. This is a useful tool for setting up worksheets, tests, multiple-choice questions, letters, reports, etc. A number of general education teachers who have been shown this feature have started using it in their classrooms as well.

- **Creating Custom Ruled Paper**

  You can use the Tables and Borders toolbar in Microsoft Word 2000 to make ruled paper customized to the needs of specific students. The lines can be drawn in different colors and thicknesses, grids can be created to help with lining up numbers for math activities, and enlarged graph paper can be easily produced for students who need it. Samples of ruled

paper that we have created are available to download from our Web site.

- **Using Print Screen**

  This feature enables the user to take "snapshots" of images as they appear on the computer monitor. We have used this to set up simple instructions for students and staff members who are using new software. It is also useful for importing pictures into communication books/overlays.

- **Creating Clickable PowerPoint Lessons**

  For teachers who are always looking for interesting cause and effect software, and other software for teaching various skills, Microsoft PowerPoint 2000 and PowerPoint 2002 are very simple and effective means of creating computer activities with a mouse, touch windows, trackballs, etc. The biggest advantage of this is that any activity created by teachers can be copied and shared with colleagues, parents, and others who can use them by saving the activity as a show. The "Pack and go" feature of this program also makes it easy to save the activity on a disk to use on a computer (perhaps in the student's house) that does not have PowerPoint installed on it. Older students who are learning to use PowerPoint in computer education classes can work on setting up activities on different topics for teachers to use in their classrooms.

Simple, clear, step-by-step instructions for these activities and more are available at the Richmond Community Schools Special Education Department website. Look under "Handouts of Presentation" at http://www.rcs.k12.in.us/eses/closing_the_gap.htm.

Note: Some students may need additional hardware such as trackballs, touch windows, expanded keyboards, switches, and scanners to utilize the software listed above. For a list of assistive technology products compatible with these products, visit Microsoft's catalog of assistive technology products.

About the Authors: Subhashini Balagopal and Patti Young work together in Indiana at the Richmond Community Schools. Balagopal has over a decade of experience as a special educator working with students with orthopedic, visual, and multiple disabilities, including many with significant medical needs. Young has nine years experience in the area of special education. Both provide training for staff and students in assistive technology devices and software.

Indiana Technology Project

The PATINS Project

The Partnerships for Assistive Technology with INdiana Schools (PATINS PROJECT) is an Indiana Department of Education assistive technology systems change initiative. The project is designed to impact both the organizational capacities of local public schools and the professional capabilities of school staff in the delivery of assistive technology services.

The mission of the PATINS Project is to provide systematic training and access to adaptations and technology tools which enable students to have the skills to control and direct their own lives.

As a part of this mission, the PATINS Project also is the official lead agency in Indiana for the National Cristina Foundation (NCF), a not-for-profit, national donation channel for recycled computers. The purpose of this project activity is to provide refurbished computer technology to disabled, disadvantaged or at-risk Indiana students where none or very little technology exists.

Indiana public school administrators/special education directors are eligible to apply for recycled technology. Applications are filled on a first come, first served basis when the appropriate equipment becomes available.

For more information on the PATINS Recycled Computer Project contact Vicki Hershman, PATINS State Project Coordinator at West Central Joint Services, 4730 West Gadsden Street, Indianapolis, IN 46241, (317) 243-5737 Ext. 138 or your Regional PATINS Site Coordinator. More information on contacting individual regional coordinators can be found at http: www.patinsproject.com.

Technology Resources

Assistive Technology and Communication Sites for Educators and Administrators

http://www.do2learn.com

This website contains ideas and teaching tips especially for students with autism; however, the tips are applicable for children with other disabilities. Each category contains pictures for art projects, communication schedules, games (that can be played on the computer), and classroom arrangements. Other categories include: picture cards - print cards and forms; fun stuff - art projects; learning helpers; set up and kid power; games - language development; facial expressions; fire and safety; make a schedule; and product guide (items for purchase).

http://www.disney.go.com/cybersafety

This website was developed to provide an entertaining, interactive way for families and educators to learn valuable lessons about on-line safety. Disney characters talk about adventure, fun, and on-line awareness tips. The interactive fables are meant to be shared between adults and children. Families can sign up for a Family Newsletter. The site reviews movies, books, cd's and games. It also contains activities (step by step), outdoor fun, as well as an activities checklist that integrates learning characteristics and skills.

Other Technology Focused Web Sites

Washington Assistive Technology Alliance
http://www.wata.org

AbilityHub - Assistive Technology for Computers and Disability
http://www.abilityhub.com/

Quality Indicators for Assistive Technology Services
http://sac.uky.edu/~jszaba0/QIAT.html

Closing the Gap Question and Answer
http://www.closingthegap.com

Closing the Gap Essential Bookmark Collection for AT Coordinators
http://www.closingthegap.com/bookmarks/html

Trace Research and Development Center
http://trace.wisc.edu/

The National Information Center for Children and Youth with Disabilities
http://www.nichcy.org/

Hattie B. Munroe Barkley Memorial Augmentative and Alternative Communication Centers
http://aac.unl.edu/

EASI: Equal Access to Software and Information
http://www.isc.rit.edu/~easi/

Barrier Free Education
http://barrier-free.arch.gatech.edu/

Special Needs Education
http://www.schoolnet.ca/sne/

Speaking To Write – Speech Recognition for Secondary Students
http://www.edc.org/spk2wrt/

Project ASSIST for the Blind
http://www.blind.state.ia.us/assist/default.htm

LD Online Bulletin Boards and Chat
http://www.ldonline.org/bulletin_boards/index.html

Resources for People with Learning Disabilities
http://www.ldresources.com/

University of Louisville Distance Education Courses in Assistive Technology
http://www.louisville.edu/edu/edsp/distance/

Special Needs Opportunity Windows (SNOW)
http://snow.utoronto.ca/index.html

CAST
http://www.cast.org

Apple Learning Interchange
http://ali.apple.com

Special Education Resources on the Internet (SERI)
http://www.hood.edu/seri/

National Educational Technology Standards for Teachers
http://cnets.iste.org

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Years ago such thoughts were merely wishful. But no longer. Scientists at the Space Vacuum Epitaxy Center (SVEC) in Houston are experimenting with thin, photosensitive ceramic films that respond to light much as rods and cones do. Arrays of such films, they believe, could be implanted in human eyes to restore lost vision.

"There are some diseases where the sensors in the eye, the rods and cones, have deteriorated but all the wiring is still in place," says Ignatiev, who directs the SVEC. In such cases, thin-film ceramic sensors could serve as substitutes for bad rods and cones. The result would be a "bionic eye."

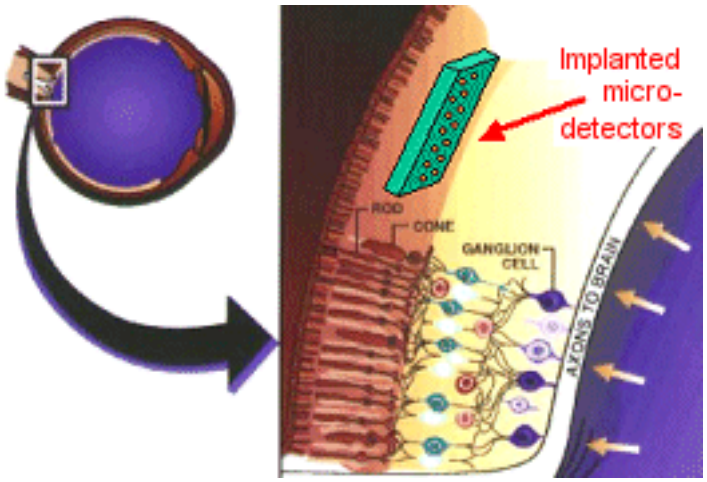
The Space Vacuum Epitaxy Center is a NASA-sponsored Commercial Space Center (CSC) at the University of Houston. NASA's Space Product Development (SPD) program, located at the Marshall Space Flight Center, encourages the commercialization of space by industry through 17 such CSCs. At the SVEC, researchers apply knowledge gained from experiments done in space to develop better lasers, photocells, and thin films -- technologies with both commercial and human promise.

Scientists at Johns Hopkins University, MIT, and elsewhere have tried to build artificial rods and cones before, notes Ignatiev. Most of those earlier efforts involved silicon-based photodetectors. But silicon is toxic to the human body and reacts unfavorably with fluids in the eye -- problems that SVEC's ceramic detectors do not share.

"We are conducting preliminary tests on the ceramic detectors for biocompatibility, and they appear to be totally stable" he says. "In other words, the detector does not deteriorate and [neither does] the eye."

“These detectors are thin films, grown atom-by-atom and layer-by-layer on a background substrate -- a technique called epitaxy," continues Ignatiev. "Well-ordered, 'epitaxally-grown' films have [the best] optical properties."

Crafting such films is a skill SVEC scientists learned from experiments conducted using the Wake Shield Facility (WSF) -- a 12-foot diameter



A schematic diagram of the retina -- a light-sensitive layer that covers 65% of the interior surface of the eye. Scientists hope to replace damaged rods and cones in the retina with ceramic microdetector arrays.

disk-shaped platform launched from the space shuttle. The WSF was designed by SVEC engineers to study epitaxial film growth in the ultra-vacuum of space. "We grew thin oxide films using atomic oxygen in low-Earth orbit as a natural oxidizing agent," says Ignatiev. "Those experiments helped us develop the oxide (ceramic) detectors we're using now for the Bionic Eye project."

The ceramic detectors are much like ultra-thin films found in modern computer chips, "so we can use our semiconductor expertise and make them in arrays -- like chips in a computer factory," he added. The arrays are stacked in a hexagonal structure mimicking the arrangement of rods and cones they are designed to replace.

The natural layout of the detectors solves another problem that plagued earlier silicon research: blockage of nutrient flow to the eye.

"All of the nutrients feeding the eye flow from the back to the front," says Ignatiev. "If you implant a large, impervious structure [like the silicon detectors] in the eye, nutrients can't flow" and the eye will atrophy. The ceramic detectors are individual, five-micron-size units (the exact size of cones) that allow nutrients to flow around them.

Artificial retinas constructed at SVEC consist of 100,000 tiny ceramic detectors, each 1/20 the size of a human hair. The assemblage is so small that surgeons can't safely handle it. So, the arrays are attached to a polymer film one millimeter by one millimeter in size. A couple of weeks after insertion into an eyeball, the polymer

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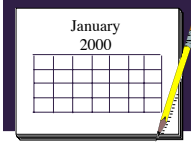
film will simply dissolve leaving only the array behind. The first human trials of such detectors will begin in 2002. Dr. Charles Garcia of the University of Texas Medical School in Houston will be the surgeon in charge.

"An incision is made in the white portion of the eye and the retina is elevated by injecting fluid underneath," explains Garcia, comparing the space to a blister forming on the skin after a burn. "Within that little blister, we place the artificial retina."

Scientists aren't yet certain how the brain will interpret unfamiliar voltages from the artificial rods and cones. They believe the brain will eventually adapt, although a slow learning process might be necessary -- something akin to the way an infant learns shapes and colors for the first time.

"It's a long way from the lab to the clinic," notes Garcia. "Will they work? For how long? And at what level of resolution? We won't know until we implant the receptors in patients. The technology is in its infancy."

Ignatiev has received over 200 requests from patients who learned of the studies from earlier press reports. "I'm extremely excited about this," he says. He cautions that much more research is needed, but "it's very promising."



Upcoming Events

May 16, 17, & 18, 2002: *2002 Conference on Deaf-Blindness - California Coming Together, Handlery Hotel, San Diego, California*
Sponsored by: California Deaf-Blind Services

Featuring Dr. Jan van Dijk, Instituut voor Doven, Sint-Michielsgestel, The Netherlands.

This is a conference for families, teachers and interested professionals focusing on issues specific to children with both vision and hearing problems. Communication, vision impairment, cochlear implants, and technology are just a few of the topics to be addressed.

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