“Sometimes, static, uni-planar geometry is insufficient to probe the dynamic dimensions of the mind.”

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Gray matter on my mind.
A new dimension in neuroscience learning.

In the future, experts say, medical students will depend less and less on the limitations of textbook and chalkboard and more and more on virtual learning. They’ll learn faster and deeper by working with computer-generated models of the human body that do things that real bodies can’t. How far off is this future? In more than a dozen neuroscience classrooms around the country, it’s already here.

Graduate students at Pitt, USC, UI Chicago, University of Michigan and other leading medical schools are exploring the brain in a totally new way with “Gray Matter On My Mind,” an interactive multimedia learning program developed by Doctor George Carvell, Professor and Associate Dean of Graduate Research Studies at Pitt’s School of Health and Rehabilitation Sciences. With this new learning tool, studying the brain will never be the same.

Gray Matter On My Mind 2000 (nicknamed GMOMM 2000 by Carvell) brings to life the workings of the human nervous system in entirely new ways. Instead of racking their own brains trying to visualize complex neurological processes with only the aid of text and lecture notes, students can now see, study and even manipulate the brain and spinal cord in three-dimensional cyberspace. The program comes complete with hypertext, pop-up study guides and sound effects.

The new learning aid solves a problem that Carvell has wrestled with for years: making the intricacies of brain function more accessible to graduate students and doctoral candidates in one of the University’s toughest four-credit medical courses, neuroscience. “The brain is complex, multi-layered and wired to all parts of the body. It’s hard to get that across in two-dimensional classroom overheads,” says Carvell.

Students use GMOMM 2000 for research through the campus computer network or in class--as an adjunct to lecture--on laptop PCs. Either way, the program is a comprehensive supplement to what’s available through textbooks, lectures, the computer lab, and expensive lab work with real specimens.

‘Index Nervicus’
GMOMM 2000 covers the entire nervous system, including sections on brain structure and function, spinal structure and function, the somatosensory system
(the body’s sense of touch), motor system, and cranial nerves. Carvell has organized a massive amount of graduate- and professional-level medical content in a variety of ways, including an extensive ‘Index Nervicus’ that gives students point-and-click access to a vast trove of meticulously gathered medical information. Its scores of technical diagrams are mapped with hyperlinks that pop up relevant notes. And the program features context-based ‘Study Buddies’ that, in a low-key interactive format, help students review and self-quiz on the hundreds of names, structures, processes and relationships that make up current medical knowledge of the nervous system. “Great care has been taken to be accurate and current,” says Carvell. “This program does offer the user control of learning, and provides detailed information with a bit of zing.”

**Better than real?**
The zingiest part of GMOMM 2000—and what makes it a unique addition to the teaching of neuroscience—is its ability to present medical information in ways that no other medium can. Through 18 virtual reality movie clips of both actual and model brains, 3D animations, multi-layered anatomy diagrams and many other interactive graphics, GMOMM 2000 presents the form and function of the human nervous system in ways that are equal to or, in some ways, better than the study of actual brain specimens.

“Spinal cords, for example, are only slightly thicker than a pencil, and examining them with the naked eye reveals little detail,” says Carvell. By using virtual specimens of spinal cord cross sections students can compare the real specimen to magnified sections that also provide details about anatomical relationships and functional correlates of the structures they are examining. “Try to get *that* from a 2D brain atlas!” says Carvell.

Students can also explore and manipulate a complete, detailed 3D image of an actual brain through Apple Computer’s QuickTime VR software. Carvell says he had to create the brain photographs himself because available photography was inadequate for the task. To show the brain’s internal structures, Carvell used computer-generated brain graphics with interactive layering and translucency.

**Fantastic voyage**
GMOMM animations also give students a sense of the dynamic processes of the nervous system in a way they could only dimly imagine before, says Carvell. Animations give students a sense of the speed and timing of nerve impulses and muscle movements. One of the most exciting virtual models is a 3D animation of the lightning-fast journey taken by a touch sensation from fingertip to the interior of the brain. Rendered from the point of view of the impulse itself, the animation puts the viewer in the driver’s seat of a roller-coaster ride through the nervous system that happens in the blink of an eye.

“I have a feel for this since I do this work on a daily basis in the research laboratory, but students need ‘props’ to bring this information alive,” says Carvell.
“Up to now, students have had to rely on their own imaginations to visualize a sequence of events that’s related to a 3D spatial construct like the brain or nervous system. You cannot get this information from a neuroscience text.”

The ability to visualize these usually invisible processes is critical, Carvell believes, to success in learning neuroscience. Students will eventually put this dynamic understanding of the nervous system to work in research and in rehabilitation therapy, where they will help disabled patients teach damaged nervous systems to rewire themselves.

**Bricks and clicks**
For Carvell, who was admittedly computer-impaired before embarking on the GMOMM project in 1997, building GMOMM was a learning experience in itself. “Prior to this project, I’d been working with DOS PCs and mainframes. With that kind of experience, I didn’t want to touch a computer!” Carvell says. But the vision that became GMOMM 2000 motivated him to learn better ways to get the job done. The current version of the program was written, designed and coded by Carvell, with assistants helping with graphics and photography. The name, “Great Matter on My Mind” is a subtle nod to Carvell’s wife, who hails from Georgia.

In 1998, Carvell incorporated Small Dog Productions to lay a foundation for a commercial version of the software. It’s currently available in three versions—one designed for campus computer networks and two others that run from a CD on a laptop PC. Carvell hopes to evolve the program from its current format to HTML, the language of the Internet. “That way we can offer it in sections, update it constantly, and make it available to schools worldwide,” says Carvell. “Universities aren’t going to be just brick any more. They’re going to be brick and click.”