Brainstorm: The Interactive Guide to Neuroanatomy. Gary Coppa and Elizabeth Tancred. Office of Technology Licensing, Stanford University, 900 Welch Road, Suite 350, Palo Alto, CA 94304-1850; 415/723-0651. Single user license, $500.00; twenty-user site license, $1,000.00. System requirements: Macintosh with color monitor.

Brainstorm is an interactive, color product designed for use in the teaching and review of human neuroanatomy. It was developed by Gary Coppa and Elizabeth Tancred, Ph.D., with guidance from the Stanford University Medical Media and Information Technologies center. Since its introduction to Stanford medical students in 1991, it has been acquired by more than twenty universities as well as Kaplan Educational Services for use in twenty of their review sites. It is intended for use by first- or second-year medical students, but its audience extends to anyone studying or reviewing neuroanatomy. Brainstorm is currently available from Stanford’s Office of Technology Licensing; however, it may be adopted by a commercial publisher, which is likely to affect cost and licensing options.

Brainstorm is well designed and easy to use. It provides four different representational modes: myelin-stained cross sections, gross dissections, custom diagrams, and text-based information screens, all accessed via menus or indexes. If, for example, a student would like to explore the structural distribution of the corticospinal tract, he may first access a cross-section image by either locating the structure in the index and then choosing a “go to section” button or by navigating through user-friendly menus to the appropriate section. Each neuroanatomical structure is represented in as many modes as is appropriate, and structures are cross-linked to allow the user rapid, convenient access to other modes with a simple mouse click. The student reviewing the cross section with the corticospinal tract highlighted can easily jump to a diagram of the tract by clicking on the diagram button. This cross-linking is one of the major strengths of Brainstorm, because it facilitates quick access to alternative views and models the complex, interconnected, and widely distributed nature of the nervous system.

Navigational interface features include the option of exploring different structures within a particular image or tracking a particular structure through a range of images. A list of structure names is displayed for each image. Clicking an item in this list outlines the corresponding structure in the image. Conversely, if a structure in the image is selected, the corresponding structure name is highlighted in the list. Once a structure is selected, the student can access text describing its function and, when appropriate, a diagram showing connections of nerve tracts. At all times, the interface displays navigational buttons to access the main menu or relevant submenu and a variety of options (index, go back, quiz, help, and quit), as well as buttons to access the representation modes not currently displayed. If the selected structure is not available in a particular mode, the button for that mode is dimmed.

The cross-section mode has two very useful navigation features: a reference image with lines representing the cross sections that, if clicked, will take the user to the section and a step feature that allows the user to step sequentially through sections. A learner could use the step feature to observe changes in a structure’s shape and location through an area such as the brainstem or spinal cord. If a structure is highlighted and the user moves to a different section, the highlight is retained if the different section contains the structure. If it doesn’t, the user is informed of this and prompted to choose whether to remain at the new section or go back to the previous one.

In the gross dissections mode, a small three-dimensional diagram of the brain is displayed in the upper right with arrows representing four available views: lateral, medial, superior, and ventral. Not only does this help orient the learner to the angle of the displayed image, but, after clicking an arrow, the corresponding view is displayed. This feature, along with navigational features discussed above, is simple to understand and implement and is very useful.

Brainstorm includes a quiz option that our medical and dental students found useful for study before exams. The quiz, available at all times, is multiple choice and image specific; questions apply only to those structures within the current image. Another helpful self-assessment feature is a cranial nerve exam simulation. A student can give a simulated patient one or more lesions and perform simple diagnostic exams to see the results of a lesion or guess a random lesion.

Images in the cross sections and gross dissections are typical of slide images one might expect to see in a medical neuroanatomy practical exam. Image quality is excellent for instructional purposes, and the image database is extensive, comprehensive, and growing. A new version of Brainstorm, expected by 1995, will have more material on the telencephalon and will be sent to owners of the current version. An annotated, guided-tour authoring facility is also in progress and will be sold as an add-on.

Learning resource managers will be pleased by the easy installation and may be interested in an optional tracking feature that collects and saves user interaction information to a file for later analysis. In our learning center, our stu-
Dents use five-megabyte RAM Macintosh IISIs to access Brainstorm from a file server. The IISIs use system 7.1, and we must enable virtual memory to load Brainstorm, but performance is still reliable though somewhat slow for random browsing. We’ve also set up a computer for the neuroscience faculty, who use Brainstorm as a lecture and review aid. The minimum configuration for Brainstorm is a Macintosh with system 6.05 or higher, at least five megabytes of RAM, a thirteen-inch or larger color monitor, and twelve megabytes of free hard drive space.

Our few criticisms are minor. Some of our professors feel the angle of orientation of the brainstem cross sections is unconventional. The application is somewhat slow on low-end Macintoshes. We’d like to see three-dimensional diagrams of structures whose spatial distribution is difficult to understand from just cross-sectional images. Our students use the University of Washington’s Human Brain Animations videodisc to get a spatial understanding of neuroanatomy, but it would be wonderful to link appropriate structures to digitized animations. We’d also like the option to hear pronunciations of structures, but, even without these embellishments, Brainstorm is one of the most popular programs available in our learning center. Our students appreciate its friendly interface, comprehensive content, and self-assessment options.

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