INTERNET

Lessons from AAAS Knowledge Environment

Until a couple of years ago, researchers in signal transduction had to scramble to keep abreast of the scientific information they needed to shine in their work. And the price paid for missing meetings or for not taking note of an important journal article could be high.

"In the pre-Web days, you would have to rely on published reviews and scouring selected journals in the hope of finding papers that were relevant to your work. And inevitably, you would miss things," says Randall Moon, an investigator with the Howard Hughes Medical Institute at the University of Washington, where he is also professor of pharmacology.

Moon and his colleagues now have at least one place to go on the World Wide Web that offers them a sort of "one-stop shopping" for researchers with an interest in signal transduction, the study of how cells use chemical signals to control their own behavior and that of other cells. The Signal Transduction Knowledge Environment (STKE), sponsored by AAAS and the journal *Science*, may be one of the first such sites for scientists, but if it lives up to its initial promise, it may someday be operating in a crowded field. Another AAAS/*Science* knowledge environment, the Science of Aging (SAGE), is to be launched in the fall, and there are several such sites with other sponsors that are in the planning stages.

The idea of a "knowledge environment" was first proposed about 5 years ago, when AAAS was approached by Island Press, a leading publisher of environmental publications.

"The objective was to allow nonprofit organizations a place that would keep them from being squeezed out of the activity that was taking place on the Web," says Monica Bradford, managing editor of *Science* and STKE project director. The two organizations then joined forces with Stanford University's HighWire Press, which publishes electronic versions of scientific journals, and the three members of the newly formed Knowledge Environment Collaborative began seeking support from foundations and other sources. In their proposals to funders, the members of the Collaborative touted their combined strengths—AAAS's credibility and its experience with *Science* and with scientific publishing, Island Press's experience as a nonprofit publisher, and HighWire Press's experience as an online publisher. They proposed a site that would offer scientists a combination of research protocols, reviews, and perspectives from experts in signal transduction, the latest relevant journal articles, and an opportunity to create an online research community

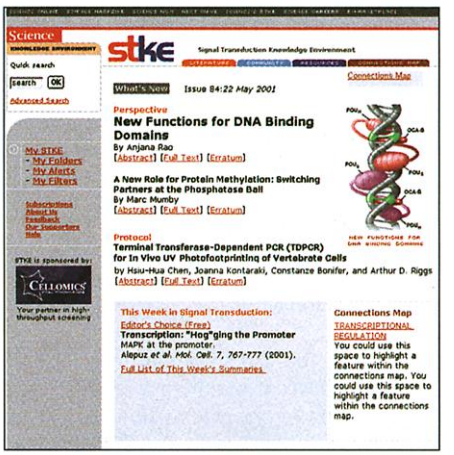
At the end of December 1997, the Pew Charitable Trusts gave the STKE project $1.3 million, promising another $400,000 if the project could raise another $800,000, which it did.

"Our plan was to use a collection of electronic networking tools to bring to one place all the resources researchers would need at their desks," Bradford says. "We created links between related pieces of information that might be from different sources. A journal article might link to a profile of the author and also link to a related component or to pathway information in the connections map database."

The final product includes a section called "This Week in Signal Transduction," which contains summaries of important papers on signal transduction published that week, as well as the site's most important contribution to the field, according to Bradford: the connections map that allows scientists to follow the latest developments in several signaling pathways, and immediate access to the scientific literature that supports the findings that the map illustrates.

Each pathway is kept up to date by a researcher known as "an authority." Every few weeks, for example, in his laboratory at the University of Washington, Moon uses a software program developed by HighWire Press to enter newly published information regarding Wnt genes and their proteins, which have been found to play a role in cancer and in the development of the embryo.

"My hopes and expectations are that by developing these tools and approaches, we will give researchers a greater ability to synthesize information from different fields and different laboratories," says Moon. "And, more important, that we will provide the potential for revealing unexpected synergy between different pathways and interaction between proteins that might not have been obvious at first glance."



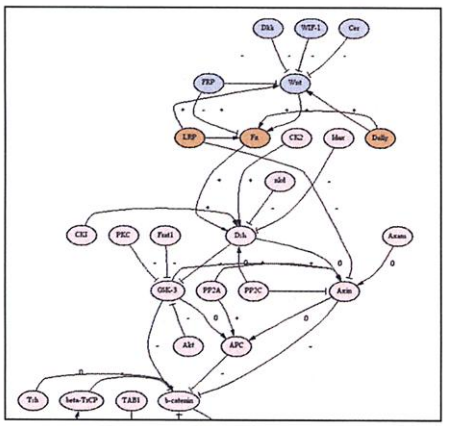
The home page of www.stke.org.

Recently, Moon got a call from a biotech company that was interested in studying a certain gene. He gave them the URL address for STKE (www.stke.org). "Now they can figure out how the gene they are interested in functions in the pathway. STKE serves as a facilitator."

Why Start with Signal Transduction?

"The choice of signal transduction for the Knowledge Environment Collaborative's first site seemed obvious," says Bryan Ray, a *Science* editor who also serves as editor of STKE. Signal transduction is an active field that interests scientists working in many disciplines, but, for that reason, there is no single signal transduction discipline, and no single journal that serves as a major source of information on the subject. Also, the information in signaling pathways lends itself to simple graphics with components that can be pulled easily from a database and updated by experts with the help of a sophisticated software system.

"It was clear that the number of connections and interacting pathways was getting to be overwhelming, and that we could use the graphic capacity of the Web to allow people to gain access to more and more specific information," says Ray. "Some labs study the signaling pathways per se, but other groups might be more interested



Signaling pathway implicated in cancer and embryonic research.

in knowing how a pathway influences some biological process of interest, even though they may not be specialists in signal transduction. They need a more efficient place they can go to understand the intricacies of signaling and to stay aware of what is new."

Overcoming Challenges

Earlier this year, after successfully passing a review by a committee of the National Library of Medicine, STKE was approved for inclusion in the libary's online Medline/PubMed database. STKE data and content is currently being entered into the database, which Ray believes will help the site overcome some of the obstacles it has faced in becoming accepted as a publishing site.

"We've had a surprising number of people who do not equate publishing with Web publishing," says Ray. "Some of them have really had to be nudged into seeing this as a natural progression for the way journals are going. And some people are refusing to write for us because of that."

Ray says that in the long run, he would like to see the site publish original research, although, for now, it is limited to publishing original reviews and perspectives.

STKE has begun to encounter competition from other sites eager to attract researchers interested in studying signal transduction pathways, according to Moon, but he notes that STKE is the only one "sponsored by a major association."

"We assume editorial neutrality from *Science* and that it aspires not to introduce a bias," says Moon. "Also, you assume that when you type in the URL, the site will actually be there, unlike some Web sites, which you don't know about from one month to the next."

Bradford and the other designers of the site say they have run into resistance from researchers in an area they had hoped would play an important role in giving the site visibility in the research community. Scientists have not seemed interested in participating in the various "community-building" components of the site—sessions that allowed online discussions and opportunities for asking and responding to questions.

"We see community-building and education as important components," says Bradford. "But how do you build community, and is it a function of publishing to do so?"

The International Bone and Mineral Society, which built on the experience of STKE, has encountered similar difficulties in its efforts to build a community of researchers and clinicians through a knowledge environment known as BoneKEy-Osteovision (www.bonekey-ibms.org).

"We were very surprised, as we thought that the discussion sessions would be used more, at least by underprivileged countries," says Thomas Reiser, executive director of the society.

Planning for the Future

Like all nonprofit knowledge environments, STKE is searching for ways to make itself viable for the long term, says Bradford. The site has begun charging an annual fee of $79 for access to certain components of the site—$49 for AAAS members or subscribers to one of the participating journals. In contrast, access to BoneKEy will remain free to its 8000 registered users, says Reiser, adding that corporate sponsors have only just begun to support the site.

"Our concept is to keep the site open to everyone as long as we can," Reiser says. "We would like to use the funds we are spending on the site on other projects, but we are committed to funding it as long as we can."

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Launching Scheduled for Web Site on Aging

AAAS plans to inaugurate its second knowledge environment Web site on 3 October to provide researchers with the latest information on the science of aging.

The SAGE (Science of Aging) Knowledge Environment (KE) (http://sageke.sciencemag.org), funded with a 4-year, $4.8-million grant from the Ellison Medical Foundation in Bethesda, Maryland, will provide a combination of original news and review articles, as well as information on available grants, access to databases on aging-related genes, online discussions, a virtual library, and a virtual journal. Access to the site will be free for the first year.

"The time is right for SAGE because the demographics are exploding in the older segments of the population of developed countries, and this is the first real opportunity scientists have had to study and affect aging syndromes by using the new tools of genetics and molecular biology," says Ellis Rubinstein, *Science* editor and publisher of SAGE KE. He notes that the site will eventually reach out beyond the research community to clinician and lay audiences, which should be particularly eager to take part in discussion groups and other community aspects of the site.

"Issues involved in aging are of interest across an increasingly broad range of people," says Rubinstein. "This is a field that was once dominated by epidemiologists and social scientists, but there are now many communities engaged in addressing aging issues. The Internet is especially suited to bridging chasms of understanding across multiple communities."

The SAGE logo.

For now, the site will focus on helping researchers address "the information overload," according to Kelly LaMarco, editorial director for the site. "Researchers need a service that pulls together content and navigational elements to allow efficient retrieval of the information sought, regardless of the user's level of computer sophistication," LaMarco says.

She notes that the science of aging field includes human geneticists, molecular geneticists, evolutionary biologists, field biologists, and cell, structural, and molecular biologists working with multiple species.

"Because of this breadth, no single journal addresses the needs of scientists in this area, nor is there one society to which all researchers belong," she says. "A knowledge environment offers an opportunity to create a virtual community where investigators in the field can come together for information and discussion."

INTERNATIONAL

Training in Science Journalism Inspires South African Fellows

When Mpho Majoro, a 22-year-old South African journalist, met up with human immunodeficiency (HIV) researchers at Johns Hopkins University in Baltimore last month, she had questions to ask that might have seemed odd in a setting devoted to battling the virus that has killed hundreds of thousands of people around the world.

She wondered whether medication to prevent transmission of HIV from mother to child was really a good idea, given that the child might be raised with no mother and perhaps no extended family. "What happens when the mother dies?" Majoro says she asked the researchers.

The exchange of ideas took place during a visit in July to laboratories at Johns Hopkins, as part of a 4-week program to provide five South Africans with training in science and radio journalism. Three of the fellows had training in science, but had had little exposure to journalism. The other two, including Majoro, were journalists with little experience in science. The group was in the United States to learn, but there were situations in which the perspectives of the visitors may have taught the hosts something as well.

"That's part of the reason we are doing the program," says Bob Hirshon, director of media programs for the AAAS Directorate for Education and Human Resources. "The South Africans have their own perspectives, and they make everything make sense in their own culture. That is why we need to increase science journalism in countries where it doesn't exist."

From left to right: Kandice Carter (AAAS staff); Thulasizwe Mngomezulu, Kabelo Masilo, and Madumane Matloa (journalism fellows); Corinna Wu and Bob Hirshon, (AAAS staff); Tebogo Gule and Mpho Majoro (journalism fellows).

CREDITS: (TOP) BETH ELZER

Program Inspired by Visit

The program that brought the South Africans to Washington, DC, was first envisioned 18 months ago, when a visitor from the South African Department of Arts, Culture, Science, and Technology (DACST) came to AAAS to talk about the agency's efforts to increase public understanding of science. The result is a collaboration planned over 3 years that will eventually bring a total of 15 South Africans to AAAS for training in science and radio journalism. The project announcement for 2001, the first year of the DACST-AAAS Science Radio Journalism Fellows Project, attracted 60 applicants, according to Alan Bornbusch, program director for the AAAS International Directorate's Africa Program. Radio was chosen because it is "far and away the major communications medium from which people get their news, particularly in rural areas," Bornbusch says. DACST is providing $132,000 to pay for the journalism program. This year's travel expenses were covered by the U.S.-South Africa Bi-National Commission, which supports cooperative programs between the two countries.

"We tried to draw in people from communities outside the Johannesburg/Pretoria area," says Bornbusch. "And one of the requirements was fluency in an indigenous language."

Hirshon and his colleague Corinna Wu, both of whom work on AAAS's Science Update radio program, traveled to South Africa, where they found that even relatively small markets had high-quality equipment in their radio stations.

Training in Radio and Science

In Washington, Hirshon and Wu often paired up the fellows in teams of scientists and nonscientists to produce weekly radio spots, training the South Africans in the use of cutting-edge software to edit their work. It was easier, Hirshon says, to teach radio technology to scientists with no journalism training than it was to teach science to the fellows who had not been exposed to science in the past.

"The journalists had a harder time because not only were they learning science, but it was in a second language," Hirshon says. "Also, the types of radio we were asking them to produce were not common in South Africa. We wanted them to do short radio pieces in the third person, with heavily edited quotes from scientists. They tended to let a scientist go on talking for a minute or two, which is an eternity on radio."

Thulasizwe Mngomezulu, 37, a speech writer for the KwaZulu-Natal Ministry of Transport, said he was delighted with the technical skills he had been taught.

"What impressed me was that on a technical basis, I understood nothing, and now I can play around with sound," Mngomezulu says. "I now know how to cut tape without compromising the integrity of the entire interview."

Mngomezulu and Majoro's colleagues were Tebogo Gule, 26, trained in chemistry and a member of EduActive, a science education organization; Madumane Matloa, 27, a science and technology radio producer for the South African Broadcasting Company; and Kabelo Masilo, 36, a mathematics and physics lecturer at the Tihabane College of Education. They were joined by Kelebogile Dilotsotlhe, a representative of DACST who took part in the program for 2 weeks.

The fellows who did not have jobs in radio to go home to when the program ended in early August said they hoped to work in science journalism on a freelance basis in their communities. DACST has promised to make scientists available for interviews, according to Hirshon. But the scientists will not be the only ones interviewed for science stories, says Matloa.

"If I write a science story, I have to do it in a way that takes into account indigenous knowledge systems," Matloa says. "We have to show that we do not disrespect the ways of our people."