



# INQUIRY

*Information from the frontiers of knowledge*

A magazine highlighting research at the University of Oregon

Spring 1997, Volume III, Number 1

A Message About Research

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Laser Technology

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## A Message About Research From



STEADMAN UPHAM

**Vice Provost for Research and Graduate Education  
and  
Dean of the Graduate School**

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Optical science, software design, electronic studying, interactive multimedia, photonics, microlasers, nanotechnology, *Energy Scheming*, and laptop computers. Internet II, electronic banana peels, web-based and wired, zebra fish aquaria, oriented-strand board, ultrafast spectroscopy, and network-deliverable maps. Quantum control, biomechanics, *Softdesk Energy*, bandwidth, and stressed skin insulating core.

If we wrote without verbs, articles, prepositions, and adverbs, the words in the previous paragraph would represent the research described in this issue of *Inquiry*. This list of words is also code for another phrase, "the frontiers of knowledge," a place where University of Oregon researchers spend much of their lives.

Most important, however, is the message this issue carries about the way the UO conducts its business. Many of the research units, projects, and results described in this issue did not exist two years ago. They were, instead, ideas about how to meet pressing social needs, improve teaching and learning, advance technology, and create new knowledge. A major goal of the University of Oregon is to convert such ideas into practical projects of research and application.

The UO responds to the creative energy of talented faculty and staff members as well as students by enabling high-quality research. We do this rapidly and strategically, and we bring new economic resources into Oregon to accomplish our goals. These resources, about \$50 million generated for research by the UO each year, help the economy of the state to grow while sustaining the intellectual environment of the university.

I invite you to learn more about the centers and institutes described here as well as about other research at the UO. Link to the frontiers of knowledge at <http://darkwing.uoregon.edu/~gradsch/>, and let

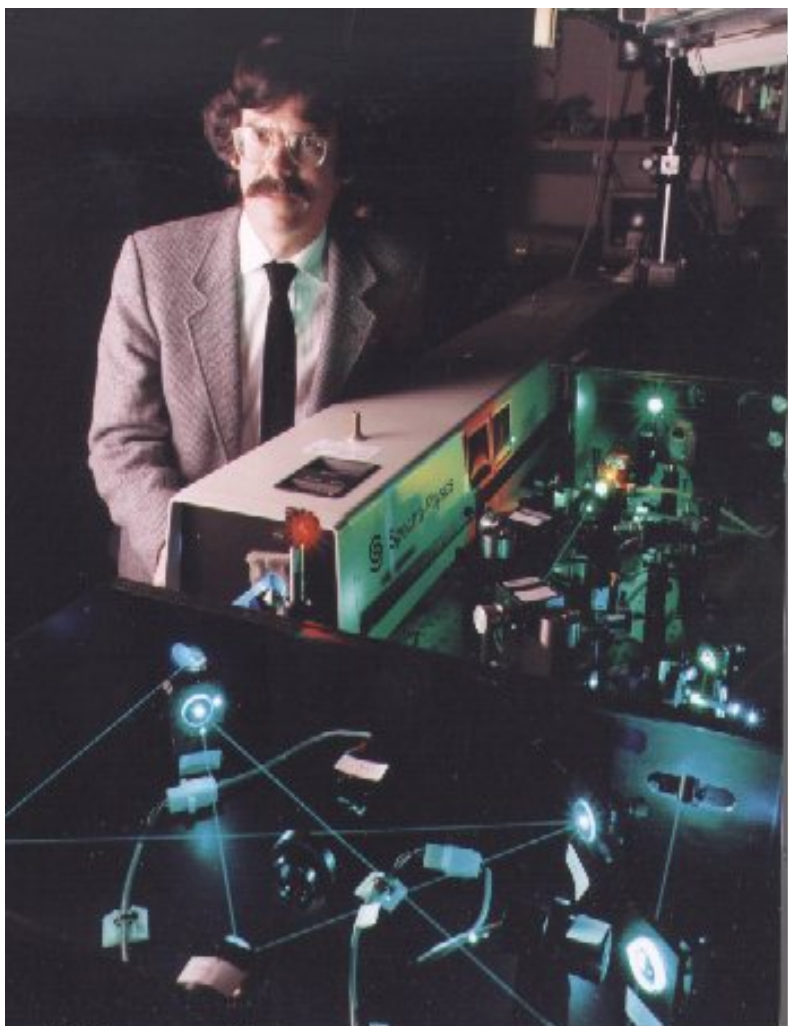
me know what you think [deangra@oregon.uoregon.edu](mailto:deangra@oregon.uoregon.edu).

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# Illuminating the Possible: The Next Step in Laser Technology



MICHAEL RAYMER

.After decades of refinement, laser technology is poised to reshape the early twenty-first century just as microprocessor technology revolutionized the last quarter of this century. Scientists in the new field of "photonics" are harnessing the photon--the basic unit of light energy that makes up laser beams--to collect, process, store, and transmit information.

. "The Oregon Center for Optics, here on the University of Oregon campus, is at the forefront of photonics research," says OCO director and UO physics professor Michael Raymer.

. The center's internationally recognized group of nine faculty members and about thirty student researchers are inventing, developing, and refining new applications of the laser that could dramatically advance current technological capabilities.

. One branch of Raymer's own research, for example, is investigating how low-energy laser light passes through body tissue. This work could lead to a harmless and more information-rich replacement for x-rays in some medical

applications, such as mammograms.

. "In optics and photonics, there can be a relatively short time between fundamental research and its application," Raymer says. "The laser was developed in the early 1960s, but it has already had a major impact on communications, aircraft technology, manufacturing, and precision instrumentation. Closer to home, every CD player and supermarket scanner contains a laser."

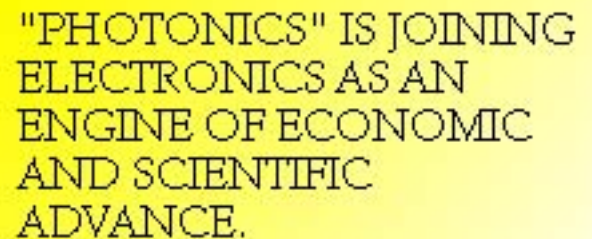
# Smaller, Faster, Better

. Into what new areas are the center's scientists shining their lasers now?

. Experimental physicists Peter Sercel and Hailin Wang are developing techniques for fabricating super-small (nanoscale) devices such as semiconductor lasers one tenth the size of a human hair.

. "As scientists push the bounds of semiconductor technology, making the devices ever smaller, there will soon come a time when current technology will be too bulky," says Sercel, who recently traveled to the White House to receive a Presidential Early Career Award for Scientists and Engineers. "We are laying the groundwork for that time. Potentially, the devices we're fabricating and studying could have applications in many areas, from microlasers to the next generation of microelectronics."

. Another OCO professor, Thomas Mossberg, is developing a new kind of optical computer memory that far surpasses the capabilities of today's magnetic storage devices (e.g., hard drives). His experimental hardware handles vast amounts of digital information, storing it in a small crystal that can be accessed at lightning speeds. The hardware already holds a world's record for information density and access speed, storing the equivalent of 700 floppy disks of information in one square inch of memory material.



"PHOTONICS" IS JOINING  
ELECTRONICS AS AN  
ENGINE OF ECONOMIC  
AND SCIENTIFIC  
ADVANCE.

## Bright Future

. The rapid growth and bright future of photonics is reflected in job prospects for those seeking careers in the field. A recent employment report produced by the American Institute of Physics states, "Although less than one [physics] Ph.D. in twelve specializes in optics and lasers, this subfield accounted for almost one fourth of the potentially permanent positions outside of academe."

. A high-tech start-up company, Templex, has recently formed in Eugene to turn Mossberg's basic research into products for market. Only a year old, Templex already employs four Ph.D. physicists and additional staff members.

. Besides start-ups such as Templex, existing industries--working in collaboration with the OCO--may also accelerate the practical applications of the basic research conducted at the UO. "We are open to having industrial members in the center," Raymer says. "Industry-university collaborations can be highly productive and mutually beneficial. We can teach industrial optical researchers the most current knowledge and techniques, and they can teach us about the challenges of using the technology in practical applications."

. The OCO grew out of the Centers of Excellence initiative passed by the Oregon Legislative Assembly in 1985 in support of scientific activities that promote economic development.

. "The legislature had the foresight to recognize optical science and technology as a wave of the future," Raymer observes. "Since their support began, we have attracted a world-class group of researchers in an area that promises to be at the center of many important technological innovations."

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## A Balanced Approach

The tightrope walker, confidently strolling on a thin wire suspended a hundred feet in the air, is saved from death by a finely tuned sense of balance. For a quarter century, Marjorie Woollacott has delved into the mysteries that keep the tightrope walker--and the rest of us--upright.

"What mechanisms in our brains provide this remarkable sense?" she asks.

Woollacott, head of the University of Oregon's Department of Exercise and Movement Science, uses a complicated piece of machinery informally known as "the electronic banana-peel" to conduct much of her research. The device consists of a walkway with hydraulically controlled plates that slip out from under research subjects, as if they had encountered Charlie Chaplin's discarded banana peel. (Unlike the pratfalling participants in slapstick sight gags, however, volunteer research subjects are kept safe by protective harnesses.) "In the past, most balance research was static, that is, based on subjects standing and receiving a jolt, as if they were on a bus that lurched forward," says Woollacott, a member of the UO Institute of Neuroscience. "In contrast, we study people in motion, where they are more likely to fall."

One study investigates balance in children in order to learn the course of normal development. This knowledge is vital for understanding--and possibly devising treatments for--abnormal development such as that seen in children with cerebral palsy.

Woollacott's lab was also one of the first to look at balance in senior citizens--seeking insights into why, each year, tens of thousands of older adults lose their balance, fall, and suffer injuries ranging from bruises to broken hips.

Some of her research has focused on the initiation of falls. To various degrees in various circumstances, three senses contribute to balance: vision, the balance center in the inner ear, and, simply put, touch (really a complex interplay of nerves, joint sensation, and muscle receptors). Many falls begin

Marjory Woollacott





when older adults must quickly switch from relying primarily on one sense to another. For example, when a person walking on a firm surface such as linoleum (touch) steps onto a thick carpet, he or she must quickly switch to reliance on a visual sense of the floor's exact location.

FEWER FALLS FOR ADULTS  
THANKS TO MARJORIE  
WOOLLACOTT'S  
RESEARCH

"We learned that younger people immediately make the switch, while elders usually do so only after a few tries," Woollacott notes. Her experiments also showed that with practice older adults could switch more quickly.

Another age-related difference manifests once a loss of balance begins: younger people routinely catch themselves while older people tend to fall. Why? No one knew, so Woollacott began her investigation. She found a culprit: insufficient muscular response.

"This means that older adults who work on muscular strength--especially in their ankles, but also in their legs and hips--will have better balance and fewer falls," she says.

Woollacott developed practical applications of this knowledge in collaboration with one of her former students, UO courtesy research associate Anne Shumway-Cook.

"We started using computers and expensive machines in the laboratory to identify and explore balance problems," says Shumway-Cook, who now runs a fall-prevention program at Northwest Hospital in Seattle. "We put that information to use in a clinical setting to develop low-tech, low-cost tests and treatments. Now those tests and treatments are used in doctors' examination rooms across the country."

For her next project, Woollacott says, she is setting her sights high. "I want to find out exactly what part of the brain controls balance. This is a mystery, and solving it would shed light on many problems and possibly suggest innovative therapies."

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## Home Is Where His Art Is



G. Z. BROWN

G. Z. "Charlie" Brown thinks big. For him, home improvement isn't about installing new miniblinds, but about building high-quality, low-cost, and energy-efficient housing for millions of Americans. As head of the UO architecture department and a member of the Center for Housing Innovation, Brown is keenly aware of America's pressing need for affordable housing--and he's doing something about it.

"My aim is to change how houses are built--to make them cost less and perform better," Brown says.

"Most changes in this area are incremental, not fast enough to keep up with the growing need--especially in the area of low-income housing. What we need is a revolution in thinking about how houses are made."

Software may be at the heart of the revolution.

Brown is director of a research group of twenty-five students and faculty members called the Energy Studies in Buildings Laboratory. This beehive of activity has developed two software programs that provide architects with an array of powerful new tools.

- **Energy Scheming** relates a building's proposed form to its energy use, allowing users to gauge the effect of major design changes--say, a bigger window here, more insulation there--on a building's long-term energy costs. Sketch in the changes and *Energy Scheming* quickly calculates an energy-use profile. The program's Expert System, a kind of electronic consultant, offers advice about how to improve the building further.
- **Softdesk Energy** is an add-on program for the widely used *AutoCAD/Auto-Architect* software from Autodesk. *Softdesk Energy* automatically interprets CAD drawing in a manner useful for making choices among various specifications to optimize energy efficiency.

"*Energy Scheming* helps with larger design questions; *Softdesk* is a tool for fine-tuning," Brown explains. "The energy savings they create can be quite significant, especially when you consider that the

savings are enjoyed year after year."

## Blueprint for Success

More than 150,000 Oregon families are in need of decent affordable housing, but state officials say many of them won't find it because entry-level housing isn't a priority for home builders in the 1990s. Brown and his team of researchers have designed a response to this "housing gap" with an affordable, energy-efficient house called Cascadia.

Cascadia is a 1,040-square-foot, three-bedroom house that's more affordable and uses 20 percent less energy than other houses of comparable size. Cascadia uses stressed skin insulating core (SSIC) panels for its exterior walls and roof. The SSIC panels (a rigid foam core sandwiched between two exterior "skins," usually made of oriented-strand board) are "very sturdy and provide great insulation," Brown says. "They represent an important new alternative building material."

His group is donating detailed development documents for Cascadia to builders who target entry-level home buyers. In addition, they are providing free consultation to help start specific projects.

## The Next Generation

Students who study and work with Brown get an education unlike any other, from helping develop cutting-edge software to pounding nails on demonstration projects.

"By the time these students move on to their careers," Brown says, "they have experience with the most advanced thinking and the most advanced software in this rapidly developing area of architecture."

As his students move into the work force, Brown hopes to see them make major contributions to the quality of life for thousands of Oregonians.

"Housing is an important strand in the social fabric," he states, "and when housing is improved, society benefits."

"WHAT WE NEED IS A  
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THINKING ABOUT  
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# Getting Education Back on Track

According to University of Oregon education professors Doug Carnine and Ed Kameenui, America's elementary and secondary education system is in trouble--big spending on fads, failure to teach the basics, little accountability for abysmal student performance. As director and associate director of the National Center to Improve the Tools of Educators (NCITE), they are dedicated to getting education back on track.

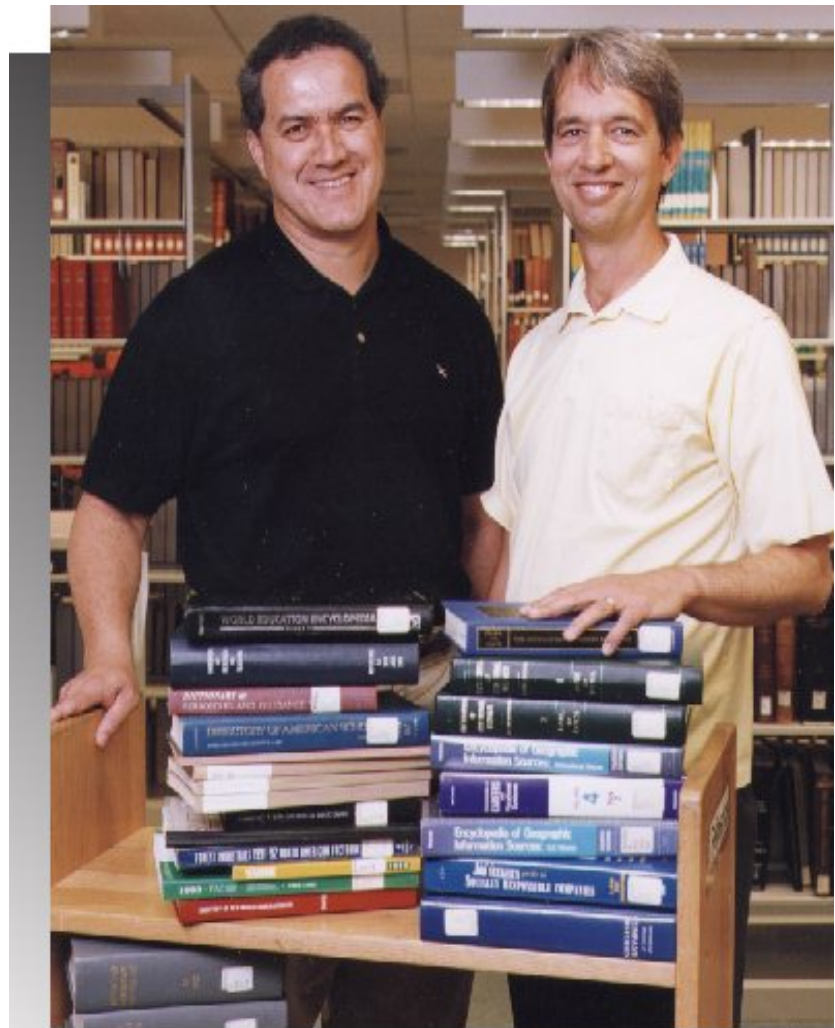
"The most shameful thing about this ailing system," explains Carnine, "is that it continues year after year, affecting millions of students at an incalculable cost to society, *even though we know how to fix it.*"

And that fix, says Kameenui, is straightforward. "Researchers have exhaustively studied these questions for decades, conducted hundreds of studies, and poured millions of dollars into the most important question--how best to teach reading," he asserts. "We know what works."

"What works" are scientifically evaluated, classroom-tested textbooks and teaching programs with proven, repeatable success rates. These practices, Kameenui states, "consistently result in children reading at grade level and performing well in school."

Perhaps the most profound and fundamental change Carnine and Kameenui are calling for has to do with making schools individually accountable for student performance. If methods and materials with known rates of success are used, a school can be held accountable for matching those rates.

"This kind of accountability leads to improved teaching and more successful students," Kameenui says.



ED KAMEENUI AND DOUG CARNINE



# The Hardest Hit

.Carnine stresses that those who suffer most from unsound teaching methods are the students most in need: learning disabled, impoverished, and nonnative speakers of English--the so-called at-risk students.

."What happens too often," Carnine says, "is that these kids are taught using unproven or faddish methods; they do poorly; they get identified as needing special education; and suddenly, they are on a downward spiral."

WE KNOW WHAT  
WORKS, SO WHY  
AREN'T WE USING IT?

.To society, the cost of this trajectory is high. School boards typically spend more than twice as much on special education students than on their mainstream peers. Long-term costs are even higher. Illiteracy, Kameenui notes, is correlated with a hornets' nest of social problems: from dropping out of school to incarceration and teenage pregnancy.

."It's a message whose time has come," Carnine affirms.

.The national media seem to agree. NCITE researchers have appeared on ABC World News, and they have been quoted in *USA Today*, the *Miami Herald*, the *San Francisco Chronicle*, the *Atlanta Constitution* and in hundreds of newspapers across the country via the Associated Press.

## Two-Pronged Approach

.Carnine works throughout the nation--Virginia, New York, California, Texas--with legislative and policy groups, recommending changes that will require the use of textbooks and materials that use research-based teaching principles. He recently spent two days discussing educational reforms with Texas governor George W. Bush.

."By changing policies we can change the marketplace. This is the key," Carnine says. "As this happens, publishers will produce better materials and classroom teachers will be better equipped for success."

.Carnine's focus on policy is matched by Kameenui's career-long interest in research on the most effective ways to teach. Along with fellow UO researcher Deborah Simmons, he developed a booklet soon to be distributed to one million parents as a key element of President Clinton's AmericaRead Challenge program. The booklet presents parents with practical, research-proven suggestions for supporting reading in their children.

."For the first four years we had a hard time getting people to listen," says Carnine. "Now they are beginning to listen, and we are getting almost too busy. But that's the right kind of problem to have."

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# Better Learning through Electronics

LYNNE ANDERSON-INMAN AND FRIEND



## How to Teach the Young?

Lynne Anderson-Inman, a UO associate professor of education, saw the glimmerings of a new answer to this oldest question in education during the early years of the personal computer's rocketing climb in popularity. By 1987 she was among a handful of pioneers researching how best to apply computers in education. Today, as director of the University of Oregon's Center for Electronic Studying (CES), Anderson-Inman continues to chart the territory and explore the uncharted regions of what she calls "the intersection of technology and literacy."

"Computers have created possibilities for learning that didn't exist before," she says. "At CES we're designing new strategies for learning from text, then testing and refining them. The knowledge we gain in these projects is helping us promote a kind of learning unlike anything we've seen previously."

The introduction of the portable laptop computer greatly expanded the usefulness of computers in education. Anderson-Inman seized on this innovation, launching a number of pilot studies using the laptop. The results: students--in local middle schools and high schools as well as at Lane Community College and the UO--showed impressive academic improvement after learning study skills such as outlining and note taking on laptops.

"For some of these students, the experience has been life changing," Anderson-Inman says. "Several that were on the verge of dropping out of high school are now working on college degrees."

In another pilot project, designed for students with learning disabilities, hearing impairment, or upper-body orthopedic impairment, a tutor accompanied each student to class to help with note taking and lecture comprehension. Student and tutor were equipped with laptops linked by infrared signals so that both of their notes appeared side-by-side on each computer screen. The tutor would model good note taking skills as well as make suggestions to the student and answer questions immediately through an on-screen chat box.

## Then Came the Web

Even as Anderson-Inman was developing these laptop uses, another electronic technology was being born: the World Wide Web.

"The potential of the Web to totally change education is phenomenal," she says.

CES will soon be developing interactive Web pages to present the ideas and teach the skills that are the core of the laptop projects.

In another effort, the ElectroText project, CES researchers are enhancing reading materials with the creation of "supported text" for at-risk middle schoolers. The idea is that by using one of the Web's most powerful features, hypertext, students can click on a word or phrase they don't understand and get immediate access to something that will help. That something might be a glossary-type definition, a pronunciation, an explanation, a picture, or even a three-dimensional simulation.

## Taking the next step

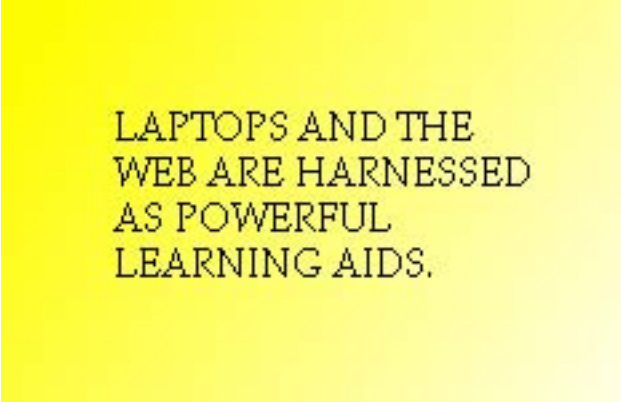
"As we began understanding the enormous value of supported text, we soon conceived of enhancing the text even more extensively," Anderson-Inman explains.

Thus was born the Anza Multimedia Project, a web-accessible group of interrelated and cross-linked documents on the Anza expeditions northward from Mexico to northern California in the late eighteenth century.

As with ElectroText, hypertext is the key. But instead of it being a single document enhanced with supported text, Anderson-Inman envisions it as a whole library of interconnected documents, supported by links to thousands of hypertext resources designed to promote extended interactive studying.

"In this kind of an elegant reading environment, learning is more a search for knowledge than an ingestion of predigested facts," Anderson-Inman notes.

"Our basic aim," she says, "is to stay on top of the technology and to help students use it to stay on top of their studies."



LAPTOPS AND THE  
WEB ARE HARNESSSED  
AS POWERFUL  
LEARNING AIDS.

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# New Media Center: Making Good Ideas Better

The vision is this: a student at a computer clicks a mouse and accesses a treasure house of human knowledge. The session is interactive and makes full use of multimedia--the intellectually engaging combination of words, photos, video and audio clips, animations, and graphics. Learning is intuitive, self-paced, fun.

The path to that bright future runs through a wilderness only now beginning to be explored, but trailblazers such as those at the University of Oregon's New Media Center (NMC) are dedicated to the task and making rapid headway.

Every week, university faculty members and others interested in developing multimedia courseware visit the NMC, located in the UO's Riverfront Research Park. They come from various departments as well as from other public institutions and private industries throughout the state.

"People come to us armed with good ideas that they want turned into even better ideas," says Mike Holcomb, director of the New Media Center and UO associate professor of fine and applied arts. "Their goal is to transform traditional educational content into state-of-the-art interactive multimedia teaching tools. And that's where the New Media Center steps up to help."

The NMC is one of about seventy associated media centers located at universities throughout the world. With support from some of the biggest names in the new media industry, the centers are equipped with an exotic menagerie of advanced hardware and software tools needed for the production of next-generation multimedia courseware.



MIKE HOLCOMB



"The use of new media to deliver information and instruction is only in its infancy," Holcomb says. "We're helping it mature into something of increasing value."

A relatively new addition to the UO--up and running for only about eighteen months--the center has already broken new ground, picking up awards for creativity and innovation along the way. Two of the center's recent courseware projects have been especially successful--each winning the honor of "Net Site of the Day" from the Chronicle of Higher Education. The Historical and Cultural Atlas Resource (<http://darkwing.uoregon.edu/~atlas>), is more than fifty interactive, network-deliverable maps for use in Western civilization and U.S. history courses. Developed with seed money from the Oregon State System of Higher Education, the Atlas Resource was a collaborative effort between the NMC and two UO history professors, John Nicols and Jim Mohr.

UO INNOVATORS  
BUILD TEACHING  
TOOLS FOR THE NEXT  
MILLENNIUM.

Another innovative project took the content of a music class off the blackboard and put it on-line. UO music professor Jeff Stolet and the NMC transformed the traditional print material Stolet had previously used in his electronic music course into an instructional package called Electronic Music Interactive, or EMI (<http://nmc.uoregon.edu/emi/>). The package includes animations and sound clips that demonstrate physical principles of electronic music, a hypertext glossary, and other user-friendly features. EMI recently won an

Interactive Media Review Award in a competition sponsored by I.D. Magazine, a leading trade publication in industrial design.

Holcomb and company are at work on a host of other projects, including participating in the rapidly evolving world of electronic journal publishing, exploring the possibility of a digital UO press for purposes of on-line publishing, working with UO faculty members to create better research tools that more fully utilize emerging technologies, and producing electronic components to make UO Museum of Art exhibits accessible via the World Wide Web (<http://darkwing.uoregon.edu/~uoma/>).

The New Media Center benefits students and residents throughout the state, Holcomb says. Students reap the educational rewards of using the cutting-edge interactive courseware the center develops. In addition, dozens of intelligent and creative students assist the center's permanent staff with multimedia production. These students go on to take jobs in some of the region's leading high-tech industries.

Transforming various types of information into an interactive format with multimedia elements is invariably a challenging and complicated enterprise, says Holcomb, whose many years of experience in the field of media and information design have given him a unique perspective on technology in education.

"The growing demand for multimedia educational products has required instructional designers to develop new ways of thinking about the delivery of information," he says. "The potential for continued growth in this area is enormous and quite exciting."

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# MAPPING HISTORY

The Darkwing Atlas Project

*The Mapping History Project has been designed to provide interactive and animated representations of fundamental historical problems and/or illustrations of historical events, developments, and dynamics. The material is copyrighted, but is open and available to academic users. Inquiries about the re-use of the material in a commercial or academic context should be sent to the editors.*

*Please send all inquiries to [atlas@darkwing.uoregon.edu](mailto:atlas@darkwing.uoregon.edu)*



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Mapping History has been supported by grants from the Oregon University System, the University of Oregon, the Norman Brown Family Fellowship Fund, the Alexander von Humboldt Foundation, and the Universität Münster.



# Electronic Music Interactive

**Electronic Music Interactive** is a multimedia primer for electronic music that prepares students for more advanced study.

Developed by the New Media Center at the University of Oregon, **Electronic Music Interactive** is a state-of-the-art example of network deliverable instructional materials. Created in Director for Shockwave, the core file occupies about 410k and can be completely downloaded over a 28.8 modem in approximately 4 minutes. It includes 80 original diagrams, 50 original interactive animations with sound and 150 interactive glossary terms explaining content distributed across 38 topic modules. Its table of contents is a navigation information system, providing access to related topics locally and at any of the topic modules.

Besides providing a survey of the subject, **Electronic Music Interactive** creates understanding through the user-controlled manipulation of audio/visual representations of key concepts like the relationship of waveform to sound. It exemplifies the power of multimedia to enhance learning to an almost startling degree.

Altogether, the project has taken about ten months from initial meetings to the final phase. Jeffrey Stolet, Professor of Music and Director of Future Music Oregon, is the content specialist on the project. Thirteen advanced students from Linguistics, Visual Design and Computer Science have worked on it as well as Steve McGrew, Project Director and Mike Holcomb, New Media Center Director.

Multimedia publishers, teachers, musicians and designers are especially invited to try Electronic Music Interactive.

[mccallum@uoregon.edu](mailto:mccallum@uoregon.edu) -or call- 541-346-1456

[enter]

# The University of Oregon in the Spotlight

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## We're Wired

.When *Yahoo Internet Life* magazine compiled the "Top 100 'Most Wired' Colleges" in its May 1997 issue, the UO ranked number one in the category of public state universities and number six overall.

.The UO has also won two national awards for innovative use of computer networks and other technology in education:

- The National Science Foundation named the UO one of only ten universities to receive a Recognition Award for the Integration of Research and Education for outstanding use of technology in education.
- CAUSE, an association for managing and using information resources in higher education, bestowed its 1996 Award of Excellence (the "Oscar of the campus networking world") on the UO for having the nation's best university computer network.

## A Rising Academic Star

.A new, hard-data analysis of U.S. research universities ranks the University of Oregon fifteenth in the nation among public institutions and sixth nationally among "rising" public universities. The study is presented in the new Johns Hopkins Press book, *The Rise of American Research Universities: Elites and Challengers in the Postwar Era*, by Hugh Davis Graham and Nancy Diamond. The authors use research grants, fellowships, and scholarly publications to gauge faculty research.

## Little Fish, Big Splash

.To support zebra fish research and improve aquarium facilities, the UO has received a series of grants totaling \$2.5 million--the latest is \$470,000 from the Murdock Trust. Zebra fish, first cloned at the UO in the early 1980s, are increasingly important tools in biomedical research, especially in the study of genetics and development.

# Get Ready for Internet II

In light of the explosive growth of the Internet, a second-generation Web is being developed. The University of Oregon is one of thirty-six research universities creating the high-speed, high-bandwidth Internet II.

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